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The virtual organisation: exploring issues associated with the design, development and management of this new organisational form

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THE VIRTUAL ORGANISATION:

Exploring issues associated with the design, development and management of this new organisational form

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ABSTRACT

The Virtual Organisation:

Exploring issues associated with the design, development and management of this new organisational form

Helen Walker, School of Management, University of Bath

This qualitative research investigated the virtual organisation, addressing the knowledge lacuna regarding this new organisational form. It involved the study of two views of the virtual organisation; the perspectives of designers of collaborative virtual reality environments and those of end users. The first strand of the research involved a participant observation study over three years of the design of a distributed virtual reality system being developed in the 'VirtuOsi project' with the purpose of enhancing collaborative work between sites in different countries. The second strand investigated end user needs within BICC Cables, one of the industrial partners in the VirtuOsi project that provided a scenario for technology development. Sixteen factories in seven countries were visited during the course of the research. Ninety eight organisational members participated in semi-structured interviews, the sample drawn from factory and administrative functions and all levels of the organisational hierarchy.

The research used a grounded approach to develop two theses regarding the virtual organisation. The first thesis argues that despite the rhetoric, there was little evidence of collaboration amongst designers or end users. The second thesis argues that despite the transformative potential of the virtual organisation, it may have first order consequences. A radical concept like the virtual organisation requires a radical model for organisational change. Such a model is proposed, identifying how to 'break the frame'. The virtual organisation is viewed as a nascent complex self-organising network of organisations with the management focus on steering interaction rather than controlling, and adaptation rather than planning. Management activities and cultural development strategies for managing the virtual organisation are identified.

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TERMS

Term	Meaning
Term	**Meaning**
BICC	British Insulated Calendar Cables
BT	British Telecom
CSCW	Computer Supported Co-operative Work
DTI	Department of Trade and Industry
ISDN	Integrated Services Digital Network
IT	Information Technology
LAN	Local Area Network
MASSIVE	A virtual reality system that can support tele-conferencing
MIC	Mineral Insulated Cables
MITS	Metaphors for Integrated Telecommunications Services
MOO	Object Oriented MUD
MUD	Multi User Dimension
PITS	Populated Information Terrain System
RACE	Research into Advanced Communication in Europe
telepresence	the use of virtual reality technology especially for remote control of machinery or for apparent participation in distant events; a sensation of being elsewhere created in this way (Concise Oxford English Dictionary)
VirtuOsi	a **VIRTU**al w**O**rld to **S**upport **I**nteraction
VR	Virtual Reality
WAN	Wide Area Network

CHAPTER 1

AIMS AND OBJECTIVES

This chapter sets out the aims and objectives of this research, explaining the rationale behind it and the research questions that it seeks to answer. The focus of this research is the virtual organisation, exploring issues associated with its design, implementation and management. I firstly want to clarify what I mean by the term 'virtual organisation'. Management writers have talked about the virtual organisation with reference to teleworking (e.g. Dooley, 1996) and networks of organisations (e.g. Byrne, 1993). In this research, the virtual organisation bears a resemblance to these conceptualisations as it concerns the networking or linking of organisations that are geographically remote from one another, providing a means of communication and interaction between organisational members. The technology that enables this networking in this instance is virtual reality. Therefore I use the term 'virtual organisation' *literally,* to describe a networked virtual reality environment constructed for the purposes of interaction.

I consider it to be a parallel organisational universe, a virtual environment in which members of real organisations in different places can come together and interact. Within the virtual organisation, you are more likely to have an e-mail address than a postal address. No matter where you are in the world, providing communication systems are adequate, you can enter the virtual organisation and work with your colleagues. You will be able to meet other users in virtual spaces, access data, reports and information, and find other users either formally using searching systems or informally by bumping into them as you make your way around the virtual organisation.

This thesis aims to investigate how the virtual organisation will change the way we work. General IT literature suggests that technology development has meant big changes for organisations and society, presenting new possibilities and eliminating former choices. There is a knowledge lacuna regarding the virtual organisation, and what new dilemmas

and opportunities we face with it's advent. Whilst there is a plethora of literature on information technology *in general* and how it brings about organisational change, there is scant little on the organisational implications of networked virtual reality. Management writers tend to talk about the virtual organisation as a concept and about the possibilities that it will create, rather than grounding their observations in research. Designers of the virtual organisation have a burgeoning literature on the applications of networked virtual reality technologies, but are lacking an organisational dimension.

Organisational issues have yet to be adequately addressed in the design and implementation of networked virtual reality environments. This omission is lamentable; there is a misplaced optimism that assumes that if technology can transcend geographical distances and national boundaries then so too can people and communication. Why should it be assumed that if a system or technology is changed, then the necessary personal, organisational and cultural change will follow? Rheingold (1991:36) expresses these general concerns succinctly:

> 'How will cyberspace tools and environments affect the way we live, think and work? And how will cyberspace affect the way we define ourselves as sensing, thinking, communicating beings?'

Whilst all-encompassing answers to these questions will only be possible in the fullness of time, study of the present development of networked virtual reality systems for interaction and communication in business is needed. It is imperative that organisational issues be put on the agendas of the designers of the virtual organisation, and consideration be paid to how the virtual organisation can be managed as a force for organisational transformation. This is the broad aim of my thesis.

This research aimed to address this knowledge gap and make a novel contribution to the area by investigating two views of the virtual organisation; the perspective of designers of networked virtual reality environments and the views of the people that the technologies are being designed for, the end users out in the 'real' organisation. The rationale behind an investigation of how the virtual organisation is being designed is firstly to understand what new ways of working and interacting virtual reality technologies make possible. More fundamental, though, is a desire to understand what

constructs the designers have of the virtual organisation. Will the virtual organisation of the future be an extrapolation of present notions of organisations, the old organisation revamped in electronic form? Or is it conceptualised as a radically different organisational form for which there is no precedent? The research questions associated with this strand of the research are:

- What is the present 'state-of-the-art' as regards virtual reality and associated collaborative computer technologies?
- How do designers conceptualise the virtual organisation?

The rhetoric of the virtual organisation is that of collaboration, of people from different organisations and countries meeting in networked virtual environments to work collaboratively. A further objective of the research is to look beyond this rhetoric; the desire to collaborate and communicate with other organisations is not assumed but investigated here. The second strand of the research therefore involves an investigation of end user issues within an international business setting. The rationale behind this strand of the research is to establish whether people are 'ready' for the virtual organisation, in terms of present technology and skills, and whether there is a 'felt need' for the virtual organisation. I also take a broader view and investigate what organisational dimensions might be affected by the virtual organisation, and in turn have an effect upon it, identifying organisational themes that need to be born in mind by designers and by companies considering 'going virtual'. The research questions posed by this strand of the research are:

- What is the present state of Information Technology (IT) systems, skills and needs within an international company?

- What are people's future IT requirements and preferences, and reactions to the concept of the virtual organisation?

- What broader organisational issues might have an effect on the evolution of this new organisational form?

These two sets of broad research questions associated with the two strands of the research are posed in order to inform research design and direct the research process. As the virtual organisation is an emerging phenomenon, it is more appropriate to ask research questions which indicate what I want to learn, rather than hypotheses that are a statement of tentative answers to these questions - what I think is going on. By seeking answers to the research questions I aim to describe the virtual organisation and interpret what it means to designers and end users.

I aim to construct theses based on these descriptions and interpretations by adopting a grounded approach to theory development. By having privileged views of the virtual organisation from the top down (how it is being designed) and from the bottom up (what end users need), I aim to develop theses that emerge from the data, rather than stating theses *a priori* to be tested. The research is therefore a process of exploration rather than an attempt to verify or falsify theory. Finally, drawing on my research and literature, I aim to develop a model of organisational change to inform the design, implementation and management of the virtual organisation. The aims of the research are summarised in the following figure.

- To address knowledge gap regarding the virtual organisation, providing the missing organisational perspective for its design, development and implementation
- To identify the technical features of the virtual organisation, and end user requirements
- To establish whether the virtual organisation is perceived as an extrapolation or transformation of the real organisation by designers and end users
- To look behind the rhetoric of collaboration to identify whether the virtual organisation is being designed and implemented in a collaborative way, and whether the desire to collaborate is apparent in the real organisation
- To develop theses grounded in the data
- To develop a model for organisational change to inform the design, development and management of the virtual organisation

Figure 1.1: A summary of the aims of the research

CHAPTER 2

GETTING STARTED

In this chapter I explain how I got started in my research by being invited to join a project called VirtuOsi (which stands for 'a VIRTUal wOrld to Support Interaction'). I specify the aims and objectives of VirtuOsi, the partners involved in it and their responsibilities. I also explain how I came to participate in the project, and what shape my involvement took.

The VirtuOsi Project: aims, partners and roles

I had the opportunity to observe the design and development of a virtual organisation during the course of the VirtuOsi project, which aimed to develop networked virtual reality systems to support collaborative work. The VirtuOsi project started in October 1993, and evolved from academic interest in applying virtual reality to Computer Supported Co-operative Working (CSCW), testing the feasibility of using networked virtual environments in an organisational context to support collaborative work between distributed sites. CSCW is a new area of study that has arisen over the past few years with the purpose of emulating on computer systems the communicative structures of work. The project was originally proposed by academics at Nottingham, Lancaster and Manchester Universities who had worked together previously on virtual reality projects. They invited a variety of industrial partners to 'tender' to participate in the VirtuOsi project. The project was part-funded by the DTI (Department of Trade and Industry) programme on CSCW, and part-funded by each of the industrial partners. The aims of VirtuOsi as articulated by Alistair Rogers (1993) of British Telecom, the Project Co-ordinator, were:

- The long term aim is to develop a general reference architecture for distributed CSCW virtual environments

- The development of virtual reality interfaces to access organisational information, general information and interfaces for group working.
- Integration of video and virtual reality
- Network requirements for new services
- Brokering services in the network

Rogers saw the main aim of the project as being to make co-ordinating and working in distributed teams much easier and a more fulfilling task. VirtuOsi intended to develop virtual reality technologies so that users could use them as a means of interfacing with information and other users within the system. The project also intended to integrate video within the virtual reality environment, so that users could have shared views of video images and have the facility to hold videoconferences within virtual spaces. Members of the project were interested in investigating network requirements for networked virtual reality systems, to evaluate the demand on ISDN (Integrated Services Digital Network) lines as more users joined the virtual space. The project also aimed to develop brokering services for exchanging information within the network.

Leevers (1993), another VirtuOsi member, offered an alternative yet over-lapping list of goals:
- Demonstrate how a unified virtual environment can support co-operative working in an organisation that is distributed across many sites
- Develop a CSCW framework that integrates our understanding of how people work together with the state of the art in Multimedia Communications, 3D User Interfaces and Multiservice Networks
- Evaluate pilots in cable making and fashion industries
- Recommend procedures for the introduction of collaborative teleworking within large organisations

From Leevers' list of objectives, it can be seen that as well as virtual reality technologies, VirtuOsi were interested in developing or integrating other technologies such as Multimedia applications. He also saw another goal of the project as identifying implementation issues. The technologies being considered by the VirtuOsi project were

being developed with two scenarios in mind. One was to network people working in the fashion industry at sites throughout the UK, such as designers, retailers and manufacturers. The other scenario was to connect people in the cable-making industry at factories and technology centres in different countries. These scenarios were chosen because one of the partners in the project, Nottingham Trent University Fashion Department, was hoping to gain the participation of organisations in the fashion industry. Another partner, BICC (British Insulated Calendar Cables), could arrange access to its cable making sites throughout the world. The other partners involved in the project and a summary of their roles are shown in Figure 2.1.

PARTNER	ROLE
BT	Management of project, video and network technology
BICC Group	Virtual meeting room user interface and factory pilot
GPT	Multiservice network implementation, brokering, status indicators
GEC-Marconi Hirst Research Centre	Representation of other users in VR
DIVISION	PC based VR toolkit for a multiparty 3D user interface
Lancaster University - CSCW Centre	Requirement analysis, factory pilot ethnography, models and metaphors
Manchester University - Psychology Department	Metaphors, ethnography of fashion pilot
Nottingham Trent University - Fashion Department	Technology transfer to small clothing manufacturers
Nottingham University - Computer Department	Spatial models and metaphors, and CSCW standards
Bath University - Helen Walker, School of Management	User needs and organisational requirements for factory pilot

Figure 2.1: VirtuOsi partners and their roles

I shall expand on the roles of the various partners. BT were managing the project, and responsible for developing video applications within virtual reality, such as teleconferencing. They were also, along with GPT, interested in investigating network infrastructure demands and requirements. GPT were also interested in developing brokering services, and facilities for assessing the availability of other users. The BICC Multimedia team at Hemel Hempstead, a research and development division, were responsible for the factory pilot and for developing the virtual meeting room metaphor as

a virtual space in which networked users can interact. GEC-Marconi were responsible for developing embodiments for representing users in virtual worlds. Division were responsible for developing a networked PC based virtual reality toolkit and platform called dVS (later to be issued as dVise for Windows NT), providing PC based access to virtual worlds.

On the academic side, members of the Sociology and Computer Science Departments at Lancaster University were responsible for assessing systems requirements, developing models and metaphors for virtual reality interfaces (e.g. the virtual factory), and conducting an ethnography at a BICC site to understand the way people worked and used documents and information. Manchester University was responsible for developing metaphors for interfaces, and conducting the ethnography for the fashion pilot. Nottingham Trent University ran the fashion pilot, and developed specific virtual reality applications such as virtual measuring booths and virtual cloth. Nottingham University Computer Science Department were responsible for developing spatial models and metaphors (e.g. the virtual foyer), and for pursuing the incorporation of CSCW standards in networked virtual reality environments. Nottingham also developed and used their own multi-user distributed virtual reality system MASSIVE, a virtual reality system that can support tele-conferencing.

The industrial partners all 'brought something to the party', not only in terms of financial support but also technological know-how, and had an understandable interest in the development of virtual reality as a means of facilitating networked communication. Companies such as Division, BT and GPT are from market sectors such as telecommunications and virtual reality technology, and shared a general interest in exploring using virtual reality technologies for communicating and exchanging information. BICC also had a vested interest in the project as they could ultimately be seen as benefiting from companies going virtual. They make the cables that provide the infrastructure that will support global communication, and therefore their markets are likely to expand if companies go virtual.

The different aims articulated by Rogers (1993) and Leevers (1993) above are testament to the different objectives that the various partners perceived the VirtuOsi project as

having. Each company had specific aims in the project depending on how VirtuOsi fitted with their own internal research and development programmes. GPT, for example, were interested in telephonic issues, and one aspect of their contribution to VirtuOsi was looking at status indicators for assessing the probability of a person being available according to whether they had used their telephone or computer recently. BT were keen to assess network demands for distributed VR systems. Division, a commercial virtual reality company, were focused on collaborating with the academic partners who were conducting leading-edge research into virtual reality technologies. The interests of the various partners had an effect on the evolving nature of the virtual organisation, affecting which technological features were pursued and which were omitted.

My involvement in the VirtuOsi project

I became involved with the BICC factory pilot in the Autumn of 1994. The BICC factory pilot was explained as follows (Leevers, 1993):

> 'Our objective is the early introduction of an effective multimedia communications network between several technology centres and manufacturing sites. This will encourage the sharing of experience and expertise in cables operations and hence support a culture of continuous improvement throughout the world . . . This application pilot wishes to extend current work on multimedia applications at BICC to provide an integrated *virtual BICC organisation* that allows technical and manufacturing staff throughout the world to trade expertise and technology and to support training (particularly in terms of introducing a culture of Continuous Improvement while exchanging Best Demonstrated Practice between manufacturing groups) without the overhead of extensive travel. In essence, this pilot will focus on the CSCW issues of representing and navigating large organisational structures, promoting awareness within distributed organisations, establishing contacts with collaborators, trading expertise and training, and arranging and holding meetings.'
>
> (Leevers, 1993; 10)

It was this *virtual BICC organisation* that I aimed to investigate, looking at how it was being designed and what people out in BICC sites needed. At the point when I joined, the Multimedia Group at BICC Cables Hemel Hempstead were already participating in the VirtuOsi project. They had three people within their department who were committed full-time to the VirtuOsi project. Nottingham University were helping with

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technical aspects and models and metaphors from which to design user interfaces for the factory pilot. The technology development was to be informed by an ethnographic study being conducted by Lancaster University at one of the technology centres, which would identify work patterns so that the technology fitted the way that people worked. People within the Multimedia Group felt, however, that a broader *organisational perspective* was needed seeing as the technology would not be restricted to one technology centre, but would connect multiple factory sites as well. As one of the project managers within the Multimedia Group had done his MBA at Bath University School of Management, it was decided that they should try and get a management research student involved. I was in the first year of my PhD, and looking for a company which I could research in, and thus began my involvement with BICC and the VirtuOsi project.

I stood out in the project team for several reasons. Firstly, I was the only woman involved in the project, although another woman from GPT did join the project for one meeting towards the end of the final year. I was also what might be described as 'technologically challenged' - I knew how to use word processing and spread sheet packages and had used the Internet, but that was the limit of my technological experience. This was initially rather intimidating, but I soon realised that the other project members did not bite! I quickly felt comfortable with asking for clarification if I did not understand technical terms, or the implications of technical decisions. At first I felt overwhelmed by the technical jargon and out of my depth. Soon I realised that having few preconceptions about the virtual organisation was a real advantage to my research. I did not assume that one interface or metaphor was an obvious choice over another, and continually questioned why certain decisions were being made.

Furthermore, I was an *observer* rather than *contributor* in the three day VirtuOsi meetings that were held every three months to discuss progress on agreed project deliverables. Whilst I was expected to input to the BICC factory pilot, I was not expected to formally contribute in the VirtuOsi meetings, although I did sometimes give them an update on my progress and would occasionally contribute to discussions. I would, however, often meet with the BICC Multimedia group that had instigated my research. They wanted me to conduct factory visits 'out in the field', to investigate organisational issues associated with the design and implementation of the virtual

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organisation. We agreed that as the virtual organisation will involve the networking of sites in different countries, and the 'tribe' or community of the virtual organisation will be all around the world, I should reflect this in my research design by investigating user issues at BICC sites throughout the world. I enthusiastically (and rather short-sightedly) agreed to this research 'remit', as it seemed a marvellous and interesting opportunity for a doctoral research student. It provided me with the opportunity to investigate not only how the virtual organisation was being designed, but also to gain a 'bottom up' perspective of what was needed. I shall elaborate upon my research design, research method and the factories that I visited in Chapters 5 and 6, and on the methodological and epistemological dilemmas that I faced during the research process.

The Multimedia group wanted me to provide insights from 'out in the field', from the perspective of organisational members with the intention of informing technology development. The extent to which user issues *actually* informed technology development is a theme that I shall pick up upon later in the thesis. I was asked to comment on some of the factory pilot prototypes that were developed during the course of the project. I also got directly involved in technology development myself, when I took a series of photos in a factory in Australia that were used to make a virtual factory walk-through. I also had the opportunity to observe the implementation of some technology at a factory site in the UK. More fundamentally, however, my involvement with the BICC Multimedia group and the VirtuOsi project allowed me to observe the process of design and the interaction between the designers, the conceptualisations that the designers had of the virtual organisation, and its various features. The results of my investigation of the process of design and user issues are recounted in Chapters 7 and 8. The theses emerging from the data and proposed model for managing the virtual organisation are argued for in Chapter 9.

In this chapter I have outlined how I got started in my research, introducing the VirtuOsi project, its key players and their interests, and my place within the project. In the next chapter I move on to review the literature to develop an understanding of the choices, opportunities and dilemmas associated with the advent of the virtual organisation. The literature reviewed ranges from considering the impact of technology on society, to how IT brings about or necessitates organisational change, to the particular metaphysical

dilemmas associated with virtual reality technologies. All the literatures that I review contributed to my understanding of the virtual organisation, and were an additional resource in my overall effort to interpret the findings of my research.

CHAPTER 3

HOW TECHNOLOGY AFFECTS
SOCIETY AND ORGANISTAIONS

The aim of this chapter is to consider literature concerning how information technology leads to changes in society and in organisations. This gives us a foundation from which to consider the implications of networked virtual reality technologies for organisations, and provides an opportunity to surface themes related to this thesis. This literature review will firstly consider humankind's relationship with tools, and how technological developments have been intimately connected with advances in the civilising process and have led to changes in society. New tools for exchanging and accessing information have been heralded as signifying a new age in the progression of civilisation. Heady claims, some anxious and some optimistic, have been made as to the impact of IT on societies, organisations and individuals.

The nature of the virtual organisation may be further illuminated by considering research into the actual impact of IT upon organisations. Arguments for a participatory approach to the design of IT systems are presented. In the virtual organisation, remote organisations will be networked, making traditional notions of the organisation as a hierarchy obsolete. Two aspects of IT and organisational change are therefore considered here; how IT affects power and control, and brings about new organisational forms. Whilst this exploration of IT and organisational change provides a background for the research, the virtual organisation represents new possibilities and dilemmas for organisations beyond those posed by present information and telecommunications technologies, and we therefore should not assume that it is merely part of something that has happened before.

The chapter therefore moves on to consider virtual reality and postmodern concerns. Postmodernist critics and cyberfiction writers have contributed to our understanding of the metaphysical dilemmas associated with the dawn of the information age. Such writers

often take already extant technological realities and push them (often only slightly) into more extreme possibilities. These extrapolations and speculations will serve to illuminate some of the predicaments associated with the virtual organisation.

My approach to reviewing the literature and surfacing issues relevant to this thesis is represented in the following figure, moving from a broad view of the impact of technological developments and information technology upon society, to the impact of IT in organisations, to a consideration of the particular issues associated with virtual reality technologies.
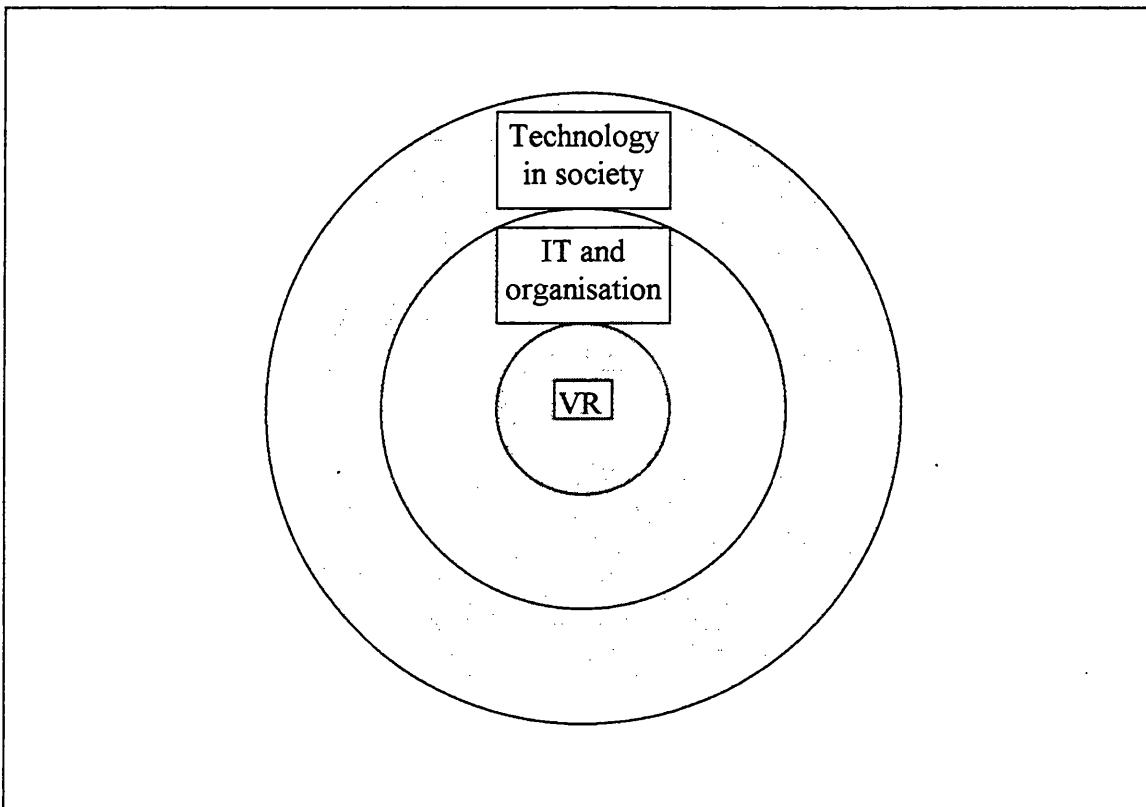
Figure 3.1: My approach to reviewing the literature

Homo Faber

The progress of civilisation is intimately intertwined with the development of tools. Henri Bergson (1911: 139) wrote:

> 'If we could rid ourselves of all pride, if, to define our species, we kept strictly to what the historic and prehistoric periods show us to be the constant characteristic of man and of intelligence, we should say not *Homo sapiens* but *Homo faber*. In short, intelligence considered

in what seems to be its original feature, is the faculty of manufacturing artificial objects, especially tools for making tools.'

The evolution of humans has been defined by our ability to create and use tools, to extend our senses and our capabilities. If we look throughout history, humankind's progress is reflected in the development of tools. The plough and irrigation systems were tools that allowed the cessation of a nomadic lifestyle and the advent of the agricultural age. Tools and technologies such as the wheel, the aquaduct, the printing press, the steam engine, the telephone, the automobile and the microchip have all made their mark on the progress of civilisation, and once such tools exist, it is often hard to imagine how we survived without them.

Such tools have freed us from physical exertion and the necessity of spending all our time pursuing more basic human needs such as food and shelter. Tools have been the means by which we have distanced ourselves from our environment and our animality. The driving force behind technical innovation is a desire to make life easier for ourselves. Marx argued that mastery of the material world was the basis upon which man humanised himself and developed culture. This is in fact the civilising process: humanisation means tempering animality with rationality, aesthetic grace and moral choice.

We have a long tradition of valuing freedom from the necessity of labour, which has been a prominent feature in most Utopian thinking. Bishop Godwin's *Man in the Moone*, 1638, reported a society where 'food groweth everywhaer without labour', and Sir Thomas Moore's *Utopia* talked of 'withdraw from the bodily service to the free liberty of the mind' (both quoted in Manuel, 1965). Further evidence of this desire to distance oneself from physical exertion is the Greco-Roman view of associating labour with slavery. Plato in the *Republic* proposed that philosophers should be the guardians of society, a somewhat self-serving proposition that indicates the valuing of the thinker over the labourer. Similarly, the Judeo-Christian theology has admired contemplation over action.

Technology makes the world a new place - a conception expressed by Fernand Braudel (1981: 435) when he wrote:

> 'It was only when things went wrong, when society came up against the ceiling of the possible, that people turned of necessity to technology, and interest was aroused for the thousand potential inventions, out of which one would be recognised as the best, the one that would break through the obstacle and open the door to a different future . . . In this sense, technology is indeed a queen: it does change the world.'

Folkert Wilken (1982), in *The Liberation of Capital*, links the civilising process to the development of tools and technology. He observes:

> 'Without a doubt, the part of mankind that has advanced intellectually is quite under the spell of technology. Its charms are twofold. On the one hand, there is the enticement of increasingly comfortable living standards; on the other, there is a reduction in the amount of work which is necessary to do . . . The irresistible pull toward technological development . . . is caused, we should remember, by the unconscious and deep-rooted desire to free ourselves from the material oppression of the material world.'

Zuboff (1988:56) relates the evolution of work and organisation to the distancing of the body from the labour process. She sees the body's role in the labour process as describing the distance between managers and the managed.

> 'The history of work has been, in part, the history of the worker's body. Production depended on what the body could accomplish with strength and skill. Techniques that improve output have been driven by a general desire to decrease the pain of labour as well as by employers intentions to escape dependency upon that knowledge which only the sentinent labouring body could provide. Skilled workers historically have been ambivalent toward (technology), knowing that the bodies it would augment or replace were the occasion for both their pain and their power.'

The development of tools and technology have therefore reflected and enabled the civilising process, and have affected the nature of work. Tools have developed in a symbiotic relationship with human needs, the most basic of which being to free ourselves from physical exertion and increase our control of the material world. The virtual organisation can be viewed as literalising our desire to distance ourselves from the body

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and from labour. In the virtual organisation, we no longer need to even be present at work; we can be telepresent. The body becomes a representation in the virtual organisation, the ultimate distantation. We shall return to this theme of distantation later in the chapter, in our consideration of the metaphysical dilemmas associated with 'going virtual'. The virtual organisation is made possible by information technology. Information technology is the latest tool with the power to change our lives. The next section considers some of the predictions associated with our entering the information age.

The information age

> '*Information technology* is a label that reflects the convergence of several streams of technical developments, including microelectronics, computer science, telecommunications, software engineering, and system analysis. It is a technology that dramatically increases the ability to record, store, analyse, and transmit information in ways that permit flexibility, accuracy, immediacy, geographic independence, volume and complexity. Information technology has a unique capability to restructure operations that depend upon information for the purposes of transaction, record keeping, analysis, control or communication.' (Zuboff, 1988: 415)

The advent of information technology has been heralded as marking a new era in the civilising process. Toffler (1980) refers to 'the information age' as the third wave, following the agricultural and industrial revolutions as major forces shaping the way in which we live in the civilised world. This revolution is occurring because microelectronics offers us a way of storing, processing and communicating vast amounts of information quickly and cheaply. It also provides a way of integrating what have previously been separate ways of handling information. The data processing that was done on large main frame computers, the text created on typewriters, the images and text copied on photocopiers, the communications via telephone, radio and television; the integration of these separate technologies provides the opportunity for a single 'information' technology.

Information is the basis for many human endeavours. The evolution of tool-making, followed by the development of language and writing, gave us the possibility of abstraction, memory and the storage of information. Many technological developments, such as the alphabet, the printing press, the calculator, the gramophone, and the

computer, would not have arisen without the human desire to communicate[1]. The list of potential applications of information technology grows longer daily, and is only limited by our ability to think of them. Nearly every activity that involves the human processing of information can, in theory, be changed by technology. H. Marshall McLuhan explains the significance of information technology as follows.

> 'Men are suddenly nomadic gatherers of knowledge, nomadic as never before, informed as never before, free from fragmentary specialism as never before - but also involved in the total social process as never before; since with electricity we extend our central nervous system globally, instantly interrelating every human experience.'
>
> Herbert Marshall McLuhan (1964) *Understanding Media*

Toffler (1980) made some much-cited predictions concerning the broader effects of information technology, including:

The paperless office	*The global village*
The unmanned factory	*The demise of the expert*
The electronic cottage	*The leisure society*
The collapse of the city	

The purpose of listing these predictions is to make clear that what starts as a change in technical capability has, through the applications it makes possible, the power to change the way in which we live our lives. There is a world to be lost and a world to be gained. All of Toffler's predictions have some vision of the changing nature of work and organisations and their subsequent effects on society in the information age. Choices that appear merely technical will redefine our lives at work.

In the late 1970s and early 1980s predictions were made as to the effect of IT on work. Below we can see some examples of headlines from 1978 - 1980, taken from Huczynski and Buchanan (1991):

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[1] For a compelling review of the technological advance of mankind leading us to cyberspace, see *Cyberspace for Beginners* (1995) by Joanna Buick and Zoran Jevtic.

'New Technology could put 5 million out of work' *The Guardian*

'Society with chips and without jobs' *New Society*

'Death sentence for paper shufflers' *The Economist*

'Daddy, what was an office block?' *Business Computing*

Such predictions articulate the fear that the information age instils. This fear has not been assuaged since the early days of IT implementation, even amongst so called experts. In 1995 I attended a Computer Supported Co-operative Work (CSCW) seminar at the Department of Trade and Industry (DTI) in London, providing a forum in which consultants, managers and academics involved with IT implementation could discuss how IT would affect the workplace and society in the future. I came away from this discussion rather surprised and disillusioned. These people provide expertise on this subject, are looked to for their opinions, and can potentially influence the direction and perception of IT in the future. Yet there the mood of the seminar was negative, and there was much hand-wringing and tales of foreboding.

Visions of the future offered by the participants were bleak: the authority and role of middle managers was threatened as responsibility and expertise were devolved (some were talking from personal experience); people would not adapt well to the leisure time that would inevitably accompany more flexible hours and job sharing; the youth of today and work force of tomorrow would be unmoved by these changes, not experiencing the effects and affect associated with them. They were Thatcher's babies, the computer generation, and would displace less computer-literate yet more knowledgeable older workers. They would not take care of the ever-increasing out of work ageing population.

These are the people who influence the development and implementation of IT, and earn their living from it, and have at least a self-serving interest in expounding the virtues of IT. Yet they had precious little that was positive to say about it. It was then that I realised what a powerful and feared force these new technologies are. I also became more aware of my own vision of the future: that it is up for grabs, as yet to be determined, and need not be all doom and gloom.

Organisational theorists have argued for positive views of the impact of IT on the world of work, facilitating flexible working and freeing employees from the routine elements of tasks (Oborne, 1996). Negative visions have also been offered, with IT leading to the deskilling of jobs (Braverman, 1974) and control in the workplace and unemployment (Johnson, 1983). Undeterministic views of IT are also expressed, that the impact of IT will depend on the circumstances (Child and Loveridge, 1990). Whatever view is taken, it is generally agreed that IT will have a substantial impact on organisations and society. Having considered the sorts of visions people have of the information age, it is appropriate to review studies concerning the *actual* impact of IT implementation on work and organisations.

The impact of IT on the workplace

Organisations have been investing heavily in IT in the last three decades, both as a means of changing internal processes and as a vehicle for gaining strategic competitive advantage in the external environment (Millar and Porter, 1985; Warner, 1987; Boynton and Zmud, 1987; Raho, Belohav and Fielder, 1987). The ESRC in 1992 estimated that 4% of the GNP was spent on information services and that this is set to double by the year 2000. Formerly, the two principal economic resources of business were capital and labour. Many now believe that information can now be added as a third principal resource.

In 1982 Benjamin published a forecast of the state of IT in 1990. He predicted that IT spending in organisations would increase over the decade as a percentage of revenue by at least 50%. This prediction has been realised. He recently predicted that the total IT cost-performance improvement relative to labour costs will be 2.5 orders of magnitude per decade (Benjamin and Blunt, 1992). Child (1987), noting that increasingly competitive strategic environments are elevating the information processing requirements of organisations, suggested that IT shifts the organisation's cost-benefit balance in favour of expanding information processing capabilities. Because the cost performance of IT continues to improve relative to labour and other forms of capital, companies will continue to invest heavily in it.

Despite evidence of huge investment in IT, evidence regarding the success of IT implementation tends to be at best mixed. After more than 25 years of experience in implementing computer systems, a surprising number of them still fail. For many organisations, implementation of IT has been a matter of necessity in order to remain competitive. Faced with this need for rapid installation and frequent upgrades, many organisations find they have little time to give to the measurement of IT results. In his book *The Business Value of Computers*, Paul Strassman examined 16 companies in a broad variety of business sectors to determine the value of their use of IT. He found that 'there is no relation between spending for computers, profits, or productivity'.

Wroe (1986) studied 10 IT systems implemented by small building firms, and found that 4 were a success, 4 were discontinued and 2 were struggling. McCosh (1984) reports that 5 out of 15 decision support systems implemented in his study were a success. Pomfrett et al (1985) conducted a survey of 92 word processing systems, and found the general rate of benefit achieved was 77%. Out of the 20 office automation projects sponsored by the British DTI in 1986, 15 were continued.
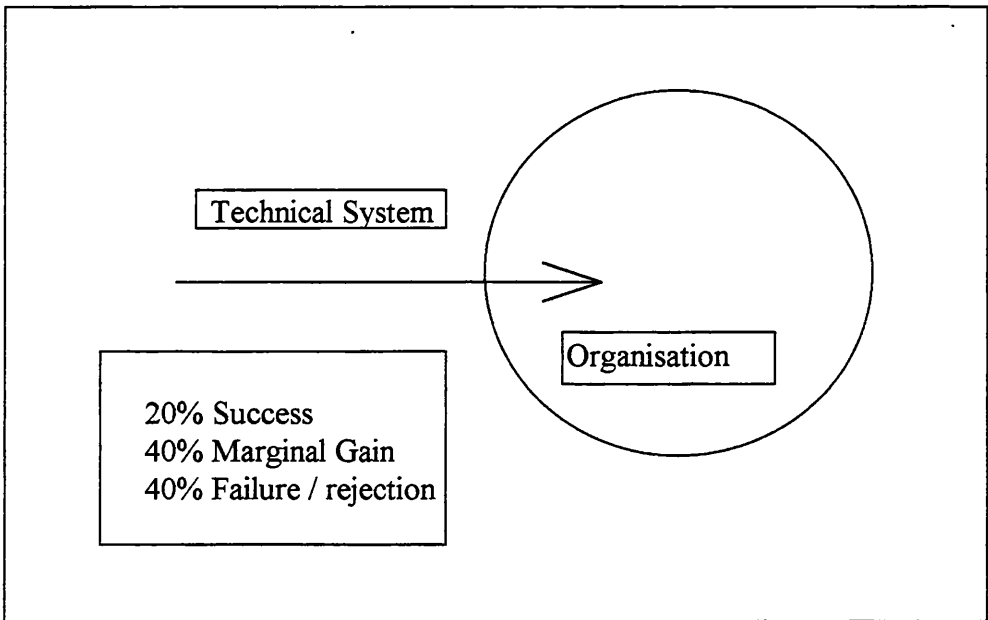
Figure 3.2:   Mowshowitz's (1976) success rates of IT applications

Mowshowitz (1976) estimated the frequency of different outcomes following IT implementation projects. He found that 20% of projects achieved success and enhanced

the effectiveness of the organisation. A marginal gain as perceived by staff was achieved in 40% of projects. The remaining 40% of projects failed. Using the analogy of an organ implant, Mowshowitz explained that the IT systems were rejected as foreign matter by staff, and led to major complications elsewhere in the organisation, requiring the organisational equivalent of a massive dose of drugs to deal with secondary problems such as training, health and safety etc.

Whilst each of the studies reported above used different criteria to define the success or failure of projects, it is clear that there is a significant failure rate associated with IT implementation, and that it is a high risk process. Fritz Jansses, Chairman of IT World, echoes this risk by saying,

> 'Chief executives are increasingly conscious that IT can go horribly wrong. Indeed they are now more aware of the problems than the opportunities.'

Part of this shortfall in implementation can be attributed to behavioural, political or organisational issues rather than to technical characteristics of computer equipment. That is, implementation failures are more about the organisational setting and the people within it, instead of issues such as equipment performance or the specific mix of hardware and software features (Sankar, 1991). Because the success of implementation is to some extent dependent on the organisational context, researchers have suggested that IT systems be designed in collaboration with end users, in order to ensure a 'fit' between the organisation and the information system. The next section goes on to consider the arguments for participatory approaches to design, as this research aims to investigate whether designers adopt a participatory approach to the design of the virtual organisation in the VirtuOsi project, and whether this is the best approach to its implementation.

A participatory approach to design and implementation

Eason (1988) suggests that to harness IT and it's effects on change within organisations, human and organisational issues must be considered as well as the technical aspects. Some advocate the sociotechnical systems approach (Marguiles and Colflesh, 1982;

Sankar, 1991; Pasmore, 1988), suggesting that human susbsystems must be congruent with technological design. Joint-optimisation is the backbone of this approach: an organisation will function at its best if the social and technological systems are designed to fit the demands of each other and of the environment. The sociotechnical systems approach looks to management as the arbiter of the balance between human and technical subsystems. When organisations fail to balance, the result can be conflict, stress, lower morale, higher costs and underuse or failure of the new technology.

Mumford (1983) is an advocate of the participation of users in IT initiatives. She maintains that IT must be used to enhance the work that is done and thus job satisfaction. The idea is that staff can contribute at all stages of the process, including specification of system objectives, criteria against which to evaluate the new technology, pilot schemes, evaluation studies and user support. By approaching the introduction of IT in a participatory style, uncertainty is reduced for the employees; they feel as though they have an element of control, and motivation may increase to use the new IT system. This all reduces the risk of failure for the organisation, ensuring it's impact on change.

However, a participatory approach to IT implementation may not be easy to achieve; for instance, technical experts may feel threatened and may have a well defined product to sell which can only be modified very slightly to fit varying circumstances. A study of participative approaches to the introduction of IT in West Germany by Mambray et al (1986; quoted in Eason, 1988) indicated that while participation *can* be used as part of a comprehensive review of people's rights and opinions, in situations of power and inequality, where end-users are not 'computer literate' and tend to assume that experts can be trusted to look after their interests, its achievements are likely to be limited. Beirne and Ramsay (1992) also offer a cautionary tale of token participation exercises, bringing the user in at a stage where their contribution will only be very limited. Participation when used appropriately can limit the risk of outright rejection.

A participatory approach to design is also apparent in CSCW (Computer Supported Co-operative Work) research. CSCW is a new area of study that has arisen over the past few years to emulate on computer systems the communicative structures of work. CSCW research argues that the observation and analysis of work in real organisations is needed

together with an identification of co-operation interrelations, which can be transformed into a set of requirements for the design of systems in order to achieve the desired support for collaboration in and across organisations. CSCW points to the importance of understanding the effects of all features of the system within a flexible working environment, rather than just the technological sophistication that might be available.

Michelis and Grasso (1993) add a sensitivity to the dynamism of organisations in their exploration of communications networks and work processes. Oberquelle (1991) suggests that four primary factors need to be considered in order to develop suitable technology for facilitating co-operative work via computer-based systems: the tasks themselves, the nature of the individuals and the groups that they create, the organisational structure and the facilitating technology. All of the above researchers argue for a participatory approach to the design and implementation of information systems, in order to harness IT and its effects on change in organisations. The literature review shall now move on to consider what form such change will take.

IT and Organisational Change

IT is not just a technical system, it has the ability to alter the very fabric of the organisation. IT leads to organisational change, not just in terms of the way that information is handled and processed, stored and communicated. It also causes changes within the organisation that are secondary to those anticipated at the start of implementation. IT does not predetermine the human, organisational and economic consequences of it's applications; it's effects do however reflect the choices made by management and these are influenced by the existing organisational structures, processes and cultures (Legge, Clegg and Kemp, 1991). The important point is that IT is not produced and introduced in a social vacuum; it will therefore not have a fixed impact.

Research has been conducted into the effects of IT upon many aspects of organisations, including job satisfaction, job design, job roles, issues of identity, skill requirements, reward systems, centralisation vs. decentralisation, politics, power, authority and control, supervision, communication, organisational structure and decision-making. In the virtual organisation, remote organisations will be networked, and therefore traditional notions

of the organisation as a hierarchy may be obsolete. Therefore, two aspects of the effect of IT upon organisational change are the focus of discussion here; how IT affects power and control, and how it brings about new organisational forms.

Power and Control

IT has the capacity to alter the power balance in organisations. Power is dependent on the control of resources, of which information is one of the most important; powerful organisational members have more information at their disposal to distribute, withhold or distort (Kiesler, 1978). Control of information leads to acquisition of power by reducing uncertainty for organisational members with access to information (Blair et al, 1985; in Clegg, 1989). It is often feared that new IT will place power in the hands of a small group of elite people within an organisation. This sovereign view of power (Clegg, 1989) is based on the belief that information is a source of power from which information providers (usually in subordinate organisational positions) would lose power to information gatherers who tended to be in positions closer to the top of organisational hierarchies (Gotlieb and Borodin, 1973). Clegg's work draws similar conclusions to that of Latour and Woolgar (1979), who studied scientists in *Laboratory Life*, and discuss the 'producers of facts'. They talk of the series of strategies taken up by members of the laboratory in their decision to back the construction of one or other fact and in their efforts to enhance their ability further to invest in the construction of 'new' facts.

From this perspective, significant change can only occur through the use of power; when one group wins and another loses. Indeed, Keen (1985) has pointed out that organisational power politics play a crucial role in determining whether and how new technology is introduced. As information systems are often designed for management, and are human artifacts, constructed by the interaction and action of individuals, they reflect current exigencies and political agendas (Orlikowski, 1986).

This sovereign view of power finds a more recent formulation in arguments about the enhanced surveillance potential of IT in the workplace (Mosco, 1989). IT is capable of providing elaborate measurements of human work activity, such as how many calls a telesales worker makes, or how long a person has logged in to the system. IT may offer

objective evaluations of performance and help stimulate the quantity of production, but what are the risks? Walton (1982) argues that employees resent the loss of autonomy and the higher pressure on peer relations. Grant et al (1988) found an emphasis on quantity over quality. Pacing, monitoring and content control of work through computers can have a drastic effect on morale if the control by management is felt to be excessive (Walker and Guest, 1952). Job satisfaction is hampered by feelings of reduced control. Rosen and Baroudi (1992) term this invisible managerial control made possible by IT 'hegemonic control'. They claim that:

> 'The post-industrial organisation will not have the obvious machine control of the shop floor or the assembly line, but will possibly have the increasingly unobtrusive control enabled by computer-based technology.'

Zuboff (1988) suggests that IT 'sets knowledge and authority on a collision course'. Zuboff makes a distinction between using technology to automate or to informate. She argues that IT can be used to replace people's jobs and thus lead to job losses, or it can change skill and knowledge requirements, empowering individuals and reducing the routine element of jobs. This has been referred to as the de-Taylorisation of work (Rosen and Baroudi, 1992) - a shrinking of the extensive specialisation and division of labour characteristic of bureaucracy. Zuboff (1985: 8) explains the distinction between automate and informate as follows:

> 'IT is characterised by a fundamental duality that has not been fully appreciated. First, the technology can be applied to automate operations . . . the aim is to replace human effort and skill with a technology that enables the same processes to be performed at less cost and with more *control* and continuity. Secondly, technology can be used to create information. Even when a given application is designed to automate, it simultaneously generates information about the underlying processes through which an organisation accomplishes its work. The word that I have coined to describe this process is *informate*'

Zuboff goes on to argue that the extent to which either of IT's two capacities is emphasised will play a central role in determining the organisational consequences of technological change. Arnold et al (1995) provide support for Zuboff's distinction in observing that in some organisations, technology is seen as a substitute for staff, not a

way of using them better. Thach and Woodman (1994) propose that informating creates the true competitive advantage that IT can offer. Whilst Zuboff advocates using IT to informate employees, informating can affect power and control within the organisation.

If technology is used to informate employees, this increases the amount of information they have access to and they can begin to make their own decisions and question those made by management. Threatened authority relations lead to management employing new techniques of control that draw upon the technology's tendency to heighten the visibility and transparency of organisational processes. Zuboff (1988) uses a concept suggested by Foucault (1980) and likens IT to the Panoptican, an architectural innovation developed by the moral philosopher Jeremy Bentham. Foucault argues that techniques designed to manage labour lay the groundwork for a new kind of society, a 'disciplinary society' in which bodily discipline, regulation and surveillance are taken for granted. In Foucault's view, the Panoptican is both a sign of and a metaphor for this new disciplinary society. The Panoptican allows visibility and illumination, providing the possibility of total control. A case of Big Brother is watching you (*1984*, George Orwell). The observer needn't be watching the observed; the observer just needs to know the possibility of being observed is there. IT is seen as a means of making organisational activities more transparent; translating, recording and displaying human behaviour. It provides information about the subordinate's behaviour without face-to-face engagement, compliance without conflict.

Zuboff (1988: 323) comments on '. . the secret comfort of the one-way mirror, the yearning for omniscience in the face of uncertainty, the conformity inducing power of involuntary display'. Managers who doubt the strength of authority-based bonds or who prefer technical certainty to the rigours of managing face-to-face relationships are drawn to the technology as a new source of techniques for shaping the behaviour of their subordinates. Their efforts engage a series of organisational responses, such as new 'subversive' ways of getting around surveillance, ironically further weakening authority. She suggests that mutual visibility helps - universal access, as a correlate of universal transparency, diminishes the feeling of oppressive surveillance. She further suggests there is an optimum span of control and access; not everyone needs to have access to everything, if it is not relevant to their job.

IT may result in both centralisation and decentralisation. Heydebrand (1985) observes that centralisation and decentralisation are no longer opposites or alternatives, but are mutually dependent and operate simultaneously. IT facilitates decentralisation of tasks and decision-making, while at the same time maintaining or increasing the centralisation of control. Robey (1981: 681) observes 'what appears to be greater decentralisation may simply entail delegation of more routine decisions whose outcomes are more closely controlled.'

Alternative views of power and IT have been offered. The notion that the decentralisation of information represents a decentralisation of power has led some to regard IT as a potential means of furthering organisational democracy and political decentralisation. 'The new power is not money in the hands of the few, but information in the hands of the many' (Naisbitt, 1982, cited in Roszak, 1988). Indeed, Wiegner (1990) proposes that IT will have an 'equalising' effect on power distribution. Highly centralised organisations will become less so as people at lower levels receive more information which allows them to challenge decisions. Highly decentralised organisations become more centralised as top managers have better access to information previously unavailable (or denied) to them.

Another view is that IT does not centralise or decentralise power *per se*, but tends to strengthen the hand of already dominant players; that is, they reinforce existing organisational games (Kling, 1991; Wynne and Otway, 1982). 'Automated information systems should be viewed as social resources that are absorbed into ongoing organisational games but do not materially influence the structure of the games being played' (Kling, 1980: 92).

Bloomfield and Coombs (1992) advocate a further relational approach which looks at the potential role of IT in the renegotiation of professional knowledge, discourses and practices within organisations. In the tradition of Foucault (1980) and a social constructionist perspective, these discursive practices define the way people see the world and themselves. Bloomfield and Coombs suggest it is not helpful to view IT as

changing the location of power between the centre and the periphery, but as a qualitative change in the character of power relations between relevant parties.

As well considering the power relations between information providers and information gatherers, two other parties can be identified as losing power with IT implementation. These are middle management and professionals or experts. As employees gain more access to information, and have more access to other parts of the organisation with IT, some of the barriers that previously existed in a more bureaucratic organisation may be knocked down. Employees may be given the power to deal with customer problems directly, or to make decisions without the stamp of approval from middle management. This can be perceived as a serious threat to middle management (Zuboff, 1988).

Individuals or experts performing tasks traditionally identified as professional are facing 'deprofessionalisation' (Rosen and Baroudi, 1992), which Haug (1973: 197) defines as ' a loss to professional occupations of their unique qualities, particularly their monopoly over knowledge, public belief in their service ethos, and expectations of work autonomy and authority over the client.' Deprofessionalisation may be seen in cases of knowledge engineering and artificial intelligence techniques (Barr and Feigenbaum, 1981), where the possibility exists for the automation of work areas that formerly required highly skilled workers, and the routinisation of problems which were previously considered too unstructured for automation. Expert systems (Shortcliffe, 1976) also allow less skilled workers to have access to knowledge and skills.

We have seen that IT can affect the power relations within an organisation. I shall now turn to considering the changes in structure that can occur with IT implementation.

New Organisational Forms

The impact of IT upon organisational structure has also been considered in research on IT and organisational change. It may be that the existing organisation needs to change before IT can be successfully introduced: several writers have noted how many organisations fail to get the best out of their new technology because they attempt to integrate it into existing structures rather than changing those structures (Child, 1987).

People have talked of the breakdown of traditional organisational structures and the new organisational forms made possible by IT. Romanelli (1991: 97) discusses various perspectives on the evolution of new organisational forms. She observes that 'the evolution of a technological innovation is integrally related to the evolution of a new organisational form.' R. Hielfgott, in *America's Third Industrial Revolution*, describes the impact of IT on the organisation of work:

> 'Accompanying this technological change are changes in the way work is organised. The traditional system of work organisation, in which jobs are arranged in a hierarchy of distinct, often multiple, classifications, each of which is assigned a separate wage rate, no longer fits the needs. Since the emphasis is on flexibility in manufacturing, there has to be greater flexibility in the utilisation of the work force.'

Paul Kaestle (1990) observes: 'As a rule one cannot use information as a competitive weapon without simultaneously considering radical organisational change. This is because both market forces and information opportunities are making current organisational logic outdated and forcing a high rate of adaption'. IT has forever changed the nature of work, forcing old organisational structures into new configurations (Thach and Woodman, 1994). These new organisational forms signify second order as opposed to first order organisational change, a radical transformation of the organisation rather than one that occurs within a given form which itself remains unchanged (Watzlawick et al, 1974; Levy, 1986).

The majority of experts agree that IT makes existing organisational structures obsolete. The traditional pyramid and matrix hierarchies obstruct the true value of IT. A looser, more flowing organisation linked by enhanced communications and relations, rather than power and control, is necessary. One consistent conceptualisation of the new structure is a 'network'. This has also been described as a 'relational organisation', 'concentric circles', 'constellations', a move from 'islands of automation' to organisation-wide global systems, 'flexible', 'integrated', 'competent', 'knowledgeable', 'elastic', 'flatter', 'boundaryless', 'simplified', 'collaborative', 'co-ordinated', 'team-based', 'centralisation-with-decentralisation' and 'virtual'.

Let us consider some of the reconceptualisations of organisation afforded by IT. Zuboff (1985) suggests that informating invites a new vision of the organisation: a group of people gathered in concentric circles around a central core that is the automated database, the electronic text. Individuals relate to the electronic information interface according to their responsibilities which vary in range and comprehensiveness. Mastery at the information interface depends on intellective skill, which becomes one of the organisation's most precious resources, and the company invests in maintaining and upgrading that skill base in measures comparable to the investment in IT itself.

Keen (1991) observes that historically, firms have brought people to work and relied heavily on organisational structure as the basis for operations and strategy. Today, Keen believes, firms can bring work to the people and begin to contemplate the design of organisations the way they design products, from first principles, while being less constrained by limits of time and place. Large transnational firms are moving to a mode of co-ordination that ends the old dichotomy between centralisation and decentralisation and substitutes co-ordination and collaboration for control. Location will no longer determine planning, control, reporting function, and communication, making the firm's telecommunications resources the real definer of 'structure'.

Smith (1994:13) offers a reconceptualisation of the organisation as a constellation. 'If the Industrial Revolution gave rise to the gigantic corporate monolith, the Information Revolution will create the thousand points of light of an entrepreneurial culture, where power and creativity are dispersed, decentralised and democratised.' These ideas come close to the oft-cited concept of the boundaryless organisation; an organisation without walls or limits, made more flexible by ridding it of the traditional boundaries of hierarchy, function and geography (Hirschhorn and Gilmore, 1992).

Murray and Trefts (1992) see IT as the strategic enabling ingredient, enabling the restructuring of business and the key to transforming business capabilities from parochial to global. They say 'global' is not just another word to describe business as usual, in autonomous, diversified, unintegrated entities around the world. They claim businesses have been constrained by IT 'islands of automation', and need to be more organisation-wide, global systems. There must be a technological and business architecture to co-

ordinate and integrate, and new business processes and IS systems must be consistent with this architecture. There need to be architectural standards - relating to technologies, data, communications, applications and systems - to ensure organisation-wide systems do not become yet additional islands of automation.

Benjamin and Scott-Morton (1988) talk of the ability to restructure through the power of electronic integration. This integration comes in several forms; integration of formerly distinct transaction processes, integration of multiple forms of data representation and knowledge, and integration of groups through communications. Wright and Rhodes (1985) consider the main aim of implementing IT as being to achieve integration. This can be both within and across organisations - so fulfilling both internal and external objectives.

Sankar (1991) claims that structures of relative hierarchical position are losing their traditional grip on the organisation. From the former hierarchy of position power there is instead developing a hierarchy of competency. Power and resources flow to centres of competency rather than traditional hierarchical loci. Leadership will be determined by who is an expert on the matter at hand - not by corporate hierarchy. Change has resulted in a shift of organising by division of labour to organising by division of knowledge. The term division of knowledge captures a reality of work in an era of rapid change and uncertainty. Tasks are no longer predictable and experience may no longer be valuable. New inputs of knowledge are needed to define tasks, and multiple skills and experience are needed to complete them. There is a need for elasticity in the structure of the organisation to adapt to new circumstances and new technologies.

Keen (1991) suggests that IT can be used to reduce organisational complexity and increase organisational invention, leading to the collaborative and relational organisation: an organisation not defined by fixed structures but by ease of relationships. Keen argues that the business team, rather than the functionally defined hierarchy or the dotted-line or matrix management variants that show up on the organisational chart, is increasingly seen as the real unit of organising. Complex environmental, societal and economical changes are pushing organisations to new forms of collaboration. These pressures are destabilising established routines and structures and placing a premium on mechanisms

for supporting rapid adjustments to new and unpredictable situations. This inevitably involves collaboration across separate boundaries - between functional areas, locations, companies and countries. Team-based structures and processes emerge naturally in this context. Teamwork is relational; the quality of performance rests on the quality of interactions, communications and co-ordination among team members. Teams can be built up, utilising the best people combinations, and disbanded at a moments notice. Management control is replaced by management co-ordination of the work of others who may know more than the manager, and decision-making occurs in the team rather than in the hierarchy.

Bleecker (1994) argues that increasing teamwork using IT means a new set of organisational behaviours: trust, accountability and empowerment. This leads to a fundamental improvement in the individual's role in the workplace. The same traits that enable companies to thrive in an information-intensive, competitive, fluid environment will also free people to expand the limits of their capabilities, bringing us back to Zuboff's concept of the power of IT to informate employees.

The basis for effective teamwork is collaboration, 'shared creation' according to Michael Schrage (1990) whose book 'Shared Minds' deals with the contribution that IT tools can make to collaboration. Instead of focusing on organisational structure, business today needs to look at the mechanisms that make communication simple, flexible and natural. According to Keen (1991), IT makes practical the visions of some popular management book authors: Peter Drucker's 'network organisation', Rosabeth Kanter's 'dancing elephants', Stanley Davis's 'future perfect' and Tom Peters' 'life without hierarchy'.

Virtual organisation(s) as networks and teleworking

One conceptualisation of the new organisational forms made possible by IT is the 'virtual' organisation. All the above conceptualisations of new organisational forms made possible by IT ('network', 'relational', 'constellations', 'global', 'flexible', 'integrated', 'boundaryless', etc) do show a degree of fit with the concept of the virtual organisation. However, they fail to grasp the point that it is no longer a case of one organisational configuration being replaced by another in the Mintzbergian sense (e.g. bureaucracy by adhocracy) but of a

transfiguration of the very concept of organisation itself - the notion of real organisations becoming 'apparent'. Objectified electronic entities. What is clear (and somewhat ironic) is that the thinking about new organisational forms have to date been extremely frame-bound, its various presuppositions still rooted in the 'object' world assumptions about organisation.

Consideration needs to be paid here to the two different uses of the term 'virtual organisation' encountered in the management literature, before we go on to consider what is meant by the term 'virtual organisation' in this thesis. One refers to temporary networks of organisations, and the other to teleworking; both visions are united in their reliance on IT as the 'enabling ingredient'. The first use refers to the strategic alliances between companies that result in 'virtual organisations' or 'virtual corporations', also called partnering, networks or constellations. Byrne (1993: 37) observes:

> 'The virtual corporation is a temporary network of independent companies - suppliers, customers, even erstwhile rivals - linked by information technology to share skills, costs and access to one another's markets. It will have neither central office nor organisational chart. It will have no hierarchy, no vertical integration. Instead, proponents say this new evolving corporate model will be fluid and flexible - a group of collaborators that quickly unite to exploit a specific opportunity. Once the opportunity is met, the venture will, more often than not, disband.'

Networks have been variously defined (Aldrich and Whetten, 1981) but common to most descriptions is the idea of complex clusters of interdependent organisations or sets of interorganisational relations (Klijn, 1997). Nagel (1993; quoted in Byrne, 1993) forsees a national information infrastructure in the USA, permitting far-flung units of different companies to quickly locate suppliers, designers, and manufacturers through an information clearinghouse or brokerage. Once contracted, they would sign 'electronic contracts' to speed linkups without legal headaches. Teams of people would routinely work together, concurrently rather than sequentially, via computer networks in real time. Bleecker (1994) observes that: 'using integrated computers and communications technologies, corporations will increasingly be defined not by concrete walls or physical space, but by collaborative networks linking hundreds, thousands, even tens of thousands of people together.'

Turning to the alternative use of the term 'virtual', management writers (e.g. Tom Clancy, 1994; Chapman and Sheehy, 1996) have referred to teleworking and telecommuting resulting in a 'virtual organisation'. That is, new technologies such as e-mail, fax, workgroups software etc., mean that for certain businesses, people no longer need to come to the office but work from home. Many services and light manufacturing industries have traditionally employed home workers. Internet connections make it possible for all computing, communications and design businesses to do the same. British Telecom suggests that 37% of British companies and up to 2.5 million employees could be described as 'teleworkers'. A recent study by the Personnel Journal (September, 1994) found that 7.6 million Americans telecommute, a figure that is expected to swell by 25 million by the year 2000.

With advanced information and communication technologies, people not only have the opportunity to work from home, but from *anywhere*. We are on the brink of untethered, unwired communications. It is estimated that 45 million US workers spend more time on the road than at their desks (Bleecker, 1994). This new mobile workforce demands new tools that both untether them from the workplace and allow them to stay in touch at any time, any place and in any way - via phone, computer, fax, pager, videoconference etc; connected to the virtual organisation through an international, wireless, wideband communication network. Increasingly, the 'office' is where the worker is, not the other way round.

The advantages of the virtual organisation are that travel and office costs are reduced, travel time is zero, communication is efficient on-line and employees have greater autonomy and can work at their own rate. Evidence that homeworking improves efficiency, because workers are interrupted less and feel guilty when they take a break, is encouraging to businesses suitable for teleworking. Location independent flexible work practices can support an organisation in its efforts to achieve the flexibility that is necessary to survive in today's economic climate. This versatility is achieved through flexibility of work patterns, skills retention, recruitment opportunities, increased productivity and reduced overhead costs (Dooley, 1996). More broadly, it offers potential for development of rural areas, and can provide work opportunities for those

excluded from the workforce (e.g. those with physical disabilities, child care responsibilities etc). Pollution may decrease as commuter traffic lessens ('Launching and Managing a Virtual Office: Setting the Stage for a Distributed Workplace', Internet document, 1995).

The downside is that people are alone all day long, removing the social aspects of going to work and possibly leading to increased home and work role conflicts. Stimulating conversation in the workplace, which has often led to innovation, will be lost. Employment will probably become part time and less secure. Other potential disadvantages for employees include reductions in status, pay, loss of benefits and possible consequences for health. Some employers may consider the possibility of organisational restructuring needed to introduce new ways of working as too great to warrant the effort. They may fear a loss of employee commitment and loyalty; they may foresee difficulties in terms of managing remote workers, communications, security of equipment and information (Chapman and Sheehy, 1996).

The effect of these emerging teleworking technologies on organisational change will be even more profound than the changes associated with IT that were considered previously. We are no longer simply concerned with implementing IT within one site, as Zuboff was, but restructuring the organisation using IT. Teleworking will inevitably require change in management strategies: there needs to be a shift away from direct observation and performance measurement based on activity, towards management by more formal contact, and assessment on the quantity and quality of output rather than any time-based measure (Pancucci, 1995).

A study of the Psychological Aspects of Teleworking in Rural Areas (PATRA, 1992-1994) high-lighted that the essential prerequisites for successful teleworking include: self-management skills on the part of the teleworker, management support, effective telemanagement, and an understanding of organisational communication and structure. Effective, reliable and relevant communication is essential to teleworking, as communication is 'the thread that holds various parts of the organisation together' (Sheehy and Gallagher, 1996). Where management style is one of openness and participation, teleworkers positively equate this to a sense of trust and commitment in

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the organisation. The culture which exists within the organisation has a substantial impact on the success of the teleworking initiative (Dooley, 1996).

PATRA found that more cognitively demanding jobs necessitate a greater degree of interaction with the organisation, both at a face-to-face level and via communications channels. A good deal of informal organisational talk proceeds on a face-to-face basis and members may find it difficult to sustain dialogues using impoverished communications mediums, and co-operative work using IT can be stilted (Mason, 1990). Trying to sustain informal networks of communication in virtual organisations will inevitably increase IT costs (Sheehy and Gallagher, 1996). Teleworking devices remove important social cues that are present in face-to-face dialogues (Sproull and Kiesler, 1986). Fewer social cues are associated with experiences of: increased psychological distance, diminished social spontaneity and engagement and diminished rates of compromise. Adrianson and Hjelmquist (1991) demonstrated that face-to-face communications induces more conformity and opinion change than computer-mediated communication.

Lubich (1995) found barriers to the use of videoconferencing, as it provides information that an individual may not necessarily wish to transmit - such as the state of one's desk, or the sartorial elegance of communications. Although video telephones may be switched off at awkward times, this can provide just as socially negative set of cues as the untidy desk. This is the equivalent of talking to someone through a closed door which, as most people would agree, is commonly considered as impolite behaviour. Sellen (1992) showed that video communications led to interactants feeling more constrained in 'taking the floor', with more 'turn-taking' speech patterns than simultaneous speaking. Teleworking technologies can therefore be seen as changing patterns of communication and interaction within organisations, and requiring a radical change in how the organisation is managed.

Will the real virtual organisation please stand up?

We have seen that the virtual organisation can be considered as a temporary network of collaborative partners, or as a new form of organisation made possible by teleworking. In

this research, the virtual organisation bears a resemblance to these conceptualisations as it concerns the networking or linking of organisations that are geographically remote from one another, providing a means of communication and interaction between organisational members. The technology that enables this networking in this instance is virtual reality. Therefore I use the term 'virtual organisation' *literally*, to describe a networked virtual reality environment constructed for the purposes of interaction.

In all of the above semantic senses, the term 'virtual' is used to describe something intangible, immaterial and amorphous; new forms of organisations that do not have a physical location. The virtual organisation goes further than established IT systems and teleworking, which have been seen to evoke profound organisational change and make possible new organisational forms. In this case, the organisation becomes an objectified electronic entity, a virtual environment that signifies not just new ways of working, but a new organisational *space*. Organisations are able to create their own virtual images. In the beginning we had transition; then we had transformation; but not we have transfiguration of the organisation (Bate and Walker, 1995).

Zuboff (1988) alludes to this when she observes of IT:

> 'Electronic text becomes a *vast symbolic surrogate* for the vital detail of an organisation's daily life. . . Such data. . are a public symbolisation of organisational experience; much of which was previously private, fragmented and implicit - lodged in people's heads, in sensual know-how, in discussions at meetings or over lunch, in file drawers, or on desktops.'

Virtual workers are embodied in the virtual organisation; what is their relationship with their avatar[2]? What psychological effects does work in cyberspace have for the individual? What do networked virtual organisations imply for our traditional notions of organisation?

The virtual organisation, and its effects on the people who work within it, is still a new and relatively unexplored area. This is a pity because technological advances have

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[2] *avatar* in Hindu means the descent of a deity or released soul to earth in bodily form; an incarnation or manifestation (Oxford Concise English Dictionary, 9th Edition).

already meant big changes in the work place and need to be studied sooner rather than later. It is important that we consider what we are getting ourselves into before it all happens. Things are only just beginning to hot up. Tom Peters, as quoted in Thach and Woodman (1994: 30), eloquently informs us that 'Thanks to technology, the world is going bonkers. And its going to get more bonkers - bonkers squared in a few years and bonkers cubed on the way'. The next sections move on to consider virtual reality literature, cyberfiction, and postmodernist critical theory to gain further understanding of why spending time in cyberspace is likely to have a profound effect on individuals, organisations and societies. To start with, let us consider the technology that makes all this possible.

What is virtual reality?

Virtual reality (VR) is a form of three-dimensional computer graphics which allows users to feel as though they are looking at a computer display, and interacting with it, from the inside. As the user manipulates the system using an input device such as a mouse or joystick, the software updates the image and transfers this new view of the virtual world back through a display such as a screen or a Head Mounted Display (HMD), which gives stereoscopic visual and audio inputs for total immersion. VR allows people to feel as if they are entering the world inside a computer display, flying around and manipulating the objects they encounter.

The major drawback with VR so far is that of virtual motion sickness. I have experienced vertigo leaning over the banister of a virtual flight of stairs, and motion sickness on a virtual flight simulation. Wearing a HMD makes you particularly susceptible, as it is quite heavy which can cause strain on the neck and also responds to every tiny movement of your head. Eye tracking[3] and the possibility of contact lenses that can sense by the user's direction of gaze where the user wishes to go are similarly problematic due to involuntary eye movements.

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[3] The use of light-emitting diodes and infrared light to detect and 'track' the movement of the human eye, for the purpose of controlling the VR system. Along with speech recognition, eye tracking is important for the development of natural language and gestural interfaces for computer systems.

To avoid the cumbersome apparatus of headsets and the problems of involuntary eye movements, transparent virtual glasses are being developed which may prove more comfortable, as well as a single eye piece attached to a light headset. Information can be projected onto the displays, allowing the user to view data such as maps and alphanumerics as images superimposed upon his or her 'real world' view. Such developments are known as augmented reality, allowing the user to view the virtual and real worlds simultaneously. Augmented reality considers virtual realities as *part of* reality rather than *apart from* reality, which expands the virtual world design space.

VR requires a lot of processing power, and is driven by a 'reality engine', a computer system designed to generate 3D virtual worlds in sound and vision. A typical system combines a powerful microprocessor, two graphic processors (for stereo imaging) and digital signal processors for stereo sound. In 3d 'worlds' every object and surface must be constructed and rendered with colour and texture. The more detailed a VR environment, the more processing power is needed to update and rerender the image for the user. Movement in 3d worlds isn't merely three dimensional. Both sensors and input devices have 6 degrees of freedom, as well as the three standard Cartesian directions (x,y,z). Movements called roll, pitch and yaw are also controllable.

Each visitor to a virtual world is represented by a self-propelled personalised avatar which can range in appearance from a simple coloured geometric shape to an elaborate embodiment with an instantly recognisable face. Benedikt (1991) sets out some proposals and principles regarding the nature of virtual worlds which serve to illustrate what virtual environments are like. Benedikt's Principle of Personal Visibility recommends that users should not have the facility to be invisible. The Principle of Personal Visibility 'installs the belief that democracy, even in cyberspace, depends on accountability, and that accountability depends in turn on *countability*, that is, on the obligation to 'stand up and be counted' (Benedikt, 1991; 178). Benedikt also suggests that no user can be in two places at once, despite the temptation for multiple avatars. Nor should you occupy the avatar of another user (no exorcisms should be necessary in cyberspace!). Bricken (1991) suggests that any person can have access to the cyberspace matrix (voluntary citizenship) and that each person has full control of his or her interactions in cyberspace (human rights).

The user's view is updated as the avatar moves around the virtual world. In order to navigate around the virtual world, users can usually switch between a 'head height' field of view, an 'above the shoulders' view or a 'birds eye view' of the virtual world. The user can fly around the virtual world, visiting different virtual environments via gateways or ports. In addition to the avatar, users can extend their capabilities by having intelligent agents working for them and interacting autonomously in cyberspace, performing tasks such as checking mail or getting data. Benedikt's Principle of Indifference suggests that life in virtual worlds goes on whether you are there or not.

Virtual worlds are usually constructed by designers to be objective experiences, without allowing users the freedom to tailor the world, although the user does have his or her own subjective viewpoint on that world. Benedikt's Principle of Commonality recommends that virtual places be 'objective' in a circumscribed way for a defined community of users. If every user could change the environment, it would require a lot of processing power, and objects might move around as though the environment were inhabited by poltergeists. An unstable environment might get in the way of interaction. Users might instead express their individuality by designing their own virtual environments that can be visited via a gateway (Pruitt and Barrett, 1991).

Applying VR to work

There has been a good deal of speculation about the implications and applications of VR as it will be in the future. Schroder (1994) emphasises how VR writers such as Lanier (1989) and Laurel (1991) swing between expounding the 'other-worldliness' of VR, and cautioning that we should not hope for too much. Jaron Lanier (1989:8), credited with first using the term 'virtual reality', speaks of:

> 'an experience when you are dreaming of all possibilities being there, that anything can happen, and it is just an open world where your mind is the only limitation . . . The thing that I think is so exciting about virtual reality is that . . . it gives us this sense of being able to be who we are without limitation; for our imagination to become shared with other people.'

This can be contrasted with Lanier's own caution that 'there is a really serious danger of expectations being raised too high'. At present, virtual environments are fairly crude and require a reasonable amount of imagination in order for one to feel immersed within the system. However, it is generally predicted that within the next two decades there will be sufficient bandwidth to enable people all over the world to interact in virtual environments where '. . the computer retreats behind the scenes, leaving you free to concentrate on tasks, ideas, problems and communications' (Pimentel and Teixeira, 1993:5).

The implications for organisations of such an anticipated improvement in global communications are profound. For example, people in different countries would not have to travel abroad to work together; they will be able to 'visit' one another without having to leave their desks, or indeed homes. The potential of such developments to assist in the integration of operations within multinational companies, and to enhance global competitiveness will ensure a sustained interest in VR from a business point of view. The business interest in VR is growing, and by 1998 businesses in the USA alone were expected to be spending $95 million a year on VR, of an estimated total market of $569.9 million, which will largely be taken up by the entertainment industry (Houlder, 1994).

What, then, are the qualities of VR that make it a viable tool for business applications? Firstly, VR can give us a new way to explore reality. Like the telescope and microscope, it can extend our senses so that we can learn or do something with reality that we could not before. For example, applications are being developed so that people can manipulate designs and prototypes; ranging from molecular structures to architectural plans. The second important aspect of VR is that it allows us to perceive abstract ideas and processes for which there is no physical model or representation. VR acts as a translator, converting concepts into experiences that our senses and mind can appreciate and analyse. For example, one company on Wall Street uses VR to represent financial data so that traders can predict share movements, and a Japanese computer company provides its programmers with virtual representations of programmes, so they can spot bugs more easily (see Bulkley, 1993, for a review of present applications of VR).

However, the most interesting experiences in virtual environments are not likely to involve simulated objects or abstract representations, but human interaction. Rheingold (1991) explains the benefits that VR can bring to communication as follows:

> 'Why would people need to put themselves into a simulated reality in order to communicate? Why would anybody invest decent money today in order to merge telecommunications and VR twenty years from now? The answer lies not so much in what today's state-of-the-art VR provides, but in what today's state-of-the-art telecommunications systems do not provide - the delicate, complex balance of non-verbal cues such as posture, gesture, facial expression, direction of gaze that characterise our oldest and highest bandwidth technology, face-to-face communication.'
>
> Rheingold (1991: 216)

Investigating interaction in virtual worlds

What is it like when people interact in virtual worlds? What size of group is most effective for different forms of interaction? How does virtual behaviour differ from behaviour in 'real' groups? Do new forms of interaction evolve? The study of Collaborative Virtual Environments (CVEs) is an emergent area of research that aims to investigate some of these questions. It involves computer science research into developing technologies and principles for virtual worlds (e.g. Chalmers, 1996; England et al; 1996), and social science research into the nature of interaction in virtual worlds (Bolzoni et al, 1996; Axling, 1996; Bowers et al, 1996). Research has tended to focus on what happens within the virtual world. There is a growing awareness that whilst users may be immersed in and interacting within virtual worlds, they continue to exist, work in and need to attend to their immediate physical environment. The user's division of attention between these mixed realities is therefore being studied (Benford et al, 1995).

One source of insight into interaction in virtual worlds has come from studies of text-based virtual worlds called MUDs (Multi-User Dimensions) and MOOs (Object-Oriented MUDs), which are essentially live adventure role play games that can be visited via the Internet. The game structure of Dungeons and Dragons, the popular fantasy game of the 1980s, was transferred to MUDs. MUD participants create a character by typing text

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descriptions of appearance and behaviour into the communal 'space' of the on-line dimension. Other players have no way of knowing if the incarnation corresponds to the real body or personality of the player. People can meet up in public MUDs, 'chat' using text with others, use passwords to gain access to private MUDs, and design their own rooms for other players to visit.

Rosenberg (1992) conducted an ethnography of MUDs, and sat about 'watching' conversations in the rooms and found that a culture of sorts has evolved within them. MUD communities are as protective of their members as any group of friends or neighbours in 'real' life. They probably have more in common than most physical groups since their allegiance is intellectual and based on shared interests rather than based on proximity. There is a strict code of what is and is not acceptable conversation, the rooms are policed by wizards who hold votes to blackball people who are perceived as violating these codes, and there have been 'trials' conducted by MUD elders if people have protested against their removal.

The New York magazine carried a report of 'A Rape in Cyberspace'. A female MUD character was made to 'speak' and 'act' in uncharacteristic and unpleasant ways by another participant. The victim claimed to have felt violated and abused as in any physical situation where one's behaviour and speech are controlled by another person. After several (on-line) meetings of the 'elders' of this community, the wizard was persuaded to exile the perpetrator of the virtual 'crime'.

It can be seen that there are similarities between these textually based 'meeting rooms' and the virtual organisation, in the sense that people from around the world can visit one another and interact within them. However, there are some important differences. In the informal atmosphere of MUDs, interactants can express whatever opinions they wish, even if they face the risk of ostracism. However, in the business context of the virtual organisation there is the problem of taking people literally at their word, as Zuboff (1988) found in a group of e-mail users. The written word is identifiable with the author, and the author can ultimately be perceived as culpable if they write something that is considered controversial and can be recorded and traced back to them. This may mean that interactants become more thoughtful and cautious.

Furthermore, whilst MUD rooms have usually been visited by college students from universities in the West (the largest group of users of the Internet), the virtual organisation will be visited by organisational members from all over the world, bringing a polyphony of cultural voices and a cultural pluralism on a scale never encountered before. Finally, MUDs are open to anyone, whereas in the virtual organisation there will be issues of security and confidentiality of information. The most important lesson to learn from MUDs, however, is that if a culture has been identified by ethnographers in meeting places with relatively limited text-based communications, then a culture is almost certain to evolve within multimedia virtual environments, where people can not only write, but also talk, listen and see.

What is cyberspace?

Although many writers use the terms 'virtual reality', 'virtual worlds or environments' and 'cyberspace' synonymously (and I am no exception here, I am afraid!), they are distinctly different. Virtual reality technologies are an ideal interface with cyberspace, and virtual worlds exist within cyberspace, which is the virtual universe. Although it depends on them technically, cyberspace itself is neither a hardware system, nor a simulation or sensorium production system, nor a software graphics programme or 'application'. It is a place, and a mode of being. Cyberspace is big. Infinitely big. Let us consider some descriptions of cyberspace.

The most striking spatial construct in the cyberpunk novel *Neuromancer* by William Gibson is 'cyberspace'; indeed, Gibson is credited with coining the phrase. Cyberspace is the virtual reality that exists in simulated splendour on the far side of the computer screen - the real centre of technological activity in Gibson's fictional world.

> 'A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts . . . A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the non-space of the mind, clusters and constellations of data. Like city lights, receding . .'

Cyberia is the territory of a collective psychology, its shape and size only limited by human desire and imagination. Cyberspace is not a world 'out there' to conquer and subdue, but an electronically assisted, unlimited collective mind. Varying definitions have been offered of cyberspace. John Barlow, Grateful Dead member and journalist, describes it as 'Where your money is' and 'The place you go on the phone'. Timothy Leary, LSD guru and Internet advocate, describes it as 'the only unconquered real estate of the 21st century, a virtual world at the electronic frontier inhabited by telematic nomads'.

The term 'cyber' tends to prefix many words to do with cyberspace - cyberpunk, cyberia, cybersex etc. Norbert Wiener, in 1948, invented the term cybernetics to describe control systems using computers. *cyber* comes from the greek κυβερ (σπαχε) : kuberman: to steer, to guide, to govern . . . to control? Wiener wrote '. . We have decided to call the entire field of control and communication theory, whether in the machine or in the animal, by the name cybernetics, which we form from the Greek word for steersman.' Leary (1991) observes that Wiener corrupts the meaning of cyber. The Greek word 'pilot' becomes 'governor or director', the word 'to steer' becomes 'to control'. He claims that cyberpunks are reclaiming the original use of the term.

Benedikt (1991) observes that cyberspace does not yet exist outside of science fiction and the imagination of a few thousand people. However, from the multiple efforts of the computer industry and the explosion of the Internet one might cogently argue that cyberspace is 'now under construction', towards the full-blown public consensual reality that will be cyberspace. On the largest view, the advent of cyberspace is apt to be seen in two ways, each of which can be regretted or welcomed: either as a new stage in the *etherealisation* of the world we live in, the real world of people and things and places, or conversely, as a new stage in the *concretisation* of the world of abstractions, memory and knowledge.

Cyberspace is not a new concept. The design of cyberspace is, after all, the design of another life-world, a parallel universe, offering the intoxicating prospect of actually fulfilling - with a technology very nearly achieved - a dream thousands of years old: the

dream of transcending the physical world, fully alive, at will, to dwell in some Beyond -
to be empowered or enlightened there, alone or with others, and to return. Human
desires for immersion in other worlds and for bodies in different shapes and sizes have
been apparent in religion, ritual and dance for thousands of years. The shape of
cyberspace, collective dreaming and consensual imaging echoes the dreamtime of ancient
cultures. From the myth of Orpheus in the Underworld through to entering Narnia in *The
Lion, the Witch and the Wardrobe* by C.S. Lewis, the ideas of transcendence, of entering
other worlds, have unstintingly fascinated philosophers, artists and writers. Alice in
Wonderland may well have been one of the first cyberpunks!

'"Let's pretend the glass has got soft like gauze, so that we can get through.

Why, it's turning into a sort of mist now, I declare! It'll be easy enough to get through - '.

In another moment Alice was through the glass and . . . into the Looking-glass room.'

(Lewis Carroll, *Through the Looking Glass*, 1871)

Figure 3.3: Alice goes through the looking glass

In the *Republic*, Plato tells the well-known story of the Cave in which people caught in the prison of everyday life learn to love the fleeting, shadowy illusions projected on the walls of the dungeon of the flesh. With their attention forcibly fixed on the shadowy moving images cast by a flickering fire, the prisoners passively take sensory objects to be the highest and most interesting realities. Only later when the prisoners manage to get free of their corporeal shackles do they ascend to the realm of active thought where they enjoy the shockingly clear vision of real things, things not present to the physical eyes but to the minds eye. Plato's simile of the Cave entails a realisation that what attracts us in the sensory world is no more than an outer projection of ideas we can find within us.

It is a short leap from Plato's simile of the Cave to the spatial metaphor of cyberspace, where our reflections are literalised. 'At the computer interface, the spirit migrates from the body to a world of total representation. Information and images float through the platonic mind without a grounding in bodily experience . . . The surrogate life in cyberspace makes flesh feel like a prison, a fall from grace, a sinking descent into a dark, confusing reality. From the pit of life in the body, the virtual life looks like the virtuous life' (Heim, 1991: 75). Our fascination with transcendence implies a desire for distance from the physical body, from earthly constraints.

'Life is a disease of matter'. *Goethe.*

When we can be what we want in cyberspace, when we spend time in this post-corporeal existence, how will we view our real physical bodies? Will we develop a 'certain relaxed contempt for the flesh'? Gibson (1984:12) spoke of the 'bodiless exultation of cyberspace' in the following passage:

'(The employers that Case stole from) . . . damaged his nervous system with a war time Russian mycotoxin.

Strapped into a bed in a Memphis hotel, his talent burning out micron by micron, he hallucinated for 30 hours.

The damage was minute, subtle and utterly effective.

For Case, who'd lived for the bodiless exultation of cyberspace, it was the Fall. In the bars he'd frequented as a cowboy hotshot, the elite stance involved a certain relaxed contempt for the flesh. The body was meat. Case fell into the prison of his own flesh.'

Cyberspace has been seen as a retreat, a Utopian world. The mystical and all-encompassing vocabulary of 'cyberia' and the 'Internet' is symptomatic of a desire to create a utopian world of total knowledge. In Channel 4's 'Once Upon a Time in Cyberville', it was argued that people are increasingly retreating from urban decay into electronic Utopias. Heim (1991: 73) observes that 'isolation persists as a major problem of contemporary urban society - I mean spiritual isolation, that plagues individuals even on crowded city streets . . . networks act as computer antidotes to the atomism of society.'

Nicole Stenger (1991: 52), in 'Mind is a Leaking Rainbow', claims that ' . . . on the other side of our data gloves, we become creatures of coloured light in motion, pulsing with golden particles. Forget about Andy Warhol's petty promise of fame for 15 minutes. We will all become angels, and for eternity. Highly unstable, hermaphrodite angels, and unforgettable in terms of computer memory. In this cubic fortress of pixels that is cyberspace, we will be, as in our dreams, everything: the Dragon, the Princess and the Sword'. In cyberspace we are afforded the possibility of escapism, of transcendence, of eternity.

'A man that looks on glass
On it may stay his eye;
Or if he pleaseth,
through it passes,
And then the heavens espy.'

George Herbert, *The Elixir*

What happens to us when we enter and spend time in cyberspace? When we pass through the soft gauze of the computer screen and transcend into cyberspace? Writers have claimed that VR has the potential to change the way we think and define ourselves and our environment (Rheingold, 1991; Shapiro and McDonald, 1992; Pimentel and Teixera, 1993). What is the significance of such technologies and the dawn of the

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information age? The next section delves deeper and explores the metaphysical dilemmas of this new era and the advent of the virtual organisation.

Postmodernism and Cyberfiction

One genre of writing that has attended to the profound effects of new technology on the world is postmodernism and science fiction that explores postmodern concerns. The myriad features associated with the slippery term 'postmodern' can best be understood by examining what is unique about our contemporary condition. And it seems undeniable that this condition derives its unique status above all from technological change.

Technological advances have introduced a broad range of tangible high technology products: computers, medical equipment, weapons, cellular phones, microwaves etc. Even more significant than these has been the rapid proliferation of 'products' that are essentially *reproductions* or *abstractions* - images, advertising, information, memories, simulated experiences and copies of original experiences. Greil Marcus (1989: 101) notes three industries: advertising, information and 'the media industry', have:

> '. . . turned upon individual men and women, seized their subjective emotions and experiences, charged those once evanescent phenomena into objective, replicatable commodities, placed them on the market, set their prices, and sold them back to those who had, once, brought emotions and experiences out of themselves - to people who, as prisoners of the spectacle, could now find such things only on the market.'

The introduction of such artifacts provides people with a host of stimulating possibilities - but an equal number of troubling psychological, moral and epistemological quandaries as well. People have throughout history debated the nature of life and death, the soul, what is real and what is illusion, and how one might achieve immortality. These obsessions have been metaphorised in memorable literature such as Mary Shelley's *Frankenstein*. Similarly, our fascination with illusion has a rich history, from shadow puppets, magicians, the masquerade, film, theatre, and the art form tromp l'oeil.

However, the quandaries that have previously been the subject of such philosophical and artistic explorations have achieved a new significance. In many cases, terms that were speculative abstractions whose existence was tied to semiotics and definitions have now become *literalised*. These explorations had precious little practical relevance until we began to develop technologies that allowed us to keep brain-damaged patients 'alive' indefinitely, or to implant technology such as pace makers that blurs the distinction between humans and machines, or to create intelligent computer systems that can simulate the features of a conscious human being. What is 'growing old', when we can be nipped, tucked and plumped in the pursuit of eternal youth? What is 'real', when we can experience virtual realities? VR sites are the essence of post-industrial society - pure information duplicated in metasocial form.

If we consider the language of virtual reality, we find the language itself alludes to the metaphysical dilemmas associated with this new era. The language of VR includes: cyberspace, representation, embodiment, reality engine, avatar, gateways to virtual worlds, knowbots. Virtual means nearly, almost; not physically existing as such but made by software to *appear* to do so. The developments in technology require some radical rethinking of several basic paradigms and metaphors through which West Europeans have viewed themselves since ancient Greeks: the nature of 'consciousness' and categorical oppositions that we rely upon to understand ourselves and our relationship with the world: male / female, organic / inorganic, artifice / nature, reality / illusion, originality / duplication, life / death, human / inhuman. The breakdown of these concepts and distinctions, as well as the rise of new metaphors, categories of perception, and new realms of experience have been theorised by postmodern critics and explored by science fiction writers.

Guy Debord provided the first comprehensive examination of the far-reaching effects of post-industrial capitalism on the individual. He theorised this 'obsolesence of the real' by describing contemporary life as now belonging to the 'society of the Spectacle' where 'everything that was directly lived has moved away into a representation' (1977: 1). He claims 'the image has become the final form of commodity reification.'

Jean Baudrillard (1983), in his work *Simulations*, probes the epistemological quandaries, simulated experiences, desires and banalities that comprise postmodern American life. He theorises Plato's concept of the 'simulacra' - the identical copy for which no original has ever existed. Borrowing an image from Borges, Baudrillard summarises the process of simulation as the replacement of the territory by the map so that the postmodern realm is now in the 'desert of the real'.

> 'It is the real, and not the map, whose vestiges subsist here and there, in the deserts which are no longer those of the Empire, but our own. The desert of the real itself'.

This is the postmodern desert inhabited by people who are, in effect, consuming *themselves* in the form of images and abstractions through which their desires, sense of identity and memories are replicated and then sold back to them as products. William Burroughs, the father of cyberfiction writers, argues that we need to attack the image machine.

> 'Storm the Reality Studio
> And retake the Universe'
>
> *Nova Express*, William S. Burroughs (1964)

Baudrillard in *Simulations* says counterfeit and reproduction always imply an anguish, a disquieting foreigness. Benjamin talks of the uneasiness before the mirror-image. But how much more so when this image can be detached from the mirror and transported, stocked and reproduced at will.

Virtual environments are constructed spaces, simulations; our sense of space and self is being given back to us in new form. The virtual world, by virtue of its being so 'real', may become a reified world:

> 'Reification is the apprehension of human phenomena as if they were things, that is, in non-human or possibly suprahuman terms. Another way of saying this is that reification is the apprehension of the products of human activity *as if* they were something other than human products - such as facts of nature, results of cosmic laws, or manifestations of divine will. Reification implies that man is capable of forgetting his own authorship of the . . . world, and,

further, that the dialectic between man, the producer, and his products is lost to consciousness. The reified world is, by definition, a dehumanised world. It is experienced by man as a strange facticity, an *opus alienum* . . . rather than as the *opus propium* of his own productive activity. . . In other words, reification can be described as an extreme step in the process of objectivation, whereby the objectified world loses its comprehensibility as a human enterprise and becomes fixated as a non-human, non-humanizable, inert facticity. Typically, the real relationship between man and his world is reversed in consciousness. Man, the producer of a world, is apprehended as its product, and human activity as an epiphenomenon of non-human processes. . . . Even while apprehending the world in reified terms, man continues to produce it. That is, man is capable paradoxically of producing a reality that denies him.'

<div align="right">Berger and Luckmann (1967: 106)</div>

In many ways the ambition of virtual world designers is reification - to make the virtual world seem real and factual for those who enter it. We will forget that the virtual world was designed by people. We will forget that the person inside the virtual world is our self and we will lose cognitive contact with it - we will lose our selves. And what of the symbolic dimension of cyberspace? Cyberspace is 100% symbols, nothing more and nothing less. Cyberspace offers infinite space for the creation and manipulation of symbols.

'We are evidently unique among species in our symbolic ability, and we are certainly unique in our modest ability to control the conditions of our existence by using these symbols. Our ability to represent and simulate reality implies that we can approximate the order of existence and bring it to serve human purposes. A good simulation, be it a religious myth or scientific theory, gives us a sense of mastery over our experience. To represent something symbolically, as we do when we speak or write, is somehow to capture it, thus making it one's own. But with this approximation comes the realisation that we have denied the immediacy of reality and that in creating a substitute we have but spun another thread in the web of our grand illusion.'

(Heinz Pagels, *The Dreams of Reason*, 1988: 136)

With virtual reality, we have an incredible thinking tool, a new way of looking at ourselves and our environment. But will it become a haven for schizophrenics, the nightmarish 'consensual hallucination' described by William Gibson in the novel *Neuromancer*. Rheingold (1990: 388) suggests that it will very much depend on the individual:

'Which way it will go - dystopia or empowerment - depends in part upon how people react to the unmasking of reality as a cognitive-perceptual construct. People tend to react in different ways to the news that reality might be an illusion, depending on their emotional attachment to their brand of reality. Denial, cognitive dissonance, resistance and satori are all possible psychological reactions to the truth we are forced to face in the illusory realm of cyberspace, in roughly descending order of popularity.'

Cyberpunk fiction draws attention to the metaphysical dilemmas we face in the information age. It does not offer speculation and extrapolation so much as simple, unhysterical unsentimental understanding of the profound technological and epistemological implications of accomplished and near-accomplished cultural fact. Tessa de Lauretis (1980: 167) observes:

'Technology is now, not only in a distant science fictional future, an extension of our sensory capacities; it shapes our perceptions and cognitive processes, mediates our relationships with objects of the material and physical world, and our relationships with our own and other bodies'.

Gibson uses the framework of *Neuromancer* to introduce postmodern concerns; the contrast between the human 'meat' and mental, the relationship between human memory and computer memory; the denaturing of the body and transformation of time and space in the postindustrial world; the 'dance of the biz' (of information, of business), and the main concern of most postmodern science fiction. That is, the uneasy recognition that our primal urge to replicate our consciousness and physical beings (into images, words, machine replicants, computer symbols, avatars) is *not* leading us closer to the dream of immortality. Instead it is creating a parody, a simulacra or meta-existence of our senses that is supplanting us, literally taking over our physical space and our roles with proficiency, without error and waste, without emotions and the passions that make life human.

Veronica Hollinger (1991) posits it is only by recognising the consensual nature of sociocultural reality, which includes within it our definitions of human nature, that we can begin to perceive the possibility of change. Hollinger (1991: 218) claims:

'The postmodern condition has required that we revise science fiction's original trope of technological anxiety - the image of a fallen humanity controlled by a technology run amok. Here again we must deconstruct the human / machine opposition and begin to ask new questions about the ways in which we and our 'technologies' interface to produce what has become a mutual evolution.'

The view is not one of technological determinism; of the inevitable consequences of technology. Man and machine exist in a symbiotic relationship. Cyberpunk writers and postmodernist critics have drawn attention to the world to be lost and the world to be gained in the age of technological change. We are approaching a time when all knowledge and all ways of manipulating it can be reduced to a string of symbols - is that what we want? But the virtual world means nothing, it does not exist, it is redundant, without the human there to make it in the first place, to spectate upon it and interpret it. Predictions and warnings range from nirvana to a totalitarian or anarchistic hell. It may be naïve to imagine that we can influence the future very much - the ball has started rolling.

Reviewing the literature review

It is apparent that there is scant literature that specifically concerns using virtual reality to make interactive work environments and what implications this has for the organisation. Findings from IT and organisational change draw attention to power and control and new organisational forms, but deal with IT implementation at one site rather than at distributed sites. Teleworking literature talks of distributed working, but does not extend to the dilemmas associated with working in virtual reality. New organisational forms literature tends to provide conceptualisations of the changing nature of organisations that are framebound, and some of which are speculative and not grounded in data.

CSCW literature concerning CVEs tends to either concern technical issues, or with understanding the social dynamics of interacting in CVEs at a micro level, without considering the broader implications for the organisation. Post modern literature and

cyberpunk fiction that explores post modern concerns give insights as to the dilemmas associated with working in cyberspace, but tend to focus upon the problems rather than the possible advantages, and provide little practical insight to guide those trying to design or implement virtual organisations. The purpose of pointing out the gaps in the literature that ranges across a number of disciplines is not to set them up to knock them down, but to acknowledge that they all tell us *something* about the emergent phenomenon of the virtual organisation. They provide the conceptual context, which has to be constructed rather than being something that already exists as the virtual organisation is such a new and frame-breaking concept.

It is also important to observe that in any active area of inquiry, the current knowledge base is not in books or journals but in the invisible library of informal associations among research workers who know the territory. Having been involved with the VirtuOsi project, I have had the opportunity associate with some of the foremost thinkers and designers of the virtual organisation in the UK, which has provided insights beyond that available in the literature. I have had the opportunity to observe the sorts of decisions the designers of virtual environments are making regarding these virtual work spaces. I have also attempted to get a fuller perspective by seeking to understand what future users of the virtual organisation need, hope for, and fear. This research therefore takes preliminary steps towards understanding this new form of organisation. The next chapters specifies the whys and hows of the research - the research design and method; the means by which answers were sought.

CHAPTER 4

RESEARCH DESIGN

This chapter explains the rationale behind the design of this doctoral research. The aims of the research and research questions were set out in the first chapter. This chapter aims to discuss in more depth the process of research, the choices that I made, and how the research design evolved through my involvement with the VirtuOsi project and the BICC Cables group. Throughout my research I continually reflected upon thesis, theory and methodology, refining my research questions and the most appropriate design and method for research as the nature of the problem evolved and the VirtuOsi project changed in scope. As is the case with most research, things never quite go according to plan. Initial research questions were outlined at the transfer report stage of this research. These have been revised as lines of enquiry have opened or been thwarted, and the aims and scope of the research have changed because of this. In the following discussion of research design, I have explained some of the turning points that occurred during the course of my research. I have also talked of my 'experiential data' (Strauss, 1987) - my research background and personal experiences that have influenced the research design.

Golden-Biddle and Locke (1993) suggest that a successful account drips with authenticity and plausibility, and it leaves one in no doubt that one is getting it straight and in the raw. I have approached my account of research design and methodological issues in the subsequent chapter in this vein, reflecting upon my approach, my role and the good and bad decisions that I made. This is done in the spirit of portraying the *reality* of my research, rather than presenting a revisionist, *a posteriori* version of events that suggests that the research process has gone smoothly and exactly as I planned.

Classifying the research

Easterby-Smith et al (1991) give three main classifications of research: pure, applied, and action research, each of which are described as follows. Pure research is intended to lead to theoretical developments, and there may or may not be practical implications. Applied research leads to the solution of specific problems, explaining what is happening, rather

than simply describing things. Phillips and Pugh (1987) distinguish between 'what' and 'why' questions in stressing that genuine research must include consideration of 'why' questions. Applied research often takes the form of an evaluation of the process and results of particular courses of action, such as the introduction of a new technology. Action research assumes that research should lead to change, and therefore that change should be incorporated into the research process. Action research attempts to create new, research based solutions to existing problems and emphasises what could be, rather than what is (Adler, 1983). 'New paradigm' research stresses the importance of establishing collaboration between researcher and researched, leading to the development of shared understandings (Reason and Rowan, 1981).

Easterby-Smith et al (1991) acknowledge that the distinctions between these types do not hold clearly in practice. When considering the three classifications of research offered, it would appear that this doctoral research is a union of applied and action research. The research is applied in that it has investigated the design and development of virtual technologies for a real-life factory scenario. The research is action-oriented to the extent that the process of development of the virtual organisation has been observed, but in an interactive as opposed to passive way. For example, I identified four factories that were appropriate for the VirtuOsi factory scenario, and Multimedia technologies were developed with that scenario in mind. I shall expand on this issue of my role within the Virtuosi project in the section on subjectivity.

Epistemological Issues

The way that organisational research is conducted depends upon the researcher's conceptualisation of reality. At one end of the continuum, the positivist or scientific researcher conceives of reality as a rigid structure, and formulates specific hypotheses that can be stated and tested against a null hypothesis using an experimental approach (Morgan and Smircich, 1980). At the other end of the continuum, the researcher working within a phenomenological paradigm views reality not as something fixed, objective and exterior, but socially constructed. Research becomes a process of discovery, posing research questions providing illumination of the phenomenon rather than setting hypotheses to be tested according to a more scientific approach. Fieldwork, study in the natural environment, in real organisations or social settings, takes preference

over experimental research. The researcher gets involved with the phenomenon being researched, and cannot be seen as independent from it but instead as interacting with it.

Different research techniques have traditionally been associated with the different epistemological perspectives. The positivist social scientist generally conducts quantitative research, and uses more quantitative, standardised techniques. Phenomenologists tend to conduct qualitative research, using more flexible, interactive, situation-specific research techniques[1].

In the following sections I discuss epistemological issues in relation to my research. It is apparent that my research falls somewhere between the two ends of the continuum, towards the phenomenological end. Whilst a phenomenological perspective can be seen as appropriate, and was the path that I set out along when I started my research, my background, research design and choice of methods bring my research back along the continuum somewhat. It is probably fair to describe my research approach as 'predominantly' (as opposed to wholly) phenomenological.
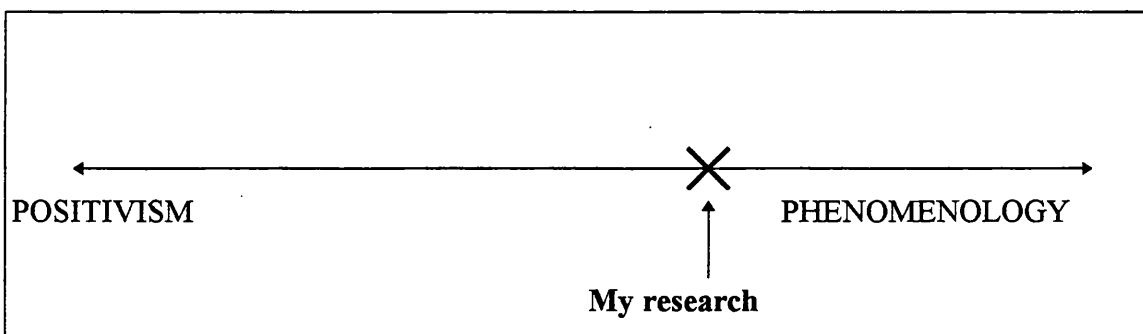
Figure 4.1: My approach to research placed on Morgan and Smircich's (1980) epistemological continuum

[1] Methods are discussed more fully in the next chapter, but are mentioned here to emphasise how epistemology, research design, context and method are inter-dependent.

The nature of the phenomenon under investigation

In considering ones approach to a phenomenon, it is important to consider the nature and context of the phenomenon, and how it might most appropriately be *known*. Morgan and Smircich (1980) observe that the appropriateness of a research approach derives from the nature of the social phenomenon to be explored. The virtual organisation under investigation in this research is 'up for grabs'; a new concept that has yet to be clearly defined. It is being *constructed* through the course of the VirtuOsi project, and its meaning is *literally* being negotiated by the designers creating it. The virtual organisation is emerging through the course of interaction of the designers. It is not something fixed and tangible, it is it is not objective and *real*, it is *virtual*. The nature of the virtual organisation would therefore strongly point towards the phenomenonological end of the continuum.

Eliciting constructs

A further reason for adopting a phenomenological approach was that I wished to elicit the *constructs* of end users and of Virtuosi project members. I wanted to understand what collaboration meant for end users rather than assuming that they wished to collaborate. I wanted to understand what the virtual organisation meant to members of the VirtuOsi team. From a social constructionist perspective, people are seen as *socially constructing* the meaning and significance of their realities, ordering, structuring and making sense of the world around them (e.g. Kelly, 1955; Berger and Luckmann, 1966). My desire to elicit constructs fits within the phenomenological paradigm, where reality is seen as socially constructed, with meanings negotiated by actors within the organisational setting (Morgan, 1986).

Methods for eliciting constructs are typically 'deep' immersive techniques, such as participant observation and ethnography, which are often used in organisational culture research for investigating the shared cultural constructs of organisational members from a phenomenological perspective (Schein, 1985). I conducted a participant observation study throughout my three year period of involvement within the VirtuOsi project, investigating the collective constructs of the designers of the virtual organisation.

However, in investigating user needs, several methodological and research design choices I made during the course of my research with regard to eliciting constructs do not sit comfortably within the phenomenological paradigm. Firstly, I chose to conduct interviews as a means of data collection, rather than adopting an ethnographic approach which is more typical of a phenomenological perspective. Secondly, I visited multiple research sites rather than immersing myself in one organisational setting. Advocates of ethnography might argue that I could not have achieved any real depth of insight from flying visits, and that eliciting collective constructs requires a prolonged period of participant observation at one site. However, there were justifiable reasons for making these choices, as I shall explain.

Firstly, I did not wish to limit my investigation of end user issues to one site. In the virtual organisation, users from different countries will have the facility to meet, work collaboratively and exchange information. The problem with an ethnographic approach in this instance is that the 'tribe' in the case of these technologies is all around the world. Whilst ethnographies at one site can provide valuable insights into collective constructs *at that site*, in this instance they miss out on the broader organisational, global context of virtual collaboration. The emphasis in ethnography is on the group, rather than thinking about dispersed groups coming together. The way that a group works at one site may be very different to the sorts of interaction that will occur in the virtual organisation. The virtual organisation is about distributed collaborative working *between sites*, and it is appropriate to reflect that in the research design.

Having established that I did not wish to limit my research to one site, but instead wished to include participants from the 'tribe' around the world, I limited my choice of method. The possibility of conducting in-depth ethnographic studies at multiple sites was implausible and impractical in my research context; I did not have the time nor the resources, and did not want to conduct 'jet-plane ethnographies'. Instead, I chose to adopt semi-structured individual interviews as a means of data collection. If I wish to understand user needs and the way people work, why not ask people? The use of interviews for eliciting constructs is argued for by Maxwell (1996: 241)

> 'To understand other persons' constructions of reality we would do as well to ask them (rather
> than assume we can know merely by observing their overt behaviour) and to ask them in such a

way that they can tell us in their terms (rather than those imposed rigidly and *a priori* by ourselves) and in a depth which addresses the rich context that is the substance of their meanings (rather than through isolated fragments squeezed onto a few lines of paper).'

However, the nature of my research design posed a number of interesting methodological problems. I will go into methodological detail in the next chapter on research method; here I want to tackle head on the limitations and problems associated with the choices I made in this strand of the research. My travel schedule meant that I had three to five days at each factory, and used translators at three of the sixteen research sites. I had an hour and a half with each interviewee - the race was on! It is questionable how deeply even an experienced interviewer can get in revealing a person's constructs in an hour and a half, especially if they are not even speaking the same language, and have to communicate through a translator! There is also an issue around my inexperience as an interviewer - looking through my interview transcripts there are in occasions where I would like to go back and ask 'Why?', 'Can you explain that?' etc., to more deeply understand the reasoning behind the attitudes of interviewees.

There was also a problem with asking people about their views on the virtual organisation. Whilst asking interviewees about teamwork, communication with other factories, collaboration, management[2] etc. was reasonable and valuable as it was within the realms of their experience, I had a problem when I asked them about the virtual organisation. I was an actor, and I shaped - and had to shape - people's definition of the situation. I wanted to know what they thought of the concept, what features they would like the technology to have, and what concerns they had. Unless I explained the purpose and nature of the virtual organisation, we could not discuss it. However, by describing the virtual organisation, I was putting words in their mouths, and imposing my constructs and those of the designers in the Virtuosi project and not eliciting theirs. It is a Catch 22 situation, as I wanted to know what they thought about the virtual organisation, but they probably had not thought of the virtual organisation before I stepped into the building.

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[2] See Chapter 5, Figure 5.1 for Interview Format

I did not phrase it so boldly as 'This is the virtual organisation, tell me what you think'. I instead asked what they thought of present collaboration between factories, of having more contact with other factories and what the pluses and minuses might be, of what would be useful in future networked IT systems. They made comparisons to technology that they had familiarity with, such as e-mail and videoconferencing. But I was still asking them to postulate about the future, and about technologies that they had no familiarity with.

There is something farcical about my trying to elicit someone's constructs, whilst imposing my own, using a translator, so that I could not fully appreciate the subtleties and nuances of their response, and asking them to talk about something of which they had no experience. But might. In the future. Possibly. Talk about wearing sunglasses to look for the black cat in the dark room, that wasn't there. Or elephants and blind researchers.

This is not to say that my research did not elucidate interesting findings. But it was certainly more 'surface' than eliciting deeper constructs, and my findings may have had more 'me' or more 'VirtuOsi' in them than I had intended at the outset. It is safer to suggest that in investigating end user issues I succeeded in identifying *organisational themes* rather than collective constructs; common issues emerging from the interview data that inform us about the *real* state of collaboration, communication and IT. I draw attentions to the limitations of my research to offer a cautionary tale of biting off more than one can chew. In my defence, I can refer to my contract with BICC to look at user issues at sites in the UK and overseas, which I short-sightedly and enthusiastically agreed to, and the fact that I was attempting something that seemed important; to not limit the investigation of end user issues to one site but instead to consider the 'tribe' of the virtual organisation to be around the world.

My methodological choices with regard to investigating collective constructs meant that I was more central on the phenomenological-positivist continuum than I had originally intended. The next section further examines the epistemological nature of my research by considering my own background.

My former life as a positivist

The criteria for choosing an epistemological approach to research and developing the research design include the personal preferences of researchers and the aims or context of the research to be carried out. Ethnographers have brought attention to the fact that researchers are part of their own community, or culture, which may at any point have acceptable paradigms through which the organisation is viewed (e.g. Van Maanen, 1988). The community that a researcher works within will influence which phenomena are attended to, which are ignored, and how the phenomenon is researched. In a sense, researchers within organisations act as translators, decoding one culture whilst recoding it into another (Barthes, 1972) in terms that their research peers will understand. Researchers have their own beliefs, interests and agendas which are to some extent projected onto the research scenario. Anselm Strauss (1987) calls this experiential data - the researcher's technical knowledge, research background and personal experiences.

Academically, I grew up immersed in the positivist paradigm, studying Psychology as an undergraduate and for my Masters. I spoke the language: significance levels, representative samples, validity and generalisability were all part of my daily vocabulary, and related to my unquestioned assumptions about what research is. During my Masters, I did a research project on organisational culture, opening new areas of literature and new approaches to research. I learnt of relativism, constructs, phenomenology, ethnography, participant observation, action research, and subjectivity. It was my own academic renaissance period.

It was hard during my doctoral research to reconcile my desire to do qualitative research, which I had come rather evangelically to perceive to be the 'right way to do research', with my ingrained positivist assumptions. Learning the qualitative tradition requires the absorption of new assumptions and 'ways of seeing', not just learning the techniques (McCracken, 1988). My supervisor has, on occasion, referred to me as a positivist, which I winced at, as it did not fit with the 'new me'. However, he had a point. Throughout my research I could not free myself from my old habits. Subconsciously, I realise now, I still had positivist concerns - was my sample sufficiently large to draw valid conclusions? Had I shown sampling bias? Whilst wishing to embracing the phenomenological paradigm, a little bit of me questioned it too. Surely someone at some

point will point the finger and ask 'That is all very well, but how generalisable is your research?' Its like learning to play a game one way, and then finding that the rules are totally changed. It was liberating, but part of me missed my old tethers, and had not fully grasped or reconciled the rules of the game. My own background, therefore, also brought me closer to the centre of the phenomenology-positivist continuum.

Subjectivity

Phenomenologists acknowledge the relationship between the researcher and the researched, whereby the researcher is seen as part of, rather than outside of, the research process. The researcher's subjectivity is seen as problematic for positivists, who see it as a potential source of bias. However, Glesne and Pashkin (1992) have described subjectivity as 'virtuous'. Seeing subjectivity as virtuous rather than as an affliction to bear because it cannot be forgone means that experiential data becomes a valid and valuable source of information. Rather than regarding personal experiences and data as likely to bias research, Strauss (1987: 11) advocates that you 'mine your experience; there is potential gold there!'. Reason (1988: 12) advocates 'critical subjectivity':

> 'A quality of awareness in which we do not suppress our primary experience, nor do we allow ourselves to be swept away and overwhelmed by it; rather we raise it to consciousness and use it as part of the inquiring process.'

My subjectivity is the basis of the story I am able to tell. It makes me who I am as a person and as a researcher, equipping me with the perspective and insights that shape all that I do as a researcher, from the selection of topics to the emphasis I make in my writing. Seen as virtuous, subjectivity is something to capitalise on rather than exorcise. My own subjectivity in this research was inevitable; in no way was I an independent observer of what was taking place. My presence certainly had some impact on the VirtuOsi project and within BICC, and vice versa. For example, as I visited factories and met factory workers, I began to care about raising awareness of user issues within the VirtuOsi project, and felt it important to give a voice to the 'unheard'. I was an advocate, coming at the research from my own particular angle, that was personal to me.

A further example of my subjectivity concerns my ignorance of technological issues at the start of my research, which meant that I continually questioned decisions made within

the Virtuosi project, and did not take things for granted as other members of the project team seemed to. Why was it necessary to have a camera in an office? Was it acceptable? Both of these examples of my subjectivity say something about my personal sensibilities, namely my beliefs in democracy and personal privacy. I was part of the action-oriented research, rather than being outside of it. I was another actor, part of the drama, with my own lines and script. I was not only subjective but *intersubjective*, interacting with other actors and being influenced by them. My roles in the research scenario are explored in the next section.

My roles as advocate, ambassador, spy, jester, ingénue, and consultant

During the course of my research, rather than being perceived simply as a doctoral student, I was perceived as having a variety of roles, that influenced the way I interacted with people and what they were prepared to tell me. Firstly, I became an advocate. I wanted to raise attention within the VirtuOsi project to organisational issues. I would be asked for my opinion on organisational matters, or on the BICC Pyrotenax pilot. I was not a neutral observer, but fighting for the corner of end users throughout BICC. Conversely, out in the factories where the technologies would be introduced, I became an advocate for the technologies being developed by VirtuOsi, explaining the advantages of the technology.

When out in the field, I was seen by the BICC Hemel Hempstead team as an 'ambassador', introducing and promoting the notion of the virtual organisation for the BICC designers who did not have the time to visit factories overseas. They saw me as paving the way for future contact with the factories, seeing me as 'good at the people stuff', 'good at listening', 'good at the softer side', 'less suspicious because you are a student' and even 'more sympathetic because you are a woman'. How little they knew.

Whilst on my factory visits, sometimes people seemed suspicious of the reason for my presence, and regarded me as a 'spy' and having a political or influential role. I did not help my cause when visiting a European factory that had undergone a lot of redundancies, and where people commented to me in interviews about their lack of optimism over it's future. I mindlessly commented to an English-speaking employee that the factory had a lot of amazing old buildings by the wharf, and that in London many

such warehouses had been turned into luxury apartment blocks. An anxious look spread across the employee's face, and my translator sniggered, and muttered 'That's reassuring, Helen'. To the employee, I must have appeared to be some property auditor, or at least as being privy to some ominous knowledge about the future of the factory. I was also perceived as having some influence over technology implementation and investment, and was 'courted' at several factories.

One organisational member that I met during my fieldwork asked if I was 'Eric Clark's daughter', Eric Clark being the CEO of BICC at that time. He was implying that this might be why I was given access to travel to so many factories and the joke alluded to the fact that they viewed my role somewhat suspiciously, fearing that I would be reporting back to those in charge. To lessen the suspicions surrounding my research, I was also told by BICC Hemel Hempstead that 'It would be better to do a survey introduced as looking at organisational cultural issues, rather than for VirtuOsi.'.

I was also the jester, the entertainer, a distraction from the day-to-day humdrum. One Australian Factory Worker, upon meeting me for our interview commented:

'Oh shit. It's a Pommie Sheila'.

I declined the bait he was offering, and went on to explain my research, who I was, and why I was there. His next words were:

'So you're not a dumb blond then?'

I could not contain myself, and launched off into an attack on the Australian male psyche, concluding with something about sexist dinosaurs who should be extinct. A slow smile spread across his face. Oh God. What a start to an interview! Had I any hope of salvaging it? Had I gone too far? Would he complain?

'You're all right Helen. You're pretty spunky. I'll tell the boys on the floor that you are OK.'

So I passed (or did I fail?) his 'Can I make her react?' test, my pride just about intact, but my credibility and gravitas (what little I had in the first place) spiralling downwards.

My role as entertainment for the interviewees also extended into my being perceived as an ingénue, an unsophisticated young woman innocent to the ways of BICC, which was

a fair perception as I initially thought BICC was a make of ball-point pen. This meant that I was at times patronised, and at times indulged. Playing (or being - let's not pretend it was always calculated!) the fool or the innocent paid off occasionally as it meant that people were not threatened by me, and were more willing to talk to me. I must have also appeared trustworthy because people sometimes made revelations beyond my expectations. People sometimes made controversial comments that could have got them into hot water if I had been indiscreet. At all times I assured anonymity, which I stuck to.

I was also perceived as a 'cheap consultant'. The BICC Hemel Hempstead team wanted someone to look at organisational issues, and one member reasoned that sending me into the field was 'cheaper than sending a member of staff or a consultant'. I did not contend this 'consultant' view of my role on either occasion as BICC were sponsoring me, and so I felt grateful and beholden to them. They could see my role as whatever they wanted as long as I could conduct my research. However, I was reminded and warned by another academic member of the VirtuOsi team that I was a doctoral student conducting my own research, and was not working for BICC. My desire to be all things to all people and not rock the boat clouded my judgement in this area - I should have made my role clearer, and tackled the consultant notion head-on, so that there were not any false expectations. As it was, I felt vaguely uneasy throughout my research about who had ownership and control of what I was doing - was I 'flying solo' or working for BICC? As my research contract with them remained unresolved until after the fieldwork was complete, I took refuge in the lack of clarity and got on with things.

What did these different roles mean for my research and the data that I collected? The interview process is interactive, and the way that interviewees perceived me and my research will have influenced what they were prepared to share with me. My role as advocate points to my subjectivity, as ambassador and consultant to my mutually beneficial relationship with BICC. My political role may have meant that interviewees were more cagey about what they told me. Alternatively, some viewed me as a mouthpiece that would communicate their concerns, with some interviewees commenting 'You ought to tell Head Office . . .' and treating the interview almost as a process of catharsis. My roles as jester and ingénue are possibly a sign that sometimes I succeeded at putting people at their ease, and established a good rapport with interviewees. Having

different roles during the course of my research was both unplanned and inevitable, as I was an actor within the research process rather than outside it.

The minefield of political and ethical issues

From a phenomenological perspective, the researcher is not seen as removed from but interacting with the research setting, and must exercise ethical responsibility and gain the co-operation and trust of organisational members. For example, I promised and upheld the promise that all interviews would be anonymous, as I wanted people to trust me and open up to me. Getting on within an organisation is a function of the personality of the researcher, and of her diplomacy and skill in dealing with what are sometimes very complex relationships. At times I felt out of my depth trying to understand and tactfully respond to the undercurrents and politics of the research situation. I must have succeeded as I completed my research without causing any offence or ructions.

One sometimes finds one self in the uncomfortable position of using people and willingly being used, which I shall come to shortly. By using people I mean that if you are participating in a situation and at the same time observing and recording (perhaps later) what has taken place, as I did during the VirtuOsi project and during factory visits, you cannot avoid some deception about your real purposes. Some of my most informative moments have come not during interviews, where I assured confidentiality, but from the informal chats, the rows, the jokes and the asides, that have been made either to me or in my presence.

Meyerson (1991:270) suggests that the responsibility for protecting a person's privacy does not reside solely with the researcher:

> 'Practices like 'eavesdropping' . . . where informants do not know of researcher's identity or intent, do not provide 'subjects' with the capacity to protect their own privacy. When researchers disclose their identity and rough intent, some of the responsibility gets shifted onto the subjects.'

Throughout my research, organisational members and members of the VirtuOsi project were aware of my role and intentions, and so had an opportunity to 'self-edit'. What was learnt informally shaped my understanding, and it was pragmatically unavoidable not to incorporate such experiences into my perceptions of events. For example, when I entered the office of one Senior Manager in a European Factory and saw him grilling the person I

had just interviewed and both of them abruptly finished their conversation and looked at me rather guiltily, I could not help but surmise that the manager viewed my visit somewhat suspiciously and wanted to know what I was asking behind the closed door of the interview room. Similarly, when one participant commented in an aside over lunch that Virtuosi presented an opportunity to get more computers, I had a valuable insight into what Virtuosi might mean to people in BICC. Such experiences, along with more formal data sources, contributed to a fuller understanding of the research context.

In commenting that I was willingly used, I mean that I had a political function for the Multimedia Group at Hemel Hempstead. As I explained in the previous section, I was perceived as an 'ambassador' for the project and as a 'cheap consultant'. Another political element to my role relates to the fact that I am what could loosely be termed 'an organisational researcher', which meant that the Multimedia group at Hemel Hempstead could reassure management that 'organisational issues' were being attended to in the project. Exactly what these organisational issues were was a moot point.

An air of mystification existed initially between myself and my contact at the BICC Multi Media Group. He had changing ideas about what my research was about, and I was still learning about the company and the VirtuOsi project and formulating my own direction. When I was in a position to be more explicit about my research questions, it had little impact as the group seemed to project onto my research what they felt VirtuOsi needed as time progressed, conferences were attended and articles were read. A sort of dragnet perception of organisational research. I was on occasion referred to as a 'Psychology Expert' because of my background and asked to verify or expand on a psychological issue, which I would do if I had something to contribute to the discussion. Sometimes I put my foot down as I did not want to provide some sort of academic backing for ideas that I had no familiarity with.

I had to sort my values and obligations and weigh them repeatedly throughout the research process. One of my guiding values was a feeling of kinship with the other academic groups at Lancaster, Nottingham and Manchester, and a desire not to tread on their toes. I was also adamant that I would not publicise or circulate information that was likely to harm the interests of informants, especially the less powerful ones, even if this avoidance of giving the identifying features of an informant led to a 'flattening' of the

data. It was also a priority to maintain access to the organisation throughout the research, so I did not want to upset people within BICC. This did not mean that I could not speak openly, making observations and expressing any concerns that I had. I felt that the Multimedia group valued my candour, and the outside perspective I brought to the project.

The above discussion of epistemological issues, subjectivity, my roles, and ethics and politics aims to illuminate my part in my research and it's design - how I did it, the choices I made, and what it's limitations are. The next section goes on to discuss issues of validity, generalisability and reliability.

Issues of validity, reliability and generalisability

The subjective researcher is faced with questions concerning validity, reliability and generalisability. The language of validity, reliability and generalisability was originally developed for use in quantitative social science (Kirk and Miller, 1986). There is some reluctance to apply these ideas to phenomenological and social constructionist research because they imply acceptance of one absolute reality. However, provided the researcher is committed to providing a faithful description of others' understandings and perceptions, these concepts prove a worthwhile discipline.

Validity concerns the correctness or credibility of a description, conclusion, explanation, interpretation, or other sort of account. Geertz (1973: 29) tells the story of a British gentleman in colonial India who, upon hearing that the world rested on the backs of elephants, who in turn stood on the back of a giant turtle, asked what the turtle stood on? "Ah, Sahib, after that it is turtles all the way down." Geertz's point is that there is no 'bottom turtle' of ethnographic interpretation, that cultural analysis is essentially incomplete. Maxwell (1996) emphasises a different lesson: that you do not have to get to the bottom turtle to have a valid conclusion. You only have to get to one that you can stand on securely.

When I started my research, I had a number of research questions in mind, but quickly became immersed in the minutiae of the research context and the data I was collecting. I adopted a grounded approach (see next section), and very occasionally had moments of clarity and enlightenment. For the most part, I felt that I was wading through my own

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confusions about what was happening and why, with the insights I sought alluding me and beyond my grasp. It was only later, when I pulled back my focus and looked at my data at a different level of abstraction, that apparent paradoxes emerged. The mists began to clear and I developed my theses. My theses were grounded in the concepts and theorising of the people that I studied in my research, and are therefore likely to 'fit and work' as the basis for explanation and prediction (Glaser and Strauss, 1967). I had reached a secure turtle, reaching valid conclusions supported by my data concerning the virtual organisation as a collaborative environment and as a force for radical organisational change.

Validity can be addressed through sampling, data collection and analysis. One approach to data collection that assists validity is that of triangulation. Triangulation is a term borrowed from navigation where a minimum of three reference points are taken to check on an object's location (Smith, 1975). Triangulation involves collecting information from a diverse range of individuals and settings, using a variety of methods (Denzin, 1970). This strategy reduces the risk of chance associations and of systematic biases due to a specific method and allows a better assessment of the generality of explanations (Fielding and Fielding, 1986). Abrahamson (1983) observes that mixing methods prevents the research from becoming method-bound; the strength of almost every measure is flawed in some way or another, so it is prudent to counterbalance strengths from one to another. Todd (1979) argues that triangulation is not an end in itself, but an imaginative way of maximising the amount of data collected.

In this research I used a variety of methods which helped me avoid biases due to restricting data collection to one method and increased the quantity of data I had access to. For example, during the course of the VirtuOsi project I not only conducted a participant observation study, but also had access to VirtuOsi deliverables. These were formal documentary sources that charted the progress of the different strands of the VirtuOsi project. I also interviewed members of the team. This mixing of methods increased the amount of data that I collected and my understanding of what was happening.

One can also address validity threats by searching for discrepant data, attempting to falsify the conclusion. In different cases, discrepant data is reported, and readers are

allowed to evaluate this and draw their own conclusions (Wolcott, 1990). By allowing for the examination of competing explanations and discrepant data, research does not become a self-fulfilling prophesy. Feedback is a further very useful strategy for identifying validity threats, biases, assumptions and flaws in logic or method. Both those familiar with the phenomenon and those who are strangers to it are valuable. I fed back the results of my study in person and via a report to European Personnel managers within BICC, the VirtuOsi team, and to a group of academics conducting research into Collaborative Virtual Environments, and received a lot of constructive comment which helped me to validate my interpretations.

By attempting to collect complete and accurate data, to gain full access to the knowledge and meanings of informants rather than fitting data into one's own preconceptions and framework, and by attending to discrepant data and considering alternative explanations of the phenomena under investigation, the researcher can pursue validity. Validity in qualitative research is not a result of indifference, but of integrity.

Reliability concerns whether similar observations would be made by different researchers on different occasions. Qualitative research is not primarily concerned with eliminating variance between researchers in the values and expectations they bring to the study, but with understanding how a particular researcher's values influence the conduct and conclusions of the study. Throughout this chapter I have attempted to explain my possible biases. As long as we are explicit about our values and biases, and approach the explication and interpretation of data and our subsequent conclusions in a way that might reasonably be adopted by other like-minded researchers in a similar research context, we can pursue reliability.

Generalisability is about whether the ideas and theories generated in one setting will also apply in other settings. Qualitative researchers usually study a single setting or a small number of individuals or sites, and rarely make explicit claims about the generalisability of accounts (Maxwell, 1996). This case study approach is appropriate 'when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within its real-life context' (Yin, 1984:13). This research clearly satisfies these conditions, researching within a

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multinational organisation that provides the factory pilot scenario for the VirtuOsi project.

However, qualitative studies can be generalisable beyond the case, setting or informants studied if they have face generalisability, where there is no obvious reason *not* to believe that the results apply more generally. This research sought to illuminate a new form of organisation, and whilst generalisability is not an aim of the research, it is fair to assume that some of the issues identified in this study regarding the nature of the virtual organisation and users perceptions of it will provide insights or at least resonate with the dilemmas faced by other organisations considering going virtual.

Which comes first, theory or data?

Having established that this is a union of applied and action research being conducted from a predominantly phenomenological perspective, it is necessary to consider the choice about which should come first: the theory or the data? Does one seek data to verify or falsify a theory? Or does one take a grounded approach, eliciting theory from the data? As the virtual organisation is an emerging concept, there was little specific research and literature to draw on when framing my research. Having few pre-conceptions about the virtual organisation nor theories to base my research upon was not necessarily a disadvantage; it avoided the temptations of the Procrustean Bed; of trying to cut or stretch my data to fit an existing theory. It also fits with a *grounded* approach to research (Glaser and Strauss, 1967).

Glaser and Strauss's (1967) term 'grounded theory' does not refer to any particular level of theory but to theory that is inductively developed during a study (or series of studies) and in constant interaction with the data from that study. Thus theory is grounded in the actual data collected, in contrast to a theory that is developed conceptually and then simply tested against empirical data. Glaser and Strauss see the key task of the researcher as being to develop theory through 'comparative method'. This means looking at the same event or process in different settings or situations. Comparative method leads to substantive and then formal theory, which can be evaluated according to whether it is sufficiently *analytic* to enable generalisations to take place, and whether at the same time

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it is possible for people to relate the theory to their own experiences, thus *sensitising* their own perceptions.

The grounded approach is flexible and is good at providing both explanations and new insights. However, it takes time and the researcher must live with the fear that nothing of interest will emerge from the work. Some people regard grounded theory as suspect because of the lack of clarity and standardisation of methods, but that concern stems largely from a positivist perspective on the importance of 'finding the truth'.

In this thesis, features of the virtual organisation are described. Description is a factual narrative of what happened, at a very low level of abstraction, that does not go beyond what is observable. Interpretation is also possible; providing an account of the meaning of the virtual organisation to its future users and its designers. To take either description or interpretation and construct an explanation based on either or both is to convert them into theory. Theory is a statement about what is going on with the phenomena you want to understand. Theory provides a model or map of *why* the world is the way it is. It is a simplification of the world, but a simplification aimed at clarifying and explaining some aspect of how it works. Maxwell explains (1996):

> 'A useful theory is one that tells an enlightening story about some phenomenon, one that gives you new insights and broadens your understanding of that phenomenon.'

In this respect, this thesis tells what aims to be an enlightening story of the virtual organisation. This research sought to produce theoretical outcomes by looking at the virtual organisation in two ways: by observing the design process associated with its development, and by looking at potential user issues in an international business setting. This approach led to the grounded development of two theses regarding the potential of the virtual organisation as a radical transforming force and regarding the paradox of collaboration. Finally, an organisational change model of virtual organisation design and development is presented that draws on the findings of the research, providing a framework with which to approach the design and implementation of the virtual organisation.

The changing nature of research: Even the best laid plans of mice and men . . .

In this final part of the discussion of research design, I shall explore how my research design changed through the course of my involvement with the VirtuOsi project and BICC Cables, as I responded opportunistically to the random unforeseen changes in my research context, and began to clarify the focus of my research.

The organisational dimension

One approach that this research took to illuminating the virtual organisation was to investigate organisational issues associated with its design and development - the organisational dimension missing from the VirtuOsi project. The organisational strand of the research aimed to explore end user needs: how people interact, collaborate, communicate and use information within the *real BICC organisation*. The key idea is that working practices, user needs and the desire to collaborate or 'trade expertise' are not assumed, but investigated in this research. It aims to bridge the gaps between what is being designed and what users do and need, leading to the development of a model of change for the design and development of the virtual organisation. The research questions posed by this strand of the research are:

- What is the present state of IT systems, skills and needs within an international company?

- What are people's future IT requirements and preferences, and reactions to the concept of the virtual organisation?

- What broader organisational issues might have an effect on the evolution of this new organisational form?

There were a number of issues guiding the evolution of this research strand in the very early stages of my research. Firstly, user issues were being researched by means of an ethnographic study as part of the factory pilot. The way that people worked, exchanged documents and used existing computer technologies was being studied by VirtuOsi team members from Lancaster University at a BICC technology centre in the UK. I wanted in my study to add breadth to the depth of ethnographic observation by conducting a cross-

cultural study and identifying organisational issues relevant to the implementation of CVEs. Furthermore, rather than focusing on one group within one organisation at one site, it seemed appropriate to look at communication and collaboration issues within and between sites, in line with the idea of a supposedly global collaboration-enhancing technology. There was also a concern that to focus on studying one factory in one country might be deemed ethnocentric, missing the broader cross-cultural perspective that seemed necessary. If the idea was to develop a technology that allowed people from all over the world to work together, it seemed inappropriate for me to study user needs in one factory.

Having established that I wanted to conduct a broad study at multiple sites, I needed to decide what form the research might take. Initially, I had hoped that the research would allow a comparative cross-cultural study of the constructs that people in factories in different countries share in terms of organisational culture; in ordering, structuring and making sense of the world around them. Comparative management research can be defined as studies comparing organisations in different cultures which are designed to identify similar and different aspects of organisational phenomena (Adler, 1983). An example of such research is Hofstede's (1980) study of work-related values in different countries. The primary focus is comparative; that is, being able to distinguish between the culturally specific and the culturally universal aspects of a phenomenon. My idea was that by exploring cultural similarities and differences I could identify the 'doors and walls' to communication between sites. By understanding the common ways that people in cable factories around the world perceive their factories, I could then inform the construction of a virtual organisation based upon these shared perceptions.

I also had initial notions of developing a quantitative technique to allow a systematic assessment of cross-cultural differences within BICC, and to also allow a longitudinal assessment of whether and in what ways an implemented VR system caused changes in culture. As with other aspects of this doctoral research, the initial aims of the research have been scaled down considerably, as the problems associated with cross-cultural research became apparent.

Firstly, it became apparent as I began to visit factories within the UK during the pilot phase of my research that there was such diversity between factory history and culture

that it would be unfeasible, undesirable and impossible to develop adequate cultural vignettes, describing the culture of each factory to show similarities and differences. Factories were similar to the extent that they were all owned by BICC, all were involved in cable-making and all used similar cable-making technologies. However, each factory had a different background, market sector, product range etc. Each factory had a different atmosphere, different perceptions of BICC, and different experiences from the merger process. Some factories had experienced many redundancies, and the future was viewed as bleak, whereas others were more buoyant and successful. To attempt to make comparisons between such diverse factories seemed both self-evident and ill-advised; to explore whether there were differences in organisational culture and what those differences were did not seem to add to an understanding of the virtual organisation.

It also became apparent that to describe the comparative strengths and weaknesses of each factory would be politically very sensitive within BICC Cables, which was undergoing change and restructuring as the metallic cables market became more vulnerable and the optical fibres market grew. It was important to maintain access within the organisation throughout the course of the research. There had been an occasion during the ethnographic research conducted by Lancaster University when an interim research document was unwittingly leaked to a department, causing considerable upset because of its perceived critical content. This caused a chain of events that ultimately led to the withdrawal of the ethnographers from the site. This was a situation which I strongly wished to avoid, partly through wishing to protect my research and partly because I felt a sense of obligation to the factories that I was visiting and did not want to present them in a negative light to the 'decision-makers' in the UK who were likely to receive my report.

It became clear that I had been too broad and vague in my early views of the cross-cultural aspect of the research. It seemed inappropriate to attempt to unearth and make comparisons between perceptions of *organisational culture* specifically in order to make subsequent inferences about the nature of some *virtual culture*. I realised I was missing the point of the virtual organisation. Looking at similarities and differences between *factory cultures* would not get me any closer to understanding or predicting what will happen in the future when cultures collide in cyberspace. The emergent virtual culture

will evolve during the course of interaction. People within the multinational organisation will all be members of the same virtual community, so identifying cross-cultural differences and variance between factories seemed inappropriate. As it became apparent that identifying cross-cultural differences might no longer be desirable, a more qualitative approach seemed appropriate and I abandoned my initial notions of developing a quantitative technique for comparing factory cultures.

Rather than conducting a comparative cross-cultural study, I realised that I needed to ground my research of end user issues more closely in what the VirtuOsi team was trying to achieve. I began to realise that some of the premises that the VirtuOsi project was based upon, such as the enhancement of collaborative work and the widespread use of CVEs, became questionable in a business context. From my observations within VirtuOsi meetings, it seemed that little attention was being paid to real-life issues that I was observing in the factories. Organisational issues did not seem to be guiding the development of the technology, which could potentially lead to an inappropriate technology being developed that will be rejected by users (Eason, 1988). An interactive virtual environment was being developed non-interactively. An organisational dimension to design was missing. I began to consider whether or not people at different sites already collaborated and communicated, whether they wished to do so in the future, and whether they were used to using IT systems to communicate with other factories.

I wanted to provide the organisational dimension missing from the VirtuOsi project, and to gain an understanding of collaborative and information technology issues across the organisation, rather than conducting a comparative cross-cultural study. My approach changed from quantitative to *qualitative*, and from looking for variance in organisational culture, to wishing to investigate in a real international setting the taken-for-granted assumptions made by Virtuosi project members regarding collaboration and IT systems; that people *want* to collaborate, that people *want* new technologies that facilitate collaborative working. I wanted to know what collaboration meant for organisational members, and how they saw their IT systems developing in the future. I wanted to identify organisational issues relevant to the design and development of the virtual organisation that the designers were missing. I therefore developed an interview format that would help me investigate the constructs of organisational members with regard to

collaboration, communication and information technology, as discussed in the next chapter.

The design of the virtual organisation

The other strand of the research set out to explore the design and development of the virtual organisation from an organisational perspective. This entailed participating in and observing the VirtuOsi project as it unfolded, and seeking to understand the issues that designers are attending to and how they conceptualise the virtual organisation. The research and development conducted in the VirtuOsi project has been viewed through an 'organisational lens', considering how Collaborative Virtual Environments might be implemented and used within an international business setting. The research questions associated with this strand of the research are:

- What is the present 'state-of-the-art' as regards virtual reality and associated collaborative computer technologies?

- How do designers conceptualise the virtual organisation?

I had originally anticipated that through the course of the VirtuOsi project, new computer technologies would be developed that would be introduced in the factory pilot. The reactions of organisational members to these technologies and their effect on the way people worked could then have been observed. One of the weaknesses of my initial thoughts about a comparative cross-cultural study was that it would be static, a snapshot across the multinational company. The virtual organisation will be dynamic and interactive, a melange of cultural forms. I wanted to see what happened when the virtual organisation went live. In virtual spaces, people from a variety of cultures will meet, and a virtual culture is likely to evolve (as has been observed within MUDs and MOOs; Rosenberg, 1992). If I could observe the implementation of the technology in a business context, I could see what happens when people meet in cyberspace, and how they respond to this new technology. However, yet again my initial plans were thwarted. The project did not advanced to this stage, and an opportunity to study the implementation of CVEs and user reactions directly within an organisational context did not presented itself.

Rather, I shrunk down my aims and instead focused on the process of design of the virtual organisation. I wanted to understand the various constructs that the members of the project team used to guide technology development. The VirtuOsi project has entailed the development, piecing together, and in some cases the abandonment of a variety of Multimedia applications as well as the development of Collaborative Virtual Environments. Contrasting views evolved within VirtuOsi of what the virtual organisation will consist of, and how it will be applied[3]. The changing concept of the virtual organisation is mapped out using a number of data sources, including VirtuOsi documents, participant observation and semi-structured interviews with team members.

Whilst it was desirable to map out the ideas of CVE designers, the research also needed to add an element of the concrete to the abstract. I had the opportunity to observe the installation of some Multimedia as opposed to Virtual Reality technologies at one Pyrotenax factory in the UK, which gave me an insight into end user reactions to the introduction of the technology, even though I did not have a chance to observe them using it.

I also wanted to gain a greater understanding of what the virtual organisation will be like and how it will be used. I wanted to observe interaction within a Collaborative Virtual Environment, even if it was not interaction amongst organisational members. There was an opportunity to sit in on virtual meetings held between academic researchers involved in designing and researching Collaborative Virtual Environments. These were live, real time international virtual meetings, with users logging in from Sweden, Germany and several sites in the UK. An account of a meeting is given, in order to illustrate what it is like to hold and participate in meetings in virtual environments.

Summary

This chapter has explicated the process of research design, defining the research as action-oriented and conducted from a predominantly phenomenological perspective (albeit less within the phenomenological paradigm than was originally intended). A

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[3] The changing nature of the virtual organisation seems to reflect the agendas of interested parties within the VirtuOsi group, and is discussed in Chapter 7 'Designing the Virtual

grounded approach to theory development was adopted, allowing theory to emerge from the data. Issues around my role, subjectivity, validity, generalisability and reliability were discussed. Finally, the changing nature of the research was recounted. The next chapter moves on to consider the research method adopted in this research.

Organisation'.

CHAPTER 5

RESEARCH METHOD

This chapter addresses issues of research method concerning how data was gathered in order to answer the research questions. It is in two parts relating to the two strands of the research: user issues in the real organisation and the design of the virtual organisation. Before going on to describe the two research strands, I shall initially explain why I chose qualitative research techniques, and why I chose to adopt certain methods over others.

Why choose qualitative techniques?

In the previous chapter, I addressed epistemological issues, and how theory, context and method are intertwined. I also made explicit that I adopted a 'predominantly phenomenological' perspective was appropriate for this research, both due to the research context and my own 'models of man' (Jones, 1985); my beliefs about how we as researchers can best learn about the world. Qualitative methods are typically employed when conducting research from a phenomenological perspective. Van Maanen (1983:9) defines qualitative research methods as:

> '. . . an array of interpretative techniques which seek to describe, decode, translate and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring, phenomena in the social world.'

It is not my intention in this section to provide an in-depth defence of qualitative research in general, which has been done in numerous methodological books (e.g. Hughes, 1976; Burgess, 1982; Van Maanen, 1983; Walker, 1985; Maxwell, 1996), but to explain what features it has that make it the most appropriate approach for this doctoral research.

Firstly, qualitative methods fitted with my 'predominantly phenomenological' approach to research. Qualitative methods tend to be employed when conducting research from a phenomenononological perspective, using more *flexible, interactive, unstructured, situation-specific* research techniques. This is because from a phenomenological perspective, the researcher is seen as interacting with the phenomenon under

investigation, and not seen as objective and outside of the research process. Filstead (1970: 4) argues that objects 'can be known purely from the outside, while mental and social processes can be known only from the inside', as well as through the shared meanings and interpretations that we give to the objects. Hence, insight may be regarded as the core of social knowledge. It is arrived at by being on the inside of the phenomena to be observed. Qualitative methods therefore allowed me to get 'close to the data', to interact with end users and designers.

I was, like those being studied, engaged in making sense of the social world. Like them, I 'constructed versions of the social world, marshalled evidence to support those versions and tested them out in an ongoing process of social interaction' (Hughes, 1976: 26). I was part of, as opposed to outside of, the research process. The humanistic view that a researcher is engaged in a social process leads ultimately to a relativistic interpretation of the knowledge that he or she uncovers (Douglas, 1970). Consequently there can be no absolute objectivity but only agreements in truth and validity shared by people who hold the same meaning system, most notably other phenomenologists. Researchers decode one culture whilst recoding it into another, in terms that their research peers will understand (Barthes, 1972). From the social constructionist perspective, I was engaged in *constructing* as opposed to *measuring* reality, and therefore employed qualitative as opposed to quantitative techniques.

Continuing this constructionist theme, I wished to elicit the constructs of participants. In this research, it was the *meanings* and not the *frequency* of collaboration, communication, IT and the virtual organisation[1] for respondents that were of interest. This contrasts with quantitative methods such as questionnaires, which seek to *measure* phenomena, and are made up of test items that presuppose what is of interest regarding the phenomena under investigation. Qualitative research methods seek to learn about the social world in ways which do not rigidly structure the direction of enquiring and learning within simplifying, acontextual, *a priori* definitions. Qualitative techniques were used so that respondents could express their views in their own terms, rather than me deciding *a priori* what I thought their views would be, and only pursuing restricted

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[1] See the section on Eliciting Constructs in the previous chapter regarding how my attempts to elicit the constructs of end users with regard to the virtual organisation may have been flawed.

corridors of enquiry fitting with my own preconceptions. By using qualitative methods I could learn of the actor's perspective, interacting with end users and designers to elicit their meanings.

Qualitative research was also appropriate because of the emergent nature of the subject under investigation, the virtual organisation being a little studied and defined phenomenon requiring exploration. As I adopted a grounded approach to research, and did not know initially what issues might be of interest, I needed qualitative methods that were sufficiently unstructured to allow me flexibility in my data collection. The flexibility afforded by qualitative methods also allowed me to be more responsive to the needs of respondents, and sensitive to specific situations. For example, when I interviewed IT managers, I could focus the interview on more IT questions, rather than following a rigid format.

Therefore, because of my predominantly phenomenological approach, my wish to elicit constructs, and my development of grounded theory, I adopted qualitative techniques that allowed interaction and flexibility, and were concerned with meanings and not frequency.

Which methods did I choose and why?

Jones (1985; 54) observes that:

> 'All research involves choices. These choices will depend on the nature of the research topic, on the particular data that are sought about the topic, on the researchers' 'model of man' . . . They will also depend on such practical constraints as the time, energy and money available to do the research, and the acceptability of particular approaches to research clients. It is pointless to pretend that these constraints do not exist . . . choices should be made with an awareness of their implications, for the kind of data that is likely, or unlikely, to be obtained.'

In this research the key qualitative methods that I used to gather data were individual interviews in my investigation of user needs, and participant observation techniques in my investigation of the design of the virtual organisation.

I had a number of reasons for choosing to conduct interviews in my investigation of user needs. Firstly, if I wanted to visit multiple sites at different countries I could not use more in-depth immersive techniques such as ethnography or participant observation.

From my exploratory study it seemed that respondents felt more comfortable expressing their views in an individual interview where confidentiality was assured than in group discussions. Other one-on-one qualitative techniques for identifying the views of respondents such as role repertory grids, Q-sorts and projective techniques would have been inappropriate due to time constraints, as they typically take longer than individual interviews, and I had limited time available at each site.

Quantitative techniques might have saved time and allowed me to get data from a larger group of respondents, but as I discussed in the previous section they did not fit with my research philosophy or the research context. There were also the problems of constructing valid questionnaire items in an emergent area of research, the questionable acceptability of questionnaires for the research organisation, and of missing the rich data obtained 'out in the field'.

I employed participant observation techniques throughout my participation in the VirtuOsi project, in order to understand the perspective of the designers of the virtual organisation. I supplemented this methodological approach with individual interviews and documentary evidence. Participant observation was unobtrusive and fitted the research context with my being present at all VirtuOsi meetings, and I would have been unable to demand more time from VirtuOsi members to participate in more time-consuming qualitative techniques.

Data collection issues are covered in more detail in the main sections below, including a description of the kinds of methods used and how the research was conducted. I have aimed to be candid about practical considerations, rather than ignoring them or concocting bogus theoretical justifications for decisions that are practically based. The first section discusses methodological issues for the research strand investigating end user needs. The second section addresses the study of the design of the virtual organisation.

INVESTIGATING USER ISSUES

Organisational context

BICC[2] Cables is an international organisation that is part of the BICC group, with European, Pacific and American regions, each of which were visited for this research. Many mergers and acquisitions of factories overseas have occurred in the last ten years, as the originally British BICC Cables has sought to strengthen its position in the world-wide cables market, with its main competitors being Pirelli, Alcatel and Siemens.

During it's expansion, BICC has undergone a process of centralisation of activities such as finance, and the purchasing and redistribution of equipment. Certain decisions are no longer in the hands of individual factories, such as the allocation of market sectors, and in some regions the sales and marketing departments are also centralised. Furthermore, the performance of factories is now benchmarked in the MBE (Manufacturing and Business Excellence) programme to measure improvements. BICC has initiated changes in work practices, such as Total Quality Management, increasing the flexibility of workers and team-working. These moves to provide uniformity of function within BICC are balanced by the individuality of each factory, as each factory has interpreted and implemented changes in slightly different ways and had different experiences of the merger process.

BICC sites participating in the research

One of the assumptions that guided the Virtuosi project is that in the future, many factories, divisions or organisations throughout the world will have the technological facilities to communicate with one another. The BICC Multimedia Team and I therefore agreed that it would be appropriate to visit BICC sites world-wide, rather than restrict my research of user needs to the UK. I initially sought sites through the Director of Personnel for Europe, who negotiated access on my behalf and endorsed my research, and then I contacted factories in North America and Australia directly. I visited a variety

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[2] British Insulated Calendar Cables; the full name is no longer used and often unknown to organisational members. The company originated in the UK and is over 100 years old.

of BICC sites, including data cable, domestic cable, energy cable, fire retardant cable and insulating material plants, as well as technology centres and administrative centres.

As well as exploring user issues at multiple sites in different countries, the BICC Multimedia team wanted me to find a few specific sites within BICC Cables for which new computer technologies could be designed and implemented. For the 'Factory Pilot', which was their contribution to the VirtuOsi project, they needed a real-life situation in which a small group of factories could immediately benefit from the new computer technologies. The scenario needed to be meaningful, in that the factories already needed to be in contact and have reasons for needing to work collaboratively using new technologies. The scenario also needed to be contained, as opposed to attempting to connect a multitude of sites at the pilot stage of the VirtuOsi project. The sites needed to be in different countries, and people needed to be willing to use the technologies to work collaboratively.

I identified a suitable group of factories during the course of my factory visits. BICC Pyrotenax is a division of BICC Cables with four factories in the UK, Canada and Australia. The factories manufacture mineral insulated cables, which is a fire retardant product that requires a specialist manufacturing process. Engineers in Pyrotenax factories have all developed their own in-house designed machines to make the cables, and would benefit from sharing their expertise, but have to date been limited by the expense of international travel. They could also join forces in competing in the world mineral insulated cables market.

Despite the Pyrotenax factories being in different countries, they have more in common than they do with Energy and Communications Cables factories in their own countries because of the specialist product that they manufacture. They are a small group that might benefit from greater collaboration and communication using new technologies, and management from each of the Pyrotenax factories also showed great willingness to participate in the VirtuOsi 'Factory Pilot'. The Pyrotenax factories therefore provided an ideal scenario and were all visited in addition to the other sites participating in the study.

Research sites

Exploratory Research Sites

A number of exploratory sites were visited during the initial stages of research, to identify issues, clarify research questions and develop an interview schedule. The factories visited were:

BICC Brand-Rex, Glenrothes, UK   BICC Cables, Erith, UK

BICC Cables, Blackley, UK   BICC Cables, Wrexham, UK

Main Research Sites

Twelve factories were all visited in a twelve month period from December 1994 to December 1995, and are detailed below. Each factory visit lasted between three days to a week, and I interviewed an average of eight people per site.

Europe:

KWO - Berlin, Germany   Ceat - Cavi, Turin, Italy

GGC - Casanova HQ, Barcelona, Spain   GGC - Abrera Factory, Spain

North America:

Philips Cables, St. Jerome, Canada

Polymers Facility / Technology Centre, Indianapolis, USA

Australia:

MM Cables, Clayton, Australia   MM Cables, Sydney, Australia

Pyrotenax Factories:

Pyrotenax, Hebburn, UK   Pyrotenax, Clayton, Australia

Pyrotenax, Prescott, UK   Pyrotenax, Trenton, Canada

Data Collection Method: Interviews

Walker (1985; 4) observes that the interview is a conversation in which the researcher encourages the informant to relate, in their own terms, experiences and attitudes that are relevant to the research problem. It provides:

> '. . . the opportunity for the researcher to probe deeply, to uncover new clues, to open up new dimensions of a problem and to secure vivid, accurate inclusive accounts that are based on personal experience'.   (Burgess, 1982a; 107)

Interviews vary in their degree of structure, and the extent to which the interviewer varies the content and order of questions asked. Jones (1985) comments that there is no such thing as presuppositionless research, so there is really no such thing as a totally unstructured interview. Obviously there is a balance between totally unstructured interviews ('*Tell me anything you want!*') and rigid interview formats that resemble a questionnaire. If one rigidly follows a set of questions in an interview, the interviewer has already predicted, in detail, what is relevant and meaningful to respondents about the research topic; and in doing this they have significantly prestructured the direction of enquiring within their own frame of reference in ways which give little time and space for respondents to elaborate their own.

In my pilot interviews at my exploratory factory sites, I used a non-standardised interview that was kept open so that interesting points could be followed up. It was through this investigative approach that some of the more valuable interview data was elicited, that informed my subsequent research and guided the development of an interview format. In this type of interview:

> '. . . the interviewer works from a list indicating, often in some detail, the kinds of topics to be covered in the interview. The interviewer is free to ask questions in whatever way he, or she, thinks appropriate or natural, and in whatever order felt to be most effective in the circumstances. . . Such an interview almost amounts to a conversation. Flexibility is the keynote and is a characteristic argued to be especially welcome in pilot studies preliminarily to a full-scale study. It allows researchers to test out various lines of questioning, try out different ways of phrasing questions, gauge the tenor of likely replies etc.'

> (Ackroyd and Hughes, 1981; 72)

After the exploratory interviews I developed an interview format (see below), which consisted of a range of questions that I wanted to cover in interviews. I recorded data of a demographic character in a standardised format, including the gender, job role and department of the interviewee. The less standardised part of the interview was used to elicit information more varied and qualitative in character. The interviews were semi-structured, as I did not always stick to the format; if participants brought up an interesting and related topic I would pursue that line of enquiry as it might provide an illuminating perspective and increase my understanding of the actor's perspective.

The interviews explored how participants viewed IT, communication, and collaboration within BICC Cables. The interviews were by no means limited to these subjects, and covered related topics raised by participants such as management styles and issues of identity and belonging within the international company. The concept of the virtual organisation was outlined and discussed with participants, to see how they saw it affecting the nature of work, whether it was a necessary or appropriate technology, and what it might make possible. As I did not have a video demonstration of technologies developed by VirtuOsi, I had to describe what the virtual organisation was like and what it might make possible.

As I conducted interviews and accumulated experience, and saw more patterns in the data, I used this grounded understanding to explore in certain directions rather than others. For example, I began to realise that collaboration was a key area of enquiry, and so asked participants about collaborative work practices within and between factories. I also tailored my questions to some degree to what the interviewees had experience of. For example, when interviewing IT Managers, I tended to spend more time discussing IT issues. When interviewing factory workers, I tended to spend more time exploring collaborative work practices within the factory, as few had had experience of working with other factories.

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Interview Format

Introductory Comments

This study is looking at organisational culture, collaboration, communication and IT at BICC Cables. It is seeking to explore how people work together within and between factories at BICC, in order to inform the development of new computer technologies that will allow people from different factories to work together. In this interview, I will start by asking some questions about you, how long you have worked here etc. Then we will go on to discuss your factory, what it is like to work here, and it's relation to BICC. I would also like to ask you about any contact you have had with other factories, and about your use of computers.

Do you have any questions? Do you mind if I tape the interview?

Statement of confidentiality

The information and views that you give in this interview will be treated with confidence. I guarantee that no member of your organisation or other interested party will be named in any report or publication resulting from the research. The interview data from all participants will be viewed as a whole rather than individually.

Turn on tape recorder

Personal Information

Factory name?   Your name?   Gender?   Age?

Nationality?   Present job title?   Previous positions held?   Length of tenure?

MAIN INTERVIEW QUESTIONS

(Remember do not have to stick to rigidly, follow up interesting leads)

Initially I want to ask you about your impressions about this factory

Organisational culture and the merger

Can you begin by describing in your own words what this factory is like? What is it like to work here? What is the atmosphere like? - free flow

What changes have you noticed here since the factory merged with BICC?

What do people generally think of the merger and of BICC?

How would you describe the way that this factory is managed?

Collaboration within the factory

Have you had experience of the teamwork initiative? What has your experience been?

What changes has it meant for the way people work together? Do people from different departments work together more? Do people swap between lines or are they trained for one job? Is responsibility for decision making devolved to the team level?

What are the ways in which people do not work collaboratively? For example, what happens if something goes wrong? Is responsibility with the individual or the group?

Communication within the factory

How is information communicated within the factory?

Aside from reports etc., does information move up as well as down? Are people's opinions sought from the factory floor?

What about communication across the factory? Do different departments communicate well?

Do you feel well informed of what is happening here?

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Figure 5.1: Interview format used in my investigation of end user issues

With individual interviews, the interaction is essentially artificial since it consists of a long detailed conversation between total strangers. I started the interview with uncontroversial and routine questions, such as how long the person had been at the

factory, and how they had seen it change, which helped relax the interviewee and ease rapport. I asked open-ended questions, such as "Can you begin by describing in your own words what this factory is like?" or "What changes have you noticed here since the factory merged with BICC?" These helped sustain rapport, got the respondent talking rather than me, elicited the respondent's frame of reference, and encouraged the respondent's thinking in a certain area.

On my visits to Spain and Germany, interpreters were used in the interview process as few interviewees spoke English. Both interpreters were themselves 'organisational researchers', one from Bath University conducting doctoral research in Germany, and one working for a management consultancy in Barcelona who had worked with the BICC Multimedia group before. I discussed my research and what I wanted to achieve in interviews at some length with both interpreters before we started. Using interpreters ensured that I was able to conduct interviews at these sites where I would otherwise have not been able to, but there were problems associated with having an interpreter. The interviews were more stilted, and I was less able to have a free-flowing interview where I could follow up leads and tune my questions to the responses of interviewees, as we were communicating through the channel of the interpreter. It was not possible to pick up on the finer nuances of their responses. Both interpreters at times took the initiative in suggesting subsequent questions, which helped the flow.

In all cases I informed those with whom I engaged of the aims of my research project. At each interview I requested taping the interview, and was only asked not to once, making extensive notes instead. I would also often make notes during the interviews to map out ideas as they came to me, either in terms of the subsequent direction of the interview, or to highlight significant comments that the informant had made that I could follow up or mull over later. Each informant was assured that the content of our discussions would remain confidential and anonymous, which I kept to. It was clear to me that if I was going to learn anything, it would depend on my informant's knowledge and willingness to share that knowledge, and I told them so. Almost without exception, I was struck by the goodwill, sincerity and generosity of those with whom I spoke.

During the course of the fieldwork, I also learnt a lot in less formal settings. As I was visiting from overseas, I was often invited out to dinner, and had coffees and lunches

with participants. These informal gatherings deepened my appreciation of their experience and helped nurture a level of trust. However, as my research visits were typically quite brief, lasting from three days to a week, I would not claim that this was participant observation, as described in the second research strand method section. I simply made notes during my visits on situations, comments or events that occurred outside of the interview process that helped increase my understanding. After each factory visit, I would also tape my impressions and any insightful comments or situations that I had observed. I wrote up my impressions after visits. Unfortunately, a lot of rich data was lost when I had my Laptop computer stolen during one of my European visits. Each organisation provided me with access to documents and reports that bore upon my interests, such as organisational charts, teamwork initiative reports, IT reports, and IT strategy development documents.

Interview Sample

I applied two methods for selecting my interview sample, and organised my interview schedules either with the Personnel Manager or the Factory Manager who had been my first contact at the factory. Firstly, I requested a cross-section of staff for interviews at each factory, in order to roughly reflect the organisational population and proportionally represent the various levels and departments of the organisation. In practice, however, I interviewed more people from the higher levels of the organisation, as managers tended to have a better command of English in those non-English speaking countries that I visited, be more flexible with their time, and be more available for interviews. I also had to tailor my requests to meet the constraints imposed by the site and the work in question. For example, in one factory my access to shift workers was limited as they had an order to complete by a tight deadline, so I spent more time talking to shift supervisors and managers.

Secondly, I applied what has been termed criterion-based sampling (LeCompte and Preissle, 1993), a strategy in which particular people are deliberately selected in order to provide important information that can not be got as well from other choices. Weiss (1994: 17) calls these 'panels'; 'people who are uniquely able to be informative because they are expert in an area.' I requested that I interview those individuals who were well-informed in my area of interest, such as members of the IT department. This approach to

selecting my sample provided a sense of the overall distribution of attitudes and themes, as well as the benefit of the most articulate and knowledgeable informants. In total, 98 people were interviewed at 12 sites throughout BICC Cables, with an average of eight people interviewed at each site. Descriptive data were recorded for all participants, as presented below.

Gender

17 women and 81 men participated in interviews. This sample reflects the traditional predominantly male pattern of employment in the cables industry. All women interviewed commented that they did not feel discriminated against because of their gender, either in their treatment in the factory, or in their opportunities for career development. Those working in production tended to do lighter or more intricate work, such as re-threading light cable spools. Women tended to be in lower job grades than men, both in the factory and in administration. The highest job grades held by women interviewed were Operations Engineer and Personnel Manager.

Factory and Administrative Staff

37 factory workers and 61 administrative staff participated in interviews. Participants were classified according to whether they spent more time in the factory or in offices. Some participants, such as Quality Managers, fell between the two and worked both in the factory and in administration. However, if they spent more of their day in an office, they were classified as administrative staff.

Job Grades

The organisational structures within BICC Cables factories are not homogeneous, but differ from factory to factory and country to country. Although the titles of some participants in different factories were the same, their positions in the organisational structure varied. Therefore, participants were asked to agree upon being ascribed to one of four levels. The descriptive data regarding job grades are given in Figure 5.2.

Level	Job roles included in level	Number of participants
Level 1	Directors, Factory Managers, Works Managers, HQ Managers	30
Level 2	Technical Engineers, Engineering Managers, Employee Relations Managers, IT Managers, Training Managers	18
Level 3	Process Engineers, Team Leaders, Quality Co-ordinators, Production Supervisors, Schedulers	29
Level 4	Apprentices, Factory Technicians, Operators, Clerks, Secretarial Assistants, Store persons	21

Figure 5.2: Job Grades of Interviewees

Analysis of interview data

All interviews were tape recorded and verbatim transcripts were made. Becker (1970: 53) argues that such rich data as that provided by verbatim transcripts 'counters the twin dangers of respondent duplicity and observer bias by making it difficult for the respondent to produce data that uniformly supports a mistaken conclusion, just as they make it difficult for the observer to restrict his observations so that he sees only what supports his prejudices and expectations.'

By having transcripts made of the interviews, I missed some of the non-linguistic data on the tapes: emphasis, mood, intonation and so on that crucially elaborate meaning. However, with 98 interviews to analyse whilst my research visits were still in progress, I felt I did not have the time to listen to all the tapes. The company was willing to pay for confidential verbatim transcription to be conducted by a temporary secretary at Bath University, and I accepted this offer gratefully.

Faced with a growing pile of interview scripts that were being transcribed during my research visits overseas, I met with the dilemma of how they might best be analysed. Maxwell (1996) observes that one should start analysing data immediately after finishing the first interview and continue as long as working on the research. The advantage of starting analysis early is that one can focus the subsequent interviews and gain what

Glaser (1978) calls theoretical sensitivity. This is all very well in theory, but in practice it was unrealistic to commence analysis in concurrence with my research visits.

I began what could be termed a broad analysis as soon as the first transcripts were complete, reading some scripts in order to reflect on what data I was obtaining and whether to further focus the interviews. However, detailed analysis of the earlier scripts was not possible as I kept going on further research visits overseas, which came together in a bit of a rush as I had little control over the timing of visits. I did manage to identify key themes and learn from my early interview experience, but the main analysis occurred later when the majority of the factory visits were complete. The whole mad process of rushing off on overseas factory visits, returning only to do my laundry and hand my transcriber my tapes and then set off again meant that my feet barely touched the ground. I had enough trouble remembering where I was going next, let alone trying to analyse the data that I was collecting. Ideally I would have liked more time for reflection between visits, but as I had little control over my schedule there was not a lot I could have done.

When approaching the analysis of large quantities of interview data, there are several strategies the researcher can adopt, including cognitive mapping (Jones, 1985), memos, categorising strategies such as coding and thematic analysis and contextualising strategies such as narrative analysis (Maxwell, 1996). Potter and Wetherell (1987), in *Discourse and Social Psychology*, draw on conversation analysis as a further means of analysing interview data. They offer 'a vision of discourse in motion, talk and text fragmented across contexts, variably constructed to performing different actions' (Wetherell and Potter, 1998: 386). A further categorising strategy is coding. The goal is not to produce counts of things, but to 'fracture' (Strauss, 1987; 29) the data and rearrange it into categories that facilitate the comparison of data within and between these categories, aiding the development of theoretical concepts.

I adopted a 'coding' approach to data analysis. When coding my interview data into categories, I made notes of statements made in interviews on cards, and grouped them into categories in a card index, also coding demographic details about the person who made the statement, such as their initials, gender, job level, and factory. These statement cards were grouped into thematic areas, such as vertical communications, management

style etc. Attempts were made to let the themes emerge from the data rather than imposing pre-defined categories on the data. For example, many interviewees commented on the age of factory workers as being an important factor in the acceptance of new technology, readiness to adjust to organisational change, and in relation to recruiting new staff. All these comments I grouped within an 'age category', which emerged from the data rather than my anticipating such responses and having an 'age category' at the ready. Any additional thoughts I had about each category I wrote on separate cards marked with thought bubbles, to show they were my comments about the relationship between statements or categories.

Having elicited all the comments from each interview, and grouped the comments together, the cards were sorted through again, as a form of iterative thematic analysis, to ensure that the cards could not be further sub-divided or regrouped. After fifty two interviews conducted in six factories and one Administration Centre had been analysed in this way, I had achieved what might be termed a 'saturation' of categories, where no new categories were being identified. At this point I decided that I could stop writing every interview statement from each script on cards and continue reading through the interviews to find comments that had the following qualities:

a) the comment suggested a new category

b) the comment gave a new insight to the range of responses within a category

c) the comment illustrated an important organisational issue

I had initially used separate card index boxes for each factory, to see if I could identify factory or country-specific views. However, as I realised that the Virtuosi project was guided by the assumption that in the future in principle all organisational members will have access to the virtual organisation, the factory and country levels of analysis seemed less appropriate. I wanted to develop a global picture, rather than compare the attitudes of the Spanish with the Canadians, for example. My approach to analysis ceased to be cross-cultural and became multi-cultural. This was an important research decision, that

coincided with my realisation that the 'tribe' in the case if the virtual organisation will be all around the world[3].

My decision to read across the data rather than compare and contrast factories and countries did not mean that I was oblivious to national and organisational cultural issues. Organisational culture had a bearing on the views expressed. For example, interviewees at one factory that had been under-performing that was perceived as having an 'uncertain future' tended to make more negative comments about BICC in general, and about investment in technology, their willingness to use such technologies etc. I then made 'thought bubble' cards about the relationships between categories such as 'perceptions of BICC' and 'willingness to accept new technologies'. National culture also influenced the responses of interviewees. For example, in Italy respondents commented on the formality and respect with which managers were treated, which they contrasted with the less formal view of management expressed by UK participants, who referred to managers by their first name.

Soon I became less formal about putting statement cards in specific boxes, concentrating instead on the emergence of categories. Having read all interview transcripts and added to, embellished or sub-divided the categories that had emerged from the data, I was left with five card index boxes full of card statements and categories. I then tried to collect categories together within superordinate categories, identifying the key themes or categories emerging from the interview data.

Glaser and Strauss (1967) argue, in *The Discovery of Grounded Theory*, that theory about the social world which 'fits and works' is that which is generated inductively from the data. Categories emerge out of the data by researchers who study it without firm preconceptions dictating relevances in concepts and hypotheses beforehand. The problem with this, if taken literally, is that categories do not just 'emerge' out of the data as if they were objectively there waiting to be discovered. Kaplan (1964: 133) points out:

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[3] See the discussion in the last chapter regarding 'The changing nature of research: Even the best laid plans of mice and men . . .'

'We always know something already and this knowledge is intimately involved in what we come to know next, whether by observation or in any other way. We see what we have reason for seeing.'

I tried to develop my conceptual categories from the crucial base of the categories and concepts of the research participants. However, in comparing and contrasting and bringing them together I inevitably formulated broader superordinate categories or 'sensitising concepts' which were not identical to the former, and also reflected my own research relevances. In categorising my data I was inevitably making connections with the concepts and theories I already had about the area of investigation, in ways which can confirm, elaborate, modify or reject them. Some categories were drawn from my knowledge of existing literature, others were developed inductively during the analysis, and still others (often called *emic* categories) were taken from conceptual structure of the people studied.

The results of the analysis of interview data are described in Chapter 6, but the key themes are given here to show how they resulted from the analysis of interview data, as statements were coded into categories. Note that the first two main groupings of data concern information technology, and then I present broader organisational issues. This does *not* reflect the order of the interview format, where I asked general cultural questions, followed by intra-factory and inter-factory issues of communication, collaboration and IT, and finally outlined the concept of the virtual organisation. Rather than follow the interview format, I have presented the data in terms of the two broadest superordinate categories emerging from my analysis of interview data, those being information technology and what I loosely term 'broader organisational issues'.

Present state of Information Technology
• E-mail, shared databases, LANs and WANs, Videoconferencing

Future requirements for Information Technology
• Control of access to the system
• Features of the virtual organisation
• Ways to search for people
• Ways to search for information
• Implementation issues and specific recommendations for VirtuOsi
• The VirtuOsi factory pilot

Broader Organisational Issues
• Strategy
• Collaboration
• Management
• Communication

Figure 5.3: Key categories emerging from the interview data

THE DESIGN OF THE VIRTUAL ORGANISATION

The other strand of the research concerned an investigation of the design of the virtual organisation in the VirtuOsi project[4]. The rationale behind having two strands to the research is that it has allowed a top-down (what is being designed?) and a bottom-up (what do people need?) approach to understanding the virtual organisation. For this strand of the research, I wanted to understand the process of design of the virtual organisation; what technologies were being developed, what choices were being made by designers, and how they conceptualised the virtual organisation and the implementation of CVEs in an international organisation. I wanted to elicit the constructs of the designers of the virtual organisation to more fully understand the guiding assumptions of the Virtuosi project.

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[4] The aims and origins of the VirtuOsi project are described in Chapter 2.

Data Collection Method: Participant Observation

In order to gather data for this strand, I relied on participant observation techniques and documentary sources. The method of participant observation has its roots in ethnographic research studies, where researchers would live in tribal villages in far away places, attempting to understand the customs and practices of different cultures. Hence it has a very extensive literature, particularly in sociology and anthropology. Since organisations can easily be viewed as 'tribes' with their own strange customs and practices, it is by no means surprising that observation has also been used in organisation and management research.

Jorgenson (1989:12) feels that participant observation is appropriate for studies of almost all aspects of human existence.

> 'Through participant observation, it is possible to describe what goes on, who or what is involved, when and where things happen, how they occur, and why - at least from the standpoint of participants - things happen as they do in particular situations.'

The observer's task is to immerse herself in the host society: 'Learning, as far as possible, to think, see, feel and sometimes act as a member of its culture and at the same time as a trained 'researcher' from another culture' (Powdermaker, 1966; 9). It is not possible to acquire more than a very crude notion of the insider's world until you comprehend the culture and language that is used to comprehend its meanings. Greater comprehension requires that you understand the words of a language as they are used in particular situations (Hall, 1976). I therefore sought to immerse myself in the language and culture of the designers of the virtual organisation.

Central to the participant observation method is both involvement and detachment - too much detachment and you are not immersing yourself in the setting, and too much involvement and you 'go native' or 'become the phenomenon'. Jorgenson (1989:59) states that it is rarely possible to remain uninvolved:

> 'You will quite likely be asked to contribute expertise, whether or not you feel qualified to do so, or otherwise assist in some way. Involvements with people indicate that you are being accepted to some extent as part of the setting'.

As I have observed, I was asked for my opinions on matters of psychology by designers, and assisted in the development of a photo-walkthrough, a technology that allows users to become familiar with factories that they have not visited.

With participant observation, the immersion need not be total or long-lasting. Moreover, the role accepted by the observer can vary along a continuum from complete participation through participant-as-observer and observer-as-participant to complete observer (Gold, 1958; Junkers, 1960). Easterby-Smith et al (1991:96) suggest: researcher as employee, researcher as a specific role, interrupted involvement and observation alone. Walker (1985; 6) observes that each approach will suit different occasions and problems and will necessarily result in varying degrees and types of insight.

My role in VirtuOsi was of interrupted involvement, where the researcher is present sporadically over a period of time. There was not an opportunity for continuous longitudinal involvement in the VirtuOsi project, as the project team consisted of individuals working for different companies at different sites. Instead, I attended eleven of the twelve three-day VirtuOsi quarterly meetings over the three years that the project ran and some methods workshops. I also had interrupted involvement with the BICC Multimedia group at Hemel Hempstead, who I visited every month to two months for a day to plan my next steps and review research progress. I also attended Nottingham and Lancaster Universities on numerous occasions to gain insight into the work of the other academics. In total I spent in the region of fifty days with some or all of the VirtuOsi designers over the three years that the VirtuOsi project ran.

The participant observer seeks to be as systematic as possible in recording data and may use a tape recorder, take extensive notes or just jot down one word notes or key phrases. Which method is used depends on the social context. The use of a tape recorder or taking extensive notes may be acceptable in a pre-arranged interview but producing a notebook in the middle of a general chat is liable to destroy the conversation completely and the researcher may prefer to rely on memory or to jot down key words or phrases once the discussion has finished. Documentary sources help the researcher to build up a

mental picture of the social group and to develop possible avenues of investigation. It may also form an integral part of the anthropologist's research data (Bastin, 1985). I used VirtuOsi documents to identify the different metaphors that designers were using to develop the virtual organisation, and to clarify technical detail. These products of human activity mapped out progress within the project, and provided rich sources of data, enhancing my observations.

As we were often in meetings during the VirtuOsi project, it was acceptable and unobtrusive for me to take extensive notes, to sketch diagrams and on several occasions to observe and video live virtual meetings. I also conducted individual interviews with six designers which were taped and transcribed, and had a lot of informal discussions with various members of the project team, often at social events in the evening or over lunch.

Data Analysis

Becker (1958) observes that data analysis accompanies data collection, occurring sequentially. He goes on to identify four main stages in participant observation research: the selection, identification and definition of problems, concepts and indices; the estimation of the distribution of phenomena; the incorporation of the findings into a model of the group, community or organisation under study; and finally, the presentation of evidence or proof. The first three stages are carried out while fieldwork is in progress and form an integral part of that fieldwork. This pattern of working is not typical of other methods of data collection used in social sciences.

If there is any single word to describe my analytical method, it is inductive. Much as with the analysis of interview data, as I took field notes, I tried to identify key themes that were emerging from the data. With the themes that emerged, I began to build a conceptual map of the territory, and subsequent meetings were used to elaborate, challenge, confirm and clarify the emerging material. I tried to identify the range of perspectives on any given issue and to triangulate these perspectives as a way of constructing a map of the design of the virtual organisation. An analysis of the literature that bears upon my subject, in the fields of history, organisational studies and post modern theory, was an additional resource in the overall effort to interpret the field data.

As Psathas (1973; 12) argues, the key issue for social research is 'whether the results of an enquiry fit, make sense and are true to the understanding of ordinary actors in the everyday world.' Theory which is grounded (Glaser and Strauss, 1967) in the concepts and theorising of the people it is about is likely to 'fit and work' as the basis for explanation and prediction. Therefore, I have grounded my observations in the terms and concepts of the virtual designers. I have also made explicit when the perceptions of the designers differed, as they did not always agree on technical matters.

I had an abundance of field notes, key themes and documentary evidence, and needed to decide how it might best be presented. A highly conscientious presentation of all the evidence would probably bore a reader or bury him or her in a surfeit of information. Becker (1958) suggests presenting conclusions in the form of a natural history 'presenting the evidence as it came to the attention of the observer during the successive stages of her conceptualisation of the problem . . . In this way evidence is addressed as the substantive analysis is presented. This gives any reader the opportunity to make his or her own judgement as to the adequacy of the research and the degree of confidence to attach to any conclusions'.

I wanted to put the description and analysis across in a way that is vivid, credible and meaningful for the reader. The researcher may:

> ' . . . quote directly from interviews or conversations that he has overheard. He can include dramatic segments of his on-the-spot field notes. He can quote telling phrases dropped by informants. He can summarise events or persons by constructing readable case studies. He can try his hand at describing events and acts and often he will give at least background descriptions of places and spaces. Sometimes he will even offer accounts of personal experience to show how events impinged upon himself. Sometimes he will unroll a narrative.'

> (Glaser and Strauss, 1967; 229)

It is only through the careful choice of examples, adjectives, metaphors and similes that the experiences of the research subjects, as experienced by them, can be made understandable and significant to the reader. The researcher needs to be explicit about the basis for his interpretation of events and, as far as possible, to provide evidence that would facilitate re-examination.

I did not attempt to code the field data into categories, as I had with the interview data, but instead aimed to construct a narrative that showed my struggle for meaning throughout my participation with the VirtuOsi project. I wanted to describe the way that technologies developed, and to identify the choices being made by designers. As well as providing a narrative, I have described in different sections the technologies that were being developed, and made observations about how those have changed through the course of the project. For example, several ways of 'Searching for People' in the virtual organisation were looked at during the project, and I have attempted to describe these and the changing zeitgeist during the course of VirtuOsi.

I have interpreted and presented data my way. The analysis of qualitative data is a highly personal activity. It involves processes of interpretation and creativity that are difficult and perhaps somewhat threatening to make explicit. The difficulty of explication should not, however, lead to the extreme of mystification. Indeed a great deal of qualitative data analysis is rather less mysterious than hard, sometimes tedious, slog (Jones, 1985b; 57). I have aimed to avoid presenting my analysis as 'mysterious', and the results of my 'slog' are presented in Chapter 7, following the subsequent chapter on 'Investigating User issues in BICC Cables'.

CHAPTER 6

INVESTIGATING USER ISSUES IN BICC CABLES

This chapter presents the data associated with my investigation of user issues in BICC Cables. Let us remind ourselves of the reasons for this research strand. The rhetoric of the virtual organisation is that of collaboration, of people from different organisations and countries meeting in networked virtual environments to work collaboratively. This strand of the research aims to look beyond this rhetoric; the desire to collaborate and communicate with other organisations is not assumed but investigated here. This strand of the research therefore involves an investigation of end user issues within an international business setting. Using Mowshowitz's (1976) analogy of an organ being implanted into a body (see Figure 3.2, page 21), this chapter investigates the body and how it might react to the implant. The next chapter goes on to consider the organ itself, the IT system being developed by the designers.

The rationale behind this strand of the research is to establish whether people are 'ready' for the virtual organisation, in terms of present technology and skills, and whether there is a 'felt need' for the virtual organisation. I also take a broader view and investigate what organisational dimensions might be affected by the virtual organisation, and in turn have an effect upon it, identifying organisational themes that need to be born in mind by designers and by companies considering 'going virtual'. The research questions posed by this strand of the research are:

- What is the present state of IT systems, skills and needs within BICC Cables?

- What are people's future IT requirements and preferences, and reactions to the concept of the virtual organisation?

- What broader organisational issues might have an effect on the acceptance or rejection of the virtual organisation?

The chapter is therefore divided into three main sections, relating to each research question.

THE PRESENT STATE OF IT WITHIN BICC CABLES

At the time of this study, computers were used on the factory floor in all twelve BICC cables factories that I visited to monitor and control the production process. Computer systems on the shop floor allowed factory workers to vary parameters in the cable-making process such as speed of drawing, width of cable, heat of the annealing process etc., depending on the requirements of a particular order. Some computers were 'dumb terminals', not being connected to a network, but being dedicated to one part of the production process and providing monitoring data.

The administration departments of all factories had computers; some were stand-alone, and some were networked, with each factory varying in their degree of integration. The disparity in technological integration is illustrated in the following statements, made by IT Managers in the UK and Germany:

> "We are still an old-fashioned company in terms of technology, and if you walk around this place you will find a conglomeration of different bits of kit, some are dumb terminals and some are 286s, some have not got Windows."

> "90% of PCs are networked within (the factory), including the ones in the production process. We are connected to other European factories with e-mail. 200-300 people use e-mail heavily. We used to have four IT departments with different systems and computers, and we could not transfer data from one system to another. We now have an integrated system, in which we are customising the database structure into a divisional arrangement. We will use Windows 95 after teething problems."

Most factories already have the facility to communicate and exchange information internally in the form of shared databases and e-mail. Interviewees commented that e-mail saves time, allows one to compose a better quality of message, and one can be more open and honest. However, several participants commented that in the beginning, e-mail had led to delays in decision making.

> "We have voice-mail and e-mail. Depending on what message you are sending, sometimes it is better to be able to sit and think about what it is that you are trying to say and type it onto a screen. You can edit it before you send it."

> "E-mail has provided a way for people to communicate within BICC. It has led to people

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having more time to compose what they have to say, communicating in shorthand or slang, and being more direct, honest and open as they do not have an immediate reaction."

"Initially with e-mail, people passed on messages and waited for replies, instead of phoning one another to arrange to meet up and make a decision. Decisions were delayed as messages went round and round."

"Before e-mail, people would pop in to one another's offices and make a decision. With e-mail, messages went round and round. I'd say that now, people are informed by e-mail, but then see one another to make a decision. The informal chats on the corridor are still important."

In some countries, such as Canada, Spain and Australia, factories are not only connected internally with Local Area Networks (LANs), but are part of Wide Area Networks[1] (WANs), and communicate and exchange information with other factories using e-mail. The major obstacle to connecting factories in WANs is the lack of standardisation. Many factories have been following their own IT path, and have evolved quite disparate systems. Now they are attempting to integrate and standardise systems within BICC, with varying degrees of success.

"With the new technology you are describing, we used to have our own internal computer system that worked well for us and of course, (the Canada Head Office) came and said no, we want you linked with other factories. This is a logical step, but the system does not work."

"There is no doubt we need a standardised system within BICC. The problem lies in the fact that a lot of companies have spent a lot of money on their system and will be reluctant to change for this reason . . . We are improving our technology bit by bit. We have a network system - soon we will rethink our system to standardise with the rest of Europe. I think we are rising on the technological curve line."

"There is a need for uniformity and coherence of system - it is very much lacking in BICC. Places are developing their own technologies at different speeds. One place may have e-mail and ISDN connections to other factories and others are still working in a traditional way. I would estimate 15% of people in Turin and Settimo work on a networked PC. . . In Italy it is just the Systems department and the General Manager's secretary. Soon this will include Sales and Marketing. We have sufficient software but lack the infrastructure - we have software for 125 people but only cables for 50-60 people."

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[1] A WAN is a computer network that interconnects terminals at many sites over very large (national and international) distances, using existing telephone networks.

Some factories already have external e-mail facilities so that they can communicate with sites in other countries, and are looking to extend communications to their customers and suppliers:

> "We want connections with our customers so that they can e-mail us, and amend an order down the line. Then you are getting instantaneous communication without the middle man. They don't have to sit and write it out, fax it or post it."

> "We have relations to BICC factories in finance, technology and training. They used to use the phone and travel. It is easier to send mail and files and figures by e-mail."

> "We have introduced e-mail in recent times but more for external communication with corporate Head Office in Sydney and our sister company in Liverpool. We are also looking to extend that. The next step is to extend to our main customer and some of our major suppliers. So I am looking more for external rather than internal communication. Mainly people have an extensive telephone network . . . . and are connected by the computer network so that they tend to share files of information rather than leave e-mail messages for one another."

Some factories, such as those in Zaragosa and Berlin, have videoconferencing facilities that they are using in trials to communicate with other BICC factories. The main problem associated with this communication technology is that there is a lack of standardisation, with different locations working from different platforms. The number of factories with videoconferencing facilities has yet to reach critical mass, which means there are few factories 'out there' to contact. People made the following comments about the problems with videoconferencing:

> "We have a videoconferencing system but could not get in touch with Hemel Hempstead or Wrexham. The problem with the videoconferencing system is that everyone has different systems and there are no standards."

> "If there were better equipment and everyone had it, it would be used. At the moment, people cannot videoconference because they are connected to a vacuum - there is no-one out there. There are not enough connections."

There were varying degrees of computer utilisation and literacy at different factories. White collar workers used them routinely to communicate and exchange information, whereas factory workers used them less frequently, and more for monitoring and controlling the production process rather than for communication. Office staff were the

main users of e-mail at those factories where it was available. Two Training Officers commented that factory workers were not that familiar with computers; basic computer knowledge, limited to what was needed to the job of monitoring the production process, was the norm in all factories.

> "People have the option to train in computers. People on the factory floor are not that used to using them."

> "People have basic computer knowledge in the factory, to monitor the process on machines. White collars use computers more, and work for themselves more on the computer rather than having secretaries, which is good for cost effectiveness."

I asked interviewees how people would respond to computers being used not just for monitoring and controlling the production process, but for communicating. The majority of respondents commenting on factory floor workers and computers made a connection with the age of workers, saying that the older factory workers would adapt less well to using computers more on the factory floor. Whilst younger employees, brought up in the 'Computer Age' and used to using computers at home and at school, were quite willing to be trained to use computers in the workplace, some older employees had a 'fear' of new technology, seeing it as potentially leading to redundancies. Some participants felt that the acceptance of new computer technologies and ways of working would take time, and was to an extent dependent upon the employment of younger, more flexible workers over time. These interviewees summed up the general view as follows:

> "Older employees have a problem adjusting to new things, such as new computers. The younger ones will take to it quite quickly, but you will have to bear the age thing and training in mind if you want to introduce something new."

> "The receptiveness of people to new technologies depends on their age. At first people do not like computers but when they see what we are doing they are more interested. Older people do not like 'strange' systems like this."

In sum, participants identified a need for greater integration and standardisation of systems within BICC Cables. In those countries where e-mail is used to communicate between factories, it is viewed as very useful, and a time saver. More widespread e-mail connections would be .a first step towards the sort of global communication and collaboration talked about in the VirtuOsi project. It was apparent

that at this time there is not adequate hardware nor sufficiently integrated IT systems within and between factories to support even the minimal kind of virtual organisation. The virtual organisation could not become a reality without massive investment, not only in terms of IT, but also because of the training requirements. Computers are used throughout BICC factories, but many shop floor workers only have basic computer knowledge, and older employees may be less adaptable to using new technologies.

FUTURE INFORMATION TECHNOLOGY REQUIREMENTS

The interviews provided insights into the technological features the people required or preferred for exchanging information and communicating in the future, which can inform the design of the virtual organisation. Issues emerging from the interview data in relation to future IT requirements are presented as follows:

- control of access to the system

- features of the virtual organisation

- ways to search for people

- ways to search for information

- implementation issues and specific recommendations for the VirtuOsi project

- The VirtuOsi factory pilot scenario is then attended to, looking at user perceptions of IT and collaboration at the four factories.

Control of Access to the Virtual Organisation

Many respondents felt that any future IT system will start with restricted access for financial reasons. Several members of management felt that if having access to such a system was not essential to a factory worker's job, then they should not have access. Against this, arguments for the inclusion of factory workers included that it would be good to tap in to the hands-on experience of factory floor workers, and increase their feeling of involvement in BICC Cables.

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"People on the factory lines need to be included in international meetings as they have more experience than managers on the machines."

"New computer technologies would make people feel more a part of BICC - the average guy on the floor does not have a lot of access. He does not have communication with people at other plants."

Participants raised issues concerning whether the system should focus on connecting factories or technology centres where the bulk of research and development is conducted, and talked of the sharing of expertise.

"There is a need to share expertise and technical developments in technology centres with factories. It is desirable to get technical people to share ideas and practices with the shop floor. When we can share expertise, it will be possible to discuss problems more openly and ensure that best practice is applied everywhere."

"I think VirtuOsi will have to be highly selective about where they set these emerging technologies. . . . They would be useful at the technology centres, and at Head Office, where people would immediately benefit and not have to fly."

"It does not really make sense to connect the technology centres where you basically connect the academics first. Why not connect the factories first which are the places that are making the money? It sums up how traditional BICC is, illustrating that the focus can be wrong sometimes."

Other issues of access raised by participants involved problems of misinterpretation associated with having access to information without understanding the context of the document or file. There is a span of information appropriate to a person's job, not only for security but also for efficiency. Not even Directors should have unmitigated access to all files! Interviewees also raised concern over the security of the system, and suggested that a group of individuals at each factory decide on access issues, and that there should be a virtual 'information traffic controller' controlling access and helping users within the system. It was suggested that communication could also be controlled by 'hubs', receiving and distributing mail and information.

"If you have an open system, factories can access free advice on how to put problems right."

"A centralised database with strictly defined rules of access is easier to manage in terms of security compared to distributive systems. However, there is a problem

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concerning whether the local manager gaining access will appreciate the significance of the document and understand its background and context. There is also a problem of misinterpretation. Someone might access a file showing productivity is down for a month. This does not tell the person why, or give any localised background . . . There must at least be a group of people in each factory who know exactly which is the confidential company information, who would benefit from access to files across the company, and the most efficient ways of communicating this."

"Having access to data and information has implications. It can be very dangerous, as people may draw conclusions which are invalid. For example, if a Director wants to see attendance records, he should approach the manager, rather than having direct access to records and misinterpreting them. People do not have the right to know everything. The system is open to abuse, and I don't see how it helps their job to have access to all areas. There is a span of information that a person has a right to know. Even a Director does not need access to all information. It is better to focus on the levels needed. Information access should reflect the management structure. The technology should support the management structure, rather than working against it."

"Company security is a problem - as soon as you have a modem, you are fair game. Efficiency is also an important issue. From an efficiency point of view you want to focus people in particular areas. You don't want people to go in and browse through everything - not from a security point of view but for efficiency's sake, as it will take time, be expensive and of dubious payback . . . One of the things we need in the future is an Information Traffic Controller, to tell people the best place to start their search for information in the system - like a librarian. This is important at a corporate level to really get security and efficiency - to approve access to a file and terminate the access at the end of the login."

"I think one must look at the manner in which people are looking for information. I think that each company must have its own computer security system, so as not to invite problems."

"(In order to reach the appropriate person on e-mail) there should be hubs. It would be like a post office. New York would be the centre for receiving all mail and it gets forwarded back out to everybody. The UK could do the same for Europe."

Features of the Virtual Organisation

In interviews I outlined the concept of the virtual organisation, describing various possible features and what it would make possible in terms of communication and information exchange. People generally had a positive view of increasing communication

and collaboration between sites with new computer technologies. They differed in their views of what the nature of the technology should be and how it should be used. Issues raised about the virtual organisation included ways to search for information, ways to search for people and the language of the virtual organisation. The technology should be flexible and facilitate the search for people or information, depending on what an individual is using the system for - some felt personal contact was important, others were more keen on finding or exchanging documents. First there are some general comments about features of the technology that would be useful, combining multimedia technologies.

"You are talking about having a common meeting without the necessity of the people physically getting together and doing all the things that you normally do at a meeting. That is ideal."

"It would be ideal if you could have a technology where you can talk, watch the eyes of the other person, write, give information and draw."

"A new IT system would be useful where you could not only talk and see your partner, you could also send files, spreadsheets, text and pictures - whatever you can process with the computer. You could even work together in the same software. The problem is time delay, and a loss of natural conversation. It gets boring."

"I would like to have a video computer . . a screen with all the people talking, a screen in which you can see all the different offices. Another part of the screen shows the person talking at the present time, a document or screen board that people can use; one piece of equipment that is capable of videoconferencing and sending files at the same time. The equipment should have a special camera that is able to focus on the paper or screen board, so you can explain as you draw. You also need a scanner for bits of magazines or newspapers, to send immediately to those people you are meeting with."

Searching for People

Participants also discussed how people might best be sought and communicated with throughout BICC Cables. One of the problems identified by interviewees was not knowing who might be the most appropriate person to contact at another site. One interviewee phrased it: " It's not a question of not wanting to share knowledge, but not knowing who to share with". Participants suggested that the system should provide information about organisational charts, job titles and job descriptions in order to inform

the user. A user's access to information should relate to their job role, giving them an appropriate span of access. Organisations are not rigid, but fluid, and the system should be updated as people move around or leave the company to prevent it becoming outmoded. Participants felt that the virtual organisation should inform the user of how the real organisation is structured, with sectors being defined more by organisational split (e.g. Pyrotenax are in one sector, Data Cables are in another) rather than by national boundaries.

"We need to have information moving around, and to know who people are, and how the company is organised. For example, I do not know the organisation of Spain. I know the MD and the Director of the factory, and the Purchasing Manager, but I know nothing of the other people there. It is important to know. I would like to share knowledge with them, ask if they have the same problems we have. I do not know where my opposite number sits in the structure of the company, and whether they are the best people to talk to, or whether someone else could give me a fuller picture . . . Information should move in a circle or network through BICC. It is important to know where to ask for information, to know who the people are, who does the same work, how the company is organised."

"The first step for any distributed system is to have a formal organisation with clearly defined roles and responsibilities. There must be clearly defined roles, and parameters for levels of confidentiality. As soon as a person's allowance to information or position changes, the system should inform users, so that they do not continue sending things that are of no interest. In the traditional company the organisation is mainly based on people - its personal. What would be useful is that if someone moves position or is substituted, you are informed, but also can see who else can be contacted due to overlapping roles. When I enter e-mail, it should allow me to see the people I am interested in talking to, or allowed to talk to by the company, as defined by their level and function. It should be the manager's responsibility to define the job description, so that people do not give themselves too grand a role. Local hierarchy and etiquette in each factory can be included in the system so that I do not bother someone too high up, and I address them in the appropriate way, such as Herr in Germany etc."

"Sectors are the more likely criteria to define organisational split, rather than national boundaries."

Finally, as well as having the facility to meet people in the virtual organisation, people emphasised the importance of continued personal contact. They also suggested that it would be preferable to have virtual meetings with people who they had already met and

established some kind of rapport with.

"You cannot avoid meeting people sometimes - not everything is written down. The detail is in peoples memories."

"Meeting people in this virtual organisation should never replace face to face communication."

"I prefer a lot of face to face communication within the factory to e-mail memos, as there are many people here for whom English is not their first language, and there are problems of misinterpretation, particularly if things are written. You need to see that people understand. At this time extensive e-mailing is probably not justifiable . . . Videoconferencing is a great way of communicating face-to-face on specific issues. It is more likely to work if you have established a relationship at an earlier personal meeting."

"Before using communications technologies you have to meet the other person. When I meet other Quality Managers they have my face in their mind - it is fundamental . . . To improve communications within the group, I tried videoconferencing. I did not like the atmosphere - it was very cold, and I felt uncomfortable. I believe in personal contact. It was a negative experience for me. I understand it is expensive to travel but personal contact is most important. After that you can continue by phone, by video, but you must shake hands first. To have a feeling, it is more important than a piece of paper or sending a document."

"The technologies you have described will not replace meetings and develop relationships. But beyond that, as a preference to having to go and meet all the time it would be very useful. People would respond reasonably well. For the last 18 months we have had e-mail here, and you wonder what you ever did before you had it. It met a need in the company and we embraced it quickly."

Searching for Information

I asked interviewees about how they would like to search for information in the virtual organisation, and whether having access to each other's files would be acceptable within BICC Cables. For some participants, having access to information was more important than having face-to-face communications. Participants generally felt that exchanging information and increasing communication between factories would be positive, as is illustrated in the following statements:

"More important than seeing faces in a new IT system, is having access to information."

"What we need is to visit, talk with   and learn from other factories. As

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technology improves, we could see with a video what is happening in the factory and interchange information with the other person. This would be an ideal aim."

As regards the present state of information exchange, some participants observed that information such as productivity reports and quality statistics always goes to the centre of BICC Cables, and then is distributed out again. Having direct communication with other factories would help people to learn from each other's experiences, facilitate collaborative efforts and break down barriers and the hold of the centre. However, having access to browse the files of other factories would be highly contentious at the moment, some participants suggested, as people are not in the habit of being open.

> "It would be useful to have a system such as you are describing for the scenario of buying equipment. It would be useful to have information concerning former purchases by other factories, and relating this to our local situation. However, at the moment, information always goes to the centre, to BICC in the UK, giving them more control. I would prefer to talk directly to Spain to get information, for example, and cut out the middle man."

> "There is a potential problem with a technology such as that which you are suggesting, in that it goes against old habits of being closed. I think openness is the way forward, but people are used to keeping things to themselves."

I asked participants about technical facilities that might assist the exchange of information. In the meeting room scenario, it would be useful for all users to share a view of a document or picture, to see any online editing done by other users. The system should incorporate the facility to share a view of documents and exchange information with the ability to see other users. There is a question of whether the shared documents should be read-only or truly interactive, so that users with access to the document can edit it or add comments on an attached document. Suggested ways to share information include Lotus Notes, an on-line discussion facility where users can join a group and backtrack and see what comments have been aired on an issue, and contribute to the discussion. One participant commented that to improve communication on the factory floor, where access to computers is limited, there should be a video screen on the wall of the factory.

> "It is possible to have a piece of paper and to focus on that paper with a special camera lens, and to be able to use that paper to point out the things you want to. It is possible to have another

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camera focused on a screen board and you can draw what you want on it and explain things . . and the other people can do that too."

"If three people have the same document open, will it be read-only for two? Will it really be interactive so that all people can make changes to specifications, or will you only be able to tell another person to make changes?"

"Some people like Lotus Notes. I think it would benefit this organisation a lot. To go and have a browse, see what is in there, see what papers people have floated on the subject."

"If I need to share information, I send a fax with the information, and then I phone so that we can discuss the information. This method has a number of benefits: people are used to faxes and phone calls, I can make sketches and scribbles on the fax to illustrate the information, and as English is not my first language I can get what I want to say down in writing. I can also read and understand what is faxed back before the phone call meeting. The videoconferencing equipment does not at the moment allow people to exchange and fax documents on the same network; you can only see peoples faces. It would be better if the system also supported the exchange of information . . . . It would also be helpful if everyone could see the same document on the screen."

"The most frustrating thing is that (a recent overseas visit) took about 6 weeks to organise, to try and co-ordinate timing, get people together. . . . So something along the lines of what you have described would be invaluable in that situation, especially if you were able to put things together over a period of time. If there were four parties involved, and it had maybe started off with two parties and it expands to include the whole group; something like that would be most useful. When you bring new people into the fold, you have to backtrack and bring them up to speed. That takes time. Whereas using this up-to-date technology people would be able to bring themselves up to scratch. Then they can contribute and the group can move ahead."

"We are trying to improve vertical communication. We are looking at those large video screens that send messages and repeat messages all day long. Then we can send messages like how many accident free days we have had, what important meetings are coming up. Get the message across immediately."

Participants also suggested that the system should facilitate the search for information by having documents or files linked in a network, so that finding one document leads to others. The system should be flexible, so that depending on how the user needs to search, they can either start focused on a particular topic and broaden out, or start broad and narrow the search down. Participants made comparisons with Mosaic, and a 'filing

cabinet approach' to arranging documents in the information system.

> "The volume of information and data are increasing as factories have been acquired. Rather than having a 'filing cabinet' approach to organising the data, it would be useful to have a recursive filing cabinet, where one piece of information has pointers to others, and where there are networks and activated paths through the data."

> "If you look at Mosaic, you are starting with the broadest possible limits, then you start to narrow it down. What would be preferable is to start narrow and then broaden out. It depends which way you come at it."

Some participants commented that people were in the habit of using paper copies rather than reading information on the computer, where documents may go unnoticed without the time to browse.

> "I prefer hard copies. Information may be on the computer, but if you are unaware of its existence, you cannot access it. People do not have the time to browse. If information is on paper I attend to it - it is in your mind and you are aware of it's existence."

> "Spanish managers are not accustomed to looking at a screen - they prefer documents. Maybe in 14 years it will be different."

> "People are not ready to work fully on PCs yet. They still rely on paper. You can make copies and send them to people who are interested. If I see a piece of paper, I remember it better, and can pass the information on easily."

English as the primary language of communication

Many participants raised the issue of what the language of communication in the virtual organisation should be. Many participants suggested that the common language should be English, as BICC Cables is a UK company so meetings are held, and documents and reports are written in English, and also a large proportion of the factories are in English-speaking countries such as the UK, Australia and America. Unless the virtual organisation incorporates an electronic 'babbelfish'[2], English is likely to be the primary language of communication within the virtual organisation. However, one participant pointed out that over half of BICC Cables employees world-wide are non-English

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[2] The 'babbelfish' was described in Douglas Adam's *The Hitch-hikers Guide to the Galaxy*. When slipped in your ear, it translates all languages in the galaxy.

speaking. There is a danger that the virtual organisation might become ethnocentric and exclude those who do not speak English.

> "BICC Cables is a UK company, but last year more than half of the people working for Cables were non-English."

> "I have one very important question. If you need to have a video conference with a lot of people, you need a common language, which is likely to be English. At the moment there are not many people in Spain who are able to understand and communicate everything that they want. People understand written English but not many are able to communicate in English."

> "A lot of people in Quebec do not have English as their first language, which is reflected in this factory. Quite a lot are used to reading BICC documents from England, but would feel less confident having a meeting like you are describing in English."

> "People are hesitant to phone the UK because of poor spoken English, they prefer faxes."

One solution could be to have a computer interface to the virtual organisation in the person's own language at his or her end-point. But this is not straightforward, as some factories are multi-cultural. For example, one Australian factory that I visited employed immigrants from over forty different cultures. English is not the first language of many factory workers within BICC. Communicating in written English as opposed to spoken English may be preferable if people are not fluent English speakers, as then they have the time to absorb a message and compose their message in return. Alternatively, a more visual icon-based form of communication may emerge that transcends language barriers. Furthermore, it was suggested that the common organisational language or terminology should be based around 'cables' terminology. An international business 'language' that is predominantly English and is based around terms associated with cable production and the MBE programme is already emerging within BICC, so this might be the most appropriate and neutral language to encourage in the virtual organisation, providing terminology and a framework in which to communicate.

> "We need to manage BICC as a whole, and share a common organisational language. The spoken language needs to be English, and the terminology needs to be BICC Cables. This will present a problem with some factories such as in Spain and Portugal, where few people speak English. Maybe it could be possible to get around this by getting away from language and using icons. "

"I think the good thing about videoconferencing and VR is that it is all visual, all graphical. People are used to graphics with icons, Windows, television. Systems that are not text-based are good because you are seeing people or things, and we rely on our vision primarily. . . What you will find is that because these things are visual and on-line, people's co-operation will expand rather than retract."

However, developing a standardised cables terminology might be difficult. To give an illustrative example, within the UK there are significant differences in regional language. I visited several factories, each of which had a different expression for dusting bitumen-coated cables with calcium carbonate. Some called it chalking, some snowballing and some dusting. This is a small and insignificant example, but if it is scaled up one can imagine communication problems on an international scale.

"We need to look at communality across the group in terms of what we call the products we make, because if something is called one thing at Factory A and the same product is called something else at Factory B, that is disastrous as far as computers are concerned. We have to tag them with the same identity and treat them the same way if we want to access each others files. Culturally, even things between us and Prescott are done differently. . . . Your perception of the quality of Class 1 cable is probably very different to what the Canadian perception is, but the most important part is what is the customers perception."

Components of the virtual organisation raised by participants therefore include control of access, ways to search for people and information, the importance of continued personal contact and of establishing a rapport prior to meeting in the virtual organisation, English as the primary language of communication, and developing a standardised cables terminology for the system.

Implementing Information Technology

Having considered the interviewee perceptions of the present state of IT and future IT requirements, IT implementation issues need to be addressed. I explored attitudes with interviewees concerning what the advantages and disadvantages of a change in the IT system might be. I also got feedback and recommendations regarding VirtuOsi and what the project was attempting to achieve and how it might best go about achieving it. Participants also raised concern over managerial support for any IT initiatives.

Pros and cons of new IT systems

Some participants felt that changes in IT systems were necessary to assist in quicker and more informed decision-making. Another advantage was decreasing the amount of international travel, which would be preferable to some employees, particularly in Australia, and would save time and money.

"Ideally, an information system should mean getting information to the factory lines to support decision-making, and the possibility of having more connections with other factories."

"We need tools to allow the devolution of responsibility. It is easiest to give people information with which to make decisions."

"(BICC) have not kept pace of what the outside world needs and it needs a customer who can communicate with you and if you have any problems within the BICC group you need instantaneous decision making. If it has got to be in video camera or video conference then so be it."

"Travel is especially an issue here in Australia, as it is huge so internal travel involves flying. Obviously it is also remote from the rest of BICC. We need instantaneous communication using computers. We have to look at ways of harnessing technology to do things like not jumping in a Boeing 747, paying for 24 hours locked up in a sardine can, its not really that much fun. . . . Usually, when you have jumped on a plane and gone half way around the world to chase something up it is usually something pretty important and it usually has a sense of urgency associated with it."

"In the future I see some videoconferencing equipment in a room that people can have access to for meetings. Its the way to go . . the return air fare at the moment to Sydney is A$500 and that is just economy class. The time travelling to and from the airport is also considerable. Therefore we would probably save money by investing in IT."

Disadvantages included a fear that a new IT system might lead to job losses, that information might be misused, and that people would be resistant to the technology and collaboration. People also questioned whether the technology would be imposed.

"One big question for me is whether the use of the computer technology that VirtuOsi is proposing is voluntary or whether it is compulsory. Are you proposing that we make them pay for the equipment, insist that it is installed and used and expect them to perform better? We want to avoid arguments. It depends on the terms of reference we give to managers. It is

politically very sensitive."

"Whilst there may be benefits for the company from a new system, such as instantaneous communication, there are casualties, usually human, in terms of job losses."

"My concern is that this virtual organisation will lead to job cuts in BICC by emphasising sharing experts, and therefore needing less of them."

Managerial Support

Interviewees also commented that managerial support would be needed for any IT initiatives. Some felt that managers would support IT investment, and that it would be preferable to collaborate using new technology compared to managers spending sabbaticals at other factories. However, managerial support for IT investment was not always forthcoming. During the course of my visits, I observed that it was not always the case that managers used computers regularly. Some did not have computers in their offices, and one manager commented to me out of interview that computers were what secretaries used. He commented that the computer was an 'anti-status symbol', likening it to a 'typewriter with a screen', and saying that the real decision makers did not need them. This was incidentally in a European factory where paper copies of memos were preferred by most managers. Middle management may also be resistant to new technologies because their jobs may be threatened by them.

"If everyone communicates more, there is less need for middle management. It can be smaller."

"The percentage of managers supporting a new technology would be very high. The percentage available to move abroad on sabbaticals would be a lot lower."

"It should not be assumed that managers who receive and manage the bulk of IT investment and facilities actually use computers a lot, or are behind larger investment."

"We still have people in the USA in a management position who are reluctant to even tie into E-mail . . . . the IT steering committee cannot even get WAN e-mail approved. . . There are some computer technophobes at high levels . . . If we want these changes to take effect then (VirtuOsi) have to let upper management know and push this forward because we cannot convince our managers that this needs doing. "

Improving the chances of acceptance of new IT systems

The majority of interviewees felt that the system would have to be of real benefit, whether in terms of cutting costs or improving the way people worked, in order to be accepted. If the IT system does not fulfil a real need in the company or does not fit with the way people work, or improve their work or make their lives easier, then it will not be accepted. Many expressed concern that too much time should not be spent in the virtual organisation, as they had their 'real jobs' to do. One participant, upon my outlining the concept of the virtual organisation, raised an eyebrow, grinned and said 'Virtual Schmirtual'.

"They want to tap us for information and force us to use a system. New technology is great in principle but it has got to be accepted and work."

"Videoconferencing is quite a new technology and it is good to look at it and see if the organisation can benefit from it. Telephone conferencing is not all that new and I am not aware of it being used significantly within the organisation, so it makes you wonder if the need is there? Systems do not go well if the users do not benefit from them."

"Videoconferencing equipment has been introduced by Hemel Hempstead at Zaragosa. I have been involved with the technical side of its introduction. People do not use it and do not feel it is useful. The equipment is not that good or realistic, but the main problem is not the technology being inadequate, but people feeling it is not useful. The same attitudes exist in Germany, where they also have videoconferencing equipment. The problem is that people do not need contact for every day work. Each unit makes plans autonomously, and then sends information by fax or courier."

"What are the benefits of this system, in MBE terms? Even in intangibles, what are its benefits? Does it make money, lead to improvement projects? If not, it will not be supported."

Interviewees also felt that if IT is launched too early, then it will lose credibility, and needs to be introduced when it is relatively 'glitch-free'. If IT is too complicated or requires a lot of training, then people will not take to it so easily. Participants commented that IT should not be introduced simply because it is available; implementation must match requirements in the organisation.

"We have experienced video-conferencing - it was terrible and uncomfortable. It was launched too early and lost credibility - the practicalities of videoconferencing make it impossible to have

a natural meeting."

"With technological innovations, the need is not realised until the product is developed and implemented. The gap between pulling the organisation forward and using people as guinea pigs needs to be addressed. It would be better to get the technologies when complete."

"Say facilities are set up at Wrexham, Chester and Zaragosa - key places for people to use it. If the learning curve is very steep to use it, then it will not get off the ground very easily because even though people find it useful, if they have to learn it and then if they only use it once every six months they are going to have to relearn how to use it every six months. It would be tricky."

"One of the things we have to start doing is capitalising on the technology that is being made available. It goes in cycles whereby the requirements sometimes outstrips what is available and yet there are other times when what is available outstrips what people can cope with. The Internet is a classic example - you have access to everything you ever could think about and you think 'How do I cope with this and do I have the time?'. Its a matter of using technology as it is appropriate. A lot of people think that they need access to the Internet and when you ask them 'What for?' they reply 'Because it is available'. It is up to IT managers like me and pioneering projects like VirtuOsi that explore the limits to provide the opportunity for people to take advantage of technology."

The VirtuOsi technology is 'cutting edge', and whilst it good to be ahead of competitors, one participant read something into the fact that new collaborative technologies are not widespread - is it because such systems are the way forward but too expensive at the moment, or because they are a technological 'turkey'? Collaborative technologies are not like a natural real meeting, and maybe they should not try to be so. The exchange of information was viewed as useful, but people still need to meet. Formal meetings when one has already established rapport with other user might be acceptable. An IT system is not introduced into a vacuum; there are organisational and cultural factors that will affect it's acceptance.

"One of the problems with the VirtuOsi technologies is that there is a lack of real interaction. There is a need to be careful and not to fudge it; to not try and simulate interaction, it must be something different. Videoconferencing is supposed to reduce travel costs, but people do not travel more than they need to anyway. If things are formal and people know one another, it will be OK. But if there are no former relations, it is very difficult. People need to be face to face, or rely on existing remote communication technologies such as the phone."

"There are problems with this kind   of networked collaborative technology.

Having spoken to other systems people there are not many companies who have implemented this new media and new tools effectively. Most of the companies have tested them and implemented them in isolated departments within the infra system such as Marketing departments or laboratories, but no more than that. It is rare to find a company that has acquired this type of technology. Everyone is probably convinced that this is the way forward but is making little steps . . . The problem is not the technology; there is an organisational and cultural problem too. It would be OK if people had a good level of English and were open-minded. A good integration of this media must be supported from the management to gradually lead the older people to change as everyone in the past was scared by this type of manager who put his information in his drawer."

Approaches to IT implementation

Participants made observations about what VirtuOsi needs to do in order to implement a new IT system. One approach could be described as 'laissez-faire'; to provide the framework or parameters of a system and then let people work out their own ways to communicate. Conversely, another approach is to standardise and procedurise the system so that it is introduced as a 'fait-accomplis', where people are taught to use the system in a particular way. Another approach is for the IT system to be introduced incrementally, starting quite simply and evolving the system by showing people it's advantages, consulting them, supporting the system and making sure any new aspects are of benefit. VirtuOsi needs to demonstrate that such technologies will provide real benefits; if users see the need, VirtuOsi will not have to 'push' the technology.

"The 'pipe' approach to IT is to go in one end and out of the other. It's bureaucratic; you tell people to do things in a certain way. Instead, we need to provide a framework in IT for people to operate within, to define the rules and then monitor the way the system is used. There is no point imposing a particular culture or way of doing things. As long as you can make and send documents, people can find their own way of communicating . . . The VirtuOsi technologies need to be developed to show what is possible, so that people can wake up to the possibilities."

"As far as VirtuOsi goes, we do not want another set of quangos - it has got to be standardised, procedurised, and people have got to know what they are doing otherwise it very quickly grows into disrepute."

"The VirtuOsi project needs to start incrementally, with something simple and easy. You have got to demonstrate to people what the good is to them. So if I was to put a laptop on your desk, linked to the network, I need to demonstrate it would make your job easier, faster, whatever. IT

(departments) have an awful habit of installing things because they like to do it, both because they like the technology and they find it easy. How would you like it if someone came to you're desk and said 'As from next Monday that is how you send your messages, chum', without asking you, or supporting it."

"One thing I would say about VirtuOsi is let's not lose sight of the keep it simple principle, otherwise we will lose people's support. The other thing I would say is lets try and tackle it in small chunks."

"If the users do not perceive the need or the benefits of the system then they are not going to work anyway. I think that if they do, then they actually need much less support, much less push."

A further concern voiced over changes in the IT system was whether it should support the business system. There are various levels to this issue. If we consider the way people work, it was identified that some people are used to and like having paper copies, and there is a potential debate over whether IT should support this or seek to change it. At a company level, if collaboration and the sharing of information is not supported and encouraged, and part of the company vision, then can and should the IT system support it?

"I would like a clear vision of where we are going, and a clear understanding that we are working together, a team working type culture, that we do not need to be threatened by one another, that we are working together and value each others contribution to achieve that. We need information systems to support that . . . Better decisions come from having a better IS system, and access to more information."

"We need to sort out business systems, and get the technology to support that."

"If we have a virtual office and a virtual factory, will we have virtual profits? We are under the hammer for performance every day."

Issues associated with implementing a new IT system therefore include the level of managerial support, the extent to which the technology brings real benefits to the way people work, how easy it is to use, how acceptable it is to end users, how standardised or flexible the system is, whether it fits with the organisational culture and to what extent it supports the business system. It became clear in the interviews that there was concern over whether technologies fit the way people work within BICC, both in terms of how

people do their jobs, and more broadly how the business is run.

The Pyrotenax Factory pilot

As well as exploring user issues at multiple sites, it was necessary for the VirtuOsi project factory pilot to find specific sites within BICC Cables for which new computer technologies could be designed and implemented. A situation was needed in which a small group of factories could immediately benefit from the new computer technologies. The scenario needed to be meaningful and contained, as opposed to attempting to connect a multitude of sites at the pilot stage of the VirtuOsi project. The sites needed to be in different countries, and people needed to be willing to use the technologies to work collaboratively.

I identified a scenario during the course of my research that met the needs of the VirtuOsi project factory pilot. BICC Pyrotenax is a division of BICC Cables, manufacturing Mineral insulated cables at four sites in the UK, Canada and Australia. Mineral insulated cables are specialist fire-retardant cables used for wiring that needs to continue to function in a fire, such as fire alarms, sprinkler systems, and elevator cabling. They are also used for thermocouples, and have domestic uses in cold climates such as Canada. They are laid in pavements around hospitals and residential care homes and wound around water pipes to prevent water freezing.

Engineers in Pyrotenax factories have all developed their own in-house designed machines to make the cables, and products are tailored to specialist markets. People in Pyrotenax factories commented that they had more in common with Pyrotenax factories in other countries that with Energy and Communications Cables factories in their own countries. People felt that they would benefit from more collaborative work, but were limited by the expense of international travel. The Pyrotenax factories therefore provided an ideal scenario within BICC Cables, and were all visited in addition to the other sites participating in the study.

Interviewees at Pyrotenax factories could see the benefit of using collaborative technologies for sharing expertise, and for having access to data on specifications and procedures. Potential problems are whether the benefits of collaboration would justify

the costs of such a system, and the problems of timing meetings with people who are in different time zones. A cynical view of getting factories involved in the VirtuOsi project is that they can get computers out of it.

"Having connections with Pyrotenax in Australia and the UK would be of more benefit as they make the same product. We could access information on the same problems . . . We have built several machines in house because we are making a specialised product. We have a lot of expertise and knowledge in this place that could be shared."

"MIC has set up a working party, one of only three in BICC. They have identified that they would benefit from sharing expertise."

"Basically the practical thing from our point of view is to gain instant access to company procedures and specifications. It might be that common courtesy has to be observed in that you don't just delve into their systems because of the security aspects anyway . . . We are the only site that have a marketing department on site. Australia haven't, nor Canada and I know from my visits to Canada there is a communication and understanding issue there. So we are talking about going across the top of that in whatever way might be . . . VirtuOsi represents an opportunity to get decent hardware without too much of a struggle."

"It would be useful to correspond in terms of quality issues between Pyrotenax factories . . . Years ago, rather than lumping us in the stranded cables group, it would have been better to amalgamate Pyrotenax. We need to bring our marketing departments back to the factory, so people are knowledgeable and dedicated to the sale of the product. We need to co-operate with other Pyrotenax factories."

"This sort of thing would be useful, but I'm not sure if the costs would be justified. I saw something in Canada, came away and I thought and asked them to send me a video. They actually brought me one the next time they were over here and it didn't cover what I meant. It would have done if I had been able to say 'Can you leave it there whilst he finishes the cable as I want to see how he takes the cable off the machine.' To see a thing in motion, to visualise the problem . . . What time of day would the videoconference between the UK, Canada and Australia be? You could do it to some extent on the telephone. As it is I sometimes have trouble getting one of them. But to get all three! Its very difficult."

"It bothers people that the name of its plant, its identity changes. People like BICC, they know it's a good company. They like it being in the UK because its removed, the further away the better. But the strong sense of 'Pyrotenax' as a group of four factories being lost. This tendency to standardise places, to make everything like a McDonald's simply doesn't work at Pyrotenax. Plus, we are in a different business,   a niche market. We do not like being

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grouped with other dissimilar factories . . . It would be useful to have contact with other Pyrotenax factories, but it doesn't necessarily have to be personal contact, just information about their costs, what they are doing, their volumes. But it does need to be topped up by personal contact."

One important issue concerning the possibility of collaboration between these sites is that at least two of the factories compete for customers, which makes collaboration more difficult.

"We have clashed over customers with Canada, which makes it awkward thinking of sharing ideas. . . Canada export to the Japanese market, but as far as European Sales are concerned, they are committing suicide without a great deal of help from us . . . If something goes wrong, one lady handles export sales who is snowed under."

"Competition between Canada and us has been such that one customer commented 'You guys are fighting one another and I am amazed BICC has allowed it to happen, to knock 10-20% off prices over the last three to four years by fighting amongst yourselves. For us it has been wonderful . . . There is no point in having one large efficient Pyrotenax factory, as you would lose on freight charges, duty costs and stocking costs . . . I think that if we got good responsive manufacturing locations on three continents you are probably going to give a better customer service. But that requires people to share ideas and I think it would be uncomfortable for people to know this is the case."

"I would need to clarify with my boss how much of my hand I could show to Canada about something under development."

One Pyrotenax manager and several Australian managers outside Pyrotenax at data and electrical cable factories raised doubts about the suitability of the Pyrotenax factories as pilot sites for the VirtuOsi project. They commented that the factories manufactured a mature product, and that there was little scope for innovation in mineral insulated cables.

"We are not a dynamic business - how much do we really need to meet?"

"With running a trial with Pyrotenax, I think it is too small and too quiet. The product is mature and the manufacturing systems are mature. In the UK they have developed a hi-tech way of making the product, but I cannot see the technology being transferred over here. By the same token, the mature method is not going to be transferred back here to Australia. At Pyrotenax, the system is not going to be seen by many people, and our IT experts will have to travel out to it. "

"I find that very surprising that we may use our oldest plant, even though to us it is highly profitable, but it seems like (Pyrotenax) has got the least opportunity to really gain anything from the sort of technology that you are suggesting."

The Pyrotenax scenario therefore meets the needs of the VirtuOsi factory pilot in terms of scale, relevance and the desire to access information. However, there are problems in terms of the extent to which people are prepared to collaborate and how much they will get out of exchanging information. Competition within Pyrotenax may well be a stumbling block, although one could conversely argue that new technologies might facilitate collaboration and improve the situation. Pyrotenax may also be too small to support IT implementation, and due to manufacturing a mature product, the scope for collaboration may be limited.

BROADER ORGANISATIONAL ISSUES

Having addressed present and future IT requirements, issues of IT implementation and the Pyrotenax pilot scenario, it is appropriate to consider broader organisational issues that may effect the development and implementation of IT systems. Broader organisational issues involve statements made during the interviews that do not directly concern IT, but were raised by participants during the course of interviews as having an impact on the acceptance or rejection of IT. Such themes emerging from the interview data include strategy, collaboration, management and communication. It is timely to repeat that IT systems are not introduced into a vacuum; research has shown that organisational and cultural factors have an impact on their acceptance or rejection (e.g. Zuboff, 1988; Legge, Clegg and Kemp, 1991; Knights and Murray, 1992).

There was a plethora of interview data that added richness and context to my understanding of what is happening within BICC, and was relevant to what VirtuOsi are aiming to achieve. I felt it was important when researching a new phenomenon such as the virtual organisation to evolve a holistic view of the issues that might affect IT implementation, and 'keep the channels open', rather than limiting myself to looking specifically at IT in relation to managerial power and control, for example. I have attempted to draw out key themes that are relevant to the VirtuOsi project, rather than getting swamped down in trying to explain the complex dynamics of the multinational

organisation and its constituent parts. I would like to reiterate that each factory I visited had a different history and culture, and not all of my observations will apply to all factories. One could also argue that these themes are personal to BICC, and that I might have elicited different results from a different organisation. I do not dispute this; the nature of applied qualitative research is that one gets immersed in a specific setting, mine being BICC as the factory pilot for the VirtuOsi project.

However, these issues are presented in the spirit of trying to establish the broader organisational factors that need to be at least born in mind in a project such as VirtuOsi, that is developing a vision of the virtual organisation. Not all will apply in all organisations considering going virtual, but the fact that similar observations were made by interviewees at twelve different factories in seven different countries, albeit part of the same company, lends some weight to their generalisability.

Strategy

One issue associated with the implementation of a new IT system is whether it fits with the corporate strategy, the vision and goals developed at a corporate level to guide organisational development. VirtuOsi is developing *collaborative* technologies; underpinning their development is a belief in uniting sites in different countries, and facilitating the exchange of information, interaction and collaborative working between those sites.

If there is disparity between the corporate strategy and the VirtuOsi vision, it seems less likely that the technologies will *fit* the organisation or be supported and accepted. Furthermore, there may be a gap between the corporate strategy as expressed at Head Office and what is happening within the organisation. This resonates with Schein's (1983) argument that the espoused culture of a company need not necessarily correlate with its actual culture. If the VirtuOsi vision does not fit with what is happening at present in the company, one could argue that this is not necessarily a major stumbling block, as long as it fits with where the company is *heading*, accepting that the way people work will change with new technology. If however, there is no commonality between either the 'present state' or the 'desired state' of the organisation and the fundamental objectives of the IT system, then VirtuOsi and what it is trying to foster

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seems mismatched to the organisation. Either the IT system must change, or the organisation.

Another interpretation might be that there needs to be a *misfit* between the IT system and the real organisation if organisational transformation is to occur, rather than reflecting traditional work processes in the IT system. This raises a number of questions: Does the VirtuOsi vision fit with the espoused corporate strategy? Do people believe that the corporate strategy tallies with what is happening in BICC? Does the VirtuOsi vision fit with what is actually happening in BICC? The first two questions are addressed here, whereas answers to the last question are sought in effect throughout the last part of this chapter.

What signs are there that the VirtuOsi vision fits with corporate strategy? The BICC proposal for VirtuOsi cites Sir Robin Biggam, the CEO, as saying in the 1995 annual report that "BICC must strive for a more coherent international identity", showing a degree of fit between the VirtuOsi vision and the BICC corporate strategy. Furthermore, there has been a company wide teamwork initiative, aiming to increase flexible working and collaboration within factories. This suggests that collaborative work practices are being encouraged within the company, and that technologies supporting this might well *fit* with what the company is trying to achieve.

A further positive indicator is the MBE programme, where the performance of factories is assessed according to a number of criteria, such as scrap, completion of order in time, etc. League tables are then created, and factories can see their relative position within their sector. The MBE programme has made factories in different countries more aware of the existence of and performance of other factories, as results are circulated throughout the organisation. It does not seem to instil competition, however, as factories are benchmarked against their own previous performance, rather than compared with other factories. The MBE programme is another sign that BICC is trying to move from a collection of autonomous newly-acquired factories in different countries to a more cohesive, mutually aware international group.

> "MBE is OK and does not instil competition as the factory is measured against its own baseline to improve performance."

"From the MBE programme we get statistics about whose scrap rate is better or worse than others; what we need is a dialogue about *why* one factory has a high scrap rate - problems need to be shared and solved."

"The MBE programme is a company-wide initiative. There are half a dozen measures allowing benchmarking. We need everyone to participate with the same ownership and spirit."

What strategies for change are apparent in BICC? People talked of a process of rationalisation and centralisation; and of changes in structure, with most factories moving to a flatter structure with less managers. Generally, most factories have changed in similar ways, with greater automation of cable production lines, often associated by participants with job cuts, and a movement towards greater flexibility in the work force, breaking the traditional pattern of people having one job on one line. The centrally driven initiative of team-working has led to devolving responsibility to teams and initiating line-orientated and cross-functional teams. Such changes in work practices have been accompanied by teaching factory workers new skills in training programmes.

Despite common experiences of change at different factories, participants felt that BICC Cables did not have a 'coherent international strategy', talking of a lack of vision, and about there being a lack of communication of corporate strategy through the organisation.

"We at the centre should provide a shared vision for the international company. . . We need to improve co-operation and identity. The average man on the shop floor does not know BICC."

"BICC is like an old man trying to cross a busy motorway. It is a large, slow to move, unwieldy, inflexible conglomerate."

"We do not have a vision of where we are going to be. We have a number of slogans. We do not have the vision of how we are going to get there in practical terms. What we have is a lot of targets and a lot of whip cracking that you will achieve this but there is no cohesive strategy for achieving the target . . . I think the key problem for all large organisations like ours is how to get the communications. It is how you share technology, how you get the true economies of scale by giving wide spread utilisation of your competencies and we do not have any strategy to manage that at all . . . At the moment it is not clear what the BICC strategy for Europe is. Are we going to be the biggest cable maker, are we going to steal the market share, are we going to be the most profitable players in Europe? If we collaborate with Spain, is that so we can get the best ideas from Spain and the UK into one factory and then close the other one down? Or is it

so that we can make two strong factories with increased output, hence increase market shares? So this makes people nervous, because nobody knows whether it means we are going to be closed down or whether we are going to be much stronger as a company. If we are clear about what we are trying to achieve than it might be a better basis on which to frame collaboration "

"The problem here is that people do not really know the long-term objective - where are we going, where will we be in 5-10years time?"

"(The Canada Head Office) know what they are planning, but they won't tell us. It makes us unsettled and people don't work so well."

Some participants raised the issue of hidden agendas within BICC - why head office might support the VirtuOsi project and say they want to be international, if indeed they really do, what the reasons are behind wanting people to collaborate using technologies such as those developed in VirtuOsi. This suspicion of the VirtuOsi project and more broadly of the espoused versus actual strategies within BICC manifested itself in a cautious reception for myself as I visited factories. People wanted to know if I reported straight back to Head Office, whether the research was really about collaborative technologies, whether I was a student or consultant; a suspicion that things were not as they seemed on the surface.

This political view of BICC was affirmed by my own experiences with the BICC Multimedia Group. As I learnt more about the company that I was conducting my research within, I was given a breakdown of who was in power, what changes would happen in management, and whether the people in power would be supportive or dismissive of VirtuOsi and what it was trying to achieve.

"We want to ask Hemel Hempstead and BICC why they want to be international, why they want us to communicate. If they want an international organisation, it does not just happen automatically - nothing can be assumed - they need to *do* something. What is the motive, the agenda behind it? They may say they want to be international, but mean something else . . BICC may mean and want to be international, and exploit the opportunities that being international affords. For example, the exchange of information is crucial in shortening product development times. But, there is a dilemma over whether factories are small, stand alone businesses that are accountable or whether they are part of a centrally driven organisation."

"In essence BICC originate in the UK, it has a highly political internal set of relationships and

the idea of emanating from there that there is going to be trust and sharing is a bit hard to believe . . .."

Centralisation vs. Decentralisation

One particular strategy that might have an impact on the acceptance or rejection of the virtual organisation is that of centralisation, where certain functions such as sales and marketing have been centralised, with departments no longer at each site but instead based at the head office of each country. This is balanced by BICC allowing factories "a certain degree of responsible autonomy", as one factory manager termed it. Whilst factories have been largely left to be managed locally, albeit with the centralisation of certain functions, each factory is now 'accountable' to head office, with information going to and targets being issued from the centre.

> "We report to BICC in a certain way, they introduce efficiency programmes, they request information. . .The MBE programme has meant that we have more contact with head office."

> "If I were MD of BICC I would leave independence to different companies around the world; but ask them to follow the guidelines of HQ. Guidelines are not as strong as they should be. BICC needs to give reference points."

> "Acquired businesses have been left as self-managed entities. Decentralisation may not be appropriate in the future as BICC strives to maximise facilities. We don't need two factories in different countries if just one is more efficient. We are starting to look at things and change the structure. Co-operation and co-ordination is required for international tenders. This does not fit with how it is at the moment in separate countries. In this scenario the VirtuOsi project fits as a way of sharing rather than enforcing best practice across the group."

Several participants commented on the tug between centralisation and decentralisation, referring to information going to the centre through a 'middleman' or 'bottleneck', as opposed to moving in a circle, and to the balance between being a large multinational versus small autonomous units that know their market. This whole versus part issue is reflected in the debate of how to structure the virtual organisation in terms of the search for information. Is information centralised in one common virtual database with broad access, or should each factory have its own database, with varying degrees of access? It is a question of who has ownership of the data; does one view factories as autonomous units that might wish to protect their own interests and restrict access to other BICC

members, or is the virtual organisation centrally controlled?

"With centralisation of functions we've seen a big change. You don't have the continuity of information - its hard to plan as we don't know about orders; you lose the feel of the business, and it doesn't give a lot of leeway to get geared for what you need in raw material."

"Ever since we joined BICC there has been a steady removal of status from the local environment to the head office. It is not so much the powers, its the status that was taken away. If you allowed yourself to become a person that didn't make any decision without reference to somebody else then you would say the power had gone. But trying to get a decision out of people at corporate level is impossible - it slows us down."

"We long for the days when we were independent. BICC has connected us with other factories and forced us to do certain things - this has generated negative strong feelings."

Identity within BICC

In the interviews, participants saw BICC as a "serious" "world class" company that "cares about cables". Whilst many participants spoke positively of being part of BICC, many felt more identification with their own factory than with BICC as a multinational group. Because they have little contact with other BICC sites, factory workers tended to identify more with their own factory, whereas managers tended to have more awareness of the BICC group. Clearly, in the context of the virtual organisation, issues of identity take on a new significance as they touch on how the virtual organisation should be designed if it is to be accessible to all users, so that it does not alienate certain levels of the organisation or the diverse cultural groups within BICC.

"People only feel they belong to GGC - it is only when they go outside of the factory on visits that they get more involved with BICC. Inevitably a broader view of BICC is limited to managers."

"The lower levels still see individual factories whereas managers see BICC as united."

"Identification with BICC is rising, with the international graduate programme and more e-mail contact."

"This company does not feel 'international'; it is UK driven and there are too many barriers. A

coherent national identity is missing, let alone a world identity."

"We all know that we are part of a BICC group but most people think that they are just part of Ceat-Cavi."

In terms of a fit between the VirtuOsi vision and the corporate strategy, there seem to be signs that BICC is seeking to promote a broader awareness of the BICC group, and enhance collaboration between factories. Some participants perceive a lack of corporate vision or strategy, however. The tensions between centralisation and decentralisation within BICC reflect a dilemma over whether the virtual organisation should be centrally controlled or dispersed in its structure. There is also a lack of shared identity within BICC, which may influence the desire to look outside the factory and collaborate. Conversely, the virtual organisation may well present an opportunity to give members a shared vision or *visualisation* of BICC.

Collaboration

The rhetoric of the virtual organisation is that of a collaborative virtual environment, where people can meet, work together, exchange ideas and information. Rather than assuming that this is desirable throughout BICC, I sought in the interviews to understand collaboration as it exists (or not) at present within BICC, whether future collaboration is desirable and what are the potential obstacles to technologies that facilitate collaboration. From the interviews, it became apparent that there are two ways of conceptualising collaboration within BICC; collaboration between factories and collaboration within factories in the form of team-working.

Collaboration between factories

Existing collaboration between sites can be seen as the forerunner to future collaboration between sites using new technologies. It is the reasons why people work together, and why they might not wish to, that are crucial to the virtual organisation and its legitimacy. People already work collaboratively between sites, although the frequency and scope is often quite limited and varies from factory to factory, depending on knowing who to contact and having shared interests. As well as providing a way of meeting and searching for information, the virtual organisation could assist in identifying who to contact and

who has shared interests by providing the user with more information about other factories, who does what, and what projects are in progress.

> "We have difficulty in building up contacts. I see it particularly from a production point of view, we are not good at building up contacts with the technical specialists all over the world. . . We never learn to share problems as we do not have that informal communication, so that we can clearly identify a issue common to factories in different countries. We can then set up a meeting or something, do something about it - shared expertise to solve the problem. But we are not good at spotting the issues."

Many felt that a lot of good has come from collaboration between factories, such as integrated R&D, optimum utilisation of resources such as buying and selling cable making machines, learning from other engineers who manufacture the same products or use the same machines, sharing expertise and ideas on best practices, and collaboration on quality and environmental protection.

> "We have contact with other people in purchasing depending on their expertise. For example, we asked Zaragosa about the technical parameters of a new machine that they had experience of - its not only the machine, but the technology for people to handle it."

> "It takes 10 years for people to get casual with one another. The technology could be used to get people to make friends quicker and more effectively. . . Co-operation is limited at the moment. Factories look after themselves and do not help putting work one another's way."

> "Exchange of experience is fundamental - you may know everything of your company - the statistics, the theory; but not about a problem which was already discovered and is already in another unit. Talking with other people means you don't reinvent the wheel - there are many wheels being invented - maybe in Chester the wheel was invented two months ago."

One example of collaborative work between factories that has been successful to date is spending sabbaticals at other factories. People who had been on sabbaticals or who saw their value commented that they could then make personal contacts, learn about the ways things are done in other places, and develop a pan-BICC perspective, rather than only having experience of their own factories. One Italian participant was concerned that sabbaticals might lead to the erosion of local cultures rather than to the development of pan-European managers. Short visits to other factories did not necessarily result in collaboration, however. Rather than leading to sustained collaborative work, they were

perceived as 'industrial tourism'.

> "Ideally, as BICC is international, it would be good if one person from here could work in England. Improving my English, and a change of culture and situation is a positive step as you learn about them and they you."

> "People do not see the benefit of communicating with other factories because they feel like they belong to Zaragosa, or Italy, but they do not share a common sense that they belong to BICC, of the complete BICC group. . . . . From my point of view, to change the mentality of the people it is necessary to send the people of Zaragosa to the UK, and people from the UK to Italy or Germany or Spain so that people can understand each other . . . . We do not have the mentality of having a lot of plants everywhere and that *we* are a world company - it is the mentality that Spain cater for the Spanish market, the people in Italy cater for the market in Italy. BICC acts locally and needs to think globally . . . . What makes the open mind is to go out of your environment. I think that BICC should make six month sabbaticals compulsory."

> "The possible problem with sabbaticals is that you are not moving towards a pan-European culture; all you are doing is eroding the local cultures - you cannot underestimate the value of local cultures."

> "We have been to America to look at what is happening, and we saw some exciting things, but that is not collaboration and that is not gaining the maximum benefits from the shared confidences . . it is industrial tourism."

One potential hurdle to collaboration between factories is that participants questioned whether it is in their interest to collaborate within the BICC Cables group. Just as there are tensions between individualism and collectivism as teamwork is introduced within factories as discussed in the next section, there are also tensions between the desire for people from different sites to protect themselves, and to exchange ideas and collaborate. I repeatedly heard the concern that with the rise in optical fibres, the metal cable market will not grow, but only retract, and possibly have a finite life span. People were concerned that if they exchange ideas on how to make improvements, they might give their 'competitors' within BICC an advantage. If it gets to the point where BICC starts to make closures of factories making the same products, then those that have 'given too much without receiving', as one participant put it, may find themselves in the position where they are the ones to close. In such a climate there may be resistance to collaborative work between factories. One German Manager explained that 'In an

unstable environment, we would be inclined to pull up our drawbridges'.

> "We need to consider whether we would be better off with one big efficient factory or lots of little ones, to cut down on distribution and transport costs. . . Big purchasers are going pan-European or global. Our main competitor has one big factory. Market pressures are forcing BICC to manage the business differently. . . We are unlikely to achieve some of our targets without closures. If we cannot grow through volume of sales, or lowering prices, then we have to look at rationalising facilities."

> "To go and have a browse, see what is in there, see what papers people have floated on the subject. That would be very beneficial to try and get, to casually go and have a look, but to do that you have to break down a lot of the barriers and the insecurities. If someone suggested today Zaragoza could come and have a browse around the electronic network here and see what the issues are it would be very contentious."

Teamwork

The main factor that participants felt was contributing to greater collaboration and involvement within and between groups in factories was the management initiative of team working. The objective of team working is a central directive; in Italy I was told by one participant that "Mr Clark gave us a book 'The Wisdom of Teams: Creating the high performance organisation.'" Some participants felt that people have always worked in teams anyway. Others feel that the new 'version' of team working was not yet a reality.

> "Teamwork hasn't been the norm at this plant, but we are getting more of it happening as the training gets fully under way."

> "By giving people more responsibility and getting them to work in teams, they feel more important. They are involved in decision-making, if they want to be, and have a greater sense of ownership of the future of the factory."

> "We have started teamworking and greater collaboration since we joined BICC, but it is not yet natural'

The Negatives of Teamwork

There was some resistance to team working, and participants commented on a 'blame

culture' not being conducive to teamwork. People's natural tendency to put themselves first was matched in some factories by a tendency to pass the buck, blame and scapegoat others when there were problems within the team, as opposed to sharing the responsibility for finding solutions. This was especially the case when individual financial penalties were given for mistakes, and rewards were given to individuals for successes, both of which seem to reinforce individualism as opposed to collectivism. The threat of job cuts also heightened the tendency to blame others and go against the spirit of team working.

> "Everyone has his own work but when they finish its the duty of another. Everyone has their own little vegetable patch to protect, with little integration."

> "People have a loyalty to the team but also to themselves, so they might point the finger when things go wrong."

> "It is necessary to work in groups - to achieve results, it is not the efforts of an individual. There is a tension between people looking after themselves with the threat of job cuts and working in a group."

> "Getting teamwork going is difficult when people are trying not to lose their own job, every other guy is a competitor. If I work with him and give him my knowledge, he may get better than me and have my job. It is not good for the atmosphere here. Management need to motivate and give security."

Cross training has accompanied the team-working initiative, aimed at increasing the flexibility of workers. There is a move away from factory workers having one job on one line and people are being cross-trained so that they can work on other lines or in other teams. However, some participants associated cross-training with a concealed desire to cut jobs on the factory floor.

> "People are being cross-trained here so jobs can be cut . . . The idea of multi-skilling is to do the same amount with less people; everyone is running around, but you're not actually getting one job done adequately. Some parts are working and some are not."

Some drew attention to the fact that teamworking is encouraged on the factory floor but is not practised by managers, or corporately. Some felt that too much time could be spent in teams when people had their own work to do.

"Managers work as individuals whereas employees work as teams - its a case of do as I say, not do as I do."

"Our management style is still very hierarchical and very much along rigid lines. 'Do as I say not as I do' . . . there have been instructions to do team working in the factory but no effort to do true team working above the shop floor, literally . . . Team working is about being open and honest and telling people what we are trying to achieve and making them understand why we are trying to achieve it and then setting all the minds of the business focused on achieving that goal. Now we do not do that corporately."

"I don't believe in an excess of teams in the company - you don't have the time and have to get on with your own work. We create a team a day until we forget how many we have created, where 90% are the same people. We should have a 'menu' of teams."

"Teams should be part, not all, of the working day. You need time to work, to think, to do, not spend all day in meetings."

It seems that increasing collaboration between sites is viewed as positive in theory, although some participants argued that for self-preservation, it may not be in their interests. Teamworking indicates a move towards greater collaboration at the factory floor level, although this becomes less of a reality in situations where jobs are threatened. Teamworking is also not seen as occurring at the managerial or corporate level.

Management

The virtual organisation relies on management devolving responsibility for the exchange of information and for communicating with other factories throughout the organisation. Just as at a corporate level, the locus of control of information needs to shift from the 'bottleneck' of head office out to the factories, so too in the factory, managers have to adjust to communications not necessarily going through them. The virtual organisation implies a reconceptualisation of management, moving from control of information and rigid hierarchies to facilitating interaction between dispersed groups.

Throughout BICC Cables factories there seem to be similar efforts to make changes in management in recent years. People from different factories talked of a more open management style, that is more participative. Levels of management have been rationalised, leading to a flatter organisation. This change in management direction

contrasts with old management styles, which participants have described variously as 'controlling', 'paternalistic', 'non-communicative', 'powerful', 'resistant to change', 'individualistic' as opposed to 'team-oriented', and 'fire-fighting'.

> "There are too many chiefs and not enough indians; we need to move to more lean management."

> "Over the last 15 years there has been quite a shift. It has gone from an authoritarian hierarchy to a more level playing field encouraging workers to take responsibility. In one sense its what you wanted all along but on the other hand its much more difficult to control."

Some participants felt that whilst the changes in management were positive in theory, some managers had not in practice changed their approach. Participants identified that it might be a problem for some managers to devolve responsibility for decision-making and to pass on information that they are used to keeping to themselves. Some talked of older managers being less flexible than younger managers; of there still being a tendency for managers to be defensive of their power. In Italy and Spain in particular managers themselves talked of there being little change in management style, with operators and managers not being ready for a less formal style of management as it marked a lack of respect. One Italian manager claimed "When managers walk through the factory, it is like a visit from God."

> "Some managers do not share information because they want it to remain their decision, so no-one can move or give a suggestion. They are blocks in the company . . . Managers work as individuals whereas employees work as teams."

> "Some managers are reluctant to give away power and responsibility to teams. I think it is natural to fear a loss of power through delegation."

> "The leader controls and he knows what goes on in his area and he can make decisions and direct work . . . I want to enlarge my activities and become a more influential manager."

> "Some of the factories on the continent, such as in Germany and Italy, have more formality of structure. In the UK it is more flexible and less hierarchical, yet there is still some class structure and status symbols. Executive dining rooms have been abolished, yet this was more because they were financially unviable rather than the company being egalitarian . . . In the UK, there is a growing recognition that the man on the shop floor has a lot to offer. This view is not widespread on the continent."

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It may be, therefore, that the openness of communication and devolution of responsibility implied by the virtual organisation is not apparent in the management of the real organisation. This raises issues over whether the virtual organisation requires new management activities if it is to be a radical transforming force.

Communication

The virtual organisation implies an openness of communications, both between various levels of the organisational hierarchy and between functions. If users are to work in the virtual organisation, they should be allowed the appropriate levels of access to information to facilitate collaborative working. To repeat the phrase coined by Zuboff (1988), employees need to be 'informated', to have access to information and to be given the responsibility to act upon that information. Communication is intimately related to collaboration; it is the sharing and exchange of information and ideas that is envisioned in the collaborative work environment.

Communication issues are broadly split into two categories; horizontal communications across the factory, between departments, lines, shifts, divisions, and vertical communications between employees and management. Improved communications was seen by participants as related to team-working.

Horizontal communication

People identified good or increasing communication and co-operation between shifts, cable lines, and departments.

> "With shifts, people come in 10 minutes early in their own time to talk about problems - that goes for everyone from the line manager to machine operator. There is good co-operation between shifts."

> "If there are problems everyone helps each other across departments because without the other departments you can not proceed with your work. If one line is busy and another quiet, people help one another without being asked now."

Less formal forms of communication such as gossip and rumours play a major part in the communication of information and misinformation across the factory.

"Our communication does not really work; people always get the very important information from the underground."

"There is the rumour kitchen; that has not changed from when it was a Kombinat."

Vertical communication

People talked of improvements in the formal communication system, in getting information from management to staff more effectively. Some employees felt they were kept well-informed by management, some commented that they would not know if they were kept well informed, whilst others talked of the inconsistency of messages from management. Participants made a connection between management styles and vertical communication, indicating that some managers still desire to control the communication of information to other levels. This has ramifications for the virtual organisation, in that if factory workers are to be encouraged to share information, factories need to devolve responsibility for communication, rather than have a traditional command and control approach.

"Some managers believe information is power and don't want to share it."

"All the managers of the different departments give information to the general manager and he redistributes this information back down the line."

In terms of the reverse flow of communication from factory workers and administrative staff to management, people generally felt there were inadequacies, both in terms of the climate being right to express ideas, and the extent to which the communication of problems and ideas is attended to and acted upon. Examples of comments include:

"Management know from statistics that we are using too much material, but they would never come down and ask why . . . Managers are not interested in people's opinions. Workers are there to receive orders."

If you want something to change you put yourself at risk. At meetings no-one says anything. If you complain, you might be the next person to lose their job."

"There is no point going to the upper level with problems - they do not listen . . . Information changes at each level. At every step there is less information and at my level we don't know anything."

"Managers are not interested in people's opinions; they don't ask - people are there to receive orders. It's paternalistic - 'I know what is best' . . . Employees do not really have the chance to be involved - there are decisions imposed from the top."

"We need to improve communications between factories and hierarchically. People on the factory floor operate the damn things day in day out, and they know what is going on down there. They can tell us a lot more probably about faults and improvements."

In sum, the broader organisational issues identified during the course of the research remind us of the organisational context into which IT is implemented. Issues of strategy, collaboration, management and communication all emerged. The next chapter looks at the development of the virtual organisation; moving from contemplating the 'body' into which the system is implanted, to consider the 'organ' itself (Mowshowitz, 1976).

CHAPTER 7

DESIGNING THE VIRTUAL ORGANISATION

In the previous chapter, the focus was on the *real* as opposed to the *virtual* organisation. The current state of information technology within BICC Cables was reviewed. User requirements for future technologies were considered, and organisational factors that might have a bearing on the acceptance of new technologies were identified. Now our attention turns to the development of the virtual organisation, as it has evolved through the course of the VirtuOsi project. The rationale behind an investigation of how the virtual organisation is being designed is firstly to understand what new ways of working and interacting virtual reality technologies make possible. More fundamental, though, is a desire to understand what constructs the designers have of the virtual organisation. Will the virtual organisation of the future be an extrapolation of present notions of organisations, the old organisation revamped in electronic form? Or is it conceptualised as a radically different organisational form for which there is no precedent? The research questions posed by this strand of the research were:

- What is the present 'state-of-the art' as regards CVEs and associated collaborative computer technologies?

- How do designers conceptualise the virtual organisation?

This chapter presents the technological developments achieved during the project. It draws on VirtuOsi reports and documentation, participant observation during the course of the project, and unstructured interviews with designers. Multimedia and virtual reality technologies were developed, abandoned, added in, and taken out. The virtual organisation was not a fixed single virtual space with clearly defined and agreed upon features, but a changing environment that evolved throughout the project. The flexible, fluid and adaptable characteristics of the virtual organisation are something that some designers believe should be maintained to some extent when the virtual organisation is

implemented within organisations, so that the interface can be adapted to the needs of the user[1].

A source of insight about how the virtual organisation will work and *enable* collaborative work was afforded by the opportunity to observe a live, real-time[2] international meeting between academics working in the virtual reality field conducted in a virtual meeting room. Although this was a meeting between virtual reality experts rather than the organisational members that are to be the end users of the virtual organisation, observing the virtual meeting greatly enriched my appreciation of what working in the virtual organisation will be like. I have therefore recounted the experience as a means of bringing the reader into the virtual world.

The VirtuOsi project was about proving the feasibility of the concept of the virtual organisation, rather than about developing technologies that could be implemented throughout BICC Cables. Whilst the project was more about development rather than implementation, the Pyrotenax factory pilot that I identified as a scenario for the VirtuOsi project reached the stage where prototype technologies were introduced at the Pyrotenax factories. I had the opportunity to visit the Hebburn factory in the UK whilst the new technology was being installed, and it was possible to get some feel for user response to the technological developments, which are presented in the final section of this chapter.

THE ARCHITECTURE OF THE VIRTUAL ORGANISATION

The architecture of the virtual organisation concerns the virtual space created by the designers in VirtuOsi. I shall recount some of my own forays into cyberspaces to give the reader some sense of what it is like to experience virtual reality. Descriptions of the virtual reality systems developed or used in VirtuOsi are given here, as well as technical requirements and some principles for movement within that space. Descriptions of the networked virtual environments created in VirtuOsi involves discussion of some of the metaphors developed for the virtual organisation, such as the virtual meeting room and

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[1] For a fuller discussion of subjectivity, see the later section Subjectivity vs. Objectivity

[2] Real-time means that systems exhibit no discernible delay between input and output - between user action and system response.

the virtual factory. Virtual environments that have yet to be developed but are on the drawing board are also elucidated. Interaction in virtual spaces between users will be addressed in a later section, as here I simply aim to describe the stage for interaction rather than the play itself.

What is virtual reality like?

My first experience of virtual reality occurred when I went up to Lancaster University Computer Science Department to visit some of the academic members of the VirtuOsi project. One of the PhD students had developed a way of constructing virtual spaces with relative ease, by using window options to choose the size and colour and dimensions of virtual spaces or objects. Therefore, in a matter of minutes I had a shell of a room, a block for a table, a block for a filing cabinet etc. Optional extras such as house plants and photos on the desk are not available yet. I then had a look around the BICC Hellsby virtual office flythrough that they had constructed as a demonstration of what was possible with the system. The office looked very basic and block-like, with name plates on desks, but I recognised its layout from my visit to the physical office. It was suggested that such an environment could provide a way for a virtual visitor to locate people that they wished to contact.

Having played 'construct a virtual office', I asked if there was something I could play on with a head mounted display and joystick, rather than going round a virtual space with a mouse. I donned the gear and was suddenly flying over Norwegian Fjords, dipping over mountains and circling water towers. The virtual environment I was in is a flight simulator used by the Norwegian Air Corps for training. Objects in the distance were blurred but as I approached them they became more detailed. There was an immense sense of freedom and space as I swooped over trees, fulfilling childhood dreams of having a birds eye view of the world. The world was quite cartoon-like, with a uniform vibrant green for grass and a cloudless blue sky.

My senses were filled with what I was experiencing visually in the virtual world, and I had to do a 'reality check' and remind myself that my physical self was sitting in an office in Lancaster whilst my virtual self was flying over Norway; an odd experience that literalises the saying 'to be in two places at once'. The headgear was pretty heavy, and every slight movement of my head swung my field of vision round, something we do not

experience in the everyday world as our eye movements compensate. This became pretty irritating, as I wanted everything to stop jiggling around. I was not very good at controlling the joystick, and was feeling slightly the worse for wear that morning and pretty swiftly felt giddy.

In contrast to this rather trippy flythrough first experience of cyberspace, I was rather underwhelmed when I saw the virtual environments developed by Nottingham and Lancaster Universities at the first VirtuOsi meeting I attended. I was initially sceptical, having a rather disappointed 'Is that it?' reaction. The environments were basic graphical representations of spaces, and do not have the feeling of immersion or slickness of most computer games. They were black spaces with white lines receding that defined the boundaries of walls and ceilings, giving the user a sense of being in a contained space rather than floating in an infinite black virtual universe. User representations or avatars were represented by blocks or geometric shapes as illustrated in Figure 7.1.
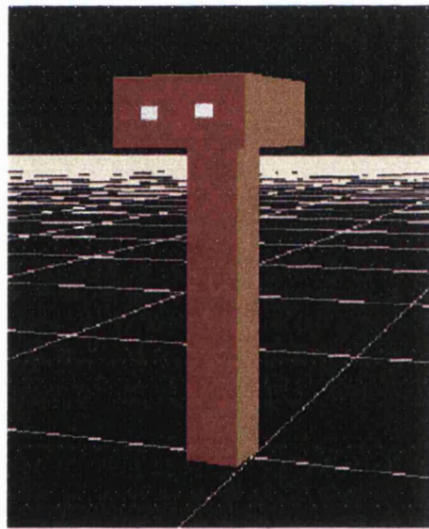
Figure 7.1: A basic virtual environment with an embodiment

However, my initial doubts were quelled by Steve Benford at Nottingham University Computer Science Department who explained two reasons for such simplistic prototypes. Firstly, the more complex a virtual environment, the more rendering is required, or to put it simply the more computer power is needed to change and store the images. Every time the user changes their view with an input device such as a mouse, the computer must update the image fed back to the user. In the initial stages of development, it was necessary to keep things simple to avoid the computer crashing and to allow exploration of the   limitations of such an environment.

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By starting simple, objects and detail could be added later. The addition of further facets of the environment could be informed by research into what users need, providing a balance between keeping things simple to avoid overloading the computer and providing sufficient detail for the environment to be meaningful to the user.

Secondly, the academics were keen to explore the principles of cyberspace design, and so flash graphics were not a necessity. The academics were used to such basic environments, and were not concerned at that point with designing them for a wider audience. One of the academics commented "The graphics are the easy part; we have lots of principles and modelling to resolve first". Benford (1993) explains that the design of virtual environments is important because 'the structure of virtual spaces will clearly impact on the nature of work within them' (Benford, 1993: 1). Having described my initial experiences in cyberspace, and the deceptively simple appearance of early virtual environments in the VirtuOsi project, I shall go on to briefly detail the multi-user virtual reality systems used for the VirtuOsi project, before describing the virtual reality environments developed to support co-operative work that such systems make possible.

Constructing Virtual Environments

The systems used to construct virtual reality environments in the VirtuOsi project were dVS (later to be issued as dVise for Windows NT) developed by Division Ltd in Bristol; DIVE, developed by the Swedish Institute of Computer Science (Carlson and Hagsand, 1993) and MASSIVE, a virtual reality system that can support tele-conferencing developed at Nottingham University Computer Science Department (Greenhalgh and Benford, 1995). With all these systems, a virtual world is encoded as entries in a distributed database in which the same information is relayed to all participants in that world. These systems can be thought of as a memory shared over a network with different processes (computer activities or entities) interacting. These processes interact by accessing the memory concurrently and sending signals to other objects or processes.

Various environments have been designed in VirtuOsi using these systems, varying from the simplistic spaces I described earlier in the chapter to detailed environments designed around metaphors such as rooms and organisations. Techniques such as texture-mapping mean that virtual environments can be made more detailed and realistic. Texture-mapping means that photos or video data are stretched onto virtual objects, tables and

walls, so that they look more real. In considering making the virtual world more realistic, it is appropriate to bring some limitations to attention. From the factory and fashion pilots I have observed it is apparent that the more detailed the environment, the slower the view of the virtual world is refreshed, becoming too slow for movement to look real time.

According to one of the virtual designers in the fashion pilot that I interviewed, there are not adequate mathematical models to represent movement in cyberspace. So, for example in the fashion pilot, embodiments walk in a jerky way, and cloth does not flow. It is not possible to spin and bend in a garment, and for the embodiment and cloth to move naturally. The material is therefore in templates, with the sleeve as two tubes that bend artificially at the elbow. Reality is *simulated* in virtual environments, but no user would be convinced that they are fully realistic. Reality in virtual reality is not yet a reality, if you will excuse the pun.

Accepting these limitations, in theory, spacemakers are only limited by their imagination and by processing power in designing worlds. I suggested to one designer that given the freedom for design in virtual worlds, conducting a meeting under a waterfall might appeal. He laughed at the suggestion, saying that it was silly, and would not be appropriate for business. I asked him to explain what *would* be appropriate for business, and was met with a blank look. This episode bothered me, and it took some time for me to clarify why I had a nagging anxiety about it. It appeared that he was thinking about the virtual organisation within a certain frame, without freeing himself to radically different alternatives for work and organisations afforded by the technology. He was also sceptical about the investigation of user issues, seeing it as premature as the technology was still in its developmental phase. The attitudes that he expressed were not uncommon within the group. So, the designers seemed to be making assumptions about what was and was not appropriate for the virtual organisation, without concern for *grounding* its development in user issues, and conversely without considering new *ground-breaking* possibilities. What was guiding the development of the virtual organisation? As will become apparent in this chapter, a fascination with new technologies rather than their application seemed to be underpinning some of the design process.

Steve Benford of Nottingham observed at one VirtuOsi meeting that ". . . if the abstract representation is not meaningful to   users, it fails." The extent to which

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the designers succeeded in adopting a participatory approach to design is returned to in the next chapter. The metaphors developed during the VirtuOsi project included the virtual meeting room, the virtual factory, the virtual organisation and the virtual catwalk. As this thesis draws on the factory pilot, the fashion pilot will not be detailed here, although some mention is given later in the chapter to the development of virtual fashion models to illustrate the development of embodiments within VirtuOsi.

The virtual meeting room metaphor

The virtual meeting room might be considered the building block for the virtual organisation. In video-conferencing, a conference has no intrinsic existence, no location. With virtual reality, the conference, embodied as a world, is given an independent existence - out in the network. Stanger (1993), a virtual environment designer in the Virtuosi project, explains that the rooms metaphor is particularly powerful because:

> 'Rooms provide a natural intuitive environment, immediately recognisable and comprehensible to the user. Furthermore, there is a natural extension to larger logical structures, such as virtual buildings, or even virtual towns and cities. Large companies might choose to restructure themselves as predominantly virtual organisations . . . One can also imagine consultants or individuals with in-demand specialised skills linking their personal virtual working environments with a corporate environment for the period of a short term-contract.'

> (Stanger, 1993a: 3)

I had an opportunity to spectate on two live virtual reality meetings through the course of VirtuOsi[3]. I watched both at Nottingham University, sitting and observing the interaction between users from different locations on one of the participant's computer monitor. The first was held in MASSIVE on 28th March, 1995, and participants visited a virtual meeting room, which was connected via gateways to other virtual spaces which I shall describe later. The meeting involved real-time interaction between nine participants who were distributed across five sites and three countries (Germany, Sweden and the UK). According to many of the participants, this degree of international participation in a virtual reality meeting was a 'world first'. They were all meeting to discuss progress in the COMIC research project in which they all participated, and to explore the possibilities of having a group of dispersed users in a virtual space.

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[3] A video of the meetings and other clips is submitted along with the thesis.
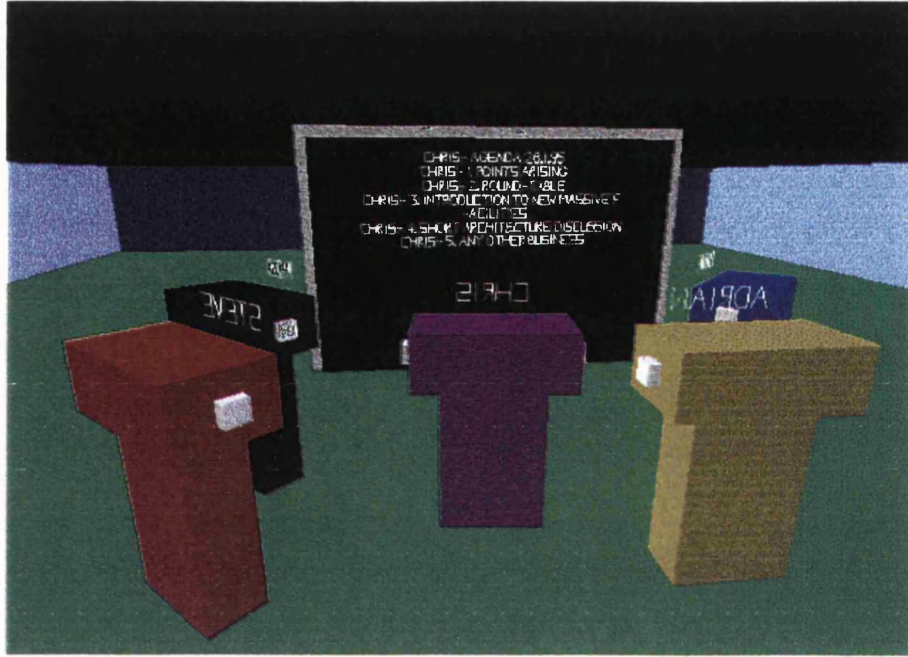
Figure 7.2: Virtual visitors gather around the text board

The virtual meeting room 'appeared' to be the size of a squash court or a bit bigger. Inside the virtual meeting room there was a text board, so that messages could be typed if the user did not have an audio link, as shown in Figure 7.2. There was also a large red box in the room, that appeared to be the size of a wardrobe. This was a text-to-speech translator which would translate the text typed in to it into a hard-to-decipher computerised voice, so that those who did not have audio links could still communicate orally to some extent with the group. There was also a conference table that people could stand around, affording the best view of the whole group.

The participants all entered the virtual space at the agreed time, having confirmed the time and agenda of the virtual meeting via e-mail. The participants were all represented by Blockies, basic user embodiments with their names on top. Initially, users milled around and chatted to one another. Moving around the virtual meeting room requires a fair degree of skill, and even experts who design virtual environments appear to find it tricky. Users can use the keyboard to navigate forward, back, left, right, up and down. The keyboard can also be used to change the user's view point, from eye level, to over shoulder, to birds eye.

After everyone had arrived, Steve called the meeting to order and invited everyone to the text board, where he put up the   agenda   for   the   meeting.   There

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followed a five minute presentation, where Steve talked and the others stood around listening, as one would in a lecture. After Steve had concluded his presentation, by joking "I need never meet people in the flesh again", the group disbanded and started to talk informally. It was quite hard to identify who was speaking and to whom. People took cues from the mouths of the embodiments which moved when users talked, and the participants also relied on familiarity with each other's voices. Steve then suggested that the group should try doing some simple collaborative exercises to familiarise themselves with moving around and interacting in the virtual meeting room.

One of the first exercises to be attempted was forming a circle. The users found it hard to adjust their positions whilst everyone else was also moving about, without a focal point such as a table. In the real world, people have a strong sense of personal space. People make eye contact, shuffle, and avoid bumping into one another or invading one another's space. In cyberspace users appeared to be awkward and clumsy and slow to manoeuvre. When one person shifted position, so did his or her neighbour but sometimes over-compensated. Moving to fill in gaps in the circle or make the circle even only made things trickier.

Lennart from Sweden crashed about like a toddler, going through other embodiments (talk about walking over somebody's grave!) and walls, then marauding through the circle in the other direction, much to the amusement of the other users. His embodiment then lay down, his computer crashing. The user from Germany kept re-entering the virtual meeting room through the walls or ceiling and then 'ghosting', or fading out, so he did not participate that much in the group.

Steve patiently tried to encourage everyone into a circle, and taught them the rules of 'Bunnys', a drinking game that Steve referred to as 'Bunnoids'. Lennart stuck both ears up and would not take them down, flouting Bunny law. "I've got it right, haven't I Steve?", John asked in a singsong voice. The group then tried standing around a virtual conference table, which proved a lot easier than trying to form a free circle. Conversation moved on to the football results. When the phone rang out of virtual world in real Nottingham office, or when a user had to talk to someone in the flesh, the virtual embodiment was made to lie down (see Adrian's embodiment in Figure 7.3 below). This was interpreted either as the user being temporarily unavailable or possibly bored,

suggesting ambiguity of protocol and gestures in this new environment.
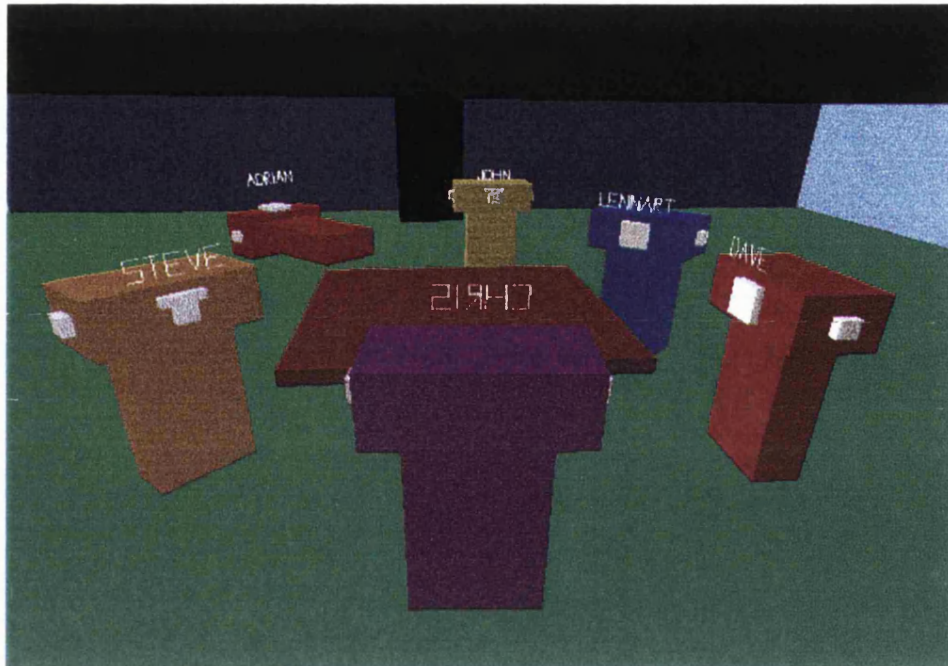
Figure 7.3: The virtual conference table

The group then went to explore different virtual environments that could be reached from the virtual meeting room by gateways. The user suspends traditional ideas about 3D space, as the new environments are neither 'next to' nor 'above' the virtual meeting room, but appear with a 'whoosh' when the user passes through the gateway. One of the virtual environments in MASSIVE is the 'sound hall', an environment constructed to explore audio possibilities in virtual reality. The user can approach objects such as bells and hear sounds, which change according to the user's orientation and distance from the object.

The second virtual meeting I observed occurred about a year later. This involved a meeting between several academics at different UK universities and members of the BT Research and Development team to check progress on joint projects. Again, Steve chaired the meeting. The embodiments were more detailed, and those with videoconferencing facilities had real-time video faces on their embodiments. The users seemed to be more skilled at moving, and turned to face the person that they were talking which acted as a cue. Two embodiments were the same yellow colour, and were mistaken for each other by other users despite the name tags above their heads.

A further environment next to the virtual meeting room was an abstract 3D landscape that users could float around to see the progress of project deliverables. The group were doing network logging trials for traffic on infrastructure between sites, as systems supporting virtual reality kept crashing. Data was represented in the virtual space in the form of interactive 3D graphs, that the user can float around, viewing the data from different angles. Data that would be represented on 2D graphs is modelled and comes alive in virtual reality. Towards the end of the meeting, the graphical and textual media crashed, leaving the participants to communicate via the audio link, like teleconferencing. Three people had quick points to make, almost like post scripts to the main meeting.

The meetings that I observed were fairly informal, because the academics all knew one another and had worked closely together in the past. This meant that rather than getting stressed or awkward when computers crashed or people's audio links got faint, people found the situation amusing. I could not envisage such informality between people who had not met in the flesh - it would probably be hard to meet virtually for the first time. People relied on recognising one another's voices, and it might help if people became more exaggerated in turning to another user when they were addressing them, as a further cue. Having more personalised embodiments would also help, as at a distance similarly coloured embodiments were hard to tell apart. Bowers et al (1996), a group of social scientists involved in the VirtuOsi project, also spectated on the meeting, and referred to the problems of turn-taking, and co-ordination of movements. They affirmed that the design of the virtual world has an influence on social interaction, as introducing a meeting table made it much easier for people to see the whole group and co-ordinate their talk. They also advocate the 'keep it simple' approach, not adding to the simple embodiments unless research shows it supports social interaction.

The text board helped to order the meeting and focus people's attention, and to counter audio distortion. The text-to-speech translator did not appear to be such a hit, as it was very hard to understand. The 3D graphical displays were quite impressive to look at, but I was unsure whether they were any more helpful than looking at 2D charts. However, if users needed to interact with and manipulate abstract data, I could imagine that it would be quite useful. Although the meetings were quite informal and between people who already knew each other, they were constructive and collaborative, and assisted in the exchange of information within the group. However, the interaction is by no means as

intuitive or easy as face-to-face communication. Users were constantly entering commands into the keyboard, either to move around, or to change their view, or to give the system further commands. The meeting was quite demanding although exhilarating for it's designers, and several in Nottingham commented that they were quite tired afterwards, with all the competing demands on their attention. Having illuminated the process of interaction in the virtual meeting room, we shall go on to explore the virtual factory metaphor.

The virtual factory metaphor

Several versions of the virtual factory evolved during the course of VirtuOsi. I shall initially describe the factory photo-walkthrough, which I participated in designing. This is not strictly a virtual reality environment, but instead a guided 3D photographic tour through a factory, where the user can navigate along production lines, have close ups of machinery and access information on machines and procedures. I will then describe the virtual factory developed by Nottingham University Computer Science Department, and based on the Volume Cable Unit at BICC Pyrotenax in Prescott. Finally, I will describe the BICC Global Virtual Factory (GVF), devised in collaboration between the BICC Multimedia group and the Stent Foundation.

The factory photo-walkthrough

A precursor to being able to walk around a virtual factory is the photo-walkthrough. This is a series of photographs of a factory that are constructed on a computer programme in such a way that they can be navigated through, so that the virtual visitor can see the layout of the factory and look at close ups of machines. The idea is that factory workers at remote sites will have an opportunity to become familiar with factories at different locations, which they would not be able to visit. By providing information that is linked to photos of machines, users can learn about how things are done at different factories. This may facilitate greater contact and collaboration between sites. For example, a user can phone someone at another site to discuss a cable-making machine with a picture in front of them, so that they are familiar with the process without ever having visited the other factory.

I have participated in constructing a photo-walkthrough of a Pyrotenax factory in

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Australia. The process of constructing a photo-walkthrough involves taking photos using a tripod and camera, following the production process through the factory. Along the factory 'route' there are points of interest, such as a cable making machine or a fork in the path where the process goes on to another machine. At each of these points, four photos are taken at 90° angles to show the view in front, behind, and to the left and right (this can in principle be increased to 8 photos at 45°, to fill in detail 'in the corners'). Close ups of machines of interest are taken, and details of their local names and functions are noted after consultation with workers in the factory. At each fork in the walkways around the factory, photos are taken to allow the user to chose which direction to go in. The points of interest and the forks in the factory walkway are marked on a factory plan. The photos are subsequently put on CD-ROM, and the factory plan constructed by computer into a 3D environment that you can navigate around. It is possible to use a computerised camera so that the photos are scanned automatically rather than a post hoc transfer to CD ROM.

I conducted the photo shoot of the factory, taking 3 days to map my way around what is in relative terms a small and simply laid out factory. Even though I had explained the purpose of the photo-walkthrough to all factory workers, I still got occasional looks of bewildered amusement as I staggered around with camera, tripod and clipboard.

The resulting photo-walkthrough, as compiled by Bob Hornor back at BICC Multimedia Communications Group in England, was stunning. Bob had had a hard time constructing the walkthrough. I had sent the photos off to be put on CD ROM in strict sequence. This had not been done and photos arrived with Bob as a 'shuffled pack', in random order. Bob had telephoned me, and I tried to help him sort out the photos by describing key views and machines in the photos, and relate them to the factory plan which he had. There followed a frustrating hour long phone call, along the lines of 'Look for the yellow walkway across the drawing bench; near the turquoise drawing drums.' Bob had never visited a Pyrotenax factory before; I had never tried to construct a virtual factory. It was a case of the blind leading the blind. We made some progress when I described the factory process, what happened at which points, the shape of machines and where the outer doors of the factory were, but decided that I would have to come up to BICC Hemel Hempstead.

I visited Bob expecting a massive task on my hands, but was amazed at how far Bob had progressed. I only had to tidy up the edges, place some photos without a home within the virtual factory, and give some names and explanations for the machines of which I had taken close ups. I was amazed at how real the walkthrough looked, and how it fitted with my mental picture of the factory. What was more incredible was that Bob, through constructing this virtual factory, knew its layout as well as I did, without ever having visited. He had explored it in cyberspace as I had in real space. We went through the walkthrough together, and I rearranged the order of some photos, telling him to make the turn into the cable testing booth more sharp, and that there should not be a path at one point as it was impossible to cross the factory there and he was effectively walking through the drawing bench like a ghost through a wall.

When I entered the photo-walkthrough, I arrived at the entrance of the factory and saw its name on a sign, and the manager smiling next to it. I had taken photos of people during my visit, not asking factory workers to move out of the way as I felt it was important to not feel that one was entering a desolate factory. I entered the factory at the powder chamber, which is where the process starts, as calcium carbonate powder is heated and dried to remove all moisture. I went in a virtual lift up to the fillers, then down along the weighing line, to the suagers and the drawing benches. When I double-clicked on a machine of interest, Bob had a series of close ups come up, with the labels and technical detail I had written down in the factory. To move around I clicked left or right, front or back on the compass superimposed on the view of the factory. It was also possible to click on a plan of the factory, and be teleported to that point and orientation, and to swing round lollipop-shaped hotspots to change your view.

It is a rather jerky way of moving around a virtual space, with pictures of the factory being discreet and separate but flowing together like a Moving Image machine on a pier, giving the feeling that you are moving through the factory. Rather than moving about a 3D space, such photos could also be inserted into a *virtual reality* environment using texture mapping, to give a feeling of immersion, of being *in* a factory rather than flicking through ordered photos of it. One possibility to make the construction of a photo-walkthrough easier considered by the BICC Multimedia group is using a robot to take photographs. As the robot bumps into things it automatically changes direction, so that slowly a catalogue of photos is built up. This would save the effort of a person having to

take photographs of the real environment, and the robot could conceivably make its photo rounds nightly to provide up-to-date photographic data.

The photo-walkthrough is a precursor to a virtual reality environment; a 3D environment in which one can familiarise oneself with other factories. The next section deals with two virtual reality environments, one of which is multi-user, that explore the virtual factory metaphor.

The Virtual Pyrotenax Factories

The virtual factory developed by Nottingham University Computer Science Department was based on the Volume Cable Unit at BICC Pyrotenax in Prescott. Dave Snowdon from Nottingham had visited the factory, and with factory plan in hand, had devised a prototype for the virtual factory. It included opaque virtual walls, ceiling and a floor that were in proportion to the dimensions of the factory. Dave had put in the A-frame beams in the ceiling which helped to gain perspective and orientation. The Volume Cable Unit machine was also represented by a series of geometric shapes that moved, with cylindrical drums spinning, flames flickering under the annealing chamber and a long cooling gutter. There was a video wall along the virtual factory wall, so that the visitor could have a videoconference with users or experts at other factories, using video and audio links to communicate. Multiple users could visit the factory simultaneously, meeting and talking in the virtual space.

A number of further features were being considered. The visitor's understanding of factory processes could be improved by real-time video views of factory processes, either by people using tie-pin cameras or video camera trolleys on the factory floor. The virtual factory could be texture-mapped with photos of the real factory to make it appear more real. Ideally, in the virtual factory as with the photo-walkthrough, it will be possible to click on machines to see videos or data concerning the functioning of the machine, specifications, the supplier and local experts. The virtual factory that Dave had designed was presented at a VirtuOsi meeting, and was immediately identifiable to me as the Volume Cable Unit at Prescott Pyrotenax factory. I was at that point the only other member of the VirtuOsi team to have visited that factory, so Dave looked quite pleased, and quipped that he would pay me £5 later.

Dave's Virtual Pyrotenax factory can be contrasted with the BICC Multimedia group / Stent Foundation Global Virtual Factory (GVF), which is a Superscape[4] virtual environment based on what could be termed an 'aggregate' of Mineral Insulated Cable factories. The GVF is generic, and if users were to want detail they could look instead at photo-walkthroughs of each factory. Having viewed the Australian Pyrotenax photo-walkthrough, and visited the two Pyrotenax factories in the UK, the designers constructed the GVF using geometric shapes to include features generic to Pyrotenax factories, such as powder-drying ovens, fillers, drawing benches, annealing ovens, cooling gutters and coiling drums. These could again be clicked on to access information about the machine or the home pages for who was responsible for it, giving co-ordinates (where they are, what they do). These machine representations were arranged in a serial fashion that was not anchored specifically to the layout of any one factory, but would be familiar to any factory worker who was familiar with the *process* of making mineral insulated cables. A version of the GVF was implemented at a factory in the UK, and this is described at the end of the chapter.

The two virtual factories were equally sophisticated in terms of graphics and the degree of accuracy with which they conveyed the cable-making process. The difference was that the Nottingham factory was a *multi-user* virtual environment in which people could interact. The GVF, rather like the photo-walkthrough, is a place to visit to familiarise oneself with the Pyrotenax process, but it is not an *interactive* virtual environment - you cannot communicate with other users as the GVF is not networked. The GVF does, however, utilise multimedia applications so that by clicking on a phone icon in the virtual environment, the user can phone people, and by clicking on an in-tray, one can access the persons e-mail address. These facilities take the user out of the virtual factory and to the virtual organisation, which is discussed in the next section.

The Virtual Organisation metaphor

So far, we have considered the metaphor of the virtual meeting room and the virtual factory. We shall now move on to consider the virtual organisation, a superordinate virtual space that might incorporate these other spaces. The virtual organisation can combine a myriad of features, but essentially it allows people to find each other, meet,

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[4] Superscape is a 3D virtual reality modelling package.

communicate, and share information as they might in a real working environment, without the constraints of geographical location. Bill Inglebright (1996: 47) comments:

> 'Virtual reality technology will be used to enable users to move around with the organisation being represented as an abstract virtual factory environment. This will allow the users to share the same mental model of the organisation and with the ability to navigate through the organisation from the overall entity to a specific person or factory. . . This will enable the user to find the right person to talk to with regard to training, trading of expertise and trouble-shooting'.

Two virtual environments developed in VirtuOsi can be considered as exploring this metaphor. One is the Global Virtual Factory, and the other is the Nottingham Virtual Reception Area, which are described below.

The Global Virtual Factory, as described above in the 'Virtual Factory' section, also has a commercial area, so that the user can not only view the production process in the factory but also contact commercial people throughout BICC. Features in this area that the designers were playing with when I last visited the BICC Multimedia group were to divide it into functional areas or offices such as Sales, Marketing, R&D, and Quality Control. Distributed databases could be accessed from each area, containing documents and files stored on computer throughout BICC. Each section could have a map of the world on the virtual wall, so that people could click on the country, and then the factory that they needed to have contact with. Similarly, people could search for the appropriate contact with a directory, or a virtual organisational chart. The main idea is that the commercial area in the GVF is a *gateway* to the real organisation, a way for the virtual visitor to find and communicate with real people and share information more easily than at present in BICC.

As I have already stressed, the GVF is not a networked virtual environment and is only a prototype, so none of this is possible yet. Nottingham, however, made further progress with facilitating a multi-user virtual organisation. They developed the metaphor of the Virtual Reception Area (see Figures 7.4 and 7.5), which combines a number of useful features that 'mix realities', bringing the real organisation into the virtual organisation, and vice versa. Organisations spend a lot of money making their reception areas look good. The reception area is a meeting place, a source of information and advice, and allows security through observation and awareness. The visitor to the virtual

organisation enters the virtual foyer which combines visualisation, embodiment, video and audio. Access to the virtual organisation is controlled by the virtual receptionist, who, after taking your name, can clear you for access to certain areas, or check whether the person that you need to contact is available. The receptionist can control access to the virtual space and to databases with firewalls, that effectively keep unwelcome visitors out. 3D graphical shapes represent web sites and information.
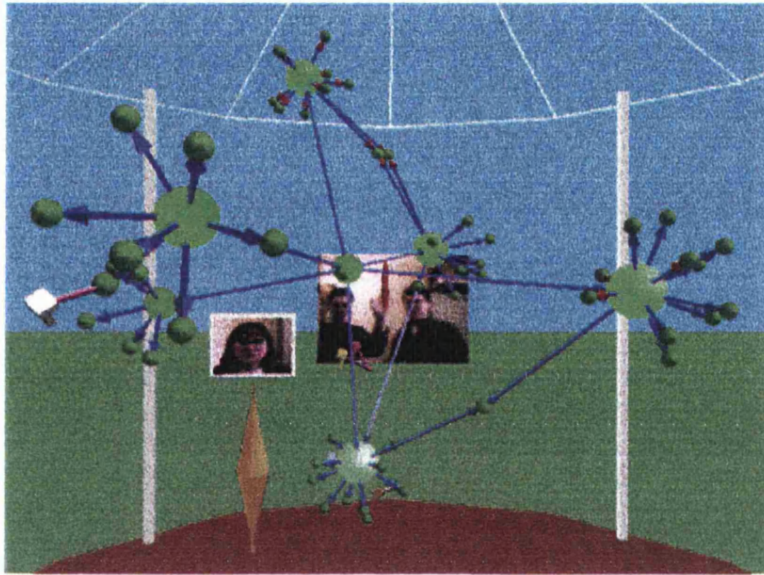
Figure 7.4: Viewing the real foyer from the virtual organisation, with yellow embodiment with a video face in the foreground.

A screen in the virtual reception area shows a view of the *real reception area.* Conversely, the real visitor in the real reception area sees the virtual foyer, visitors and web sites via a projected interface on the wall of the real reception area and using a mouse or joystick can navigate around, and chat to virtual visitors with audio links. The real visitor is herself embodied and can see the embodiments of other virtual visitors. Those that are immersed in the virtual world have detailed humanoid representations and have video faces. Other visitors who are visiting the virtual organisation on-line from Netscape and are accessing the databases, but that do not have audio or visual communication technologies available, are less detailed and buzz about like little geometric flies. The virtual visitor can look out into the real organisation's foyer via the camera, and communicate with the receptionist in order to approach real people in the real organisation.
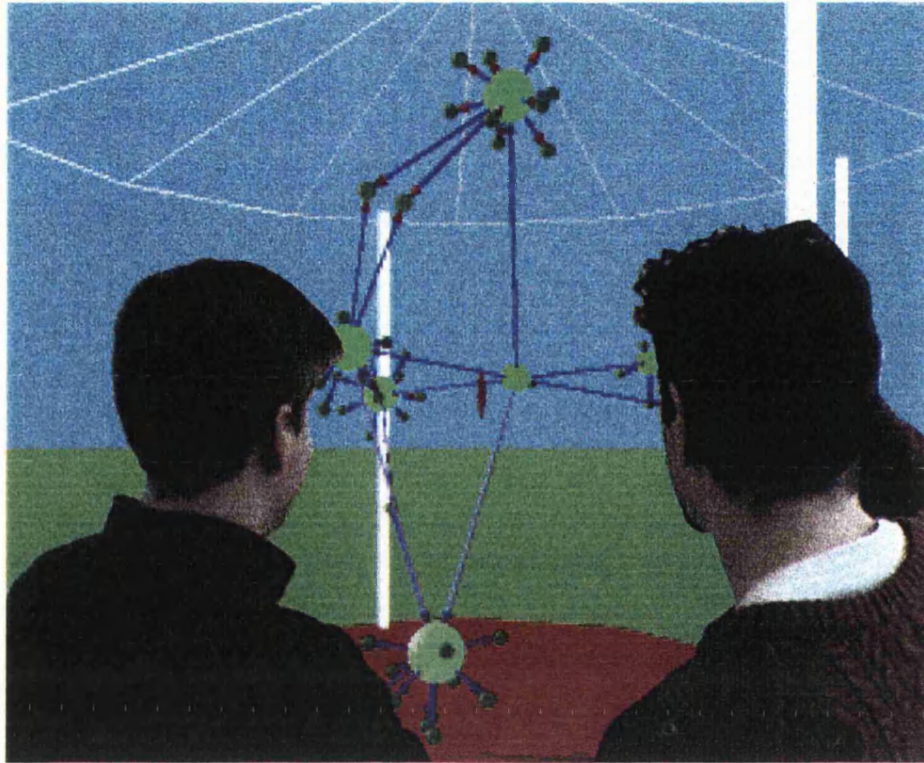
Figure 7.5: Viewing the virtual organisation from the real foyer

The positive thing about this virtual foyer is that it provides an interface between real and virtual organisation, and provides an intuitive and natural scenario for visiting an organisation that people are familiar with. It also allows the receptionist to screen visitors, and prevents visitors having direct access inside the organisation. This deals with some of the problems of privacy within the virtual organisation, and controlling access. The security afforded by the virtual reception area is an important feature, as is the way it facilitates the meeting of virtual and real visitors. To revisit the idea of the gauze-like mirror in Lewis Caroll's *Alice Through the Looking Glass*, there is a view from the virtual world to the real, and vice versa. Whilst visiting virtual worlds, people continue to exist in the real organisation, where the phone rings, people pop in to the office, and the printer goes hay wire. This split of attention between real and virtual worlds has been addressed by the designers and is returned to in the 'Back to (and from) reality' section.

USERS IN VIRTUAL ENVIRONMENTS

This section addresses users in the virtual environment; the representation of users, the degree of subjectivity given to users to change the virtual environment, awareness of other users, the user in the real and the virtual world, and how to find other users.

Embodiments

Embodiments are graphical representations of the user in the virtual environment. They can vary in complexity from a simple block or arrow to a detailed avatar with a video face superimposed to show the user as he or she talks. The complexity of representations affects single frame rendering and latency, the time lag between a user's action or movement and the systems response. If embodiments are static, they can be as complicated as you want. Users are normally embodied in a collaborative virtual environment as artifacts; this supports the sense of self and presence, and facilitates interaction and co-operation between users by communicating presence, location and identity (Benford et al, 1997).

Stanger (1993b), one of the VirtuOsi designers, observes:

> 'The user can have a self-propelled personalised representation in virtual space, so that users are directly aware of her position, directed attention and actions. This representation might be as simple as an arrow icon representing one of the user's hands, or as complex as an animated mannequin with an instantly recognisable, personalised face . . . (I)t is interesting to consider whether users will eventually want to mould their self-representations to their whims or even to the requirements of the application. For example, a car designer collaborating with other engineers might find advantages in representing herself as a drop of oil passing through a virtual engine . . Unfortunately, too much freedom to 'personalise' could lead to problems. A misleading self-representation could easily confuse other users . . . and there might also be thorny legal problems in relation to appropriating personality attributes from other people . . . One already hears about cases of fake personae on the Internet.'

In the MASSIVE virtual environments designed by Nottingham University, and shown in Figure 7.2, the individual is represented in the virtual world by a 'Blockie', a T-shaped embodiment that can lie down, blush, and point or get attention with two arms that go up or down. Above the head of the Blockie is the user's name, which as well as providing a means of identification also gives an indication of orientation. The text turns as the Blockie turns, and is seen in reverse   when the Blockie is facing away.

The T-shape of the embodiment is reminiscent of a person's shoulders, so it is possible to see what direction the embodiment is facing and what is being attended to. The Blockie also has a 'face', and the mouth moves when the user speaks with the audio link.

The colour of the Blockie can be changed by the user, and the facial 'blush' allows some expression of emotion; it can be used to get attention, or to show affect such as anger, irritation or embarrassment. It is rather hard to know what the user is trying to communicate when they blush, but protocols will probably evolve. When the user attends to something in their own real environment, the virtual embodiment can be put 'on hold', and appear to be lying down to others in virtual environment. If the users computer crashes, Blockie lies down or fades out of the wall or floor.

The user's view from his or her embodiment can be changed in three ways. The user can look out from eye level, which seems most appropriate when interacting and talking on a one-to-one basis. The user can also look out to the virtual world from above the head as though the user were on the Blockie's shoulders, which seems to be preferred in the meetings I have observed when interacting with a group. Finally, the birds eye view is particularly useful for navigating around objects and other users in the virtual environment, and for moving over distance as opposed to making small moves and turning.

The problems with the Blockie include a narrow 90 degree field of view, making it hard to see things on the periphery of one's vision, and hard to talk to neighbouring users who are standing either side. Despite the Blockie having a mouth that moves when the user speaks, it is hard to tell who speaking, so there is a reliance upon recognising people's voices. The manipulation of the Blockie in the virtual environment demands the users attention, as the user has to enter commands on the keyboard to make the Blockie turn, advance, etc. There is also poor sensitivity of navigation with the mouse control.

The Blockie changed through the course of the VirtuOsi project so that it was no longer a T shape and looked more human, having a head, eyes, a body, legs and arms. In some of the demonstrations I saw, the head had a video screen on it which showed the user's face (e.g. Figure 7.4). There is a lack of realism in virtual reality which might present a problem in persuading the uninitiated of its value. Blockies look like crash dummies, and video conferencing with others might be more convincing. Despite VirtuOsi aiming to

enhance interaction, the unrealistic representations may alienate people and be a hindrance to interaction. Trials with novices as opposed to experts would help to gauge a lay person's response. Whilst the academics insist that for development purposes, environments and representations must be simple, for commercial purposes it may be that convincing embodiments will be important.

In the VirtuOsi fashion pilot, a virtual mannequin is being developed to model the garments and cloth that the user selects. The walking mannequin, called Naomi or Jeff depending on the gender required, responds to voice commands, and will move forward, turn, raise an arm or walk back along the catwalk. Speech input is not easy because the system has to distinguish between the user's conversation and commands meant for the mannequin. It may help to press a button when the user wishes the speech input to register. The fashion mannequin looks more sophisticated than the Blockie, having a humanoid form and limbs.

Despite the computer graphics being more sophisticated for the fashion pilot, the mannequin cannot talk. Rather than the user being embodied in the mannequin, it is a slave to the user's commands, and is something objective and external to the user. This is similar to the idea of virtual agents, that can perform tasks for the user, delivering information or holding e-mails, but not strictly embodying the view of the user. The fashion mannequin can also be considered an object in the sense that the female version is an idealistic cartoon-like representation of a woman. I felt more identification with the less humanoid, genderless, anonymous Blockie than with the Stepford Wife[5]-like mannequin in the fashion pilot. The embodiment within dVS, Division's virtual reality software, is even more extreme with the same caricatured figure but with no facial features and dull shiny metal in colour. Rather like selling cars at a car show, it seems some virtual reality designers have opted for the cliché of virtual page 3 girls.

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[5] In the film *Stepford Wives,* all women in a town were replaced by automatons, who were designed by the menfolk to be 'perfect' in their eyes rather than individual.

Subjectivity vs. Objectivity

One of the dilemmas facing designers concerns subjectivity; how much scope they give users to modify their embodiments, their environments, and the embodiments of other users. Subjectivity is the ability to add viewer dependent features to a virtual environment. In almost any multi-user virtual reality systems each participant is given their own independent virtual body, and so their own unique viewpoint on the virtual world. This is our experience of the everyday world; as such, we expect people to be skilled at relating to viewpoints and reasoning about these kinds of subjective effects.

On the issue of subjectivity, Benford (1996) comments:

> '. . . the issue of subjectivity goes right to the heart of CSCW in that it reflects the unavoidable tension between the needs of the individual and those of the groups to which they belong. Thus, one might expect all applications to require a balance between the highly objective (too much of this and the individual loses autonomy) and the highly subjective (too much of this and co-operation becomes difficult). Of course, the balance point may well be dependent on the application and the group in question.'

Snowdon et al (1995) suggest that when considering large scale, long term habitation of virtual worlds, it may be useful to consider aggregate worlds which represent the combined views of many people. For example, if the majority of people subscribe to a common view then this could be identified as the *prevailing view* among these users and so acquire particular significance, e.g. as the default view for new users. Given a large and diverse community of users, there might be many factions each with its own prevailing view or views. If a historical perspective is introduced then users could be made aware of how previous users have chosen to construct worlds from given sets of data. Both public consensus and the weight of history can be employed to construct and manage worlds, especially when relating directly to other users.

The idea of allowing users to maintain their own views and yet being able to construct and reason about aggregate views enables an evolutionary approach to virtual world management. Under such an approach, users are free to construct their world view as they wish and may diverge from the prevailing view when appropriate. At the same time, maintaining awareness of the prevailing view and using it as a default for new users

encourages a general convergence of views, providing a sort of gravity or glue between users. In this way, different worlds may evolve through periods of convergence and divergence and the prevailing view will evolve with them.

The extent to which users of the virtual organisation are afforded subjectivity may be limited in communal spaces or databases, as these may be *corporate virtual spaces* with a fixed architecture. For example, it may be rather confusing if users could rearrange the virtual organisational charts of another factory. In this respect, the virtual organisation may not have the freedom of expression associated with and hotly defended on the Internet. However, the way in which people search or view data may well be flexible so that they can tailor the way that they *interface* with the virtual world to their needs without altering the actual architecture of the system. Users may also express their individuality in their personal virtual offices, or in their embodiments.

These issues of whether views are controlled or subjective touch on whether the virtual organisation is perceived as a democracy of hegemony, and are developed in the next chapter, along with the extent to which the virtual organisation has a pluralistic or unitary culture.

Mutual Awareness and Privacy in Virtual Environments

One of the key concepts to have emerged from the field of CSCW is that of awareness of each other's activity as essential to the co-ordination of interaction in the workplace and the smooth running of co-operative activities (e.g. Bowers, 1995). This proposes that, in addition to the ability to communicate directly, users of shared systems should be made generally aware of each others presence and activity. Direct communication between people incorporates a degree of intent. The key CSCW concept of *awareness* reflects the idea of unintentional interaction between people, including aspects such as bumping into one another, overhearing others, seeing out of the corner of one's eye and so forth. Although less tangible than direct communication, awareness is an important aspect of co-operation in the real-world. In many cases, it is the precursor to establishing more direct communication. Snowdon et al (1995) observe that such awareness is significant to enabling communication and to the general on-going co-ordination of work in real world settings, such as studies of real-world control rooms for air traffic control (Bentley et al, 1992) and the London Underground (Heath and Luff, 1991).

In virtual worlds, this notion of awareness implies that users should be aware of other users whose actions potentially impact upon their own. In order to avoid users making themselves invisible and sneaking up on others, the visibility of individual users is also preferred, as 'democracy depends on accountability which in turn depends on countability.' (Benford, 1993: 3). This implies that *all* users should be visible rather than the possibility of a 'spy' being able to spectate on a virtual meeting incognito.

In increasing user's mutual awareness, one must be careful not to shift the balance so that awareness becomes an invasion of privacy. With regard to the technologies being developed by VirtuOsi, some aim to assist in assessing the availability of a person. One idea that BICC are keen on is to have a camera on your desk as a status indicator, so that people can see whether you are in, what you are attending to, whether you are on the phone, in a meeting etc. Having cameras in the corner of a room may be extremely sensitive, and may give the impression that 'Big Brother is watching you'. Despite the view held by some members of the VirtuOsi group that 'people will get used to it and forget it is there', the majority of designers seemed to feel felt that people were unlikely to consent to it unless it was essential or of real benefit.

Unlike CCTV, where the justification for monitoring peoples activity is security and combating crime, there appears to be little reason to have a camera on full time in an office environment. People would not probably object to having a camera on their desk that they could switch on when they were holding a video conference, but the thought that anyone can observe your activities in your private office is crossing a fine line where ones actions can be monitored remotely. This brings attention to how technology can change the ethical dimensions of the organisation. Furthermore, being seen on camera sitting at your desk is not necessarily an indicator of your availability. Consider leaving the phone to ring so that the answer phone picks up the call and you can monitor calls. Just because you are in, it does not mean that you would like to be contacted at that time.

A different approach to assessing the availability of the person you wish to contact is by *rich fingering*. You 'finger' someone and see if they are available telephonically. This is possible because of the AP-IA server - Availability of Person - Intelligent Agent, which holds and monitors information regarding a person's availability by monitoring their equipment. This works by data   regarding your colleagues phone use

and status being fed back to your computer, displaying whether or not he or she has been contacted or used the phone recently. In effect you see a percentage likeliness of availability based on your colleagues telephone use. In principle, you could finger people based on computer use as well. Trials associated with monitoring phone use at one of the VirtuOsi companies apparently revealed who was organising the lottery that week and who was having an affair with whom in the office.

Mutual awareness can be increased by making fingering explicit; to finger someone or something in a virtual environment is to approach it, look at it, or contact it. If the fingerer leaves a fingerprint, then the user is informed of who has been hanging around or trying to contact them. As well as preventing spying and being a means of security, this would facilitate mutual awareness in the virtual world, providing a further means of finding other users that share your interests. For example, if a user had left their fingerprint on a particular set of files that were of interest to another user, they could then identify the fingerer and have a means of contacting one another.

An emerging area of research is contacting people who are on the move. Existing technologies include mobile phones, wireless computers, and modems so that you can plug in to any ISDN line around the world. One way of contacting people on the move is with Smart Buttons. These are worn or carried by people so that calls are relocated to them if they are out of their office. The effect in trials was that when people walked along corridors they were followed by a wave of ringing telephones in their wake. Smart buttons signify the end of fag breaks in the loo, as the smart button lets people know where you are. A heated debate has emerged around Smart Buttons such as Olivetti's Active Badge technology and the extent to which it restricts freedom of movement. Such technologies have an impact on the informal aspects of organisational life.

Awareness issues also arose in VirtuOsi when considering sharing media with other users. If, for example, users are having a video conference, it was suggested that as well as seeing the faces of other participants, one should also have a miniature view of what is on their computer screen. This would apparently help to appreciate what they were attending to, and some parts of their screen could remain private space only seen by the user. Several members of VirtuOsi objected to this, with one academic making the analogy of it being like wanting to see what notes everyone was making during a

meeting, did not facilitate collaboration and verged on paranoia.

Issues of awareness and privacy resonate with Zuboff's (1988) findings that computer systems could be a further source of managerial control and surveillance; recall her description of the Information Panopticon, where the activities of information workers become transparent to managers. Without adequate consideration of people's need for privacy, the kinds of information gathering and display made possible by the technologies being developed in VirtuOsi may be unacceptable to users and may result in users creating ways around them. One simple example of this occurred upon a visit to a UK factory where a camera was being installed on a computer in an open-plan office so that virtual visitors could videoconference with office workers, get a feel for the real environment and see who was available. I asked one office worker if they minded having a real-time video link in the office, and she wryly commented "If it gets on our nerves, we'll just 'accidentally' put a stack of paper in front of it". Another suggested placing the small plastic troll that sat on top of her computer right in front of the lens, adding "That will give them a good impression of what it's like here."

Back to (and from) reality

Although in the future people might inhabit and work in virtual worlds, they will continue to physically exist in the real world, where the phone rings and someone drops in to the office. People will be existing in two parallel universes - the physical and the electronic. Designers have considered how to address this split of attention between real and virtual environments. The first observation to make is that it may not facilitate interaction in the physical world to be fully immersed in virtual worlds; imagine someone at work trying to get the attention of a cybernaut in full head gear and datasuit. This relates to the issue of how much time we will spend in virtual worlds; participants in the BICC interviews commented that they would not use a system too often as they had 'real jobs to do'.

Using a mouse or joystick to navigate around a virtual environment that is displayed on a monitor may allow the user to attend to the virtual and the real world. This means that the user will still be aware of the physical environment whilst visiting a virtual environment. In the MASSIVE meetings that I observed, people walked through the computer lab, and asked questions of people trying to participate in virtual meetings.

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Trying to simultaneously hold a conversation in cyberspace and with someone at one's shoulder appeared to be quite tricky for the user. One possibility is not having a continually open audio channel, but instead pressing a button in order to speak in the virtual world. Mixing realities may be achieved in augmented reality, where the user is still aware of the physical environment, and has graphical data or images superimposed on to her 'real world view' by wearing transparent glasses or head-up displays.

It is also important to pick up on a point made when discussing the virtual reality meeting earlier in the chapter; meeting in virtual environments is quite demanding and requires preparation. In the meeting I observed, users were constantly entering commands into the keyboard, either to move around, or to change their view, or to give the system further commands. Bowers (1995) has emphasised how important it is to study 'the work to make it work'; all the multiple mundane tasks that are necessary to keep technology working, to 'oil the wheels', to keep things 'up and running', to manage all the unexpected contingencies that arise when good research ideas collide with workplace implementation. Ethnographers of the virtual meetings observe that:

> 'The virtual meetings in CVEs that we have observed are far from spontaneous affairs in that much planning and preparation occurs in advance of the connections actually being made and the virtual environment created as an arena for the meeting. The dates and times of meetings are planned by means of other technical arrangements (the research group's e-mail list), and on many occasions an agenda is drawn up in advance. Whilst procedures seen as necessary for the completion of a task such as 'holding a meeting' might be thought of as straightforward - simply turn up, listen and contribute where necessary - our observations of meetings held in CVEs lead us to contend otherwise drawing attention to the skilled judgement and effective co-operation displayed by those observed in the set up of the meeting. Indeed a great deal of collaboration between individuals in the real world is required in order to collaborate successfully in the virtual world.'   (Bowers et al, 1996: 24)

Much work is required in assembling the worlds and tending to them in the first place. Effort is also required to manage the meeting, and deal with interruptions from the real world. To quote Bowers et al (1995: 39)

> 'In short, CVEs may well support co-operative work; they certainly require it.'

'The work to make it work' needs to be manageable, and graphical, text and audio interfaces need to be juxtaposed such that technical troubleshooting can be supported

and social interaction problems repaired as they arise. The observed demands of setting up and managing virtual meetings does not mean that we should consider throwing the baby out with the bath water, and decide that the technology is too 'high maintenance'. All technologies require set-up, support and repair work. What is important is that such work is possible, manageable and proportional to anticipated benefits. This is the case for the academics observed in virtual meetings, but may not hold true for end users in commercial settings.

Searching for other users

Having considered the embodiment of the user in the virtual environment, and issues of subjectivity, awareness, privacy and competing attention, it remains to consider how the user might more formally locate other users. Several possibilities were raised during the course of VirtuOsi, based on existing forms of searching for people. One possibility is a virtual directory, where organisational members are listed and the user can search for people alphabetically, or according to location or function. The idea is to have a flexible system, where the user can change the way he or she searches.

Another possibility is having virtual organisational charts for each factory, showing the location of members in the organisational hierarchy, and who their co-workers are. Each node that represents a member could also display information such as documents authored by that member, and show links to other members that, for example, are co-workers on projects or share similar interests. It seems important that such an organisational chart be updated to reflect the fluid nature of the organisation.

A further way of searching for other users is by using Web pages, where a picture of the member is given, along with job title, contact number, nearest co-worker (in terms of physical location and also an alternative professional contact), and job description. Such details ensure that the searcher is as informed as possible before she contacts the person, choosing whether contacting someone else might be more appropriate. The added advantage of Web pages is that people can give their own links to other pages, showing their interests, colleagues or team membership. This raises the issue of how the member wants to be presented, and who they connect their pages to. Whilst members should be given some freedom in designing their home pages, this does not mean that they should over-state their job description for example, and managers may want to authorise Web

pages in a professional context.

All of these ways of searching for other users can incorporate the facility to contact or finger the user, either by phone, e-mail, video-conference or virtual meeting. By providing various communication media and mechanisms such as real-time audio, text and video as well as asynchronous devices such as notice boards, people in different locations can communicate in real-time or leave messages for one another. It is likely that having found a contact, the user will have a variety of media available for communication in the virtual organisation.

INFORMATION IN THE VIRTUAL ORGANISATION

We shall now move on to consider the storage, browsing and retrieval of information in virtual environments. The factory pilot ethnography focused upon the production, storage and use of documents within a Technology Centre, and argued that such documents must be seen as records within socially organised work activities. Metaphors for storing and searching for information include a virtual library, virtual filing cabinet, virtual database; possibly virtual 'anything' that one would conventionally use to store information. Some metaphors are more abstract, such as PITS, the Populated Information Terrain System (see Figure 7.6) designed by Lancaster University, and VR-VIBE developed by Nottingham University. A further possibility investigated by BT and GPT is the use of Brokering Services, a clearing house for information.

One approach explored by VirtuOsi could be termed an 'InterNet' approach. On the Internet, people can put their Web page along side other pages of relevance or importance or have hypertext[6] links to sites of interest. Similarly, information in the virtual world has an architecture of associations and links between people and databases. One of the early concepts within the BICC Multimedia group was a landscape of hypertext documents and people, whereby there is a current hypertext page closest to the user on the screen. Documents accessed previously recede below the new document, as

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[6] Hypertext refers to the automation of cross-referencing for information retrieval. Hypertext gives us the facility for following up 'associative links' between related items of information. Navigating around an information database in this way can reveal all kinds of new associations that may or may not entice the user along new pathways, enabling the user to follow existing hyperlinks, to link related items of text together, or retrieve cross-references in a non-linear and random access manner.

well as the associations with the authors of the documents. Possible future paths that the user might find of interest are activated, and the current status of authors is shown (e.g. on-line and available). The interface that the user uses is the Communications Control Console.

This system could be described as 2.5D, creating the illusion of being 3D, but without the spatial data to generate different views of that scene. 2 D is text which people are familiar with; 3D is a spatial architecture for storing documents, whereas hypertext is somewhere between the two. This system is designed on the assumption that a document-based rather than person-based searching system is preferable, and automatically omits those people who have not written documents. The plus side of searching for people through documents is that it avoids problems of people changing jobs or leaving the company; a document-based system is likely to be more stable that a person-based system. Alternatively, a hypertext organisational directory was explored, the problem with that being that it assumes enquiries for information are led by a search for the individual rather than for a specific document. As there are pros and cons to searching predominantly for people and for documents, a more flexible approach might be best, where people can search either for people or for documents.

In PITS (see Figure 7.6), there is a virtual terrain where the user can fly about to search for information. Information and people are graphically represented by shapes linked by nodes, rather like a chemistry model. This virtual environment provides visual and spatial associations between people and information; the closer two nodes are spatially, the closer they are in terms of inter-relatedness of content Benford et al, 1994). The user can use the names of authors and key words to search for documents. They can also fly through the terrain as a less formal way of searching. If someone is visiting a database, the user can see their representation and make contact. Benedikt's (1991) *Principle of Transit* suggested that travelling should incur cost to the traveller in proportion to some measure of the distance. This principle is interesting for PITS, as social interaction is promoted through flying around a terrain. In PITS, it might be preferable to dawdle and loiter rather than be transported to a document.
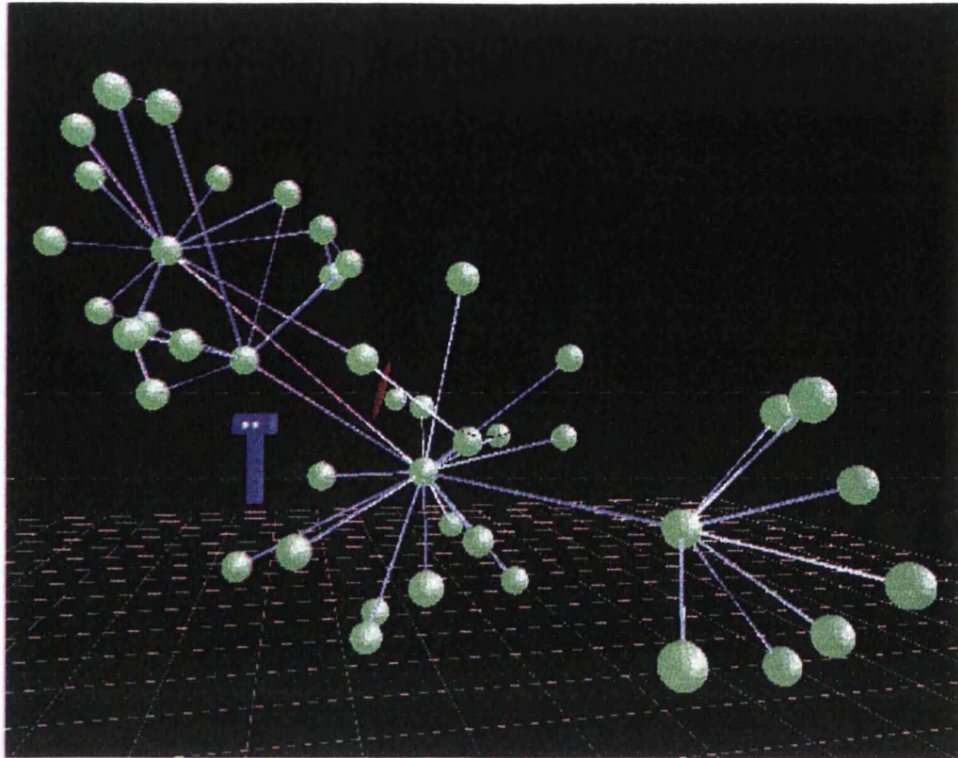
Figure 7.6: An embodiment in the Populated Information Terrain System (PITS)

If a person has recently visited the database site in which the user is interested but is no longer there and has left a 'shadow' or 'fingerprint', this information is available to the user, providing a further way to identify people with similar interests. Having located a relevant person that the user wishes to make contact with, the person can then be 'fingered'. Their virtual representation can metaphorically be tapped on the shoulder, to see if they are available. PITS can also be designed around the organisational hierarchy, as the following comments by designers show:

> 'The hyperstructure PITS has been used to generate initial visualisations of the BICC company hierarchy showing relationships between the BICC sites. PITS prototypes will be improved and modified to support the requirements of the factory pilot. In PITS, the organisational hierarchy is represented by links and nodes. Colours or icons could represent people's jobs, and their physical position could reflect their position in the organisational hierarchy. The nodes and links of the organisational structure can be browsed, and web pages can be brought up. It will be a problem to keep the model up to date in a fluid organisation.' (Steve Benford, 1995)

> '3D organisational charts are a way of searching for people using PITS. We are trying to develop cityscaping to provide boundaries and walkways so that the user can orientate him or

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Similar to PITS is VR-VIBE as shown in Figure 7.7 (Benford et al, 1995a; 1995b); an application which generates a visualisation for a set of documents. It constructs a 3D document space from a bibliography file and a corresponding set of queries. Each query, called a Point of Interest (POI), consists of a location in space and a set of keywords which can be matched against each document (or relevant sections of the document such as the abstract and keywords). A simple graphical object represents each document and is placed in the space defined by the POIs according to how well it matches (is attracted to) each one. Thus, a document which appears directly on top of a POI is attracted to only that POI; a document on a line between two POIs is attracted to both with the distance from each representing the relative strength attraction, and so on. The *overall relevance* of each document - its total match against all queries - is represented by both the size and the brightness of the document icon. The *overall significance* of each POI (i.e. its total effect on the visualisation) is represented by its brightness. Users can mark documents as of interest by changing their colour, and filter out less relevant documents so they are not displayed, and change their location, tailoring the visualisation to their needs and personal interests.
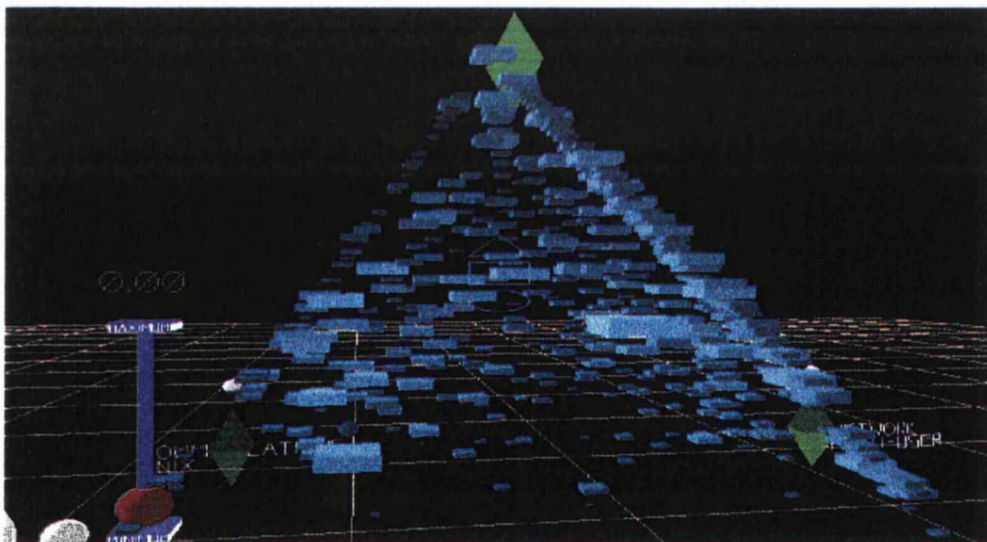
Figure 7.7: VR-VIBE document terrain

This 'links and nodes' approach to representing people and information in the virtual world does *not* reflect what we see in our real world. Our 3D spatial world is not made up of links and nodes. If I look at a cat, there is not a physical link between it and saucer,

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milk and fridge. The associations are not physically apparent but in my mind. In cognitive psychology it is suggested that our memories are linked in such a networked way. We have cognitive maps of associations between events, objects, people, feelings etc. (Bartunek and Moch, 1987). Therefore the virtual PITS world resembles our mental world rather than our spatial world.

Each person's cognitive maps are unique. For example, I associate bluebells with a sense of dread, which is probably not that common an association. This is because there was a bluebell wood near my parent's home, and bluebells always came out around exam time at school. A more tangible example of the uniqueness of a person's cognitive associations is the address book. My address book contains the addresses of a group of people with which I associate, and will have overlap with the address books of my friends, yet is likely to be unique to me. I have built it up through the course of social interaction. Just as people's cognitive maps are unique, it may be preferable to allow people to build up their own associations within the virtual world. A user might make links between people and information that would be meaningless to others but relevant to them.

This is already happening in the Internet, with people providing their own links and associations between sites, showing their key interests and connections with people. The structure of the virtual world might be fixed, with designers arranging people and information in a way that is relevant to the organisation. However, people could benefit from having the autonomy to make their own relevant and unique links between those nodes. These individual associative links could build up to represent an alternative informal organisational structure, an alternative to the organisational chart, showing who contacts whom.

Issues associated with the representation of information in the virtual world include the possibility that too large a terrain may be overwhelming; a 'global' terrain that represents all the documents ever written in BICC might give the user the feeling that they do not know where to start to look for information. Too large a terrain may also lessen the odds of chance interactions, and may not facilitate co-operative work. Also there is a question over whether people will have the time or facilities to peruse large 3D databases; a concern expressed in the following observation by an ethnographer:

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'It was assumed that these applications would be used by experts, but they will not. They will be used by people involved in network use, such as managers. They will not be as much use to engineers, who do not have the time nor access to the network.' (John Hughes, 1995)

This can be contrasted by the view of a member of the BICC Multimedia group, expressing a view that gave justification for the project.

'The goal for BICC is to develop the ability to communicate with people in other countries more effectively than at present. For example, one objective is for technical staff, who instead of visiting one country per week, would be able to give advice to several countries in the course of a single day.' (Bill Inglebright, 1996: 47)

IMPLEMENTATION OF VIRTUOSI TECHNOLOGIES

I had the opportunity to witness the introduction of VirtuOsi technologies at a Pyrotenax factory in the UK. The system, based on the concept of the Global Virtual Factory, had the following features:

- The Picturetel system, a shared video application, so that users have video and audio links, and get access to files on a shared white board.

- Access to the photo-walkthroughs for all four Pyrotenax factories.

- Homepages with status indicators, incorporating video glances to see whether a person is present, and shrunken screens to show what they are working on. The home pages also have 'hot' phone numbers, that can be automatically dialled when clicked on.

- A telepresence factory trolley so that users can ask factory workers to point the video at various cable making processes. The image is put onto the LAN with a radio link to the Ethernet, and users can see this on a shared screen.

- Base stations with video-conferencing equipment in the factory, the Development Engineering area and the commercial area.

For the BICC Multimedia group, the Pyrotenax factory pilot fitted well with and built upon the efforts of other collaborative R&D projects in situ, such as BRICC, a

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construction site scenario for using virtual reality, and MICC, a project investigating mobile communication and collaboration with emerging technologies. The Pyrotenax factory pilot became known by the BICC Multimedia group as 'MIC' (from Mineral Insulated Cables), matching the 'ic' names given to the BICC projects. This 'ic' obsession inspired rather inevitable and rude suggestions of alternative names from other members of the VirtuOsi team. Staff at the Pyrotenax factories that were involved in the pilot looked blank when I referred to the project as 'MIC'; the acronym having no meaning for them. This is a small example of how VirtuOsi team members appeared to be remote from the organisational reality and preferences of end users.

Bill, a contract worker at BICC Multimedia group, and I travelled up to the factory for a whirlwind visit so that he could install some new kit contributing to the GVF, and I could observe the implementation process and the reactions of users. Upon our arrival, Bill was greeted by the IT department rather like Father Christmas bringing goodies. The reactions of people outside the IT department to the new kit ranged from sardonic smiles to genuine enthusiasm. One less-than-keen gentleman, when asked where he would like one of the computers placed, responded 'I'd like it thrown out of the window if possible.'

The experience left me surprised at the briskness with which the new technologies were being introduced. I had been reading literature arguing for a participatory approach that stressed the importance of user involvement in design and implementation in order to achieve successful IT 'implants' (e.g. Mowshowitz, 1976). However, Bill was in a rush, and having on a previous visit had a green light from the factory manager to install equipment, had a lot to do. The lack of consultation was not his fault; he simply had a job to do and limited time to do it in.

I talked to people in the commercial area about the in-coming technologies. The majority of people had not been consulted regarding this equipment. They had not been asked if they wanted it, if it would help their jobs, how they felt about having a real-time video camera in the office, or where would be the most convenient place to have the equipment installed.

Consultation was not a priority to Bill, as he lugged kit around the building. He returned to the IT department where I was waiting for him, and mentioned that he had just had an argument with a man whilst trying   to install a computer at his desk.

The following conversation took place between Bill and myself:

"Did you ask him if he wanted it there, Bill?"

"No. Do you think I should have?"

"Er . . . yes. I think people might be a bit sensitive about having their territory invaded."

"Well, its a good thing you are here, Helen. You are a social scientist, and a woman, so you should be good at these sorts of things. Why don't you go upstairs and smooth things over?"

I decided not to ask exactly why being a woman and a social scientist would make me more qualified than Bill in asking a simple courteous question about where the man would prefer to have the computer placed. I did not want to give Bill the satisfaction of rising to him; we had a long drive home and besides, Bill had the car keys. Instead, swallowing my reply, I left the IT department to go upstairs to the commercial area where the GVF was being introduced. Suspicious looks greeted me. The open plan office is partitioned, and has a central walkway along its length. Bill had been trying to install the computer with the video camera on top at one end of the walkway, which gave a good view of the length of the room, but because of the partitions, did not provide the user visiting the office virtually with a view of any people.

I thought that maybe another position for the computer might be better. My conclusion was strengthened by having a chat with the by now somewhat irate gentleman who sat at that desk, who was shifting furniture back to how it had been before Bill arrived. I went to the manager of the commercial area, to check if he was aware of the installation of kit that day (he wasn't) and whether he minded us putting the kit at the other, more visibly inhabited end of the office (he didn't, provided everyone at that end was happy). I then went and asked the women at the other end of the office whether they were aware of what the kit was for (they weren't, so I explained) and whether they minded it being placed near them (they didn't). They looked uncomfortable when I explained that there was a video camera on top of the computer.

"Is it going to be used to spy on us?"

"No, it just lets people visiting the factory by computer see the commercial area."

"What's the point in that?"

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"I suppose it would satisfy Trenton's (the Canadian Pyrotenax factory) curiosity for what the commercial area looks like, and they could see if people were available."

"Why does it have to be a live video? Couldn't there just be a still picture?"

This seemed a fair point, especially if that would make people feel more comfortable. I went on to explain that people could use the video camera for video conferencing, and they visibly brightened, commenting that that would be useful, and that it would be good to see the people around the world that they had talked to for years but never met. Having established that they were fine with the new installation site, I called Bill and he came and set the equipment up. He then demonstrated the kit, to a man from the IT department, the factory manager and an Engineer, who all looked interested as the demonstration was compelling, and seemed to be open to the possibilities of the technology. I wanted to suggest that the people in the office should be invited to join the demo as they were the ones who would be using it and having it in their area, but I did not want to question Bill's judgement in front of the factory manager.

My experience that day was in some ways indicative of my experience throughout VirtuOsi; surprise at the seeming lack of concern shown by some members of Virtuosi over user issues. As CSCW work has shown that these technologies need to be relevant to and add something to the work of users; how can designers know what is appropriate unless they consult users? It is rather like designing in the dark. There is a danger that they are creating technological 'turkeys'.

In sum, we can see that the designers have developed virtual environments based around familiar metaphors such as the virtual meeting room and the virtual factory. These are to some extent a reflection of the real organisation, rather than a radical change from traditional notions of organisations. Issues emerge from the data regarding the extent to which designers adopted a participatory approach to design, or a participatory approach to implementation. The next chapter moves on to consider the constructs of the designers, and draw attention to the apparent paradoxes emerging from the data elicited in the two strands of the research that investigated the design of the virtual organisation and end user issues. It argues for two emergent theses and a model for managing the design, development and management of the virtual organisation.

CHAPTER 8

THE EMERGENT THESES:
TOWARDS A MODEL FOR MANAGING CHANGE

The purpose of this chapter is to develop the theses emerging from the data. This research sought to produce theoretical outcomes by looking at the virtual organisation in two ways: by observing the design process associated with it's development, and by looking at potential user issues in an international business setting. This approach led to the grounded development of two theses regarding the potential of the virtual organisation as a radical transforming force and regarding the paradox of collaboration, which are set out here.

The previous two chapters have sought to answer the research questions posed in the two strands of the research in some depth. Rather than recapitulate, providing a précis of findings in relation to each research question, I shall juxtapose literature, end user issues and design issues, weaving themes together to develop and argue for the theses emerging from the research. As well as generating theory, an organisational change model is presented here, providing a framework with which to approach the management of the virtual organisation so that it is a radical transforming force rather than an electronic reincarnation of the traditional organisation. The theses and model for organisational change are summarised in the following conceptual grid:

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│                                                                                   │
│  ┌──────────────────────────────┐      ┌──────────────────────────────────┐      │
│  │         First Thesis:        │      │         Second Thesis:           │      │
│  │  The Paradox of Collaboration │      │   Second order potential, First order │  │
│  │ Paradoxically, those designing collaborative │  outcomes                │      │
│  │ virtual spaces do not seem to collaborate with │ Despite the potential of the virtual organisation │ │
│  │ one another or with end users. Equally, the end │ to be a radical second order transforming │ │
│  │ users for whom the technologies are being │ force, it is conceptualised by it's designers and │ │
│  │ designed may not wish to collaborate. Despite │ end users in first order terms, and is therefore │ │
│  │ the rhetoric of collaboration, the reality seems │ in danger of having only first order │ │
│  │ to be of competition and control. │      │ implications.                    │      │
│  └──────────────────────────────┘      └──────────────────────────────────┘      │
│                                                                                   │
│                   ┌──────────────────────────────────────┐                        │
│                   │       Model for Managing Change       │                        │
│                   │ A  radical  concept  like  the  virtual │                       │
│                   │ organisation needs a radical change model, │                    │
│                   │ reframing  traditional  concepts  of  the │                     │
│                   │ organisation. The virtual organisation may │                    │
│                   │ be managed by focusing on the process of │                      │
│                   │ interaction  within  networks,  and  by │                       │
│                   │ pursuing both integrationist and pluralistic │                  │
│                   │ strategies for managing culture. │                               │
│                   └──────────────────────────────────────┘                        │
│                                                                                   │
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Figure 8.1: A conceptual framework for the theses and model of organisational change.

THE PARADOX OF COLLABORATION

This section develops the first thesis emerging from this research, that despite the rhetoric of collaboration, even the advocates of collaborative virtual environments do not appear to collaborate. Rather than a culture of collaboration within BICC, it would seem that we have competition and a culture of control.

The rhetoric of collaboration

One of the fundamental and unquestioned, subconscious beliefs of designers of the VirtuOsi project is that of *collaboration*, that people wish to collaborate. It is on this assumption that the technologies are being developed. This assumption is implicit in the rhetoric of the virtual organisation, in the terms CSCW (Computer Supported *Co-*

operative Work) and CVEs (*Collaborative* Virtual Environments). The following quotes by VirtuOsi members reveal the collaboration construct:

'VirtuOsi aims to make *co-ordinating* and working in distributed teams much easier and a more *fulfilling* task'.

'(VirtuOsi's main aim is to) . . demonstrate how a *unified* virtual environment can support *co-operative* working in an organisation that is distributed across many sites. . . (and) recommend procedures for the introduction of *collaborative* teleworking within large organisations'

'We are moving from the era of personal computing to the era of *collaborative* computing'.

'If virtual communication gave the same effect as a face-to-face meeting, then people could opt for meeting in a networked virtual environment rather than to travel to meet in the same location. . Executives could do *more work* in a smaller area of space and time. *Organisational communication* could benefit greatly from this concept. Executives could maintain a consistent and *managed corporate culture* with their employees no matter where they were. '

'Our objective is the early introduction of an effective multimedia communications network between several technology centres and manufacturing sites. This will encourage the *sharing of experience and expertise* in cables operations and hence support a culture of continuous improvement throughout the world . . . This application pilot wishes . . .to provide an *integrated* virtual BICC organisation that allows technical and manufacturing staff throughout the world to *trade expertise* and technology and to *support training* . . without the overhead of extensive travel. In essence, this pilot will focus on the CSCW issues of representing and navigating large organisational structures, *promoting awareness* within distributed organisations, establishing contacts with *collaborators, trading* expertise and training, and arranging and holding meetings.'

'If people can *co-ordinate* research and development, the same work will not be repeated at different factories. We will not have the situation where people are reinventing the wheel. . .We have the possibility of *centralisation of expertise,* having one expert making virtual site visits, rather than having expertise out in the factories.'

Note the words that I have highlighted in these quotes. The designers envision the virtual organisation as unified, integrated, co-operative, and collaborative, enabling co-ordination and making distributed working easier and more fulfilling. The designers also

see the benefits of the virtual organisation as promoting awareness, improving organisational communication, supporting training, facilitating awareness, the remote management of corporate culture, the trading of expertise, the sharing of experience, and allowing more work in a smaller area of space and time.

What are the constructs that the designers have of the virtual organisation? The virtual organisation is seen as something that brings people together, uniting remote parts of the organisation, like an organisational *'glue'*. The virtual organisation is seen as *informating* organisational members, giving people the opportunity to know who is at other plants, what their areas of expertise are, and the facility to communicate. *Trading* expertise implies that people's knowledge is a commodity of value to be exchanged - the virtual organisation is not perceived as 'altruistic' or as a learning institution, where people share knowledge unselfishly or for the sake of learning. The virtual organisation is also seen as a way of *managing corporate culture remotely*, leading from a distance. The virtual organisation is seen as *efficient*, allowing co-ordination of work throughout the organisation and more work to be done in less time, by fewer people. It is assumed that bringing people together to work collaboratively is desirable and beneficial, without awareness that there might be resistance to sharing knowledge with other sites.

Collaboration within VirtuOsi?

However, the designers themselves do not appear to be particularly collaborative. The virtual organisation is being designed by technicians in isolation from one another, who meet once every three months and who appear to be cagey about *trading their expertise*. From my original field notes, I noted that there was not unity within the group, and that misunderstanding and playing ones cards close to ones chest was the norm. Interested parties were unwilling to give anything for free; knowledge, expertise and the exchange of equipment and technology between members were seen as commodities for bartering. I think that I had somewhat naively expected more open co-operation within the research and development project, and not the calculative interaction and even confrontation that I witnessed during my involvement with VirtuOsi. Asking a seemingly straightforward question 'What will the Virtual Organisation look like?' was more sensitive than I had

initially imagined, as it meant different things to different people in accordance with their own agendas.

Two episodes that I observed illustrate this lack of collaboration within the group. Andy, a student member of the project team, collected phone cards, and I had picked up several interesting ones on factory visits overseas to add to his collection. At one meeting, one member said he had a card for Andy that he had picked up in America. One of the other designers joked that he ought not to give it to Andy straight away, as he could use it to persuade Andy to do some VR design work for him at a later date. A look of comprehension came over the card donor's face, and he put the card back into his pocket. Andy was pretty fed up, and commented to me later that it typified the bartering mentality of the group. The episode struck me as significant, as it revealed the somewhat calculative nature of the interaction within the group.

A more extreme event illustrating not only a lack of collaboration but also confrontation occurred when the group went out for the night during the course of one of the three day VirtuOsi meetings. We went to a Quasar evening, which for the (blessedly) uninitiated involves running around a dark building shooting lasers at one another. We split into teams, and the game commenced, to the piped music of Wagner's 'Ride of the Valkyries', a take off from the classic helicopter scene from the film *Apocalypse Now*. I adopted the rather cowardly tactic of hiding in a corner and shooting like a sniper, with 17 men running around me.

At one point, two designers came face to face in front of my dug out. High Noon at the OK Corrall. One of them, squatting on his haunches, tripped, and the other closed in for the kill. He pressed the man to the floor with his foot, with his laser firing at the prone man's chest console, screaming 'Die, die'. The game finished, and the lights came up. The prone man leapt up, laughing it off and ready for the next battle. The attacker, however, was rather shaken by his own behaviour, so we bowed out of the next game and I took him outside for a drink. Tensions had been running high that day in the meeting, and had manifested themselves on the Quasar battlefield. We had a VirtuOsi battle, with the teams from different companies and academic institutions. Maybe we should have had a

more collaborative exercise, like building a bridge to cross a river. But the *collaborative* rhetoric of the group, as identified in the earlier quotes, belied the reality.

Even the advocates of collaborative virtual environments have difficulties in working collaboratively! They seem unaware of this irony, and yet expect that others would wish to do so, a classic case of 'Do as I say, don't do as I do'.

A collaborative approach to design?

Not only were the VirtuOsi group not terribly collaborative within themselves, but the extent to which they had a collaborative approach to design is also questionable. In the literature review chapter we learnt that numerous IT writers argue for a participatory approach to designing IT systems, where end users are consulted throughout the design process (e.g. Mumford, 1983; Eason, 1988). Some advocate the sociotechnical systems approach (Marguiles and Colflesh, 1982; Sankar, 1991; Pasmore, 1988), suggesting that human subsystems must be congruent with technological design. The perspective of end users is also important in Computer Supported Co-operative Work (Fuchs and Prinz, 1993; Oberquelle, 1991).

The academic partners involved in the project advocated understanding the workplace as part of technology development rather than attempting to design and implement technologies blind. Before designing a tool, you must look at the way people work. Therefore, ethnographies were being conducted for both the factory and the fashion pilots. As some of the academics involved with the project observed:

'. . .our approach to understanding the social organisation of work is predicated on the presupposition that this needs to begin from a close involvement with work as a 'real world, real time' phenomenon; hence the argument for ethnographic fieldwork and case studies.'

Hughes et al (1996:36)

The designers wanted to consider the views of end users, and indeed my own research and the ethnographic studies are evidence of this. But they seemed disinterested in our findings in meetings. In fact, on several occasions when I raised the issue of user needs,

industrial members asked why that should be of interest to them, despite their having requested 'an organisational perspective' from me. Their request was the very reason that I was present throughout VirtuOsi. It seemed that unless organisational fieldwork could be translated directly into specific recommendations for the designers, it was viewed as interesting but not very informative. Some of the ethnographers had a similar experience, and discussed the divide between the roles of designers and fieldworkers, and the pressures on the fieldworker that can arise from false expectations, including reactions typified by the comments 'Is that all then?', 'Well, we knew that', and 'Tell me what to build' (Hughes et al, 1996). This is not to say that the designers and the fieldworkers were strictly divided into two polarised camps - it is probably fair to say that we had different roles and priorities.

It is as though, having initiated a 'participatory approach to design', they were not that interested in our 'tales from the field'. They seemed cocooned, remote from organisational issues and commercial concerns. They were in their ivory towers, had a private club with its own language, and made untested assumptions about the desirability of the virtual organisation. It is as though they wanted to be seen to be attending to user issues, but in reality seemed more concerned with technological development in isolation from user issues. They had an organisational blind spot, if you will.

My experiences with Bill at the Pyrotenax factory as recounted in the last chapter typify this organisational blind spot. He was so engrossed in the technology and in such a rush that he forgot to consider the people who were going to use it. He was the technologist; he did not want to get his hands dirty out in the field. I was the one who was supposed to talk to people.

Why were they not that concerned by end user issues? The first rationale that I identified through discussions with members of the group was that the VirtuOsi project was 'blue sky' - staring at the stars and considering the possibilities. It was about proving the feasibility of a concept - demonstrating the possibilities of networked virtual reality. It was about design rather than implementation, and exploring ideas, so one could argue that the onus must be on the technologies rather than the end users. It was argued by one

designer that it was premature to look at user issues and commercial concerns as the technologies are not advanced enough to warrant it.

The technology development was relatively *ungrounded* in end user needs - whilst they received feedback from ethnographers and myself (although I was not required to formally feed my research back to the group), user needs were not the key driving force guiding technology development. The members of the team were information technologists, and were excited by new pieces of equipment available off the shelf or designed within the project. They were neologists and technological magpies, into fads and fashions and the latest technological breakthroughs. Computers appeared to stimulated them, rather than end user needs. As they all crowded round the latest computer demonstration at one meeting, one member of the team commented dryly:

"Toys . . Boys . . For . . The . . rearrange these words, and you can see what excites them."

The designers were more lenient on the technologies than people would be in a commercial setting, as they could see past the lack of graphics to the potential of the technology. They were immersed in the world of computers.

There could have also been an element of not being that interested in end user needs as a means of self-preservation, as negative feedback might undermine the justification for the VirtuOsi project. If no one wanted the technology, why was the project in existence? It requires a good imagination to see how virtual reality technologies might evolve and be used practically in business for *collaboration*, as opposed to how they are mainly applied in business at present for simulation and design work. Even if the technologies developed considerably and cost a lot less than they do at present, in the light of my research into user needs at BICC, I feel unsure whether VR technologies are really what users want or whether they would simply prefer more phones and fax machines. The VirtuOsi technology is 'cutting edge', and whilst it is good to be leading the field, one participant in a BICC factory read something into the fact that new collaborative technologies are not widespread. Is it because such systems are the way forward but too expensive at the moment, or because they are a technological 'turkey'? Intel Chairman, Andrew S. Grove, reflects this view:

"The virtual organisation is a business buzz phrase that's meaningless; it is appetising but you get nothing out of it".   (quoted in Byrne, 1993)

One could argue that the virtual organisation should offer something over reality, something different. If it does not, why not continue to fly people to meet one another? Why not continue to rely on present technologies? Unless the virtual organisation is *feasible*, unless the commercial world at least sees the possibilities afforded by the technologies, then we are in danger of being left with attractive yet misguided demonstrations of what is possible, not what is needed.

Whilst the development of the virtual organisation may progress unhindered, their implementation in organisations may not be straightforward; as my research has identified, many organisational factors prevented people from having the inclination, the skills, the scope or the resources to work collaboratively using new computer technologies, as the next section shows.

Collaboration out in the field?

If the advocates of collaborative virtual environments are not themselves particularly collaborative nor seemingly willing to adopt a participatory approach to design and implementation, then what about collaboration out in the field. Is collaboration what end users want and need? In my investigation of end user issues, I aimed to explore collaboration within BICC. The key idea is that the desire to collaborate or 'trade expertise' were not assumed, but investigated in this research.

In terms of collaboration within factories, progress has been made through the initiative of team working. People are more willing and used to flexible working in teams. In some circumstances, such as where jobs are under threat or where individual initiative is rewarded or individual errors are penalised, the climate may not be conducive to teamwork, with operators regarding other team members as competitors, and displaying 'non-team' behaviours such as scapegoating and 'passing the buck'.

Participants also questioned whether the hidden agenda behind the virtual organisation was job cuts, either in management with one manager able to 'survey' more workers, or in areas of technical expertise, having one expert being able to visit many sites virtually. This is referred to as 'deprofessionalisation' (Rosen and Baroudi, 1992), which Haug (1973: 197) defines as 'a loss to professional occupations of their unique qualities, particularly their monopoly over knowledge'. The knowledge held by experts is either available from fewer on-line specialists or built into information systems.

As regards present collaboration between factories, international exchange programmes, the MBE programme and the sharing of expertise have been successful in increasing inter-factory awareness and communication. Problems were identified, however, in the willingness of people to collaborate in the future if the cables market shrinks and other factories are seen as competitors. Competing for customers does little to foster feelings of collaboration, and factories are likely to 'raise their drawbridges'. Newly acquired factories may be used to having autonomy, and may not see the need to collaborate, or not know who to contact if they did. These tensions between collaboration and competition at the individual and factory levels may impact upon whether people ultimately collaborate within the virtual organisation. Competition and sharing knowledge are not easy partners.

Byrne (1993:40) observes that 'Before companies can more routinely engage in collaboration, they must build a high level of trust in each other'. One could argue that the virtual organisation presents an opportunity to build up that trust, but if the inclination to collaborate is not there in first place, we are leading our horses to water, but there is no guarantee that they will drink. I certainly picked up on a reticence to collaborate and share ideas in the factories. Is there a need for collaboration? Paradoxically, the BICC situation may both benefit from and yet be resistant to greater collaborative working facilitated by the virtual organisation.

The rhetoric of collaboration, the reality of control

So far, we have seen that collaboration is not necessarily that straightforward in the organisational setting due to competition between factories. The other theme to emerge from the data is that of control. Within the design group, the surface rhetoric of collaboration belies a further construct - the virtual organisation as a means of organisational control and surveillance. Likewise, in the organisational setting, a 'culture of control' can be identified within BICC.

Let us consider first the 'culture of control' within BICC. Where is the locus of control within BICC? Is it held centrally, or is control and responsibility devolved outwards and downwards? *Knowledge is power* - it may be an old cliché, but it has relevance here.

Power is dependent on the control of resources, of which information is one of the most important; powerful organisational members have more information at their disposal to distribute, withhold or distort (Kiesler, 1978). This sovereign view of power (Clegg, 1989) is based on the belief that information is a source of power from which information providers (usually in subordinate organisational positions) lose power to information gatherers who tend to be in positions closer to the top of organisational hierarchies (Gotlieb and Borodin, 1973).

If we consider the way that information moves within BICC Cables, it appears that there is a 'hub and spoke' form of organisation, with a centralised locus of control of information. Certain functions such as sales and marketing have been centralised, with departments such as sales no longer at each site but instead based at the head office of each country. Each factory is now 'accountable' to head office, with information going to and targets being issued from the centre, and then information being distributed back out. Some participants described this as a 'bottle-neck' to communication between factories.

We have already established that as the cables market shrinks, factories may be more reticent to collaborate and share information, as it is a valued commodity. As one

participant put it "Why share information, when it might make the other factory stronger?". It also emerged that having access to the databases of other factories would be highly contentious at present, as factories are not in the habit of being open, and there were fears of mis-interpretation of data without understanding the context of a document or file.

If we look to the management and distribution of information within factories, we see that information and decision-making, and therefore to some extent power, have been devolved with the team-working initiative. However, factory floor participants also commented that they felt ill-informed, were kept on a 'need to know basis', and even that communication was so poor that they would not know if they were well informed or not. Some managers did not distribute information because 'they have their own vegetable patches to protect'. A culture of collaboration was not in evidence, as illustrated by the next comment:

> "Our management style is still very hierarchical and very much along rigid lines. 'Do as I say not as I do' . . . there have been instructions to do team working in the factory but no effort to do true team working above the shop floor, literally . . . Team working is about being open and honest and telling people what we are trying to achieve and making them understand why we are trying to achieve it and then setting all the minds of the business focused on achieving that goal. Now we do not do that corporately."

Throughout the data, we see indications of a 'culture of control', where the management style is not open, the locus of control is centralised, and factories are resistant to sharing information. As one participant phrased it:

> 'BICC . . . has a highly political internal set of relationships and the idea of emanating from the centre that there is going to be trust and sharing is a bit hard to believe . . .'.

This 'culture of control' runs contrary to the *collaborative* concept espoused by designers. The virtual organisation may provide the opportunity for a 'culture of openness', facilitating international communication and information exchange, helping people to learn from one another's experiences, supporting collaborative efforts and

breaking down barriers. Yet people are not in the habit of being open, and access to other factory's databases would be highly contentious. Ironically, the technology has the capacity to transform the 'culture of control' to one of openness, but there is a danger of the existing culture suppressing this capacity. The transformative force of the virtual organisation may become culture bound.

If we consider some of the of the technological developments for monitoring and assessing availability within VirtuOsi, we see that beneath the rhetoric of collaboration, the virtual organisation can also be seen as a means of organisational control and surveillance.

Democracy or hegemony?

Is the virtual organisation seen as furthering organisational democracy or as a means of further controlling the work force? There seems to be an apparent duality concerning the political visions of the virtual organisation. On the one hand the designers speak the rhetoric of collaboration, the almost 'tender' views of *democracy, co-ordination and unity*. On the other hand, we have a more totalitarian perspective emerging, with views of *control, monitoring and surveillance*.

Let us consider the more egalitarian view first. Within the BICC Multimedia group, it was decided that for the purposes of the factory pilot, in principle all organisational members should have access to the virtual organisation. I asked what the designer's rationale behind this was, and was told that it prevented the virtual organisation from being elitist, restricted only to experts or management. The virtual organisation would be egalitarian, people would be aware of the wider BICC group and share an identity, and they could be encouraged to share ideas concerning best practices.

If the virtual organisation is being conceived by designers as promoting the possibility of collaboration among all members, it presupposes relations of equality and freedom. It also implies an openness of management and communication. The assumption is that people will have the freedom to meet, to exchange information, and to work

collaboratively. This notion of freedom also comes across in the following quote from a designer, advocating a democratic virtual world, where there is freedom of *views*.

> '(In an evolutionary approach to virtual world management) users are *free* to construct their world view as they wish and may diverge from the prevailing view when appropriate. At the same time, maintaining awareness of the prevailing view and using it as a default for new users encourages a general convergence of views, providing a sort of gravity or glue between users. In this way, different worlds may evolve through periods of convergence and divergence and the prevailing view will evolve with them. '   Snowdon et al (1995:15)

In this egalitarian world no one particular view is privileged, and people are free to see things as they want to. The democratic vision implicit in Snowdon et al's (1995) evolutionary virtual worlds can be contrasted with a more totalitarian vision of the virtual world that combines the facility to monitor. Information technologies not only provide access to information, but also make work processes more transparent, which may be viewed as a means of control (Zuboff, 1988). We saw in Chapter 3 that Rosen and Baroudi (1992) term this invisible managerial control made possible by IT 'hegemonic control'. They claim that:

> 'The post-industrial organisation will not have the obvious machine control of the shop floor or the assembly line, but will possibly have the increasingly unobtrusive control enabled by computer-based technology.'

Monitoring technologies are being promoted by some industrial partners in VirtuOsi. These include the facility to view the screens of others in multimedia applications, and to be able to see via a video camera if they are at their desk. Other possibilities discussed in VirtuOsi include the Smart Button that shows where a person is, and the Availability of Person - Intelligent Agent (AP-IA), which assesses a person's availability via their telephone or computer use. These might well be status indicators that assist the user in communicating with others, but they can equally be used to monitor and control the user. One of the designers acknowledges this technological capacity for control, and suggests that the facility to monitor be two way, again a vote for democracy:

'. . . there is only so much information that can be gained about whether people are available for interaction or not (e.g. people cannot tell if you are ignoring the phone or cannot see into your diary to find out whether you are truthfully telling them that you are unavailable to meet). However, *some of the technical developments being pursued in VirtuOsi seem to wish to shift this balance.* . . in making information about an individual available to others, CSCW services should provide mechanisms for both parties to control its flow and availability.'

Benford (1996)

Without adequate consideration of people's need for privacy, the kinds of information gathering and display made possible by the technologies being developed in VirtuOsi may be unacceptable to users and may result in users creating ways around them. Zuboff (1988) observed that managerial efforts to monitor work and use IT as a means of control engaged a series of organisational responses, such as new 'subversive' ways of getting around surveillance. This was indeed the case when I assisted Bill in his installation of kit at the Pyrotenax factory, where people commented they would 'accidentally' put a pile of papers in front of the camera, or obstruct the view with a plastic troll. Gabriel (1991) points out that no matter how much power resides in the ruling group, there will always be an 'unmanaged organisation' in which control attempts can be subverted and robbed of their effectiveness by informal, grass-root processes.

Collaboration revisited

Despite the rhetoric of collaboration apparent in the VirtuOsi project, we have seen that the advocates of collaborative virtual environments appear themselves not to be that collaborative with one another or in their approach to design. It is also apparent that the assumed desirability of collaboration is not a forgone conclusion in the organisational setting: many organisational factors prevented people from having the inclination, the skills, the scope or the resources to work collaboratively using new computer technologies. Factories are in competition, and a culture of control seems to exist within BICC Cables, which runs contrary to the concept of collaboration. Likewise, within the VirtuOsi project, the virtual organisation is viewed not only as a means of collaboration (democratic) but as a means of control (hegemonic).

Where does this lack of collaboration leave the virtual organisation? Let us clarify what the mindset of the designers has been. In essence, the designers have envisioned *organisational change* through collaboration in virtual spaces. They see the organisational changes made possible by the virtual organisation as improving communication, facilitating collaboration, managing corporate culture, the exchange of best practices, the facility to monitor, the need for less experts, the sharing of a corporate identity etc. The virtual organisation is the virtual *stage* on which organisational change is anticipated to unfold; the *means* of effecting organisational change is envisioned as *collaborative*.

This collaborative approach to organisational change resonates with the predominant Organisation Development (O.D.) view that the collaborative approach of employee participation is the one universal way to effect organisational change. O.D. writers argue for using participative methods as a means of overcoming resistance in the workforce. Indeed, Saskin (1984) argued that employee participation is not only effective but that its use by management is an ethical imperative.

However, the collaborative approach is not the only way to bring about organisational change. Some management theorists (Locke et al, 1986; Kanter, 1982) have argued that participation is a managerial technique that is appropriate in *certain circumstances*, rather than universally effective. Seeing as there is little evidence of collaboration in my research, we may conclude that this may *not* be one of those circumstances. Another mode of bringing about organisational change identified by Dunphy and Stace (1988) is that of coercion. They state that:

> 'There is an emerging recognition in the organisational change literature that the political dynamics of change are often shaped more directively or coercively than a traditional collaborative approach would recommend, and that this may be the only (or even best) way to bring the organisation back into fit with changed environmental circumstances. So we posit a continuum of the means of bringing about change that includes participative means, authoritative direction and coercion. . .'   (Dunphy and Stace, 1988: 325)

The coercive approach to change is also identified by Kotter and Schlesinger (1979) in their discussion of overcoming resistance to change, and by power politics writers such as Mason and Mitroff (1981) and Bourgeois (1984). Coercive change involves the use of implicit or explicit force between managers and employees, and an autocratic (as opposed to participatory) process of decision making by management or other key stakeholders (Heller and Wilpert, 1981: 47). The process model of change suggested by Dunphy and Stace combines two dimensions, the type and the mode of change. My discussion here is of the mode of change, and in the next section I shall move on to consider the type of change presupposed by the virtual organisation. For the time being, it is the collaborative - coercive continuum that is of interest. Dunphy and Stace emphasise that no value judgements are attached to this continuum - they are simply acknowledging that no one change technique works well in all situations. Dunphy and Stace's matrix is presented below.

	Incremental Change Strategies	Transformative Change Strategies
Collaborative modes	1. Participative Evolution Use when organisation is in 'fit' but needs minor adjustment, or is out of fit but time is available and interest groups favour change.	2. Charismatic Transformation Use when organisation is out of 'fit', there is little time for extensive participation but there is support for radical change within the organisation.
Coercive modes	3. Forced Evolution Use when organisation is in 'fit' but needs minor adjustment, or is out of fit but time is available, but key interest groups oppose change.	4. Dictatorial Transformation Use when organisation is out of 'fit', there is no time for extensive participation and no support within the organisation for radical change, but radical change is vital to organisational survival and fulfilment of basic mission.

Figure 8.2: Dunphy and Stace's (1988) typology of Change Strategies and Conditions for their Use

The change types suggested by Dunphy and Stace are situational, and represent equally effective means of bringing organisations into environmental fit, the effectiveness of the strategy being mainly dependent on the volatility of the organisation's strategic environment and workforce support for change. If we consider the organisational

context of my research, we find a relatively volatile strategic environment, as the cable market shrinks and factories within the same group become competitors.

If we consider work force support for the organisational change implied by the virtual organisation, we find a degree of resistance. Whilst in principle organisational members like the idea of greater communication and collaboration, in practice they have numerous reasons to resist collaboration, such as competition and the 'culture of control'. Participants are also resistant to other organisational changes implicit in the virtual organisation, such as the need for less experts or managers, or the possibility of increased monitoring in the workplace.

As well as resistance, we can identify indifference to the virtual organisation. There was no 'felt need' for the virtual organisation within BICC: it is not as though people had been waiting for the technology to arrive to solve all their problems. People felt technologies would have to be of real benefit and make people's jobs easier, otherwise it would not be accepted. As one participant phrased it:

> "If the users do not perceive the need or the benefits of the system then they are not going to work anyway. I think that if they do, then they actually need much less support, much less push."

Some participants commented that rather than use the technology they had 'real jobs' to do. Consider also the reaction of the boss of the BICC Multimedia group to the virtual organisation - he was sceptical whether the organisation needed the technology, and whether it would make a 'real, bottom-line difference'. All classic change models suggest that change has to emerge from a 'felt need' within the organisation, that there has to be some 'trigger for change' (Brooks and Bate, 1994) or 'leverage to break the pattern of inertia' (Pettigrew, 1987). Most writers on organisations agree with Kuhn (1970) who claims that to break the old deep structure and establish a new one a paradigm failure is needed: something that forces people to be receptive to arguments that they would otherwise ignore (Gersick, 1991: 23). There was no such 'crisis', 'paradigm failure', 'trigger', 'lever' or 'felt need' in BICC, none of the conditions necessary to bring about radical change. We may have a situation where we have a radical transforming

technology (see the discussion of second order change in the next section) being introduced in non-radical times.

If we consider the following quote from Dunphy and Stace (1988: 325), it appears that a lack of a collaborative culture is pointed to as a further reason for the abandonment of a collaborative approach to organisational change. We find a lack of collaborative culture both within the design group and BICC.

> '(The coercive approach) accords with our own observations of organisations: managers, executives and key stakeholders often abandon a collaborative approach to change if that approach is demonstrably unsuited to achieving the changes they value. In other cases, *collaboration may be tried but fail, if there has not been a history or culture of collaboration within an organisation.'*

Having outlined the coercive-collaborative continuum identified by Dunphy and Stace, it appears that in my research context we find little support for a collaborative approach to organisational change.

A further argument for abandoning a collaborative approach concerns whether organisational members are *able* to participate in the design of the virtual organisation when they do not have the scripts for it, and are limited by their previous experience. This argument emerges from my own epistemological dilemmas as a researcher during this research project, which I outlined in the research design chapter. Whilst I could ask people in interviews about collaboration, communication, management and other themes that they had experienced, I ran into problems with eliciting their constructs of the virtual organisation, *as they had not thought of the possibilities until I stepped into the room and outlined the concept to them*. How can people contribute to the design of something that they do not *know*, that is a possibility in the future? People are limited by what they already know, confined within the limits of their knowledge and experience.

Uncollaborative themes have persistently emerged from the data. Does this mean that we should abandon a collaborative approach in favour of a coercive mode of organisational change, as the alternative suggested by Dunphy and Stace's continuum? This goes

against the literature on sociotechnical systems and CSCW research that was discussed in Chapter 3, that argues for participation and the user's perspective in guiding IT implementation. Rather than focusing on either collaborative or coercive *modes* of change, this research offers a reconceptualisation of organisational change management as a *process*; as the *steering of interaction*. Rather than persuading or forcing people to change, management has a more facilitating and educative (Bate, 1994) role, instigating and maintaining interaction between actors.

Calling networked virtual worlds *Collaborative* Virtual Environments implies that collaboration will go on in these spaces. *Interactive* seems a safer and more neutral term, as people may interact but not collaborate. I will pick up on this theme of interaction in my model for organisational change. The next section goes on to consider the virtual organisation in relation to the other dimension of Dunphy and Stace's model, concerning Incremental and Transformative change, also known as First and Second Order change.

SECOND ORDER POTENTIAL, FIRST ORDER OUTCOMES

This section develops the second thesis emerging from this research; that the virtual organisation has second order potential but is in danger of having first order outcomes. What do we mean by first and second order change?

Watzlawick et al (1974) define them as follows:

- First order change: one that occurs within a given form which itself remains unchanged.
- Second order change: one whose occurrence changes the form itself

Similarly, Levy (1986) defines them as:

- First order change: change taking place by incremental adjustments that do not change the system's core.
- Second order change: change involving alteration of the system's basic governing rules. A multi-dimensional, multi-component and multi-level alteration that shifts the system irreversibly to a new and revolutionary paradigm.

First and second order change has also been referred to as incremental change and transformative change (Dunphy and Stace, 1988; Tushman, Newman and Romanelli,

1986; Fiol and Lyles, 1985) and evolutionary and revolutionary change (Miller, 1982; Pettigrew, 1985).

What type of change can we anticipate with the virtual organisation? Let us firstly return to the literature to consider how the virtual organisation is conceived. In the literature chapter I described how the advent of information technology has been heralded as marking a new era in the civilising process (McLuhan, 1964; Toffler, 1980). What starts a change in technical capability has, through the applications it makes possible, the power to change the way in which we live our lives. Writers express the issues as follows:

> ' . . . a powerful new technology, such as that represented by the computer, *fundamentally reorganises* the infrastructure of our material world. . The informating capacity of the new computer-based technologies brings about *radical change* as it alters the intrinsic character of work - the way millions of people experience daily life on the job.'
>
> Zuboff(1985: 5)

> 'The new technologies offer unique opportunities for *rethinking conventional approaches to work organisation* - the challenge is to make sure it happens.'
>
> Blackler (1988)

> 'The impact of information technology on how organisations change and development has been nothing short of profound (and) has forever changed the nature of work, *forcing old organisational structures into new configurations.*'
>
> Thach and Woodman (1994: 30)

> 'As a rule one cannot use information as a competitive weapon without simultaneously considering *radical organisational change.* '
>
> Paul Kaestle (1990)

Many other writers agree that IT makes existing structures obsolete, and offer a variety of *reconceptualisations of organisation,* or *new organisational forms,* such as the 'network', 'concentric circles', 'constellations', and 'boundaryless' (Zuboff, 1985; Keen, 1991; Smith, 1994; Murray and Trefts, 1992).

Note the phrases that I have highlighted above. Writers talk about IT bringing about radical change, fundamental reorganisation, rethinking approaches to work organisation, forcing old organisational structures into new configurations, reconceptualisations of organisation and new organisational forms. IT is seen as having the potential to bring about *second order, radical, revolutionary, transformative change*. What are the constructs of the designers and end users? Let us first consider some of the comments made by end users.

"Information access should *reflect the management structure*. The technology should support the management structure, rather than working against it."

"When I enter the information system, it should allow me to see the people I am interested in talking to, or allowed to talk to in the company, as *defined by their level and function*."

"*Divisions or sectors* are the more likely criteria to define organisational split (in the information system), rather than national boundaries"

"The VirtuOsi project needs to start *incrementally*, with something simple and easy. You have got to demonstrate to people what the good is to them."

"One thing I would say about VirtuOsi is lets not lose sight of the keep it simple principle, otherwise we will lose people's support. The other thing I would say is lets try and tackle it in *small chunks*."

Here are some of the conceptualisations offered by designers:

'The hyperstructure PITS has been used to generate initial *visualisations of the BICC company* hierarchy showing relationships between the BICC sites. . . In PITS, the organisational hierarchy is represented by links and nodes.'

"If the abstract representation is not *meaningful to users*, it fails"

"*3D organisational charts* are a way of searching for people using PITS. "

"Although cyberspace may eventually ditch all vestiges of the real organisational world it will not do this immediately. It will proceed in *small uneventful stages* starting with the very real. A meeting is like a convoy, it can only be as virtual as the most technophobic member is prepared

to accept. That member will hang on to the props of real meeting rooms for as long as possible, only giving them up when alternative representations are agreed to be more effective than the organisational reality. People change very slowly."

Aspects of the virtual organisation designed in the Virtuosi project are based around the traditional organisation. For example, it uses familiar metaphors, such as the virtual organisational chart, the virtual meeting room, the virtual foyer, and the virtual factory. In this respect it has the advantage of being meaningful to users, but is not frame breaking. Other aspects do not reflect the organisation, such as having distributed databases so that information is under less central control. It also uses metaphors that have no physical precedent, such as the Populated Information Terrain System (Figure 7.6), with databases arranged in an abstract virtual network. These aspects of the virtual organisation are offering new, different approaches to organisation, rather than a simulation or reflection of the organisation.

It is interesting to note that with the exception of these last examples that hint at the transformative power of the virtual organisation, designers and end users predominantly want an electronic representation of the traditional organisation, rather than a radically different kind. We also see a desire for taking things in small chunks, for incremental or first order organisational change, rather than radical, second order change. It seems that people want the virtual organisation to *fit* the organisation, to enhance existing organisational processes and strategies rather than *change* them. Unlike the conceptualisation of the virtual organisation predominant in the literature, designers and end users see the virtual organisation in primarily first as opposed to second order terms.

In the previous section I argued that the virtual organisation has the *potential* to transform culture from one of control to one of collaboration, but that the existing culture may suppress that capacity. We have second order potential, but may achieve first order consequences. Bate (1994) provides a matrix for understanding different consequences of a change programme. From Bate's matrix it is apparent that with the advent of the virtual organisation we may encounter the problem of *underachievement* (Box I), where outcomes fall short of ambitions. Bate's (1994: 164) discussion of underachievement offers a cautionary tale with regards to the virtual organisation:

'Change strategists must assess the likelihood of this happening to their change programme. They need to ask whether they are being too ambitious, whether there is too much resistance or indifference to the desired change to allow it to occur, whether the timing is all wrong and whether there is sufficient political support and momentum to achieve the desired outcome.'

CONSEQUENCES

		First Order	Second Order
AMBITIONS	First Order	II Anticipated developmental change	III Overachievement
	Second Order	I Underachievement	IV Anticipated transformation

Figure 8.3: Bate's (1994) matrix of different outcomes for a change programme

It is important to observe at this point that the designers are not *change strategists*; they are providing the technology that may, or may not, bring about organisational change, that may, or may not, be rejected. It is how the technology is conceived, managed and implemented within the organisation that will determine its consequences. I have not meant to imply that the designers are the 'fall guys' with regards to the outcomes of the virtual organisation. We need to look at the bigger picture, and consider the potential of the virtual organisation as a evolutionary or transforming force for organisational change. The choice about whether the virtual organisation signifies transformative or evolutionary organisational change does not rest with the designers; the consequences of the virtual organisation depend on management exploiting the potential of the virtual organisation, and on the response of organisational members. Zuboff agrees:

(Technology) poses fundamentally new choices for our organisational futures, and the ways in which labour and management respond to these new choices will finally determine whether our era becomes *a time for radical change or a return to the familiar patterns and pitfalls of the traditional workplace.* '   ·   (Zuboff, 1985:5)

Whether the virtual organisation is transforming or evolutionary may be dependent on whether we see the virtual organisation as a *tool* or as a *new organisational form*, and whether the virtual organisation is designed to *fit* or *misfit* the organisation . If the virtual organisation is seen as a tool, then we may achieve *anticipated developmental change* (Box II). We can adopt a participatory approach to design, making sure that the technology *fits* the organisational processes already established, enhancing rather than changing communication and existing structures and not having any allusions to new organisational forms. The virtual organisation becomes an electronic reflection of the real organisation.

If we wish to achieve *anticipated transformation* (Box IV), fulfilling the potential of the virtual organisation as a radical transforming force as it is portrayed in the literature, then there may have to be a *misfit* between the organisation and the virtual organisation. Rather than attempting to *fit* the technology to the organisation, the organisation is made to change. The virtual organisation can offer something different from what is happening at present. Whilst people may not 'buy in' initially or have a 'felt need' for something with which they have no familiarity or experience of, there may be an argument for a 'top-down' rather than 'bottom-up' approach to IT system design and implementation if new ways of organising are to emerge rather than old ways revamped in electronic form. Scripts are ripped up, and the virtual organisation becomes the new paradigm, a second order change rather than a first order one. Alternatively, the mode of change may not be coercive and top-down, but educative, introduced as a new way of working through training programmes.

So, we have two ways of conceptualising the virtual organisation. It can be regarded as a *tool* and be designed to *fit* the organisation, which could be described as static, conservative, a continuation, an evolutionary approach to the virtual organisation. Or it can be regarded as a new organisational form and *misfit* the organisation, facilitating new, different, radical change in organisations. Both include the risk of rejection, but only one leads to a new organisational form.

A lack of awareness within the design team

The designers seemed to lack awareness that their own perceptions of the virtual organisation were *framebound*. Recall my suggestion to one designer that meetings could be conducted under a waterfall, and his view that this was silly. His thinking was framebound, in that he was thinking about the virtual organisation within a certain frame, bounding his thinking with untested assumptions about what was and was not appropriate for the virtual organisation, without freeing himself to radically different alternatives for work and organisations afforded by the technology.

The designers saw the virtual organisation as *collaborative* and *first order*, and appeared to be unaware of and restricted by this frame. Bartunek and Moch (1987) take a cognitive approach to organisational change, discussing schemata - templates or frameworks that, when pressed against experience, give it form and meaning (Markus and Zajonc, 1985). They suggest that *third order change* requires training people to be aware of their present schemata and appreciate alternatives and thereby more able to change these schemata as they see fit, lessening reliance on one way of 'seeing'. This might also be termed 'praxis - the reflective, questioning and consciousness-raising stage of the change process' (Bate, 1994: 272).

The designers were unaware that they were thinking about the virtual organisation was within a fixed paradigm, and seemed unaware of the dangers of a closed frame. Schemata, once established, tend to endure. Nystrom and Starbuck (1984) argue that organisational members frequently continue to interpret organisational problems using schemata that no longer guide them to useful solutions. Had the designers been aware of their own 'cultural lock' in a predominantly collaborative and first order view of the virtual organisation, then they may have appreciated alternatives, such as an educative mode of implementation and the potential for radical change. As it was, a radical concept such as the virtual organisation became frame bound.

There were blind spots in the design mentality; the designers were missing the organisational dimension. Their concern was predominantly with the architecture of the virtual organisation, with the physical aspects of the virtual environment, and with the

technology itself, rather than the nature of interaction facilitated by the technology. The social and organisational aspects of the virtual organisation were neglected. In order to break the frame regarding the virtual organisation in this instance, I propose a model for change for the design and implementation of the virtual organisation. This intends to provide a new lens to counteract the 'schematic myopia' (Harris, 1990: 25) apparent in the design group.

A MODEL FOR MANAGING THE VIRTUAL ORGANISATION

We have seen from the two theses emerging from the data that despite the rhetoric of collaboration, designers themselves do not appear to be particularly collaborative, and end users have reasons to resist collaboration. Furthermore, despite the potential of the virtual organisation to be a radical transforming force for organisational change, it is in danger of being subsumed under a first order label, with the existing organisational culture of control limiting the reorganising capacity of the virtual organisation. Designers seem to see the virtual organisation in predominantly first order terms, and lack awareness of their own framebound conceptions. In this section I aim to move on to suggest a model for change, to inform the design and development of the virtual organisation, that breaks the frame and suggests how the virtual organisation might be managed so that it realises its capacity to be a radical transforming force for organisational change.

I do not wish to end with a hypothesis, speculating about the various specific elements that the virtual organisation may or may not have in the future. Nor do I feel in a position to be to be prescriptive, arguing for certain ingredients that will make the virtual organisation a success or failure. As I have already observed - we are dealing with the unforeseeable. The virtual organisation is polyvalent, and could go either way, a democratic utopia or a totalitarian dystopia, or anything in between. The crucial point is that the virtual organisation has no inherent characteristic, it is neither good nor bad. What determines its success or failure, and the form that it takes, is how it is *managed*.
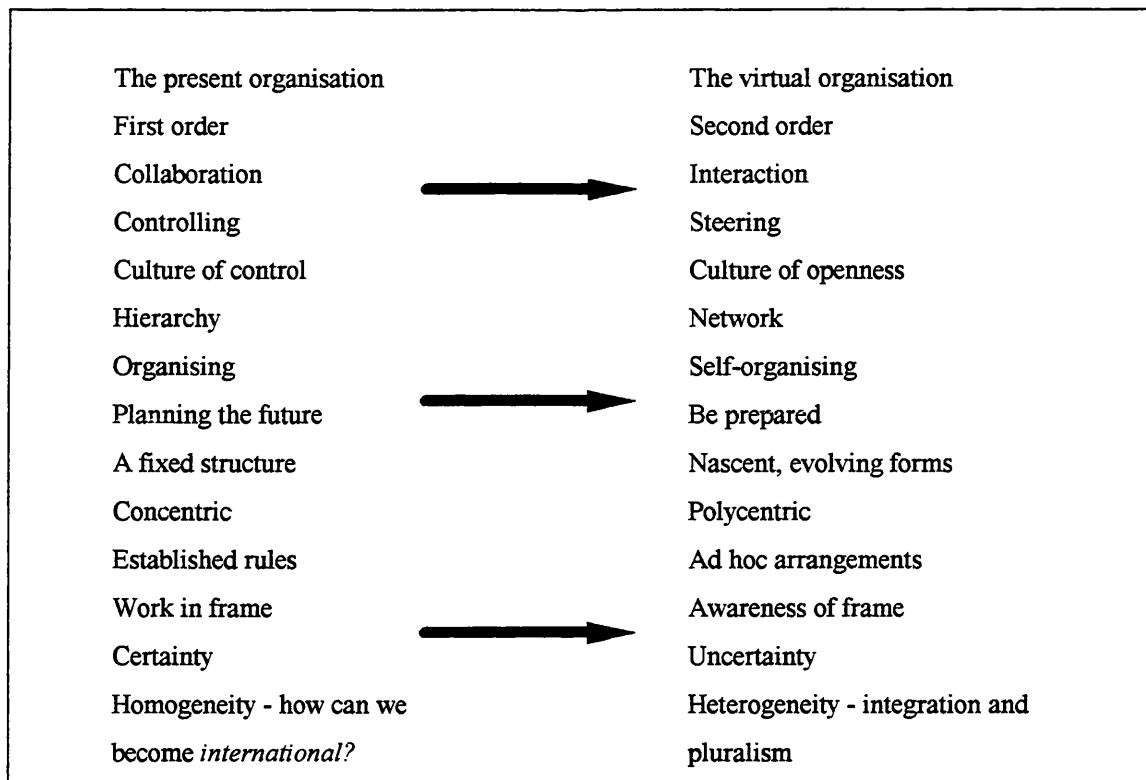
As I have already observed, the designers are not the ones that will make the virtual organisation happen. They are providing the 'clay', but management must mould and

breathe life into it. I cannot specify the form that the virtual organisation will take. What I can do is talk about the virtual organisation as a *process*. How to *go virtual*. I want to set aside designing the detail, and focus on how the virtual organisation may be managed when it goes live.

A radical new organisational form like the virtual organisation requires a radical model for managing organisational change. The model I propose is *radical* and second order as it does not reflect what is happening within BICC at present. It also aims to break the first order frame that the designers are working within. It emerges from insights and apparent paradoxes identified in my data and from management literature that challenges the traditional rational control models of organisations, including chaos theory (Stacey, 1992) and evolutionary theory (Van der Erve, 1994) and network theory (Kickert et al, 1997). I have summarised the key shifts in mental models that the virtual organisation represents in Figure 8.4 below.

Before going into detail, I shall summarise the key aspects of the model of change for managing the virtual organisation. The virtual organisation is based on the infrastructure of a distributed virtual reality network. It is a complex network of interrelated organisations, and as such traditional notions of managerial control may give way to concepts of self organising and self managing. The form of the virtual organisation will be nascent, emerging through the course of interaction between the various organisations. Rather than focusing on designing the detail and planning for an unpredictable future, the best approach to managing the emergent form of the virtual organisation may be to be prepared and be adaptable. The virtual organisation requires *network management* - to *steer* rather than *to control*, governance over government. In a complex network, there will be no centralised sovereign power, but brokers and mediators that facilitate interaction. Because of the heterogeneity of cultures existing within the network, we need to consider how to manage a networked culture that is both pluralistic *and* unitary, collective and separate. The following sections aim to explore these issues, and identify management activities for the virtual organisation.

The present organisation		The virtual organisation
First order		Second order
Collaboration	⟶	Interaction
Controlling		Steering
Culture of control		Culture of openness
Hierarchy		Network
Organising		Self-organising
Planning the future	⟶	Be prepared
A fixed structure		Nascent, evolving forms
Concentric		Polycentric
Established rules		Ad hoc arrangements
Work in frame		Awareness of frame
Certainty	⟶	Uncertainty
Homogeneity - how can we become *international?*		Heterogeneity - integration and pluralism

Figure 8.4: The shift in mental models represented by the virtual organisation

A Nascent Form

The first observation to make regarding the virtual organisation is that it will have a *nascent* form. It will find its own *emergent* form, rather than managers being able to plan strategically in advance the forms of interaction that will take place. Rather than being designed, it will design itself. It will be an organisational reflection of the Internet, a complex emerging *network* of actors that are interconnected and interdependent. It is impossible to predict what form the virtual organisation will take, because it is impossible to predict the future with any degree of certainty, or to control the process of interaction within complex self-organising networks (I shall consider the self-organising nature of networks in more detail in the next section).

Networks have been variously defined (Aldrich and Whetten, 1981) but common to most descriptions is the idea of clusters of organisations or sets of interorganisational relations. Klijn and Teisman (1997) observes that networks exist because of interdependencies between organisations, consist of a variety of organisations each with their own goals, and consist of relations of a more or less lasting nature between

organisations. Networks are made up of autonomous organisations. In my research, BICC can be seen as a collection of autonomous units such as factories, divisions, and head offices, each of which is a social structure of its own. However, actors within networks are interdependent - they need to exchange resources (for example, designers in my research envisaged the exchange of information, expertise and best practices) to achieve their objectives, to maximise their influence over outcomes, and to avoid being dependent on other actors in the network.

The dual tendencies of the autonomy of different actors and their interdependence is an inevitable feature of social structures. Arthur Koestler introduced the word 'holons' for biological and social structures which are both wholes and parts. He observed that each holon had two opposite tendencies: an integrative tendency to ensure its togetherness with other elements, and a tendency to sustain its individual autonomy. Weber (1965) in *The Growth of Cities in the 19th Century*, identified social structures as 'all-embracing social organisms' consisting of small social units, each complete in itself and independent of the others. Van der Erve (1994: 57) suggests that the groping relationship between autonomy and interdependence causes new organisational forms to evolve[1], with the hierarchy evolving into the matrix, the matrix into the network, and the network into the virtual organisation. In evolution, each wave results in a more complex self-organising whole which requires new and more refined ways of establishing autonomy and interdependence. As creation catalysts, Van der Erve suggests, managers walk on the fine line between the interests of the overall culture and the cultures of the contributing elements.

The 'groping' relationship between autonomy and interdependence leads to the evolution of more *complex* forms of self-organising structures. Von Hayek (1988) observed that operationally closed, self-organising structures are complex particularly because of the dynamic interactions between their mutually interdependent elements each of which is a social structure in itself. Networks are 'nascent forms' (or in Van der Erve's parlance 'evolving forms'), of 'discourse' in which all the affected parties participate 'together to

work out possibilities for what to do next' (Fox and Miller, 1996: 149). The virtual organisation will have a nascent form because of the complexity and unpredictability of interactions within it, with goals and agendas emerging through the course of interaction.

> '. . . processes in networks are unpredictable and complex. Not only are many actors involved but actors' preferences change in the course of interaction. As a result of a situation where there are many actors with different strategies and a wide variety of goals, actors cannot know in advance which outcomes are likely to occur and which targets they can meet in the process. They have to learn this partly during the process itself.' (Kickert et al, 1997: 8)

Because networks are nascent, complex and self-organising, and the future is inherently unpredictable, does this mean that we should throw our hands in the air and abandon notions of managing the virtual organisation? Is concern for the long term redundant? Stacey (1992: 102) in his book 'Managing Chaos' argues against this:

> 'When we recognise that the future is unknowable and abandon any attempt to design our actions on spurious forecasts of that future, we do not abandon all concern with the long term . . Instead we realise that we have to create the long term, that we have to learn about it continually and rediscover it. . . We become concerned with how to develop challenge and aspiration, spontaneity and difference. And we see that all of this is inconsistent with an exclusive concern with order, stability, harmony and consistency.'

Pascale (1990) observes that managing by existing maps leads to repetition, imitation and excess. The future becomes the present recycled. Stacey (1992) suggests that effective management should instead create ever-changing agendas of strategic issues, and the development of new mental models (rather than relying on existing maps) for each new strategic situation. He suggests that top executives do not drive and control new strategic direction. Rather than focusing on planning what will happen, the best approach is to be prepared, and to use a nautical metaphor, to 'tack when the winds change'. The network perspective argues that we should stop trying to guess whether the virtual organisation will represent a first or second order change, and rather that we should just

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[1] Van der Erve talks of evolution in the Darwinian sense of natural selection, rather than in the first order (evolution) / second order (revolution) sense we encountered earlier in the chapter.

get on with the *process*. The process is educative, one of learning where we are not sure in advance of where we are heading. The future is learnt as we go along rather than planned. It is through the journeying itself that a route and destination are discovered.

This goes against traditional 'rational' 'mechanistic' 'Cartesian' (Capra, 1986) notions of organising, where our view of organisations has been shaped by an image of organisations as machines, where the organisation is 'a pattern of precisely defined jobs organised in a hierarchical manner through precisely defined lines of command and communication' (Morgan, 1986). This classic bureaucratic view assumes that management can set clear organisational goals that can be achieved by the *control* of organisational processes. From my research we have seen that there is a culture of control at BICC, with a centralised authority structure and the accumulation and distribution of information controlled by the centre. Centralised managerial power and control may not be possible in the virtual organisation, purely by virtue of its infrastructure being based on a distributed and complex *network* of organisations.

Governance - to steer or to control?

If the virtual organisation will be a nascent form, that we cannot plan for strategically due to the unpredictability of the future and the complexity of interactions between its many actors, traditional notions of managerial power and control may be questionable. Policy network theory discusses the relationships between government and public, private and voluntary institutions within policy-forming networks (for an excellent review see Kickert et al, 1997). Some of the concepts that have evolved in policy network theory give an indication of how networks may be managed. If we use the analogy of political systems in my research context, the managerial centre of BICC Cables may be thought of as 'central government', and its component factories may be thought of as 'actors' linked within the virtual organisation network in the following quotes. Klijn and Teisman (1997: 31) in their overview of policy networks observe that:

> 'There is no single actor who has enough power to determine the strategic actions of the other actors. There is no central actor and there are no a priori given goals of one central actor which

can be used as a method of measuring effective policy. . . Governmental organisations are no longer analysed as the central actor but as one of the actors in the policy process.'

We can see that according to network theory, the centre no longer has control and power, but is one of the actors in the process. This is a radical shift from the existing power relations identified in my research. What new form does management take in the network? Von Hayek (1988) concludes the more complex a system, the more we are dependent on its self-organising forces, rather than trying to control it. Networks are *self organising* - autonomous and self-governing. Kickert observes (1993: 275).

'The control capacity of government is limited for a number of reasons: lack of legitimacy, complexity of policy processes, complexity and multitude of institutions concerned etc. Government is only one of many actors that influence the course of events in a societal system. Government does not have enough power to exert its will on other actors. Other social institutions are, to a greater extent, autonomous. They are not controlled by any single superordinated actor, not even the government. They largely control themselves. Autonomy not only implies freedom, it also implies self-responsibility. Autonomous systems have a much larger degree of freedom for self-governance. Deregulation, government withdrawal and *steering from a distance* . . . are all notions of less direct government regulation and control, which lead to more autonomy and self-governance for social institutions.'

If networks are self-organising and self managing, then in our case BICC Cables no longer occupies a sovereign position (Clegg, 1989). Central government is no longer supreme, and we live in a 'centreless society' (Luhmann, 1982: xv). Although the centre cannot control, it can indirectly and imperfectly steer networks. Government becomes *governance*, referring to 'a *new* process of governing; or a *changed* condition of ordered rule, or the *new* method by which society is governed' (Rhodes, 1997: i). Kickert et al (1997) describe governance as the 'directed influence of social processes'. Rather than controlling, the task of government is to enable and steer interactions. This may mean that the 'centre' needs to be reskilled and trained to adapt to its new facilitatory role.

The notion of 'steering' rather than controlling lends itself to managing in cyberspace, as *Cyber* comes from the greek κυβερ (σπαχε) : kubernan: to steer, to guide, to govern. Wiener (1948), the inventor of the term cybernetics to describe control systems using computers, corrupts the original meaning to one of *control*. The Greek word 'pilot'

becomes 'governor or director', 'to steer' and 'to guide' becomes 'to control'. Network theory suggests that governance replaces government, returning *cyber* to its original form. Managing in the virtual world does not mean control, but steering or guiding interaction.

What does 'steering' mean for management activities?

The notion of steering and guiding activities rather than controlling them implies a new set of management activities. Management activities in the virtual organisation can be seen as directed to a greater extent at improving and sustaining *interaction* between the different actors involved and uniting the goals and approaches of the various actors. I would like to re-emphasise that the focus is on managing the process of *interaction* rather than *collaboration*, because as we have seen in my data, collaboration between groups cannot be assumed. The outcomes of interaction are indeterminable, and may not be collaborative. Kickert et al (1997: 33) suggest that management activities may involve network activation, arranging, brokerage, facilitation and mediation and arbitration. I aim to expand and elaborate upon these new management activities with reference to my own research and other literature.

Network management conceived as the steering of interaction processes may involve identifying problems or issues and activating networks to tackle them, initiating interaction between groups. This may involve acting as a broker, bringing together solutions, problems and parties, which requires knowledge of the various skills and competencies or knowledge-bases of the actors in the network, bringing people together that might not have found one another themselves. This implies that managers are not remote from but part of the network, getting to know the various actors and their perspectives, and linking together those with similar interests. Actors may have similar competencies, similar interests in product development, or see similar opportunities.

Clusters of actors join together, and may disband once the objectives of the network are achieved. In order to manage this simultaneous deconstruction and reconstruction of networks in the virtual organisation, managers may select specific actors or bring in 'external' actors to work together to generate new perspectives, or actors may

recommend one another (typified by the popular use of the term 'networking'), or actors may be self-selecting. In my research I identified that people wanted more information about who might be the best person to contact at different factories. Managers may exploit the informating capacity of the virtual organisation, and its capacity to make organisational processes transparent (for example, who has worked with whom) and increase access to information (for example, what particular skills or interests an actor has), assisting managers in selecting actors and in actors searching for one another.

Once clusters of actors have been brought together or gravitate together, management activities may focus on establishing *ad hoc* organisational arrangements to support interaction. Arranging interaction may involve the setting up of a 'constitution' of agreements, rules and regulations which guide interaction, and are agreed to by all actors. This agreement signifies a commitment to the group (Teisman, 1992). The development of rules and regulations is discussed in the next section as a strategy for cultural integration within the virtual organisation.

Management activities may then focus on facilitation, promoting favourable conditions for joint action. Management may set non-directive problems to be investigated or encourage an open discussion about alternatives. The self-organising groups may select their own goals and issues of concern, identifying what the problems and opportunities might be. Furthermore, exploration plays an important role in the negotiation process, creatively searching for new solutions which take account of the problem and interest definitions of all parties concerned. The group may need a ball to keep their eyes on during the process of interaction. In the case of Pyrotenax, for example, this might be a desire *not* to compete within the same markets but to collaborate, or to develop a new product. After a history of competition, a concentration on one necessary source of collaboration, that is agreed upon and mutually beneficial to all parties, may aid the interaction process and provide a common superordinate goal that unites.

Once self-organising groups are established, management may have a role in legitimating choices made and to allocate resources for the exploration of ideas. One concern expressed by participants in my research was that the virtual organisation would lead to less need for middle management. On the contrary, the participation in and management

of networks takes time and management resources in order to realise the benefits (Stacey, 1992; Bird, 1996), and has an unpredictable return. But without such investment, interaction may not occur and new strategic directions may not emerge.

In order to foster a creative environment within self-organising teams, another management approach to facilitate interaction might be to encourage actors to toy with ideas. In my research, academics that I observed interacting within virtual environments were quite playful and informal. Watson (1994) suggests that organisational members need to be more playful in order to adjust to novel circumstances and think creatively. Klijn and Teisman (1997) use games and play as a metaphor for the interaction processes within networks. Bettelheim (1987) insists that we all need *speilraum*, literally room for play, or space to toy with ideas. Virtual environments may well provide such a space. Management activities therefore may include providing space and time for the *unmanaged, informal* dimension of organisations.

A further way of encouraging frame breaking concerns 'praxis', that I discussed earlier in the chapter. Managers may have a role in helping actors to become aware and reflect upon their existing ways of framing problems. Managers may intervene with challenging questions designed to enhance understanding. The capacity of technology to make organisational processes transparent may also provide an opportunity for learning and reflection (Zuboff, 1988). Awareness may also emerge through interaction with other actors who have different mental models.

The idea of awareness of mental models resonates with Argyris and Schon's (1978) distinction between single and double loop learning. Single loop learning is where the same mental model, the same assumptions and techniques are retained without question. Double loop learning involves questioning the mental model, and is aimed at generating different perspectives. The behaviour is one of openness and a willingness to change ones mind, listening to others and playing with the possibilities. People spark new ideas off each other, and are encouraged to argue and disagree in searching for new meanings. New perspectives are important not only in terms of innovation of, for example, new products or work processes, but also because they inform the emergent strategic agenda

associated with a nascent form of organisation, identifying new problems or issues for investigation.

A further way of facilitating interaction and the development of new mental models may be to provide new representations within the virtual organisation that do not rely on existing metaphors. Virtual reality allows us to perceive abstract ideas and processes for which there is no physical model or representation. It acts as a translator, converting concepts into experiences that our senses and mind can appreciate and analyse. The VirtuOsi team have new conceptualisations of how information should be represented, such as terrains or networks of information. Such new representations may assist in the development of new perspectives.

The process of facilitation of interaction may also involve the coordination of meetings (Susskind and Cruikshank, 1987). In my research, I identified that participants seemed very concerned over the importance of meeting one another in the flesh, with shaking hands and seeing one another's eyes as a means of establishing rapport and building up trust. This might mean that another aspect of managing the virtual organisation involves ensuring that different actors have the opportunity to meet one another face-to-face initially if this facilitates the process of interaction. It may also suggest that during the course of interaction, 'real' meetings may be arranged as well as virtual ones.

In my research it was apparent that collaborative working and the sharing of information, or more simply, interaction between sites was politically sensitive due to the different interests and goals of the various factories. Managers may also therefore have a diplomatic role in handling the political dimensions of organisational life in the network, ensuring that relations are maintained and channels are kept open. This includes calling on parties to recognise and respect the interests of other parties, and heightening awareness that the actors are interdependent, and are reliant on one another to some extent. Making actors aware of their interdependence may also help assuage anxieties over perceived differences in power; persuading actors that everyone contributes and gains in the network may prevent conflict. Network management may also require arbitration, the resolution of conflicts. This may involve appointing a committee who come up with solutions for getting beyond an impasse.

Management activities to facilitate interaction may also involve helping actors to live with ambiguity and uncertainty. Change, unpredictability and uncertainty will be inevitable in the virtual organisation as groups join and disband, and as new strategic agendas are formed and reformed. A strategy for the unpredictable involves finding ways of working effectively in unpredictable environments rather than engaging in pointless attempts to make them less unpredictable (Bate, 1994). Therefore, managers may focus on helping actors live with uncertainty rather than attempting to *reduce* it. Insights, goals and strategies will evolve during the course of interaction. Uncertainties are 'built in' to the process of steering, and unexpected effects are possible. Nicoll (1984: 160) makes the point:

> 'Our task, like that of the early sailor learning the rhythms of an ocean's winds and tides, is to discover enough to ride the unpredictable forces respectfully toward a distant, yet desirable shore.'

Managers may also have a role in managing the ethical dimensions of organisational life within the network. As we have already seen from my data, there is the possibility of monitoring and surveillance in the virtual organisation, and of those that are monitored engaging in subversive behaviour to avoid being controlled. Trust is essential to authentic discourse within networks (Byrne, 1993; Fox and Miller, 1995), and is destroyed by insincerity, misinformation and 'sly' behaviour. Some of the designers in my research seemed aware of this, and suggested two strategies for managing ethical dimensions. Benford (1993) suggested that 'Democracy depends on accountability which in turn depends on countability'. Furthermore, Benford suggests that the facility to monitor should be a two way mutual process. Managers might also therefore have a role in 'policing' the interaction process, ensuring that actors are not underhand, and must be visible to other actors and accountable for their behaviours. Managers may also arbitrate when disputes or transgressions to the network 'constitution' occur.

Finally, as well as network activation, managers may be involved in network *deactivation*. Managers may have a role in disbanding network clusters within the virtual organisation, once they have met their objectives, tactfully drawing matters to a close. Alternatively, managers may reactivate the cluster to address different problems, or new

clusters, forms or mutations may evolve spontaneously from the original network. Along with the different management activities involved in steering interaction in complex networks, there is also an issue of how the culture of the virtual organisation may be managed.

Managing culture in the virtual organisation

In the virtual organisation we will have a multiformity of actors linked together. The actors will have similarities. For example, in my research factories shared similar methods of manufacturing cables. They will also have differences, such as differences in local culture. What will happen when cultures clash in cyberspace? How can cultural development in the virtual organisation be managed? Should the aim be to impose a unifying view of culture, or to encourage a cacophony of voices in cyberspace? The key may be in finding and building upon similarities and respecting differences, as I shall argue for below.

Traditionally, culture has been viewed as either unitary (e.g. the strong culture argued for by Deal and Kennedy, 1982) or pluralistic (e.g. the subcultures observed by Smircich, 1983). Bate (1994) criticises the 'either/or' approach:

> 'Models like these are monistic and one-eyed, having in this case caused integrationists to overlook (and therefore underestimate) the differences between people, and pluralists to overlook their similarities.'

Young (1989) feels that in reality unitarism and pluralism are not opposites but interdependent processes through which values and issues are negotiated by organisational participants. 'Both/and' thinking is an approach to cultural development which involves the simultaneous pursuit of unitarism and pluralism, integration and differentiation, with the intention of producing a 'hybrid' culture that is appropriate and optimal for the kind of situation in which it has to operate, and for the goals the system is trying to achieve. Similarly in policy network theory, Termeer and Koppenjan (1997) suggest that the management of perceptions is not about creating consensus, and that strategies should be directed towards creating conditions for reflection by promoting, not

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eliminating, variation. Managing perceptions is about creating a common ground for joint decision making and action, while accepting and respecting the autonomous positions and preferences of the actors involved.

The aim should be the management of similarities and differences. The management of differences concerns the development of greater sensitivity towards multicultural differences, accepting - even welcoming - them, and continually looking for ways of expressing, accommodating and reconciling them. The management of similarities involves a search for as much coherency as one can find in the cultural system, one that culminates in strategies that identify, enlarge and extend the common ground that exists between groups. The aim should not be for balance between unitarism and pluralism, but for an avoidance of both extremes. The extreme of unitarism is imposing a culture where different views are not allowed for, and of pluralism is of divided parts that do not communicate. Either extreme may lead to inflexibility, a lack of innovation, and resistance to change within the virtual organisation, resulting in first order outcomes.

Bate (1994: 79) compares the network culture with that of the pluralistic and unitary visions. He comments:

> '. . . the integrative culture has all the features of the unitarist, community ideal: one culture, one language, strong hierarchy, restricted channels of interaction and communication, everyone knowing her or his place, clarity and simplicity of purpose. Network cultures . . . are much more open, non-hierarchical, egalitarian, voluntary and permissive. They do not profess to have everything worked out before it happens (they are too pluralistic and multidirectional for this) and they learn to live with ambiguity and uncertainty. Complexity, contingency and informality are the norm. In networks, any attempt directly to control events becomes problematic to the point of futility. If networks are pluralistic so, too, are they unitary. Whereas segmentalist cultures . . . abandon collectivity entirely, network cultures nourish it through reciprocal contracting arrangements. The parties, many of them potential adversaries, negotiate a framework of jointly agreed rules and rights. Hence, while conflicts of interest (pluralism) continue, these are managed within a unitary framework of joint, agreed procedures. By following a philosophy of 'shared rights, different interests', the parties are able to manage pluralism and unitarism.'

In order to manage cultural development within the virtual organisation, there are several strategies that emerge from my data and the literature. In terms of integration, or building upon similarities, the culture of the virtual organisation may be managed by developing an infrastructure or architecture that provides a common ground for communication. By developing architectural standards - relating to technologies, data, communications, applications and systems - the integration of the virtual organisation may be pursued. Let me illustrate this with an example. Optical fibres are called 'fiber optik' in Germany. If virtual organisational members search the virtual database for information on optical fibres, different labels will be problematic for the computer systems, as they require some degree of standardisation. The standardised system may be negotiated between actors, and renegotiated over time as patterns of communication emerge. The system may change, evolve, be tinkered with or radically altered over time. But it provides an initial framework for communication.

A further integrationist issue concerns the language of communication within the virtual organisation. In my research English was identified as the language that was common to most groups within BICC. I do not mean that one language should be imposed, merely that this is the most *likely* language to be used within the virtual organisation. Visual or icon-based modes of communication may emerge that transcend language barriers, or an organisational 'esperanto' may emerge in the virtual organisation. Providing there is a common infrastructure, actors may find their own ways of communicating. Managers may have a role as interpreters, not only of different languages, but of different ideas and perspectives, translating concepts into a form that others can understand.

A third integrationist strategy for the management of virtual culture concerns the reciprocal contracting arrangements referred to by Bate (1994) in the above quote. In my research, I identified resistance to collaboration between factories as they did not want to 'show too much of their hand' to others. They did not want to strengthen the positions of their competitors without getting something in return. These conflicts of interests will not disappear with the advent of the virtual organisation, but may be managed by encouraging the negotiation of a constitution, a normative framework of joint rules, rights and procedures that addresses the diversity between groups. Any parties that transgress these rules may be held accountable and may be excluded from the virtual

organisation. This accountability of actors is argued for by Fox and Miller (1995) as a means of 'policing the discourse' within networks.

A further integrationist strategy concerns the management of perceptions within the virtual organisation. By this I do not mean to imply the imposition of one 'correct' way of seeing things, or manipulating views with propaganda. What I mean is that interaction within the virtual organisation may not be straightforward due to the heterogeneity of perspectives that different groups bring. Blockages in interaction might arise not only because of conflicts of interest and power relations, but also by the perceptions of the different subcultures involved. Actors have their own constructions of reality which may be stable and difficult to change. In order to accomplish joint decision making, a mutual adjustment of perceptions may be necessary.

Partners in a collective structure share space, time and energy, but they need not share visions, aspirations or intentions. Managing perceptions is not aimed at the creation of an overall consensus, but the minimum agreement that allows joint action. The most basic agreement involves the acceptance of interdependence (Weick, 1979), of accepting that actors are reliant upon one another. To return to a theme I raised earlier, sharing a superordinate goal may assist in uniting different groups. Termeer and Koppenjan (1997) suggest strategies aimed at the cognitive and social dimensions of interaction in order to manage perceptions. Negotiating procedures (agreements and rules, as discussed above) preventing the exclusion of actors and introducing new actors can all help to prevent fixation and are aimed at the social dimension. Furthering a common language (as discussed above), preventing the exclusion of ideas and the introduction of new ideas can shed light on the subject and are aimed at the cognitive dimension. These strategies can help managers mediate different perspectives that may hinder joint ventures in the virtual environment.

A final intergrationist strategy concerns the symbolic potential of the virtual organisation, providing the opportunity to develop a *shared visualisation*, which may foster feelings of identity and belonging amongst the different cultural groups. Managers in networks may promote 'collective image building' to facilitate interaction (Agranoff, 1986; Susskind and Cruikshank, 1987). By this I do not mean imposing a privileged view, but the joint

negotiation of a shared representation that is meaningful to different users. This could be a non-directive problem for a self-organising team - to identify symbols that build upon the common ground between actors within the group. For example, in the case of BICC, symbols might relate to the manufacture of cables, and the twisting of various wires into a cable might symbolise the linking or intertwining of the various elements within the group.

The unitary approach alone will not work. Organisations are inherently pluralistic, and never entirely succumb to 'unitary' (Fox, 1973), 'integrative' (Kanter, 1983) ideologies and initiatives. Green (1988: 123) observes:

> 'Organisations are multicultural, to such an extent that the imposition of a core-value complex on a plurality of subcultures requires a manipulative process based on propaganda and procedure. Inevitably, this process breaks down when the complexity of social life defies managerial intentions.'

Managers may have a role in instigating a virtual 'show and tell', encouraging different actors to show how they do things at their factories. Managers who had been on sabbaticals within BICC said that it helped them develop a 'pan-European perspective'. One commented, 'to change the mentality, you have to go outside the environment'. Actors may use media such as the photo-walkthrough to provide a guided tour, so that actors can familiarise themselves with different environments and procedures. Schein (1985) described culture as 'the way we do things around here', so by encouraging discussion of actors' different ways of doing things, different perspectives and cultures can be appreciated and acknowledged.

A pluralistic strategy for cultural development involves not only the acknowledgement of different perspectives but also the active encouragement of differentiation. Stacey (1992) argues that in order to provoke different insights, different views are needed. He suggests that management need to actively promote counter cultures rather than trying to change diverse cultures into a common one. He stresses the importance of cultural diversity over uniformity. In *Evolution Management*, Van der Erve (1994: 33) suggests:

'By the continuous process of creating purpose-driven divisions in their companies (each of which then operates as a self-organising system) managers can effectively establish new environments in which innovation is boosted. The subcultures . . . permit the development of new insights. . . Dividing and regrouping result in 'mutations' and the reincarnation of corporate entities'.

Zuboff (1988) talked of the vision of a concentric organisation, that relied on metaphors of wholeness - interdependency, fluidity and homogeneity each contributing to organisational integration. Rather, I think that the virtual organisation will be polycentric and heterogeneous, consisting of various groups or factions that are activated or gravitate together. In the virtual organisation, different actors with different perspectives are networked, and pluralism is therefore inevitable.

However, cultural groupings different to those existing at the outset will also emerge, as clusters of actors form and reform. Again, we see the virtual organisation as having a nascent form, or more likely, *forms*. The virtual organisation will be deconstructed and reconstructed as managers activate new networks, and old networks are disbanded. It will be a shifting constellation of nodes and links, or actors and interrelationships.

Managing the virtual organisation: a summary

In the last part of this chapter, we have seen that in order to realise the potential of the virtual organisation, a radical shift in the way we conceptualise organisations may be necessary, that breaks the frames that the VirtuOsi designers were working within. A model for managing the virtual organisation as complex self-organising networks of interdependent organisations may be directed towards improving and sustaining interaction, focusing on steering rather than controlling, and adaptability rather than planning. Management activities aimed at steering interaction, and integrationist and pluralist strategies for managing culture are summarised below.

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MANAGING INTERACTION


Network activation        Identifying issues and initiating interaction between groups

Brokerage                 Bringing together issues and parties

Informating               Using the informating capacity of technology to select and allow self-selection

Arranging                 Establishing rules of the game

Facilitation              Encouraging groups to set own goals, to provide a ball to keep eyes on

Legitimating              Assisting in choosing which issues to pursue

Playing                   Encourage groups to toy with ideas, space for informality

Praxis                    Assisting in making members aware of their mental models

Tools for thought         Providing new representations within virtual reality

Co-ordination             Co-ordinate meetings, both virtual and real

Diplomacy                 Handling the political dimensions of interaction

Mediation                 Keeping channels open

Arbitration               Resolving conflicts

Rolling with it           Helping actors live with uncertainty

Policing                  Managing the ethical dimensions of interaction

Deactivation              Disbanding clusters


MANAGING CULTURE

Integrationist Strategies:

Infrastructure            Developing an infrastructure for communication

Language                  Identifying and/or developing a common language

Constitution              Negotiating a normative framework of rules

Perceptions               Creating minimum agreement to allow joint action

Symbolism                 Instigating collective image building

Pluralistic strategies:

Revelation                Instigating virtual 'show and tell'

Pluralism                 Accepting different views

Mutation                  Encouraging differentiation

Polycentric               Different clusters emerging
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Figure 8.5: A summary of management activities and cultural change strategies for the virtual organisation

CHAPTER 9

CONCLUSIONS

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In this chapter I review the aims of the research and consider whether those aims were achieved, summarising the findings of the research. I then goes on to discuss the limitations of the research, and what I would do differently if I had my time again. Finally, I discuss what implications my findings have for further research.

Reviewing the research objectives and findings

This research had the broad aim of addressing the knowledge lacuna regarding the virtual organisation, providing the organisational dimension missing in its design. It achieved this aim and makes a novel contribution by developing two theses and a model for managing the virtual organisation.

The research aimed to identify the present 'state-of-the-art' as regards the technologies that make the virtual organisation possible. Within the virtual organisation, people from different divisions, factories, or countries will be able to work together without leaving their desks, via a distributed virtual reality network. They will be able to meet face-to-face via video and audio links, make presentations on a text board, watch videos together, and discuss documents. They will be able to search for other users using hypertext virtual directories, and search for information in abstract information terrains. Most of the metaphors developed within VirtuOsi rely on familiar environments, such as the virtual meeting room, the virtual foyer and the virtual organisational chart.

Furthermore, the research aimed to identify end user issues. Whilst the design and development of the virtual organisation may progress unhindered, it's implementation in organisations may not be straightforward; as the research has identified, many organisational factors prevented people from having the inclination, the skills, the

freedom or the resources to work collaboratively using new technologies. The organisational dimension needs to be considered in the development of the virtual organisation, as it may ultimately influence the success or failure of implementation.

The research aimed to look behind the rhetoric of collaboration apparent amongst designers of the virtual organisation, and found that collaboration was significantly lacking within the design team, a classic case of 'do as I say, don't do as I do'. A participatory approach to the design of the virtual organisation was also lacking, as technological considerations and the physical aspects of virtual environments led the design process rather than organisational or social considerations. Furthermore, rather than a desire to collaborate within BICC, competitiveness and a culture of control were apparent. These findings suggest that a collaborative approach to the design, development and implementation of the virtual organisation may not be appropriate in this circumstance, and that the virtual organisation may be more successfully implemented if it is introduced in a top-down, coercive manner rather than the need for it welling up from within the factories.

The research also hoped to investigate whether the virtual organisation is perceived in first or second order terms by designers and end users. The literature suggests that the virtual organisation will radically transform the organisation. Despite these second order ambitions, the research found that the virtual organisation is in danger of having first order consequences. The designers rely predominantly on metaphors for designing the virtual organisation that come from the real organisation, such as the virtual meeting room, the virtual organisational chart etc. The virtual organisation is set to become an electronic reflection or simulation of the real organisation, rather than a radically different kind. The designers lack praxis; they are unaware that they are framebound in thinking of the virtual organisation in collaborative and first order terms. End users similarly see the virtual organisation as supporting or fitting in with real organisational processes, rather than radically altering them.

Researchers arguing for a participatory approach to the design of IT systems suggest that before designing a tool, you must look at the way people work. This is a first order

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approach to the organisational change associated with IT systems, as the aim is to enhance organisational processes and make incremental adjustments but not to radically alter how things are done. Whether the virtual organisation is transforming or evolutionary may be dependent on whether we see the virtual organisation as a tool or as a new organisational form, and whether the virtual organisation is designed to fit or misfit the organisation . If the virtual organisation is seen as a tool, then we may achieve anticipated developmental change. We can adopt a participatory approach to design, making sure that the technology fits the organisational processes already in existence, evolving rather than radically changing communication and existing structures and not having any allusions to new organisational forms. The virtual organisation becomes an electronic reflection of the real organisation.

If we wish to achieve anticipated transformation, fulfilling the potential of the virtual organisation as a radical transforming force as it is portrayed in the literature, then there may have to be a misfit between the organisation and the virtual organisation. Rather than attempting to fit the technology to the organisation, the organisation is made to change. This resonates with the coercive, top down mode of organisational change that was identified in this research as an alternative to the participatory approach. The virtual organisation needs to offer something different from what is happening at present. Whilst people may not 'buy in' initially or have a 'felt need' for something with which they have no familiarity or experience of, there may be an argument for a 'top-down' rather than 'bottom-up' approach to IT system design and implementation if new ways of organising are to emerge rather than old ways revamped in electronic form.

So, we have two ways of conceptualising the virtual organisation. It can be regarded as a tool and be designed to fit the organisation, which could be described as static, conservative, a continuation, an evolutionary approach to the virtual organisation. Or it can be regarded as a new organisational form and misfit the organisation, not reflecting the present and facilitating new, different, radical change in organisations. Both include the risk of rejection, but only one leads to a new organisational form.

This research also aimed to develop a model for organisational change, identifying how the virtual organisation as a network of interdependent organisations might be managed.

Rather than focusing on designing the detail of the physical space, I suggest that the virtual organisation might be managed by attending to improving and sustaining interaction within those spaces. Drawing on paradoxes and insights from my research, and literature associated with the management of networks, chaos theory and evolutionary management, I suggest management activities associated with the facilitation of interaction. I also suggest both pluralistic and integrationist strategies for the management of cultural change within the virtual organisation.

The next section moves on from reviewing the aims and findings of my research, to considering its limitations; what I did *not* achieve, where I went wrong, and what I would do differently if I had my time again.

The limitations of the research

My first disappointment with this research was that I did not have an opportunity to observe the virtual organisation 'going live'. At the start of my research, I had anticipated that the VirtuOsi project and the BICC factory pilot would progress to a stage where I could observe end users working in the virtual organisation, but unfortunately the project did not progress to that stage. I did have the chance to go along with Bill to observe the installation of some multimedia equipment at a Pyrotenax factory, but did not have the opportunity to observe how it was used. So I was unable to gauge the organisational response to the technology, nor identify whether it was assimilated into the organisation, led to radical change in the organisation, or was rejected.

I have articulated the different roles that I was perceived as having or adopted during the course of my research. Such roles were an inevitable element of my being part of as opposed to outside of the research process. However, if I were starting out again, I would have given more thought to my role of advocate, presenting the virtual organisation out in the field on behalf of the VirtuOsi project, and attempting to provide the perspective of end users within VirtuOsi. As has been observed in much ethnographic study, I felt a tension between involvement and detachment, that remained unresolved throughout my research. I would also have reflected more upon my perceived role as consultant, as it had an impact on how independent I felt as a researcher.

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A further source of regret concerns my approach to investigating end user issues. I did not want to limit myself to research at one site, as the virtual organisation concerns a network of organisations, so I wanted to reflect this in my research design. In a sense I was creating a rod for my own back, as this involved a gruelling schedule of international travel. At first I found the prospect exciting, but soon all notions of glamour were set aside; sitting in a traffic jam in order to visit a cable-making factory feels the same whether in Sydney or Manchester. The limited amount of time that I spent at each factory was an inevitable trade off, as I did not achieve the depth of insight that an ethnography at one site may have allowed, but I did have the opportunity for a greater breadth of perspective.

In interviewing organisational members, I made several decisions, some pragmatically based and some personal judgements, that seemed appropriate at the time but had an impact on the data that I collected. I felt it was important when researching a new phenomenon such as the virtual organisation to evolve a holistic view of the issues that might affect IT implementation, and 'keep the channels open', rather than limiting myself to looking specifically at IT in relation to managerial power and control, for example. However, this desire to not focus my research too early may have led to some of the data appearing rather generic or obvious. I also had little time for reflection or analysis of my interview data whilst I was visiting factories, which may have meant that I missed leads or opportunities for investigation that may have elucidated more interesting findings.

Also, whilst asking people about their perceptions of collaboration, communication and IT may have been valid because they had experiences to draw on, I had a problem with asking them about the virtual organisation, as they had no experience of it. I described the virtual organisation to organisational members - and had to describe it, as I wanted to investigate their views of it. But in doing so I was framing their responses, and putting words into their mouths. This meant that my approach to research was rather less phenomenological than I had originally planned, and may have portrayed more of my own constructs rather than eliciting theirs.

All of these limitations of the research were either due to factors beyond my control, or due to pragmatically based trade-offs, or due to my own short-sightedness concerning

the consequences of the decisions that I was making. In the next section I build on some of the omissions and limitations in order to consider further research in the area.

Further research

If we start by considering the virtual reality dimension of the virtual organisation, there is a need for further lab-based research, investigating interaction in virtual worlds and developing cyberspace principles. Interaction can be investigated by conducting electronic ethnographies of interaction in virtual worlds, with the researcher immersed and conducting participant observation. Studies also need to be conducted of the split of attention between real and virtual worlds, looking at ways to lessen the demands on the user. The psychological impact of interacting and working in virtual environments also needs to be explored; whether people interact in different ways to how they would in a face-to-face meeting, and how spending prolonged periods in virtual worlds affects people psychologically, such as their attention, performance, and detachment.

Preferences need to be investigated; the preference for one embodiment over another, for different ways of searching for other users, and for different spatial metaphors. It may be appropriate in a laboratory setting to start simple and add features when they are found to make a positive difference to interaction. If users are given a variety of media and virtual environments, which are preferable? This can build on studies of videoconferencing and teleworking, helping to make virtual environments easy to use, intuitive, natural, and ergonomically designed. Preferences can also be investigated by giving users the facility to make changes to a prototype on-line, changing their environment and the way that they interact with it. It may be beneficial to pilot such prototypes with novice users and organisational members, rather than with virtual reality experts.

Studying the virtual organisation as it is designed requires evaluation, monitoring and feedback techniques. Virtual reality systems could incorporate the provision of services to support automatic data capture as part of ethnographic and experimental evaluation, such as the provision of various virtual cameras and microphones which might be attached to participants or other objects in a virtual world and whose output might be recorded for later analysis.

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A further area of research concerns the conceptualisations that designers have of the virtual organisation. In this research, the designers lacked praxis, 'the reflective, questioning, consciousness-raising stage of the change process.' (Bate, 1994: 272). Action research may therefore be conducted with designers to investigate alternatives to a participatory approach to design, questioning whether the virtual organisation will be a democracy or a means of managerial control, and reflecting on whether the virtual organisation is perceived as a tool or a new organisational form. This research could help designers to question the underlying assumptions that are guiding technology development, assisting them in reflecting upon their mental models and 'breaking the frame'.

When technologies are sufficiently sophisticated and are suitable for implementation, their impact on the way people work needs investigating, as part of an ongoing development programme. Again, ethnographies within virtual environments rather than the physical environment might be appropriate for networked VR systems, to avoid the complications and cost associated with having a researcher at each site. Conducting ethnography from *within* the virtual organisation addresses the problem that I encountered of one researcher trying to conduct qualitative research at multiple sites and on a global scale. By immersing the researcher in the virtual world, the process of interaction amongst actors may be investigated.

Research within the virtual organisation might include a study of power relations, investigating user and managerial responses to the increased transparency of work processes, and the facility to monitor and assess the availability of others. The facility to access information may also be studied, comparing user reactions to having a centralised or a distributed database. The informal dimensions of organisational life may also be illuminated, investigating the importance of having chance encounters in virtual worlds. The cultural dimensions of the virtual organisation may also be studied, looking at what happens when people from different cultures meet in cyberspace. Cultural differentiation and mutation may also be investigated, the extent to which interaction in the virtual environment spawns new cultural groupings and clusters.

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This research identified management activities and strategies for managing culture within the virtual organisation. Management is focused on steering interaction, on improving and sustaining discourse between actors in the network. The model for change that I propose needs evaluating, to embellish and clarify the new management activities and strategies associated with the virtual organisation. This requires a study of network management when the virtual organisation 'goes live', observing the process of interaction between virtual organisational members in order to identify effective and viable approaches to the management of this new organisational form.

The virtual organisation presents an opportunity to bring people from all over the world together to interact in one networked virtual space, transcending geographical distances and time zones. How people respond to this opportunity requires further investigation - why should it be assumed that if the technology can cross boundaries, then the necessary personal, organisational and cultural change will follow? The virtual organisation is polyvalent, and could go either way, a democratic utopia or a totalitarian dystopia, or anything in between. It has no inherent characteristic, it is neither good or bad. What determines its success or failure is how it is managed. The findings of this research present an preliminary exploration of issues associated with the design, development and management of the virtual organisation.

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