Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

Circuits of Power

A Study of the Development of Computer Software and its Use in General Medical Practice

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Arts in Sociology

at Massey University, Palmerston North,

New Zealand

Elizabeth Phillipa Cornford

2000

Abstract

This thesis explores several phases in the life history of a software package developed in New Zealand for the primary healthcare market in order to show how the package is implicated in maintaining or changing existing distributions of power.

The theoretical concepts which inform the study come primarily from Wiebe Bijker who works within the constructivist tradition of technology studies. The methods include documentary research and fieldwork, including open-ended interviews with five people involved with the package at the development site and seven who work in large and small general practice sites.

The study concludes that the introduction of computers into general medical practice is associated with a small shift in the balance of power within general practice which has significant consequences for those who are unable or unwilling to acquire computing expertise. It also concludes that computerisation of general practice is associated with changes in the autonomy of general practitioners as their work becomes open to greater surveillance and in the GP-patient relationship where the computer has the capacity to substantially alter the nature of the interaction.

The main findings of the study are that the groups most influential in the development of the package continue to exercise their influence as the package is deployed and used in a general practice setting. In this way the package both reflects and reinforces their power as it moves between development and use. The study also shows that those most influential in all phases of the package's existence draw on a number of skills and resources such as business acumen, clinical knowledge and computing expertise but that the most significant resource is money in the form of purchasing power or economic authority.

Acknowledgments

I would like to acknowledge my debt to the people who agreed to be interviewed who gave me more time than they could spare from their busy working lives. Without the information and insights that the interviews provided, this thesis could not have been written.

My thanks go to Mary Murray for her support and encouragement during the last few months as I struggled to bring the thesis together. It went beyond what could be expected from any supervisor. I would also like to thank my sister Yvonne for bringing her experiences with the New Zealand health system and her considerable editing skills to what I thought was final text. I will always think twice before writing 'however' or attempting to end a sentence with 'with'.

Finally, my thanks to Bart for living with this thesis for much too long. It wasn't always easy I know but your understanding of computer development was crucial when I began to lose sight of the significance of purchasing power in a modern capitalist society.

Contents

Chapter 1

Introduction

This thesis is about the movement of computers into general medical practice and how some groups gain by this movement while others lose out.

This movement, reflecting the trend towards computerisation in many facets of public and private life, began in the early 1980s but it is only in the last decade that the presence of a computer in a doctor's surgery has changed from being an exception to being the rule.

The presence of computers in the everyday lives of many New Zealanders sits in contrast with images portrayed in the fictions of the popular media. Security leaks, privacy invasions and out-of-control computers with awesome power are presented as threats to the 'free world' and the democratic way of life. Other fictional representations of computers connect them with heroic and utopian visions. Even in more factual accounts, such as those which can be found in the *Infotech Weekly* of each Monday's *Dominion,* the idea of technological progress can be found in every page.

More rarely is there informed debate about how computers might support or change the status quo. An exception is the article by Helen Trinca published in the *Sydney Morning Herald* dated March 21, 1998 which presents the utopian perspective of Bill Gates, the founder of Microsoft, and the views of Hans-Peter Martin, a European journalist and author who is one of Gates' most outspoken critics. In typical style, Gates claims that the word wide web will enhance democratic rights and that computer technology is about 'empowerment' and 'closing the gap between the haves and have-nots'. Martin describes these claims as 'bullshit' and connects the use of technology with excessive profit taking and an unregulated global financial market. He then goes on argue that unless we make the market subservient to social and ecological concerns, the

world population will soon comprise twenty percent 'haves' and eighty percent 'have-nots'.

Appealing though Martin's arguments are, they take a macro view of technology as an economic and political tool and are not designed to explain how computer technology achieves its effects. Similar difficulties exist in the theoretical framing of Marxist and feminist sociology which draws much of its inspiration from the labour process debate initiated by Braverman in 1974. Although it is hard to generalise, especially in more recent texts where the boundaries are increasingly blurred, technology studies in the Braverman tradition are concerned with showing inequality between different social groups and tend to focus on the impact of technological innovation in the workplace. In contrast, constructivist studies which are closely connected to the sociology of science and scientific knowledge are more concerned to show how a particular technology takes the form it does through the interaction of humans and (sometimes) non-human things and may or may not be concerned with distributions of power.

Despite these differences, case studies in both traditions frequently illustrate the complexity of the relationship between society and technology even when this relationship has not been theorised.[1] They also show that specific development strategies or technological artefacts cannot, on their own, guarantee specific outcomes. Perhaps because of the complexity of the relationship as well as the contingency of outcomes, few studies examine the role development plays in achieving these effects.

One of the few which attempts this task is Cockburn and Ormrod's (1993) study of microwave cookery. This study provides rich details of the manufacture, marketing and use of the microwave and its flexibility but, ultimately, fails to be an equally rich story of development and the features of the microwave which limit its flexibility. In consequence, little is learnt about how development and

---

[1] See for example Barker and Downing's (1985) study of women office workers which shows complex politics at work almost despite the authors theoretical frame of reference.

use are linked and the role the features of the technological artefact might play in this link. Equally significantly, the study provides little substance to the claims which Cockburn and Ormrod make about the importance of certain social groups (in their case, women) being involved in the development of technology if social inequality is to be redressed.

In an attempt to fill the gap, this study explores several phases in the life history of an application software package[2] developed in New Zealand for the primary healthcare market. It also explores the links between these phases, including the links which are forged by the features of the package and other socio-technical outcomes of the development process. This is an ambitious undertaking, particularly for a masters thesis, but it reflects my concern to explain how computer technology is implicated in maintaining or changing asymmetrical distributions of power.

The focus of the study and my choice of a specific application package reflects a personal interest in software development gained from working in the computer industry and a growing awareness that many of the systems that I developed along 'user friendly' lines were more 'friendly' to some users than others. There is, for example, nothing universally 'friendly' about systems which provide management with cost savings and some groups of workers with a pleasant-to-use tool but which contribute to the long term unemployment of others.

The choice of a specific package rather than computers in general not only arises from my working history but also from a concern to narrow the focus of the study down to something amenable to a grounded study. As Karin Knorr-Cetina, who works within the social constructivist tradition of science studies reminds us, it is in the specifics of the micro-order, rather than through more generalising approaches, that one comes to understand how the macro-order 'ticks' (1981:41-42).

---

[2] For a definition of this and other computer terms used throughout the study, see Appendix 1.

The theoretical concepts which inform the study come primarily from those developed by Wiebe Bijker who works within the constructivist tradition of technology studies. In this tradition, the classic sociological division between the social and technical worlds is constantly undermined and disciplinary boundaries are not strictly observed. This is evident in Bijker's work which combines an historian's concern with the unique characteristics of particular technological developments, an engineer's interest in the content of the technology and a political activist's concern to understand the politics of technology and to bring about social change. At the same time, Bijker is more willing than many who work in the constructivist tradition to suggest that his findings may be applicable to other studies of socio-technical change and to trace the effects of technology to social causes. These more sociologically-oriented aspects of his work, as well as his concern with the politics of technology, make it an appropriate basis for this study.

Bijker's findings, in common with many case studies and life histories, are presented in narrative form. The narrative form should not be confused with a simple story for Bijker's accounts provide evidence of the complex interactions surrounding the development of technological artefacts and the way that power becomes materialised in artefacts as well as social arrangements. In addition, Bijker's findings derive from meticulous research using a wide variety of archival sources.

The case study which informs this thesis draws on written records but the main source of material has been interviews with those who work for the company which produce and sell the package and with those who use it. My aim throughout has been not only to understand how the package is developed and used but also to explain how the package and development strategies are implicated in maintaining or changing existing distributions of power. Although, as Sayer (1992) warns, case studies are not generalisable in the statistical sense, this study should allow something useful to be said about how power relations might be changed or sustained through technological innovation.

The two chapters which follow this introduction discuss in greater detail the theoretical basis and methods of the study.

Chapter 2 examines a variety of literature, drawn primarily from the social sciences, which suggests ways of understanding how technology is implicated in relations of power. I discuss the strengths and weaknesses of this work, including its adequacy for this type of research. I also examine some of the practical difficulties political activists have experienced in making technology 'human centred' rather than a tool for profit. I conclude the chapter by summarising Bijker's perspective on power which forms the basis of my own approach.

In Chapter 3, I discuss the methods of the study which include a mix of documentary research and fieldwork. Documentary sources include professional journals used by doctors, nurses, pharmacists, managers and those working in the social sciences and the computer industry. The fieldwork involves interviews, informal discussions and observation as well as the use of written documents obtained from the research sites. In this chapter I also explain my reasons for using open-ended interviews as the primary source of material, discuss the ethics of the research, the process of data collection and problems which arose during the research process. I then explain how I analysed the findings and conclude the chapter by discussing the reasons for my choice of representational format and style.

Chapter 4 sets the scene for the emergence of Primetech2, the medical software package at the centre of the research. It sketches a history of the package, linking it with the history of Healthserv, the New Zealand company which develops, sells and supports the package and with widespread changes in computer technology and with recent changes in the New Zealand health system. The chapter concludes with Healthserv's decision to embark on the development of Primetech2 in 1996. This chapter serves two main purposes. Firstly, it provides an understanding of the distribution of power which existed before the current domination of the PC software market by Microsoft, the health reforms of the 1990s and the wide scale movement of PCs into general

medical practice. It therefore provides the basis for subsequent discussions about the consequences of these changes in Chapters 7 and 8. Secondly, Chapter 4 provides the reader with general information about the New Zealand health system and computer technology which is essential to understanding the content of the subsequent three chapters.

Chapters 5, 6 and 7 comprise the main findings of the study and, as I explain in Chapter 3, the text includes the voices of the participants as well as my own. As might be expected, the business and computer terminology and the economic concerns which permeate these chapters are consistent with the concerns and words of those who participated in the study. This does not mean that I abdicate responsibility for what I write or that these three chapters are a simple unmediated reflection of what I have been told. They are, rather, my attempt to produce text which will have meaning for the participants in the study should they read the thesis and allow readers unfamiliar with the worlds of software development and general medical practice to gain a glimpse of these worlds.

In Chapter 5, I show how the package was developed through the interactions of a number of different individuals and groups. I also show how the requirements of different groups of users were gathered by Healthserv and how priorities were set. The second part of the chapter, discusses the micropolitics of development and the outcomes of the development process. These include the features of the package as well as a group of strong advocates for its use. In terms of the central thesis, this chapter shows the processes through which the power relations associated with development became materialised in Primetech2 and the socio-technical outcomes which accompany the package as it is acquired and brought into use.

Chapter 6 examines how Primetech2 is acquired and brought into use. I identify the groups which make the decision to purchase the package and what and who influence their decisions. I also discuss how acquiring Primetech2 brings with it a number of choices about how much software, hardware and training will be purchased and how existing files will be converted. I then

discuss the potential impact of these decisions as the package goes live. In terms of the central thesis, this chapter shows a further reduction in the flexibility of the package as it becomes part of the working life of a particular general practice site. It also suggests some of the ways in which Primetech2, and its accompanying social and technical arrangements begin to act as instruments of power.

In Chapter 7, I examine the package in use at a small general practice site and its impact on the different groups of end users, including GPs, practice managers, practice nurses and receptionists. I also discuss how the package has the capacity to alter relationships within the practice and the relationship GPs have with their patients as well as those outside the practice. I link these changes to several factors including the characteristics of the participants, the content of the package and the platform on which it runs. I also link them to the local circumstances of use and implementation, the circumstances of development and the all-pervasive economic relations of the New Zealand public health system. In other words, it shows how Primetech2 plays a significant part in the interactions between groups within and beyond the general practice site and, in this way, realises its capacity as an instrument of power.

Chapter 8, the conclusion, draws the discussions in the previous four chapters together and examines the possibilities for affirmative action during the development of a package such as Primetech2, its deployment and its subsequent use. It evaluates the use of Bijker for research of this type and the suitability of the methods employed. It also suggests avenues for future research.

Chapter 2

Literature Review

Chapter 2 discusses a variety of literature which suggests ways of understanding how technology is implicated in relations of power. I begin by examining work in the labour process tradition which draws its inspiration from Braverman's (1974) classic deskilling thesis. A number of texts extend Braverman's categories while others grapple with oversimplified conceptualisations of the relationship between capitalists, workers and new technology. An important strand of work within this tradition is concerned with the practical difficulties of making technology 'human centred' rather than a tool for profit.

I then move on to an inter-disciplinary body of work known as science-technology-society or STS. STS includes historical research and research which draw on the labour process debate but the dominant source of inspiration for technology studies in the STS tradition has been the sociology of science and scientific knowledge which emerged in Europe and the English-speaking world during the 1970s. The positions which I examine in this chapter include the so-called actor network theory or sociology of translation as well as work which maintains clearer distinctions between the human and non human 'actors' involved in technological development.

I conclude this chapter with an examination of the work of Wiebe Bijker whose conception of power informs my own research.

Technological determinism: power exercised by technology

An important central concern within the social study of technology which has developed over the past twenty-five years has been to refute the idea that technology has an imperative of its own, separate from social circumstances. Although rarely explicitly claimed, elements of technological determinism can

be readily discerned in many popular discussions of technological innovation and in the notion of technological progress which often accompanies the introduction of new technology into the home and workplace. There is also an equally widespread form of determinism which suggests that social change can be seen to derive, in a determinate way, from technological change. In a range of popular and other literature on the impact of computerisation, social revolutions of either a utopian or distopian kind are said to flow from its introduction.[3]

As Rob Kling and Suzanne Iacono (1991) point out, such rhetoric has significant effects for it can undermine serious inquiry into what social changes are actually occurring and which of these might be meaningfully attributed to computerisation. Equally significantly, it directs attention away from understanding how this happens and how, in consequence, things might be otherwise.

Technological power derived from the social relations of production

Studies in the labour process tradition are based on the premise that capitalist social relations give rise to certain forms of technology in the workplace. In the classic work of Harry Braverman (1974), new technology, developed as part of twentieth century monopoly capitalism, is said to deskill the working classes and reduce their control over the labour process. In other words capitalist social relations are both reflected and enhanced by new workplace technology in a relatively straightforward way.

Braverman's thesis, with its focus on technology and inequalities of power, has had a profound influence on industrial sociology as well as the sociology of work and organisations. In the decade following its publication and beyond, there have been numerous studies of the impact of new technology on the

---

[3] In *The Road Ahead* (1995) Bill Gates is optimistic about the way new digital technologies will transform all our lives. Other literature is more pessimistic. For an extensive and thoughtful discussion of utopian and distopian literature on computing see Charles Dunlop and Rob Kling's (1991) review essay.

labour process and workplace relations. Some refine Braverman's thesis by extending his categories and telling more complex stories.

Jane Barker and Hazel Downing (1985), for example, stay within his general framework by suggesting that replacing typewriters with wordprocessors should be seen as a move from skilled work to factory style office production. They also argue that wordprocessor operators are subjected to increased control over their conditions of work because people are more readily replaced than in the past and because throughput can be readily monitored. This is classic Braverman so far but his thesis is supplemented by a gender analysis when Barker and Downing suggest that the move from typewriters to wordprocessors should be conceptualised as a shift from patriarchal to capitalist social relations and that women find capitalist control harder to resist than patriarchal control.

During the 1970s and 1980s, many feminist philosophers and social theorists debated the nature of patriarchy and its links to capitalism.[4] If Barker and Downing's work is examined from within the context of this debate, it is clear that few participants would support the way Barking and Downing treat capitalism and patriarchy as discrete systems. Sylvia Walby (1986) and Harriet Bradley (1989), for example, argue that both systems interpenetrate at all times in all spheres of life, while Iris Marion Young (1980) and Alison Jaggar (1983) argue for an even closer union in the form of a single system which embodies both forms of domination. At the same time, at least in the work of the four authors just cited, the historically and culturally specific nature of patriarchal power is stressed as well as the different types of patriarchal power.

Over the past decade, the debate about how patriarchy and capitalism articulate has all but disappeared as feminist theorists have questioned the adequacy of Marxist conceptual tools to encompass other forms of inequality and the very possibility of any meaningful alliance between feminism and

---

[4] See Barrett (1980), Jaggar (1983), Walby (1986) and Tong (1989), for useful general reviews of the debates.

Marxism.[5] It is from the context of this debate that a number of critiques of feminist work in the Braverman tradition, such as Barker and Downing's (1985) study, have emerged. Sonia Liff (1993), for example, draws on a range of research carried out in the UK during the 1980s which suggests that office work may be less skilled today than in the past if long-term trends are analysed but that any deskilling which has occurred cannot be directly related to the introduction of computer-based technologies. Liff also points out that the research suggests that in some organisations, new technology has little impact on the nature of the work while in others, women office workers find computer-based work requires a wider range of skills and may be associated with more stress than in a non-computerised environment. She concludes that lack of understanding by management of the new skills that computer-based technologies require and inadequate training contribute to this stress.

Juliet Webster (1993) draws an interesting connection between academics who subscribe to Braverman's deskilling thesis and managers who underestimate the skills required to carry out office work using the new computer-based technologies. According to Webster, both groups underestimate the expertise, of both an organisational and technical kind that women office workers bring, to their work. She cites a range of literature, including the ground breaking work of Cockburn (1983) which shows the close relationship between notions of technical skill and the gender of the worker.

Rosemary Pringle (1988) argues this point strongly in her study of secretarial work and goes on to suggest that there is a strong cultural connection between masculinity and technology. She cites as an example the way women secretaries are regularly represented in advertisements and elsewhere as the servants of technology while men are its masters. Pringle also suggests that using computer-based office technology to monitor throughput as a matter of course may be resisted by executives and secretaries alike while her research

---

[5] The introduction to Barrett (1988) discusses in some detail the difficulties involved in a Marxist-feminist union and the movement away from further attempts to reconcile the differences by herself and many other feminists.

clearly shows the diversity of tasks, from tea making to personal shopping, which a particular secretary might do and which sit outside any computer-based technologies and all forms of automated monitoring.

In the work of Pringle (1988), Liff (1993) and Webster (1993) then, where the gender of the worker, different occupations and different organisational contexts are considered, technology is not the primary means by which capitalist or patriarchal power is wielded in the workplace and Bravermanian notions of deskilling cannot be sustained. All four researchers suggest that the meanings of masculinity, skill and what counts as technology are linked in some way and that the link provides (some) men with power over (some) women. However, the authors leave important differences unexamined. The 'bosses' are described variously as supervisors, executives, managers or capitalists and, in addition, important differences between groups of office workers are described rather than discussed. Equally significantly, the authors provide little in the way of a satisfactory theoretical conceptualisation about how power actually operates in an organisational context.

Child (1988) creates a useful distinction between higher level managers who set strategic objectives and middle managers who have the job of putting the strategies into practice and making sure that objectives are met. Child also offers a further critique of Braverman's deskilling thesis and a more subtle analysis of power by showing that new computer-based technology can meet what he calls 'fundamental capitalist objectives' in a variety of ways. In some circumstances, new technology will be introduced to deskill workers. In others, new technology will be used to reduce the number of workers, to allow work to be contracted out or to break down traditional job or skill demarcations. This last consequence might be described as job enrichment from some perspectives, job enlargement from others.

Child also argues that computer technology should be thought of as facilitating rather than determining such changes and that increased control by management over the labour processes of workers is not necessarily linked to management intent. In some situations where a better quality product or

improved flexibility is the primary aim, workers may lose control over their work without clear intent on the part of management. Conversely, management strategies to gain more control may be not realised or even actively subverted by middle managers, by those who organise the work processes or by the workers themselves. As Child sums it up, strategic objectives may set the parameters, but 'actors, processes and contextual conditions all need to be taken into account' (1988: 233).

The case studies in the volume edited by John Jermier, David Knights and Walter Nord (1994) illustrate a number of ways in which workers, either individually or collectively, resist the power of management to control their working lives. The influence of Foucaudian thought[6] on organisational theory and the labour process debate can be discerned in many of the studies which stress the importance of knowledge and information in the exercise of power and which show how power and resistance go hand in hand. Stewart Clegg (1994), discusses these issues and then goes on to argue that lack of resistance should not be confused with consent. Firstly, the cost of resistance may be too high, especially in the absence of collective support and, secondly, workers may be unaware that power is being exercised. This latter point is well illustrated in Terry Austrin's (1994) article on the New Zealand Banking Industry in which he suggests that performance reviews seem to be in the interests of workers and management alike but form part of a series of sophisticated strategies whereby management directs workers to behave in ways that management consider desirable.

In the same volume, Davidson (1994) shows women office workers in the service industry protesting against the new profit-oriented philosophy of their organisation through individual acts of sabotage in the form of experimenting with ways to make the new computerised customer system lose data, 'forgetting' to input data and keying in obscenities. However, as Davidson

---

[6] Particularly Foucault's widely cited discussion of power and resistance found in *The History of Sexuality Vol I*, Part 4, Chapter 2 (1981).

points out, the workers were ambivalent about what they were doing for they were concerned about the impact of their actions upon customers as well as those at the top. They also expressed concern about their own job security given the audit trails in the computer system. Gottfried's (1994) study of temporary office workers also shows how they exercised power individually and quietly in the form of long breaks or a refusal to obey the dress code, and comes to the conclusion, like Davidson, that individual rather than collective acts of resistance have little real effect.

Although the studies in Jermier et al (1994) show resistance as well as domination, the focus is still on power operating between management and workers. There is a single conduit even if the flow is rarely without obstructions and counter-flows. Roberta Hill and Bob Gidlow's (1988) analysis of the introduction of new printing technology into the Christchurch Star, on the other hand, focuses on power operating between different groups of workers such as the journalists and printers, as well as between workers and management. The study also spells out a number of the contextual conditions that lead to the introduction of new technology as well as shaping its implementation and subsequent impact.

Hill and Gidlow (1988) suggest that the new printing technology introduced at the Star offered the opportunity to substantially reduce staff costs and that this was seen as critical by both management and workers in an industry experiencing a drop in advertising revenue. They point to the economic downturn which emerged in New Zealand in the mid-1970s and to increased competition from the electronic media as factors in the drop in revenue. At the same time, the authors argue that television imposed new standards of timeliness and that lack of parts and technical support for the old equipment made the old technology harder to maintain. In other words, obsolescence of existing technology and concern for product quality, not just staff costs, contributed to the decision by the management of the Christchurch Star to migrate to new printing technology.

The main focus of Hill and Gidlow's work, however, is not the process of deciding to adopt new technology but the complex process of implementation where the

> outcomes of technological change are seen as the results of shifting patterns of conflict and alliance among and between groups of workers and employers. (1988:25)

For Hill and Gidlow, the contextual conditions surrounding the implementation play an important part in shaping the outcomes and the authors bring into focus the influence of labour laws, the industrial relations climate and cultural constructions of gender found in New Zealand society at the time.

Detailed empirical studies of the type discussed in Child (1988), Jermier et al (1994), and Hill & Gidlow (1988) clearly show that new technology in the workplace may be associated with variable amounts of change and that these changes can be seen to derive from the interactions of individuals and groups situated in local and historically specific conditions. Child in particular stresses the interpretive flexibility of computer-based technologies, that is their ability to be understood and used in many different ways. In his work, there is no simple conception of power as capitalist or patriarchal oppression but the asymmetries of power that characterise these interactions are not forgotten. According to Child, those who make the purchasing decision and those who set the general guidelines about how new technologies will be implemented both shape and constrain the actions of those who actually use the technology, even if they rarely fully configure how it will actually be done.

Although these and the feminist studies of the impact of new technology in the workplace may critique aspects of Braverman's work, they share the same concern to refute technological determinism. Perhaps because of this concern, the technology itself tends to disappear. In the classic labour process tradition, workplace technology becomes a transparent means of reproducing existing social inequalities. In studies which critique Braverman, technology also sits on the sidelines while a variety of social, cultural and economic factors interact in interesting ways. The interpretive flexibility of the technology is stressed

even where the study itself implicitly shows that there are limits to this flexibility.[7]

To draw a simple example, the computerised typesetting technology discussed by Hill and Gidlow (1988) may have been interpreted in different ways by different social groups but all groups saw it as a technology which would be used to enter, store and format the content of a newspaper using photographic and computer-based equipment rather than hot metal type. The new technology also opened the door to other changes, such as the direct entry of copy by journalists, although these changes were contingent on other processes as well. In other words, an analysis of the impact of technology would benefit from taking the technology and its genesis into account.

Technological power derived from the social relations of development

How to take the technology into account has been the subject of considerable debate within social studies of technology and has led to an increasing concern with the development and design of technology. In the human centred systems (HCS) and participatory design (PD) literature this concern is frequently merged with practice.

In the work of Mike Cooley (1987) HCS has a broad scope. It tells us that we should be concerned with what we produce as well as how we produce it. It also tells us that substantial changes need to be made in the development and design phases if technological systems are to deliver sustainable benefits for all social groups rather than short-term profit for the few. Inherent in this statement is the assumption that the involvement of those who will be using the technology and those who understand how the work is done will make a difference to the type of technology we produce and its impact on the work

---

[7] A parallel might be drawn between the way sociology has treated the body. A long-standing, and still very necessary concern to refute biological determinism often leads to its opposite, a form of social determinism which ignores the way we are simultaneously biological and social beings ..... and technological, economic, cultural and political beings too, of course.

process. There is a strong move within HCS that user involvement will lead to worker control of the technology rather than the reverse and to a greater integration of the execution and conception phases of the work process.[8]

The specific idea of user involvement in the development and design of computer technology as a means of shaping the outcomes is taken up in the PD literature as well.[9] In general terms, the proponents of HCS focus on how to improve the quality of people's working lives through user involvement in development, while those who advocate PD seek to develop successful computer systems through user involvement. In practice, it is hard to differentiate between the two, especially in relation to HCS and the Scandinavian version of PD, both of which are based upon principles of workplace democracy. There are also considerable overlaps in the conclusions of those who have developed systems according to PD and HCS ideals.

Mike Hales and Peter O'Hara (1993) describe and analyse their experiences of using 'an ideology of participation and bottom up activism'(153) during the development of a large computerised system for local government between 1986 and 1990. The authors discuss how equal employment opportunities for women were of central concern to those who managed the project and how this was achieved only in the design phase. Hales and O'Hara conclude that no real changes in women's working lives occurred because insufficient attention was given to the participation of women in the implementation phases and in future development strategies.

---

[8] Concern with the alienating effects of separating the hand and the mind, or the conception and execution aspects of the labour process, is an abiding feature of the Marxist literature on work. This can in fact also be conceptualised as a critique of Taylorist practices rather than capitalist social relations *per se* which suggests that integrating the hand and the mind is not necessarily the only issue.

[9] For a detailed discussion of the participatory design literature see the June 1993 special edition of the computer science journal *Communications of the ACM*, edited by Kuhn and Muller. In addition, Green, Owen and Pain (1993) and Greenbaum and Kyng (1991) provide a comprehensive introduction to the human centred systems literature.

In contrast, Andrew Clement and Peter Van de Besselaar (1993) conclude that many users do benefit through participation. At the very least, the process of participation ensures that users are better informed and more confident about their ability to contribute to the development process and come to see that computer systems are neither neutral nor value free. In addition, systems which have been developed using PD strategies appear to work well from the perspectives of those who use them.

At the same time, Clement and Van de Besselaar(1993) point to the limitations of a narrow focus on design. This focus cannot, for instance, guarantee the implementation or the long term survival of any computer system and that HCS or PD strategies will continue to be used in future redevelopments. Nor, as Hales and O'Hara (1993) have shown, does the redesign of an artefact guarantee specific types of changes in how work will be done. In other words, just as the critics of Braverman-type impact studies successfully contest any simple link between the social relations of production and technological outcomes, practitioners of HCS and PD show that the relations of power surrounding the technology in use cannot be determined by the relations of power which surround the design and development of the technological artefact. This is particularly true of Hales and O'Hara (1993) who argue that there cannot be any such thing as a human-centred artefact, only human-centred practice which occurs at every phase of the artefact's existence.

Those who draw on ethnomethodology offer similar insights. In an early work, Dorothy Smith (1974) discusses the way technology is reified in many Marxist accounts of social change. She suggests that reification can be avoided if technology is alway associated with practical activities carried out by an embodied user, located in an actual and historically constituted place. Lucy Suchman (1994), in a detailed study of the introduction of image processing technology into a United States law firm, argues similarly for seeing technology as something in use. She backs up her arguments with an exemplary account

of the work done by a group of women employed to encode the data and set up the database. [10]

Much as Webster (1993) and many other feminist researchers have shown in their studies of women office workers, Suchman (1994) argues that the attorneys in charge of the project underestimated the complexity of the work, and the skills required to do it well. Suchman describes how this 'invisible' work included a great deal of articulation work which drew disparate bits together in creative ways and made things work in situations where there were no clear guidelines or rules.[11] Suchman goes on to suggests that computer systems might be designed in ways which support human skills rather than ignoring or attempting to replace them.

In an earlier text, Suchman (1987) provides useful insights into the nature of human-computer interaction by showing how the computer appears to talk and behave as if it were human but that its reactions can only be those which have been determined in advance by those who design and develop its component parts. She compares the limitations of pre-planned human-computer interactions with human-human interactions which are sensitive to local circumstances and thrive on vagueness. For Suchman (1987), who works in the computer industry, the challenge is to improve the way computer systems are designed while retaining the distinction between humans and computers. But, in common with the texts examined so far, Suchman (1987;1994) does not provide a conceptual understanding of how local circumstances of use connect with wider patterns of interaction and how power operates between the human and non-human participants.

---

[10] Image processing technology allows paper-based documents to be copied into a computerised database and retrieved at a later date. As Suchman states in this study, the successful retrieval of the electronic information cannot be taken for granted as this action is dependent upon the skill and accuracy with which the indexes (or what she calls 'codes') are allocated to the electronic form of the document.

[11] This might be described as 'not working to rule', given that 'working to rule' is an important form of worker resistance.

Technological power as the outcome of human and non-human interaction

Concern with the complex interaction of society and technology characterises many studies which fit under the general rubric of science-technology-society (STS). This broadly-based and interdisciplinary body of work includes Marxist and feminist-inspired literature which posits a straightforward link between gender or class interests and technological outcomes. Much of the work, however, draws on different traditions and avoids replacing technological determinism with an oversimplified social determinism.[12]

Historical analyses using a network model of technological innovation

A number of the studies within STS are concerned with major technological developments and wide scale patterns of interaction. This is particularly true of social histories such as Ruth Schwartz Cowan's study of changing cooking technologies (1983) and Thomas Hughes' chronicle of the electrification of the Western world during the late nineteenth and early twentieth century (1983).

Both histories show successful technological innovation being forged by the interaction of many individuals, groups and non-human entities. Existing technologies, governments, financial institutions, the natural world and existing social arrangements all play their part. Hughes and Schwartz Cowan also show that technological outcomes always include particular social arrangements as well as technological artefacts.

---

[12] STS had its beginnings in the 1970s when social scientists, influenced by the work of Thomas Kuhn (1962), began to examine the internal practices of those working within the scientific enterprise. Detailed studies of scientific work by social constructivists such as Karin Knorr-Cetina (1981) clearly show that science is a thoroughly social activity and that even the most esoteric scientific facts are not 'given' by nature but constituted through this activity. Relating such findings to technology seems to be eminently possible, given that technological artefacts are more intuitively the outcome of social activity than are scientific 'facts'. See Knorr-Cetina & Mulkay eds.(1983) for a brief summary of the rise in post-Kuhnian social studies of science and Pickering ed.(1992) for more recent approaches. For the applicability of the sociology of science to the study of technology, see in particular Pinch & Bijker (1987).

Schwartz Cowan (1983, 1987) describes the outcome of technological innovation as a network of diverse interacting elements and explicitly places the consumer at the hub. She suggests that without consumers, no technological innovation would be a success and that the factors which turn non-consumers into consumers may not be revealed unless we examine the network of entities and relationships in which consumers are enmeshed (1983; 1987). Schwartz Cowan gives as an example the increasing success of cast iron stoves in the US during the mid nineteenth century. This success, she proposes, cannot be linked to design changes nor to consumer-demand but rather to alterations in the structure of the iron and steel industry which allowed the stoves to be produced in much greater quantities and at lower prices.

Hughes(1983), in contrast, places those who drive successful technological innovation at the centre of his inquiry. He shows that by focusing on notable figures such as Thomas Edison the multi-faceted character of technological innovation comes into view. According to Hughes, Edison actively sold his ideas and involved himself in the politics and economics of innovation as well as design. For Edison, the cost of making something work and connect into existing networks were central problematics rather than something that could be attended to after technical problems had been solved. Hughes also tells us that what appears to be a revolution is often long in the making and that creativity is not something magical but an ability to use ideas drawn from other disciplines and to modify what is already in existence. In other words, by focusing on Edison and the socio-technical network that comes into view, Hughes shows that technological success derives from entrepreneurial skills as well as creativity and that the technical, political, financial and promotional aspects of technological innovation are all significant.

The studies of Schwartz Cowan (1983) and Hughes (1983) can also be read as studies of power. Power can be discerned operating in the detailed descriptions of the situations in which innovation is accomplished and in the socio-technical outcomes. It is clearly a capacity as well as an event for Hughes' work in particular illustrates that ready access to a diverse range of

resources[13] allows some to be more influential than others. This does not imply a zero sum conception of power nor any simple reproduction of power relations. Power in both studies is clearly something enabling as well as oppressive and may be reproduced or redistributed in unexpected as well as expected ways.

Actor network theory: a sociology of translation

A network model of technological innovation has achieved dominance within STS although its precise form is the subject of considerable debate. At the centre of the debate sits actor-network theory, the highly influential work of Michel Callon and Bruno Latour and others,[14] which can be connected to the approach taken by Hughes (1983). What Callon and Latour share with Hughes is a similar concern with networks and network building from the perspective of the builders. They also share his conclusion that network building and networks themselves are dynamic processes involving the assembly of a range of human and non-human entities into something which becomes an established feature of the world. However, the set of conceptual tools that Callon and Latour develop for their analyses of scientific and technological innovation and the workings of power are very much their own.

The most central of these is the concept of generalised symmetry, namely that the same terms and methods should be applied to studying all the human and

---

[13] Hughes (1983) shows actors drawing on a range of skills and knowledge and making use of formal and informal relationships and their own positions in the worlds of politics, business etc in order to construct new socio-technical systems or networks. Interestingly, the resources Hughes describes have much in common with the phenomena of power (class, status, party) used within Weberian sociology.

[14] John Law, who has been closely involved in the development of actor network theory, is often included with Callon and Latour when the characteristics of actor network theory are discussed but there are important differences. He is, for example, more explicitly concerned with issues of inequality and more willing to work from a variety of perspectives rather than just his own or the inventor-entrepreneurs so favoured by Latour. In addition, perhaps because of his sociological connections and British background, his writing is less flamboyant and his claims more modest than those of Callon and Latour. Callon, Latour and Law have published widely but see in particular Latour (1988), Callon (1986) & Law ed.(1991).

non-human entities, or actants, which belong to the network. This is not, as Callon and Latour (1992) state, an ontological commitment to the uniformity of human and non-human actors but rather a refusal to accept any existing ontological commitments to the constitution of the natural, social or technical worlds. One of the consequences of this refusal is that the analyst is directed to find out the characteristics or roles of different actants in relation to the network that is being examined, rather than impute structural interests based on the class or gender of the human actors.

Callon and Latour's directives produce explanations in which the actants are situated within a particular network rather than more generalised social structures. They also allow non-human actants such as seat belt warning devices and automatic door shutting mechanisms to play an active part in shaping the actions of the car driver and the user of doors respectively (Latour, 1992). In many accounts, such as Callon's (1986) tale of the scallops 'who' resisted scientists' attempts to make them part of the aquatic life of St Brieuc Bay, members of the natural or technical worlds are allowed to 'speak for themselves', much as the scientists and fishermen of the bay are allowed to have their say.

But Callon and Latour are more interested in the establishment of actor networks rather than their maintenance or effects and they offer the concept of translation as a means of understanding how they take shape. The influence of Machiavelli can be discerned in an early work where they explain the mechanisms of translation as

> all the negotiations, intrigues, calculations, acts of persuasion and violence thanks to which an actor or force takes or causes to be conferred on itself, authority to speak on behalf of another actor or force. (Callon and Latour, 1981:279)

In other words, translation or the building of actor networks, is the way micro actors become macro actors.

The first phase of translation, which they call 'problematisation', is effectively a skilled marketing exercise which involves the network builders identifying key actants, seeing how they can contribute to the new network and then

persuading the actors to see that it is in their own best interests to join in. Once these actions are accomplished, the network builders move into the next phases where existing networks are disbanded, the actants are locked into their new roles and as many additional actants as possible are enlisted to the cause. This last phase is important, for it connects the new network to those already in existence and gains size and strength through such attachments or, in their terms, 'associations' (Callon and Latour, 1981; Callon, 1986).

Success, or network stabilisation, then, involves enlisting durable objects such as technological artefacts as well as human actors and constructing an integrated set of meanings associated with these actants. Stabilised networks, like games, define who or what may participate, the characteristics of the participants and the rules of participation. To become a member of a particular network or an insider, an actant is required to go through what Callon and Latour (1992) describe as obligatory points of passage which could involve formal or informal procedures or the presence of specific physical characteristics or capabilities.[15] However, it is not just the overt rules of membership of a network but its taken-for-granted existence which minimises other possibilities and establishes what can be thought and spoken about as well as what the actants might do.

Clearly socio-technical networks are a means of constituting power for they allow some to harness the agency of others in non-coercive as well as coercive ways. Barry Barnes (1988) provides additional insight into the nature of non-coercive social power by describing it as something embedded in routines and organised interaction. Barnes, in common with the proponents of actor network theory, is also willing to talk about collective actors. Committees, for example,

---

[15] The plugs on electrical devices, which vary substantially between countries, are a good example of obligatory points of passage which have a physical manifestation. However, the less obvious procedures and standards which characterise the use of computers and many other facets of our socio-technical lives, serve to exclude those who are unable or unwilling to interface in the prescribed manner. The term 'interface' seems to be a particularly apt in this context as it brings in the idea of translation as well as connection..

can have discretion over routines and therefore can be said to have authority through this as well as overt forms of decision making. Unlike Callon and Latour, Barnes focuses on the way power is possessed and exercised by human actors rather than a mix of human and non-human actants. This places him in the same camp as Harry Collins and Steven Yearley (1992a; 1992b) who argue for the value of foregrounding the social as they critique the actor theorists' principle of generalised symmetry and, most significantly, what they perceive to be its consequences.

Collins and Yearley: A critique of the principle of generalised symmetry

Collins and Yearley are sociologists of science and scientific knowledge but criticisms in their two 1992 articles relate to the actor network theorists' studies of technology as well as of science.[16] Collins and Yearley are willing to concede that by giving non-human actants a voice, Callon and Latour provide interesting and provocative stories but argue that these stories are sometimes little more than the imaginative inventions of the actor network theorists themselves or just unreflective accounts of the scientists' or technologists' versions of events.

In contrast, according to Collins and Yearly (1992a, 1992b), foregrounding the social encourages the social researcher to focus on the scientists' and technologists' social worlds and, through careful research, bring to light the way scientific facts and technological artefacts are socially constructed. This sociological approach, they argue, may be less radical than Callon and Latour's attempts to break down existing analytical distinctions between the social, technical and natural worlds but it produces knowledge that is more radical in a world where natural scientists continue to hold greater authority and influence than social scientists.

---

[16] Collins and Yearley draw particularly on Callon's (1986) study of the recalcitrant scallops and various studies where Latour attributes agency to technological artefacts (see Latour (1992)).

Fujimura and Star: Critiques of and alternatives to actor network theory

What is also missing from Callon and Latour's work is any clarification of how the authors investigated and constructed the actions of the non-human actants. As Joan Fujimura (1991) points out, the actor network theorists critique sociological theory but fail to acknowledge the limitations of their own theoretical commitments and representational practices.

For Fujimura (1991; 1992) and Star (1991a; 1991b; 1995), who draw on the symbolic interactionist tradition and feminism, Callon and Latour's approach has a number of serious inadequacies. Fujimura (1992) offers the important insight that the concept of translation seriously underplays the negotiation and cooperative work which contribute to technological innovation, while Star (1991b) argues that much can be learnt about technology and power from those who are unable or unwilling to be enrolled and who experience a socio-technical network as a source of chaos and trouble.

As Star (1991b) points out, formal models of work are inadequate representations of how things actually get done in particular situations. In the first place, many of the working practices of those with little status are not represented and in the second, much work, especially articulation work, is resistant to formalisation. Star, similarly to Suchman (1994), defines 'articulation work' as that which 'gets things back on "track" in the face of the unexpected and modifies action to accommodate unexpected contingencies' (1991b:275). It is work which involves continuing translation, in the general sense of the term, so that differences between social groups might be accommodated and links between them forged and maintained.[17]

---

[17] Star's (1991) discussion of the 'productivity paradox' is germane here for it suggests that the apparent drop off in productivity which occurs when many new computer-based information systems are introduced is not a paradox at all if articulation work and other invisible work is taken into account. It seems to me that the 'productivity paradox' could be seen as a failure of many managers to understand that translation is an ongoing process and to accord sufficient value to the part played by lesser mortals in this process.

Fujimura and Star, then, advocate an interactive model of technological innovation which incorporates genuine negotiation as well as the translation process elaborated by Callon and Latour. They also advocate studying technology in use as well as during innovation because such a study provides greater insight into the experiences of those who lose out as well as those who win.

Cockburn and Ormrod: losing the technical in the social

Cynthia Cockburn and Susan Ormrod's (1993) study of the microwave oven and microwave cookery is one of several European studies of different domestic technologies which were commissioned in the late 1980s to illuminate how gender relations shape technology and how technology in turn shapes gender relations.[18] These aims clearly set the direction of the research and dominate the findings. However, the researchers' rich descriptions of the many different groups of people and their activities involved in the production, sale and use of a particular microwave show that the actors are never *just* men or women. They are, rather, men and women with a range of other characteristics and responsibilities who participate in a variety of social worlds, including the newly emergent world of microwave cookery. With a different focus, the story of the gendered relations of microwave cookery could have been a story of the class or ethnic relations of technology or the significance of the actors' ages.

Unsurprisingly, Cockburn and Ormrod's (1993) findings confirm the presence of a sexual division of labour and the material inequalities associated with the work that men do and the work that women do at every phase of the artefact's existence. These inequalities, which include pay, office space, company cars, mobility, training and authority over people, work processes, materials and technical things do not, the researchers suggest, necessarily relate to the skills men bring but to the way these skills are named and valued. Cockburn and Ormrod point out that work described as scientific or technical is equated with

---

[18] See the volume edited by Cynthia Cockburn and Ruza Furst Dilic (1994) for a summary of each of the projects and points of commonality among them.

masculinity and more highly valued than other forms of work, especially nurturing work which is equated with femininity. This argument is backed up by an extended example of the superordination of engineering skills and knowledge over "cooking" skills and knowledge throughout each phase of the microwave oven's existence.

There is nothing novel about Cockburn and Ormrod's (1993) insights into the material and symbolic dimensions of gender inequality in the places where technology is developed, produced, sold and used. Similar conclusions abound in the extensive literature on the gendered nature of paid and unpaid work.[19] The researchers move on to newer ground when they map these insights on to the interactions which give shape and meaning to a particular technological artefact at various phases in its history and to the way each phase is linked.

For Cockburn and Ormrod, describing an artefact and its associated processes and know-how as technical, sets out the characteristics of those who should have the greatest say in its design and production, namely those with technical skills and knowledge who are primarily men. It also influences who sells it, how it is sold and who is willing to use it although the researchers show the meaning of the microwave oven becoming more predominantly that of cooker over time. The researchers suggest that domestication of the microwave oven and a corresponding increase in the role played by women in its development and sale relate to both the reduced appeal of an aging technology to those interested in technological 'gismos' and a concern to repackage it as a sophisticated cooker so that it would continue to sell once it had lost its novelty value.

In other words, Cockburn and Ormrod show the dominant meaning of the artefact changing in different situations and over time. At the same time, the

---

[19] See for example the work of Liff, Pringle, Webster, Bradley, Walby, some of which is referenced in the early part of this chapter and the extensive pay equity debate which emerged in New Zealand in the late 1980s. Cockburn (1983) also writes at length about the power associated with calling certain forms of work 'technical'.

researchers claim that there are limits to its interpretive flexibility and that technology can be said to have the effect of perpetuating existing stereotypes about men and women through promotional material, instruction booklets and design features.[20] One way of breaking the cycle, they suggest, is to have the users more adequately represented in the innovation processes.

Unfortunately the authors provide little evidence to back up these claims. They suggest that the technology is associated with a new arena in which gender relations will act. More specifically, they conclude that some men see it as a 'non-sissy' way of cooking but still rarely cook for others, that it shores up inequitable distributions of domestic work and that it contributes to a trend away from family meals and cooking from 'scratch'. But it is hard to see from these conclusions what the limits to interpretive flexibility might be, apart from the limits imposed by existing gender relations. It is equally hard to imagine what might be different with more adequate user representation during the process of innovation. These gaps might have been filled if the researchers had paid greater attention to the features of the central artefact and how they came to be there. Why, for example, is the oven at its most effective when cooking small quantities of food? Were there other options, and, if so, why was this one chosen? How significant is this feature to the way it is sold and used?

Wiebe Bijker: reintegrating the social and the technical

Wiebe Bijker (1987,1995), an influential contributor to technology studies in the social constructivist tradition, shows more concern for the artefact and its obduracy. In other respects Bijker's work has a number of important general similarities with that of Cockburn and Ormrod (1993): both are based on an understanding of technology and society as a 'seamless web', thoroughly intertwined and constantly shaped and reshaped through a diverse range of

---

[20] This point is made particularly strongly by Cockburn and Ruza Furst Dilic (1994) in relation to the findings from several of the studies. In the introduction to the collection, the editors argue that the designers of domestic technologies bring a mixture of stereotypes, folklore and a deficit model of the user as clumsy, absent minded and dangerous into their work.

interactions; both provide rich descriptions of a particular innovation which illuminate the complexity of the interactions; both show an explicit concern to move beyond a uniquely detailed story to theoretical generalisations and political action. Bijker's case studies of the development of the bicycle, bakelite and fluorescent lighting, however, show that a greater concern with non-human factors allow a researcher to open up the 'black box' of technology as well as the 'black box' of society and to understand how both are implicated in relations of power.

As already discussed, Callon and Latour attempt to do this from their position of generalised symmetry where non-human actants, such as technological artefacts, are posited as both the *explanans* and the *explanandum* for socio-technical change. Bijker, in contrast, stays more in the sociological camp and one step further removed from technological determinism by retaining a focus on the human actors and by continuing to point out that it is the socially-constructed technology that can be used to explain subsequent processes and events. To express this in terms of power, one might say that Bijker is concerned with showing how power relations come to be materialised in technological artefacts and how these in turn become instruments of power. Bijker (1995:263) uses the term 'the micropolitics of power' for the processes which give rise to technology and the term 'semiotic power' when describing how technology has its effects.[21]

Bijker provides a number of conceptual tools for investigating socio-technical change. The first of these, which he terms 'relevant social groups', provides a means of classifying the human actors for whom the artefact at the centre of the investigation is relevant in some way. In the case of the bicycle, for example,

---

[21] Bijker (1995:263-264) explicitly draws on

- Foucault's *Discipline and Punishment* (1975) for his 'micropolitics of power'. In Bijker's work, however, the exercise of power results in new technology rather than obedient bodies and
- Laclau and Mouffe (1985) and Clegg (1989) for his 'semiotic power conception'. In Bijker's work, which is clearly very similar to that of the actor network theorists, meanings become fixed or reified in certain forms which then go on to articulate particular facts, artefacts, practices and so forth.

Bijker suggests that anti-cyclists as well as cyclists need to be included in the story of its early development for the bicycle was relevant to those who thought it should be banned. He also shows that, at this stage, the general category of 'cyclist' comprised more than one relevant social group and identifies several, including one he calls 'young men of means and nerve' who saw the bicycle as sport rather than transport (1995:48).

Classifying the relevant social groups in this way, Bijker suggests, allows such things as the economic strength of the group to enter the picture and avoids empty general statements such as 'producers', consumers and 'end-users'. He also points out that finding the relevant social groups is an iterative process involving the actors' as well as the analyst's perspectives. Although Bijker shows that the members of a relevant social group may diverge in significant ways, he also shows that enough is shared for the group to interact as a unit with other relevant social groups. Once tentative groupings have been established, the analyst is in a position to look more closely at the interactions which occur between and within the identified groups.

Bijker provides the concept of 'technological frame' as a way of describing the elements which structure the interactions which occur within a particular social group. It exists between actors rather than above them and may include social and material elements such as shared ideas, tacit knowledge, rules of practice, ethics, techniques, equipment, goals and problems. 'Technological frame' describes a milieu more localised than the concept of social structure or even 'structural conditions' suggest but one which encompasses much more of the technical and physical world than is generally encompassed by the terms 'social world' 'subculture', 'discourse' or 'paradigm'. It also describes the elements which hold Callon and Latour's socio-technical networks together although Bijker himself prefers to use the less precise term, socio-technical ensemble, for a large heterogeneous grouping as it does not ignore the possibility of hierarchical as well as networking arrangements.

Bijker also utilises the concepts of 'stabilisation and closure' as a means of conceptualising critical processes during technological development. During

the early stages of development, a high degree of flexibility exists in terms of the content of the artefact and its meaning. As development proceeds, Bijker suggests, the flexibility of the artefact is reduced through processes of stabilisation and closure. 'Stabilisation' refers to the way the content of the artefact becomes increasingly taken for granted by a single relevant social group while 'closure' describes the decreasing interpretive flexibility of the artefact across several relevant social groups. According to Bijker, closure and stabilisation may occur repeatedly during the development of an artefact and are part of the movement which fixes both the shape of the artefact and its meaning.

This movement overlaps the mechanism the actor network theorists call translation and Bijker himself suggests that closure may be effected through the redefinition of problems or via rhetorical moves which involve the exercise of power. It may also be effected, as Bijker shows in his empirical studies, by negotiation, co-operative work or a certain amount of chance but these acts are not devoid of power. The problems of some groups and the solutions to these problems will be more influential than others during the process of closure and, typically, a single technological frame, derived from the frame or frames of the most powerful group or groups, will come to be associated with the artefact.

As discussed earlier, there will be important differences between the members of a particular technological frame including, Bijker suggests, the degree of inclusion. Those with low inclusion may be able to think outside the frame, but cannot modify the artefact or use it in imaginative ways. It will also be experienced as something inflexible which constrains what one does rather than an enabling device. On the other hand, gaining familiarity and competence draws one more closely into the artefact's world where one has the ability to use the artefact imaginatively or even to modify it while simultaneously making it harder to think outside the frame. In Bijker's conceptual schema then, artefacts, especially those which are obligatory passage points, do have consequences, albeit complex ones, which can be traced retrospectively to their socio-technical history.

Before moving on to conclude this review with a statement of my own position, it seems worthwhile to address the work of Steve Woolgar which has been influential in sociological studies of science and technology. The main features of Woolgar's arguments, which can be discerned in a 1997 publication written in association with Keith Grint, seem to be that there can be no essence to computer technology hiding beneath the social layers, for what a particular technology is, as well as its capabilities and effects, is socially constituted through and through. Grint and Woolgar (1997) stress the interpretive flexibility of computer technology and suggest that the most politically important questions a sociologist can ask are those related to the process of interpretation rather than to any imputed effects. They specifically critique Kling for adopting a social realist position[22] and for trying to posit similarities as well as differences in the way computer systems are thought about and used.

Grint and Woolgar's (1997) sceptical approach may be of some value to those who have never thought to question the way meanings are made and the constructed nature of the divide between humans and machines, but in this particular text, and in much of Woolgar's other writing[23], his arguments too often degenerate into an attack on other academics who are found to be lacking in intellectual excitement or afflicted with various forms of essentialism. More importantly, the stress on ambiguity, difference and deconstruction in Woolgar's own work seems to offer little help in doing what Bijker (1995) seems to do so effortlessly, namely showing how some technologies and their

---

[22] The term 'social realist' in this context does not refer to any Bhaskarian form of metaphysical realism but to the type of social realism espoused by Collins and Yearley (1992a:308), which the authors define as 'experiencing the social world in a naive way, as the day to day foundation of reality (as natural scientists naively experience the natural world.)'.

[23] See Woolgar (1991a; 1992) for critiques and (1991b) for a short article on one of Woolgar's own research projects which shows his concern with showing how meanings and boundaries are constructed, in this case the boundary between a new computer and its users. The article also incorporates a certain amount of novelty - the computer is made to speak for 'itself'. However, to paraphrase Collins and Yearley (1992), such rhetoric gambits may avoid 'truth making' but do little to demystify technology.

meanings come to be widely shared for what may be substantial periods of time and how this helps sustain certain relations of power.

In his critique of Woolgar's position, Kling (1992) points out that social scientists need to do more than deconstruct the knowledge claims of others for deconstruction provides just a critique of hardware and software vendors who have

> strong interests in selling their wares and facilitating a discourse that is unreflexive about the social-roles of computer-based systems...[and that] key national discourses about technology are usually framed by commercial interests (1992:350-351).

He argues for a 'reconstructive interpretivism', by which he means the construction of 'compelling narratives' and 'grounded stories' as alternatives to those which are dominant. These, Kling suggests, will provide the material for more informed debate.

Bijker (1995), like Kling (1992), advocates a politics of technology but recognises the limitations of constructivist studies to benefit any particular group. As he points out, there are no particular strategies or set of policy instruments that are certain to guide socio-technical change in a particular direction. However, his work does show how asymmetrical relations of power are the cause and consequence of technological development and it does suggest points where intervention might be most effective. My thesis therefore draws on the model of power which is inherent in Bijker's (1995) conceptual schema.

Bijker's model of power as the basis for this study

Bijker's model is based on Giddens' well-known definition of power, namely 'the transformative capacity to harness the agency of others to comply with one's ends' (Giddens, in Bijker (1995:262). Bijker, however extends this definition by placing technological artefacts as well as people into the category of 'others'.

For Bijker, technological innovation derives from the interactions of different groups. Each group shares access to certain types of resources such as

knowledge, skill and money. Each group may also be invested with various forms of formally or informally delegated authority which allow its members to represent the requirements of others or act on their behalf. Bijker also utilises the concept of technological frame, a semiotic structure which derives from the frame(s) of the group(s) which have access to the most significant resources and are therefore the most influential during development. Thus the power capacity of an artefact can be linked to the micropolitics of development and may be exercised through both its content and its technological frame. The processes of stabilisation and closure described by Bijker are about creating semiotic structures or technological frames as well as the content of the artefact.

Technological frames, which manage the interactions of those operating within them, have consequences beyond the intent or interests of those who participate in their creation. They may be experienced as enabling by some groups with resources appropriate to the new technological frame and constraining by others without access to the appropriate resources, particularly where artefacts are obligatory points of passage. For unwilling users without the appropriate skills, knowledge, machinery and so forth, new technologies may be experienced as a form of domination.

Bijker work is highly suggestive of how technology might be implicated in maintaining or changing asymmetrical distributions of power although his focus on development means that the impact of the technology is not explored in any depth. Bijker's work, however, can be extended using concepts developed by Star (1991a,1991b) and Suchman (1987) who have compatible theoretical commitments. Their insights into the specific nature of computer-mediated interactions and their concepts of invisible work and articulation work, which are discussed earlier in this chapter, allow more detailed analyses of how some groups gain from computer technology while others lose out.

This chapter has provided the general theoretical basis for this study. In the next chapter, I discuss how I designed and carried out the research and how I analysed and wrote up the findings.

Chapter 3

Research methods

I have argued in Chapter 2 that macro approaches, whether they be technologically determinist, Marxist or feminist do not provide an adequate framework for understanding the role technology plays in maintaining or changing unequal distributions of power. I have also shown that strategies, particularly development strategies, which draw on these traditions have had little success in redressing existing inequalities. In contrast, research which draws on the social constructivist tradition within STS, most particularly the work of Bijker (1995), shows that a theoretically-informed case study can provide an understanding of the way technology is both an effect and a cause of power.

Bijker (1995) discusses his methodological concepts at length but he does not discuss his methods or his sources of information to any great extent. Nor does he describe how he arrives at his interpretations of events. I therefore begin this chapter by examining what Yin (1994) has to say about the design and methods of case studies as well as drawing on the work of Sayer (1992) who provides a number of insights into research of this type.

I then go on to discuss how I planned and carried out my own research, paying particular attention to the researcher/participant relationship and the ethics of research. The chapter concludes by discussing how I analysed the material and my choice of representational format and style.

Case Studies: approaches and methods

Case studies are a type of 'intensive' research which Sayer (1992) suggests can show how something works in a particular instance and what produces a certain change. A case study approach can answer 'how' and 'what' questions and show how something works in a particular instance. It can also, as Yin

(1994) suggests, be used to examine any phenomenon which cannot readily be separated from its context and can be used to show the links between different situations and events. A case study is therefore the ideal means of examining a phenomenon such as an application software package where the boundaries between package, systems software and local conditions of use are unclear and of finding out how the package is both an effect and cause of power.

Sayer (1992) does not prescribe specific methods although he does suggest that ethnographic-style studies and interactive interviews provide information about agents in context and are therefore typical of intensive research. Although cautioning against 'empty-headed "fishing expeditions"', Sayer argues for a research plan which allows 'learning by doing', and which reflects the evolving and interactive nature of intensive empirical research (1992:245).

Yin (1994) does not advocate such a fluid design but does argue for some degree of flexibility and for using any sources which provide answers to the questions driving the study. He lists documentation, archives, interviews, direct observation, participant observation and the review of artefacts as possible sources of information. Yin suggests that any one source does not have a complete advantage over another. All may be biased or provide only partial views, but several used together can have the advantage of confirming or corroborating the same fact. For contemporary phenomena, he suggests, interviews and direct observation, can be highly complementary.

According to Yin (1994:84-85), open-ended interviews provide the interviewer with judgments and insights as well as the 'facts of the matter'. He also points out that extra data may be obtained if interviews are held on site as the researcher has the opportunity to examine such things as general location, work spaces, furnishings and physical artefacts and to draw tentative conclusions about the participants and their work situation. These insights contributed to my choice of methods as well as to my general approach.

Initial Contact

After an unsuccessful attempt to gain access to a small local development site, I followed up an advertisement in the business pages of the *Dominion* for an application software package developed in New Zealand for the primary healthcare sector. The package is described in the advertisement as a patient and practice management system designed for GPs, specialists and midwives working as individuals or in group practice. In December 1998, Primetech (not its real name) was used in over 400 sites in New Zealand in one of two distinct forms: Primetech1, the version developed in the early 1990s and its replacement, Primetech2 which became available for general release in 1998.

My interest in medical software had been raised by a recent visit to a GP who used a computer during the consultation. I was also aware that the New Zealand health system was undergoing substantial and highly politicised change and that this study would provide the opportunity for a critical analysis of power. After a brief conversation with the managing director (MD) of the company, which confirmed the possibility of the company's involvement, I forwarded a letter (see Appendix 3) which explained the study. Within a week the MD had responded and we arranged to meet at the development site.

The meeting confirmed his interest in the project and willingness to participate, although the company's written archives would be out of bounds as they contained commercially sensitive information. The MD also gave a similar reason for limiting my observation, as a participant or otherwise, at the development site but confirmed that he had no problem with my interviewing development staff and users of the package.

Before leaving the development site, I took the opportunity to pick up the material posted to prospective clients. It contained a wealth of information about the company and the package. A few days later I contacted an acquaintance who worked in a general practice which, fortuitously, used the company's software. She passed on the names of several other general practice users who might be willing to participate. Using this information, and

what I had learnt from my visit to the development site, I developed my research plan and procedures.

Research plan

I had hoped to observe how development took place but now realised that interactive interviews, as Sayer (1992) suggests, would be my primary source of information. I would supplement the interviews with limited observation and with sales documents, user guides, information bulletins and other material provided to potential and existing clients. I anticipated that interviews with staff at the development site would yield information about the company and the way development, sales and installation were carried out as well as a greater understanding of the package itself. I expected similar information to emerge from the general practice site in terms of how the package was used rather than developed. I also hoped to conduct the interviews on site as Yin (1994) suggests although I was aware that privacy could be an issue, especially when interviewing users in a general practice setting.

My initial meeting with the MD had tentatively identified five relevant social groups working at the development site and four at the user site. Having been a patient at both a large and small practice, I was also aware of substantial differences in the way each operated. I therefore thought that it would be fruitful to examine the package in use in both types of site so that different experiences of the package and its interpretive flexibility might emerge.

The number of potential interview subjects threatened to expand my research beyond the scope of a Master's thesis. I therefore decided to limit the interview subjects at the development site to the five people who participated most directly in the development of the package and to seven users at two general practice sites. These seven users included one practice manager, two GPs, two practice nurses and two receptionists. I also conducted a brief telephone

interview with the chief executive of an IPA[24], once the significance of the IPAs became apparent.

The research sites and participants are described in Appendix 2. Note that the names of all participants and the company have been changed in order to meet the requirements of the Massey University Human Ethics Committee although no absolute requirement is stated in the *Code of Ethical Conduct*.[25] In retrospect, it was important to make the user sites unidentifiable but little was gained by renaming the company and the package. The medical software industry in New Zealand is too small to prevent the development site and the participants involved in development being identified by someone familiar with the industry. Martin Tolich and Carl Davidson's (1999) article on the ethics of research suggests that the difficulties I experienced are not unique. New Zealand's small population makes it difficult to guarantee anonymity in many research situations.

While writing up the findings, I examined the possibility of naming the company and the package but felt unwilling to risk the successful completion of the thesis by altering the basis of the participants' involvement. At best, this change would be time consuming, as I sought the participants' approval and the approval of the ethics committee to proceed on different terms. At worst, it might result in a key participants withdrawing from the research. In consequence, I have been forced to exclude published material which identifies the company and the thesis loses some of its historical interest and relevance.

Interviewing

Yin (1994:84-86) suggests that interviews of an 'open-ended nature' are commonly used in case studies because they provide the researcher with the

---

[24] The IPAs or Independent Practice Associations emerged along with the reforms of the New Zealand publicly funded health system. They sit between the between the GP and the funding body and in the late 1990s, have begun to take an increasingly significant role in the health sector. See Chapter 4 for a more extensive discussion of these associations.

[25] *Code of Ethical Conduct for Research and Teaching involving Human Subjects*, Massey University (undated).

'facts of the matter', 'opinions about events' and with insights which can lead on to further inquiry. Open-ended or, as in Sayer's (1992) terms, 'interactive' interviews, allow the interviewer to understand the world of the person being interviewed and Lynda Measor (1985) suggests that gaining access to this world may be facilitated by

- relationship building through dressing and acting in ways which the participants find appropriate, communication of shared interests and sensitive handling of the issues which arise during the research process
- careful, critical listening and observation so that within the above constraints, the interview covers all areas vital to the research
- building in strategies of respondent validation.

Measor goes on to suggest that, if done well, many participants will experience the interview as similar to a more informal social encounter with a compatible person who is an excellent listener. Reflections and insights taken away by the researcher may therefore be more characteristic of a private rather than a public account and the onus is on the researcher to manage the process and the data carefully so that there is no betrayal of trust.

Going out into the field

The interviews involved a number of practical activities associated with gathering and confirming the research material as well as making sure that ethical issues were addressed. My plan was to conduct an initial interview of approximately one hour which I would record on tape. The interview would be guided by a list of general topics that I wished to cover which reflected the research questions, concepts drawn from the literature and my own knowledge of the area.[26] In that my knowledge of the topic grew during the research process and no two participants did exactly the same work, the interview guide

---

[26] My knowledge of the area has been gained through participating in New Zealand society for the past five decades, working in the computer industry and, over the past four years, more directed reading of newspapers, academic texts and profession journals for health managers, GPs, nurses, and people involved with computers.

was a 'living document', changing with each interview and becoming more specific over time. Two sample interview guides are provided in Appendix 3.

I also planned to engage each of the participants in a subsequent discussion. This discussion would take place after all interviews had been completed and transcribed and after I had carried out a preliminary analysis of the material. Once this was accomplished, I would send the participant a copy of the transcript or a more readable summary of the interview and arrange a time to discuss it. The discussion would allow the participants to correct inaccuracies and to ask for changes and deletions. At the same time, I hoped it would provide me with the opportunity to resolve contradictions in factual matters[27] and to fill gaps in my material that the analysis had brought to light. I also planned to discuss aspects of my preliminary analysis with participants who had showed their interest in the project.

Before I could arrange the interviews I needed to develop a protocol for recruiting participants and to make sure that I obtained informed consent. In developing this protocol, I followed the Massey University *Code of Ethical Conduct* and gained the approval for the research from the Massey University Human Ethics Committee. Approval was contingent upon my providing each participant with an information sheet and gaining their signed consent prior to the interviews. An additional agreement which the manager of the company would sign, was also required. The information sheet, the consent form and the management agreement can be found in Appendix 3.

I began the research in earnest by contacting the MD in Auckland to confirm a suitable time for an interview. On finding out that he had left the company I made contact with the new general manager and then went through the process of requesting his and the company's involvement informally and through a follow-up letter. This letter included an information sheet and the

---

[27] For example dates of certain actions and the cost of equipment and so forth. Given the differences between participants, I expected that their perception and experiences of the package would often differ.

special consent form and, upon gaining his approval for the project to proceed, we agreed a suitable date for my visit to the development site. I then mailed the information sheet with a short covering letter to the three additional participants at the development site and to the remote consultant, Catherine, who was based elsewhere. The information sheet stresses that participation is optional as well as providing a description of the project and the extent of each participant's involvement.

On arriving at the site for the first interview, with briefcase in hand and dressed in my best business attire, I found that the general manager and the other three participants had spoken amongst themselves and had rearranged the interview times to accommodate work commitments. As I had guaranteed confidentiality, not anonymity, this was only of passing concern and the new arrangement, which involved speaking first with Ann, the manager of the customer service side of the company rather than Stephen, the general manager, proved to be very useful. Ann knew a great deal about the package, the company and the business of healthcare and, as a bonus, invited me to a user group meeting which was to be held that evening.

At the beginning of each interview I introduced myself and made a little 'small talk', if this seemed appropriate. I then made sure that the participants were aware of the content of the information sheet and what it meant. After the consent form was signed, the tape recorder was turned on and I began with a simple question about their involvement with the company. Each interview lasted between 40-90 minutes and at the end we discussed what would happen next. None wanted the full transcription of the interview and so I agreed to make a summary which would allow them to confirm the portion of the interview I planned to use. The interview with Catherine, the remote consultant, and the various users of the package followed a similar pattern although I interviewed each participant in a location which suited them best.

I found myself adapting to the characteristics of each of the participants, using their words rather than my own and sensing what was important to them about the package rather than just my own perception of what this might be. Several

enjoyed talking about themselves and their work and the conversation achieved the informal quality which Measor (1985) describes. These 'informal' interviews tested my skills in keeping the conversation focused on the general topic and listening critically to what was being said. In contrast, other participants looked for directed questions which they could answer quickly. I found myself asking more questions in interviews of this type but tried to leave some silences which I hoped the participants would fill. This strategy was sometimes successful and sometimes not. In the worst case, with a particularly brisk participant, the silence made it look as if I had nothing further to say and the interview almost finished too soon.

Making contact with general practice users required some ingenuity and patience as there are issues of busyness and privacy associated with this particular setting. I followed the protocol of contacting by telephone the practice manager at the large site and the GP at the small site and then confirmed, via letter and a further telephone call, their willingness to be involved.

For the larger practice, anonymity was assured by meeting the practice manager, the practice nurse and the receptionist outside the practice setting. This was particularly important to the receptionist who was concerned about the practice manager not knowing that she had spoken with me and needed confirmation that some of the informal comments that she made would not 'get back'. I made a point of reassuring her that no one would be aware of her participation let alone what she said.

I had a great deal of difficulty making contact with a GP who worked in the large practice but towards the end of the research met Ruth, a GP who had worked in a similar site, and who had used the company's package between 1993 and 1996. As Ruth's interview dealt with the general characteristics of using a computer during the patient/doctor encounter and provides some thought-provoking contrasts to the interview with the other GP in the study, I have included this material in my findings.

At the smaller general practice site, I observed the requirements for anonymity by interviewing the GP after other staff had gone home for the day. I also interviewed the receptionist while she sat at her desk on an afternoon when the doctor and practice nurse were not in attendance. However, my concern with anonymity was not shared by the participants and I found at a later stage that they had spoken about the research amongst themselves. This reflected the easy relationship that existed amongst the three staff but it made me particularly careful with confidentiality. Without being asked, I edited out the small amount of material which could have caused some unease on the part of one of the participants should either of the others read the thesis.

Transcribing and analysing the material

Transcribing the tapes was an arduous task, but it gave me the opportunity to gain familiarity with the material. I also made a number of notes in the margins about any particular emphasis, concern or frustration that the participant expressed. Although this fell well short of the full 'tracking of the contours of the voice' which Anne Opie (1994:8) suggests is necessary to understand 'the institutional and political relations in which the speaker is immersed', it did increase my understanding of how power operated. I noted in particular the frustration many of the participants felt when having to deal with the bureaucracy (but not the IPAs) which controls the health dollar in New Zealand. This frustration usually arose from the amount of time wasted battling incompetence and elaborate procedures rather than the underlying policies.

Once the tapes were transcribed, I extracted the material that I would include in the thesis. This was done using a simple 'cut and paste' facility on my own PC and created separate documents for each participant. In each document, I marked each category of interest, namely the characteristics of the participants, the interactive processes involved in each separate phase in the 'life history' of the package and the histories of the company and the software. Throughout, I made notes about how the information answered the research questions and how power was operating in various situations, relationships and outcomes. I also did extensive documentary research into the recent history of the New

Zealand health system and changes in computer technology, tracking down the small amount of information which existed about the use of computers in general practice.

Analysis was an iterative process and I found myself returning to each transcript and listening to parts of the tapes from time to time. Finally, when I was confident that I had extracted the most significant material and quotes for each person, I created a readable summary which I forwarded to each of the participants via email or post along with a covering note which forewarned the participant of any additional questions that I might have. (See Appendix 3 for a sample covering letter.)

During the analysis, I had particular difficulty in identifying the relevant social groups which, as Bijker (1995) suggests, should be relevant to those involved with the package as well as to the analyst. As Bijker forewarns, my difficulties reflected the overlaps that exist in the real world and were particularly pronounced in a small business or general practice environment which adopted a flexible approach. For example, some of those involved in marketing the product also provided customer support while the practice manager role could, in small practices, be taken over by a receptionist, the GP or a practice nurse with computing knowledge and skill.

Further difficulties in delineating relevant social groups related to my decision to extend Bijker's (1995) conceptual tools into a study of the movement of the package from development and into use and my interest in the effects of the technology rather than just the process of innovation. Thus Bijker always shows social groups relevant to the development process while this study is concerned to show social groups relevant to development, to use and to the processes involved in moving the package from development and into use.

My analysis suggested that some groups retained the same shape and authority across all three phases while others appeared strongly in just one or two. For example, the technical developers, so influential during the development of the software had less direct influence than the marketers and

customer support group on how the software was sold and used. In other circumstances, the defining characteristic of the group seemed to change. This was particularly true of GPs who were sometimes defined by their purchasing power, sometimes by their computing knowledge and skills and sometimes as a group with clinical knowledge and skills. My solution to this analytical problem was to conceptualise GPs as multiple groups: the technically competent GPs who have enough spare time to involve themselves in developing a new package; the practice partners and solo practitioners, Healthserv's current and potential clients who made the financial decisions related to the package; and the more generic term GPs which refers to GPs as an occupational group.

My final decision about the delineation of other relevant social group reflects their occupational groupings. At the development site, the groups include those who market the software, the technical developers and those who provide customer support. At the general practice sites, the groups include the practice managers, practice nurses, receptionists and the various types of GPs. In addition, my research identified two groups or third party organisations which control or manage the public funding of health in New Zealand, namely the Independent Practice Associations (IPAs) and a group which fund GPs. In 1998 and 1999, this was primarily the Health Funding Authority (HFA) but the ACC was important as well. Finally, I identified the patients as a highly relevant group. They were not mentioned in almost half of the interviews and took a leading role in just two - a significant finding on its own.

The follow up discussions

Due to pressure of work, two participants were unwilling to involve themselves in further discussion but I spoke with the others over the telephone, in person or via email. In all, there were no more than a dozen minor changes requested and just one significant misunderstanding on my part. Once the changes were discussed and the participants had agreed that my summary was accurate, I raised my own questions, making notes of the answers which, at the end of the discussion, I read back for confirmation. Having validated this new material, I thanked the participants for their assistance and updated the extract

documents, indicating where the data had been derived from amendments rather than the original interviews. At this point I changed all names in the documents to those used in this thesis and blanked out the tapes.

The follow-up discussion with the practice manager took place in her office and there was some possibility that I would be observed by the other participants. This didn't happen, but it made me aware of the contradictions inherent in offering anonymity while simultaneously attempting to do a piece of research concerned with human interaction in a small organisational setting.[28] In retrospect, I should have pressed my case more strongly with the Massey Human Ethics Committee and assured the participants of confidentiality only.

Writing up the findings

Bijker (1995), Fujimura (1992) and many others who adopt a case study approach produce findings in the form of rich descriptions of people, processes and events in narrative form. Bijker argues for writing in a way which does not close off 'alternative interpretations' (1995:289). From my own perspective, the narrative form seemed the most appropriate way of presenting the findings of this study. However, the act of writing the narrative proved more difficult than I imagined as I attempted to impose meaning on the material while simultaneously retaining the richness of the stories and the complexity of power relations.

My solution to this difficulty involved attributing comments and actions sometimes to individuals and sometimes to groups and separating out the narratives from my categorisations of the people and my more theoretically-informed analyses. This separation can be seen in Chapters 5, 6 and 7 where I discuss the development of the package, its sale, installation and use. This

---

[28] Should the receptionist at the large site read the thesis, for example, she might recognise herself and would therefore immediately know the practice manager in question. The practice manager was aware of this possibility and had no concerns. However, the reverse, which concerned the receptionist, should not occur as there are several receptionists working in the practice and I have left out all identifying material.

approach allows the voices of the participants as well as the complex politics to emerge. The narrative effectively becomes what Van Maanen (1998:136) describes as a 'jointly told tale' which

> provides space for the natives to tell their own tales without the undue interference or wanton translation of the fieldworker.

The term 'jointly told' means that the narrative depends upon the narrator as well as the informants and there is no doubt that the theoretical perspective and data collection strategies that I have adopted for the study have influenced the content of the narrative as well as the discussion. My own history and academic background[29] also play a part in what I have looked for and therefore what I have found. This should not be confused with unacceptable bias for, as Fujimura (1991) reminds us:

> ...our interpretations will always be guided by our own perspectives. But again, there is no viable alternative. None of us can avoid making an interpretation, even at the descriptive level. We begin to interpret when we choose whom or what to study. The point is to make our perspectives as analysts clear and our interpretive statements explicit and systematic, in order to provide our readers with as broad an array of information as they need to form their own perspectives and to judge our analyses (1991:231).

In this chapter, and throughout the thesis, I have endeavoured to provide information which will help the reader make such judgements.

The next chapter provides a brief history of the package and Healthserv, the company which produces it, interwoven with changes in the computer industry and the New Zealand health system. This information sets the scene for the emergence of Primetech2, the package, which is at the centre of the study.

---

[29] I could describe myself as a 50 year old woman who has lived most of her life in New Zealand and who has a working history in software development and an academic interest in feminist and (post) Marxist thought. This seems more relevant in the context of this research than many of my other characteristics and interests.

Chapter 4

Setting the scene for the emergence of Primetech2

In Chapter 3, I described the methods of research and how I collected and analysed the data. I concluded the chapter by discussing how I planned to write up the main findings.

Chapter 4 provides a brief history of the medical software package which sits at the centre of the research, linking it with the history of Healthserv, the New Zealand company which develops, sells and supports the package and with widespread changes in computer technology. It also links the history of the package to changes in the New Zealand health system, particularly the health reforms of the early 1990s. It concludes with Healthserv's decision to embark on the development of Primetech2 in 1996.

Chapter 4 interweaves the historical material derived from the interviews with information taken from the academic literature, professional journals and the popular media. It has also been guided by my discussions with people working in the New Zealand health system which, like the interviews, kept me grounded in the real world of people attempting to do their daily work in a climate of constant change, political manoeuvring and heated debate.

This chapter serves two main purposes. Firstly, it provides an understanding of the distribution of power which existed before the health reforms of the 1990s, the domination of the PC market by Microsoft and the wide scale movement of PCs into general medical practice. And secondly, it provides the reader with general information about the New Zealand health system and computer technology which is essential to understanding the chapters which follow.

1960-1976: The emergence of the PC and application packages

The general consensus in the literature is that modern computing began in New Zealand in 1960 when a digital computer, an IBM 650, was hired by the New

Zealand Government to provide Treasury and other government departments with computing facilities. By the end of the decade nine departments had their own computers and 131 were used in the private sector. The largest and most powerful of these computers, the mainframes, were used primarily to automate the handling of large quantities of data, particularly financial and accounting data (Isaac,1982; Beardon,1985; Monin,1997).

Efforts to automate the financial side of businesses continued throughout the 1970s and there was a steady growth in computer bureaux which offered smaller companies the opportunity to use computer facilities without taking on the cost or problems associated with in-house machines, including the problem of developing application software.[30] Computer bureaux were not immune from the problems of developing reliable software in a timely and cost-effective manner and many small users of their services shared the same application software rather than paying for development tailored precisely to their needs.

This trend towards shared software became even more pronounced in the 1970s when package or 'off-the-shelf' software designed to run on in-house mini computers became more readily available. Package software, although not always as flexible as users might have wished, was rarely as expensive as bespoke development and purchasers could see from the beginning what they would get. The rise of package software was also associated with the rise of the small computer for business and home users which had become much more powerful with the development of microprocessors based on the silicon chip. However, in 1976, the year Steven Jobs and Stephen Wozniak sold their first Apple I[31], few could have predicted how successful package software and the PC would become.

---

[30] See Friedman & Cornford (1989), for a detailed discussion of the difficulties of developing software during the late 1960s and the 1970s. As the authors point out, software development in the 1970s was a slow and costly process and restricted to those who had mastered a number of unsophisticated tools.

[31] Although there is some debate in the literature, Friedman & Cornford (1989:232) give the label 'the first PC' to the Apple I.

1976-1983: The early years of Healthserv

1976 was an important event in the history of Primetech, for it was the year that Stephen, the current general manager of Healthserv, purchased a large mainframe computer, moved it to a town in the central North Island and established a computer bureau operation. The company's initial business comprised electricity billing and payroll processing on the mainframe but within five years, the bureau operation had given way to the supply and support of mini-computers and the development of software for the retail pharmacy market.

A local pharmacist had approached Stephen to set up patient records on the mainframe, but off-site processing brought with it a number of problems associated with maintaining the accuracy of patient and prescribing details in a timely manner as well as speedy and secure access to this information. Installing a mini computer on site, as many companies in the United States were doing in the late 1970s, seemed to resolve these problems. So, in search of an appropriate product, Stephen and the pharmacist travelled to the United States, returning with an early mini, the Polaris. This was a cumbersome and unreliable machine which had very limited storage facilities - just two 8" diskettes with 50KB on each. Stephen described its assembler software as 'a disaster', but the company did manage to modify the software and in the end, sold 15 for around $60,000 each. His next foray into the computer market was much more successful when Stephen became the agent for a mini computer which was much more like the modern PC.

The mini had its own operating systems software, an integrated keyboard, a nine inch screen and much greater capacity in the form of 1MB of storage on four 5 1/4 diskettes which could be increased to 2MB when Winchester hard drives became available. Stephen recalled that the mini was 'avant-garde' at the time but, in common with others on the market, it could not support multi-users. The company therefore developed its own operating software and mechanism for switching data around the network.

The development of operating systems and networking software was accompanied by the development of a pharmacy software package and by the early 1980s, the company had installed more than 400 pharmacy systems. The large number of customers provided a good revenue stream and with 20 staff employed in development and support, the company had the resources to move into the medical software market.

1983-1990: Automating the business of general practice

In the early 1980s, according to Stephen, it was just the 'dawn of practice accountability' and few doctors kept track of their incomes. GPs were paid on the basis of patient consultations, and many were unaware of who their patients were, how many they had and how often they saw them. Nor was the New Zealand Health Department interested in supporting the introduction of computers into general practice. Stephen described how Health Department officials were 'very hostile and non-communicative', warning him that 'it couldn't be done'.

Stephen, in contrast, considered that a PC-based patient and practice management system was not only technically feasible but would also meet a ready market, especially amongst those who had a large number of patients and were already using a bureau for their practice management. At a cost of 35 cents for each patient, a GP was faced with a processing bill of over $1000 each month for a system which did little more than bill patients and print off health benefit claims.

Stephen described the development of the early medical software as 'trail blazing'. User requirements were gathered from 'a few helpful doctors' recruited through the pharmacist who had been involved in the original development of the pharmacy system and the first version of the medical software package managed appointments and recalls as well as automating the accounts and printing off health benefit claims. The company did a full mailing to all practices in New Zealand and there was a great deal of interest.

In a 1995 article in *New Zealand Doctor,* Sanka Baker cites the experiences of a Bay of Plenty GP, Dr Jonathan Simon, whose group practice took part in the move from a bureau to a PC-based operation during the mid-1980s. According to Simon, the bureau had been equipped to store basic patient information[32] and a simple disease register. It could also run a rudimentary monthly recall system and produce the monthly accounts but there were unacceptable delays in reconciling the accounts and frequent complaints from patients who had not been correctly billed. In contrast, the in-house PC system provided real-time accounting which improved cash flow and reduced complaints. It also offered computerised appointment scheduling and improved patient recall.

Stephen described how his company offered clients a 'total solution'. It would supply and support the hardware and software platforms that the medical software package ran on, as well as the package itself. It would also provide regular upgrades of the medical software which included corrections to known problems and new features. Doctors could therefore have the advantages of an in-house system without the problems associated with its support.

A typical configuration would be very similar to the client/server arrangement common today. A server (a Z-80 processor with 4 MB of hard drive) would cost over $20,000 and terminals with some intelligence, around $6,000. The package cost $8000. Thus a practice of 6 GPs with 5-6 terminals would have to pay close to $80,000 if the cost of a printer and various extras were taken into account.

In 1984, the company employed Malcolm straight out of University to develop the second version of the package. The first version had utilised the company's purpose built operating system and mechanism for switching data around the network. Despite its good performance, it left the company isolated from other applications and developments and a decision was made to develop

---

[32] Within general practice, patient demographic information is most commonly called an 'age/sex register' which reflects the basic demographic information which doctors were required to store about each of their patients.

a package which would run on a 286 server and the Unix/Xnix operating system. At $20,000 the 286s were marginally cheaper than the Z-80s. However, they were much more powerful - one 286 could support 20 dumb terminals.

Stephen described how the redeveloped package was highly successful. There was a 'frenzy of sales' which continued until 1986, the year the business was sold to a large US-based pharmaceutical company. Stephen stayed on as manager but was not happy with the way the company was run. The business model it used, which included subsidised PCs, was more suited to the United States than the New Zealand environment where distribution and transport costs were much higher. Overstocking and poor customer service were commonplace and board meetings were 'slovenly affairs'. There were cash flow problems as pharmacists took their business away because of poor service. Stephen suggested that it was almost inevitable that the pharmaceutical company, 'under capitalised and over committed' became a 'victim' of the 1987 sharemarket crash.

In 1988, the pharmaceutical company was bought out by a Swiss transnational which, according to Stephen, took 'fierce, immediate, autocratic control' and returned the pharmaceutical company to its core business of drug wholesaling. The new purchaser retained the pharmacy side of the software business and Stephen bought back the medical side and a newly developed dental package, retaining just one programmer for software support. Stephen's new company was christened Healthserv and, in 1990, moved to Auckland to be closer to its customer base. There was also a good potential for new business. In 1991, just 29 percent of Auckland GPs used a computer in their practices (Gribben et al., 1995).

1991-1996: Accelerating change

In 1991, Ann joined Healthserv to manage the customer service and administration sides of the business. The company was still small at this stage, comprising just five staff plus Stephen and Ann and, as Ann described it, a

rather 'ad hoc way of doing business'. As the company expanded, Ann instituted more formal procedures within the company, especially in the areas of customer training and support. Malcolm, who had left the company in 1986 during a lull in development, was re-employed in the same year to develop a specialised dental software package. In the following year, with the dental package complete, development began on a new version of the medical software.

The new version of the medical software, Primetech1, offered clients a migration path for it could operate in a Unix environment as well as under Windows 3.0 or Windows NT. In other words, users who installed Primetech1 could use their existing hardware as well as Windows and 386 technology. The driving force behind the redevelopment was, according to Stephen and Malcolm, customer demand for a system which could run on the same platform as word processors. State-of-the art word processors ran on the MS-DOS operating system and 386 hardware, and Stephen described how the company would have been 'blown out of the water' if it hadn't followed market trends.

Malcolm described how new Healthserv clients were happy with Primetech1 right from the beginning and the majority of existing clients had no difficulty with the system as it incorporated the main functionality of the previous version. A minority, however, were unhappy with the new system. They were used to receiving certain reports and did not want to have to obtain this information in other ways and, as Malcolm pointed out,

> it was hard to maintain the idea that this package would do things better when some customers had lost out or perceived that they had lost out by the change.

But, after a few weeks, the problems were resolved through a mixture of client education and software changes and 'it all went quite smoothly in the end'.

The new software package was released, according to Stephen 'with quite a fanfare' and 100 new sites were sold in the first year. By 1996, Primetech 1 had been installed in 350 sites and the company had grown to 22 staff employed in a variety of customer service, sales, administration and technical roles. In addition to Primetech1, the company installed and supported

packages for dentists, radiologists and physiotherapists, managed the installation of a variety of hardware and operating systems platforms, trained staff, and provided on call support.

An important part of the business involved issuing upgrades of the software. Upgrades incorporate new system features as well as fixes to known problems and, in the volatile climate engendered by the Health Reforms, new features became an increasingly important part of the service Healthserv offered.

The Health Reforms of the 1990s

Ann spoke at length about the significance of the Health Reforms of the 1990s to Healthserv's customers and there is a great deal of agreement in the literature that the publication of Simon Upton's 'green and white paper', *Your Health and the Public Health* (1991) heralded a number of significant structural changes.[33]

According to Fougere (1993, 1997), the situation which the new policy sought to revoke had its roots in the legislation passed by the First Labour Government in the 1930s and 1940s which provided for state funded hospitals and subsidised primary care. This legislation reflected the successful fight by doctors to retain the right to work where they chose, to provide whatever services to patients that they thought appropriate and to charge an additional fee on top of any subsidies that the government provided.

Fougere (1993, 1997) describes how the state continued to provide a variety of primary healthcare subsidies in the 1950s and 1960s which covered all or most of the cost of consultations and diagnostic or therapeutic services and the cost of prescribed pharmaceuticals. During the 1970s subsidies started to lag behind the cost of primary care and this continued into the 1980s when a

---

[33] See *Health Policy* (29) published in 1994 (George Salmond et al. eds.) for a number of articles on the significance of the health reforms initiated by the 1991 paper. Also see Geoff Fougere (1997:2) who calls the paper no less than 'a blue print for the radical restructuring of the New Zealand health system'.

population-based formula was applied to the contracting of services for primary care as well as the funding of hospital care. An outcome of this lag was an increase in GP's fees.

The impact of fee increases is greatest on those who are least able to pay either directly or through private Health Insurance and comes in the form of inadequate access to primary healthcare by the poor and chronically ill.[34] One of the consequences was an increasing politicisation of health decisions fuelled by doctor resistance to state control of fees and the services they offered to patients.

Changes in the 1980s had had profound implications for the organisation of secondary health care, and the publication of the *New Zealand Health Charter* by the Labour Minister of Health, Helen Clark, in December 1989 had signalled an increasing concern with the role of the GP in preventative care and early interventions.[35] Simon Upton's 'green and white paper' heralded more profound structural changes for the primary healthcare sector. It proposed a

---

[34] There are a number of flow on or related effects. The better off receive more of the primary healthcare subsidies in the form of laboratory tests and pharmaceuticals, without necessarily an improvement in health, while the poor and chronically ill cannot afford to pay for early interventions which would reduce mortality and morbidity rates and this group's high utilisation of expensive secondary healthcare services (Malcolm, 1996, 1998). At the same time, many GPs, already facing a drop off in real income, find themselves charging a higher proportion of patients a reduced fee or no fee at all (Tilyard, Gurr & Dovey,1996).

[35] The '10 health goals' discussed in this document can be summarised as:

- reducing smoking
- reducing alcohol consumption
- improving nutrition
- reducing motor vehicle crashes and their effects
- reducing hearing loss in children under five
- managing high blood pressure
- managing asthma
- managing coronary heart disease
- managing uterine cancer
- managing skin cancer

The document also discusses the significance of the GPs' role in achieving reduced morbidity and premature mortality through managing, screening, monitoring, treating, recalling, detecting and preventing a variety of patient activities and conditions.

new split between the funding and provision of healthcare and four Regional Health Authorities (RHAs) were to be established as the funding bodies. Their task was to purchase healthcare services from the most competitive provider. As any type of provider could bid for any type of service, Upton's paper set the scene for the removal of existing divisions between primary and secondary care and between public and private healthcare.

RHAs were formally established in 1993 and a centralised body, Health Benefits Limited (HBL), was set up in the same year to manage the health benefits system on behalf of the four RHAs. HBL would process and pay claims for medical and pharmacy services, provide information back to the RHAs and the service providers and last, but not least, audit provider claims (Health Manager, 1997). The same article in *Health Manager* cites HBL assertions that auditing significantly reduced the number of subsidy claims, but in other arenas, the cost containment as well as the depoliticising of healthcare that the health reforms were meant to achieve appear to have been as elusive in 1996 as they were in 1991.

Fougere (1997) points to increasing rather than reducing costs in the healthcare sector, high waiting lists and highly vocal health politics. He also discusses the emergence of a new organisational form, the Independent Practice Associations, or IPAs, which sits between the GP and the funding body. In 1996, nearly sixty percent of all GPs were members of an IPA and this number was growing as IPAs became increasingly accepted by the RHAs and GPs alike. IPAs varied in size from 5 to 198 members who usually shared the same geographical location (Malcolm & Powell, 1996). Although the functions performed by each IPA might differ, some general characteristics were beginning to emerge. The IPA would negotiate with the RHA for funding on behalf of its membership but would not be involved in any financial risk taking. If savings could be made by the members of an IPA, they would be channelled into free or subsidised services to the GPs' patients and the community. At the same time, the RHAs were coming to view the formation of IPAs as a significant

step towards the control of primary healthcare costs and a vehicle for getting the best possible value for the health dollar.

Malcolm & Powell (1996) point out that in 1996, many IPAs were becoming increasingly involved in budget holding for the pharmaceuticals and laboratory tests ordered by their membership and a number were negotiating capitation[36] contracts with their RHA. Capitation provides a particular IPA with much greater discretion in how government funding is spent which in turn places greater responsibility on the IPA to support and audit its membership. But regardless of the type of funding, many IPAs were instituting education programs, monitoring the activity of their members, funding a variety of community health initiatives and, relatedly, providing the RHAs with a variety of information.

The precise information requirements of the RHAs and other participants in a restructured and restructuring healthcare system are not readily discernible,[37] but there are a number of general directions which emerged from the interviews and which can be discerned in the literature. These can be summarised as a concern to

- find out the characteristics of patients in relation to the amount of government funding that they consume
- monitor GP activity, including screening and recall programs, laboratory tests, and prescribing practices as well as for system abuse and fraud
- facilitate the electronic transmission of claims and the electronic sharing of patient information

---

[36] Capitation within the primary healthcare sector provides GP funding on the basis of the number of registered patients with adjustment for demographic variables connected with morbidity (age, ethnicity etc). As Malcolm (1998) points out, capitation was provided for in legislation in the 1930s, but was not taken up until 1979 and, during the 1980s and early 1990s, became more widely adopted as a number of Union Health centres and centres serving Maori, opted for capitation payments rather than a fee for service.

[37] The substantial variations between RHAs, particularly North Health and the others, make it difficult to describe RHA information requirements just as each IPA involved itself in different initiatives. The situation is also complicated by the climate of constant change.

- obtain additional information required to forecast, plan and cost the provision of various health service initiatives[38].

In order to meet these aims, the use of computerised medical systems by GPs was actively encouraged by the IPAs and RHAs.

Meeting the needs of a maturing market

In 1989, just 17 percent of all general practices used a computer (Walls, 1989). By 1995, 84 percent of GPs used a computer for at least one task and almost all GPs (97-98 percent) considered that a computer could be usefully employed for patient recalls, maintaining patient information and for administrative tasks. Fewer GPs (26 percent) used the computer to record clinical notes but the number was increasing rapidly. It seems likely that cost savings associated with reduced paper handling within general practice as well as the information demands of the health reforms were influential in the increase.[39]

The upward trend in computer usage is also confirmed by the figures provided by the General Manager of Healthserv which were taken from an industry survey which showed that in 1996, 90 percent of all GPs in New Zealand used computer systems in their front offices and more than a third of these GPs also used the type of clinical system that Healthserv provided. In other words, the medical software market had matured to the point where the majority of GPs worked in practices where computers were used and a growing number of GPs were using a computer during patient consultation.

The Thakurdas et al. (1996) survey suggests that just over a quarter of GPs were dissatisfied with the software they were using and with the hardware and software support that they were receiving. Many of the changes instituted by Healthserv in 1996 reflect the company's concern to address these needs. Ann

---

[38] An acquaintance who worked for HBL in the mid 1990s and the interviews with Ann and Catherine were also invaluable aids to understanding these general aims. These were also confirmed by a number of articles in journals, such as Soar, Anand & Davies (1997) & Health Manager (1997) and in the popular IT media.

[39] The Bay of Plenty GP mentioned earlier in this chapter discusses his move towards a 'paperless practice' and its advantages in the article by Baker (1995).

had already changed the way Heathserv provided customer support. She had, for example, hired customer service staff with experience in the health sector and empathy with users rather than technical expertise alone. The 1996 changes to the company, however, altered all parts of the business.

The first series of changes which involved hiring a general manager were not successful. The company began to lose staff and, for the first time in its history, did not make an annual profit. The second set of changes instituted after the MD moved on, which integrated prior arrangements, were more successful. Ann and Stephen set the company's strategic direction with Stephen continuing to direct the technical and sales side of the company. Ann managed customer services, administration and, reflecting their increased significance, liaised regularly with the IPAs and other third party organisations. At the same time, the company instituted a number of new supervisory positions, more formal procedures and more clearly delineated lines of responsibility, particularly in relation to resolving customer problems and prioritising and testing software changes. Ann also spoke about her concern to retain the culture of co-operation and flexibility which allowed the company to respond quickly to the constant series of changes in the healthcare market.

By 1996 it was becoming increasingly clear that changes in the market related to changes in computer hardware and software as well as changes in the business of healthcare. It was also becoming clear that if Healthserv were to meet the demands of a mature and increasingly sophisticated market, it would need to redevelop Primetech1 rather than just apply a series of upgrades. Certainly Primetech1 could deliver most of the functionality GPs' wanted and needed in 1996[40] but it was becoming more and more difficult to incorporate

---

[40] The study by Thakurdas et al.(1996) matched against a system overview provided by the company in 1996 shows that Primetech1 could provide most of the functionality that doctors wanted ie it could be used to

- store a detailed age/sex register (patient information)
- support the processing of patient recalls and screening
- manage appointments

what users required in a satisfactory way.[41] Malcolm described how it looked 'antique' in comparison with more recent Windows-based systems and users of Primetech1, increasingly familiar with the way these systems operated, were demanding that their medical software package functioned in much the same way. Many of the interviewees, Malcolm included, spoke about the time saving and convenience of having multiple modules of the package open at once, something not possible with Primetech1.

Beth, the practice manager I interviewed, spoke about Primetech1's 'slowness and 'inflexibility' especially when compared with Windows-based systems running on modern, networked PCs. She had found Primetech1 'reliable and a 'good workhorse' but it was 'vital' to move on to faster practice software which ran on the same platform as the applications she used for the rest of her work. She looked forward to having just one PC in her office rather than one PC and two terminals and to work in an environment where data could be moved electronically or 'ported' between different applications.

- support a wide range of practice management functions, such as claims, patient billing, EFT-POS payments and banking
- hold patient clinical records, with diseases, symptoms, signs and tests classified using Read codes
- provide information to doctors and practice nurses about pharmaceuticals, including their generic names and costs, and to print prescriptions
- collect and store laboratory results arriving via electronic mail
- scan incoming mail of a variety of types and attach it to patient records
- speed up the writing of referral letters
- allow for ad hoc reporting as well as reporting required by the RHAs and IPAs

Only two software features: doctor and patient education, signalled as important by GPs in the Thakurdas et al.(1996) study, were not provided by the package. Nor were issues surrounding data security for electronic exchanges adequately addressed.

[41] A comparison can be made with altering a shirt. It may be patched when it frays and a collar or sleeves may be added or removed. A shirt may be dyed or the buttons changed, which alters its appearance to some extent, but the amount and type of cloth and style of garment limits the amount of change. In comparison, a brand new shirt, in common with a brand new package, provides the maker with much more choice about what will be made and how it will look....and, at a certain point, making a new shirt may be far easier than mending or altering the old one.

Beth ran Primetech1 on a Unix platform and was aware that new practice software would also mean a change to Windows NT and a hardware upgrade. Malcolm also confirmed that the 'writing was on the wall' for Unix-based systems for small businesses. PCs had come down in price and the cost savings associated with a Unix configuration had become a thing of the past He suggested that many existing Unix users were also 'showing genuine excitement about the new release', despite the substantial cost of new hardware.

Discussion

In this chapter, I have traced a number of trends and key events in the history of the medical software package developed by Healthserv. I have shown the first version of the package emerging in an environment of technological experimentation and multiplicity through the entrepreneurial activities of Stephen. There was nothing certain about which platform the company would choose and development was characterised by technical problems with the platform and few sophisticated tools to solve these problems.

In contrast, the business functionality required of the package was relatively straightforward. The cost of a computer system excluded smaller practices but larger practices, especially those using a bureau, could justify the purchase of an in-house computing even though it did little more than store patient data, automate the accounting side of the business and generate patient recalls. In this situation, the involvement of users was important for setting out the business requirements of the system but practice requirements were not dissimilar from the requirements of any small business and could be gathered in an ad hoc way.

I have gone on to show how the situation evolved over the subsequent thirteen years as the platform changed at regular intervals to accommodate new technological forms and, via more frequent upgrades, additional business and clinical features. By 1996 the novelty of computers had been replaced with familiarity as PCs had become a common feature of home and business life. At

the same time, the increased sophistication of some users and the demands placed on GPs by the health reforms of the 1990s was matched by their demand for sophisticated package software which was similar to and could interface with packages used for other purposes. In 1996, this meant a package which could run under Microsoft Windows.

The changes which occurred over this thirteen year period can also be described in terms of changes in the power relations in which the medical software was enmeshed. In 1983, GPs had a great deal of autonomy over their own clinical activities and had, in effect, been delegated individual authority over the spending of a substantial portion of the publicly-funded health dollar. By 1996, this situation was undergoing substantial change as control over public funding of primary healthcare became increasingly related to clinical activities and devolved to the IPAs. Meanwhile, Healthserv no longer had the same degree of control over the technical side of development as Microsoft windows dominated the small business market. In other words, the distribution of power which existed in 1983, where Healthserv provided a technological solution to a GP's practice management problem had been increasingly replaced by a more complex distribution. This new arrangement included the IPAs and Microsoft as well as clients with substantially different clinical and business requirements and diverse levels of computing expertise.

In Chapter 5, I discuss how the new medical software was developed, who was involved and how priorities were set. I also describe the outcomes from development, including the content of package and the form that it took.

Chapter 5

Developing the package

In Chapter 4, I sketched the history of the medical software package linking it to widespread changes in computer technology and to changes within the New Zealand health system. I concluded with Heathserv's decision to embark on a new development of the medical software package as the existing version became increasingly out of date.

In this chapter, I discuss the processes which gave rise to Primetech2. Stephen, as general manager and marketer of the software and Malcolm as technical expert had been the main participants during the development of earlier versions of the company's medical software and they continued to play key roles. However, customer support staff and Heathserv's existing clients contributed to the shape and content of the package in a number of ways.

Bijker (1995) writes in terms of different individuals and small groups interacting as well as those which occur between relevant social groups. My own approach is similar as it allows comments and actions to be attributed to individuals as well as to groups. To speak of power at the level of individuals alone hides the force it achieves when individuals act together. So, in the final part of the chapter, I analyse the capacity each group has to influence the outcome of development through resources such as computer expertise, clinical knowledge, business knowledge, purchasing power, force of numbers or delegated authority.

Software development is the subject of a great deal of debate amongst practitioners as well as within the academy,[42] but in general terms all software development involves:

- determining the features or requirements of the system
- translating the requirements into the code or language of the application software
- testing the system to make sure that it works correctly and, finally,
- packaging the software up into a product that can be used outside the development setting.

The first task on the list has implications for the work which follows and contributes significantly to the ultimate success or failure of a package such as Primetech2. If the scope is too broad, development is likely to be slow, expensive or might even fail.[43] If the scope is too narrow, the product is likely to have limited appeal. In either situation, market share will be lost, particularly in the New Zealand general practice market of the 1990s where there is active competition from other suppliers.

When I began this study in 1996, the broad scope of development had already been set. Primetech2 would be a Windows-based system which would duplicate the business functions of Primetech1, enhancing them where possible. It would also introduce a limited number of more radical improvements in the areas of electronic information exchange, patient and doctor education and provide GPs with a substantially improved clinical support system. The new clinical support system in particular was generating a great deal of excitement within Healthserv and Stephen described how it was 'breaking new ground'.

---

[42] See for example Bond, (1995) Davis (1995), Gibbs (1994) and most Management Information Systems (MIS) and Computer Science journals, such as *IEEE Software* for contributions to the discussion and about the nature of software development (is it Art or Engineering?) and what constitutes 'best' practice.

[43] Setting too broad a scope appears to be a major factor in the expensive failure of the National Library project and of Incis, the project which was meant to provide the New Zealand police with a comprehensive crime fighting computer system.

Developing a Windows-based system

The major reason for redeveloping the software had been to take advantage of the speed, flexibility and multi-processing facilities of relatively cheap, state-of-the-art hardware and software products, most notably recent versions of Microsoft Windows and Pentium PCs. Windows NT operates in a client/server environment which can equally well support a single workstation or many, depending upon the requirements of the site and the speed and capacity of the server. Thus, by redeveloping the software to run on a single platform which was cost effective for both small practices and large, Healthserv could eliminate the cost and technical complexity of supporting a package which ran on multiple platforms. It was therefore expected that the company, as well as its clients, would gain from the move to Windows.

Microsoft provides guidelines for developing Windows-based systems. Murray described the aim as 'no matter what the users are doing, the system looks much the same and responds in the same way'.[44] Standardising in this way saved design time as well as creating a product that users, familiar with other Windows-based applications would find easier to use. But there were other benefits. Malcolm spoke with enthusiasm about the 'excellent tools' which had become available for use in this environment since the mid-1990s. The company had authorised the purchase of a product which would be used for the main technical development and Malcolm had sought out something which could handle a large project, encourage the writing of 'clean code' and which could be used by a good commercial programmer - 'not rocket science stuff'. Malcolm expressed his satisfaction with his final choice, Delphi, stating that it was 'the fastest and most productive tool' that he had ever used.[45]

---

[44] Standardisation involves the way the screens look as well as ascribing certain meanings to the function keys, mouse clicks etc.

[45] As a software developer, I recognised the advantages of a standardised development tool such as Delphi - they remove many repetitive tasks and help produce a package which can be readily changed. From a more critical perspective such tools can be said to take time to learn and constrain the creativity of the development team.

Duplicating existing business functionality

Malcolm described how the starting point and 'safeguard' for establishing the business requirements for Primetech2 began from the functionality supported by the existing system. The company had failed to do this rigorously enough when developing Primetech1 and a number of existing clients had been unhappy with the results. Using the functionality of Primetech1 as the baseline for developing Primetech2 was about more than keeping a few important clients happy. It was about drawing on a system which encapsulated 13 years of development and which already provided many users of the system with what they needed to do their job.

Included in this group were the reception and practice management staff. Malcolm suggested that this group would gain from the speed and improvements associated with a Windows-based system but in other respects, Primetech1 provided adequate functionality. This view was backed up by Ann who suggested that the requirements for reception and practice management had

> not really changed....Receptionists dealing with patients who were not feeling well needed a quick and easy system with few keystrokes....We wouldn't have survived as a company if the requirements for practice management hadn't been met.

Beth, the practice manager, made similar comments while Karen and Donna, the two receptionists, backed this up with comments about the desirability of fast printers and a system which responded quickly while they were speaking to patients over the telephone.

Additional business requirements

Additional business requirements came through to Healthserv from a variety of sources. Regular user group meetings convened by the remote consultants and other customer services staff provided opportunities for participants to share information and for users to come together to exert pressure for change. As the use of the clinical module became more widespread, Ann found that more GPs were attending user group meetings although practice managers

and those who took this position (head receptionists or practice nurses) were still the main attendees.

Beth took a leading role in the one held in her city. She suggested that user groups were an excellent mechanism for promoting change and that Healthserv had been receptive to the group's requests. In contrast, Karen, the receptionist at the small provincial practice was aware of the existence of a user group in the nearest city but didn't think she would attend. She had a young family and wasn't sure she could spare the time for the meeting plus the hour and a half travelling there and back. Thomas and Ruth, the two GPs who participated in the study, also suggested that their spare time was taken up with activities which they regarded as more significant than attending user group meetings.

During the formal training provided by Healthserv, there would sometimes be requests for new features and for changes, especially from clients who were familiar with other medical software packages. Malcolm described the process of converting users from 'opposition systems' as 'fertile ground' for new ideas. In a similar way, on-call support and observations at user sites presented Healthserv with ideas for improving the system and the company had developed a special form for users and staff alike to use for software improvement suggestions (SISs). Catherine, the remote consultant, and Stephen both informed me that the majority of SISs came through from GPs.

I asked the users I interviewed whether they had seen or thought of using an SIS but drew a complete blank. Beth had an established business relationship with the company and would go directly to the appropriate person with problems and requests while, in the past, Thomas had raised requests directly with Stephen. In contrast, the receptionists and practice nurses who participated in the study treated the package as a 'given', something that must be learnt and worked with rather than changed.

When I interviewed Stephen in 1996, he described the number of SISs coming through as 'quite a volume' but could not give me an exact figure. At this time, he was still in charge of the 'filtering' and prioritising of SISs but by 1998, this

had changed and the procedure was being co-ordinated by customer services with significant input from Stephen and Malcolm. Stephen pointed out that 'it wasn't possible, or desirable to say yes to everything' and that he was forced to 'arbitrate heavily' on what was included in the new development or in a new release. 'Daft ideas and knee jerk reactions to what went wrong' were immediately excluded. Things that could already be done, albeit in a different way from that requested were also excluded. Stephen considered that the people raising these suggestions were used to a different package and needed 'to get into the right mindset'.

Stephen went on to say that even good ideas had to be prioritised and those which made the grade were 'urgent, simple, useful, do-able, feasible changes'. These comments were backed up by Margot, the customer services manager and by Malcolm who added in the widespread applicability of the change and lack of detrimental effects as significant criteria. When probed about the possibility of some types of users having disproportionate influence, Malcolm stated that the company 'resisted pressure' to incorporate changes with limited applicability for it was the 'universality' of the change which mattered, not its source. The only exceptions to this rule were the data extraction facilities or 'unloads'[46] requested by IPAs which were treated as 'add ons' rather than part of the core system.

Third party organisations

Requirements also emerged through regular contact with third party organisations, the term used within Healthserv to describe organisations which have an interest, usually financial, in patient and practice activity. In an email communication at the end of 1998, Ann provided me with a list which included

---

[46] The term 'unload' is used by GPs, Healthserv staff and IPAs alike to describe the process of transferring information held at the general practice site to the IPAs computer system. The formal agreement signed by the GP as part of IPA membership determines what information can be extracted.

ACC, the Ministry of Health and the RHAs/HFA.[47] She also described how she made regular contact with the 25 IPAs who had members using Primetech1 or Primetech2 and how the IPAs provided their members with a high level of training and technical support. She also spoke approvingly about her own dealings with the IPAs and how they were increasingly employing professional managers with a good business background and staff with computing expertise. Ann explained how Healthserv provided individual service to many IPAs:

> IPAs often request specific 'Unloads' for their members and while we encourage them to look at what is currently available in the package, they more often than not require a specification of their own. The IPA is always charged for these unique unloads and we charge for their deployment to their members as well.

John, the manager of the IPA with whom I spoke expressed a rather different view. His experience with the three main software vendors was of being told what he could get rather than being asked what he required. With the majority of vendors based in Auckland, and the large number of IPAs, John considered it inevitable that the requests of Auckland-based IPAs would be listened to first.

In the same email, Ann described how she liaised with the other third party organisations. Her frustration in dealing with these organisations can be read from her comments about how software vendors, including Healthserv, were 'more often than not' left out of discussions about changes to GP subsidies and claiming, even in situations where electronic claiming was involved. Nor was Healthserv given adequate warning about changes. As Ann put it

> We often only hear when one of our practices sends a fax or letter asking when the software change can be expected!!!...There are many times when changes have been made and if they had involved us in the discussions, we could have advised much simpler ways to handle data.

The lack of consultation created difficulties for Healthserv, but the changes would be made regardless of the short notice as third party organisations set the rules for subsidies and the claims that GPs make, enforcing the rules

---

[47] When I spoke with Ann in 1996, the RHAs were still in existence. During 1997, the RHAs were restructured into a single organisation, the THA or transitional health authority. Early in 1998, the THA became the Wellington-based Health Funding Authority (HFA). HBL remained as the processing subsidiary throughout.

through economic penalties or incentives. In a 1997 interview, Caroline described how electronic claiming was desirable for GPs as the HFA, through its processing arm HBL, would provide payment of claims within ten days of receipt instead of the previous five weeks.

Other user involvement

The process of gathering the requirements which I have described so far does not include many of the ways in which Healthserv staff kept abreast of new technology and changes in the health sector. Seminars, conferences, professional journals, newspaper articles and industry contacts were all mentioned during the interviews. It also leaves out a significant set of encounters initiated by the members of Healthserv with users who were variously described as 'experienced', 'knowledgeable', 'progressive' and even 'power users'. During earlier redevelopments and upgrades of the medical software, the opinions and knowledge of such users had been sought from time to time.

With Primetech2, such users would be much more closely involved, particularly in the creation of the new clinical support system. Malcolm spoke about how the Healthserv strategy was not one of replacing the clinician with a computer for such systems were prohibitively expensive and there was little to be gained. He described how an expert system developed in the UK which could diagnose and suggest treatment for just three diseases had taken three years to build and had cost the sponsors over five million dollars.[48] Hence the company's strategy of 'supporting doctors in their own knowledge' with checklists and diagnostic aids.

Margot explained how Healthserv had actively sought input from a large number of users working in a variety of settings and roles. There were special meetings held throughout the country during the two year development period

---

[48] Dreyfus(1979), and Suchman (1987), using a phenomenological perspective, explain this in terms of the difficulty of replacing human judgement with disembodied, decontextualised logic.

and all of Healthserv's clients had been invited to attend. I attended one such gathering in Auckland while visiting the user site. The attendees, which numbered 22 were a mix of male and female doctors, practice managers, nurses and receptionists. Healthserv was represented by Margot, Ann, Stephen and Malcolm. I noted a good mix of voices at the reception which preceded the presentation but this changed with the presentation itself.

Stephen presented some sample screens and took the audience through how they would work. Malcolm answered the technical questions while three male doctors, all in their forties, supplied the audience involvement. Ann provided some commentary and involved one of the practice managers in discussion but their participation was brief. As the rest of us took our leave, the five men who had dominated the presentation remained behind, locked in discussion about how to manage the clinical notes.

Specific involvement in the clinical support system came in the form of a specially convened panel of over 50 practices. Doctors were the main participants, but the panel included three practice managers as well. Margot explained how it was useful to include practice managers as 'they realise that general practice is a business and understand what being in business entails'. Each participant received regular information about the development including paper copies of screens plus a brief written description of the functionality and was asked for a detailed critique.

This the tasks of design, coding and testing by development staff involved multiple iterations which included regular comments from users. Prototyping minimises misunderstanding and is therefore likely to create a more useable system but there is another advantage for the company. Davis and Leffingwell (1995:7) write about prototypes 'winning the hearts and minds of the customers' and Malcolm expressed something similar when he stated that

> user involvement helps create user commitment..[and] many of the users who had contributed to the development of the package were its strongest advocates.

The movement of the new systems from the status of development software to that of 'package' occurred when prototyping was over and the system had been

tested to Malcolm's satisfaction. At this point, the application software, which included an online help facility, was ready for user acceptance testing, beginning with 'alpha' testing by Healthserv's own customer service staff and then moving on to 'beta' testing at selected sites. Malcolm described the selected sites as 'willing, competent and large enough'. This last characteristic was important as it provided the opportunity to check how the system performed with multi-users and large volumes of data. Beta testing also provided the opportunity to confirm important adjuncts to the package such as the configuration of the hardware and training.

If user acceptance testing raised issues and problems, Malcolm and his team would determine the causes, apply corrections to the software if necessary and reissue the package for further testing. In some situations, problems would merely indicate a lack of user understanding and this would be rectified through user training rather than software changes.

In the middle of 1998, with beta testing complete, there was a moratorium on further change. The package, in a form suitable for general release, had stabilised. Healthserv had done what it could to ensure that the package would be problem free at the user site.

The outcomes from development

The outcomes of development include a package with a variety of business and clinical features designed specifically for the New Zealand primary healthcare market. Margot described the package as a fully integrated system which included all significant features of the old package [49], plus

- a large library of information about diseases, drugs and laboratory tests which could be used by doctors, practice nurses and/or provided to patients
- flexibility in how the system looks and operates for a particular user. Users could, for example, customise their screens so that several windows are automatically open at the same time

---

[49] see footnote[40] for the features of Primetech1.

- an ability to port data between the application and other MS-Windows applications
- 'firewalls' for access security and virus protection. Significant given the increased level of outgoing and incoming data.

The outcomes of development also include a group of user in harmony with the package and its technological frame. A significant component of this frame is the hardware and software platform on which Primetech2 runs. This does not mean a platform that only Healthserv can sell or a particular brand of PC but it does include a particular type of server which is compatible with the package and which can run under Windows. Intel, the creator of the 286 and its heirs, create such a microprocessor and the link between Microsoft and Intel is so tight that the computer industry has coined the word 'Wintel' to describe the combination. Further significant components of the technological frame include peripheral hardware such as keyboards, screens and printers which attach readily to an Intel microprocessor, and a variety of skills and knowledge of both a tacit and explicit kind[50] which all those who use the package must acquire.

Discussion

The narrative of development accords with Bijker's (1995) model of technological innovation showing as it does the way the package took shape through a variety of processes. To express this using Bijker's conceptual tools, one might say that the package emerged from the interactions of a number of relevant social groups which simultaneously stabilised the content of the artefact and closed off the possibility of it existing in any other form. Expressed in these terms, setting the scope of development is an early stage of stabilisation, while prototyping, group meetings, presentations and beta testing

---

[50] It becomes hard to list out everything one must know and be able to do in order to use a package such as Primetech2.. Implicit skills include an ability to turn on a PC, load paper into a printer, insert a diskette and understand a wide variety of computer and health system terms. More explicit knowledge and skills, and those more likely to be taught, include an ability to transmit claims online or load new patients into the system.

involve processes of closure as well as stabilisation for they not only contribute to the form and content of the package but also bring client and user expectations of the package into line with what they will get.

The process of development, as Bijker (1995) also suggests, is one characterised by unequal distributions of power. Those sitting closest to the technical core of the package, Malcolm and his team of technical developers, have the most immediate influence over what will be included and how it will look. The highly specialised technical skills and knowledge of the technical developers are significant resources during development for they provide choices which are not available to the members of other groups. The technical developers have the option, for example, of addressing the same business requirements in different ways and can say at any point...'it is too difficult to do it that way...why not have it this way instead'. *Their* solution to the business problem will often become *the* solution that is implemented.

This situation is evident in the process of prototyping which begins from a solution proposed by the technical developers. They have, as it were, the first word and immediately set the terms of the conversation. In contrast, those who respond may reject some aspects of what has been proposed or may suggest amendments but they are always working from and therefore constrained by the original solution. The technical developers also have the final word when it comes to deciding what will be changed when the system is undergoing user acceptance testing. To use Bijker's (1995) terminology, they have the capacity to effect closure through rhetorical moves and by redefining the problem, as well as through making actual changes to the package.

Control over the way the system will look and operate is not the same as saying that the technical developers have the greatest power or even a free hand. They will be constrained as well as enabled by the Microsoft guidelines and other software tools that they are using and the functions that the existing package provides. More importantly, they must provide Healthserv's clients

with what they require if Healthserv is to retain or increase its share of the general practice market.

Healthserv's current and potential clients, the purchasing GPs, are central to the process of development for they hold the significant resource of money or purchasing power. However, this group, as Chapter 4 has shown, are accountable to their IPA and the HFA for their clinical activities. The pro-active approach of Ann and others in the customer support group in dealing with third party organisations, particularly the IPAs and the HFA (or its processing arm, HBL) reflects the authority of these two groups over publicly funded money and their economic significance to Healthserv's clients.

Although the majority of potential users will not be directly involved in development, a minority of GPs, practice managers and, much less commonly, practice nurses and receptionists may influence the content of the package. These users, generally, have some degree of expertise with computers and knowledge of how computers can be applied to general practice work. Equally significantly, they have sufficient spare time to participate in the development process and do not live or work in a remote location.[51]

In addition to these shared resources, GPs bring specific knowledge of the clinical side of general practice work and some may join the practice managers in bringing business knowledge to the development process while practice nurses and receptionists bring knowledge and skills specific to their particular areas of work. For this last group in particular, force of numbers and intervention on their behalf by involved GPs, practice managers and the customer support group will allow their voices to be heard, albeit indirectly. The same representing groups may introduce the voices of the patients, but there is only the force of legislation such as the 1993 Privacy Act or individual acts of resistance that will insist that they be heard.

---

[51] Except in the feminist literature, spare time is rarely mentioned as a significant resource. My own experiences of taking responsibility for children, running a household and of living in the country, suggest that 'spare time' and 'convenient location' are significant resources in many situations.

To sum up, many different groups contribute to the development process with Heathserv's clients, the HFA and the IPAs setting the general strategy of what will be developed. These groups have access to significant resources in modern capitalist societies, namely purchasing power and authority over how public money will be spent. The HFA and IPA are collective voices and this gives extra strength to their demands.

Computing expertise is a significant resource during development, particularly in terms of determining how the package will look and operate at the detail level. The technical developers have the esoteric knowledge and skills required for software development and they must translate all requirements into code which will 'work' but those who have knowledge of how computers work, particularly in relation to the clinical or business side of general practice, can bring more influence to bear more than those who do not have such expertise. In this way, GPs, practice managers and, less commonly, practice nurses and receptionists may influence the way the package works, particularly if they attend user group meetings and can make their individual voices part of a collective request.

The wide variety of skills and knowledge associated with the package, as well as its features and content, are suggestive of its impact in a general practice setting. However, how technology achieves its power effects cannot be understood from examining just the development process and its socio-technical outcomes. The processes and circumstances of its use and those which intervene between development and use must be examined as well. So, in Chapter 6 I examine the processes involved in moving the package from development and into use.

Chapter 6

Moving the package into use

In Chapter 5, I discussed the processes involved in developing Primetech2 and the socio-technical outcomes, including the features of the package itself. I also argued that the impact of the package cannot be assumed from the process of development or its outcomes. Intervening processes and the context of use must be examined as well.

For a package such as Primetech2, there are a number of intervening processes which involve Healthserv's existing clients as well as new clients converting from manual systems or competitors' products. New hardware and software must be purchased and installed, existing paper and computer files converted to the format required within Primetech2 and users need to acquire new knowledge and skills.

In this chapter, I discuss and analyse these processes. Although not accorded the same microscopic treatment as the processes of development or use, they show the continuing significance of money and computing expertise which were such important resources during development.

The previous chapter drew primarily on the interviews with the technical developers, the customer support group and Beth, the practice manager at the large city site. This chapter continues to draw on the interviews with the customer support group but the voices of those who market the software and a larger number of users of the package begin to be heard.

Computerising general practice

Catherine, the remote consultant involved in marketing the package, spoke with some surprise about the unexpected amount of new business that was emerging from single doctor practices operating manual systems. Even GPs who had stated a dislike of computers were looking to automate the

requirements of the IPA and were aware that even more would be demanded as practices became capitated and funding was channelled through the IPA to which the GP belonged.[52] Practices were also driven to computerise by HBL incentives and demands. The main incentives came in the form of early payments of health subsidy claims and the demand for NHI numbers on all claims.[53]

Unlike many single-doctor practices converting from manual systems, Thomas had a decade of past experience with computerised systems and looked forward to Primetech2 becoming available. He had bought a new practice early in 1998 and the patient records and clinical notes were 'in a real mess'. Thomas expected that the process of computerising would be an aid to tidying up the system as well as bringing real advantages over time. Computerised clinical notes would allow him to speed up the processing of referral letters for parts of the notes could be pasted in to the letters while coding[54] the clinical notes would allow him to monitor his own activity as well as report on that activity to the IPA.

Thomas also spoke at some length about the speed, accuracy and ease of doing the practice accounts, sending claims online and having an automated patient recall system. He also looked forward to the possibility of discharge summaries being sent electronically and receiving them much sooner than paper-based summaries which were sometimes hard to read and often

---

[52] The emergent role of IPAs in the management of this funding is signalled in the *New Zealand Doctor* dated 21 Jan 1999.

[53] National Health Index or NHI numbers came up as an issue during many of the interviews as they were due to become compulsory in February 1999 and were causing a number of problems. The manual system of allocating and checking NHI numbers for patients was time consuming and inaccurate and an online lookup system which would help resolve many of the problems was being developed. Thus practices which were not computerised would have the dual problem of transcription inaccuracies as well as problems in getting NHI numbers for new and existing patients.

[54] Coding involves the categorisation of symptoms, conditions etc with the appropriate identifier. This coding, which uses an agreed standard called the Read Clinical Classification (RCC) or Read Coding, is a way of representing in computer-readable form almost any aspect of a clinical encounter and consequently making this information available for subsequent retrieval.

delayed. He cited a number of experiences of seeing patients who had had recent surgery where he had no information about the exact surgical intervention or any complications which had ensued and could not be sure of how to go about further treatment.

Purchasing Primetech2

For Thomas, there had been no 'shopping around'. He had used Healthserv's medical software in the past and was 'reluctant to take on the learning associated with moving to an entirely new system'. He also considered from his past dealings with the company that he could trust Stephen's description of what the package would provide and that Primetech2 would be competitive with others in the market. So for Thomas the purchase of Primetech2 was based on an established business relationship as well as an expectation that his knowledge of Primetech1 would be partially transferable.

For many practices using competitors packages in 1998, the situation was different. A major buy out of existing suppliers in the medical software market had left many practices with a package which was not being upgraded and with hardware and software which would not handle the changeover to the new century. Even Mac[55] users were being forced, through lack of upgrades, to change to a new system. The company which had bought out the opposition, had offered to sell its own Windows-based product to those practices left stranded, but their 'clean sweep' of people and products had also done away with the bonds which tie clients to their vendors.

In such circumstances, Healthserv anticipated that business would be brisk and they were not disappointed. When I spoke with Margot at the end of 1998, she informed me that they had installed fifty new systems in the first six months

---

[55] The Mac or Apple Macintosh provides an integrated platform which has a high degree of sophistication in a small business environment and its users are often devoted to their product. They quite rightly point to the sophistication of the Mac when Microsoft was still in the dark ages of MS-DOS. Many Mac users describe discarding the Mac in favour of MS-Windows as an emotional wrench and a backward step.

after the package's release and that twenty five of these were for clients moving away from competitors' software. Eight were for clients computerising for the first time and the rest were moving from Primetech1 to Primetech2. Healthserv's installation schedule for 1999 was already beginning to fill and Margot's main concern for the foreseeable future was satisfying client demand.

For practices moving from Primetech1 to Primetech2, the most compelling reason for the move was the obsolescence of Primetech1 and its platform. Beth, the practice manager I interviewed made this point when she spoke about the advantages of any Windows-based system to meet practice requirements for a fast and accurate system which could link readily to the Internet and which was compatible with a range of other applications. At the time of the interview, Beth was determining whether GPs in the practice had any specific requirements and evaluating a number of different packages and hardware options. Beth pointed out that the practice would 'need a very good reason' to move away from Healthserv as it would be much easier to convert the data and the people in the practice to Primetech2 rather than something totally new. Stephen had made a special visit to the practice and she had also sought advice from an independent consultant with technical expertise. At a cost of around $100,000 for a full install[56] it was important that they 'got it right'.

For the majority of potential clients, important sources of information were other users of the software and the IPA. Many IPAs would recommend a particular

---

[56] The $100,000 breaks down to
1 server @ $9000
20 workstations @ $2500
3 days training @ $500/day
data conversion @ $500 - $1500
plus new printers, if necessary and various other software and hardware expenses

In comparison, a small practice would require a cheaper server and printer, one or two workstations and less of everything else. In total, around $10,000. Note that the list does not include the cost of the package itself as Healthserv considered that this information was commercially sensitive. I was able to discern, however, that Primetech1 cost $3,800 in 1996, that the price of Primetech2 was negotiable with existing Healthserv clients paying minimally, if at all, for their copy of the new package.

software package but in a small but increasing number of situations, a particular package would actually be mandated as this provided cost and time savings to the IPA and directly and indirectly to the membership. Special hardware and software deals could be negotiated on behalf of the members and within an IPA those employed on IT support would need to learn the particularities of just one package and deal with a single vendor rather than several. In addition, the data provided by GPs could be more easily collated.

John, the IPA chief executive I spoke with, however, suggested that mandating a particular package was not on his agenda. His primary aim was to have all member GPs computerised by the year 2000 as this was a necessary precursor to making GPs accountable for their clinical activities. He agreed that standardising on one package would be the ideal situation but pointed out that most practices had already made investments in technology and that all major packages provided adequate functionality.

Selling more than the package

High functionality and ease of use are listed as important feature of Primetech2 in a Healthserv marketing document which potential clients received in 1998. Others were its standard but sophisticated and flexible Windows-based software and secure links to the Internet. At the top of the list were features outside the platform and the package, namely the longevity of the company, its loyal and dedicated user base and its ability to support the users no matter what changes emerged in the New Zealand health environment. In the words of the document, the company delivers not just any medical software package but one backed by 'Experience, Expertise, Commitment [and] Dedication'.

Customer support could include on-call support of all the software that the practice used if Healthserv was the supplier. It might include spreadsheet and other office applications as well as the Windows operating systems software. Healthserv could also supply and support the hardware. Catherine pointed out that the server in a client/server environment was a key player. It must have sufficient speed and capacity for the general practice site and must be reliable.

For these reasons, Healthserv provided a detailed specification of the server or, preferably, sold it themselves. Healthserv would also provide the client workstations, printers and additional application software.

Thomas chose to receive all his hardware and software from Healthserv as he considered that there was nothing to be gained by dealing with several suppliers, all of whom would implicate the others if problems ensued. Beth, on the other hand, had no reservations about dealing with multiple suppliers for peripheral devices, such as workstations and printers, and expected that her practice might lease rather than purchase workstations if there were cost advantages.

I asked Catherine whether the hardware and software were high profit items. Her reply was that strong competition kept the margins small and that support of the package was the main source of company income. The company had, historically, supplied the platform that its medical software package required as it made support of the package easier from the company's perspective, as well as from the client's point of view.

Configuring the user site

As well as offering advice about the type of hardware and software that the practice might require, selling Primetech2 necessarily involves those marketing the package in providing advice about the number and location of PCs and printers. Catherine explained that their advice was sometimes ignored as doctors were very cost conscious. Catherine pointed out that practice nurses were usually the worst affected:

> The doctors might allow just one PC between two nurses...[or] in the worst case, which happens too often, nurses would have to try to get time on the computer at the front desk- a very difficult arrangement for all concerned, especially the nurses. [In contrast] each GP would have one. There was never a problem here - this was usually attended to very well. The front desk would have around two PCs if the practice catered for more than one doctor [and] in most circumstances, the practice manager would have a dedicated PC which would also run software which managed the payroll and financial accounting side of the business.

Ann suggested that this problem had begun to lessen as GPs became more experienced with computerised systems and listened to the advice of their IPA.

Once a commitment had been made by the practice to purchase Primetech2, and any associated hardware and software, installation and training times were scheduled and an information pack sent to the prime contact at the site. It might be a GP, the practice manager or someone in the practice with computer skills. The information pack provided a date for the arrival of the hardware and raised a number of critical issues about the installation such as establishing suitable locations for the workstations, printers and server, data conversion and the structure of the training. Catherine spoke with wry humour about the importance of informing more than the prime contact, especially if the prime contact was a GP as they were 'notorious for their poor communication with staff'. She explained that she and other Healthserv trainers had the experience of arriving at a site and being told:

> I don't know anything about computer training. The doctors have bought them. They've just landed on the desk and I don't know what we do now.

Training the users

Training costs $500 per day and GPs were rarely willing to pay for more than 2-3 days. Ann spoke about how even this amount could be hard to sell as some GPs would argue that 'if the package is good enough staff won't need training'. Healthserv's charges are only one of the problems perceived by clients. Staff needed to be released from their day-to-day work and a separate area away from practice activities needed to be found. Catherine spoke about how Healthserv attempted to minimise the problems for clients by breaking down training into two hour modules so that staff could attend at separate times. Jane, the practice nurse at the large city practice described how one doctor she had worked for took a very cost-effective approach. Training was scheduled at weekends and attendance was 'unpaid - of course'.

A similar tale emerged from Catherine who had attempted to encourage doctors to send staff to Windows-based training courses but found that this was 'rarely done although practice managers and receptionists sometimes did the training

on their own initiative'. She suggested that a small amount of Windows knowledge could make 'a world of difference' to how quickly people learnt and in overcoming their fears. Karen, the receptionist at Thomas's practice, had attended a Windows-based training course at the local college which she had paid for herself. The course was helpful but it did not stop Karen feeling what she described as 'really stupid' and 'a twit', during the two days training which Thomas had bought. Karen was at pains to point out that the fault did not lie with the Healthserv trainer who had been 'very patient and helpful' but with her own fear of the computer and the difficulties of understanding the technical language and terms.

Catherine used similar words when describing her experiences of training older practice nurses and receptionists who were unfamiliar with computers. She had often been told by those she was training that they had feared her arrival, 'terrified' that she would be 'a computer person who wouldn't be able to speak in plain English'. Catherine suggested that this fear was often based on users' experiences of computer people in retail shops who 'don't even seem to speak the same language' and that their terror of computers, computerisation and computer people was made worse by a lack of communication from GPs.

Converting the data

Healthserv provided a data conversion service for practices converting from Primetech1 or from a number of competitor products. The users paid for Healthserv's time as data conversion could be time consuming if practices had not used data in standard ways. However, some Primetech1 to Primetech2 conversions had been very straightforward and the changeover had happened within the space of a week.

For those converting from manual systems, the changeover could take a month or extend over a year if the system was being slowly brought over. HBL provided an incentive for practices to computerise through supplying helpers who would download patient information from paper files on to disk. This information could then be converted into the required format when the new

system was installed. This conversion was not perfect as staff still needed to check and tidy up the results. Thomas, however, had not chosen to take this approach as he preferred to employ someone for a month to key the data directly into the new system and bypass this step. From his perspective, the conversion had been as quick and trouble free as possible, given the 'messy' and incomplete state of the paper files.

The outcomes from moving the software into use

The socio-technical outcomes from the processes described in this chapter have some superficial similarities to the outcomes described in the previous chapter but they are not the same. The package, as it moves out of the development site provides certain arrangements, procedures and tools, much as a game such as chess has a set of rules as well as a board and pieces which are used in play. Implementing the package is equivalent to learning the rules, setting up the board and pieces and then drawing on one's skills and knowledge to strategise the play. In the case of Primetech2, implementing means that patient information and other data specific to the practice have been incorporated into the package and that the procedures the package provides have become integrated into the procedures of receptionists, practice managers, practice nurses and GPs.

The specifics of a general practice site, including the skills and knowledge of the people who work there, as well as decisions made about training, conversion and equipment during its deployment, ensure that no practices go live in precisely the same way. Incomplete manual records, for example, will be incomplete online records unless time and money is invested in upgrading the data. Decisions about hardware purchases and training will result in different types of technological frames and, most significantly, whether the package is experienced as enabling or as a constraint.

Discussion

As I discussed in the previous chapter, the release of the package for general sale signalled the stabilisation of its content and an important point of closure as the features of the package and its meaning became shared amongst several different relevant social groups. In contrast, the process of selling is primarily a process of closure for it moves the package out to a larger number of clients, drawing them into its frame, without substantially changing the meaning of the package in any substantial way. The sales description, for example, maps closely with the description of the product provided by Malcolm, the technical developer and by Margot who manages user acceptance testing and customer support.

A skilled marketer such as Stephen would stress the features of Primetech2 which appealed to a particular purchaser. New and reluctant clients, for example, would be sold something which is easy to use, and well supported. Those migrating from Primetech1 would be sold its Windows features as well as the secure Internet access and its standard, state of the art hardware and software. In other words, marketing Primetech2 is more a process of selecting which of the features of the product and company to bring to the fore rather than one where new features or 'selling points' are created by those who market the technology.

As with development, the process of acquiring the package is marked by unequal distributions of power. At the centre, are the purchasing GPs, the partners in group practice or the solo GPs, who have the final say over whether to computerise or not. But to have the final say does not imply a totally free hand. Those who resist computers will surely suffer, probably financially, by a refusal to computerise as the IPAs and HFA (HBL) continue to offer financial sanctions and rewards for providing information and carrying out certain clinical activities. The cost to the GP would be in the form of slow payment of claims and increasing difficulty of staying in practice as electronic exchange of information becomes the norm.

For the minority of purchasing GPs, the IPA will mandate a particular package which means that GPs will be forced to bow to the pressure of the group unless they feel so strongly that they will relinquish their membership. In other situations, a particular package may be acquired because of the way Healthserv conducts its business. Personal relationships established through past purchases and day-to-day support help establish repeat business while the difficulty of moving one's thinking and one's data outside the Primetech frame also binds the authorising GPs and practice managers to the new package. In such ways, the past including the technological past, is carried into the future although in no sure and formulaic way.

Purchasing GPs will also decide how much hardware, extra software and training will be bought, how, when and where training will be given and whether staff will be paid during training time. They may, however, be influenced by other groups. Healthserv's marketers and customer support people will make certain recommendations and many practices will act on the recommendation of the practice manager. This may provide a better deal for those working in the practice but, at the end of the day, those with economic power will make the decisions about what will be provided during installation and those without economic power can choose only their response to the decisions.

The training and assistance provided by Heathserv's customer support staff, and conversion of existing data can also be regarded as additional processes of closure for they draw more users into the package's technological frame. Training in particular encourages those in general practice to use the system in the way it was intended while conversion of existing data creates information within Primetech2 which may no longer be available elsewhere. Having data accessible only through the procedures that the package makes it an obligatory point of passage for those who need to access this data.

Through the processes of training and conversion, then, the package begins to exercise its potential as an instrument of power although there is nothing certain at this stage about whether it will be experienced as enabling or a constraint when those at a particular general practice begin to use it. So, in the

next chapter, I examine the experiences of those who use the package in a small general practice and a number of more general experiences of using medical software in a larger site. I then go on to discuss the effect of the package on the groups which use it in their daily working lives as well as those impacted by its existence in a variety of ways.

Chapter 7

Using the package

In Chapter 6, I discussed the movement of the package from development through to a working system in a general practice site and showed that a working system in one site is not necessary identical to a working system in another. Conversion and training strategies, hardware purchases and levels of computing skills, as well as specific conditions at the site have the potential to create differences in the way the package is experienced and used. At the same time I showed that those groups with economic authority, purchasing power and computer expertise who were so influential during the development of the package continued to exert their influence as the package is brought into use.

Chapter 7 describes how the package is used to manage the business of general practice and the impact of the package and its technological frame on those who work in general practice and on patients. Although the main focus of the chapter is on these groups, it also discusses how the package and its technological frame links the world of general practice to a variety of other worlds, including the global world of computers.

This chapter draws almost exclusively on the field work at the two user sites; the single doctor practice in a provincial town where Primetech2 is part of daily working life and the large city practice where Primetech1 is still in use. The comparison is useful as it suggests how different levels of authority, computing expertise, age and local conditions can make a difference to one's experience of using medical software. As might be expected, the voices of those who work in general practice, namely the practice manager, the GPs, the receptionists and the practice nurses are those most strongly heard. In most instances, they speak for themselves. More rarely, they speak on behalf of the patient. In

order to create a better balance, I include my own experiences as a patient visiting a computerised general medical practice for the first time.

As I have shown in the previous chapter, Thomas had bought Primetech2 convinced of the benefits of computerised medical systems. From his past experiences with Healthserv's products he was sure that it would be a valuable tool and he planned to use the package in his clinical work as well as for accounting and practice management. Thomas had told Karen that it would be 'hell on earth' for the first three months but when I first visited the practice just two months after 'going live' the package was running smoothly and there was no sign of the anticipated hell.

It should be noted that all three participants had their own PC and had received two days paid training plus informal support from Healthserv's remote consultant.

Managing the work with Primetech2

Karen, the receptionist at the small city practice spoke approvingly of how the package saved her a week of typing up the monthly accounts as well as allowing the practice to deal more quickly with health benefit claims. She also spoke with some enthusiasm about the way it managed patient receipts and helped reconcile the daily banking. Karen remarked on her own increasing expertise, showing me several examples of problems she had resolved and features she had learnt to use.

She also expressed satisfaction with Primetech2 being 'up-to-date' and found that at the practice managers meeting she attended, other practice managers and receptionists were a little envious that she was on a new Windows-based system. Karen felt 'quite proud' that she was the only one using the new package and suggested that, apart from the first few weeks, learning to use a computer had been good for her personally. Computer skills had become essential for most forms of work and she was glad that she had finally acquired them.

The effectiveness of the accounting side of the package, including the billing system came as no surprise to Thomas who considered that 'the company would *have* to be able to get this right after fifteen years in the business'. He also went on to suggest that, in comparison with the clinical side, such functionality is 'made for computers as the variables are not there'. Thomas was aware that he could use Primetech2 to see how the practice was doing financially but didn't feel the need to constantly check up. The important thing, from his perspective was that he could buy what he needed and that the practice statement 'stayed in the black'.

As well as speeding up the accounting side of her work, Karen found that the package helped solve some of the difficulties associated with communicating with the doctor.[57] The 'waiting list' feature of the appointment book meant that a receptionist could always find out who was with the doctor while the doctor could determine who was still waiting to be seen. This feature depended upon the receptionist updating the list when new patients arrive and for the GP to indicate on the system that a new consultation has begun. Another useful feature, from Karen's perspective, was the 'red alert' placed on patients who hadn't paid. She explained that this feature made Thomas aware if a patient he was seeing had an overdue account and was pleased that Thomas was willing to raise this issue with the patient in the privacy of the surgery rather than leave this job to her.

During a visit to the site six months after going live, Karen spoke with some enthusiasm about having NHI number lookups online. This feature removed the problem of obtaining numbers for non-registered patients, especially when consultations were outside the normal hours. Karen was also in the process of learning to send health benefit claims electronically. She was finding the process 'a bit nerve racking' but was aware that it would improve the practice cashflow.

---

[57] The difficulties involve communicating in the public arena of the waiting room and, for the receptionist, intruding on the private space of the patient/doctor consultation.

Karen's obvious appreciation of Primetech2 and computers in general was not shared by Susan, the practice nurse who took over the reception desk when Karen was not there. Susan stated that she still 'liked having a book in front of me - I can see exactly what's going on' but admitted that the transition to a computerised system was 'better than I feared'. After some probing, Susan did say that she expected immunisation, screening and recall programmes would benefit from automation but, at the time of the interview, was still having problems getting them 'up and running'. Her problems were not with the computer but with low patient response which she could not readily explain. Susan went on to say that the IPA was aware of what the practice was doing and there had been no pressure to have any screening or recall programme in place by a particular date.

Thomas himself was in the process of getting information out of the system so that he could supply some information to the IPA as well as achieving a better understanding of the health status of his patients. Through this and a number of other comments it was clear that Thomas had no concerns about any form of audit, IPA or otherwise, nor of supplying government agencies with information. As he pointed out

> I'm an honest man. How this information is used depends as it always does on the commonsense and goodwill of those interpreting the data....Hopefully it will be used rationally and with wisdom [and in a manner]...which takes the full circumstances into account...not as the basis for arbitrary judgements and blanket cutbacks.

Thomas did suggest that, with computers, the 'parameters can be shifted in many ways' and that large governmental organisations had the resources to 'fudge the evidence when they wanted to justify certain actions'. He also spoke about how he would resent money being spent on refuting such justifications as any available health dollars should be spent on providing

> better and cheaper healthcare to those who need it rather than being poured down the management spout.

Managing the work with Primetech1

The situation in the large city practice differed in a number of ways. Primetech1 had been in place for almost five years and Beth, the practice manager, had the IPA reporting well in hand. A summary of patient demographics was sent to the IPA each month along with information about GP activities. Management of diabetes, immunisation and cervical screening rates were some of the activities Beth spoke about and she described how this information was collated by the IPA with data from chemists and laboratories. In addition to sending regular reports to the HFA, each GP was sent information about their own professional practices so that they could monitor their performance in relation to other GPs in the area. Over-prescribing and excessive use of laboratory tests were of particular interest and Beth suggested that the GPs in the practice she managed were rarely outside the norm.

In response to my question about the significance of practice nurse activities in the GP's performance, Beth agreed that they played an important role but that the patients were registered to particular GPs and that GPs took overall responsibility for the management of their healthcare. However, Jane, the practice nurse I spoke with, answered the question rather differently. She suggested that the invisibility of practice nurses was an 'occupational hazard' and that many worked hard with little acknowledgment. They were rarely paid for overtime hours, and many practice nurses earned little more than the government subsidy of eleven dollars an hour. Even Masters graduates in city practices were lucky to receive eighteen dollars an hour.[58]

Jane recalled that her early training in computers had been carried out in the late 1980s and that right from the beginning she had found the computer easy to use. She had been running computerised screening, recall and immunisation programmes in the current practice for four years and the

---

[58] Barbara Docherty (1996) makes a number of similar comments about the lack of value placed on the work of practice nurses. She also provides a brief history of the government subsidy scheme since its inception in 1970.

computer was just a fact of working life. Jane was aware of some older practice nurses leaving their jobs because they found the computer 'too difficult', especially when they had to change packages. Jane, however, was a fervent advocate for computer systems, describing them as 'such a time saver' and said with some feeling that she would 'hate to go back to a manual system'. Too much of her working life had been spent filing, photocopying and trying to read indecipherable handwriting.

Although a large amount of patient information was online, the practice Jane worked for still held a proportion on paper. When questioned about the possibility of a paperless practice, Beth considered that it would be some years away. Issues of security and patient confidentiality still had to be fully resolved and many providers were still not computerised or Internet ready.[59] Beth pointed to a large office full of paper files and explained that scanners were no panacea. They were helpful in some situations, but the type of scanner the practice could afford would be neither accurate nor fast enough. Historical data and the amount of paper coming in from outside were not the only impediments to a paperless practice. They also came from the continued use of paper-based clinical notes by the majority of the practice's GPs.

Beth explained that the clinical notes system had been installed for five years but the GPs at the practice were obliged to use the system only for prescriptions so that practice nurses could safely handle repeats. Out of the six full-time doctors at the practice, only one went to the extent of recording and coding the clinical notes. When asked why, Beth suggested that the practice partners, like most doctors over 40, had limited computer skills and found it hard to work with online material.[60]

---

[59] This term is often used in the advertising literature to describe PCs which have the software and hardware which will allow easy connection to an Internet provider.

[60] Many of the participants made such comments and the computing literature suggests something similar. See for example Warneminde (1998:69) whose experiences of developing computer systems for Australian doctors led him to the conclusion that 'doctors are often one of the most technophobic groups of business professionals'.

Donna, the receptionist, at the same city practice had well-established computer skills and was aware that these had been important in securing her employment. I was initially surprised that she had no health sector experience but found when interviewing Beth that this was as much an advantage as a problem for it was important that reception staff did not 'cross the boundary into medical matters'. Nor was 'chattiness' wanted in a busy city practice which dealt with patients from all walks of life. When asked to describe the characteristics of the ideal receptionist, Beth listed efficiency, computer expertise and customer service skills.

The patient at reception

My own feelings as I waited to speak with Beth for the second time was that she had succeeded in making the organisation operate like an efficient business rather than a medical practice which dealt with the emotional and messy human conditions of health and illness. There were few people waiting and those who did, sat in silence. The practice was tidy and tastefully decorated and two receptionists sat in a separate area cut off from the patients by a solid, chest-high wall. There was little sense of disturbance as patients came and went and even the telephone, which rang in muted tones, was promptly answered with the minimum of movement.

This contrasted markedly with the informality of the single-doctor practice and Thomas's comment that his first requirement for a receptionist is a 'good friendly way' with the patients. Karen herself described the practice as 'chatty' and I observed first hand many informal conversations between her and the patients and among the patients themselves during several visits to the practice. Karen suggested that

> elderly patients who are lonely enjoy the opportunity for a bit of company and seem to come in particularly early, perhaps with this in mind

Because of the informality, Karen was aware that patients had concerns about confidentiality and data security and offered reassurance that patient files could not be accessed by anyone outside the practice. She also expressed concern about the difficulties some elderly patients had in distinguishing between

prescriptions, xray requests and receipts. I understood their difficulties, as all three were printed in black on the same sized plain paper and, without my reading glasses, they looked much the same.

Karen had backed away from handing out patient numbers because of her own views ('They call me by name so why should I know them by a number') and because of patient reaction ('We're not a number in this practice'). Occasionally, patients transferring from the local medical centre specifically requested a number which she would then supply. In other words, Karen showed her concern to spare patients the feeling of being secondary in importance to the computer. This particular concern was not apparent in my interview with Thomas.

The consultation

The interview with Thomas was held in his consulting room and I noted that his computer screen had been placed so that it did not create a barrier between him and the patient and that the printer was placed about two metres away. Thomas explained that he liked to talk with the patient while printing out requests for laboratory tests and prescriptions and this minimised the noise. He also suggested that using the computer for laboratory tests was a little slower than doing them by hand. Despite a number of questions on my part, Thomas could offer no other suggestions about how the computer altered the patient-doctor encounter.

Thomas did make two observations about the limitations of the clinical notes feature of the package. Firstly, he had been unable to devise quick non-textual ways of recording observations which had been easy to do with hand-written notes. And secondly, Thomas had found some difficulty with tracking conditions with complex interconnections such as back pain and depression. It was possible to enter codes for both conditions into the system, but a later search would show one or both conditions, but not the link between the two. As Thomas pointed out

> interconnected conditions are characteristic of human beings but computers are limited in their ability to model and bring to light complex connections.

My interview with Ruth, a GP who used Primetech1 between 1993 and 1996 provided an entirely different list of concerns about using medical software during a patient consultation. She explained that, as an associate rather than a partner, she was given no choice when the practice she worked in moved to fully-online clinical notes. At first, Ruth felt unworried as she had a computer a home and had just completed a course of study which involved the extensive use of a PC. Within a short space of time, however, she found the influence of the computer both undesirable and profound.

An early problem related to the lack of extensive patient history on file. Only the most recent history had been copied on to the system and this was aggravated by a decision by the partners, as a cost-saving measure, that reception staff would not retrieve paper-based notes in advance of the consultation. Thus Ruth found herself sometimes leaving the consultation to retrieve the notes from the paper files and spending extra time summarising long medical histories which she though important to have online.

Ruth described how, with the computer,

> it took three times as long to write prescriptions and referral letters and that this took away my confidence - I'd always been so quick....When I was hand writing prescriptions and referral letters it was instinctive. I could do them while I was talking with the patient. Suddenly I was stumbling and had to stop and think.

She went on to say that many of her patients 'hated the computer'. At first, she attributed this to her own lack of typing skills and computer expertise but came to see that it was a bigger problem when several of her elderly patients complained that the other doctors in the practice 'talked more to that blimmin machine' than to them.

Although the emotion that I experienced when visiting a computerised general practice for the first time in 1997 was not hatred, the notes I made shortly after the visit reflect a concern about the way the GP interacted with the computer rather than with me:

> After a brief review of the reason for my visit, the screen became the main subject of his attention as he searched for the right drugs to prescribe and made a record of my visit. He even called the computer system 'stupid' when it refused to print the prescription that he had just keyed in. Eventually, after the doctor managed to make the system do what he wanted, he turned and gave me some brief advice. My feeling as I left the consultation was that the doctor had heard what I had said, but that I had not truly been 'seen'.

The problem, according to Ruth is that the computer is 'like a third person in the room' which 'rules because it takes your attention'. She explained that having patient notes, prescriptions, referral letters and laboratory results on the screen meant that the doctor spent far too much time 'looking at the computer, not the patient'. Ruth recognised that the odd 'computer buff' would be interested, but many of her patients were older people who found the presence of the computer particularly 'alienating' and 'intrusive'.

Ruth tried to minimise the intrusion by making sure that she ignored the screen and communicated only with the patient as the beginning of a consultation. Only then would she excuse herself to look up test results or other clinical information. Once this information appeared, Ruth would turn the screen towards the patient so that they would be included rather than excluded from the communication. Although Ruth was aware that few patients could fully follow the medical language and had insufficient time to read the large volume of data which often appeared on the screen, she felt that this procedure reduced the alienation many patients felt. It also gave them a chance to ask questions rather than wait for her pronouncements. However, it slowed the consultation down considerably.

In 1996, Ruth found that her annual income had dropped to less than $20,000 even though she was working, on average, thirty hours each week. She therefore decided to retire some ten years earlier than planned and stated with some feeling that 'the computer was a major factor in my leaving the profession'.

Dependence upon the computer

During the interview Ruth spoke about the problems caused when the computer was unavailable for a morning. There was no paper backup and everyone in the practice, including the GPs, were unable to work. Beth, the practice manager also described a 24 hour outage which had not stopped the GPs doing their work as most clinical notes were in paper form but which had created havoc elsewhere.

> Staff were sitting around thinking - 'what do we do now?' and many tasks, such as running an appointment book for five to six doctors, were found to be highly demanding. The experience showed that staff did not know how to manually carry out tasks such as raising benefit claims. Reconstructing what 20 staff had done for the day was just horrific - it took me all Easter to put just the accounting side through. Overall, it showed just how reliant everyone is on the computer system and that the doctors who distrust computers have some justification for this.

Outcomes for staff within a general practice setting

As the narrative shows, Primetech2, has been readily incorporated into the working life at Thomas's practice. At the time of the study, the receptionist and practice nurse had the knowledge to operate a manual system but, as Beth and Ruth's comments suggest, it is only a matter of time before much of this knowledge becomes stored in the routines of the package rather than the minds of those who use it. Even a single doctor practice will become increasingly reliant upon what the package does as well as the information it stores.

To be dependant upon the package brings about a dependence upon the skills and support which Healthserv provide and, less directly, of those who have developed the hardware and software which form part of its technological frame. Thus a decision or assumption by a Microsoft Windows programming team in the United States or by those at Intel who develop the server could have consequences for millions of people. A medical receptionist working in a small New Zealand town might find, for example, that she cannot make

appointments or print receipts on the last day of February because some distant technocrat forgot to take leap years into account.

The package is, as I have described elsewhere, an integrated system which means that those who work in general practice are dependant upon the work of others within the practice. But there is nothing new about this particular form of interdependence. The electronic files mirror the paper files of the past which have always been available to the receptionist, the practice nurse and the GP and the package supports the work of each of these groups. At the same time, the package does open the door to changes in how work is done.

Some features, such as improved communication within the practice may be invoked if the GP is willing to chase up bad debts or to use the waiting room facility. Other features, such as the package's ability to help manage multiple appointment books and to produce detailed financial reporting will be important only in practices which involve more than one GP. In other words, there is some degree of interpretive flexibility in the package, at least in the sense that features which have explicitly been designed as optional may not be brought into use

Receptionists have responsibility for many functions of the package which are mandatory, namely managing appointments, recording payments, non-clinical patient information and generating customer billing and claims. They are not considered optional because they form part of the core processing of the package or are used for tasks particularly amenable to computerisation. For receptionists, then, the package is an obligatory point of passage. Given adequate training and support, younger receptionists such as Karen are likely to experience computerisation as a chance to gain additional skills which provide opportunities outside the immediate work context rather than a negation of skills she has.

The package will also save a receptionist time once she has gained some expertise but time saved in a general practice setting does not equate to either redundancy or free time. In Karen's case, it provides the opportunity for her to

spend more time at reception or to do additional administrative work. Those who gain from this spare time include the GP who does not need to employ additional staff and, in theory, the practice nurse who used to cover for Karen at reception.

Job enlargement is a feature of the work of practice nurses in the climate engendered by the health reforms. The increased screening and monitoring activities carried out by practice nurses is reflected in their growing numbers[61] even with the increased use of automated systems. Without automation, the time and cost of such activities would increase substantially. The package, once installed, is therefore an obligatory point of passage for practice nurses. They, like the receptionists, will experience it as either enabling or a constraint depending upon their age and past experience with computers as well as decisions about equipment and training made by the purchasing GP.

For practice nurses such as Jane, the computer is experienced as a useful tool but for others who are older, inadequately trained or without their own PC, the computer is just another difficulty and restraint which sits alongside existing inequalities between practice nurses and GPs. In some instances, practice nurses and receptionists may resign rather than face the daily difficulties and fear of using a PC. They will be unlikely to find work in general medical practice elsewhere as new employees are expected to have computing experience.

Electronic claiming, unlike the automatic generation of claims, has little impact on work within the practice but it does impact on employment elsewhere. An article in *The Dominion* dated 2 March, 1999 shows that electronic claiming by doctors, midwives and pharmacies was expected to remove 170 jobs by the middle of 1999, although at the end of 1999 this expectation had still not been realised. My informant at HBL suggested that technical problems at HBL had

---

[61] The number of practice nurses increased from 2465 to 3077 between 1996 and 1998. In comparison, the number of GPs increased from 2935 to just 3159 during the same period. (New Zealand Health Information Service, 1999a, 1999b; Docherty, 1996)

been the main stumbling block. The majority of redundancies involve data entry work in Wanganui and Christchurch. Statistics produced by the Ministry of Commerce indicate that those employed in this work are women under 35 years of age (Templeton, 1998). Thus GPs may have improved cashflow and the HFA may (possibly) limit costs as well as gain strategic health information but young women in Christchurch and Wanganui will be forced out of work. At the same time, the New Zealand balance of payments worsens as we contribute to the ongoing success of Microsoft, Intel and other large transnationals computer corporations.[62]

For practice managers such as Beth, the health reforms have created additional reporting and training demands but this reflects the particular circumstances of the practice. GP resistance to using and encoding the clinical notes reflects the power of GPs to run their practices as they see fit, even if it means additional work for the practice staff. Paper files must be retrieved for each consultation and GP activity which is reported to the IPA must be manually collated and summarised along with practice nurse activity which has been recorded on the computer. The package may include sophisticated IPA unloads, but these unloads cannot extract information which has never been entered and encoded.

How long GPs, such as those at Beth's practice, can resist entering and encoding the clinical notes depends upon how long the practice partners are willing to bear the cost of manually collating IPA information and how much financial pressure the IPAs and HBL place on individual GPs to provide information in electronic form. It looks likely that few will be able to resist the pressure to computerise their clinical notes once electronic exchange of information between providers becomes the norm. Failure to participate in this exchange may result in unacceptable delays in receiving patient information

---

[62] Total New Zealand end-user sales of Information Technology in 1998, excluding exports, reached almost 5 billion dollars with hardware alone exceeding 2 billion (Statistics New Zealand, 1999). Only a small percentage of hardware in particular would stay in New Zealand,

and a degradation in the level of care that a GP can offer his or her patients. In this environment, GPs have little choice but to use a package such as Primetech2 which provides for secure electronic exchange as well as a sophisticated facility for entering and encoding clinical data.

Outcomes for GPs and patients

In using the clinical features of the package, GPs and their IPAs are in a position to gain financially from the electronic interchange of information. This information is a key resource when the IPAs negotiate with the HFA for funding on their members' behalf for without the information, the HFA cannot manage the public funding of primary health care. Thus an IPA gains power through giving the HFA the information that it needs as well as through the management of bulk funding which it receives on its members' behalf.

Management of the funding involves a variety of activities which can be summarised as making sure that the best possible use is made of each health dollar. The narrative shows that this takes a variety of forms including the education of GPs and practice nurses and the monitoring of their work. The consequence for GPs is increased scrutiny of their clinical practices and clear directives towards what is perceived by the HFA and IPAs as the most cost-effective ways to treat and prevent disease. Current indications are that doctors whose clinical practices are inadequate in these terms are being brought into line. At the same time, the non-profit basis of IPAs means that any budget savings are being used to fund a variety of healthcare initiatives such as those described by Fougere (1997) in relation to Pegasus, a Christchurch-based IPA.

Standardisation of clinical practice and a business approach to heath have a number of dangers to GPs. GPs have always fought to retain their professional autonomy and the type of monitoring or peer review being instituted by the IPAs has much in common with the performance reviews of bank staff described by Austrin (1994) for it is a sophisticated way of drawing GPs into line. From the perspective of those seeking primary healthcare,

standardisation has the potential to protect patients from seriously incompetent GPs. The bulk funding of healthcare which is associated with standardisation, might also direct 'unproductive' spending away from better off groups which are the greatest current users of the primary health care dollar to the poorest in the community who use it least.[63] However, if bulk funding is to be associated with greater equity of access, primary healthcare must be adequately funded by public money and IPAs must retain a clinical rather than a business focus. Parallels might be drawn here between bulk funding in the health sector and bulk funding in the education sector where the dangers and opportunities have been well publicised.

The package, with its new clinical guidelines and large library of information about drugs, diseases and laboratory tests, reflects and reinforces the standardisation of clinical practice. These features derive from the influence of the HFA and IPA during the development of the software, either through contact with those working for Healthserv or through the GPs who participated in development. Use of these features, however, means that a GP will spend an increased proportion of the consultation viewing as well as entering information into the computer.

For GPs such as Ruth, using the computer will be experienced as a loss of expertise to the point where their earnings drop to the level of a well-paid practice nurse. For others, especially younger GPs who prefer to use computers, it will be business as usual. At the same time, computer usage has effects which relate to both the features of the package and its technological frame. The widespread recording of clinical information on the computer produces a store of information which is, by necessity, decontextualised and partial. Links between conditions and between prescribing practices and demographic variables are likely to be hidden from view. How this information is used and by whom and for what purposes are the key issues but without computerised clinical notes, such questions could not even be asked. In other

---

[63] This point is made by Malcolm (1996).

words, the storage and encoding of data electronically makes future retrieval and ab/use possible. Equally significantly, the extended use of a PC during the consultation has an immediate effect on the patient-GP encounter.

GPs have always viewed written texts and paper-based notes during a consultation but these do not intrude in the same way. The computer screen, as the interview with Ruth and my own experiences as a patient demonstrate, draws the gaze of the GP away from the embodied patient and into a world of medical terms, treatments, computer screens and printers as well as the patient's encoded clinical history and financial status.

GPs with empathy and insight will continue to see and interact with their embodied patients but, as Star (1991a,1991b) and Suchman (1994) suggest, they will be continually involved in articulation work as they move between the tidy codes and categories of a package such as Primetech2 and the complexity of the human condition. This work, as Star and Suchman also suggest, is time consuming, difficult and often invisible to those who sing the praises of computerised systems. GPs who do it well are likely to lose out financially as they take more time over each consultation. Refusing to use the computer is no real solution as GPs are likely to suffer professionally as well as financially from this decision as the health system like so many others in New Zealand society becomes populated with professional managers who judge the competence of practitioners by what they record rather than what they do. The third choice which is the most likely as GPs become increasingly at home with the package and its technological frame is to limit the amount of time spent on articulation work. The consequence may be that human patients and their problems become secondary to their over-simplified, electronic representations.

Chapter 8

Conclusion

This study has provided a glimpse into the politics surrounding the development and use of package software in general medical practice at a time when the New Zealand health system is undergoing far reaching changes. Although computers have been used in general practice since the early 1980s, the research indicates that the health reforms of the 1990s have fuelled the widespread movement of computers into this domain. At the same time, the current reforms could not have occurred without the automation that application packages such as Primetech2 have been designed to provide.

Heathserv's promotional literature resonates with the idea of progress and many of those who participated in the study were convinced that computers were a valuable tool. This thesis, however, does not provide support for any uncritical notions of technological progress. Nor does it claim that computer technology is inherently 'good' or 'bad'. It has shown instead that Primetech2 is a social product with contingent outcomes and complex effects.

Despite the contingency of outcomes, some conclusions might be drawn about which groups gain and which lose out when a package such as Primetech2 becomes integrated into general practice life. Those without computer skills who are unable or unwilling to acquire them will find themselves dominated by the package and unable to do their jobs. In the recent past, receptionists and practice nurses were most at risk but this risk has now been extended to GPs. In contrast, those with computer expertise are likely to increase their authority in a general practice setting especially if others in the practice have limited expertise. But computer skills are not as significant as economic power or delegated financial authority when it comes to determining if and how computers will be used.

Using a computer need not radically alter the nature of human interactions within the practice but my suspicion is that it will be associated with increasing formality in the way communication occurs within general practice. This formality, which already exists in larger practices, will become more pronounced as computer-mediated communication replaces many conversations and handwritten notes. Smaller practices will not be immune from increased formality if those who work there become more comfortable with the computer than they are with the spoken word or pen.

One of the significant findings of this study is the increased influence of groups outside general practice on working life within the practice. The package draws those in general practice into the global world of computers and the Healthserv fold. This movement reflects and supports the success of Healthserv and the global power of Microsoft and Intel while simultaneously increasing New Zealand's unemployment rate. As the computerisation of general practice has not been directed to these ends, they can be thought of as the unintended consequences of the New Zealand government's decision to apportion and account for the public funding of primary healthcare in a 'cost-effective' way. The social costs of such decisions are likely to be profound while their effectiveness in monetary terms, given the substantial cost of computer technology, is open to debate. This study could therefore be said to provide some empirical evidence for Hans-Peter Martin's claims about the role computers play in increasing the wealth and power of the 'haves' while simultaneously increasing the number of 'have-nots' (Trinca, 1998)

A further outside influence derives from the IPAs which, as Fougere (1997) suggests, are significant new players in the serious game of controlling how and where the health dollar is spent. The government, through the HFA, may hold ultimate control of the public health dollar but the IPAs have its delegated authority and the delegated authority of their member GPs. When this is combined with computing and clinical expertise and business acumen, it is easy to understand how the IPAs have achieved their strategic position.

So what part does medical software such as Primetech2 play in controlling the health dollar? Firstly, it provides specific features which make it possible for those who work in general practice to enter, store, extract and transmit wide ranging information about patients and the clinical activities of GPs and practice nurses. This data would be difficult and costly to collect in other known ways. Secondly, the package introduces a number of standardised routines and ways of conceptualising patients and their treatments. Thirdly, it provides tools for immunisation and screening programs which reflect the movement towards preventative healthcare which is considered to provide the very best value for the heath dollar.

All these requirements emerged as significant during the development of Primetech2 when input was gathered from third parties, GPs and practice managers alike. Some interpretive flexibility has been intentionally built in to the package but is otherwise very limited. To express it another way, Primetech2 has been developed for the major players in a particular market and its features reflect the requirements of the market. If the market changes to the point where its features are inadequate, Healthserv already has the mechanisms in place to alter or replace Primetech2. If it does not, the package will be more likely to fall into disuse rather than be creatively adapted in the manner of more flexible packages such as wordprocessors or spreadsheets which might equally be used at home, in business or in an educational setting.

Thus the link between development and use emerges through the content of the package, but the content of the package is not the sole determinant of its use. Those groups influential in development need to continue to exert their influence as it is deployed and again as it is put to use.

So what can be said about those who influence the life history of packages such as Primetech2 and gain most from the computerisation of general medical practice? Although there is no single capitalist centre of power which shapes and controls the development of the package and is subsequent use, economic authority and power are clearly the most significant resources. The boards and chief executives of IPAs, senior officials in the HFA and Ministry of Health and

purchasing GPs hold these resources. Business acumen, computing expertise and clinical knowledge although less critical, are also significant for they allow those involved with the package some degree of influence.

The groups who lose out most from the computerisation of general practice are those most silent during the development process and who cannot influence its purchase and use. People who fear computers, particularly those with minimal economic power, are most at risk. Older practice nurses, associate GPs and receptionists belong in this group and it is therefore predominantly but not exclusively women. However, the professional autonomy of GPs is under threat and patients, regardless of technological know-how, gender, wealth and age, are also at risk. The risk is hard to quantify and relates to current health strategies as well as the use of computerised systems. It can be described as the way the package, through its automated screening and recall procedures draws people who are well into a medical system which has traditionally been concerned with curing disease. A great deal is written in the sociological and feminist literature about the dangers of conventional medicine and the restricted perspective it provides. With the introduction of computers into the consultation, and the widescale electronic representation of patients, the body and disease, it is certain that this perspective will become even more restricted.

So what can be done?

How can existing asymmetrical relations of power be minimised or redressed? For those working in a general practice setting, gaining computer expertise will be a useful first move. In theory, local Ucols and evening classes provide cheap training which is readily available to practice nurses, practice managers and receptionists who may be on limited incomes while more individualised training is available for those willing and able to pay. However, living in remote locations and having domestic responsibilities make attendance difficult. Ideally, GPs with purchasing power should accept greater responsibility for staff training but it is hard to see how this can be mandated in a labour relations climate dominated by an ethos of individual responsibility. The study,

however, indicates that the IPAs hold the key to better training of staff, either through courses that they run or through advice to their membership.

Gaining expertise with computers will help individuals experience a package such as Primetech2 as more enabling than restraining but does little to change the circuits of power in which the package is enmeshed. In a similar way, participating in development, as the participatory design and human centred systems literature suggests cannot on its own bring about substantial change. All one can hope for through participation are more 'user-friendly' systems rather than a more 'user-friendly' world.

Altering the status quo, then, involves participating in ways which will influence the provision of healthcare. Participating in vocal patient advocacy groups or within the HFA or IPA will be critical to ensuring that patient and clinical concerns rather than just business or technological concerns come to the fore. Although such strategies are unlikely to redress or minimise asymmetrical distributions of power in a society where money rules, they may at least help minimise their effects.

Comments on the research

Case studies usually raise more questions than they answer and this particular study has been no exception. At the personal level, the research has been fascinating and instructive. I have learnt much about the current politics of health in New Zealand although, as I complete the final draft, I am aware that this knowledge is already becoming out of date as the newly-elected Labour government disbands the HFA. I have also extended my understanding of the computer industry and been constantly reminded of the increasing use of computer technology in every aspect of our daily lives. During the course of this study, the Internet has emerged as a significant phenomenon. Unsurprisingly, Microsoft has participated in its development and is strategically positioned to gain financially from its widespread use.

One of the consequences of my fascination with the material and the complex power dynamics that emerged during the research has been keeping the study

within reasonable bounds. It may not be quite as small and neat as a masterate thesis should be but then, nor are the relationships in which Primetech2 is enmeshed.

Bijker's (1995) empirical work provides rich descriptions of a complex socio-technical world and I have followed his lead rather than take a more classically sociological approach. His constructivist position and descriptive methodology demonstrate a complex micropolitics in action. They are well-suited to their subject, that is, a study of technological development. The other side of the coin, his more structurally-oriented semiotic conception of power which is concerned with how the meaning and content of artefacts becomes less fluid and more fixed has proven to be less well developed. It can only be regarded as a useful starting point for examining how technology achieves its effects and how these effects extend beyond the field of use.

Bijker himself uses the work of Star and others who adopt a fluid, interactionist conception of society and of power. There seems no reason why the concepts and approach of those who draw on the symbolic interactionist tradition could not be merged with Bijker's overall schema and his interest in the content of artefacts as well as social groups. Joan Fujimura's (1991,1992) work looks particularly promising for it shows a concern with the resources and identities that people share outside specific situations (the much maligned structures of sociological theory) and might be used to explain how certain types of skills and resources are disproportionately held by people with certain identities and characteristics. More specifically, the concept of 'standardised package' which she develops in relation to scientific 'bandwagons' could be readily extended to the development and use of computer software and aid our understanding of the way localised changes become major trends.

Opportunities for future studies

This study, as I have already suggested has opened up more questions than it answers. Microsoft is a transnational phenomenon but its increasing dominance of the New Zealand market and the impact and cause of this

dominance warrants further investigation. Although this study suggests that standardising on a particular platform brings benefits to users and sellers alike, it would be illuminating to have the benefits to Microsoft and other transnationals quantified in dollar terms and connected with the New Zealand's balance of payment problems and high unemployment rate. Similar studies, which could adopt a classic political economy perspective, might also be done into many aspects of the New Zealand computer industry. Much is made of the potential of a New Zealand high-tech export industry but my sense is that US-based giants such as IBM, Microsoft, Intel and EDS dominate many facets of the New Zealand computer market.

The significance of gender emerges at several points in the study but the gender-technology relationship is far from straightforward. Certainly the specialised software development team at Healthserv were male, and there were signs that males were beginning to take charge of user group meetings which had been the preserve of women. But this study was populated with women who willingly and competently used computers at work and at home. There has been a movement towards an integration of post-structuralist and actor network positions into feminist studies of technology. The various articles in Grint and Gill (1995) testify to this movement. A better way ahead, I believe, can be forged from the symbolic interactionist tradition, feminist thought and the type of constructivist position that Bijker espouses. Fujimura's perspective, which draws extensively on the work of Strauss (1969), would be a valuable resource in such a project.

The study constantly reminded me that we should be concerned about how the widespread introduction of computer technology marginalises people who have not been introduced to computers by a certain age. Many of those who participated in the study used terms like 'terror' and 'hate' when describing human reactions to the machine. Age-at-first-use seemed more significant than current age when determining ease with computer technology. Future studies which might be carried out using ethnographic methods or by adopting a

phenomenological perspective should be concerned with understanding what would make technology less terrifying rather than just documenting the terror.

The particulars of the GP-patient encounter also lends itself to a study from a phenomenological perspective. The interview with Ruth, where the computer became something to be constantly considered rather than ready-to-hand resonated with issues which could be explored from within this tradition. Phenomenology also lends itself to an exploration of the problems which emerge when human perception gained through sight, sound, smell and touch is replaced by electronic representations of conditions and symptoms. Studies of this type become particularly significant as we move to an age where doctors visits and prescriptions are readily available on the Internet.

Throughout the research, I regretted my inability to actually observe how decisions were made at the development site and in a general practice setting. The interviews were useful tools but the small amount of time that I spent at each site made me aware how much more could be learnt through full participation. In summary, an ethnographic study of how power operates during the development of technology and its deployment and use would provide much more information than I have been able to provide using a restricted range of qualitative methods, particularly if it is written in an accessible way. A best seller for the future perhaps?

Appendix 1

Glossary of Computer Terms[64]

286 A shorthand for the Intel-80286, a microprocessor considered to be a high performer when it was developed in the 1980s.

386 A shorthand for the Intel386 (or 80386) a microprocessor which followed on from the 286 and which offered significant performance improvements. The 386, inevitably, was followed by the 486 and then the Pentium.

Apple Macintosh A US-based producer of PC hardware and systems software. Apple pioneered the Windows concept and was an early market leader in producing sophisticated computer systems for the home and small business user.

Application (software) package A collection of programs or modules containing data as well as code which can be used to perform a particular task. The term 'package' implies that the modules work in a similar environment and are bundled together as a single item.

Applications (software) Software which is used to perform or is applied to a particular task such as word processing, statistical analysis, credit card billing, general medical practice and so forth.

Assembler A programming language which requires minimal translation by the computer to machine-readable code. Coding in assembler is slow and painstaking as it requires the programmer to be aware of the inner workings of the computer and to be fanatical about detail.

Client/server A formalised arrangement of components in a computer network where the server acts as the hub or central point. Typically, data and programs which are shared reside on the server. It therefore needs to have greater capacity and be more powerful than the clients it supports. However, each client carries out parts of the processing and has the capability of storing some data if this makes for greater efficiencies.

Code Instructions which can be interpreted by the computer. Code is to computer program as text is to document or manual. Most modern code is translated into machine-readable codes by software called compilers.

---

[64] This glossary draws extensively on the *Oxford Dictionary of Computing, 4 ed.*, 1996.

Computer program/programmer See program/programmer.

Computer (system) A loose term which covers all the hardware and software and communication links which make up a working system.

Configuration The particular hardware elements and their interconnection in a computer system.

Delphi A software development tool and database management system which provides facilities for storing, accessing and processing data in a controlled way.

Dumb terminal A simple device, such as a VDU which allows a computer user to communicate with a central processor. A dumb terminal, as its name suggests, has limited intelligence and its main purpose is to send and receive data.

Electronic Concerned with the storage, transmission or representation of information by electrical means.

Firewalls Parts of a computer system which prevent the intrusion of un-authorised data or processes. In systems connected with the Internet, firewalls prevent unauthorised access to information held on the system (hacking) and its corruption by viruses or other unauthorised procedures.

Floppy disk or diskette A small, portable disk which can be used to store information in computer-readable form.

Graphical user interface (GUI) see User interface.

Hard drive A mechanism for storing and retrieving information from disks which are permanently resident in a computer.

Hardware The physical, tangible parts of a computer such as the screen, keyboard, central processor, hard disk and hard disk drive.

IBM A large, US-based transnational corporation which supplies hardware software and computer services. IBM dominated the computer industry during the mainframe era.

Intel A large, US-based transnational corporation which supplies micro processors to the computer industry.

Mac See Apple Macintosh.

Mainframe A computer system with a large centralised storage and processing capability.

MB One million bytes or characters. The letter 'a' for example will take up one character or byte when stored in the computer or on floppy disk.

Medical software A generic term used throughout the thesis to describe application software packages designed for general practice.

Microcomputer A computer which utilises a microprocessor. The term is used synonymously with PC.

Microprocessor The central processor or main 'brain' of a PC.

Microsoft A US-based transnational. Microsoft effectively dominates the PC environment with a number of widely used systems software and application software products such as (MS-)Windows, (MS-)DOS and (MS-)Word.

Minicomputer A small computer. Historically, this meant a small, slow computer. Today, the boundary between mini and micro computers is not clear cut and the term PC or microcomputer is used in preference.

MS-DOS An operating system with limited functionality and a simple user interface developed to run on early versions of the IBM PC.

Multi-processing The ability to run several applications or several modules of the same applications simultaneously. One of the advantages of more recent Windows systems is their multi-processing capability.

Network/Networked A collection of linked terminals and other resources and the communication paths between them.

Networking software Systems software which controls the resources of a network and the switching of messages around the network.

Operating system The systems software which controls the hardware and manages the data flows within a computer system.

Package See Application (software) package.

PC An abbreviation for personal computer. The term PC generally refers to the type of micro computer which was first developed by IBM and which emerged as the industry standard during the early 1980s.

Pentium An Intel microprocessor which became the industry standard during the 1990s.

Platform A combination of hardware and systems software which makes the computer system sufficiently different to require specially written or special versions of applications software.

Port To move or carry between different applications or between different parts of the same application.

Program A set of statements written in code which can be interpreted and then executed by a computer in order to produce a desired behaviour from the computer.

Programmer A person who designs and writes programs.

Prototyping The process of creating samples or exemplars which are then reviewed. Prototyping is an iterative process which reflects the ability of most people to understand concrete examples more easily than abstract ideas.

Software A generic term for the parts of a computer system which are intangible rather than physical. It refers to the coded instructions or programs which work 'behind the scenes'. A distinction can be made between **i) systems software** which is an essential component of the computer and **ii) applications software** which depends upon the specific requirements of the user.

Switching Communication techniques which allow control to be passed to different points on a network. The process of turning lights on or off is a simple example of a switching process.

Systems software Generalised software which includes operating systems and any other software essential to programmers as well as end-users.

Unix A operating system which provides a working environment for several users operating on one or a small number of related projects.

User Interface The face which the computer presents to the user as opposed to the 'behind the scenes' processing. A graphical user interface or GUI is the term used to describe presentation techniques involving icons, menus and various pointing devices rather than characters alone.

Windows or MS-Windows

3.0 An early version of the graphical user interface developed by Microsoft which ran in conjunction with MS-DOS and concealed many of its limitations.

NT A more recent version of Windows which is designed to operate in a client/server environment. Windows NT incorporates the functions of MS-DOS and can much more effectively exploit the multi-processing and other capabilities of the Intel microprocessors which come as standard in modern PCs.

Workstation A PC and its immediate environment. This may include ancillary devices such as a printer and scanner as well as desks etc although the term is sometimes used to mean just the PC on its own.

Appendix 2

The sites and the participants

Healthserv

Primetech2 can be obtained only from Healthserv, an Auckland-based, privately owned company. The core business of the company is the development, sale and support of the package. It also supplies and supports the hardware and software platforms on which Primetech2 runs. Sixteen people, including management, sales, development, support and technical staff work from the Auckland office. In addition, two consultants, who provide support and marketing to sites outside the Auckland region are based in separate locations in the lower North Island where there are particularly high concentrations of Primetech users.

During my three visits and many phone calls to the Auckland site I observed that the company ran a busy working office rather than a luxurious sales organisation. Staff were efficient and courteous rather than chatty and dressed in a variety of styles ranging from jeans to business suits. They ranged in age from mid-twenties through to mid-fifties. Despite differences in age and appearance, the staff I spoke with and observed were either Pakeha New Zealanders or of British origin and there was a clear division of labour along gender lines. Those in administration, sales, and customer support were women while those in software development and technical services were men.

The people I interviewed included those involved in marketing, customer support and software development. All were in their forties or fifties.

Stephen

Stephen, the general manager of the company and supervisor of the sales people has, as he put it, 'a history of fronting the sales' but this task is now shared with other staff. Before entering the computer service industry in the mid-1970s, Stephen had worked as a photographer and as a surveyor. He had little formal training in computing although his early employment as a surveyor involved some mathematically-oriented programming.

Ann

Ann's background is in public health nursing as well as management and administration and she shares the management of the company with Stephen. She had intended to pursue her career outside Healthserv but joined the company in 1991 after 'becoming increasingly disillusioned with the health environment...finding it hard to get ahead with the constant restructuring'. Ann currently manages staff and the operations side of the business as well as

liaising with IPAs and third party organisations. She described how she was familiar with the job of receptionist, trainer and help desk support as she had taken on all of these roles. Ann's technical expertise is that of a very knowledgeable user.

Margot

Margot is employed as the customer services manager and, since taking up the offer to purchase shares in the company in 1998, is also a shareholder. Margot has part of a nursing qualification but her work experience is primarily in accounting and financial systems where she achieved a high level of seniority in the private and public sectors. In 1993, Margot took on the job of practice manager for a six doctor city practice and an important first job involved coordinating the installation of Primetech1. In doing this, she drew on the computing experience gained in her previous work. Two years later, Margot was recruited as a remote consultant by Healthserv and, at the end of 1996, moved to Auckland to take up the newly established position of customer services manager.

Malcolm

Malcolm first joined the company in 1984 and leads the software development team of four. Like Margot, he became a shareholder in 1998. He has a Masters degree in computer science and has what might be described as 'elite' programming skills and is also capable of working with the hardware. Malcolm's long history with the company and experience in the business of healthcare environment allow him to contribute to decisions and activities associated with medical practice which would be beyond the scope of most software developers.

Catherine

At the time of the interview, Catherine had worked for Healthserv for 18 months as a remote consultant. She was offered the job while working as a practice manager, a position she held for five years. Catherine, who has also worked as an enrolled nurse, considers that her background in nursing, practice management and as an end-user of Primetech allows her to understand the issues and problems associated with general practice and to support and train the users of Primetech. As well as supporting, training and liaising with existing users, Catherine is involved in demonstrating and selling Primetech to potential clients.

The small general practice site

This site is situated in a provincial town which is less than an hour's drive away from a good-sized city. In common with many New Zealand provincial towns, it has an aging population and high unemployment. A large proportion of the practice's patients are on low incomes. The practice is owned by Thomas the GP who employs one receptionist and a part-time practice nurse.

Thomas

Thomas, who is in his early fifties, has almost a decade's experience with computerised medical systems and has a Windows-based PC for home use. He has used the Internet to look up one or two unusual diseases but considers that it has limited applicability given the demographics of his patients. In 1998, shortly after purchasing the practice, Thomas contracted to purchase Primetech2.

Susan

Susan, who is in her late forties, works part-time as the practice nurse. She qualified as a registered nurse after leaving school but married and never practised. Prior to taking on her current position, Susan had worked as a receptionist using Primetech1 and had completed a number of refresher courses in order to obtain a current practicing certificate. She uses a Windows-based PC at home, primarily as a word processor, but considers herself to be a novice with the computer.

Karen

Karen is about thirty years of age and, apart from two years part-time work in the current practice, had not previously been employed in the healthcare sector. Her full-time employment as a receptionist and exposure to computers began after Thomas bought the practice.

The large city practice.

This practice is on the edge of the central business district of a large New Zealand city and serves mainly middle to upper-class patients. It employs up to twenty staff, including eight doctors, six administration and reception staff and four practice nurses. The practice installed its first computer system in the late 1980s and migrated to Primetech1 in 1993.

Beth

Beth joined as practice manager in 1989. Her computing skills, gained through administering a school computer system, were an important reason for being offered the job. She also uses a PC extensively at home. Beth, who is in her

late forties, has a background in nursing, education and financial management. She finds all three aspects helpful in her current position.

Jane

Jane is a Registered Nurse who left hospital work before her first child was born. She returned to part-time practice when her youngest child started school. Jane had no computer skills and little training when she started to use a computerised recall system in 1993 and suggested that this experience helped her gain her current position when the family moved cities in 1994. At the time of the interview, Jane had been working as a practice nurse for ten years and appeared to be in her late thirties or early forties.

Donna

Donna, who is in her fifties, has more than two decades experience of using computers at work. She has a PC at home which she uses extensively. Donna has no work experience in the health sector but considers that this has not been a problem for her in her current position as receptionist.

Ruth

Ruth is in her fifties and, at the time of the interview, had been retired from general medical practice for three years. She considered herself to be a good doctor and felt a sense of loss when she retired. Ruth has a degree in business administration as well as medical qualifications and since retiring, has embarked on a significant business venture which she runs from home. She has a PC for business and personal use and considers herself to be competent with computers but not expert.

Appendix 3

Communications with the participants

3.1 Management Letter

C/- Dept of Sociology
Massey University
Private Bag 11-222
Palmerston North
(date) (06) 356 9099

The Managing Director
(company name)
(address)

Dear (name)

Thank you for agreeing in principle to participate in the research. As we discussed, I am particularly interested in the health care industry and in examining software which manages a variety of tasks for divergent user groups. Given the aims of the research, (*software name*) and its use within general practice seems particularly appropriate.

An information sheet which describes the project, and how the research would proceed, is attached. At the development site, I should like to interview you, and others who are responsible for developing and supporting (*software name*).

I would expect to make contact with everyone who would be involved by letter and, subject to their consent, the interviews would be arranged at a time and place which was convenient to them and which took account of work commitments. I also plan to take a similar approach with the user sites. In other words, I would seek permission from the practice manager or senior practitioner in the first instance and then approach other staff individually through the mail. All potential participants would receive an information sheet similar to the one that is attached to this letter. This would mean that consent to participate would be informed consent.

Prior to the interviews, I would need to make myself familiar with the system. I have already received a brief history and description of the (*software name*) but I would appreciate the opportunity to review any other material which is available, such as the user manuals. I would welcome the opportunity to spend time at the development site in (*suburb*), and could read the material there if this was appropriate. Otherwise I could take it offsite for the day.

Although the research has an academic orientation, the thesis produced at the end of the research will include a short history of a New Zealand software company during a period

of rapid business and technological change. In addition, it will almost certainly report some of the difficulties that users experience with computerisation and suggest what contributes to the successful use of software such as (*software name*). However, a thesis is not the most 'user-friendly' document and I would be happy to provide a shorter report of significant findings in addition to a copy of the final thesis.

I am hoping to complete the interviews and discussions by the middle of December. This means that I would need to meet you before the end of October and begin interviews early in November. Your personal involvement would include this initial meeting, providing authorisation for me to proceed with the study, plus an additional one and a half hours of interview and discussion time.

If you would like discuss any further aspect of the project, including the timing of interviews, I may be contacted at the above address or by email (liz.cornford@xtra.co.nz). My supervisor, Dr Mary Murray can be reached at Massey on 06-356 9099, extension 4974.

I hope that you are still willing to participate in the project and I look forward to hearing from you soon.

Yours sincerely

Elizabeth Cornford

3.2 Management Agreement

Circuits of Power: Linking the development and use of computer software

I have read your letter dated (*date)* and the attached information sheet which describes the study. In my capacity as Managing Director of (*company name*), I consent to your study of (*software name*) subject to the conditions set out in the letter and in the information sheet.

Signed: _____

Name: _____

Date / /

3.3 Information Sheet

Circuits of Power: Linking the development and use of computer software

In this study, I want to examine how the introduction of new computer technology alters the relationships between people at work. Usually there are some choices about exactly how computer technology will be used at the work site but most computer technology has certain characteristics which shape the way it works and place limits around the options available to those who use it. I am interested in understanding these 'shaping' characteristics in the medical software that you work with. I am also interested in understanding how they came to be there.

This study involves tracing the history of the software and current development strategies. I also want to find out how work was done before the medical software was installed and how work is done now. I am particularly keen to find out what new skills are required, as well as understanding which skills are not as important in a computerised environment.

Who is conducting the study

The study is being carried out by Elizabeth Cornford, a postgraduate student in the Social Science Faculty at Massey University. My supervisor is Dr Mary Murray, a lecturer in the same faculty. Dr Murray or I may be contacted:

C/- Department of Sociology,
Massey University
Massey University
Private Bag 11-222
Palmerston North (06) 356 9099

Objectives

This study will be written up in the form of a thesis. I will also produce a short report of the main findings. Both will be made available for you to read. The study may also form the basis of articles in academic journals and could lead on to further research into how certain development strategies makes some computer software more 'workplace friendly' than others.

Your participation

I am seeking your involvement in the research because you work with (*software name).* Participation is voluntary. An interview lasting no more than one hour is required. This would be held at a place and time to suit you. A follow up discussion which should last less than thirty minutes will be arranged at the time of the interview.

NB: For participants who are not managers only: (*manager name)* is aware that I am carrying out this research and has provided me with your name and work position so that I could contact you. Should you decide not to participate, s/he will not be aware that you have declined and it will not affect your work status in any way.

Confidentiality

All interviews and follow-up discussions will be taped and transcribed by myself and one other person who will sign an agreement to keep all material confidential.

NB. For participants at the user site only: Note that your name and any identifying characteristics will be changed in the thesis and the report so that your participation is anonymous.

NB: for participants at the development site only: Note that the name of your company will be changed but, given the size of the medical software industry in New Zealand, the anonymity of the company cannot be guaranteed. Similarly, the small size of the company means that your personal anonymity cannot be assured. This means that it will be important to exclude information confidential to yourself or the company.

Your rights

Should you agree to take part in the study, you have the right to.

- refuse to answer any question and to withdraw from the study at any time
- have the tape stopped at any time or ask that anything you have said be excluded from the transcript
- ask any further questions about the study that occur to you during your participation
- examine and amend the transcript of the interview and the discussion and indicate any part of the transcript that you do not wish to be used
- determine the disposal of interview tapes, transcripts of interviews and any personal documents made available to the researcher.

If I do not hear from you beforehand, I will contact you in one week's time to check your willingness to participate.

3.4 Consent Form

Circuits of Power: Linking the development and use of computer software

I have read the information sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction and I understand that I may ask further questions at any time.

I understand that I have the right to withdraw from the study at any time and to decline to answer any particular questions.

I agree to provide information to the researcher on the understanding that my name will not be used without my permission. (*The information will be used only for this research and publications arising from this research project).*

I agree/do not agree to the interview being audio taped.

I also understand that I have the right to ask for the tape to be turned off at any time during the interview.

I agree to participate in this study under the conditions set out in the information sheet.

Signed: _____

Name: _____

Date / /

3.5 Sample Interview Guides

1. Malcolm

Confirm length of time with company, previous training/experience

Doing development
Tell me about what you do and how you do it

Probes:
who do you deal with on a daily basis
what development and testing strategies/methodologies and languages do you use
where do the system requirements come from
how are priorities set
who are the users from your perspective (GPs, practice managers, health funders, IPAs, receptionists, practice nurses))
how do you find out their requirements, :
who do you talk to
are the requirements clearly spelt out
do you think this could be improved
what do you think the users like about the package
what problems do you think the users have with the package and why

Tell me about new releases:

Probes:
what determines the cutoff point
how much system and user testing are you able to do
how tough are the time constraints

How do you think working for a software house compares with inhouse development

2. *Catherine*

Confirm length of time with company, experience with the software,
general training/background

Doing regular user liaison
Tell me about your daily work, what you've done this past week

Probes
is this typical
in the case of larger general practices, who is usually your primary contact person at the user site (receptionist, practice manager, nurse, doctor)
would this person be the formal contact or the one with most computer skills
how varied is the level of computer literacy esp Microsoft/package knowledge
do you talk with anyone else (IPAs)
who do you deal with at head office
what do you think the users like about *meditate*
what issues/problems do the users have with Primetech
do you have any problems yourself with the software
what do you do with each type of problem: record/resolve/escalate/ignore
what sort of people would raise change requests
what do you think initiates changes in the software
Are there many new users - are they new to computers or just to Primetech software
Who is involved in and who tends to make the purchasing decision
Implications for patients
Do the users run other software on the PC (email/Internet, word processing, games etc
How important is this to them - did they do this in the past?

Doing installation and training
Tell me about what you do with a new site (for example)
What about incorporating new modules
Tell me about the new release

Probes
    when did it come onstream
how did/is installation and training go(ing)
what training is needed (Windows, and/or the package
how much time is allocated - who decides
what are/were the issues (pluses and minuses) with the new software from the users' perspectives
how are/were any problems resolved
    access to screens, security of screens issues: adequately resolved?

Do you sometimes find that you have to juggle user and company requirements

3.6 Covering Letter

C/- Dept of Sociology
Massey University
Private Bag 11-222
Palmerston North

(06) 356 9099

(date)

(practice name and address)

Dear *(name)*

Thanks for spending time with me last month explaining how you use *(package name)*. What you have told me is clear and I have no outstanding questions. I would appreciate your reading through the attached excerpts from the meeting, checking for any misunderstandings and inaccuracies on my part and to confirm that no issues related to confidentiality arise. Note that all names will be altered when excerpts from the meeting notes are included in the final thesis.

If I don't hear from you beforehand, I will call you next week to find out whether anything should be changed.

Yours sincerely

Liz Cornford

Bibliography

Austrin. T. 1994. 'Positioning resistance and resisting position: human resource management and the politics of appraisal and grievance hearings,' in J.Jermier et al. eds.

Baker, S. 1995. 'From PC and print out to full clinical notes.' *New Zealand Doctor,* Sep 1: 36.

Barker, J. and Downing H. 1985. 'Word Processing and the transformation of patriarchal relations of control in the office,' in D. MacKenzie and J. Wajcman eds.

Barnes, B. 1988. *The Nature of Power.* Cambridge: Polity.

Barrett, M. 1980. *Women's Oppression Today: Problems in Marxist Feminist Analysis.* London: Verso.

Barrett, M. 1988. *Women's Oppression Today: The Marxist/feminist encounter,* Revised edition. London: Verso.

Beardon, C. 1985. *Computer Culture: The information revolution in New Zealand.* Auckland: Reed Methuen.

Bijker, W. 1987. 'The Social Construction of Bakelite: Toward a Theory of Invention,' in W.Bijker et al eds.

Bijker, W. 1995. *Of Bicycles, Bakelites and Bulbs: Toward a Theory of Socio-technical Change.* Cambridge Ma: MIT Press.

Bijker, W. Hughes, T. and Pinch, T. eds. 1987. *The Social Construction of Technological Systems.* Cambridge Ma: MIT Press.

Bijker, W. and Law, J. eds. 1992. *Shaping Technology/Building Society: Studies in Sociotechnical Change.* Cambridge Ma: MIT Press.

Bond, D. 1995. 'Patterns: Project-Level Design Archetypes.' *Software Development.* July, 1995.

Bradley, H. 1989. *Men's Work, Women's Work.* Cambridge: Polity.

Braverman, H. 1974. *Labour and Monopoly Capital. The Degradation of Work in the Twentieth Century.* New York: Monthly Review Press.

Callon, M. 1986. 'Some Elements of a Sociology of Translation: Domestication

of the Scallops and the Fisherman of St. Brieuc Bay,' in *Power, Action and Belief: A New Sociology of Knowledge*? J.Law ed. London: Routledge and Kegan Paul.

Callon, M. and Latour, B. 1981. 'Unscrewing the big leviathan: How actors macro-structure reality and how sociologists help them do so,' in K. Knorr-Cetina and A.Cicourel eds.

Callon, M. and Latour, B. 1992. 'Don't Throw the Baby Out with the Bath School,' in A. Pickering ed.

Child, J. 1988. 'Managerial Strategies, New Technology and the Labour Process,' in *On Work: Historical, Comparative and Theoretical Approaches*. R.Pahl ed. Oxford: Basil Blackwell.

Clark, H. 1989. *New Zealand Health Charter*. Wellington: Minister of Health.

Clegg, S. 1989. *Frameworks of Power.* London: Sage.

Clegg, S. 1994. 'Power Relations and the Constitution of the Resistant Subject,' in J. Jermier et al eds.

Clement, A. and Van den Besselaar, P. 1993. 'A retrospective look at PD projects.' *Communications of the ACM* 36(4): 29-37.

Cockburn, C. 1983. *Brothers: Male Dominance and Technological Change.* London: Pluto.

Cockburn, C. and Furst Dilic, R. eds. 1994. *Bringing Technology Home: Gender and Technology in a Changing Europe.* Buckingham: Open University Press.

Cockburn, C. and Ormrod, S. 1993. *Gender & Technology in the Making.* London: Sage.

Collins, H. and Yearley, S. 1992a. 'Epistemological Chicken,' in A.Pickering ed.

Collins, H. and Yearley, S. 1992b. 'Journey into Space,' in A. Pickering ed.

Cooley, M. 1987. *Architect or Bee: The Human Price of Technology*, New edition. London: The Hogarth Press.

Davidson, J. 1994. 'The sources and limits of resistance in a privatised utility,' in Jermier J. et al eds.

Davis, A. 1995. *201 Principles of Software Development.* New York: McGraw Hill.

Davis, A. and Leffingwell, D. 1997. *Using Requirements Management to*

Speed Delivery of Higher Quality Applications. Boulder Co: Rational Software Corporation.

Docherty, B. 1996. *Nursing in General Practice: A New Zealand Perspective*. Christchurch: The Caxton Press.

Dreyfus, H. 1979. *What Computers* Still *Can't Do: A Critque of Artificial Reason*. Cambridge, Ma: The MIT Press.

Dunlop, C. and Kling, T. eds. 1991. *Computerisation and Controversy: Value Conflicts and Social Choices*. Boston: Academic Press.

Dunlop, C. and Kling, R. 1991. 'Introduction: The Dream of Technological Utopianism,' in C. Dunlop and R.Kling eds.

Foucault, M. 1981. *The History of Sexuality: Volume 1*. London: Penguin.

Foucault, M. 1975. *Discipline and Punish: The Birth of the Prison*. London: Penguin.

Fougere, G. 1993. 'Struggling for Control: The State and the Medical Profession in New Zealand,' in *The Changing medical profession,* F. Hafferty and J. McKinlay eds. New York: Oxford University Press.

Fougere, G. 1997. *Transforming Health Sectors: New Logics of Organizing in the New Zealand Health System.* Paper prepared for the SAA(NZ) annual conference 'Postcards from the End of the Millennium' Massey University at Albany, Nov 28-30.

Friedman, A. with Cornford, D. 1989. *Computer Systems Development: History, Organisation and Implementation*. Chichester: John Wiley & Sons.

Fujimura, J. 1991. 'On Methods, Ontologies and Representation in the Sociology of Science: Where do we Stand?' in D. Maines ed.

Fujimura, J. 1992. 'Crafting Science: Standardised Packages, Boundary Objects and "Translation",' in D. Maines ed.

Gates, B. 1995. *The Road Ahead.* New York: Penguin Books.

Gibbs, W. 1994. 'Software's Chronic Crisis.' *Scientific American*. Sep 94.

Gottfried, H. 1994. 'Learning the score: the duality of control and everyday resistance in the temporary-help service industry,' in J. Jermier et al eds.

Green, E., Owen, J. and Pain, D. eds. 1993. *Gendered by Design? Information Technology and Office Systems.* London: Taylor & Francis.

Greenbaum, J. and Kyng, M. eds. 1991. *Design at Work: Cooperative Design*

of computer systems. Hillsdale: Erlbaum.

Gribben, B. Bonita R. Broad J. McAvoy B. and Raymont A. 1995. 'Geographical variations in the organisation of general practice.' *New Zealand Medical Journal.* 108: 361-363.

Grint, K. and Woolgar, S. eds. 1997. *The Machine at Work: Technology, Work and Organizations.* Cambridge: Polity.

Grint,K. and Gill, R. eds. 1995. *The Gender-Technology Relation: Contemporary Theory and Research.* London: Taylor & Francis.

Hales, M. and O'Hara P. 1993. 'Strengths and Weaknesses of Participation: Learning by Doing in Local Government,' in Green et al eds.

Health Manager. 1997. 'Electronic claiming through HBL a step towards integrated health information management.' *Health Manager,* 4(4):17-19.

Hill, R. and Gidlow B. 1988. *From hot metal to cold type: Negotiating change in the New Zealand newspaper industry.* Wellington: DSIR Publishing.

Hughes, T. 1983. *Networks of Power: Electrification in Western Society, 1880-1930.* Baltimore: John Hopkins University Press.

Isaac, P. 1982. *Computing in New Zealand.* Lower Hutt: INL Print.

Jaggar, A. 1983. *Feminist Politics and Human Nature.* Totowa: Rowman & Allanheld.

Jermier, J. Knights, D. and Nord, W. eds. 1994. *Resistance and Power in Organizations.* London: Routledge.

Kling, R. 1992. 'Audiences, Narratives and Human Values in Social Studies of Technology.' *Science, Technology and Human Values,* 17(3): 349-365.

Kling, R. and Iacono, S. 1991. 'Making a "Computer Revolution"' in C. Dunlop and R. Kling eds.

Knorr-Cetina, K. 1981. *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science.* Oxford: Pergamon.

Knorr-Cetina, K. and Cicourel, A. eds. 1981. *Advances in Social Theory and Methodology: Toward an Integration of Micro-and Macro-Sociologies.* Boston: Routledge and Kegan Paul.

Knorr-Cetina, K. and Mulkay, M. eds. 1983 *Science Observed: Perspectives on the Social Study of Science.* London: Sage.

Kuhn, S. and Muller, M. eds. 1993. *Communications of the ACM* 36(4).

Kuhn, T. 1962. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press

Laclau, E and Mouffe, C. 1985. *Hegemony and Socialist Strategy: Towards a radical democratic politics.* London: Verso.

Latour, B. 1988. *The Pasteurization of France.* Cambridge Ma: Harvard University Press.

Latour, B. 1992. 'Where are the Missing Masses? The Sociology of a Few Mundane Artifacts,' in W.Bijker and J.Law eds.

Law, J. 1991. 'Power, discretion and strategy,' in J. Law ed.

Law, J. ed. 1991. *A Sociology of Monsters: Essays on Power, Technology and Domination.* London: Routledge.

Liff, S. 1993. 'Information Technology and Occupational Restructure in the Office,' in E. Green et al. eds.

MacKenzie, D. and Wajcman, J. eds. 1985. *The Social Shaping of Technology.* Milton Keynes: Open University Press.

Maines, D. ed. 1991. *Social Organization and Social Process: Essays in Honour of Anslem Strauss.* New York: Aldine de Gruyter.

Malcolm, L. 1996. "Inequities in access to and utilisation of primary medical care services for Maori and low income New Zealanders.' *New Zealand Medical Journal,* 109: 356-358.

Malcolm L. and Powell M. 1996. 'The development of independent practice associations and related groups in New Zealand.' *New Zealand Medical Journal,* 109: 184-187.

Malcolm, L. 1998. 'Capitated primary care: policy, problems and prospects.' *Health Manager*, 5(3): 7-9.

Massey University. (undated). *Code of Ethical Conduct for Research and Teaching involving Human Subjects.* Palmerston North: Massey University

Measor, L. 1985. 'Interviewing: a Strategy in Qualitative Research' in *Strategies of Educational Research: Qualitative Methods,* R.Burgess,ed. London: The Falmer Press.

Medical Council of New Zealand 1999. *The New Zealand Medical Workforce 1998.* Wellington: Medical Council of New Zealand.

Monin, J. 1997. *Job Skills Inventory for Information Systems Personnel in New*

Zealand: an exploratory study of change. PhD Thesis, Massey University, Albany.

New Zealand Health Information Service. 1999b. New Zealand Workforce Statistics: General Practitioners,' *Health Statistics,* http://www.nzhis.govt.nz'stats/nursestats.html. 13 Dec 99:1-3.

New Zealand Health Information Service. 1999a. 'New Zealand Workforce Statistics: Nurses and Midwives,' *Health Statistics,* http://www.nzhis.govt.nz'stats/nursestats.htm/#01. 17 Dec 99: 1-12

Opie, A. 1994. *Tracking the contours of the voice: Transcription practices and textuality in qualitative research.* Paper presented at the Qualitative Health Research Conference, 10-13 June, Hershey, Pennsylvania, USA.

Pickering, A. ed. 1992. *Science as Practice and Culture.* Chicago: University of Chicago Press.

Pinch, T and Bijker, W. 1987. 'The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other', in W. Bijker et al. eds.

Powell, I. 1998. 'A world apart from the white board.' *New Zealand Health Review,* 1(2): 30-31.

Pringle, R. 1988. *Secretaries Talk: Sexuality, Power and Work.* Sydney: Allen and Unwin.

Salmond, G. et al. ed. 1994 *Health Policy* 29.

Sayer, A. 1992. *Method in Social Science: A Realist Approach,* 2nd ed. London: Routledge.

Schwartz Cowen, R. 1983. *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave.* New York: Basic Books.

Schwartz Cowen, R. 1987. 'The Consumption Junction: A proposal for Research Strategies in the Sociology of Technology,' in W. Bijker et al. eds.

Smith, D. 1974. 'Theorising as Ideology,' in *Ethnomethodology: Selected Readings,* in R. Turner ed. Harmondsworth: Penguin.

Soar, J. Anand, Y. and Davies G. 1997. 'An information strategy for health funding,' *Health Manager* 4(2):18-22.

Star, S.L. 1991a. 'Power, technologies and the phenomenology of conventions: on being allergic to onions,' in J.Law ed.

Star, S.L. 1991b. 'The Sociology of the Invisible: The Primacy of Work in the Writings of Anslem Strauss,' in D. Maines ed.

Star, S.L. ed. 1995. *The Cultures of Computing.* Oxford: Blackwell Publishers.

Statistics New Zealand. 1999. *Information Technology Survey: 1998 Financial Year.* http://www.stats.govt.nz/domino/external. 16 Dec 1999: 1-2.

Strauss, A 1969. *Mirrors and Masks: The Search for Identity.* San Francisco: Sociology Press.

Suchman, L. 1987. *Plans and situated actions: the problem of human-machine communication.* Cambridge: Cambridge University Press.

Suchman, L. 1994. 'Supporting articulation work: Aspects of a feminist practice of technology production,' in *Women, Work and Computerization: Breaking old boundaries and building new forms,* in A. Adam et al eds. Amsterdam: Elsevier Science B.V.

Templeton, M. 1998. *Statistics on Information Technology in New Zealand.* Wellington: IT Policy Unit, Ministry of Commerce.

Thakurdas, P. Coster,G. Gurr, E. Arroll, B. 1996. 'New Zealand general practice computerisation; attitudes and reported behaviour.' *New Zealand Medical Journal,* 419: 419-22.

Tilyard, W. Gurr, E. and Dovey, S. 1996. 'Changes in payments in general practice consultations.' *New Zealand Medical Journal*, 109:252-254.

Tolich, M. and Davidson, C. 1999. 'Beyond Cartwright: Observing Ethics in Small Town New Zealand.' *New Zealand Sociology,* 14(1): 61-84.

Tong, R. 1989. *Feminist Thought.* Boulder: Westview.

Trinca, H. 1998. 'The future gloom or boom?' *The Sydney Morning Herald,* March 21: 40.

Upton, S. 1991. *Your health and the public health.* Wellington: Minister of Health.

Van Maanen, J. 1988. *Tales of the field: On writing ethnography.* Chicago: University of Chicago Press.

Walby, S. 1986. *Patriarchy at Work.* Cambridge: Polity.

Walls, C. 1989. 'Computer usage amongst New Zealand general practitioners.' *New Zealand Family Physician,* 16: 88-90.

Warneminde, C. 1998. 'Hospital Automation: What the Doctors Ordered.' *MIS*

Australia, March: 67-70.

Webster, J. 1993. 'From the Word Processor to the Micro: Gender Issues in the Development of Information Technology in the Office,' in E. Green et al., eds.

Woolgar, S. 1991a. 'The Turn to Technology in Social Studies of Science'. *Science, Technology and Human values,* 16(1): 20-50.

Woolgar, S. 1991b. 'Configuring the user: the case of useability trials,' in J.Law ed.

Woolgar, S. 1992. 'Some Remarks About Positionism: A Reply to Collins and Yearley,' in A. Pickering ed.

Yin, R. 1994. *Case Study Research: Design and Methods* 2nd ed. Thousand Oaks, Ca: Sage

Young, I. 1980. 'Socialist Feminism and the Limits of Dual Systems Theory.' *Socialist Review*, 10(2 &3) March-June: 174.