THE RESPONSE TO AND EFFECTS OF MICROCOMPUTERS IN THE EDUCATION SECTOR:
The Introduction of an Innovation in Local Authority Secondary Schools

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The study addresses the introduction of an innovation of new technology into a bureaucratic profession. The organisational setting is that of local authority secondary schools at a time at which microcomputers were being introduced in both the organisational core (for teaching) and its periphery (school administration). The research studies innovation-adopting organisations within their sectoral context; key actors influencing the innovation are identified at the levels of central government, local government and schools.

A review of the literature on new technology and innovation (including educational innovation), and on schools as organisations in a changing environment leads to the development of the conceptual framework of the study using a resource dependency model within a cycle of the acquisition, allocation and utilisation of financial, physical and intangible resources.

The research methodology is longitudinal and draws from both positivist and interpretive traditions. It includes an initial census of the two hundred secondary schools in four local education authorities, a final survey of the same population, and four case studies, using both interview methods and documentation.

Two modes of innovation are discerned. In respect of administrative use a rationalising, controlling mode is identified, with local education authorities developing standardised computer-assisted administrative systems for use in schools. In respect of curricular use, in contrast, teachers have been able to maintain an indeterminate occupational knowledge base, derived from an ideology of professionalism in respect of the classroom use of the technology. The mode of innovation in respect of curricular use has been one of learning and enabling.

The resourcing policies of central and local government agencies affect the <u>extent</u> of use of the technology for teaching purposes, but the <u>way</u> in which it is used is determined within individual schools, where staff with relevant technical expertise significantly affect the course of the innovation.

<u>Key words</u>

Innovation; Resources; Computers; Schools

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INTRODUCTION

The potential long-term effect of microcomputers on the education sector is claimed by many people to be substantial. The Carnegie Commission (1972) suggest that the application of new microelectronic technology constitutes a fourth revolution in the field of education - the first three being the appearance of written materials, of books and of schools. Others agree. Maddison (1982) sees microcomputers as "the most significant new educational tool since the printed book". And the French Minister of Education, Beullac, refers to education and informatique as "le mariage du siècle" (Ministère de l'Éducation, 1981). In this country, the Secretary of State for Education and Science said in a television interview that "the microchip and the consequences of the microchip are going to transform the techniques of education, and they are going to transform to some extent the content of education" (Baker, 1987a). And a Cabinet Office advisory panel concluded that "IT will have a sufficiently wide field of application in education that it may have the eventual effect of removing formal education from its position at the centre of our educational system" (Cabinet Office, 1986, p32).

Some people in key positions within schools also see the technology as potentially very important: one headteacher, for example, stated that:

"It is idle to pretend that our jobs will not change significantly over the next few years as the world develops. Much of what we now do will be taken over by machines and teachers who do little other than instructing and testing will, properly, be replaced by devices which perform those tasks more effectively." (Douse, 1980, p7)

The debate concerning microelectronics in education conjures an image of mass education that can be profoundly changed by the technology. As Apple (1986, p152) says, "vast areas of school life are now seen to be within the legitimate purview of technological restructuring". As in other sectors of the economy, microelectronics in education is potentially pervasive - it can affect not only the <u>curriculum</u> and with it the teachers, but also the <u>management</u> of the school and with it the relationship between teachers within schools and between schools and local education authorities; not only part of the curriculum, but the whole of the curriculum; and not only the delivery of the curriculum, but also the content of the curriculum.

Although there is wide agreement that microcomputers are of importance for the education sector there is less agreement about the desirability of the changes associated with the new technology. There is, as we shall see later, a continuing, and sometimes heated, debate between those who see microcomputers as having beneficial consequences for the organisation and delivery of an education service and for the teaching and learning process, and those who see the new technology leading to the harmful depersonalising of the learning experience, a narrowing of the curriculum by the down-grading of non-vocational or non-technological aspects, and negative effects on the role of teachers and on schools as organisations.

1.1 Research on microelectronics

Although some of the issues within the debate on the use of microelectronics within education are sector-specific, most reflect those which are of concern also as such devices are introduced into a range of organisations in both the manufacturing and service sectors of the economy.

In sectors other than education, too, the rapid growth of the use of microelectronics has received a very mixed reception: it has been seen in some quarters as a threat and in others as a means of improving various facets of individual or national life. Different analyses have drawn very different conclusions. Perhaps the feature about which there is most agreement is that changes following the introduction of microelectronics will be extensive, whether viewed at the level of the individual, the occupation, the organisation, the sector, the nation or globally.

At the level of the individual, a major focus has been on the effect of new technology on the labour process, particularly on the skill content of jobs and control over the conduct of work. In specific labour market contexts, different studies have reported microelectronics being used: as a vehicle for the de-skilling or re-skilling of particular jobs or the polarisation of skills; the fragmentation of jobs, in which the level of skill required is reduced, or specialisation, in which the range of skills is narrowed but the skill level required may be increased (Littler, 1982); a reduced need for motor skills but possibly an increased need for conceptual skills (Wilkinson, 1983); and a reduction in the area of autonomous decision making (Abercromby and Urry, 1983). A key segment of the analysis of the effects of microelectronics on the quality of employment, particularly that concentrating on the degradation of work, is rooted in the Marxist tradition (e.g. Braverman, 1974) and takes as its starting point the separation of the conception and the execution of work within a process of capitalist rationalisation. The assumption in such analyses is that the effects on the labour process are designed; other studies (e.g. Bjorn-Andersen *et al*, 1979) have found labour process effects to be residual.

The effects on the labour process are not uniform but are unequally distributed across different jobs. A major area of study has been the differential effects of new technology on jobs in different vertical and horizontal sectors of an organisation, with greater impacts generally being found on jobs with low discretion (in Fox's (1974) terminology) than on those with high discretion; or in terms of internal labour market concepts the larger impact being on jobs in the secondary labour market (essentially peripheral jobs) rather than those in the primary market (the central core). There have been a large number of studies, as will be developed later, of the impact of new technology on senior management jobs, middle management jobs and those of point of production or point of delivery of service workers. The extent to which jobs have succumbed to or avoided the potentially negative effects of new technology or have been able to incorporate that technology to advantage has been beneficially analysed in terms of labour market position. For example Child (1984), in a study which has considerable relevance for the education sector, discusses the way in which senior medical practitioners were able to use their institutional and occupational positions, and the preservation of an indeterminate occupational knowledge base, to maintain control of aspects of their work which are potentially programmable and subject to transfer to a lower grade of worker. Many of the case studies of the effects of new technology have made extensive use of the political concepts of interests, power, influence, coalitions and control in interpreting and explaining the control of work and hence the effects of new technology on individuals' jobs. Microelectronic technology is not neutral or apolitical. Individuals may react to the ambiguity created by changes in technology in ways which further their own interests, and although changes in information technology can modify the balance of power, the *ex ante* distribution of power is crucial in understanding post-implementation effects on the labour process.

A further theme at the level of the individual, but which lies outside the scope of this study, is that of the direct and indirect effects on changes in life style which are associated with both the widespread availability of new technologies in the home and with increased leisure and non-work time.

Many of the concerns and concepts used in addressing the effects of microelectronics at the level of the individual are central also at the level of occupations and occupational structures. Peitchinis (1983), for example, refers to "the vulnerability of different occupations". Studies have reported the increased centrality of some occupations and the marginalisation of others, and the emergence of occupational specialisation (Pettigrew, 1973b). A recurring feature at the occupational level, and of particular concern in this study, is the tension between professional identity and organisational needs in the bureaucratic professions; the effects of new technology on that relationship is explored, for example, in a number of papers in Pitt and Smith (1984).

At the level of the organisation, studies have mainly focused on changes in organisational structure and the locus of decision making, on integrating and coordinating mechanisms and on changes in the labour process and its control, as will be taken up in more detail in Chapter 2. Many of the studies of the effects of microelectronics on organisational structures have related directly to the centralisation-decentralisation debate. The findings have been complex and, indeed, contradictory; changes in each direction have been reported in different studies. There is, however, at least some agreement that those differences can be synthesised into the conclusion that new technology is not deterministic with respect to organisational structures, but that changes in technology can be used to facilitate choices made for other strategic reasons to change organisational structures in either direction along the centralisation-decentralisation dimension. Some of the literature addressing the effects of technology on organisational structure treats organisational decision making as homogeneous, and looks for evidence of the locus of decision making becoming either increasingly centralised or increasingly decentralised. But decision making is not homogenous: changes can be occurring in both directions simultaneously - for example strategic control can become more centralised while operational control is decentralised, as Wainwright and Francis (1984) point out. Further, the effect of technology on structure is not unidirectionally causal; the existing organisational structure itself affects the uptake and application of new technology, so there is a bidirectional interactive causality.

Although such changes in the vertical distribution of control have been the main concern of the majority of studies of the effects of new technology on organisational structure, the effects on its lateral distribution are also of relevance. These may relate simply to changes in the relative influence of different functional groups. They may, however, be more extensive - for example a change from a parallel to a functional structure, such as in the establishment of a data processing department to replace an arrangement whereby management information is processed separately in each functional department. A further important aspect of the lateral distribution of control is the effect of new technology on the power of trade unions relative to that of management within the organisation, and indeed at national level also.

A third major theme at the level of the organisation is the effects of new technology on organisational coordinating and control mechanisms, particularly in terms of the use of personalised direct or bureaucratic forms of coordination and control, or a strategy of responsible autonomy. Insofar as the coordinating and control mechanisms are likely to be different for central and peripheral workers, as Friedman (1977) discusses, such issues of concern at the organisational level also relate, of course, directly to those at the individual level.

At the sector level, two kinds of studies have been undertaken. First, the concerns listed above at the individual, occupational and organisational levels have been addressed also at the sector level, for example in the studies of the retailing, banking and health sectors (Child *et al*, 1984; and Belaton and Loveridge, 1985) and the chemicals and process industries (Evans, 1980). Several of the large number of studies carried out at sector level have illustrated the tension between sector-specific explanations of the response to microelectronics and analyses which seek to synthesise sector-specific findings with wider frameworks. Secondly, studies carried out mainly by economists (for example Rosegger, 1980; Rosenberg, 1982) have assessed the effects on the economic competitiveness and consequent growth or decline of particular sectors of the economy with methods and conclusions which are clearly of major importance but which address concerns lying outside the main area of focus of this study.

At national level, analysis has been concerned, amongst other things, with economic competitiveness and with effects on employment (e.g. Sleigh *et al*, 1979), especially in relation to numbers of jobs. The debate on the effects of microelectronic technology on aggregate employment at national level is characterised by two fundamentally opposed views. One is that increases in productivity afforded by new technology in certain sectors of the economy are resulting in an irreversible reduction in job numbers - the structural unemployment model. The other is that, while such effects may occur at the level of the organisation or the sector, increased productivity and reduced costs will lead to increased income of the factors of production and, in turn, increased demand, output and employment, so the employment effects will be not structural and permanent but essentially cyclical and transitional. In addition to a concern at the national level about quantitative shifts in employment demand there is a parallel concern with qualitative shifts in skills requirements. That has considerable implications for training needs, both for specific cognitive and psychomotor skills but also attitudinally in respect of the acceptance of retraining and the acquisition of flexible transferable skills. Such issues have direct consequences, of course, for the education sector itself, and the way in which the use of microelectronic technology may affect cognitive, attitudinal and psychomotor skills.

Additionally, at national level, a number of analyses have been concerned with locating the effects of microelectronic technology within a historical context. The work of Schumpeter (1939) is prominent in that respect. He associated Kondratiev's identification of cycles of technological and economic activity with particular technological, indeed meta-technological, developments. The first Kondratiev wave, from about 1790 to 1840, was identified with the introduction of steam power; the second, from about 1850 to 1890 with railways; the third, from about 1900 to 1930 with electric power; and the fourth with microelectronics.

Many of the studies of microelectronics have concentrated on an organisation or a sector within a country. Where cross-national studies have been undertaken they have commonly used comparative data primarily to illuminate the implications of cross-national differences for a particular country. But in parallel with this research has been another range of concerns at global level, within a development studies framework, in relation to the interdependence of nations, and economic imbalances between North and South. In particular, King (1982) and Rada (1982, 1985) have addressed the effects of new technology on changes in the relative labour costs in different countries and the consequences of those changes for economic competitiveness, growth rates and living standards in

Western and Third World countries.

The majority of studies of the effects of microelectronics have focussed at the level of either the individual, the organisation or the sector, or some combination of those, such as the organisation-in-sector approach. This study is concerned with all of those three levels: with a sector (education); with organisations (schools) within that sector; and with individuals (teachers, clerical staff and others) within those organisations. The assumption is that to understand the response to and impact of microcomputers in education one needs to see in an innovation, as Fullan (1982) says, "both the small picture and the big picture". One needs to know what the change looks like for the teacher, the pupil, the parent and the administrator. And, if we are to understand the "big picture", those aggregated views need to be combined with an understanding of organisational and inter-organisational factors as national and local government educational systems interact with schools and those within them.

In addition to being located within a tradition of studies of the effects of technological innovation, this study is rooted within a second tradition also - that of education management, and in particular of the management of change within educational institutions and the means by which change is introduced and managed in the education sector. The interfaces between sector and institution (government and school), and school and teacher, are of key concern also in the literature on the management of change in education, including that addressing the adoption of educational innovations. The dominant perspective in the education innovation literature has been that of pluralism. The tripartite partnership of central government through the Department of Education and Science (the DES), local government via the local education authorities (LEAs) and teachers has been the dominant model at the levels of both the sector and the individual, though there is increasing evidence, as McNay and Ozga (1985) indicate, of the breakdown of the consensus.

Although studies of the management of educational change and studies of technological innovation potentially have much in common they have proceeded independently of each other. The two strands of discourse have had few points of contact; they have drawn from separate literature bases and theoretical concepts and operated in isolation from each other. This study is therefore, interestingly, located at the intersection of two traditions - technological innovation and education management - which have previously had little in common. In addition to drawing independently from both of those traditions and feeding back into them, the study provides the possibility for a synthesis of concepts from the two traditions.

1.2 Attractions of the education sector for the study of microelectronics

The education sector is a particularly interesting one for a study of the response to and impact of microelectronics, for a number of reasons.

First, the sector is relatively homogenous. The governance processes within the sector are fundamentally similar within an education system which is frequently referred to within the pluralist model as "a national system locally administered". Similar aims apply to the sector as a whole, policies are applied across the sector as a whole, operational practice is similar in institutions throughout the sector, organisational structures are rather similar, there is a considerable transfer of teachers and managers from one institution to another within the sector, and the technology (in both the broad and narrow senses of that word) is similar in all schools. The homogeneity of the sector surfaces at two levels. First, the whole country is homogenous in respect of central government policies. And, secondly,although different local authorities may develop and apply policies different from their neighbours they do so consistently in the schools within that local authority. Although people working within the education sector frequently put forward the respects in which their school or LEA is unique, relative to other sectors the education sector is one of considerable homogeneity. That enables within-institution variables to be separated from between-institution variables in a way which is much more problematical in more diverse sectors.

Secondly, the education sector offers the advantage in research terms of having, within that homogeneity, a large number of research sites from which it should be possible to discover common patterns and systematic differences in response and outcomes. The large number of schools enables either case study or large-scale survey methods to be used, as deemed appropriate; neither is excluded because of the characteristics of the sector. The large number of sites should also reduce problems of research access.

Thirdly, although the education sector is not normally regarded as at the leading edge of the application of microelectronic technology, the rate of uptake within the sector has been very rapid - arguably more rapid, and with a higher level of saturation, than in many other sectors. In 1980, less than 5% of schools had microcomputers. But by the end of 1982 the government minister with responsibility for information technology, who subsequently became the Secretary of State for Education and Science, was able to announce that

"as far as we can judge, every secondary school now has some computer facility, and we are the first country in the world to achieve this" (Baker, 1982, p283).

And by 1984 the Minister of State in the Department of Trade and Industry could state that

"the United Kingdom has a more advanced educational IT programme than any comparable country. No other country has a similar level of penetration within schools" (Butcher, 1984, p554).

That, of course, makes Britain a particularly suitable location for research into microcomputers in the education sector.

Fourthly, if a significant part of the teaching process is seen as being concerned with the development of skills of classifying and processing information, making deductions and arriving at conclusions, those skills are ones which microelectronic technology may particularly affect. There have been a number of claims (for example Cooley, 1981; Stonier, 1983) that just as mechanical automation affected particularly the sectors in which physical labour was paramount, microelectronics will affect substantially those sectors characterised by mental labour, and/or those in the information sector. The education sector offers a particularly suitable location for assessing the effects of microelectronics in a sector which some people claim has those characteristics.

Research in the education sector, then, offers a number of attractions in contributing to the debate on the effects of microelectronics. But, in addition, research on microelectronics in schools has important policy implications for the education sector itself. It is not without significance that the education sector has a considerable role to play in developing the different patterns of skills required by employers in other sectors of the economy as they themselves respond to the opportunities and challenges *afforded* by the introduction of microelectronic technology. Education is one of the vehicles which society uses for both understanding and creating societal change. If the education sector is fully to contribute to a nation which is increasingly affected by microelectronics then there is a need within the education sector itself to evaluate current practice and to formulate and implement policies concerning the purposes, content and methodology of education. In an increasingly technologically-oriented society it would indeed be ironic if schools claimed to prepare children for such changes without themselves addressing fundamentally the implications of those changes for their own practices. At a minimal level, as Dutton *et al* say:

"The integrity of an education system depends on its ability to equip youngsters to cope adequately with adult life. If schools do not respond adequately and speedily to the challenge of electronic technology that integrity will be lost." (Dutton *et al*, 1984, p16)

More strongly, the OECD fear that responding inadequately to new technology may result in schools "declining quietly into increased irrelevance and ultimately succumbing to total atrophy" (Organisation for Economic Cooperation and Development, 1986, p18).

There is a need within the education sector not only to understand the implications for the sector of technological and societal changes but also, at the policy level, to ensure that the education system is organised to facilitate rather than inhibit societally preferred changes. That policy development process needs to be based on an understanding of the way in which the education sector itself is responding to the opportunities and threats afforded by microelectronic technology.

The timing of this study is, fortuitously, propitious for two different reasons. First, there is general agreement that the education system is at a point of profound change. Criticism from employers, parents and politicians is now more vocal than at any other time in recent history, and educational matters have a higher profile on the political agenda than at any point since the landmark of the 1944 Education Act. There has been a retreat from stability, esteem, abundance, expansion and optimism, into turbulence, criticism, scarcity, contraction and doubt. Many, though not all, of the reasons for those changes are unconnected with new technology. But the current policy thrusts of central government - increased central control of the curriculum and conditions of employment, pressure on unit costs and a concentration on "value for money", earmarked funding, and greater parental choice as part of a move towards a consumer-led market economy approach - are such that microelectronics could be embedded in the implementation of those policies. Secondly, the timing of the study is of relevance for reasons relating to the current stage of the diffusion of microelectronic technology. There is now a sufficiently large number of microcomputers in schools for computing to be a significant issue on the educational agenda, but this study is sufficiently early in the development potentially to have some influence on the policy formulation process.

Policy development needs to be underpinned by an understanding of the way in which educational organisations are currently responding to microelectronic technology. But that task is not simple. As the OECD states: "the links between education and the new technologies cover a field of enquiry which is as vast as it is complex" (Organisation for Economic Cooperation and Development, 1982, p3).

That vastness and complexity requires boundaries to delimit the research. On the assumption that both the innovation process and policy implications may be different in educational organisations other than schools, the study is limited to schools rather than extended to colleges, polytechnics, universities or governmental or private sector training agencies. For similar reasons the study is confined to schools in the state (or maintained) sector rather than those in the private sector. The school sector comprises both primary and secondary schools. At the start of the research, in 1982, a large number of secondary schools had microcomputer equipment but virtually no primary schools had. Although at that time it was expected that by the conclusion of the research many primary schools would have a certain amount of computer equipment a decision was taken to restrict the study to the sector - the secondary schools sector - which was using microcomputers throughout the study period rather than include those which might (or might not) acquire the technology only towards the end of the study. The study is limited, then, to secondary schools, and subsequent references to schools refer to those only. But that sector is not small. It comprises more than 5,000 schools, costs approximately £17 billion per annum (slightly in excess of 5% of Gross Domestic Product), employs about 200,000 teachers (almost 1% of the working population), as well as large numbers of clerical staff, technicians, cleaners and school meals staff, and affects directly as pupils the whole of the 11-16 population - about 4,000,000 people (approximately 7% of the population of the country).

The study is further defined and delimited by the technology studied. The use of microelectronics in secondary schools is restricted essentially to the use of microcomputers. While a small number of pilot projects using other microelectronic technologies (for example Prestel and interactive video) are being conducted in various parts of the country, new microelectronic technologies other than microcomputers are used rarely in schools, and the convergence of computing and communications technologies and the development of mixed configurations have impinged on schools as yet only marginally. Consequently, this study is limited to the use of microcomputers.

Microcomputers are not the first technology to enter schools. The recent history of education is littered with technological innovations - such as programmed learning, language laboratories, tape-slide presentations, and some educational television - which have subsequently been abandoned. School cupboards and storerooms testify to that. That experience has left many teachers and educational administrators sceptical about the usefulness of microelectronics.

Are there reasons for believing that the innovation of microcomputers is different from other previous educational technology innovations? There are. The pervasiveness of microelectronics in society results in microcomputers being accepted, particularly by pupils, but also by parents and teachers, as of increasing rather than diminishing importance as pupils seek employment, and are therefore seen as important as curriculum content rather than, as previous educational technology, simply as an aid in delivering the curriculum. The economic, social and political factors impinging on the education-employment interface thus modify the institutional context in which educational technology is introduced. Further, microelectronic technology has important pedagogical features which contrast with previous educational technology. It can be used to promote active rather than passive learning and, because of its capacity for being used interactively and for providing feedback, it can be used to facilitate individualised learning rather than being restricted to group-based activities. Microcomputers could be used as simply another educational aid. But there is a widespread agreement that potentially they provide a vehicle for a quantum change in the educational process.

For that reason there has been a substantial interest in microcomputers in the educational press, and as a matter of debate at conferences and courses as well as a subject of staff-room discussion. That interest has also led to a not insubstantial volume of research on educational computing, focussed on a narrow area.

1.3 Limitations of previous research on microelectronics in the education sector

There are a number of lacunae in the existing research on computers in the education sector. Some of those lead to severe limitations on our understanding of the innovation in its sectoral context. It has mainly been restricted to a pedagogical rather than an organisational perspective; it has focussed only at the level of the individual pupil or the classroom and ignored the broader dimension of the school as an organisation and its interface with local and national governance processes; and it is almost exclusively concerned with single school subjects. There have been a considerable number of research studies which have evaluated computer-assisted learning in history, in mathematics, in chemistry, and so on (for example, Kelly, 1984; Reid and Rushton, 1985; and Wellington, 1985). Those studies have been narrow in being concerned with the use of a new technology to deliver an existing part of an existing curriculum within an existing organisation. They are also limited in looking for explanations of change solely within the framework of the education system itself, and have ignored or undervalued the external political, economic and technological influences on schools and have therefore failed to contextualise change processes. Particularly with the recent higher profile of education politically, an analysis of changes in educational content and process needs to be set within the broader economic and political context as a backcloth against which to address specific changes. It cannot be fully encapsulated by a study located solely at the organisational or sub-organisational level. That need has been stated clearly elsewhere:

> "There is a partly hidden but exceptionally close linkage between computers in schools and the needs of management for automated industries, electronic offices and skilled personnel. Thus, recognising both what is happening inside and outside of schools and the connections between them [my emphasis] is critical to any understanding of what is likely to happen with the new technologies, especially the computer in education." (Apple, 1986, p152)

The other end of the spectrum of debate on educational computing is characterised by speculation about the possible long-term effects of the technology on the education sector. Some commentators on educational developments predict that the advent of microcomputers will result in vast changes in the sector at the level of the education system as a whole. It has been suggested for example that the use of computer-based learning will eliminate the need for people to meet in buildings for purposes of education, which could instead be conducted in the home on a individual or small group basis. Gershuny (1983; and Gershuny and Miles, 1983) identified a trend away from the purchase of services by households and towards the acquisition of capital assets by which households could carry out activities on a "self-servicing" basis. That trend has emerged strongly so far particularly in the domestic, entertainment and transport functions. But the manufacturers of microelectronic devices clearly see at least part of the learning function being amenable to similar changes and schools loosing their near-monopolistic position. That is particularly the case given current government policy of shifting part of the economic burden of education from government to other groups, including companies as sponsors of City Technology Colleges, and to households, partly through charging for activities on the "curriculum boundary", such as musical instrument tuition, which were previously provided free of charge. Technological developments and the widespread availability of computers in the home could facilitate a move towards the "deschooling of society" which is advocated by some (e.g. Reimer, 1971; Illich, 1973) on the basis of an ideology very different from a technological one. Within that ideology, schools do not even have the residual role relating to social and life skills which is assumed in other predictions (e.g. Stonier, 1983) which also incorporate an increased emphasis on education in the home. An alternative scenario (Papert, 1980) involves the retention of educational institutions, but with the class disappearing as the basic unit of organisation of teaching and being replaced by individualised computer-managed instruction. Much of that speculation and debate is based solely on a consideration of technological possibilities. It has a deterministic orientation and ignores the social, political and economic factors affecting the uptake of the innovation and the way in which its use is controlled.

A shorter-term focus of debate is tendentious and is reflected in a position which is exhortatory rather than speculative: schools must respond to the changing needs of the economy, they must become more technologically- and vocationally-oriented, and their purposes, organisation and management must change accordingly. That view confounds analysis with advocacy, and also ignores the mechanisms of change; it requires that obstacles to change <u>must</u> be overcome without addressing <u>how</u> they may be overcome, and assumes that change can be implemented unproblematically.

Research and debate on computers in the education sector, then, is either located at the level of the pupil or the classroom, where developments are well-informed by research, or is concerned with speculation at the level of the school or the education system, in the absence of research evidence. There is an absence of research focussed at the level of the school as an organisation and its interaction with its local and national environment. That neglect empirically is surprising given the emphasis attached to the school-environment interface in the education management literature. Further, the research and debate on microelectronics in the education sector has failed to draw from, or feed back into, the substantial body of research on the effects of microelectronics, or indeed of labour process theory more generally. A recent review (Ozga, 1988) claimed that teachers "deny the legitimacy of examining teaching as work" (p xi) and that the literature "reveals how little we know about teachers in comparison with other workers" (p xiv). The two frameworks have simply not been connected.

1.4 Purposes of the study

This study has two main purposes:

(i) To contribute to the development of theory and practice in relation to the management of technological change within the education sector, and to the study of technological change more generally.

(ii) To provide an empirical base for the formulation of policies on the use of microcomputers within the education sector at institutional, and local and central government levels.

1.5 Key questions

Those two purposes can be served by addressing two key questions:

(i) What factors affect the extent and type of response to microcomputers in schools?

(ii) What impact does the use of microcomputers have on the ways in which schools are organised and managed?

In relation to each of those questions it is not sufficient to consider, as the previous research on microelectronics in schools has, the innovation of microelectronics in isolation from the economic, social and political context within which the education sector is currently operating. Rather, it is necessary to relate the particular decisions and processes investigated to the wider context of the strategic policy thrusts of both central and local government, and indeed the tension between them. The study attempts to address the two key questions in that way.

1.6 Organisation of the thesis

The following chapters provide a structure with which the two key questions identified above can be addressed. Those two questions have implications for the literature base of the study, which is reviewed in Chapter 2. The "response" question leads to a review of literature on models of innovation (incorporating both rational and political models) and on educational innovation specifically, focussing on the powers and duties of the key actors affecting and affected by the introduction of microcomputers, and their zones of influence. In reviewing the literature based on the "impact" question, research relating to its effects in sectors other than education is discussed particularly in relation to effects on the labour process and organisational structures. The technological determinism debate is also addressed. The literature from two decades ago on the effects of the introduction of mainframe computers is not ignored because of changes since then in the technology. Rather, the assumption is made that the issues in that literature which dealt with first-time users of computer systems may illuminate an analysis of first-time users currently, as such automation issues are on the educational agenda for the first time because computers have only recently entered schools in significant numbers. The results of the limited previous research on the use of microcomputers in schools are also incorporated.

In Chapter 3, a conceptual model of the adoption of microcomputers in schools and their subsequent impact is synthesised from the analysis of the literature in the previous chapter. Twelve operational hypotheses are derived from that model, for subsequent testing. The analysis of the particular characteristics of the education sector in respect of exchange relationships with the environment, and institutional decision making processes, leads to the derivation of a resource dependency model, with resources defined broadly to include the intangible resources of skill, knowledge and information, labour market position and position within the workplace organisation, as well as the "real" physical and financial resources. The strategic use of those resources by key actors and groups within the dynamic of the resource management cycle of the acquisition, allocation, and utilisation of resources is at the heart of the conceptual model.

In Chapter 4, a focussed discussion of both the positivist and the interpretive research traditions is followed by the derivation of the research design, incorporating both survey and case study methods, to address the key questions identified and the hypotheses derived from the conceptual model. The choice of the sample for the surveys and the case study sites is incorporated into that methodology chapter.

In Chapter 5, the fieldwork based on the research design developed in the previous chapter is discussed in the chronological order in which it was carried out. The organisation, execution and analysis of the initial survey is discussed and the findings on the extent and type of use of microcomputers in the sample as a whole are summarised. The middle section of the chapter concerns the four case studies which were carried out - one in each of four local education authorities - where key policies and decisions in both the school and the local education authority are identified. The chapter concludes with a discussion of the final survey and a summary of the changes in practice for the sample as a whole between the initial and final surveys.

Part C, comprising Chapters 6, 7 and 8, forms the analytical core of the research. A concept used extensively in the analysis is that of role as a linking mechanism which mediates between organisational processes and the actions of individuals. The concept is used both in its sense of formal or occupational role, which is adopted as a classificatory device for structuring within the chapters, and in the sense also of the dramaturgical roles played by key actors. In Chapter 6 the role of change agents external to the school are analysed. Using data from both the surveys and the case studies on the use of microcomputers in both teaching and school administration, the policies and influence of change agents at national level (government departments and agencies) and local level (local education authority politicians, officers and advisers) are addressed. A key conclusion from the analysis in Chapter 6 is that the funding of microcomputers (and the differential funding in different local education authorities) significantly affects the <u>extent</u> of use of microcomputers in schools, but not the <u>way</u> in which they are used.

Chapter 7 concentrates on change agents and user groups within the school, particularly on headteachers and their deputies, computer teachers, other teachers and school office staff, again by using data from both the surveys and the case studies. The conclusion is drawn that it is key actors within the school, rather than those external to it, who affect the way in which the computer technology is used. The role of computer teachers is seen to be particularly important in that respect in controlling critical organisational uncertainties.

In Chapter 8, the effects of the innovation on the labour process in schools are discussed with particular reference to the jobs of senior managers (headteachers and deputies), teachers and school office staff. The ways in which those effects are systematically related to the role of key actors in the implementation of the innovation are addressed. The limited effects of the innovation on organisational structures and the relationship between schools and local education authorities are discussed and the reasons for the small magnitude of the consequent changes explored.

Although the concluding chapter, Chapter 9, incorporates a summary of the findings, its function is primarily one of synthesis. That synthesis operates at two levels. First, the conclusions from the analytical chapters are synthesised, with the conclusion being drawn that the use of microcomputers for teaching purposes is progressing in an "enabling" mode while their use for school administration is being implemented in a "controlling" mode. That conclusion provides a second level of synthesis in which the question of the integration of the findings of the study with those of other studies of the effects of microelectronics is addressed within the work organisation tradition. Finally, the implications of the research findings for policy formulation and implementation are addressed, and the research design, methodology and implementation are reflected upon.

Chapter 2

THE ADOPTION AND CONSEQUENCES OF TECHNOLOGICAL INNOVATION

2.1 Models and strategies of innovation

The purpose of the literature review in this chapter is to facilitate the formulation from the two main research questions stated in Chapter 1 of a conceptual model from which operational hypotheses can be developed to address those research questions.

To address the first of the two research questions (what factors affect the extent and type of response to microcomputers in schools?) the literature on models of innovation is examined in this chapter. After defining an innovation and examining various taxonomies of innovation the main analytical perspectives on the process of innovation (especially the distinction between innovation as a rational and a political activity) are discussed. A number of key roles in the innovation process are identified and the strategies which can be adopted by actors in those key roles are assessed. The distinction is made between strategies available to those actors external to the organisation intending to influence an innovation and a different set of strategies applicable to actors within innovation-adopting organisations.

2.1.1 Innovation

There is a great number of definitions of innovation in the extensive innovation literature. One of the most frequently quoted is that offered by Rogers and Shoemaker:

"An innovation is an idea, practice or object perceived as new by an individual. It matters little whether the idea is 'objectively' new. It is subjective newness for the individual that determines whether it is an innovation. If the idea is new to the individual, it is an innovation." (Rogers and Shoemaker, 1971, p19)

The concentration on "subjective" newness, rather than the "objective" newness characteristic of invention, is important. Thus, in this study, the adoption and use of microcomputers in a variety of schools will be regarded as an innovation in respect of each of those institutions, not merely in the first to adopt the change.

But Rogers and Shoemaker exhibit, even within their definition, a limitation of much of the literature on innovation: the implicit assumption that innovation is exclusively concerned with individual adopters. That preoccupation with individuals, and the neglect of organisational factors affecting the corporate adoption of innovations within the institutional setting of complex organisations, and the diffuse decision making processes in them, are serious shortcomings in much of the innovation literature, particularly that adopting a diffusion orientation. It has the further unfortunate consequence of channeling much of the research and discussion in the diffusion tradition into the characteristics of individual adopters - age, sex, wealth, position in social networks, etc. - rather than in factors which are policy-manipulable. The individualistic bias of the literature is pervasive but not absolute. Daft (1978, p197) in defining innovation as:

"... the adoption of an idea or behavior that is new to the organization adopting it. The idea can be old with regard to other organizations so long as the idea had not previously been used by the adopting organization"

falls into the opposite trap of concentrating only on organisations as adopters. An innovation, it is assumed in this study, can be adopted by either an individual or an organisation.

The diffusion studies have tended to lead to the development of single-factor theories of innovation. In some, the focus has been on the characteristics of adopters; in others, on the characteristics of the innovation; in yet others, on communication channels; and so on. Too infrequently have there been attempts to contextualise innovation and encompass predisposing factors within a contingency framework or to assume that unsuccessful innovation is for any reasons other than mirror images of those for success. A further limitation of much of the literature within the diffusion tradition is that it underplays the intentionality of actors other than the adopters themselves and therefore fails to capture the richness of the innovation process. In many innovations, and certainly those which apply to organisations rather than individual adopters, an understanding of the purposive actions of a range of individuals and groups is necessary in considering the life cycle of an innovation; those actions are frequently ignored or undervalued in diffusion studies.

Normann (1971) makes the important distinction between innovations which are concerned with only marginal changes or variations and those which are reorientations and hence fundamentally alter the core characteristics of the organisation. Loveridge (1987) extends that distinction in discussing the implementation of marginal change within an "engineering" mode by the use of existing and organisationally-accepted recipes for action. The incommensurate innovations (reorientations) are implemented in contrast entrepreneurally in ways which challenge and change the existing paradigmatic recipes. In relation to the use of microcomputers in education, some people (Papert, 1980; Stonier, 1983) regard the innovation as a reorientation; others regard their introduction as a variation. That point is important. The strategy of change adopted is likely to be different depending on whether the innovator perceives the change to be marginal or a reorientation. In discussing educational innovations particularly, Becher and Maclure (1978) distinguish further between subject-based developments, in which changes take place in the content or teaching method of individual subjects, and system-based reform focussed on changes throughout an organisation or across a range of institutions. Clearly, unencumbered innovations are potentially the simpler, and implementation of change incrementally rather than radically is more common than the prescriptive management texts advocate. Shipman (1974) similarly distinguishes between unencumbered educational innovations in which teachers makes changes in their own teaching and encumbered innovations in which they have to coordinate their actions with those of others. It is suggested here that, although the introduction of microcomputers is resulting in considerable subject-based unencumbered change, the innovation is potentially fundamentally a system-based encumbered development.

The strategies of change which the key actors identified below may choose to adopt are likely to be different depending on whether the innovation is perceived to be encumbered or unencumbered; they are likely to be different also depending on the source of the innovation - particularly on whether it originated within the organisation or externally. Miles (1964) distinguishes between innovations initiated by the target system itself and those originated by others - voluntarily sought or externally imposed, in Fullan's (1982) terms. Rogers and Shoemaker (1971) similarly distinguish between internal and external recognition of a need for change, and introduce a second dimension in relation to the origin of the innovative idea being either internal or external, in which case the adopting organisation might either implement it unchanged or modify it during incorporation. This classification can be related to the more specific distinction discussed in the industrial innovation literature between "technology-push" innovations, where the driving force is the technical capability to carry out a process which was not previously possible, and "needs-pull" innovations, where the change is the result of a search for a solution to an existing and important problem.

A number of the above taxonomies of innovation can be subsumed within the distinction made by Miller and Friesen (1984) between the conservative and the entrepreneurial models of innovation. In the former, innovation occurs only reluctantly in response to challenges from the environment when the risks of not changing outweigh the risks of departing from existing practices. In the entrepreneurial model, by contrast, innovation is the norm; it is actively sought, highly valued and is pursued proactively. The core assumption within that distinction is that different organisations react very differently to superficially similar environments. That assumption goes to the heart of the study of the innovative behaviour of schools.

2.1.2 Models of the innovation process

The analysis, or indeed advocacy, of a particular strategy of innovation, is commonly carried out on the basis of one of a range of perspectives on innovation. House (1981) distinguishes between "technological", "political" and "cultural" perspectives. A technological perspective is normally associated with the assumption that the innovation process will be similar in different institutions; the political and cultural models are based on the assumption that the innovation will be different in superficially similar institutions. Further, the latter two perspectives might lead to an expectation that the innovation mechanisms operating in organisations which are pioneers may be different from those in organisations which are late adopters.

His approach has much in common with Allison's (1971) seminal analysis of the Cuban missile crisis through "rational actor" (which is similar to House's technological perspective), "organisational process" (cultural) and "governmental politics" (political) models. Allison's three models of the decision making process are useful perspectives from which to analyse educational innovation, and specifically the introduction of microcomputers. The three models are:

(i) decisions as the products of more or less systematic analysis;

(ii) decisions as the outcomes of organisational processes;

(iii) decisions as resultants of micropolitical activity.

The rational decision making model is based on the assumption that change can be achieved, in G.B. Shaw's terms, by "brute sanity", and that innovations will be adopted on the basis of their self-evident merits. The model is associated in the introduction of new technology with the use of cost benefit analysis as a decision making and evaluation methodology (Fielden and Pearson, 1977), and with the use of feasibility studies. McKinsey and Company (1968), for example, advocate the evaluation of technical feasibility, economic feasibility and operational feasibility in relation to decisions about the introduction of computers. Studies of the diffusion of innovations concentrating on factors affecting their success or failure, using as independent variables characteristics of the innovation such as perceived relative advantage (including cost, compatibility, complexity, divisibility, trialability and observability) have implicitly adopted a rational decision making model. There is an implicit assumption in many studies of successful or unsuccessful innovations that the innovation mechanism and correlates of success which apply in, say, agricultural or medical innovations are transferable to educational settings, and vice versa.

The organisational process model emphasises the mechanisms developed within organisations to ensure patterns of organisational behaviour which are structured and persist over time, and takes particular cognizance of the distinctive processes which come into play when decisional activities in polyarchic organisations are distributed among many individuals whose participation is fluid. It gives weight also to the personal and professional goals which may conflict with the claimed organisational objectives and policies, which themselves are problematical, being possibly both unclear and changing. Applied within schools this perspective emphasises the benefits of analysing innovations in terms of existing organisational structures and decision making mechanisms, of which the most significant include the traditions of departmentalism and professional autonomy as will be developed in section 2.2 below.

The conceptualisation of organisations as political systems has been an important development in the decision making literature of the last decade. A central concern is the way in which the competing values and interests of various individuals, groups and coalitions are resolved within a structured negotiating arena. Of equal importance is the use of political power not only at the stage of resolution of issues but also at the prior stage of defining which issues appear on the agenda and which do not; indeed, Schattschneider (1960) identified "deciding on what to decide" as the most important aspect of organisational power. Unfortunately, the central concepts of power, influence and authority are used in the literature in ways which are not only inconsistent but, on occasion, contradictory. Here, power will be taken as the potential for mobilising resources to preferred ends, influence as the successful mobilisation of power, and authority as recognised legitimacy in the use of power. Such concepts are central to the political interpretation of organisational activities, despite the fact that organisational members tend not to articulate activities overtly in political terms. Mannheim (1936, p105), for example, identified "the fundamental tendency of all bureaucratic thought to turn problems of politics into problems of administration". And despite Hoyle's (1982) assertion that the "organisational underworld" of micropolitics has an unacceptable aura in educational circles, and touches on issues which many would prefer to ignore or deny, an increasing concern with organisational micropolitics is observable in the recent literature on the management of educational organisations, for example Hoyle (1986) and Ball (1987). And as Hoyle himself says, bargaining and political activity is no less potent for remaining implicit rather than being brought out openly; it may, indeed, be more potent. Watson (1982) identifies the central questions of the political perspective in a way which is particularly pertinent to the establishment of the conceptual framework developed in the next chapter:

"What is the relationship between the allocation of power and the allocation of economic resources? Who gets what and how? Specifically,with respect to the particular situation, what are the mechanisms which relate power and influence, on the one hand, to the acquisition and allocation of financial, staffing and other resources, on the other?" (Watson, 1982, p23)

Political behaviour preceding the choice stage of decision making, for example by defining constraints as either rigid or flexible, by shaping the agenda of discussions, and prior to that by the appointment of particular individuals to nodal posts, and the cooptation on to decisional bodies of potential dissidents, is likely to be at least as important, if not more so, than the activity at the time at which a choice might be said to have been made. In considering academic politics Bailey (1977) bridged the organisational process and political models in making the distinction between discourses which are "front-stage" and those which are "back-stage" or "under-stage". The front-stage decisions are formally taken by established committees which provide scope for the ritualistic assertion of values and purposes. The basis of the compromises which will subsequently be made are typically promulgated back-stage in various temporary groupings or sub-committees, whilst the reputations and alliances which underpin those solutions are built or destroyed under-stage.

Political activity may be particularly associated with change, with its consequences for established ways of working and peoples' resulting self-image. Stenhouse claims in respect of educational change that:

"Most innovations have strong implications for the internal politics of the school. The school has a hierarchy of status and power. Curriculum and organisational change disturbs that allocation of status." (Stenhouse 1975, p172)

Similarly, Pettigrew suggests that:

"Political behaviour is likely to be a special feature of large scale innovation decisions. These decisions are likely to threaten existing patterns of resource sharing. New resources may be created and appear to fall within the jurisdiction of a department or individual who has not previously been a claimant in a particular area. This department or its principal representative may see this as an opportunity to increase its or his status and rewards in the organisation. Those who see their interests threatened by this change may invoke resistance in the joint decision process. In all these ways new political action is released and ultimately the existing distribution of power is endangered." (Pettigrew, 1973a, pp20-21)

Innovations which allow the possibility of expansion (such as microelectronics in education) rather than simply change (as has been the case with many recent educational innovations) may particularly generate political activity as actors see monies available for deployment, the possibilities for appointments and promotions in an otherwise static labour market, and new areas of organisational activity available for capture.

The work of Lindblom in putting forward a disjointed marginal incremental model rather than a rational comprehensive model of decision making both descriptively and normatively in his classic 1959 paper "The science of muddling through" and its 1979 development in "Still muddling; not yet through" challenges "the myth of rationality in innovation" (Schon, 1967).

So too does the development of ambiguity models, of which the most celebrated is that of the "garbage can" (Cohen, March and Olsen, 1972) containing a mix of problems, solutions, participants and choice opportunities from which decisions emerge. The ambiguity which innovation creates can provide room for manoeuvre, and an innovation can act within such models as a "projective screen" onto which issues quite unconnected with the specific change itself can be directed. Organisational participants may see a particular innovation as an opportunity to pursue their own interests and load their objectives and preferred solutions into the decisional garbage can.

The garbage can model emphasises, helpfully, the transitory nature of many decisions - that decisions are not always "made", but are frequently only "pinned down temporarily" by a particular concatenation of events, so problems are not "solved" but simply superseded, with issues and opportunities to amend decisions re-emerging as on a carousel, with some regularity. In a similar vein, Daft and Becker (1978) stress the importance of focussing not only on organisational rationales but also on factors such as personal gratification and the advancement of the careers of the idea champions in determining the outcomes of an innovation, and thereby underline the need to understand individual rationality as well as organisational rationality in interpreting the unfolding of change processes.

The significance of the various perspectives on innovation - particularly the distinction between rational and political approaches - is three-fold. First, as is convincingly demonstrated in Allison's (1971) book, the Cuban missile crisis (and by implication other complex decisions) can be understood in terms of each of the three models individually, but the interpretation of events varies considerably depending upon the model employed. A policy analyst starting from any one of the analytical perspectives may well produce a persuasive account of a decision making process rooted within that perspective and ignoring others. Although the account may be persuasive it will be no more than partial, and runs the risk of distortion. The adoption of a particular perspective, while illuminating certain insights, will hide others from view. The message for the policy analyst or the researcher is deemed here to be an eclectic one - that an account can be full only if elements of each perspective, rather than merely one, is adopted. That has implications for research design, as will be taken up in Chapter 4.

The second is that the strategy adopted by those concerned with the innovation is likely to be systematically related to the perspective which they hold - the adoption of a rational actor model will lead to a strategy of innovation very different from that for which the *weltanschauung* is a political conflictual model. And, thirdly, the three perspectives in aggregate underline the importance of understanding the goals of key actors. As March and Simon (1958) conclude, where there is widespread agreement about objectives, rational decision making approaches will typically be adopted, but where there is goal dissensus, persuasion, bargaining and vested interest rationales become more prominent.

So, who are the key participants in the process of innovation, what roles can they adopt, and what strategies of innovation are available to them?

2.1.3 Key roles in the innovation process

Many different innovator roles are identified in the literature. Eraut (1977), for example, identifies eleven distinct change agent roles (the expert, the resource provider, etc), Lippitt and Lippitt (1978) put forward a list of nine (advocate, informational expert, etc) whilst Jung's (1977) taxonomy extends to nineteen possible roles. A distinction which appears to be critical, though it is made in the literature with a terminology which is inconsistent, is that between what will be referred to here as the role of the "advocate" and that of the "project champion". The advocate is normally a person of seniority within the organisation who can give the innovation support, status and visibility, although he or she may well not be involved with it on a day-to-day basis. The advocate can, in some cases, usefully be seen as a change catalyst whose role may be to inhibit change at some times as well as to facilitate it at others. The project champion is typically of less seniority, is involved in the minutiae of the innovation on a continuing basis, actively and enthusiastically promotes it and seeks to secure the resources necessary for its adoption and development. This may involve acting intrapreneurally "to fight, argue and cajole their pet projects to fruition.... True intrapreneurs champion their causes beyond the call of duty" (Pinchot, 1985, p54). The successful project champion will need to possess certain skills in managing the process of change. Beyond that he or she will also need knowledge and skills concerning the content of the change. Where the innovation is a technological one, such as the introduction of a computer system, the project champion will typically need technical computing knowledge and skills comparable with or in excess of those of his colleagues within the organisation.

In addition to the intangible resources of enthusiasm, knowledge and skills brought to the innovation by the project champion, and the support and status of the advocate, many, though not all, innovations also require physical or financial resources. That implies a third distinct role - that of the resourcer, as identified by Eraut (1977), for example. In some situations the physical and financial resources may be supplied by the advocate or the project champion, especially the former; in others they may come from elsewhere within or outside the organisation, but the role of resourcer is frequently of critical importance.

The term "change agent" will be used here to encompass all of the roles of advocate, project champion and resourcer, though it is recognised that in addition to the broad interpretation used here the term is applied in parts of the literature, particularly that on organisational development, with a narrower and more specific meaning. Most people within the organisation will, of course, not be change agents in respect of a particular innovation, but may be targets or recipients who are required or expected to adopt it, or have an opportunity of doing so, or are otherwise affected by the innovation to a greater or lesser extent. Such individual targets can respond very differently to the opportunities and problems which the innovation may present for them. Those responses may range from a rejection of the innovation and a diehard loyalist defence of the status quo, through what Rogers and Shoemaker (1971) refer to as dissonant adoption (the implementation of "visible" or "public" aspects of an innovation without adopting it "faithfully") to what Elliott-Kemp (1982) identifies as passive reception, enthusiastic adoption, and active interpreter roles.

Such discussion takes us on to the strategies which can be adopted by individuals and groups affecting or affected by an innovation. It is convenient to review initially the strategies of change available for use by external organisations before considering change processes within educational and other organisations.

2.1.4 Strategies of innovation: External change agents

A frequently-cited taxonomy of strategies of change which are available at the macro level is that suggested by Havelock (1973), who distinguishes between "research, development and diffusion", "problem solving" and "social interaction" models. The research, development and diffusion model assumes that the innovation process can be an orderly sequence in which a solution to an identified problem is developed and diffused to a target audience. Fidelity of implementation is of central concern. The model typically involves high research and development costs which can subsequently be amortised over a large number of similar or identical implementation sites. The problem solving model, in contrast, focusses on local processes of change. User need is seen as of paramount importance, voluntary change is assumed to have the greatest prospect of success, and external change agent activity is seen as helpful only if it is non-directive. The social interaction model, which is dominant in the diffusion and dissemination emphasis of Rogers and Shoemaker (1971), Whitehead (1980) and others, emphasises the importance of opinion leadership, patterns of communication and access to information in the spread of an innovation.

Those three models have considerable explanatory power in addressing the strategies of innovation employed by change agents external to schools, as will be developed in Part C. They have something in common with the taxonomy of change developed by Schon (1967), who identified "centre-periphery" and "periphery-centre" models and one based on the "proliferation of centres". The power and influence relationship between the periphery and the centre are clearly of critical importance in such models, and, it will be suggested later, are at the heart of the decisional processes concerning the introduction of microcomputers to schools. One of the most helpful ways of addressing such relationships is that developed some time ago by Chin and Benne (1969): the "empirical rational" strategy emphasises the importance of evidence in rational decisions to adopt innovations, the "normative re-educative" strategy focusses on the importance of change agents acting in the affective rather than the cognitive domain, whilst the "power coercive" strategy addresses primarily implementation by fiat and emphasises the use of prescriptions and sanctions.

Such strategies of change can be related to Havelock's and Schon's models of innovation, which in turn may be related to the perspectives on innovation which Allison and House describe. Thus, a technological (House) or rational (Allison) perspective may give rise to a research, development and diffusion (Havelock) or a centre-periphery (Schon) model of innovation, which may well be implemented by a rational empirical or power coercive strategy. Similarly, a cultural (House) or organisational process (Allison) perspective underlies Havelock's social interaction model of innovation, and the adoption of a normative re-educative strategy of implementation. The implicit or explicit use of a particular perspective, then, is likely to lead to the use of specific strategies of innovation by both external organisations interested in introducing change, and actors within organisations introducing or influencing the change process. As House suggests:

"One might also expect somewhat different action strategies to be derived from the three perspectives. A technological strategy might concentrate on the development of an innovation and its proper employment in the school. An effective innovation and proper skills to implement it might be the focus. A political strategy might focus on the interests of the participating groups, anticipating that the ultimate success of the innovation would reside in how motivated people are to employ it. A cultural strategy might take cognizance of the values of the teachers and consider how congruent the innovation is with the school culture." (House 1981, p39)

The strategies of change are not necessarily applied consistently throughout the time during which an innovation enters an organisation. Although different authors within the diffusionist tradition specify different stages of innovation, most of their models assume a temporal linearity which can be condensed into the phases of initiation, implementation and institutionalisation which Fullan (1982) identifies. Different strategies of innovation may well be used at different phases of a particular innovation. Equally, different strategies may be used in respect of different potential adopters on the S-shaped ogive of innovators, early adopters, early majority, late majority and laggards which Rogers and Shoemaker (1971) use. Such taxonomies provide a rich means of interpreting the strategies of change adopted by key actors at particular points in the life history of a specific innovation.

2.1.5 Strategies of innovation: Internal change agents

Various strategies of change are available, then, to change agents external to the innovation-adopting organisation who seek to promote change. Although some of them may be used also by internal change agents, they can be extended by a similarly wide range of rather different strategies which can be employed by change agents and innovation-recipients within the organisation.

Much of the innovation literature, including a large proportion of that which deals with the introduction of microelectronics, is based on the "managerial prerogative" assumption - that the prime influence on the selection and use of new technology will be that of management, either external to the site at which it is to be used or within the adopting site. That assumption is similarly reflected in the balance of attention given to different strategies of innovation. Many of the strategies available to both external and internal influencers of change are based on the concept of control. That concept is central to both the classical management literature from the early years of the century and to the more recent organisational analyses based on the political sciences. Indeed, a major stand of the organisational literature is that a fundamental managerial objective is reducing organisational entropy and increasing predictability. That view is shared by some of those who analyse organisations from a political perspective and those whose view is more influenced by an engineering model. The desire to maintain control over the "technical core" (Thompson, 1967) and to protect that core from environmental impacts is particularly great.

Two major foci of control may be identified: control of outcomes and control of processes (or control of outputs and control of behaviour, in Ouchi and Maguire's (1975) terms). In the former, performance standards are set and the manager is responsible for achieving those standards but has discretion over <u>how</u> they are attained. In the latter, an attempt is made to control directly the process by which inputs are transformed into outcomes. Those two means are related to control via goals contrasted with control via rules, as discussed in the educational context by Watson (1981).

At both of these points of intervention a variety of taxonomies of methods of control have been developed. Mintzberg (1979), for example, suggests that the main methods of control are direct supervision, mutual adjustment and the standardisation of work processes, outputs or worker skills. Child (1977) also cites supervision and self-control (broadly equivalent to mutual adjustment), but includes impersonal control through prescription and/or feedback (which has similarities with Mintzberg's standardisation of outputs and processes) and centralised decision making as alternative strategies. Friedman (1977) distinguishes between direct control, which seeks to suppress the variability in the labour process, and responsible autonomy, which seeks to enhance that variability and harness it in pursuit of organisational goals by generating commitment rather than merely compliance.

Much of the literature on control mechanisms is based on experience in the manufacturing sector. Loveridge (1982), however, in addressing service organisations (which would include education) suggests that the variable nature of the product results in task performance being subject to less control, and certainly less control by direct supervision and the applications of standardised procedures, than is the case in the manufacturing sector. He further suggests (1972) that in the service sector control over goal-setting and the feedback of information remains to a greater extent with the employee at the point of delivery of service. Within the education sector this may derive from both the difficulty of direct supervision and from the notion of professionality leading to self-control, as will be developed below.

In a further taxonomy of control methods, Edwards (1979), in addition to direct control, distinguishes between two structural forms: bureaucratic and technical. Bureaucratic control involves "incentives for workers to identify themselves with the enterprise, to be loyal, committed and thus self-directed or self-controlled. Such behaviour involves what may be called the 'internalization of the enterprise's goals and values'" (Edwards, 1979, p150). That clearly has much in common with Friedman's concept of responsible autonomy. Technical control, on the other hand, involves the embodiment of the control mechanism within the organisational technology in ways which are exemplified in detail in Braverman's (1974) seminal study of the development and operation of the labour process in capitalist economies. From another perspective Woodward and her colleagues also address the relationship between technology and control in coming to view control as a bridge between technology and organisation (Reeves and Woodward, 1970).

Computer systems have a particularly interesting bi-directional relationship with control. They can be used as a mechanism of control through technology. Indeed, in stating that "computer systems are normally introduced to increase the level of control in the organisation", Bjorn-Andersen and Rasmussen (1980, p101) give prominence to that strategic concern. But the way in which computers are introduced and used is itself affected by the *ex ante* distribution of control within the organisation. As Pfeffer puts it:

"We consider technology and information systems to be strategic variables that both affect but are also affected by the contest for control." (Pfeffer, 1978, p.xvii)

The use of technology, and computer technology in particular, to increase control operates via a set of direct and intended effects especially in relation to job content and organisational structure, as discussed below. There are commonly, however, a variety of counter-strategies available for use by those on the receiving end of such measures, as identified by Mechanic (1962) and Lawler and Rhode (1976), which to some extent nullify the intended consequences and the negative effects on job content of the kind discussed in section 2.4. Such counter-strategies are usually regarded as dysfunctional effects in terms of centre-periphery or research, development and diffusion models of innovation.

The use of negative power and blocking strategies to thwart the top-down implementation of an innovation will be discussed shortly.

More subtle strategies are available also and are particularly in evidence where the responsible autonomy mode of control is prominent. The ways in which key actors can use the ambiguity, created not only by the specific innovation itself but also the secondary uncertainty caused by the unfreezing of existing organisational relationships, to further their own interests through the acquisition of more responsibility, power and prestige have been emphasised by Mumford and Pettigrew (1975) and documented in a range of case studies. So too have the ways in which those whose present position is threatened can attempt to protect and preserve it. Some of those strategies concern groups of people in similar positions within one or more organisations and are based on occupational ideologies and labour market positions; others are strategies which key individuals within an organisation can pursue.

Both are based on increasing the centrality of the individual or the group to the organisation, which in turn may depend on their capacity to handle critical organisational uncertainties. According to Thompson (1967, p159) "uncertainty appears as the fundamental problem for complex organisations". It would therefore follow that absorbing that uncertainty is a key organisational task. And, according to the strategic contingencies theory of Hickson *et al* (1971), power accrues to those who can reduce critical uncertainties; the more central the uncertainty and the less substitutable the actors the more influence they will have. It will be suggested that a fundamentally important organisational characteristic of schools is that of their dependence on a small number of external agencies (directly on the LEAs and, indirectly, on central government) for the acquisition of resources. The control of the uncertainty surrounding that resource acquisition and the "strings" with which it is provided therefore becomes a critical organisational task. Within an organisation various individuals or groups may have relevant knowledge, skills or expertise which is critical to the organisation. To the extent to which they can maintain the centrality and the monopoly of that expertise, and succeed in defining organisational problems as those which are within their area of expertise, the dependency of the organisation upon them will remain. Managing that dependency can therefore be a crucial activity during a process of innovation. Such considerations, and their associated vocabulary, have affected only peripherally the education management literature, where organisational micropolitics has been treated less seriously than is warranted, despite its relevance to an understanding of organisational behaviour.

The people who succeed in absorbing uncertainty are not necessarily of seniority within the organisation as the case studies of Crozier (1964), Pettigrew (1973a) and others illustrate. As Brown states:

"great power is wielded by those at the point where the greatest amount of uncertainty is absorbed, since they can considerably influence the decisions that will finally be made by others. Such a position may be filled by an 'expert' who is nominally quite junior in the hierarchy." (Brown, 1976, p88)

Uncertainty can be particularly great, and the problems of planning and decision making therefore particularly acute, in contexts of rapid technological change. One method by which senior managers who are technically unsophisticated can handle that uncertainty is by setting objectives in broad terms only, those objectives subsequently being, in Whipp and Clark's (1985) terms, "translated" by subordinates into operationalised plans. Another is by transferring decision making, deliberately or by default, to a subordinate who is deemed to have relevant technical expertise. Barnett developed that theme in considering subordinate teacher power in schools:

"There is some evidence that the power of subordinates in any organisation resides in their resource access and the resulting dependency relationships which emerge. For example, many times superordinates have to cope with problems with insufficient resources and no satisfactory alternatives. Because organisations strive to reduce uncertainty in their operations those subordinates capable of providing the necessary assistance in helping superordinates solve their problems can attain power over them." (Barnett, 1984, p44)

Where the possession by subordinates of relevant technical knowledge about the operation of new technologies combines with a managerial incomprehension of such technologies the dependency of the titular superior and the opportunities for strategic advancement by the subordinates may be considerable, as Loveridge (1972) discusses, even if they are only temporary and the window of opportunity may diminish as managerial learning takes place.

Wrong (1979) also stresses the significance of specialised knowledge, skills and expertise (which he terms "competent authority") and expresses surprise at the paucity of its treatment in the literature on influence, authority and power. The resource of "competent authority" is of particular relevance in schools. Because teachers see themselves as being concerned with imparting specialised knowledge, skills and expertise the notion of competence goes to the heart of schools as organisations, and a high value is consequently placed on competent authority.

In addition to the resource of expertise, Mumford and Pettigrew (1975) list among the other power resources potentially available to the internal consultant that of the control over information, which may be seen as "the political base on which institutional power rests, and he who controls the distribution and allocation of most information is in the position of greatest power" (Theodossin, 1982, p2). Although the organisation is being considered by Theodossin in global terms the same point can be made in respect of a single issue or of a particular innovation. Lawrence and Lorsch (1967), for example, found that power in a decision process tends to rest at the level where the necessary information can best be accumulated; for some decisions that was at a senior level within the organisation whereas for others it was at a much less senior level. Similarly, as Pfeffer states:

"Power can accrue to a person because of his position in the flow of communication and therefore because of his ability to filter, summarise and analyse information as it is passed." (Pfeffer, 1978, p18)

The culture of schools, discussed in the next section, results in expertise being highly valued, and authority based on expertise being regarded as legitimate. Of the four bases of power which Bacharach and Lawler (1980) identify, that, together with remunerative power derived from the control of material resources and rewards are particularly important, as Hoyle (1986) discusses, in contrast with the normative and coercive bases, for which the cultural legitimation, and indeed the formal legal basis, have been diminishing.

The utilisation of knowledge, expertise and information, like other political resources, is most effective when it is employed as unobtrusively as possible. That unobtrusiveness may involve the presentation of individual or sectional interests as organisational interests. Particularly within the "caring professions", which is normally held to include teaching, organisational value systems typically incorporate a transcendent rhetoric such that decisions are justified according to their effects on the clients. The equation of the collective good with that which would further the interests of key actors, particularly project champions, is a strategy which such individuals have available and can use at critical decisional points in the life cycle of an innovation. But not all those who have knowledge, expertise or information choose to use that power base to further their own interests. The distinction which Bell (1973) makes between the *technicien,* who applies his expertise apolitically, and the technocrat, is a useful one in that respect. Nor are all those who would wish to use their technical expertise for political purposes able to do so; political ploys require not only possessions of resources but also skills in using them.

The significance of the control of information in respect of the introduction of a computerised information system is two-fold. First, the control of information, its selective release, and the timing of that release can be critical in the decisions surrounding the adoption, implementation and use of a computer system, in the same way as for other innovations. Lucas (1981) uses the contingency theory of intraorganisational power developed by Hickson *et al* (1971) in considering the power base of those who control organisational information systems. He concludes that they typically meet most or all of the four conditions of organisational power proposed in that theory - they cope with organisational uncertainty, they are not easily replaced, they have links with many other areas of the organisation, and those links are such as to create a high degree of interdependence between those organisational sections. But, secondly, information can be considered, indeed defined, as "that which reduces uncertainty" (Lucas, 1981, p4). A computerised information system provides information which itself further changes the control and distribution of information within the organisation and the various gatekeeping roles. A changed information system can therefore be used in potentially subversive ways and is likely to affect the capacity of key individuals and groups who receive all or part of that information - including those who are newly enfranchised by the information system - to control the critical uncertainties of the organisation.

The process of decision making surrounding the adoption of an innovation is likely, then, to be far from simple. And its implementation, too, is unlikely to be straightforward. In the introduction of computer systems particularly, Abbott (1978) claims that resistance to change is the rule rather than the exception. Resistance to change is a strategy available in a variety of guises to both individuals and groups within an organisation who may perceive themselves to be adversely affected by an innovation. There is no shortage of reasons which can be brought forward by those who see innovation as something other than unproblematically a good thing and are reluctant to change. Eichholtz and Rogers (1964) identified resisters to technological innovation as the uninformed ("the information is not easily available"), the doubtful ("I want to wait and see how good it is before I try"), the comparing ("other thing are equally good"), the defensive ("the regulations will not permit it"), the depressed ("it costs too much in time or money"), the anxious ("I don't know if I can operate the equipment"), the guilty ("I know I should use them but I don't have the time"), the alienated ("if we used these gadgets they might replace us") and the convinced ("I tried them once and they aren't any good"). Such responses emphasise again the importance of understanding individual rationality in addition to organisational rationality. And as Zaltman *et al* (1973) discuss, if an individual's calculus is such that he does not wish to adopt an innovation which the organisation has taken up the dissonance can be reduced not only by that person changing his attitude to make it consonant with the behaviour expected by the organisation, but alternatively by misusing, circumventing or discontinuing the innovation to attempt to make organisational behaviour consonant with his attitudes.

Resistance to the adoption of an innovation may be overt, ranging from open hostility and rejection to sabotage by dissonant rejectors. Or it may be covert, perhaps by its implementation by dissonant adopters being merely symbolic or token (Bardach, 1977), or by the assumed consentients attempting to delay, deflect or subvert the innovation. Such passive subversion can be very effective in schools, where, as Watson explains:

"significant innovations need not merely acquiescence but active cooperation: there is a myriad of ways in which, by acts of omission and commission, those who are not supporters of the innovation can quietly subvert it from within." (Watson, 1986, p103)

Resistance to change, at the individual level, may be issue-specific. Although certain individuals may be resistant, or conversely receptive, to many or all innovations, the specificity of response to a particular innovation is of obvious concern. But in addition to individual responses the collective response of relevant groups through trade union and other formal or informal channels is also of relevance. In relation to microelectronic technology, such groups have frequently been more concerned with the *post hoc* adaption to new technology rather than with intervening at the systems design stage. For example, van der Auwera and Mok (1982, p154) found that "current union strategies are predominantly defensive, safeguarding the achieved benefits and stabilising the existing job structure. Unions have rediscovered professional protectionism". A defensive and protectionist stance may involve, for example, the negotiation of manning levels, and the seeking of no-redundancy agreements and/or delays in implementation. Salaman (1980) indicates that trade unions have, in some cases, been more concerned with such substantive issues than with the procedural issues which ultimately may have the greater effect on the way in which the control of the labour process is affected by change. The importance of procedural issues is particularly great as a rapidly changing innovation develops, when early concessions won on substantive aspects are likely to be rapidly eroded. The stance adopted by the teachers' unions on the innovation of microcomputers will be discussed in section 2.2.3 below.

Many of the studies which give prominence to resistance to change of individuals are interesting at the anecdotal level but have frequently neglected the structural properties and organisational characteristics of the settings in which innovations, and resistance to them, take place. Just as the policies and strategies of trade unions and other collectivities need to be contextualised, so too do the strategies of those individuals and groups in key organisational roles concerning the specific innovation.

A range of key individuals and groups within the innovation-adopting organisation and external to it may have a greater or lesser influence on the adoption or implementation of an innovation. Within schools, who are the key actors and groups who significantly affect educational innovations in general, and the introduction of microcomputers in particular? And what are the particular characteristics of the education sector which have implications for the mode of adoption of innovations? Those questions are the focus of the following section.

2.2 The education system and its operation

In Chapter 1, studies of the effects of microelectronics were identified at various organisational and supraorganisational levels and it was suggested that in this study it is important to consider the innovation at national, local and institutional levels, and the relationship between them. It is convenient first, then, to analyse in turn the structures and functions, and the powers and duties, at the three main organisational levels of central government (the Department of Education and Science - the DES), local government (the local education authorities - LEAs) and institutions (the schools) before discussing briefly the role of the various governmental "quangos" and other advisory bodies which are relevant in the context of the development of the use of microcomputers. At each of those levels the prescribed and extant roles of the key actors operating within those organisations and structures will be identified; both the relatively permanent structural elements and recent contextual changes in emphasis are included.

2.2.1 Central government: The Department of Education and Science

The structural anatomy of the education system in Britain, and the relationship between the Department of Education and Science and other relevant organisations is described in essence in a publication which the DES itself has produced:

"In England and Wales responsibility for the education service is distributed between central government, the Local Education Authorities (LEAs), the governing bodies of educational institutions, and the teaching profession. The service can be described, therefore, as a national system locally administered. The Department of Education and Science (DES) and the Education Department of the Welsh Office are major partners in this service rather than its sole controller in each country." (Department of Education and Science, 1982, p1); and:

"The Department of Education and Sciences's main concern is formulating national policies for non-university education in England, and Government policies for the universities in England, Wales and Scotland. It has few executive functions and does not provide or administer schools or colleges or determine their detailed curricula. Although part of the Department's work involves carrying out specific statutory duties, its main functions are the broad allocation of resources, and influencing the other partners in the Education Service (the Local Education Authorities, the School Governing Bodies and the teachers)." (p5)

The DES has a relatively small number of staff in comparison with many other government departments, reflecting its concern primarily with policy development, and the major location of executive responsibilities with local education authorities. The Department is headed by a Secretary of State for Education and Science, who is a member of the Cabinet, supported typically by two Ministers of State. It is perhaps of relevance in the context of the use of microcomputers in schools that the current Secretary of State (Kenneth Baker) was formerly Minister with Responsibility for Information Technology within the Department of Trade and Industry, the resourcing role of which is identified below. The DES has a structure of civil servants headed by a Permanent Secretary, similar to that of other Departments. It is unusual, however, in having also a large and influential group of independent professional staff - Her Majesty's Inspectors (HMI) - who number approximately 500 in total and who, being almost all former teachers, have a very different background, and possibly different values, from those of the civil servants with whom they work. It would be wrong therefore to regard the DES as monolithic; there are three clearly identifiable groups - politicians, bureaucrats and professionals (HMI) - each with a separate ethos. During the last few years the influence of the politicians within the Department has been changing in both mechanism and extent. Until the mid 1970s it would have been true to say that the Secretary of State had considerable negative regulatory powers through the use of statutory instruments, circulars and administrative memoranda, but his means of influencing developments positively were essentially catalytic rather than direct. Secretaries of State of both parties in government since then have taken an increasingly direct interventionist role in matters - such as the curriculum and, more recently, the employment contracts of teachers - which were previously influenced to a greater extent locally. Those trends have continued and have been justified by the "lack of professionalism" of teachers equated with the teachers' dispute of 1984-86. The position that "the curriculum is too important to be left to the teachers" had become more prominent after Prime Minister Callaghan's famous Ruskin College speech in 1976. And at the 1986 Conservative party conference the Secretary of State expounded that view:

"Education can no longer be led by the producers - by the academic theorists, the administrators, or even the teachers' unions. Education must be shaped by the users - by what is good for the individual child and what hopes are held by their parents." (Baker, 1986, p10)

A variety of specific schemes have been developed which reduce the powers of the producers and transfer it partly to the DES and partly to parents. Those schemes include the Technical and Vocational Education Initiative (TVEI), the development of a core curriculum, the abolition of the Schools Council, the establishment of the Audit Commission, the development of explicit contracts of service for teachers, the reform of governing bodies, the introduction of open enrolment, and the various more detailed moves towards the erection of a centralised infrastructure incorporated in the 1986 Education Act.

That very volume of initiatives, along with other changes as a consequence of falling rolls, and the establishment of tertiary colleges partly to unify academic and vocational education, has implications for the introduction of the specific innovation studied here. It is the conventional wisdom that change is best implemented against a background which is otherwise stable, as Handy (1985) discusses. If that is valid, the environmental turbulence and uncertainty and the competing claims of a range of other innovations may not be perceived by some to auger well for the introduction of new technology. But the means of funding that variety of innovations also has implications for the relationship between centre and periphery. Most of the recent educational initiatives are linked by a theme of increasing centralisation. But there is another link also: the use of earmarked funds as a resourcing mechanism to buy change. As Fairhall says:

"If you look at the trigger for so many of the Government's educational initiatives, it has been money; not always public money, not always public money directly applied, but money nevertheless" (Fairhall, 1987, p15).

He cites as examples of that mechanism: the introduction of TVEI, the settlement of the teachers' dispute, the establishment of City Technology Colleges, the proposed introduction of entrepreneurialism into higher education courses, and, indeed, as will form the core of the analysis in Part C, the entry of computers into schools.

The influence on curriculum developments via specific financial mechanisms of categorical funding and earmarked grants of various kinds (what Knight, 1987, refers to as "honeypot management") has occurred simultaneously with the use of cash limits, expenditure targets and rate-capping with its associated financial penalties to limit local financial autonomy and increase the prominence of an "agent model" rather than a "partnership model" of local government. In terms of Griffith's (1966) classic conceptual framework for the analysis of central and local government relationships, the DES has changed markedly from an approach which was at times "*laissez faire*" and at times "regulatory" to one which is explicitly "promotional". That, of course, establishes a context which directly affects policy making in local education authorities in both scope and style.

2.2.2 Local government: Local Education Authorities

The legal responsibility for the publicly maintained schools, of which there are approximately 5,200 for the secondary age range, is defined in the 1944 Education Act as resting with the Local Education Authorities, of which there are 104 in the area to which that Act applies - England and Wales. And, importantly, it is the local education authorities (not the DES) which employ the teachers, unlike in many other countries where teachers are civil servants.

Constitutionally, the elected local authority itself (in some cases the metropolitan district council and in others the county council) is the local education authority and the Education Committee is a committee of the local authority acting under delegated powers. Despite the constraints resulting from central government legislation and financial regulatory mechanisms, the decisional legitimacy of local authorities is underpinned by the twin features of their being locally elected and being at least partially self-funded via the rate levy. The local authority has substantial discretion over the volume of resources allocated to the education service in comparison with those to other services, and is a major resourcer of educational provision through decisions about teacher numbers, per-pupil capitation allowances to schools, accommodation standards, and so on. Within local government it is highly significant that the education department is by far the largest in terms of both manpower and expenditure. That dominant size has implications both for the popularity among elected members of a seat on the education committee and also, in times of financial retrenchment, for the identification of prime targets for savings, with a tendency to treat the Education Department as a "milk cow".

The professional staff of the LEA is headed by the Chief Education Officer who is assisted by a number of education officers. The LEA also employs a number of advisers, some of whom will typically have responsibilities for particular subject areas of the curriculum across all the schools in the LEA, while others will be general advisers for a group of schools. In a medium-sized LEA there may be about twenty advisers and fifteen education officers, with associated clerical, administrative and technical support.

In the same way that it was suggested above that the Department of Education and Science should not be seen as a monolithic organisation, similarly LEAs are not unitary bodies. The same three groups are present: politicians, bureaucrats (education officers) and professionals (education advisers). A major concern is therefore the locus of policy making and the distribution of power and influence in the policy arena amongst those three groups. Their relative influence has been changing recently. Just as there has been a change in the distribution of powers vertically in terms of the relationship between central government, local government and schools, as will be developed in some detail throughout this chapter, there has also been a change in the horizontal distribution of power both within schools (and this study has produced evidence of the influence of technological change in that context) and in the relationship between schools and LEA offices. The "naive classical" model of elected members being responsible for policy determination and officers for working out the details of policy and for its implementation has long been challenged. The officer-led policy making model dominates much of the literature of the last two decades, not least, understandably, that incorporating the memoirs of chief education officers (for example, Birley, 1973; Bush and Kogan, 1982; Tomlinson, 1982; and Wilson, 1985). Much of that literature conveys a picture which is now misleading and can be challenged. The recent increasing politicisation of education, not only nationally but also locally, has changed the boundaries between the administrative and the political and increased the visibility of councillors in the educational policy making process. But that politicisation is issue-specific. It will be argued below that the response to microcomputers in schools is supported at the local level, albeit for different reasons, by all of the major political parties and in that sense is not a politically contentious issue within local education authorities and, despite changes in the politico-professional frontier, does in fact, conform with the officer-led policy making model.

The influence of education officers on the policy making process is facilitated by a particular feature of their occupational structure. In contrast with the civil service (and thus with the Department of Education and Science), where specialists provide advice and the line manager bureaucrats are generalists whose career structure involves moves between government departments, education officers are specialists with a line management role, supported by general administrators. They are recruited almost exclusively from teachers and their career path is almost without exception entirely within education departments. That identification with a single department contributes towards the establishment of an "educational culture" within the office. The occupational structure of education officers gives them a particular means of contributing to the policy making process, and a set of values which perhaps has more in common with those of the service deliverers than is the case in many other departments of the council, or of central government. The consequences for this innovation of that shared set of values, as will be developed in Chapters 6 and 7, are profound.

The other major group within the education office - educational advisers - are also mainly former teachers who have been variously referred to as "the eyes and ears of the chief education officer" and "the quality control branch of the LEA" (Winkley, 1985). The role of education advisers is Janus-like - they have to face both the education office and the school. Their role in the latter has been compared with that of the diplomat acting "as a bridge between a set of policies, goals or ideas on one side and on the other a host culture which it is hoped to influence in some way" (Hewton, 1985, p1). Similarly, Bolam (1984) stresses the adviser's duality of role: in his advisory and professional role he provides advice to schools and advocacy to the LEA; in his inspectorial and administrative role he delivers policy to the schools and evaluation to the LEA. One adviser (Dean, 1984) identifies the conflict in being "the friendly neighbourhood adviser" and at the same time being involved in inspection, dealing with failure and involved in interviews for promotion. That complex role is one which is close, more close than that of the education officers, to the school curriculum, and to innovations which affect the curriculum. Advisers see themselves as promoters of innovation (Bolam *et al*, 1978) and are able to provide patronage and support (often including, crucially, as we shall see, financial support) for innovations which they wish to see developed.

2.2.3 Schools and their staff

The LEA (through the Education Committee, comprising elected members and some co-opted members) in practice delegates some of its powers relating to individual schools to the school Governing Bodies (which typically comprises LEA-nominated appointees as well as elected representatives of teaching and non-teaching staff, and of parents) operating through the headteacher. The particular powers and duties which are delegated vary somewhat from LEA to LEA and are expressed in the Articles of Government of the school. Those relating to schools in one LEA, for example, provide for the governors "through the agency of the Head Teacher to have general direction for the conduct and curriculum of the school" (City of Sheffield Metropolitan District Council Education Committee, 1982, p1) while the headteacher "shall control the internal organisation, management and discipline of the school, the choice of books, the methods of teaching and arrangement of classes; and he shall exercise supervision over the teaching and non-teaching staff" (p5).

The headteacher, then, has a high degree of legal authority, deriving partly from the decentralised nature of the education system in Britain compared with that in most other countries. He or she also has authority derived from the control of a range of important resources. Hoyle (1986) includes among those the material resources of finance, equipment and consumables, the control of internal promotions of staff and the provision of evaluative information which critically affects external job applications, and control of the autonomy of teachers individually and their esteem through, for example, public comments and the differential application of rules. Indeed, headteachers have been identified as having "a unique position as what at times appears to be quasi-baronial figures in their own independent fiefdoms" (Bacon, 1978, p74). That resource control is a key feature of the conceptual model derived in the next chapter.

But few headteachers would see themselves now as autocrats; the "chief executive" model is more common, as Morgan *et al* (1983) discuss, and the *primus inter pares* assumption, if not the vocabulary, is still prevalent. And although the authority and autonomy of headteachers have been increasingly circumscribed and attenuated by legislation and by local regulations and policies, the "ship's captain" or "managing director" images are still more common than that of the employer's agent or the "branch manager reporting to head office".

The headteacher is clearly in a position to manage the school rather than merely to administer it on behalf of a superordinate body; he or she is to a great extent a role-maker rather than a role-taker. As Jennings stated (prior to the emergence of a concern with gender in writing style):

"As there is enough work that a head might well think fit to do himself to keep three or four men fully occupied, a head chooses which things he will do himself and different heads make very different choices" (Jennings, 1974, p907).

Not only do different heads make very different choices about what they will involve themselves in, they also make very different choices about how they will involve themselves. That applies particularly to the balance of use of the two styles of "chief executive" and "professional leader" which Hughes (1976) identified.

It is the received wisdom that the management skill of the headteacher is reflected in the school. A study carried out by Her Majesty's Inspectors (Department of Education and Science, 1977) identified the ability and style of the head as a key factor in determining the success or otherwise of a school. Stenhouse (1975) sees the role of the head as particularly important in relation to innovation because of his authority, his ability to take a synoptic view, his contact with the environment and the expectation by the LEA that he will innovate. The headteacher is, of course, particularly well-placed to ensure that his own objectives are promoted as those of the school. Shipman (1974, p86) sees the head as "the focus of all changes in school life without any suggestion that they all originate from him".

The headteacher's role in promoting innovations can be either one of direct leadership or by creating the conditions and support and providing the resources to encourage the emergence and development of innovations by others. In either case his role is central. A major educational innovation research study in the

United States concluded that:

"The importance of the principal to both short and long run effects of innovation can hardly be overstated.... The principal amply merits the title of 'gatekeeper of change'" (Berman and McLaughlin, 1978, p.viii); and:

"the principal's opposition to projects sharply increased the prospects for failure, whereas their active support was necessary for perceived success (Berman and Pauly, 1975, p59).

Similarly, based on studies in this country, Ball (1987, p60) concluded that "headteachers are, arguably, the most active change agents in schools".

Thus, although in one sense schools are state apparatuses, that does not mean that headteachers are passive receivers and implementers of policies passed down hierarchically. That applies also to teachers who can be viewed, formally, as assistants to the head; indeed the terms "headteacher" and "assistant teacher" implies such a relationship. The reality, though, is more complex than that implied by the formal structural relationships. Although teachers have accepted, in Braverman's (1974) terms, their formal subordination, they have not interpreted that as implying a real subordination, at least not within the classroom. Research in schools (Taylor *et al*, 1974; Hanson, 1977) identifies the school and the classroom as separate zones of influence with classrooms being pockets of decisional autonomy where the teacher has the major influence, but with the head being the key figure in relation to school policy and the allocation of resources. Hanson develops this theme into an "interacting spheres" model:

"There are at least two decisional systems within the school. The first, reflecting mainly school-wide affairs, lends itself to rational, centrally controlled procedures that restrict behaviours to conform to well-programmed events. The second, reflecting mainly classroom affairs, requires the flexibility and autonomy to initiate acts of creativity. These systems merge in such a way as to operate simultaneously, each presenting a relatively low level of interference to the other.... However, at times the teachers protect their pockets of autonomy using their own devices." (Hanson, 1977, p37)

As King (1983, p91) states: "the concept of the headteacher as sovereign of the school is matched by that of the teacher as sovereign of the classroom". Within such models there are, of course, zones where hegemony is unclear. That is particularly the case when innovations straddle previously defined zones of influence, or can be used to change their boundaries. The introduction of computers in schools is one such innovation.

The separate zones of influence of the school and the classroom are not necessarily permanent. Indeed, the existence of separate classrooms is not required by the organisational task. The technology of education, broadly defined as the means of organising resources for the achievement of the task (learning) by the transformation of inputs into outputs, does not require the establishment of separate classrooms (or even of schools). The development in secondary schools of separate subject departments, classrooms, and a timetable by which access is divided into administratively convenient time slots is a device rooted historically partly in the way knowledge has been classified and framed, as Bernstein (1971) discusses. The possibility that a new generic technology <u>in</u> education may be used to change the technology <u>of</u> education is at the heart of the concern with microelectronics in schools.

Located between the two zones of influence which Hanson discusses (the school and the classroom) a third can be identified - the department. The classification of knowledge which is central to Bernstein's schema concerns the way in which knowledge is compartmentalised and the degree of boundary rigidity between subjects. In the secondary school curriculum that classification has historically been very strong, and has been underpinned by the examination system. Indeed, Becher and Maclure (1978, p97) refer to the secondary school curriculum as "a territory carved up and balkanised into a series of separate empires over which the more powerful disciplines hold sway". The traditional "collection curriculum" of separate subjects which has developed over a long period of time is a powerful and deep structural root of the school system in this country. The tradition of departmentalism is, then, associated with a third zone of influence - the department - which may be in tension with those of the headteacher and the class teacher. And, importantly, the introduction of computer-assisted learning across the curriculum meets, challenges, and potentially introduces a discontinuity in that powerfully rooted zone of influence.

The existing zones of influence are important but they are not immutable, and they may be further blurred as the values and ideologies which individuals develop and reinforce in their teaching careers are maintained as they are promoted into headships. The strong internal labour markets within the school sector diminish hierarchical ideological differentiation. The school sector as a whole, rather than each school individually, can be addressed in terms of the dual core labour market model discussed by Doeringer and Piore (1971) and developed by Loveridge and Mok (1979). In schools, the primary sector is occupied by teachers and headteachers, and the secondary sector by secretarial and clerical staff, technicians, and catering and cleaning staff. The employment relationships within the primary sector of the internal labour market with which we are centrally concerned here is dominated by the contradictory norms of bureaucratic and professional employment principles. There is, of course, a substantial literature addressing the conflicts endemic in organisations staffed by those from what are variously described as the ascriptive, heteronomous or bureaucratic professions.

Some of the literature on professionalism adopts a trait or inventory approach and identifies a number of characteristics, for example mastery of a body of knowledge, commitment to an ideal of service, licensing powers and self governance, which are said to distinguish professions from non-professions. Further categories such as a semi-professions are sometimes included to accommodate occupational groups which do not meet in full the attributes ascribed to professions. Etzioni (1969) includes teaching as a semi-profession. The teachers' associations and unions have, like other occupational associations, used the term profession as a claim rather than a description, and with varying degrees of enthusiasm have aspired to professional status and long advocated the establishment of a General Teachers' Council as a licensing body.

The key question, however, is not the sterile, static one of "is teaching a profession or not?" but the processual question of "how do teachers collectively influence the control of the teaching process and of educational provision more generally?" As Larson puts it:

> "Professionalisation is the process by which producers of special services sought to constitute and control a market for their expertise.... Professionalisation is thus an attempt to translate one order of scarce resources - special knowledge and skills - into another - social and economic rewards" (Larson, 1977, pp.xvi-xvii).

That control of expertise autonomously is central to the concept of professionalisation, as others have emphasised:

> "The central and defining aim of a profession is the maximisation of its autonomy or freedom of control by others, both within the immediate work setting and in the institutionalised regulation of the relations between the professionals and the customers of their services" (Laffin, 1986, p21).

The issue of teacher autonomy will arise frequently in the analysis of the process by which the innovation studied here has entered schools and classrooms and has affected (or not affected) both individual and collective occupational autonomy.

The employment relationship of teachers is further delimited by the public sector being a near-monopolistic supplier of formal education and a near-monopsonistic buyer of teachers' services.

Johnson (1972) identifies mediation as a type of control manifested when the State intervenes between a practitioner and client in order to define needs and/or the means by which such needs are met. But in the case of teaching, it is not clear who the client or clients are. Pupils, their parents and the State are each in some respect clients, and the fact that the State is part of the client set poses particular problems in relation to professional autonomy. Lortie (1969) contrasts the position of teachers in respect of what he sees as their "one big client" with the established practitioner in an autonomous profession whose economic independence of any single client enables him to withstand pressures which he considers contrary to his professional principles or interests.

Ozga and Lawn emphasize the complexity in use of the concept of professionalism, both descriptively and prescriptively, in suggesting that:

"Its use as an ideological weapon aimed at controlling teachers must be appreciated whilst, at the same time, it should be understood as a weapon of self-defence for teachers in their struggle against dilution." (Ozga and Lawn, 1981, p2)

The job market position of teachers is clearly of significance in influencing the content of jobs and with it the impacts of technologies used within those jobs. Some writers on educational technology suggest that while previous educational technologies did not ultimately have the impacts suggested at the time of their inception, this was because of their rather limited technical capacity. In contrast, it is suggested that "microcomputers are different" as they are a meta-technology, and will therefore have a greater impact. Such arguments applied to educational technology are based commonly on the technical characteristics of the innovation in isolation from a consideration of job market factors.

Teachers' job market position has been eroded as the capital and revenue expenditure allocated to education at national level has diminished, as the number of pupils has decreased due to falling birth rates, and as teachers who have traditionally been governed by specific employment regulations are increasingly being affected by general employment legislation. Ozga and Lawn link these changes directly with changes in posture of teachers' unions in a way which is worth quoting at length:

"A major consequence of the cuts has been to make teachers aware of their similarities with other wage earners ... teachers are turning to employment legislation - which codifies employee's rights and employer's duties - as a defensive strategy.... An allied development has been the growth of codification of teachers' terms and conditions of service, so long confused by local 'agreements' about the 'professionalism' or otherwise of supervising children waiting for school transport, playing in playgrounds, eating school dinners and so on. These duties were often fulfilled by teachers in the past because of their reluctance to put unsupervised children at risk, a danger greatly emphasised by employing authorities who were quick to underline the disastrous consequences of such neglect of professional duty. Teachers thus fulfilled unpaid, non-contractual 'voluntary' duties which diluted their claim to professional expertise.... Thus these factors, given considerable force by the economic situation, the declining school population, and the State's willingness to scapegoat teachers as part of its drive to rationalise education, have continued to force teachers into a re-examination of the real strengths and weaknesses of their relationships with their employer. In so doing, they have embraced the strategies and adapted the experience of other workers who have more widespread experience of resistance or a stronger collective sense of the past." (Ozga and Lawn, 1981, p139-140)

Until a few years ago it would have been true to say that school teaching was permeated with the ideology of professionalism and that teachers saw themselves essentially as autonomous professionals rather than bureaucratic functionaries. The concern of central government in the latter half of the 1980s to codify the employment contract of teachers, and the abolition of the Burnham Committee for negotiating salaries and conditions of service, has emphasised the bureaucratic employee dimension of teachers' work, and hence changed teachers' self-image. But, using the distinction which Berg (1983) makes, the attention has been, at least initially, on reducing the collective autonomy of teachers (through the establishment of more tightly defined employment contracts, the reduction of teacher influence on the content of the curriculum compared with that of government, parents and school governors, and other forms of lay control and accountability) rather than their individual autonomy concerning the delivery of the curriculum "behind the closed door of the classroom".

The historic informality of labour relations within the education sector has been changed by both the increasing politicisation of education and by the relative economic decline of teachers in comparison with other white collar workers. Those developments have, of course, affected the trend in teachers' activities collectively via their unions. Lumley, writing in 1973 stated that:

"As white collar employees' perceptions of the social status of their occupation alters, so do their attitudes to unionism. An example is given by the teachers who, in the face of a falling economic position and dissatisfaction over employment conditions and their degree of autonomy, shifted the emphasis of the NUT from a professional association to a militant trade union." (Lumley, 1973, p33)

While such trends are identifiable, it is unwise to view teachers as a homogeneous group. Different teachers' associations and unions occupy very different positions on the "professionalism"-"unionism" continuum and the trends identified by Ozga and Lawn and by Lumley have proceeded simultaneously with the emergence of the Professional Association of Teachers whose "professional" orientation and refusal to engage in strike action has attracted increased numbers of teachers recently, while the membership of the more militant unions has declined.

Teachers associations are among the longest established of the white collar unions. But they are far from united. The existence of the relatively large number of unions, and their fragmentation and rivalry, are deeply rooted historically and continue to be highly important. Indeed, that rivalry has increased rather than diminished during the last decade. That disunity, in the face of an increasingly powerful and interventionist state, was manifest most clearly during the teachers' dispute of 1984-86. The professionalism-unionism continuum (which equates almost directly with the moderate-militant distinction) is relevant to a range of issues, including the use of microcomputers. At the "professionalism" end of that continuum, espousing a moral or altruistic position rather than an instrumental economic stance, are the Professional Association of Teachers (PAT) and the Assistant Masters and Mistresses Association (AMMA), whose 1982 code of practice on the use of computers in schools related solely to the "professional" issues of confidentiality and security of data concerning pupils. At the "unionism" end is the National Association of Schoolmasters / Union of Women Teachers (NAS/UWT), which was the first of the teachers unions to be affiliated to the Trades Union Congress, which openly recognises and addresses the potential effects of computers on teachers' jobs. For example, their publication entitled "Microelectronics: Is there a future for teachers?" opened by identifying that "the spread of computer devices is a potential threat to the employment expectations of teachers" (NAS/UWT, 1980, p1) and went on to argue that teachers need to maintain control of the technology in the classroom if that threat was to be averted.

Three areas of concern can be identified from the policy statements on microcomputers of the teachers associations and unions. The first is a recognition of a need to familiarise pupils with microelectronic technology. That recognition is accompanied by calls for adequate (increased) funding. The second is a recognition of the potential use of microcomputers in computer-assisted learning, and that teachers individually and collectively need to become more knowledgeable about the advantages and limitations of such technology within the classroom. The third is the concern identified above about the potential threat to the employment of teachers and the consequent control issues.

The different responses of teachers in aggregate to a changing employment relationship and to innovations which are associated with it, or are independent but coterminous, are matched by an equivalent disparity of response at the classroom level. The distinction which Hoyle (1974) made between the "extended" and "restricted" professionality of teachers has been widely cited. The "extended professional" is well aware of curriculum developments through reading, membership of relevant organisations, discussions with colleagues and voluntary attendance at up-dating courses and is willing to consider promising innovations and to change his or her classroom practice accordingly. The "restricted professional", on the other hand, is the good classroom practitioner who relies on intuition and past experience rather than influences from a professional community beyond the classroom or school, is less likely to be aware of potential innovations and more likely to be sceptical of them. Attempts to introduce computerisation or other innovations on a wide scale must, necessarily, address the values of restricted professionals as well as those of extended professionals within the zone of influence of the classroom.

In the same way that, as discussed earlier, neither the DES nor the LEAs are unitary organisations, neither, as we have just seen, are the teachers a unitary body. They have, for example, different ideologies in the sense of different educational commitments and preferences based on different ideas about the relationship between individuals and society and the purposes of education in understanding, and possibly changing, that relationship. The response of different teachers to the innovation studied here will be analysed later in terms of that interpretation of ideology. So too will teachers' actions within a second meaning of ideology - as a resource used by and on groups and individuals as a means of attempting to ensure the acceptance of preferred decisions and actions, in the sense that, for example, the ideology of professionalism is used, sometimes for different purposes, by both teachers and employers. Teachers, for example, have attempted to use that ideology as a means of preserving occupational autonomy, while employers have invoked it as a contrast to the portrayal, during and subsequent to the teachers dispute of 1984-86, of teachers as uncaring, mercenary, politically suspect and resistant to change.

The ideology of professionalism is crucial to an understanding of the uptake of the innovation of microelectronics in schools. Educational innovations, of course, both affect and are affected by the relative extent to which teachers act as autonomous professionals or bureaucratic functionaries. Structures and processes aimed at ensuring compliance and meeting standards and targets are imposed only awkwardly on a delivery system which requires at least some autonomy and initiative; that tension is at the heart not only of the current debate about the governance of education, but also of the adoption of the innovation studied here.

Within the secondary sector of the internal labour market the group most likely to meet the innovation studied here are the secretarial and clerical staff whose jobs may be affected by the use of microcomputers for school administration. In most schools there is a full-time school secretary and a number of full-time or part-time clerical staff. Although the school secretary typically will have worked in the school sector for several years, many of the clerical staff would look towards the external rather than the internal labour market. The ancillary staff usually play little part in the decision making process within schools, and although significant numbers are members of trade unions, commonly NALGO, militancy is not characteristic, and industrial relations are low-key. The President of the School Secretaries Association claimed that "the school secretary has to be like a duck - calm and unruffled on the surface but paddling like hell underneath" (Clegg-Smith, 1981, p132); the job is characterised by high task variety with a large number of tasks having a relatively short duration.

At regional level, however, NALGO and other unions such as NUPE which represent clerical staff, have been involved in the negotiation of new technology agreements. In some authorities such agreements have followed bans on the use of a new technology. Provisions in the agreements commonly include job grading and policies of no redundancies, no compulsion to work on the new equipment, periodic health checks relating primarily to eyesight and separate negotiations within the context of the agreement in relation to each new installation. Where such agreements exist they relate not specifically to education departments but to all clerical staff within the metropolitan or county council and therefore include clerical staff within schools.

Superimposed on this educational governance structure at national, local and institutional levels are a number of advisory and facilitating organisations whose importance is reflected in their funding capacity and influence on policy making at national and local level.

2.2.4 Organisations affecting the uptake of microelectronics

A number of government departments (in addition to the DES), agencies and "quangos" affect the uptake of microelectronics in schools. Among the most important are the Microelectronics Education Programme which is concerned with the production of software and the provision of teacher training, the Department of Trade and Industry which has funded the provision of some hardware, and, as in many changes affecting the curriculum, the various curriculum and examination bodies. The influence of each will be developed in this section in turn.

2.2.4.1 The Microelectronics Education Programme

The most directly relevant body in the context of microcomputers in education is the Microelectronics Education Programme (MEP). This was announced by the then Labour government in 1978 and introduced, virtually unchanged, after the 1979 general election by the Conservative government in 1980. That support by both parties in government is a particular example of the non-politicisation of computer education, in contrast with many other educational issues. The MEP was established to develop educational software and to provide training, and was funded from the DES to the extent of £9 million (at 1980 prices) for the period 1980-1984, and later extended until 1986 funded to a total of £23 million. Its significance is much greater than the extent of its funding (amounting, as established, to only about 0.1% of the national education budget, or £0.30 per pupil per year) would imply. The significance of the MEP is two-fold: it was designed to act as a pump-priming device, and has been successful to the extent that its funds have been multiplied by those provided directly by schools and LEAs. Secondly, during a period of contraction in education it has helped to legitimise one of the few areas of expansion.

The twin aims of the MEP were identified by its director as:

"Firstly: encouraging such parts of the curriculum as will ensure that children can learn about microelectronic technology, its uses and effects. Secondly, to help teachers appreciate the best ways of using the technology in helping children learn any subject" (Fothergill,1982, p3).

To do this it has commissioned the development of software and provided for the dissemination of software and training, working in conjunction with LEAs via fourteen regional centres whose boundaries are in the main coterminous with those of the LEAs. The target identified for change was teachers individually (rather than, for example, schools as organisations). The assumption was that:

"Teachers, we would like to believe, are the main instruments for change in education, and the MEP has focused its attention very much on the teacher in its initial strategy" (Aston, 1982, p14).

Dissemination relied initially on a cascade approach with two teachers from each school attending courses provided by MEP in the hope that those teachers would educate others in each of the schools and that professional emulation would be a key factor in the dissemination of the innovation and the achievement in each school of a critical mass of teachers committed to the aims of the programme. The strategy had much in common with a simplistic view of curriculum development as analogous to economic aid, which Shipman (1974) has discussed, based on the assumption that external investment will enable a society to break through to self-sustained economic growth when there are sufficient resources to provide not only for consumption but also to generate further investment from within the society rather than from external sources. The strategy of the MEP has implicitly been one of simple linear growth. Little attention was paid to the way in which means of achieving the programme aims might change as expansion took place. The assumption, at least initially was that the means of supporting teachers who were early innovators would be applicable also to those who were late adopters. It appeared to have been illuminated less extensively than might have been expected of a national programme from the experience of other educational innovations or of technological innovations in other sectors. The strategy was initially focused, then, entirely at the level of the individual teacher, and ignored the school as an institution. It also ignored the use of microcomputers in administrative applications.

The models of innovation implicitly used by the Microelectronics Education Programme were a "social interaction" model (through the "cascade") in respect of its training role, but a "research, development and diffusion" model in relation to the dissemination of software. Much of the software was produced by teachers, and that for which the production was sub-contracted to software houses had a large number of teachers involved at the design stage. The rhetoric of the MEP is that its software has been "designed for teachers by teachers", but the programs were produced very much according to the assumptions embedded in the research, development and diffusion model. Once an item of software had been produced it was diffused to teachers on a "take it or leave it" basis; if the software needed to be modified to meet a particular teacher's scheme of work that typically required the involvement of the technical expert within the school. But the aim, and the attainment, was the production of a large amount of software (a total of approximately 1,000 different titles) so that teachers individually could choose the programs which they would use from that range.

2.2.4.2 Department of Trade and Industry

In parallel with the work of the MEP in the production and dissemination of software has been a programme - the "Micros in Schools" scheme - introduced by the then Department of Industry (now the Department of Trade and Industry) to assist schools in the purchase of hardware. This initiative, funded originally to the extent of £5 million has, by assisting in the purchase of one microcomputer for each secondary school provided hands-on experience amounting to an average of only about 3 minutes per pupil per week in an average sized secondary school. But again, the initiative was a pump-priming exercise and must be interpreted in that light.

The involvement of the Department of Trade and Industry in this scheme is but one manifestation of the increasing involvement of government departments other than the Department of Education and Science in education. The Manpower Services Commission (MSC), which reports not to the Secretary of State for Education and Science but to the Secretary of State for Employment, has since the start of the decade been increasingly influential firstly in further education and subsequently in the secondary schools sector. The funds with which the MSC is able to support particular developments in educational and training provision (e.g. the Technical and Vocational Education Initiative and the Youth Training Scheme) are particularly significant when the funds provided to educational institutions through the normal LEA route are diminishing in real terms. The role of microcomputers and information technology have been stressed in the developments which the MSC has sponsored.

The direct involvement of the MSC and the significance of the extent of its funding has been seen in some quarters (for example, by one of the MSC commissioners, Pearman, 1986) as a further diminution of the control of education from within the system itself. The means by which resources are allocated is a prime mechanism of control within the education system, as elsewhere. The 1976 House of Commons Expenditure Committee expressed concern about the apparent lack of control which the DES had of how money was spent, as education, like other local authority services, is funded on a block-grant rather than a specific-grant basis. Although more recent attempts to remove block-grant funding have not come to fruition, the specific project funding arrangements via the Manpower Services Commission, the Department of Trade and Industry and the Microelectronics Education Programme are clearly significant in terms of the control of education development by direct funding.

2.2.4.3 Curriculum and examination review bodies

The establishment of the Schools Council for the Curriculum and Examinations in the mid-1960s institutionalised the influence of teachers in the direct determination of the curriculum and its influence indirectly via the examination system, which had long been recognised as a powerful determinant of the curriculum and hence a major influence on the processual activities of schools. One of the major activities of the Schools Council was the development and dissemination of curricular packages, including computer-assisted learning materials relating to half-a-dozen secondary school subjects.

The prime role of professionals in the determination of both the content and the delivery of the curriculum has been a central tenet of the teachers' unions and associations. This was institutionalised by the dominance of teacher representatives via union nominations in the convocation and committees of the Schools Council; teacher control of the curriculum was considerably facilitated by their power in the Schools Council.

The replacement of the Schools Council in 1983 by two bodies, with the Schools Curriculum Development Council responsible for the curriculum and the Secondary Examinations Council for examinations, and the diminished representation of teachers on each body is but one manifestation of the increasing centralisation of the education system.

The requirement, in DES Circular 6/81, that each LEA review its policy for the school curriculum has been interpreted as a method of ensuring that the freedom of individual schools to determine their own curricula is reduced, that the curriculum is too important to be left to the teachers, and that the LEA and school governors should become more active in that context. Lawton recalls that "when there was no controversy about the content of the curriculum, there was no argument about its control" (Lawton, 1980, p1) and suggests that:

"We are witnessing a quiet struggle for control and influence. One interesting feature of the struggle and the changing scene is the shift in the dominant metaphor from partnership to accountability. Partnership indicates satisfaction and trust; accountability dissatisfaction and distrust" (Lawton, 1980, p12).

That feature, identified by Lawton at the start of the decade, has continued. More recently, Ball has asserted that on a micropolitical scale also:

"What is going on is conflict over the definition of the school, what kind of schools they are going to be, and struggle over who is going to control these definitions, over the locus of power to define (Ball, 1987, p251).

There is no assumption that local autonomy has disappeared; rather, that the area of discretion has been reduced and some choices pre-empted. Dale (1979) encapsulates that change in describing a shift from "licensed autonomy", in which "an implicit licence was granted which was renewable on the meeting of certain conditions" (p100), to "regulated autonomy" through "codification and monitoring of processes and practices previously left to teachers' professional judgement" (p104).

The move towards greater centralisation may have been compounded by the effects of contraction in the education system as pupil numbers have fallen by about 30% from their peak in 1977. That reduction in pupil numbers has been met by a reduced requirement for teachers, and as it occurred at a time of both an increased output of qualified teachers from the higher education sector and a labour market in which it was increasingly difficult for those qualified as teachers to move into other occupations, this resulted in a corresponding reduction in teachers' expectations about career advancement, and their morale.

One frequent effect of contraction is increasing centralisation of decision making.

It has been suggested that:

"The loss of autonomy means not only the surrender of power to the external controller but also significant changes within the structure of the organisation itself, no matter what its intrinsic needs - more power concentrated at its strategic apex, tighter personnel procedures, more standardisation of work processes, more formal communication, more regulated reporting, more planning and less adapting. In other words, centralisation of power at the societal level leads to centralisation of power at the organisational level, and to bureaucratisation in the use of that power" (Mintzberg, 1979, p291).

The discussion above has deliberately moved from the static picture given by an emphasis on the structure and governance of the British education system to the more dynamic view of recent changes in its operation. The development of that discussion is now continued by identifying the characteristics of schools which are particularly significant in respect of the adoption of innovations.

2.2.5 Organisational characteristics of schools

A number of organisational features characterise schools. While there is no single defining characteristic of schools and each characteristic is not unique to schools, in aggregate they form a distinctive collection of features which is unique. Among the most important of them are:

(1) Goal diffuseness: The organisational mission of schools is multiple and diffuse. The developmental functions of schools (both the development of cognitive skills and knowledge, and the development of social skills) and the integrative function (socialisation into familial, societal and perhaps occupational roles) are frequently cited; less frequently cited, though recognised, is the custodial role. Further, the extent of achievement of many of the goals is difficult to measure, at least partly because of the long time spans involved. Not only are the goals diffuse, the ideological diversity within schools and externally in those who influence the education system results in them being also contested, particularly in respect of the reproduction or changing of an existing social order. The difficulties of measurement and prioritisation of frequently divergent goals result in educational objectives being stated, according to a former Permanent Secretary at the DES, in terms that are "as wide as a church door ... or as narrow as the eye of a needle" (Pile, 1974, p18). It is a truism that when goals are not stated and agreed upon the potential for political activity is greater.

And the obscurity and complexity of organisational goals results in it being possible to present many different, indeed in some cases diametrically opposed, policies as being consistent with organisational goals and mission.

(2) Unclear technology: Not only are goals diffuse, blurred and contested, but means-ends relationships are not well understood. In that sense the technology of the organisation is unclear, the predictability of outcomes is poor and there are high levels of performance ambiguity. Because the knowledge base underlying educational practice is relatively weak and the link between instrumental means and terminal ends is unclear very different policies can be presented as organisationally valid.

(3) Low technology: Schools are labour-intensive low technology organisations. Indeed, they have been described as the last remaining handicraft industry (Coombs, 1985). Hawkridge (1982) contrasts the capital investment of $1,500 per job in schools with that of $25,000 for an industrial worker and $60,000 for an agricultural worker. Approximately 70% of the recurrent costs of a school are salary costs with the remainder being accommodation costs rather than that of the technology. The technology within schools, in both its narrow and wider meanings, has changed little. As one chief education officer stated: "if you had woken up after a hundred years there is only one place where you would feel at home - the secondary school" (Brighouse, 1983, p324). That low technology has been associated with the delivery of formal education at pre-determined locations, during fixed hours, and based on an annual cycle with a starting point at one particular time of the year. That inflexibility is potentially challenged by new technology. And insofar as an organisation embodies the culture of the technology which it uses, the technological base of schools has considerable implications for the acceptance of and effects of changes in that technology.

(4) Loose coupling: Although schools superficially have some of the characteristics of a bureaucracy (for example, there is a functional division of labour and the specialisation of work, an organisational structure which is at least partly hierarchical, and there are numerous policies, rules and procedures) they are perhaps more accurately classified by Mintzberg's (1979) term of "adhocracies". The allegedly bureaucratic features of schools are possibly assumed rather than manifest. Schools are structurally compartmentalised polycentric organisations with the traditions of departmentalism and departmental competition remaining strong, with only weak articulation between subunits. They have at least some of the characteristics of

holding companies rather than unitary organisations in terms of the relationship between departments and the school as a whole. Further, the teachers' autonomy "behind the closed door of the classroom" is deeply rooted, and collegial controls over tasks are weak, and ideologically of low salience. That loose coupling applies both within schools and between schools or between a school and its superordinate bodies. The subunits are enucleated and relatively independent and may respond to the environment separately and in an uncoordinated way so that actions taken in one subunit have relatively little effect, or are slow to affect, others. Organisationally, schools have more in common with "jobbing shop" methods of production rather than with integrated continuous process industries. The image, according to Weick, who developed the concept of loose coupling indeed within the education sector, is that of "numerous clusters of events that are tightly coupled within and loosely coupled between" (Weick, 1976, p14). That is exacerbated by "role performance invisibility" (Miles, 1975) with the teachers' prime task being only rarely observed by their colleagues or superordinates. So schools are, at least to some extent, confederations of subunits (teachers in classrooms) with considerable autonomy to respond to unique events, rather than unitary organisations. That structural looseness and distributed control inevitably has profound implications for the adoption of innovations, especially those which were identified above as "encumbered" innovations which cut across subunit boundaries.

(5) Common orientation of managers and workers: The "managers" of the schools (headteachers and other senior staff) have almost without exception been promoted from within the ranks of the "workers" (the teachers) within a long-established occupational internal labour market. That enables the headteacher to make claims about leadership grounded in experience of the core organisational activities in a way which is not always available in other organisations (though we shall see later the considerable organisational consequences of information technology being an innovation of a qualitatively different kind from most other curriculum innovations with which headteachers deal). Further, the common experience of both teachers and headteachers of the "shopfloor" (the classroom) results in a high value being placed on collegiality and shared assumptions, the obfuscation of ideological differences and the suppression of dissonance. It also assists in legitimising demands by teachers for their involvement in organisational decision making relating not only to the classroom but also to the school as a whole.

(6) Client relationships: Schools are people-processing rather than product-processing organisations, client-oriented rather than profit-seeking. But they have not a single client but multiple clients - pupils, parents, employers, society - each with different objectives and expectations. That, of course, is a major reason for the goal diffuseness addressed above. There is a further ambiguity about the relationship with a major (conscripted!) client - the pupils. Handy and Aitken (1986) starkly identify views of the relationship of the pupil to the school as an organisation as, alternatively (a) a worker who is a member of the organisation and cooperates in a joint endeavour, (b) a client who is a beneficiary of the organisation and is served by the endeavour, and (c) a product which is shaped and developed by the organisation. The purposes for which microcomputers are used can be very different depending on which of the assumptions about relationships with pupils dominates.

(7) Vulnerability to multiple influences: Schools are plural organisations which have a distributed control structure and are subject to multiple influences from within and from a wide range of external organisations. Although constitutionally they are politically controlled, the influences locally and nationally through the LEAs and the DES were identified above as including also those of bureaucrats and professionals as well as politicians. Further, there are a wide variety of advisory bodies and formal and informal pressure groups of various kinds. Schools are therefore vulnerable to a variety of stakeholders. And because they are dependent on others for resources, particularly for financial resources, Sieber (1975) characterises schools as being "subjugated to their environment" and identifies a consequence of that vulnerability as being the adoption of those innovations which are promoted by key stakeholders, to the extent that political feasibility may carry greater weight than educational value in determining the adoption of certain innovations. That subjugation to the environment is reflected in the literature on educational administration, according to Bumbarger and Thiemann (1972, p3) in the assumption "that resource levels are to be largely taken as givens, operating as constraints within which the administrator must work". That assumption is not shared here. Rather, an alternative assumption is made that managing resource acquisition, to obtain both real and symbolic resources, becomes a critical organisational activity. Jacobs (1974) identified five points at which organisations are dependent on their environments: for input acquisition, output disposal, capital acquisition, acquisition of production factors and the acquisition of a labour force. Schools are dependent at most of those interfaces on two specific external agencies

- directly on LEAs, and indirectly on central government - so exchange relationships and resource dependency relationships with those two stakeholders become particularly important. Building on the work of Emerson (1962) and Blau (1964), Jacobs (1974) analysed the dependency relationships of organisations whose technology is inexact, whose results are not easily assessed, for whose products there is no market mechanism, and for which "dependencies are therefore controlled by a process of indirect exchange". In such cases, where an organisation receives resources "in order to meet a dependency through indirect exchange relationships, the fewer the number of potential donors there are for the good or service, and the more essential that good or service is to the organisation, the more problematic that dependency relationship will be for the organisation" (Jacobs, 1974, p51).

The control of the uncertainty surrounding resource acquisition and the managing of those dependency relationships are therefore crucial. That assumption, leading to what, in a different organisational context, Benson(1975) refers to as the importance of "the acquisition and defense of an adequate supply of resources" is one of the pillars on which the conceptual model in the next chapter is built.

Although schools do not generate their own financial resources and are therefore dependent on influencing external agencies for the acquisition of resources, once such resources are received the goal diffuseness, blurred means-ends relationships and distributed control systems results, in the absence of a market mechanism, in considerable discretion in their utilisation. That requires, in the study of innovation in such an organisational context, a central focus on organisational decision making processes; that in turn implies that the real and intangible resources, and the strategies discussed in section 2.1 which organisational members use to influence such decision processes are critical. That provides a second pillar of the conceptual model.

In relation to the innovation of educational computing specifically the vulnerability to the environment is only one of a range of pressures - social, political, technological and educational - affecting the innovation. Some of those pressures originate from within schools themselves. Importantly, many of them emanate from outside the education system. It is timely at this point to enumerate the range of such pressures and factors affecting the uptake of microcomputers within schools.

2.3 Microcomputers in schools as an innovation

The organisational characteristics of schools discussed in the last section are relevant to a range of innovations. In respect specifically of the innovation of microcomputers there are a number of pressures for adoption of the technology, both from within schools and external to them, which significantly influence to the uses to which that technology is put. It is widely known that microelectronic technology has fallen in price rapidly in recent years. Without that price reduction the microelectronics issue would not be as prominent on the educational agenda. But the economics of the technology is by no means the sole explanation of its pervasiveness in schools. The uses to which the technology can be put in schools, and the way in which those uses are determined by the internal and external pressures which are influential on its adoption, are the focus of this section.

2.3.1 Pressures for the adoption of microelectronics in schools

There are a range of different political, educational and technological pressures acting on schools, from different sources and with different motives and objectives, but all encouraging the adoption of microelectronics in schools. They represent what would be referred to within a force field analysis, as the driving forces promoting change. Among the most influential of those driving forces are:

(1) Demands for technological literacy

There have been increasing demands, especially from those employers who perceive the organisational culture of schools to be fostering an anti-industrial and anti-technological ethos in pupils, that the work of educational establishments should be more closely aligned with the needs of industry, and particularly that students should be more technologically literate. Such demands are not new; accounts of the history of education show them recurring frequently. They emerged particularly forcibly following the Soviet launch of Sputnik in 1957. But they have intensified recently. The relatively poor performance of the British economy since the last war has been blamed in some quarters on the schools being insufficiently concerned with industrial and commercial matters, inadequately articulated with the needs of the economy, and that economic performance is used as a justification for demands for the greater technological-orientation of the school curriculum. Such demands are not universally welcomed. One criticism of the influence of a technocratic ideology for example, is that:

"Computer literacy now joins the curriculum, not with the aim of producing citizens informed enough to take part in techno-social decision making, but as functional training to feed the short term need for programmers in industry" (Taylor, 1983, p8).

Narrow instrumental economic expediency is juxtaposed with demands for an increased emphasis on "education for enterprise" and "technological capability", based on arguments which are often couched in the language of education as an investment rather than as consumption.

Such demands were reflected in announcing the Department of Trade and Industry's "Micros in Schools" scheme, the importance of which was reflected in its being launched personally by the Prime Minister:

"Britain's greatest natural asset has always been the inventive genius of our people. This is the asset which we must tap if we are to profit from advances in technology. In microelectronics and information technology, we must do everything to encourage and train people with the ability and skills needed to design systems, write software and develop new businesses and products. We must start in our schools. The microcomputer is the basic tool of information technology. The sooner children become familiar with its enormous potential the better." (Thatcher, 1982, p1)

Such reasons for developing educational computing are but one further manifestation of a move from a predominantly liberal to an increasingly technically-based education. The Technical and Vocational Education Initiative (TVEI) for the 14-18 age range, developed by the Manpower Services Commission, is a further example of that trend.

There is by no means universal acceptance within the education system of the view that schools should become more responsive to the needs of employers. Indeed, the position that "schools should not be in business to produce industrial fodder" is translated in some quarters into demands for an increasing emphasis on non-work-related education, given the realistic expectations of many pupils of unemployment following leaving school, notwithstanding the variety of MSC provision.

(2) Parental pressures

At a time of high unemployment of school leavers, the demands of industrialists for job-relevant education are supported by many parents who see vocational skills, including computing, as instrumentally beneficial in terms of the future employment prospects of their children. The large number of microcomputers in homes in Britain, which has the highest saturation of home personal computers in the world (Linn, 1985), provides indirect evidence of that parental concern. Further evidence is based on the funds which parents have provided, often through Parent-Teacher Associations, for the acquisition of computer hardware in a number of schools. A recent survey of that funding (Department of Education and Science, 1986) found that computers were ranked second, after educational visits, of nine items towards which parental contributions were directed; and Carter (1982) identifies PTAs as "a school's best friend" in the acquisition of computer resources. That source of funds has implications for the way in which computer resources are used within schools, which is discussed in section 2.7 below. Particularly, such funds may come packaged with an expectation that the equipment purchased will be used for the benefit of all pupils in the school rather than merely some of them.

As the total number of pupils has diminished, to the extent that a number of schools have been closed, and parents have an increased choice in determining the school which their child will attend as a result of the 1980 Education Act, the need for schools either to "keep up with the Joneses" or to obtain a competitive advantage has increased, and many have adopted a more pronounced market orientation. The previous insulation of schools from such pressures results in their market-orientation being a sensitive issue to staff. Against such a background, the marketing significance of microcomputer use is two-fold: it can be seen as instrumental with respect to employment prospects; and although the days are past when the acquisition of a computer could guarantee the school half a page of good publicity in the local newspaper, the use of such technology can still be presented as an example of the progressive character of a particular school, and assist in providing a competitive advantage. As Ingersoll and Smith (1984, p8) claim from a study in the United States: "computers are mentioned by all concerned as one of the most important ways that schools can improve their reputation".

(3) Pupils' expectations

As more pupils become familiar with microcomputers in the home and elsewhere, an expectation develops that teachers will use microcomputer technology confidently and appropriately in the teaching context. Conversely, if teachers do not use the technology in those ways they risk a loss of credibility with pupils who have increasingly questioned the relevance of education as youth unemployment has increased; and in the absence of the incorporation of new technology into the learning process pupils may perceive the gap between the school and the world outside as increasing rather than diminishing. Such expectations that teachers will utilise new technology, and the confidence with which some pupils use it, can be particularly threatening to those teachers who operate with the model of education that teachers are knowledgeable and skillful and pupils are not, and that the function of teaching is to transfer knowledge and skills from teacher to pupil.

(4) Demands for increased accountability

The increasing influence of employers and parents are facets of the move in education towards greater accountability to client groups, including accountability to pupils, who are increasingly questioning the relevance of education given the current level of youth unemployment. In a more narrowly bureaucratic interpretation of accountability, the stewardship function is also becoming more significant, particularly with the incorporation into the 1987 Education Bill of the devolution of budgetary autonomy to schools, which are then required to account for the disposition of their resources, especially financial resources, and to report in more detail on their activities. The use of microcomputers in school administration can be part of a response to such accountability requirements.

(5) Demands for increased efficiency

As the financial resources available to educational institutions diminish and the relative prices of the factors of production change, the efficiency with which the available resources are used increases in importance. During the downturn of a financial cycle innovations are frequently directed towards rationalisation, cost reduction and increased efficiency. The "cost imperative" within the education system currently gives efficiency and rationalisation issues a high profile, particularly at the present time of low public support for schools. Given that salary costs in education account for approximately 70% of expenditure, and labour costs are rising while those of technology are falling both absolutely and relatively, efficiency and cost pressures bear directly on labour costs and the utilisation of staff, and means of reducing labour costs and increasing the intensity and flexibility of labour utilisation become more central. Those pressures may be difficult to resist. As Whiston *et al* say:

"since the educational expansion of the 1950s and 1960s is now contained and reversed, then if real cost savings can be demonstrated by such [educational technology] system provision, arguments for wider application may be considerably more forceful, irrespective of the potential social and control problems which may be attendant with these techniques." (Whiston *et al*, 1980, p17)

That certainly applies to the administrative work of schools, both that performed by clerical staff and the administrative content of the jobs of teachers, headteachers and other senior staff, where the use of microcomputers can be expected to improve the efficiency with which existing tasks are performed. The administrative complexity of schools has increased with the extra burdens imposed by various educational and other legislation. And there is no doubt that the administration of comprehensive schools, with their curricular diversity, is more complex than that of their grammar and secondary modern predecessors. Such increasing administrative complexity and cost results in issues of administrative efficiency being of increased importance.

If teaching is viewed as a technological production function for which new technology can change the mix of inputs used to produce a given set of outputs, the same assumptions can apply and lead to the expectation that the use of computer-assisted learning can increase productivity and efficiency by producing the same outcomes with the use of fewer teachers in a school (essentially viewing teachers as a variable cost rather than an overhead); or that the same number of teachers can enable a increased amount of learning. Papert (1979) has calculated that a "substantial" provision of computer resources would consume about 5% of existing educational costs, so a saving of more than that amount on other factors (for example, by increasing class size by more than 5%) would result in a net saving. The educational production function is highly labour-intensive, and the partial replacement of teachers by other factors of production, or the more efficient utilisation of teachers, offers substantial efficiency attractions.

There is a general agreement that microcomputers can take over some of the teachers' more routine tasks, such as drill and practice in teaching, and record keeping in administration. What there is not agreement on is what may happen to the time released. Some, especially trade unions and "educators", see this as liberating and enabling teachers to spend more time on their prime teaching activity; others, though rarely stating it explicitly, may see this as a means to achieve the same outputs from a school by the use of fewer teachers.

(6) Assumptions of increased effectiveness

A rather different view, which receives greater support from teaching staff, is that the main justification for the use of computers is that they can be used to produce educational experiences which would be difficult or impossible to achieve without their use, and can therefore be the vehicle for the transition from one pedagogical archetype to another. Papert (1980) for example, argues that microcomputers can be used to generate new ways of thinking in pupils as they can encourage individuals to control their environments via the exploration of non-structured problems rather than react to their environments by encountering structured problems at the initiative of the teacher. The desire to move from dependence to independence in learning has for long been an educational vision. As Papert states:

"my attitude towards Illich extends to many other educational visionaries. Dewey, Montessori, Neill all propose to educate children in a spirit that I see as fundamentally correct but that fails for lack of a technological basis. The computer now provides it; it is time to reassess the practical possibilities for instituting what previous generations have dismissed as romantic." (Papert, 1979, p85)

Many educational technologists and teachers would agree with Papert and regret that much of the use made of computers in schools is trivial and fails to exploit their educational potential, either in relation to individual pupils' learning methods or as a way of organising schooling. The pressure from that constituency for an extended and enhanced use of microcomputers in schools is based almost entirely on claims of the increased effectiveness of the learning process.

(7) Technological push from technical experts

Pettigrew (1973a) documented a strategy used by technical experts (in his case computer experts) of promoting technical solutions to problems as a means of increasing the power base of those individuals with relevant technical expertise.

It might be expected that similar strategies would be used within schools and that individuals with computing expertise might argue for the increased use of computers within the classroom and in the administrative system. Similarly, within administration particularly, individuals without such expertise who have traditionally controlled administrative systems might be expected to resist such changes.

(8) Marketing policies of microcomputer equipment manufacturers and suppliers

Suppliers of microcomputer equipment and software clearly have an interest in promoting the use of microcomputers in the education system. The market is large even though it is yet immature; twenty medium-sized microcomputers in each secondary school and college department, and four in each primary school is a market of well in excess of £200 million. One manufacturer alone (Acorn) has sold in excess of 250,000 BBC microcomputers to the education market in the last five years. And beyond the direct sales there are two further benefits of the education market to manufacturers: the adoption of a particular model of microcomputer in school enhances the sales of that model to homes, where parents purchasing a microcomputer will prefer one which is identical or at least compatible with those in the school; and the familiarity of school-leavers with a particular machine may subsequently be of benefit as they move into employment and eventually affect purchasing decisions. Enlightened self-interest rather than altruism and philanthropy clearly underlies the heavily discounted prices at which microcomputers have entered the education system. Manufacturers have been keen and successful in underlining the technological imperative by using rigorous marketing to build a mystique and momentum and generate a bandwagon which teachers and parents may feel they need to be on. Government, through the Department of Trade and Industry's "Micros in Schools" scheme is clearly keen to use the education market to assist the British microcomputer industry in a way which is reminiscent of public sector purchasing policy of mainframe computers in the 1960's and early 1970's. The DTI scheme applies only in respect of British microcomputers, produced by companies such as Acorn which were relatively small when the scheme was announced and which could use the educational market as a springboard to expansion. A leader in the *Times Educational Supplement* has referred to:

"the Department of Industry's proper determination to boost the British microcomputer industry by getting microcomputers into every school"(*Times Educational Supplement*, 1983, p2).

More cynically:

"Rushing government-subsidised British micros into every school, largely untested and before good quality software and training are available, is a policy influenced not just by long term skills needs, but by the short term needs of the UK micro industry for a slice of the potentially lucrative education market" (Taylor, 1983, p8).

Taken separately, each of those pressures has important, even if different, implications for the adoption of microcomputers in and by schools. In aggregate they have been material in leading to the range of uses discussed in the next section.

2.3.2 Uses of microcomputers in schools

As a meta-technology, computers could be used in schools in a variety of ways for a variety of purposes. There is a wide measure of agreement in the educational community that computers are important. The agreement, however, ends there. The deployment of computer resources amongst the range of potential applications, and the processes by which those deployment decisions are reached, are therefore of central importance.

There are two main types of use of microcomputers in schools: use for instructional purposes and use for administration. Within the instructional domain, a further distinction is that between teaching about computers (for example by introductory computer appreciation courses or computer studies courses leading to external examinations) and teaching with computers in various areas of the curriculum.

The innovation has assisted the emergence of a relatively new subject - computer studies - which has been the most rapidly growing subject in terms of entries to GCE and CSE examinations. But even within the area of computers as content of the curriculum there is pressure from some sources not to limit the use of the resource to an elite who will take external examinations in computer studies. Particularly where funds have been provided by Parent-Teacher Associations or other community sources, the equity principle is sometimes invoked in favour of the provision of non-examinable computer awareness programmes for all pupils.

There is a positive feedback loop in the relationship between the acquisition of computer resources and the provision of courses of which computers are the content. The provision of such courses creates demands for the technology which is being studied, and the availability of the technology itself can be used to justify the provision of such courses, creating a self-fuelling set of demands.

The educational computing literature generates a plethora of computer-assisted learning case studies ranging from the obvious applications in the mathematical and physical sciences through the life and social sciences to languages, history, music and home economics. The use of computer-assisted learning, because it affects many areas of the curriculum is likely to raise more issues for the institution as a whole than is the introduction or growth of the separate subject of computer studies. Computer assisted learning may be advocated or introduced with the intention of producing more active learning, individualised learning and a richer learning environment, with the intention that the existing curriculum is delivered in qualitatively different ways and, frequently, that the "medium changes the message". The latter objective is often associated with an educational vision with prominent and explicit values, as reflected in "the organisation of a society in which knowledge is a commodity to be shared with others, rather than transmitted through a downward hierarchy" (Adams and Jones, 1983, p119). Computer-assisted learning can be classified further into uses such as drill and practice and individual tutorials, where although instruction may be individualised rather than group-based, the dominant mode is teacher-centred with Skinnerian operant conditioning (the computer teaching the pupil); or use for problem solving and simulation where the aim is learning enrichment and perhaps a movement away from the dependency model of education, and the mode is more explicitly learner-based (the pupil learning from the computer).

The use of computers in individualising learning is frequently cited. Where that simply means that individual pupils have sequential access to a program conducting a pre-defined process the effects of that use on the organisation of the learning process are likely to be minimal. But where individualising instruction involves the use of software (of which type there is yet little) which takes into account individual pupils' strengths and weaknesses, the effects of that mode of learning may be considerable, not only for the pupil but also on the labour process of teachers, by addressing the aspect of indeterminacy - individual pupils' needs - which is at the heart of the teachers' craft.

That range of possible applications is considerable. Some of them are, in principle, simple and are concerned with increasing the efficiency or effectiveness of teaching particular topics within an existing curriculum and with existing objectives (essentially an unencumbered innovation). Others are more complex and may involve challenging the basic structural element of departmentalism in school organisation and/or the role of the teacher, and will therefore require consensus, or at least coordination, across the body of teachers in the school (clearly, an encumbered innovation). That immediately raises questions about priorities. It also elevates the importance of the otherwise more trivial and routine question of "for what applications are computers being used in schools?"

Within the administrative area, case studies from the educational computing journals illustrate use in a range of applications, the most frequently reported being timetabling and associated option choice schedules, word processing and the use of databases, commonly student record databases, for the production and aggregation of information about individuals and groups within the institution and for external reporting. Again, the alternative uses for teaching and for administrative purposes, or both, raises questions about priorities and the organisational processes through which those priorities emerge.

Although there have been a number of reports in the educational computer journals about the <u>content</u> of educational computing innovations, those reports have concentrated primarily on descriptions of the technology used and of the systems operated; there has been a neglect of the <u>process</u> by which such innovations were introduced. There has been a neglect also of the <u>effects</u> of such innovations. For that reason the final section of this chapter makes use of literature only from studies other than in the education sector of the effects of microelectronics.

2.4 <u>The effects of technological change</u>

In the literature addressing the effects of technological change two different means of addressing the intentionality of change effects can be discerned. In viewing technological change from either a political or a control perspective there is usually little disagreement about the intended consequences of the change, though different parties may not agree about the desirability of such consequences. But effects are rarely exclusively intended effects: intention and achievement have frequently diverged. A systems perspective, and particularly a socio-technical systems perspective focusses not only on the designed effects of change but also on those which are unintentional, indirect, delayed, and possibly dysfunctional. That can be a particularly helpful perspective in analysing the effects of a pervasive technologies, such as microelectronics, which typically have pervasive and unanticipated effects also. The underlying assumption within a socio-technical systems perspective is that organisations can be viewed as systems comprising a variety of interacting sub-systems such that a change in any one of the sub-systems will potentially result in changes in all of the others. One formulation of that view was put forward by Leavitt *et al* (1973) in viewing an organisation in terms of four major sub-systems: task, people and how they carry out tasks, structure and technology. The assumption is that a change in technology (for example from the use of a manual administrative system or a "chalk and talk" method of teaching to the use of a computer) will result in changes in the tasks to be carried out, the way they are organised, and the structure of the organisation. That perspective derives from and is supported by the theoretical and empirical work some time ago of Emery and Trist (1960), Miller and Rice (1967), Trist and Bamforth (1951) and their colleagues at the Tavistock Institute and elsewhere. They criticise new systems which have been designed to optimise on technology alone and in which human sub-systems have been assumed to be compliant and have been either ignored or treated simply amelioratively. The assumption within a socio-technical systems perspective is that if an attempt is made to optimise on technology alone, there will be unintentional and dysfunctional consequences in other sub-systems. Davis (1971) suggests that:

"This leads to the central concept of joint optimisation, which states that when achievement of an objective depends on independent but correlated systems, such as technological and social systems, it is impossible to optimise for overall performance without seeking to optimise these correlative systems jointly" (Davis, 1971, p167).

The introduction of new technology has commonly had significant organisational impacts. Of particular interest in relation to this study are the effects on the labour process, which will be discussed first, and on organisational structures.

2.4.1 The effects of technological change on the labour process

The effects on the labour process of a wide variety of technological changes have been reported in the literature. Two major foci are prominent. First, the effects of technological change on the level of employment through the creation of new jobs, and the elimination of existing jobs; and, secondly, the effects on the balance of skills through changes in existing jobs, and the net effect on skill requirements of changes in job numbers. Both of those affect, and are in turn affected by, processes of job regulation.

Several studies, including those of Sleigh *et al* (1979) and Barron and Curnow (1979), have addressed the effects of new technology on aggregate employment levels. The ratchet mechanism has been advanced (for example by Stonier, 1983) to explain the phenomenon of jobless growth in periods of economic expansion with the use of redundancies during recessions.

The effects of technological and other changes on aggregate employment are differentially distributed across different sectors of the economy. Despite the empirical econometric problems of disentangling structural from cyclical unemployment, there is a wide agreement that, in respect of the information sector, productivity increases resulting from the widespread use of information technology could substantially reduce total employment levels unless there is a considerable increase in the volume of activity within that sector. Handy (1984a) cites data from the University of Warwick Institute for Employment Research forecasting between 1980 and 1990 a net loss of 42,000 jobs from the education professions, broadly defined according to the Warwick occupational categories.

An equally important area of concern in the literature, and of direct concern here, is the impact of technology on the content of jobs. The work of an individual can be affected in one or both of two ways by technological changes; it can affect directly the tasks which that person carries out or it can affect indirectly his activities by affecting directly those of the people for whom he is responsible or with whom he works. And those direct or indirect effects can concern the whole of a person's job or only a part of it.

The effects are not homogeneous throughout an organisation; different groups have different subjective experiences of new technology. An organisation can be viewed as being segmented or differentiated with respect to jobs both vertically and horizontally; the effects of technological change have been found to be very different in different vertical and horizontal segments of the organisation.

The effects of technological change on jobs are different depending on the prescribed or discretionary content of the job, in Jacques' (1967) terms (or whether the tasks are of low or high discretion in Fox's (1974) classification). Technological change has typically affected low discretion jobs more substantially, and earlier, than those of high discretion, though the technology can be used to replace what were previously discretionary tasks by prescribed ones. Similarly, new technology has been found to affect jobs differently depending on the degree of their structuring, with substantial effects being manifest on jobs which are highly structured and therefore potentially programmable, and correspondingly less impact on jobs which are unstructured and deal with a high proportion of non-routine events.

The discretionary-prescribed and structured-unstructured distinctions may be related to that of core and peripheral tasks. In a number of organisations the core tasks and jobs have a high discretionary element whereas peripheral tasks and jobs are more highly prescribed and structured. New technology may be used in respect of the peripheral tasks in such cases to attempt further to minimise the dependence of the organisation on the individual. The use of computer technology specifically is particularly significant in relation to the distinction between peripheral and central tasks as it is typically used initially by organisations for the background peripheral tasks (the use of computers for payroll, stock records, ledgers and other bookkeeping work are classic examples) and subsequently impinges on the foreground or central tasks (such as for use in planning by financial modelling, to take the accountancy example further).

Because many organisations have introduced new technology first in respect of peripheral jobs, many of the research studies and theoretical analyses have concentrated upon such jobs, including many which are jobs at the point of production or delivery of service. Amongst the effects identified are declining manning levels (Rothwell and Zegveld, 1979), alienation (Blauner, 1964; Emery, 1959), fragmentation, polarisation of skills and de-skilling (d'Iribarne, 1981) within a process of proletarianisation. Although many of the early studies of the effects of technological change on the labour process concerned jobs which previously had low discretionary content, more recent work (Cooley, 1981; Smith, 1986; Whalley, 1986) has extended that analysis in considering the proletarianisation of jobs whose knowledge base had been assumed to protect them from such phenomena and where a competing, diametrically opposed, professionalisation thesis had been assumed. That analysis raises the dilemma faced by those intending to control the labour process of others. Direct control strategies used within a conflict paradigm are likely to lead to resistance and subversion and perhaps at most a pyrrhic victory, while cooptive consensual strategies based on professionalism carry different risks, of deflection, particularly in contexts in which objectives are not well defined and performance not easily measured.

A major theoretical framework which has been used extensively in analysing the effects of new technology on jobs, particularly on those at the point of production or delivery of service, and especially those in the private sector, is that of Marxism. It is not possible to do justice here to the extensive analysis carried out within a Marxist perspective. Yet it cannot be ignored as a framework through which an explanation has been developed to address the effects on the labour process of the adoption of new technology within capitalist organisations. That analysis has been extended within the alternative strands of the new middle class theories of Carchedi and Wright, and the new working class models of Gorz and Mallet. The conclusion within the former strand - that the white collar worker is increasingly in a contradictory position in being expected to subscribe to an ideology based on a "lost position" while his job becomes increasingly proletarianised - is certainly apposite. The starting point in analyses within a Marxist framework is the desire of capitalists to appropriate maximum surplus value from the production process. That valorisation is achieved by the separation of the conception from the execution of tasks, which enables their execution to be carried out, possibly with the utilisation of technology, at wage levels lower than would otherwise be required, with consequent increases in the surplus value realised. Technical progress is applied such that new or redefined jobs are designed to require only minimum qualifications and can be staffed with cheaper labour than pre-existing jobs, so the erosion of workers' control over the labour process results in its fragmentation and the proletarianisation of workers. Such an explanation can be applied to both productive and non-productive work within capitalist organisations. But little similar analysis has been applied to the labour process within the education sector. Although there is a considerable literature examining the education system from a Marxist perspective, the dominant, indeed perhaps the only, themes are those of the social stratification of life chances and, related to it, the education system as a means of the social reproduction of inequality and as a vehicle for supplying the labour force required by the capitalist system of production and distribution. The analysis has been concerned primarily with the production of labour rather than with the consumption of labour in that sectoral setting. The few writers in the Marxist tradition who have addressed the labour process in the education sector have adopted a model in which the public sector follows the lead of the private sector. For example Carchedi takes the view that:

"The teacher is not employed by capital (the production of services is production neither for nor of surplus value) and yet there is no difference between him and his colleagues working the same hours, under the same conditions, at the same pay, etc., in the privately owned school (capitalist and productive).... There is direct appropriation (this time on the part of the state rather than of the individual capitalist) of surplus labour so that the production process can be thought of as the unity of the labour process and of the surplus labour producing process. We can thus extend the concept of economic oppression to the employee of the non-capitalist state activity." (Carchedi, 1977, p132)

Although much of the analysis of the labour process effects in the Marxist tradition addresses a de-skilling dynamic and focusses on various modes of job impoverishment, empirical findings are not consistently pessimistic. Employers have the need, of course, to ensure that employees have the necessary skills to handle the inevitable variety of task, and frequently also have the desire to develop their personnel resources to gain the benefits or reduce possible detrimental effects by designing jobs which are intrinsically satisfying rather than not. That motive lies behind many of the schemes of job enlargement (increasing the range of tasks at a particular skill level), job enrichment (incorporating some tasks of a greater skill level) and job rotation (providing task variety at a particular skill level).

Job enlargement, however, may be a transitional rather than a permanent effect. Hedberg (1979) and Child and Loveridge (1981) distinguish between short-term and longer-term effects. They found short-term improvements in secretarial posts following the introduction of office automation but both put forward the possibility that in the longer-term the office labour force may become segmented into de-skilled keyboarding work for a large number of office workers and a smaller number of secretaries whose skill and responsibilities may be upgraded.

Although there are many reports of new technology being introduced to enable jobs to be de-skilled and fragmented into atomised tasks, those effects are not inevitable or the only ones manifest. Indeed, the technology can be used to combine previously isolated tasks, such as the merging of the editorial and the composing functions in the newspaper industry which Martin (1981) reports.

The distribution of task skills among different occupational categories may result in one group being de-skilled while another is re-skilled, or by an increase in the polyvalence of labour across previous task boundaries, particularly, as Loveridge (1983) discusses, in periods of significant discontinuity in work organisations caused by changes in technology.

Technological changes may represent significant discontinuities for some organisations or occupations but only gradual and incremental change in others. There are reasons for not expecting the major discontinuities found in some jobs resulting from new technology to apply to the same extent within the education sector. If one considers work in schools to be horizontally segmented into teaching and the supporting administrative and clerical work, the same expectations may apply in respect of both segments. The administrative, clerical and secretarial functions, while important, are not sufficiently voluminous or homogeneous to facilitate the easy fragmentation of such work. Because the technology will be used intermittently rather than continuously the effects may be less dramatic than in some other sectors.

Similar expectations may apply to the teaching function. Again, if the technology is used intermittently the effects may be less dramatic than in jobs in which it is used continuously. The thesis that technology can lead to the polarisation of skills might give rise to expectations of the introduction of teaching assistants supported by computer technology, with access to more highly qualified, experienced and senior teachers acting in a consultancy capacity. The teachers' unions have always been resolutely opposed to such developments and were successful in opposing their introduction when there was a serious shortage of teachers. Now that there is an over-abundance of teachers such opposition will be even stronger and one of the incentives for dilution correspondingly less.

There is little agreement about the effects of technological change on senior management jobs. It has been claimed by Mumford and Ward (1968) that the extensive use of information technology will be the first technological change to affect senior managers because it is the first technical change affecting the basic commodity with which senior managers deal - information. Indeed, Boreham (1983) identified the paradox that senior managers, who may previously have planned and implemented changes in information systems which have affected the labour process of their subordinates, may themselves now be the subject of change and be similarly affected. Much of the analysis of the effects of computer-based information systems on senior managers' jobs (for example, Eason, 1980) focusses on the anticipated or identified changes in their informational and decisional activities, rather than their inter-personal role, which is assumed to be only tangentially affected. A similar conclusion has been drawn from the use of a different taxonomy of managerial activities - that developed by Anthony (1965), who distinguished between strategic planning, management control, and operational control. Many jobs within organisations at levels other than at the first line will incorporate all three of those activities but in very different proportions, with the more senior posts having the larger strategic planning element and a relatively small emphasis on operational control. The conventional wisdom is that information technology affects primarily operational control rather than strategic activities, or at least does so at an earlier point in time. But there is little consensus in the literature about whether the effects of information technology on senior managers' jobs will be marginal or substantial. Kanter (1972) distinguishes between traditionalists who feel that senior managers will continue to operate with a high degree of independence from technology with a mode of operation which will be essentially unchanged, and futurists who feel that the availability of accurate, reliable, comprehensive and timely information via "predictive", "decision making" or "decision taking" information systems (Mason, 1975) will enable senior management to control the organisation to a greater extent. Such an analysis leads to a consideration of the effects of computers on organisational centralisation or decentralisation; that will be discussed below.

Discussion of the effects of technical change on middle managers tends to be derived from assumed impacts at senior management level, and demonstrates an equivalent lack of consistency. The claims have ranged from, at one extreme, that the computer will be to middle managers what the assembly line was to hourly paid workers, to, at the other extreme, the assumption that middle managers, like their superordinates, will be unaffected by the technology. Where the assumption has been that changes in information technology will lead to substantial changes in middle management roles the focus has commonly been on the supervisory aspect of middle management jobs. And where the assumption has been one of increasing control being vested at senior rather than middle management level, this has been associated with the view that the middle management role will lose some or all of its monitoring, evaluation and control aspects and be to that extent de-skilled. Conversely, the consultancy aspect of middle managers' jobs has sometimes been seen to increase in importance. It is significant in the school context that the middle management job has normally been seen in terms of team leadership rather than as a monitor and controller; to that extent information technology may be expected to have less significant impact on middle management roles in schools than in some industrial or commercial sectors. It is perhaps significant also, in the educational context, that a large proportion of people entering teaching have achieved middle management positions as their careers have progressed, or at least have expected to do so. The thesis developed in industrial contexts that technical changes can lead to job polarisation and diminished promotion opportunities may be expected to apply to a lesser extent in educational organisations than in some others but to change career patterns to a greater extent if it does apply.

Issues concerning the influence of new technology on the leadership and monitoring roles of middle managers are clearly relevant to the curricular use of that technology. Similar issues surface also in relation to its administrative use. Handy's (1984b, p35) claim that "a deputy head in many secondary schools is in fact a rather expensive and under-trained bursar" identifies one important step on the career path which has the potential to be substantially affected by new technology.

Much of the literature on the effects of changes in information systems on the labour process, particularly that dating from ten or fifteen years ago, has ignored or under-valued the design assumptions built into operational systems. The more recent literature has been influenced by the pioneering work of Mumford (1981; and Mumford and Weir, 1979) on how the values of system designers and their assumed, and often implicit, "models of man" have constrained the user-system interface. Such design assumptions can profoundly affect the way in which computer-based information systems are used, and consequently their effects on the labour process. Such considerations have significantly influenced the technological determinism debate, which is addressed in section 2.3.3 below.

The effects of new technology on the labour process can be thought of as the resultant of superordinate managerial intentions and individual or collective occupational strategies. The managerial intentions are likely to be different for jobs which are in the central core, where a responsible autonomy control strategy linked with a management development policy may be used, compared with those which are peripheral, where a direct control strategy, perhaps incorporating an element of de-skilling, may be more common, as discussed earlier.

But managerial intention by itself will not necessarily be translated directly into intended effects on the labour process. The resources which can be brought to bear by those whose jobs may potentially be affected are also of central concern. Those resources may be individual or collective.

A strategy which applies particularly to occupational groups rather than individuals has been developed from a formulation introduced by Jamous and Peloille (1970) based on the concepts of "indetermination" and "technicality". These concepts are of direct relevance in addressing the innovation studied here, though the concepts and vocabulary, and labour process analysis more widely, are notably absent from the education management literature. Technicality refers to the degree to which knowledge can be codified and is therefore, in principle, programmable. That concept clearly relates to Perrow's (1970) concern with organisational technology being affected substantially by the number of exceptional cases encountered within the work task and the processes by which those exceptions are dealt with. Indetermination refers to the aspects of professional knowledge which, in contrast, are not subject to codification and communication in the form of rules, and remain opaque to those outside the work group. That indetermination is a base upon which professional ideologies and legitimation are preserved. Jamous and Peloille suggested that the *ratio* of indetermination to technicality (the I/T ratio) is crucial, in that the higher the I/T ratio the greater will be the workers' potential for defending existing work practices. It is not at all clear, however, why the two variables of indetermination and technicality are linked via a ratio relationship specifically; a number of other linking relationships, such as $I>I_{critical}$ and $T<T_{critical}$ may be equally plausible.

The perceptions about indetermination and technicality, and of the occupational territory of which work groups can succeed in gaining acceptance, are of profound importance. The "social construction of reality" (Berger and Luckman, 1971) rather than an "objective" view of occupational task is central. The way in which senior medical practitioners have been able to use the ideological basis of their labour market position to preserve the perceived indeterminacy of task, and in turn to control the way in which new technology changes or does not change task performance, has been documented in case studies of the health sector reported by Child *et al* (1984) and Child (1985).

Those studies and others in the service sector by members of the Work Organisation Research Centre at Aston University have identified among the occupational characteristics influencing the effects of new technology on the labour process in the service sector:

(i) the preservation of an indeterminate occupational knowledge base of direct relevance in task execution;

(ii) the organisational position of the occupational group within the institution as it affects the decision making process in respect of the incorporation of new technology;

(iii) labour market conditions and the consequent position of the occupational group within what Althauser and Kalleberg (1981) refer to as the occupational labour market rather than the more specific organisational labour market.

In the latter context it is clearly relevant to this study that public confidence in teachers has recently diminished (and, indeed, recent criticisms from central government of teachers' "lack of professionalism" has fuelled that erosion of confidence). It is of significance also that, in contrast with most of the autonomous professions, teachers have consistently pressed for an increase in their numbers, the effects of which is adversely to affect the balance of supply and demand and further to undermine their labour market position, particularly, as at present, following reduced birth rates with consequently fewer people of school age.

Although a consideration of the labour process effects of new technology in sectors other than education and the labour market position of teachers are suggestive, it is necessary in generating hypotheses about the effects of new technology in schools, as will be addressed in Chapter 3, to take into account at least two significant contextual differences between the education sector and some others:

(i) the technology studied in industrial contexts is relatively complex and capital-intensive whereas that in schools is more simple and less expensive in both absolute terms and relative to other costs;

(ii) technology in industry is commonly used continuously and therefore affects the job for the whole of the time in which that job is being carried out whereas in schools it is more usually used intermittently and therefore affects the job for only part of the time.

2.4.2 The effects of technological change on organisational structure

A consideration of labour process effects of new technology leads naturally into a consideration of how individual work tasks inter-relate, how organisational tasks are differentiated and integrated, and how changes in technology can affect roles and role relationships, and also communication arrangements and workflows, and hence organisational structures.

A major conceptual framework within the organisation design literature relevant to such structural considerations is that of structural contingency theory. Some (for example, Burns and Stalker, 1966; Lawrence and Lorsch, 1967) view organisational structures normatively as contingent on the environment in which the organisation operates. Others (such as Woodward, 1965; Perrow, 1967) see technology as a major contingency. And yet others (e.g. Galbraith 1977; Uhlig *et al* 1979) view organisations as information processors and see structures essentially as functions of the ways in which information is processed. The latter two perspectives - of structures as contingent on technology or on information processing methods - have led to a number of studies investigating changes in organisational structures consequent on changes in computer-based information systems. The outcomes of such studies in aggregate, however, are far from clear.

There are essentially two different ways by which the introduction of computers may affect organisational structures. In both cases the structural changes can be confined either to the vertical distribution of control or its horizontal distribution (for example the emergence or cessation of a particular functional department, or changes in the relative influence of different functional departments), or both. First, the computer may, intentionally or unintentionally, affect job roles and the reasons and ways in which individuals and groups interact with each other, with changes in the formal structure following such changes in the operation of the organisation. Secondly, the opportunities offered by the computer to bring about radical changes in organisational structure (for example in changing from a hierarchical to a matrix structure) may be exploited. Lamb (1972) and Rowan (1982) suggest that the latter mechanism of change in structure is much less frequent than the former.

But there are two countervailing alternatives. Information systems may be used to prevent changes in organisational structures by enabling existing structures to operate more efficiently after they have ceased to be appropriate and therefore to freeze the organisation into an existing bureaucratic state, as Pitt and Smith (1984) describe in the public sector in the case of the Department of Health and Social Security. And secondly, the relationship of technology to structure is not unidirectional. The *ex ante* structure can affect the relative benefits of different technological alternatives (for example an organisation in which decision making is already dispersed may be better served by the use of distributed processing systems than by a stand-alone minicomputer).

The impact on organisational structure depends, of course, very much on the uses of the computer. Mumford and Ward (1968) distinguish between the automation of existing tasks which may be associated with very little structural change, and the use of integrated data processing systems where the structural consequences may be more extensive.

Although a number of the early studies of the introduction of mainframe computers (for example Whisler, 1970; Brink, 1971) identified extensive, if contradictory, effects on structure, the more recent studies of the introduction of microelectronics have been more circumspect, and have often reported technological changes being implemented within existing organisational structures with only minimal consequences for those structures. Indeed, the failure to change organisational structures when new technology has been introduced has been identified by Strassmann (1985) as a prime reason for the failure to exploit the potential of new technology and for poor returns on technological investment.

Perhaps the most extensive analysis of the structural consequences of the introduction of computers has concerned the centralisation-decentralisation dimension. The results of that voluminous analysis, unfortunately, are not totally consistent. Indeed, a decade ago it was stated that "no topic has sparked more debate, with perhaps less enlightenment, than the possible effect of computers on centralisation" (Pfeffer, 1978, p70).

It is possible that at least some of the lack of consistency has arisen from the confounding of technological causes with other causes of structural change. To take a particular example, it is the conventional wisdom that organisational contraction and environmental threat is best handled at least partly by increasingly centralised decision making whereas a benevolent or diverse environment is more appropriately addressed by a decentralised and organic structure. Where such environmental changes occur simultaneously with technological changes, the two influences may be confounded. Methodologically it is important, though difficult, to attempt to disentangle them.

In the discussion of the structural consequences of technological change ten or fifteen years ago in connection with the widespread introduction of mainframe computers, a major issue was whether the centralisation of data inevitably or normally led to a centralisation of decision making. Certainly one of the reasons for decentralised decision making - an overload on senior managers of information and its associated processing - was to some extent removed by the use of computers, thus enabling a recentralisation of decision making. Whilst such centralisation was more frequently reported than further decentralisation, a common conclusion (e.g. Lamb, 1972) was that computers are an enabling technology with the potential to facilitate either centralisation or decentralisation. Gilman, for example, concluded that:

"The computer can serve equally well to support a move toward greater decentralisation as toward greater centralisation. If change in either direction develops, it will be the result of managerial choice, as it always has been. The computer's role in this respect is neutral - except as it offers the possibility to do what ought to be done in any case" (Gilman, 1966, p89).

The new dimension introduced by the use of microcomputer technology is that, in contrast with the use of mainframe computers, where data and the provision of computer services was inevitably centralised (even if local access was available via terminals), microcomputer facilities are available for use on a distributed basis, even if they are connected to a central point to act as data transmitters and receivers. Similarly, software, databases and operating staff no longer need to be physically located centrally.

There is considerable agreement now that different organisational arrangements can be <u>supported</u> but are not <u>required</u> by technological decisions - that organisational structure decisions are less technologically constrained than they were in the past, and that structural decisions can therefore be at least partly decoupled from technological ones.

Although many of the early studies attempted to identify definitively whether computer technology resulted in centralisation or decentralisation there has been a recognition more recently (for example, Pitt and Smith, 1984; Wainwright and Francis, 1984; Gill, 1985) that structural changes may be more subtle and that both centralisation and decentralisation may occur simultaneously. For example operational decisions may be decentralised while strategic decisions and/or financial control are centralised.

In the education sector it is useful to view centralisation-decentralisation at two levels; firstly within the school, and secondly in relation to the interaction between the school and the LEAs and the DES.

Within the school, considerations similar to those addressed in relation to commercial organisations may apply to administrative work. In those schools in which centralised control has depended on denying wide access to information, the information processing and dissemination possibilities which microcomputers present makes it more difficult to defend that practice; and the exposition generally within schools of a collegial value system reinforces the possibility of the dispersal of information and decision making which the technology facilitates. In relation to the use of microcomputers for instructional purposes it is possible organisationally for the responsibility for and the physical location of equipment to be either centralised (in for example a computer services department), or distributed (for example with provision and responsibility being located in various teaching departments).

At the interface between the school and the LEA or DES the possibilities afforded by microcomputer technology to transfer information for monitoring purposes (particularly administrative information in the direction from the school to the centre) clearly implies the possibility of increased central control. On the other hand, a number of LEAs have initiated "local financial management" practices (the devolution from LEAs to schools of budgetary and expenditure decisions), a locally empowering development which has now been adopted as government policy within the 1987 Education Bill. In such schemes the availability within schools of appropriate microcomputer-based accounting systems may give the LEA increased confidence in the administrative systems within schools and thus be a catalyst towards decentralisation and the erosion of administrative unitarism.

The identification of interfaces between organisational levels within a sector is important. It allows the recognition of at least the possibility that structural change on the centralisation-decentralisation dimension might not occur in the same direction at each organisational level. It is possible, for example, that decisional autonomy may be decentralised to a particular unit but centralised within that unit; so it could be the case, for example, that decisions are decentralised to schools but centralised within them.

Related to, but distinct from, the centralisation-decentralisation dimension is the standardisation of equipment and of software. It is possible for decisions about the choice of microcomputer equipment to be made at the level of the school, in which case there may be a considerable variety of provision across the country and within each LEA; or at the level of the LEA or DES, in which case systems are likely to be replicated to a greater extent. Similarly, in relation to software, the programs can be written or chosen either within the school, or produced and provided from a central point to a range of institutions

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Within schools the introduction of standardised administrative systems would seem to be a necessary but not sufficient condition for increasingly centralised control. Similarly, in relation to the control of the curriculum, the distribution of standardised equipment and instructional software could be a route to an increasingly centralised control of the curriculum, but such increasingly centralised control may not be a necessary consequence of the central production and dissemination of equipment and programmes.

2.4.3 Technological determinism?

The question of whether technology leads or follows economic, political and social choices has been the locus of controversy since the emergence three decades ago of the automation debate. The effects of the introduction of technological changes have sometimes been seen as deterministic and of having necessary consequences in relation to, for example, changes in job content and organisational structure. Cosyns *et al* refer to the automation debate of the 1950s and the 1960s and conclude that:

"Despite the drawing of opposing conclusions the consensus among observers was, however, that there would be necessary consequences of increasing automation" (Cosyns *et al*, 1981, p2).

Some of the studies which purported to uncover necessary consequences were hampered by the problems endemic in the retrospective reconstruction of change, and by insufficiently taking into account the extent to which the very existence of a particular technology is a consequence of prior choices. As Cherns explains:

"All technology is a matter of choice, a truism often obscured by its apparent determinism. Once the choice is made it appears inevitable; in the light of the technology we now possess, the choices that led to its emergence appear not to have been choices at all; a steady progression can be discerned, the blind alleys are forgotten." (Cherns, 1980, p711)

The view converse to that of determinism is not that technology and work structures are independent, but that technology can be used to enable or facilitate a variety of different outcomes. The effects are mediated by economic and social mechanisms so the outcomes are the result of a set of political negotiations between strategic groups with their own particular interests and are therefore technologically indeterminate (Wilkinson, 1983).

The technological determinism debate has much in common with an associated and parallel discussion about the relative significance of "technology-push" and "needs-pull" factors in the adoption of innovations, with technological determinists emphasising the importance of technology-push factors. Both debates have been hindered by semantic problems. The latter is equivalent to that in economics a century ago about the relative importance of supply and demand in determining price, a debate which was dismissed by Marshall's famous (1890) book with the analogy of supply and demand acting "like the blades of a pair of scissors". Similarly, in relation to the technology-push or needs-pull distinction:

"One of the problems of saying that the need for something led to a technical change is that the need corresponds to the advantage. Any surviving technology must have had some advantage. After the event that advantage can be interpreted as a need which led to the development of the technology. This is the classic Adam's navel or chicken and egg dichotomy. Does the need for the advantage produce the technology or does the technology produce the advantage and hence the awareness of the need for that advantage?" (Langrish, 1977, p27)

Like the rather sterile technology-push / needs-pull distinction, the technological determinism debate is now perhaps passé, and certainly is less prominent in the general management literature than it was a few years ago, though determinist assumptions still pervade the educational computing literature.

In principle the technological determinism hypothesis in its most precise form is refutable by a single contrary example. And many such examples of adopter-dependent effects have been brought forward, not only in single case studies but also in the cross-cultural studies such as that of Gallie (1978) in which almost identical technology was studied in operation in different countries.

Dede (1981) recognises, simply, both a dominance and a malleability of technology:

"These effects of technological innovation can be divided into two categories: outcomes likely regardless of method of implementation, and outcomes highly contingent on the particular implementation strategy" (Dede, 1981, p204).

Abell (1975) similarly uses both a conflict model and a consensus model in developing the concept of technically-constrained bargaining zones. He uses a conflict model in which technology sets constraints within which organisational participants' power and influence determines outcomes. The model is recursive to the extent that organisational power and influence are taken to be derived not only from hierarchical position but also at least in part from the "technological infrastructure". He uses a further recursive model, based this time on consensus rather than conflict, in which organisational choices within technological constraints arise by consensus but the consensus is in turn derived partly from the technology leading to a uniform belief about the appropriate course of action, so "technology determines belief and belief determines outcomes so by transitivity technology determines outcomes" (Abell, 1975, p5).

In discussing the "tension between technical and social determinants", Noble (1979, p19) similarly concludes that "technical imperatives define only what is possible, not what is necessary; what can be done, not what must be done".

The view taken here is not that technology is deterministic with respect to organisational outcomes but that it may set constraints and thus define the realms of possibility within which a considerable area of choice is available. The existence of particular technologies, however, may alter the balance of advantage of various alternatives, making some of them increasingly attractive and others less attractive than they would otherwise be.

In this chapter a range of literature has been reviewed focussing, first, on models of innovation both within the education sector and more generally; secondly, the structures and dynamics of the education sector, the key actors within it and their zones of influence; and thirdly, the effects and consequences, particularly on the labour process and for organisational structures, of the introduction and use of microelectronic technology. Based on the concepts addressed here a conceptual model is developed in Chapter 3 and operational hypotheses derived from it.

Chapter 3

CONCEPTUAL FRAMEWORK

3.1 Key questions

The two main research questions were identified in Chapter 1 as:

(i) What factors affect the extent and type of response to microcomputers in schools?

(ii) What impact does the use of microcomputers have on the ways in which schools are organised and managed?

Those questions need to be operationalised into a researchable form. In doing so, the assumption is made that it is necessary to consider the actions and rationales not only of the relevant individuals and groups within schools but also the key actors in the changing economic and political environment in which schools operate. In contrast with a significant part of the previous research on technological innovation which has focussed at the level of either an occupational group, an organisation or a sector, it is important in this study, and indeed others, to analyse in relation to both of the main research questions the links between the individual, the occupation, the organisation, and central and local government (and indeed the tensions between the latter) as they affect and in turn are affected by the innovation studied.

Given the importance of the linkages between the different levels of analysis, a number of subsidiary questions can be developed from the two main questions. Specifically:

(i) Why and how was the innovation initiated in the school sector as a whole and in each adopter school individually?

(ii) Who are the key change agents external to the school?

(iii) What are the policies and strategies for influencing change of those external change agents, and what resources do they have to support those policies and strategies?

(iv) Who are the key change agents within the school?

(v) What are their strategies for influencing change, and what resources do they use in pursuing those strategies?

(vi) What are the results of the strategies and policies of the external change agents?

(vii) What are the results of the strategies and policies of the internal change agents?

(viii) How do those strategies and policies affect the definition of the innovation within different schools? i.e. does the school affect the innovation, and if so, how?

(ix) What are the effects of the innovation on user groups and change agents? i.e. does the innovation affect the school, and if so, how?

(x) How, if at all, is the innovation changing over time?

In this chapter, a conceptual model will be developed and from it a number of hypotheses derived which will enable those questions to be addressed by a methodology derived in the next chapter.

As Scott (1965) points out, there needs to be a clear relationship between the definition of the problem, the design of the research study, the kinds of data gathered and the researcher's role; that relationship is the focus of this and the next chapter.

The two main research questions and the subsidiary questions need to be operationalised and couched in a form which makes them susceptible to testing. It is a common practice, which will be followed here, to do this by identifying a number of hypotheses which are more specific and focussed than the main research questions and the subsidiary questions. As Leedy (1974) states:

"Research seeks direction through appropriate hypotheses. Having stated the problem and attendant sub-problems, the sub-problems are then each viewed through logical constructs called hypotheses. An hypothesis is a logical supposition, a reasonable guess, an educated conjecture which may give direction to thinking with respect to the problem and thus aid in solving it." (Leedy, 1974, p6)

The use of hypotheses both forces the researcher to address at the data collection stage the rationale for focussing on certain questions rather than others, and gives direction to data collection by placing boundaries around the area from which data is drawn. Also, at the data analysis stage, it helps the avoidance of "data dredging" (Selvin and Stuart, 1966), a trap into which it is increasingly easy to fall as computerised statistical analysis packages become more powerful and user-friendly.

Medawar (1969) puts forward three criteria to be considered in deriving hypotheses: first, they should account for the phenomena; secondly, they need to be testable; and thirdly, their falsification should lead to learning rather than merely the search for a different hypothesis. Pugh and Hickson (1976) suggest that hypotheses can be stated:

(i) *a priori*;

(ii) in terms of past work in the same field;

(iii) in terms of past work in other fields.

Each of these sources is used here to some extent. Use is made of previous findings in the field of educational innovation, though this of necessity relates to innovations other than microcomputers. Some of the research issues are derived from past work in other fields, including the introduction of mainframe computer systems into business organisations; it is assumed, however, that the response to and effects of microcomputers may be different in kind rather than merely different in scale from those relating to mainframe computers. Further, following Bush *et al* (1980), it is argued that the characteristics of schools, discussed in section 2.2.5, are in some respects sufficiently different from business organisations that the response and impact may be different in the two sectors. Some hypotheses must therefore be stated on an *a priori* basis.

3.2 Conceptual model

The literature review in Chapter 2 identified key actors in the innovation process, both in terms of general roles (change agents, comprising advocates, project champions and resourcers; recipients of innovations; etc.) and in relation to specific posts within the education sector (headteacher, teacher, LEA adviser, etc.). The different strategies of innovation which are available to those actors were discussed, with some of them having a wide range of alternatives while others are more circumscribed. Each of the alternative strategies depends on a resource base, where resources are interpreted broadly, as defined by Yuchtman and Seashore (1967, p900) as "generalised means or facilities that are potentially controllable by social organisations and that are potentially usable - however indirectly - in relationships between the organisation and its environment". The resource bases available to the different key actors are very different. In some cases they are financial resources; in some they are constitutional statutory or legal resources, or derived from the incumbency of a particular post; in others they derive from access to other key individuals or groups; in still others they are political; in others they are based on personal qualities; in others they are resources of expertise or knowledge; and in yet others they derive from the control of information. Those resources are very different in terms of, for example, their liquidity, stability, substitutability, scarcity and centrality in a particular arena. Those characteristics affect the ways in which the resources can be used and the constraints on their use. The availability and use of those strategic physical, financial and intangible or mediating resources underpins the conceptual model used here.

The thesis is that the distribution of both real and mediating resources in the legislative and cultural structure in which schools operate critically affect negotiations and decisions concerning the adoption and implementation of innovations. But the mere possession of those various resources does not by itself indicate the ways in which they might be used or with what effects. To do that we need to examine not only the resource base of key actors and decision makers and the centrality and substitutability of the resources which they have available, but also their rationales, their strategies (for example the timing of, and conditions for, the exchange of resources), and the outcomes of the use of those resources and strategies. The assumption is that the incentives, barriers and constraints created by the deployment of those real and mediating resources affect not only the initial decision to change but also the transition from adoption decisions to implementation.

The conceptual model adopted is pluralist rather than unitary. It is based on the assumption that influence on decisions and organisational practice in schools is widely distributed amongst individuals, formal groups and temporary coalitions both within a specific school and in its external environment, and that those interest groups have different, and possibly conflicting, objectives and rationalities from which a negotiated order is produced. Specifically, within the taxonomy of pluralist exchange models discussed by Shipman (1984), the conceptual model is one based on resource dependency theory. That theory has been applied by Rhodes (1981, 1986) in the analysis of relationships between central government and local government, based on five propositions:

(i) any organisation is dependent on others for resources;

(ii) to achieve goals, organisations have to exchange resources;

(iii) because of the need to exchange resources, decision making within an organisation is constrained by other organisations, but a dominant coalition can retain some freedom of action; the appreciative system (the combination of factual and value judgements which describe the "state of the world" or "reality") of the dominant coalition influences which relationships are seen as problematical and which resources will be sought;

(iv) dominant coalitions of organisations employ strategies within the known "rules of the game" to regulate the process of resource exchange;

(v) variations in the balance of power between organisations depend on their goals, their relative power and therefore their availability of resources. The relative power is a product of the resources of each organisation, of the rules of the game, and of the process of exchange between organisations.

Archer (1981) similarly used a resource dependency model, this time specifically within the education sector, but again at the macro level, in addressing "the changing inter-relationship between the structure of the resource distribution and the structure of educational interest groups" (p33). And Aldrich (1976, p419) in proposing a resource dependency model "as a conceptual scheme to account for organizational behavior observed under conditions where interorganizational relations are a critical environmental contingency" limited his analysis to boundary management activities.

In this study a resource dependency model is extended beyond the area in which Rhodes and Archer used it to the relationship between local government (specifically, LEAs) and schools, and to the relationship between actors within schools (including, for example, the headteacher-teacher relationship) as further instances of central-local relationships.

It is extended also beyond the static, equilibrium model which Rhodes proposed and used, to incorporate a resource dynamic. That dynamic is acted out within a cycle of:

(i) Resource acquisition or mobilisation, in which phase an organisation or organisational subunit uses strategies to acquire resources from its environment (which in relation to an organisation as a whole, such as a school, will be external to the organisation, for example the LEA or the DES; and in relation to an organisational subunit, such as a department or a particular teacher, may be the school as a whole).

(ii) Resource allocation, in which the resources mobilised from the environment are allocated amongst alternative uses. Those alternative uses, in the context of the innovation studied here, may involve use by different organisational subunits such as departments; additionally, or alternatively, they may include different applications of the technology, such as curricular use and administrative use. Processes of resource allocation can be very diverse, of course, and range from authoritatively imposed allocations, through manipulative and cooperative strategies, to collegial processes.

(iii) Resource utilisation, in which the resources allocated to particular organisational subunits are used by them, and the ways in which they are used may be part of a strategy directed towards the acquisition or allocation phases of a subsequent resource cycle.

Particular actions may represent different phases of the resource management cycle for different actors. For example, the process of mobilisation of resources by an individual or group overlaps, but is not identical with, the resource allocation processes of other, particularly superordinate, individuals or groups. The rooting of the resource dependency model within the resource cycle is important: the assumption is that the resources which an organisation seeks to acquire and the way in which it allocates and utilises those resources conveys important information (and information of a kind different from that obtained by, for example, conventional interview methods) about organisational priorities and the conscious or subconscious priorities of key individuals and groups.

The resource dynamic within the conceptual model extends along a second dimension also. Particular resources are not necessarily static and immutable during the resource cycle. Rather, the dynamic encompasses the possibility, indeed assumes, that they are not. The distinction which Gyford and James (1982) make between resources as <u>prizes</u> and resources as <u>weapons</u> incorporates that same dynamic. The resources which are bargained <u>for</u> (prizes) during an earlier stage of the resource cycle are part of the array of resources which are bargained <u>with</u> (weapons) during a later stage of that cycle.

Dependency relationships between individuals, groups and organisations, and mutual dependency operating through exchange relations, does not, of course, imply equality; major inequalities are likely to exist even within an equilibrium relationship of interdependence. The strategies which can be used by an individual or organisation at each of the stages of acquisition, allocation and utilisation within the resource management cycle are constrained within a dependency relationship by other individuals and groups outside and within the subunit seeking to acquire and use those resources. White (1974) identifies the major constraints as emanating from:

(i) direct control by individuals as individuals;

(ii) direct control by individuals as members of organisations;

(iii) constraints on allocation imposed by members of other organisations;

(iv) constraints on availability created by the allocations of other individuals and organisations.

The constraints, and the resource "weapons" which those affected by the constraints can themselves bring into play, may apply only, or apply particularly forcibly, at one stage only of the acquisition-allocation-utilisation cycle, and as that stage is passed other constraints and other resource weapons become more relevant.

The resource dependency model used here is claimed to be particularly relevant not only to the general analysis of decisional processes in not-for-profit service sector organisations where resource acquisition, typically "through various forms of subsidization" is critical, as Aldrich (1976) discusses, but specifically also to schools. That is particularly so given the current context in which both central and local government are increasingly using specific funding mechanisms (of which schemes for the funding of microelectronics in schools are prominent examples) to change the dependency relationship of schools, and in which an increased market orientation, with its consequent elevation of boundary management activities, is both being encouraged by central government and being developed by schools to obtain a competitive edge as part of a strategy to respond to an approximately 30% reduction in the number of pupils. The conceptual model has, then, both a general applicability to schools and a specific applicability to the innovation at this point in time.

In a context in which change is expected and being forced, access to and use of resources affects which individuals and groups will be able to negotiate and steer change. Aldrich and Pfeffer (1976) remind us that "the resource dependence model posits that organisations attempt to manage their environments and that variations are conscious planned responses to environmental contingencies" (pp86-87) and "the resource dependence model calls attention to the importance of environmental contingencies and constraints, at the same time leaving room for the operation of strategic choice on the part of organisational members" (p84). That strategic choice (Child, 1972) is assumed to lie at the heart of the response within schools to the innovation, within the legal, financial and cultural constraints on the school-environment boundary. The resource dependency model has the further, not inconsiderable, advantage of articulating well with the way in which school staff see the interface between the school and its environment.

A resource dependency model is not restricted, of course, to an analysis of innovations. But where innovations are on the agenda the model focusses attention on the identification of the resources which change agents (both external and internal to the innovation-adopting organisation), and those potentially affected by it, have available and the way in which those resources are deployed.

The term resource is used within the model not narrowly but, as discussed above, to incorporate a range of physical and financial resources, and the intangible resources of skill, knowledge, reputation, expertise and information. And the different external and internal change agents and the target recipients of innovations are likely to bring very different resources into the decisional arena. Their resource base is not static but changes at different phases of the resource management cycle. It changes also as, for example, their labour market position and strategic position within the workplace organisation change. Those latter changes can be for a variety of exogenous reasons; but they can also be affected by the particular innovation itself, to further modify the dynamic of the innovation process.

It is assumed also therefore that the effects are systematically related to the response; for example that the effects on users depend, in part, on the way in which the eventual users influence the definition of the innovation. The model is therefore recursive. It is of the general form:

$$R = f1(E, k, l, m, ...)$$

$$E = f2(R, u, v, w, ...)$$

where R represents the response to the innovation and E its effect.

The distribution and use of both real and intangible resources within the acquisition-allocation-utilisation cycle are taken within this study, then, as the "ground" against which the "figure" of decisions about the use of microcomputers in schools, and the effects of that use, are analysed.

A number of assumptions are incorporated within the conceptual model. It is useful to state those assumptions explicitly (while recognising that inevitably, as in any model, there will be some assumptions which remain unrecognised by the developer of the model and are therefore, to the reader, at best, implicit).

A major assumption is made that the institutional setting substantially affects the course of the innovation and that it can in principle be defined differently at different adopter sites. So what the innovation <u>is</u> (i.e. the extent and type of use of computers) at a particular time in a specific school is defined by an interaction of change agents outside and within the school and by potential users within the school, on the basis of the physical and intangible resources which those actors bring to the decisional arena, the constraints which those resources generate, and the "appreciative system" of the relevant key actors at the various stages of the acquisition-allocation-utilisation cycle. It is assumed that the key change agents external to the school are central government and local education authorities, through their elected politicians and professional education officers and advisers. Within the school it is assumed, from the education management literature, that the headteachers' support of the innovation is vital and that the organisational value system, based on an ideology of teacher professionalism, implies that the internalisation of the innovation requires teacher acceptance of it. From the literature on the effects of technical innovations it is assumed that the innovation is affected to a great extent by control of the organisational labour process and, in turn, will affect that labour process, the internal organisational structure and external relationships, as particular aspects of centre-periphery relationships.

The model therefore incorporates the assumption of implementation dominance (Berman, 1981) rather than technological determinism. The local processes of change are assumed to be of major importance in moulding the innovation and in adapting it as its implementation and institutionalisation proceed and evolve.

The model is recursive, as discussed above. It is assumed that the innovation is not static, but dynamic - that it has effects on the users and, potentially, on the change agents, as the innovation develops and is re-defined as individuals and groups learn and change over a period of time as a result of their experience.

In essence the model comprises independent variables of the different actors' resources at a particular stage of the resource management cycle, dependent variables of effects on the labour process and organisational structures and relationships, and intervening variables of the use of microcomputers in teaching and administration. The conceptual model to depict in an abstracted and simplified schematic form the key variables and the relationship between them is shown in Figure 1:

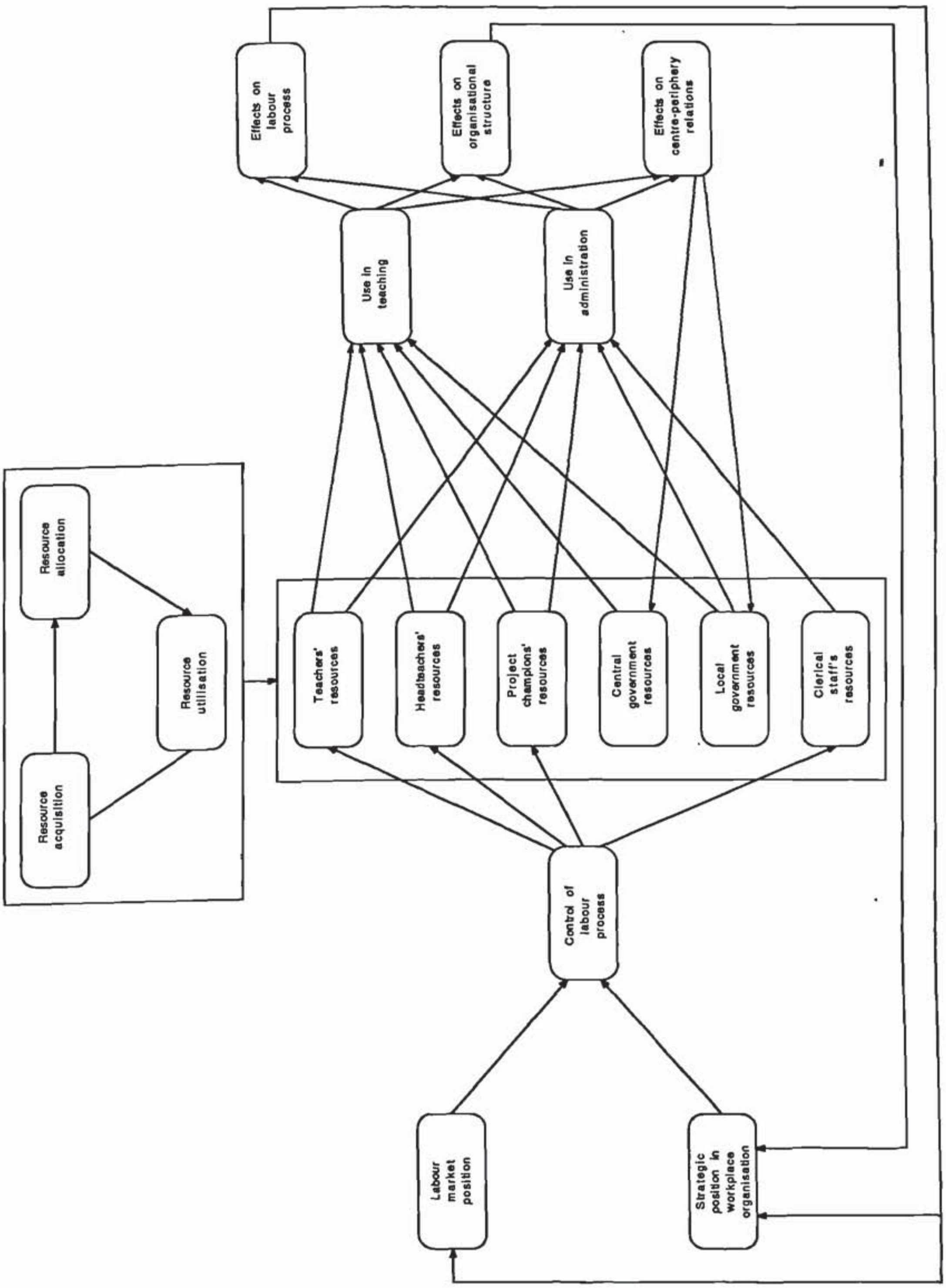

Figure 1: Conceptual model

From that conceptual model a number of specific hypotheses can be derived which are testable by the research methodology developed in the next chapter.

3.3 Hypotheses

(1) The English educational system is commonly described as a national service locally administered. That description obscures many of the subtleties of its operation, but, nevertheless, it is assumed here that the local (LEA) element is important in affecting the extent of provision and use of microcomputer facilities. Thus:

Hypothesis 1: The greater the volume of resources provided by LEAs to support educational computing, the greater is the extent of use of microcomputers in schools in those LEAs.

(2) It is assumed that the autonomy of schools is such that provision varies significantly from school to school in the large number of schools within the same LEA. Given the extent of institutional autonomy, and the centrality of the role of the headteacher as reflected in the literature, it is assumed to be attributable in part to the support of the headteacher. So:

Hypothesis 2: The greater the support and involvement with microcomputers of the headteacher of a school, the greater is the extent of use of microcomputers in the school.

(3) The extent of use is also assumed, following Pettigrew (1973a), to be attributable in part to the motivation and skills (technical and political) of various individuals, particularly those possessing the relevant technical skills who act as project champions:

Hypothesis 3: The greater the involvement with microcomputers of the technical expert(s) in a school, the greater is the extent of use of microcomputers in the school.

(4) It is further hypothesised that bodies at national level, particularly the DES, the MEP and the DTI are influential via funding mechanisms in determining the extent of provision. Thus:

Hypothesis 4: The policies and support mechanisms used by central government agencies affect the extent of provision of microcomputers within schools.

(5) The conceptual model proposed is based on the assumption that the type of use of microcomputers is determined differently for instructional and administrative purposes. In relation to instructional uses it is assumed, despite the increasing central influence on the content of the curriculum at national level, that teachers remain in control of the delivery of the curriculum and of the labour process at classroom level. Although the provision of information, advice and materials by, for example, LEA advisory staff may be influential, the decision as to whether to use computer-assisted learning in particular subject areas, and if so to what extent, is determined by teachers individually within schools. It is assumed that whether microcomputers are used in a particular school for instructional purposes, and if so to what extent, is determined by the school's teachers of those subjects. Those arguments lead to the following hypothesis:

Hypothesis 5: The pattern of use of microcomputers for teaching purposes is different in different schools within an LEA.

(6) But, because applications are determined primarily within individual schools rather than by LEAs, on aggregating those differences:

Hypothesis 6: The pattern of use of microcomputers for teaching purposes is not significantly different in aggregate in different LEAs.

(7) The control of administrative functions is more diffuse, both within schools, where the senior management team, teaching and administrative staff interact, and in terms of centre-periphery relationships (specifically the relationship between schools, the LEA and the DES). The ideology of professionalism is restricted to teaching activities and does not extend to the peripheral administrative support arrangements. The LEA can cause various administrative operations to be carried out by their requirement for statistical and other information to be provided and the increased emphasis on accountability and a reduced financial base has resulted in LEAs increasingly being concerned with school administrative efficiency and effectiveness. It can thus be hypothesised that:

Hypothesis 7: The use of microcomputers for administrative purposes in schools in different LEAs depends on the policies of those LEAs in respect of administrative use and the resources provided in association with those policies.

The model is thus one of a number of parties influencing the extent and type of use of microcomputers and therefore the response to their availability, that influence varying between different applications and within and between different schools and LEAs.

(8) In relation to the second of the main research questions - concerning the impact of microcomputers on schools - two main issues can be identified from previous research on the impact of computers in other (primarily business) sectors. First, what impact does the introduction of microcomputers have on the labour process? Within schools this can be analysed in terms of teaching jobs, secretarial and clerical jobs and the jobs of senior managers (headteachers and deputy headteachers). Secondly, what is the impact in terms of organisational structure, particularly in relation to changes along the centralisation-decentralisation dimension and more generally on the tension between the centre and the periphery? That is relevant both within institutions and in terms of the relationship between schools and the LEAs and the DES. A technological determinist perspective would lead to expectations including increased job fragmentation and probably to increased centralisation; but the model put forward above is based on an assumption of implementation dominance rather than technological determinism. It is further assumed that the impact is systematically related to factors affecting response, which in turn were derived partly from a labour process perspective. Accordingly, it is assumed that the use of microcomputers for instructional purposes, while it may facilitate changes in the teaching strategies employed "behind the closed door of the classroom", will by remaining under the control of teachers individually and collectively have little impact on the organisation of teaching at institutional level. That line of discussion leads to:

Hypothesis 8: The use of microcomputers does not result in substantial organisational changes outside the classroom relating to, for example, the use of teaching assistants or the use of individualised resource-based learning organised other than by teachers individually.

(9) In relation to the use of computers for administrative purposes, where control is assumed to be more diffuse, the impact will be different in respect of clerical, teaching and management jobs. In relation to clerical posts the model posits that the job rationalisation, based on the point of control of the labour process, which has occurred in sectors other than education, will occur within schools also:

Hypothesis 9: The use of microcomputers for administration results in a reduction in the number of clerical posts and increased specialisation of those posts.

(10) It is hypothesised that the increased efficiency available by the use of information technology and the carrying out of parts of the monitoring and controlling functions at LEA or DES levels rather than at school level will result in changes in the jobs of school senior managers and teachers:

Hypothesis 10: The use of microcomputers results in a reduction in the administrative content of senior (headteacher and deputy headteacher) managers' jobs.

(11) It is also hypothesised that such changes will have consequences for centre-periphery relations in directions similar to those found in organisations outside the education sector:

Hypothesis 11: The use of microcomputers, in association with changing government policies, results in increased centralisation of strategic control activities by educational agencies external to the school.

(12) But, it is assumed, information technology will be used to extend and continue the trend of participatory decision making in schools, and the ease with which the technology can be used to generate and disseminate information will enhance that change, thus implying the final hypothesis:

Hypothesis 12: The use of information technology results in decentralisation of decision making and operational control activities within schools.

The range of hypotheses developed from the conceptual model above reflect the need expressed in Chapter 1 to understand the innovation at both institutional and sector levels - some of the hypotheses concern the school as an organisation and the individual actors within it, some concern the education sector as a whole, while others focus on the interface between the organisation and the sector. The empirical research will similarly need to collect evidence at both of those levels and at the interface between them.

A methodology to achieve that is unlikely to be simple or to use only a single instrument. In the next chapter the characteristics of the major research paradigms are analysed to develop a methodology for collecting data to enable those hypotheses to be tested and hence the major research questions to be addressed.

Chapter 4

THE RESEARCH METHODOLOGY

4.1 Positivist and interpretive methodologies

Two main research paradigms can be identified; they are variously referred to (Bynner and Stribley, 1978) as the positivist-experimental-nomothetic and the interpretive-ethnographic-ideographic.

The positivist approach rests on the use of a research design which is specified before data collection commences, the research design focusing on the testing of hypotheses derived from the use of specific models and theories. The predominant methods of data collection are the use of experiments and/or surveys and the data analysis is primarily quantitative. Wallace (1971) discusses this tradition in terms of the cyclical process of observation leading to generalisation and the formulation of models or theories from which hypotheses are deduced. Methods to test the hypotheses are developed and the hypotheses are either accepted or rejected. Proof and disproof are logically asymmetrical; only disproof is conclusive, whilst acceptance of the hypothesis merely continues its probationary status. With appropriately formulated hypotheses, however, either their refutation or continued acceptance should contribute to the model from which the hypotheses were derived and the theories on which that model was based.

The positivist approach is used most explicitly in experimental research where changes are observed and interpreted in terms of predetermined hypotheses. In the social sciences the positivist approach can be traced back at least as far as the social theorists of the nineteenth and early twentieth century, particularly Comte and Durkheim. The approach emphasises the development of valid and reliable measures of the variables included and the control of extraneous variables. At the hypothesis testing stage the focus of the hypothetico-deductive methodology is the search for refutation rather than verification of hypotheses. Hypothesis testing will otherwise be "doomed to success":

"For if we are uncritical, we shall always find what we want. We shall look for, and find, confirmations and we shall look away from and not see whatever may be dangerous to our pet theories. In this way it is easy to obtain what appears to be overwhelming evidence in favour of a theory which, if approached critically, would have been refuted." (Popper, 1960, p134)

The positivist methodology is also used in non-experimental research where it is not possible to control extraneous variables; in such cases factorial or multivariate designs replace physical controls. Data analysis depends on the correct choice and use of appropriate statistical tests, of which the most common are tests of significance, perhaps related to the use of multiple regression, factor analysis or the analysis of variance.

Statistical tests can, then, be used convergently as means of testing hypotheses; such tests and statistical analysis more generally, can also be used divergently. For example:

"A statistical treatment obliges the researcher to tell the reader more about the nature of any patterning which appears in his data than is the case when the reader has to rely totally upon the writer's own interpretive account." (Child and Partridge, 1982, p xii)

But, as Fisher (1937) stated in his definitive text on positivist research methodology, statistically significant relationships which emerge in the course of a study but which have not been previously hypothesised cannot be treated as findings but instead provide only the basis of hypotheses for further studies.

The hypothetico-deductive methodology embodies two quite distinct logics (one based on the derivation of hypotheses from a model, and the other based on the testing of those hypotheses) with different criteria of, respectively, plausibility tests and statistical tests, each of which need to be satisfied separately.

Multivariate methods, while they can show relationships between variables, cannot by themselves show <u>why</u> there is a relationship. Daft and Becker, in a research study of educational innovation, emphasise the limitations of statistical analyses of survey data:

"Thus far our major findings have depended upon correlation and regression analysis. These types of analyses are efficient and enable us to identify the correlates of innovation adoption, but they do not yield specific evidence about internal organisational processes. Researchers can make conjectures about internal organisational processes on the basis of correlations and regressions. We have done that ... in an attempt to weave the correlation findings into a coherent explanation about the innovation process. But these explanations remain conjectures unless we can verify them with data about what is happening inside the schools." (Daft and Becker, 1978, p97)

The finding of statistically significant relationships does not, by itself, establish causality. It can do no more than lend support to imputed causality established by substantive considerations of other kinds which are, in Weber's term, "adequate at the level of meaning". An understanding of the mechanisms of change is likely to be most persuasively obtained by the use of an interpretive or evaluative approach within particular organisations. Bolam (1975) suggests that this approach is particularly necessary in relation to an understanding of the unintended consequences of an innovation.

The interpretive methodology rests on the foundations laid by Weber. A particularly influential strand within the interpretive paradigm is that of phenomenology, which emphasises the understanding of actions from the actor's own frame of reference, and aims primarily not to discover the social "facts" which the positivist seeks but to collect rich data and thus to establish an insightful portrayal of social situations, recognising that different actors have very different perceptions of the same set of events.

An interpretive methodology using case studies is frequently used for the discovery or generation of "grounded theory" (Glaser and Strauss, 1967) rather than for the testing of theory. When an evaluative methodology is being used for the discovery of theory, the unusual, unrepresentative or "deviant" case is assumed potentially to enable more to be revealed about social processes than the "normal" cases:

"Population samples are chosen to be illustrative rather than statistically representative. The atypical and abnormal result, far from being averaged out into insignificance, is regarded as of equal interest with, or even of greater interest than, the norm. The investigator is concerned with trying to understand why things happen rather than simply with measuring what does happen." (Becher and Maclure, 1978, p142)

The details of an interpretive research design tend to be emergent rather than pre-specified. The dominant approach to data collection and analysis within such a paradigm is qualitative rather than quantitative. Three major methods of data collection used within the interpretive approach are interviewing, observation and the use of documentation.

Zelditch (1962) discusses the use of interviewing in field studies and distinguishes between using:

(i) the informant as a surrogate census taker;
(ii) the informant as a representative respondent; and
(iii) the informant as the observer's observer.

and emphasises the need to clarify the role(s) which the informant is expected to adopt. Dean and Whyte (1958) further emphasise the need to evaluate informants' reliability, their values and how these might affect their responses and the plausibility of their reports. The evaluation advocated is based primarily on triangulation methods, which will be discussed below.

Zelditch (1962) suggests that methods based on interviewing are most appropriate for obtaining information about "institutionalised norms and statuses"; they are less appropriate for building a picture of incidents or histories, where observation methods are superior. Campbell *et al* (1982) similarly point out the limitations of methods based solely on interviews for collecting information about decision making, as respondents will tend to report a decision making process as more rational than is warranted. Both Zelditch and Campbell *et al* prefer the use of observation methods in such cases.

The third method, the use of documentation, can be useful both in respect of documents relating to the internal affairs of the organisation and of relationships between the organisation and others in its environment.

The use of each of these methodologies, but particularly interviews and observation, raises questions about the role of the researcher in the organisations studied. Johnson (1978) emphasises trust as a key dimension: "developing trust is a necessary condition for valid observation but not a sufficient one" (p141); and "what the observer is allowed to see in the setting and what one will be told about the activities there will vary according to the existing relations of trust" (p200). Pettigrew (1973a) underlines the importance of trust in analysing organisational change from a political perspective, and in discussing the political strategies adopted by individuals or groups.

While it is unlikely that the researcher will have a neutral effect, he needs to be aware of the effects of his presence. The consequence of Heisenberg's uncertainty principle - that one cannot measure something without changing it - is equally valid in social research as in atomic physics. That is particularly the case if the focus of the study is organisational change. In such cases Pratt (1983) emphasises particularly the potential problems when the researcher is viewed as an external expert and may be invited simultaneously to adopt the roles of researcher and change agent. Although I was careful during the field work to maintain a distance and not be drawn into an "external expert" role, a number of the organisational participants asked me to comment on developments in their school in comparison with others. I felt that it was an acceptable part of my psychological contract with the participants for me to respond to such questions and to do so in some detail rather than minimally, though not to provide unsolicited comments. It is recognised that it is not beyond the bounds of possibility that such discussions influenced subsequent decisions in those schools. Indeed, the very act of participating as a case study site is likely to elevate the issues under investigation to a higher place on the organisational agenda than they would otherwise occupy, and thus influence subsequent developments at that research site.

Interpretive approaches do not have the disadvantages attributed to the positivist methodology, but they do have rather different limitations, derived from the different theoretical frameworks which underpin those methodologies. For example, in their use of interviews coupled with a phenomenological, political or garbage can model, interpretive methods may lead to an over-emphasis of the importance of individuals' actions and motives and a danger of what Woods (1983) calls "macroblindness", and a neglect of, for example, structural and legislative factors, which tend to be emphasised to a greater extent by positivist methods resting on a systems framework. Further, within interpretive methods it is common for data collection to be at least partly dependent on recall by key informants. And as Marsh (1982) discusses, explanations of the form "event is followed by outcome" run the risk of circularity as the respondent or the researcher may imbue a previous event with a meaning which it did not have at the time. It is easy to over-interpret, and to read into actions motives which may be counter to those of the actors themselves. A further problem to be addressed within an interpretive approach is that actors reconstruct reality, so there may be a gap between the rhetoric and the reality. In organisations such as schools in which the cultural expectation is that decision making should be rational and the negotiated order requires that conflicts be subterranean rather than overt, reality may be reconstructed, with certain events or values suppressed and others elevated, and inconsistencies and micropolitical activities ignored or glossed-over in order to justify retrospectively the meaning of various decisions, events and actions. That poses difficulties not only with interviews but also when observation methods are used as people re-define and re-interpret prior events. As Lynn and Jay (1983) put it, humorously in a rather different context, it can be difficult to discern whether any particular statement represents

(i) what happened;
(ii) what he [the informant] believed happened;
(iii) what he would like to have happened;
(iv) what he wants others to believe happened; or
(v) what he wants others to believe he believed happened.

The methodologies used within an interpretive approach may overlap to some extent with those employed within the positivist tradition, but there is a definite disjuncture between the two. Since positivists (primarily seeking social facts or causes of social phenomena) and phenomenologists (seeking mainly understanding from particular points of reference) approach social situations differently, and focus on different issues, that is not surprising. But it has given rise to an extensive, and sometimes heated, debate about the relative merits of the two paradigms and the advocacy of one rather than the other. Although there have been reports of "an outbreak of peace" (McNeill, 1985) not all the partisans recognise that. Attempts to establish the superiority of one paradigm, and the attachment of particular researchers and groups to one methodology or the other, have unfortunate consequences and diminish the possibility, with its attendant benefits, of drawing from each of them. Although there is wide agreement that a research method should be chosen which is appropriate to the particular study being undertaken, that is often taken to mean the choice of one particular paradigm <u>or</u> the other, rather than a method which draws from both. The reader of research reports is often left with the uncomfortable feeling that the choice has been derived more from the preferences of the researcher and his familiarity with a particular methodology rather than from the requirements of the topic under investigation. As Trend said in attempting to reconcile the qualitative and quantitative analyses upon which the two paradigms primarily draw:

"Few researchers are equally comfortable with both types of data, and the procedures for using the two together are not well developed. The tendency is to relegate one type of analysis or the other to a secondary role according to the nature of the research and the predilection of the investigators." (Trend, 1978, p352)

Both positivist and interpretive paradigms have limitations; each gives only a partial and incomplete picture. The implications discussed in Chapter 2 of Allison's (1971) use of three perspectives on decision making (rational, organisational processual, and political) are relevant also in designing a research strategy. The adoption of a particular perspective opens up various possibilities for insight but also excludes others; as Mangham (1979, p2) says: "any way of seeing is simultaneously a way of not seeing".

It will have become obvious by now that this discussion is leading not only to a regret that not more research draws from and utilises the methods of both positivist and interpretive paradigms, but that this study will attempt to do so. The problematic nature of that exercise is fully recognised. In making that attempt it is recognised that:

"the kind of research which seeks to bridge the gap between the two standpoints comes under attack from both sides. Research in this area is regarded by the objective purists as woolly and unscientific, and by those adopting a subjective stance as too concerned with essentially artificial theoretical concepts far removed from the day-to-day realities of the actors in the situation. To hold the middle ground means accepting that both subjective and objective viewpoints are important in interpreting a social situation." (Hewton, 1986, p172)

The relationship between positivist and interpretive paradigms has much in common with a parallel debate about systems and phenomenological perspectives on organisations and whether they are incompatible or capable of synthesis. Hoyle drew an analogy in respect of the latter which has implications for the positivist-interpretive methodological distinction:

"I agree with Greenfield that there are two sociologies which represent mutually exclusive ways of making sense of the social world. One cannot look down both ends of a telescope simultaneously, but I do not believe that we should be condemned to look down one end only. There is no reason why the two approaches should not be considered as complementary." (Hoyle, 1976, p4)

In attempting to draw from both traditions here, there is a danger, which is recognised, that neither will be as fully developed as an analysis rooted within one theoretical tradition only.

A variety of research methods, some based in a positivist tradition, others in an interpretive tradition, are available then, singly or in combination. The choice of an appropriate methodology depends not only upon the context of the research, in this case technological innovation in educational organisations, but more importantly on the objectives of the research and the criteria which are felt to be most important.

In the present context two criteria are considered to be crucial: internal and external validity. If a number of changes are occurring simultaneously it is difficult but necessary to attempt to explain the extent to which such changes can be described as effects of the focus of the investigation, in this case microcomputers, rather than resulting from other environmental changes. This relates to the criterion of internal validity. For example, a common finding in the literature on the impact of computers, discussed in Chapter 2, has been that their introduction has been followed by increased centralisation. Centralisation may, however, result from factors unconnected with technological change. Mintzberg (1979) suggests that organisations facing an increasingly hostile environment typically respond by increasingly centralised decision making. Few would argue that the environment of educational institutions, and indeed the education system as a whole, became increasingly hostile in the 1980s. If decision making in the education service becomes increasingly centralised, it is important not to assume that this has resulted merely from the contemporaneous introduction of microcomputers but to consider the effect of the technological change in relation to other factors.

In addition to the possible confounding effect of history and maturation, Campbell and Stanley (1966) identify the possible lack of instrumentation reliability, reactivity (the effect of repeated data collection), bias in sample selection, statistical regression to the mean, and sample attrition, as possible threats to internal validity.

While cross-sectional studies using, for example, analysis of variance methods can, in principle, help to separate out the confounding effects of various independent variables, longitudinal studies using interpretive methods offer more persuasive possibilities of addressing the problem of simultaneity and of untangling cause and effect by using inter-temporal variations to facilitate causal inference. Indeed, Bjorn-Andersen suggests that:

"Ideally an investigation of the impact of computer technology should be designed as a longitudinal study.... The best research approach would be to monitor and record the change processes as they take place rather than to take snapshots of an organisation before and after the introduction of each new technical development." (Bjorn-Andersen, 1979, p25)

Longitudinal studies are, nevertheless, used less frequently than cross-sectional studies. Indeed, due to constraints of time and finance, Bjorn-Andersen himself did not use a longitudinal research design. Again, in the context of educational change, Taylor (1975) regrets that for a field in which administrative courses of action are bound to be of critical importance, the absence of longitudinal studies is noticeable.

The use of a longitudinal design suggests the use of case study methods, which in turn implies studies in a relatively small number of organisations. While those cases may be, and indeed need to be, internally valid, the use of case study methods raises questions about external validity and the extent to which the findings are generalisable. In the present study there are two reasons arising from the research purposes listed in Chapter 1 for attempting to reach conclusions which are generalisable beyond a small number of case study institutions: the desire, first, to carry out research which is policy-relevant and, secondly, to contribute to the research on microelectronics in sectors other than that of education. While internal validity is the *sine qua non*, the possibility of producing generalisable results requires a number of potential threats to external validity to be overcome. Campbell and Stanley (1966) enumerate those also. They include again the invalidity of instrumentation and reactivity to it, bias in sample selection and the "Hawthorn effect". Although interpretive case studies at a small number of sites can certainly be externally valid, the criterion of external validity is more commonly addressed by the use of a positivist approach, typically incorporating the use of survey methods.

The requirements to meet the criteria of both internal and external validity suggest the use of an eclectic approach encompassing both case study methods using primarily interpretive methods and survey methods deriving from a positivist perspective.

Pettigrew (1973a) in an influential case study of the introduction of a computer into an organisation advocated the use of multiple methods within the case study and quoted Webb *et al* to support the choice of this approach:

"The issue is not choosing among individual methods. Rather it is the necessity for a multiple operationalisation, a collection of methods combined to avoid sharing the same weaknesses" (Webb *et al*, 1964, p1-2).

The advantages of the use of triangulation or multiple methods are well rehearsed in the research methods literature. Four types of triangulation were specified by Denzin (1970) and have since been elaborated by others. They are:

(i) theoretical triangulation - the use of different, and possibly competing, theoretical perspectives, such as phenomenological and systems models, as discussed and advocated earlier in this section;

(ii) data triangulation - the use of different sources of data within a particular data collection method, for example the use within case studies of both interviews and documentation;

(iii) methodological triangulation - the use of more than one method of collecting data, as Pettigrew advocated in the quotation above, for example the use of both case study and survey methods;

(iv) investigator triangulation - for example the use of more than one researcher within a case study.

The fourth of those triangulation methods was precluded but the other three were incorporated within the study. It was felt appropriate for triangulation to be used partly within the case studies but also in an attempt to relate case study findings to survey findings and documentary evidence. In addition a fifth variant was used: confronting the research primary data with that from secondary sources. For example, the periodic reports by Her Majesty's Inspectors (HMI) on individual schools and LEAs usually contain only brief references to the use of microcomputers, but they can be used as a means of checking the research data.

4.2 The research design

The research design was influenced both by the methodological issues addressed above and by the theoretical issues and conceptual framework developed in Chapters 2 and 3. Those considerations led to a research design for this study incorporating three methods of investigation:

(i) Documents were analysed to obtain information about the policies, goals and expectations of interested parties, particularly the DES, MEP, DTI, LEAs and teaching and administrative staff unions and associations. Interviews and correspondence were also used in respect of some of those parties to elicit further information. The specialist educational journals were also monitored throughout the research both to keep abreast of developments nationally and also to enable a judgement to be made about whether the outcomes found in the empirical fieldwork were similar to or different from those elsewhere as implied by the fragmentary evidence in such reports.

(ii) Surveys were carried out near the beginning and near the end of the research. Pilot surveys preceded the distribution of the survey questionnaires in both cases. Both surveys were used to obtain "position statements" of the extent and type of use of microcomputers in schools, and to test some of the hypotheses by the use of multivariate analysis. The surveys were used primarily, though not exclusively, to investigate the factors affecting the response to microcomputers, the factors which differentiate between adopters and non-adopters, and between those organisations where the use of microcomputers was deemed to be successful and those where it was not. In addition, the initial survey was used to produce a data base from which case study sites were selected.

(iii) Case study investigations were carried out in four schools to monitor changes longitudinally. The case studies were used primarily, though not exclusively, to investigate the impact of the introduction of microcomputers, and to relate the impacts to the process by which organisational change has taken place. The case study methods concentrated on the use of interviews and documentation. A significant constraint was that the research was carried out on a part-time rather than a full-time basis which precluded the use of observation methods to the extent which may have been undertaken, for example by attendance at meetings, had that constraint not existed. While observation methods were used to some extent, the predominant methods were the use of internal and external documentation and interviews, with interviewees adopting to some extent the role of observer's observer (Zelditch, 1962).

The changes found during the longitudinal case studies were related to the "position statements" derived from the surveys to compare the type, direction and extent of changes found in the case studies with those in the larger sample included in the surveys, and hence to assess the external validity of the case studies.

The different strands of the methodological web were designed to support each other. The information gained in the surveys about structural and contextual factors affecting outcomes and that obtained in the case studies about organisational processes are complementary, and even if they are not strictly mutually-validating they at least highlight the areas where apparent inconsistencies need to be further considered. The methods of investigation were thus not used separately and in isolation from each other, but complementarily, with each assisting in interpreting the data from the others.

The research design enables a number of the advantages of survey-based studies to be obtained. The survey element enables information to be obtained from a relatively large sample and enables the case studies to be at least partially tested for external validity. Those elements facilitate the formation of conclusions which are policy-relevant to an extent which is greater than might be obtained from an alternative design such as a single in-depth case study, or at least is so perceived within the policy making community locally and nationally. The research design used here does, however, have some disadvantages compared with the alternative of a single, more detailed, case study. That alternative would enable issues to be investigated in more depth than the design used in this research and to relate the "single issue politics" dealt with here to wider organisational activities. The research design developed here is claimed, however, to be appropriate to the purposes of the study and to the main research questions identified in Chapter 1, and to enable the hypotheses developed in Chapter 3 to be tested.

The research design is summarised in Figure 2.

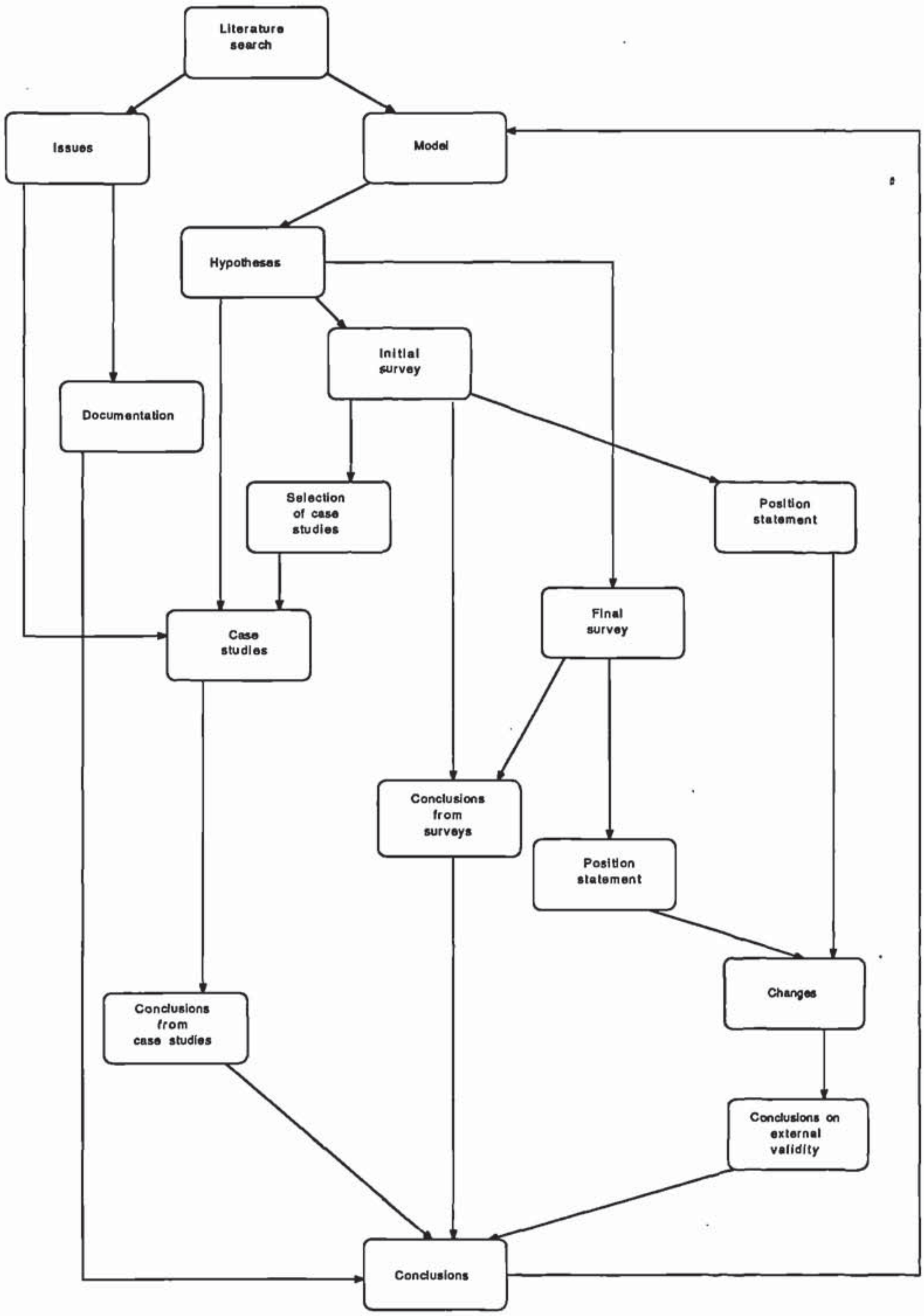

Figure 2: Research design

4.3 Choice of Sample

Having determined the research methodology in outline it was necessary to decide, in respect of both the survey and the case studies, the sample size and the method by which the sample was to be chosen.

An evaluation of the relative importance, on the one hand, of factors internal to the innovation-adopting organisation and, on the other hand, factors external to it, is facilitated by the use of a number of case studies where the external factors (in this study, particularly LEA factors) are rather different. That is an important feature of the research design. It is exploiting one of the attractions identified earlier of the education sector as a locus for the study of microelectronics - that similar, indeed virtually identical, technology is being introduced simultaneously into a large number of superficially similar organisations in a context in which external resourcing (which is deemed to be an important factor affecting the uptake of the innovation) might be differentially applied. That design enables the relative importance of within-LEA and between-LEA factors, and within-school and between-school factors to be addressed. For that reason the sample in this study was initially a sample of LEAs from which case study sites and survey questionnaire recipients were subsequently to be chosen, with the schools in those LEAs providing the sampling frame from which survey schools were later selected.

The decision about the size of the sample (the number of LEAs) was not made in isolation from considerations about the means by which the sample was chosen; rather, the two decisions were inter-related. Initially, only upper and lower bounds were placed on the sample size; there is inevitably a degree of arbitrariness in the choice of those bounds but further considerations of sample choice, discussed below, were used in finally determining the size of sample of LEAs. As a significant part of the empirical work was to be carried out using case studies, that methodology had implications for sample size. It was felt that case studies in five, six or more sites would result in their being superficial, whilst considerations of external validity, discussed above, led to an initial preference for more than one or two case study sites. Initially, then, the preferred number of case study locations, and hence LEAs from which they were to be chosen, was three or four.

The importance attributed to possible LEA-effects, particularly for a sample of three or four LEAs, implies the use of a purposive rather than a random sample.

A number of criteria were used in deriving that purposive sample:

(1) Accessibility. As the research was being carried out on a part-time basis, the case study sites needed to be accessible on a short-term basis from the researcher's home and work base; that restricted the choice to about twenty LEAs.

(2) Type of LEA. It was assumed that differences between LEAs, deriving for example from different LEA policies and the extent and type of advisory support provided, were likely to be important. As LEAs were known to differ in respect of characteristics which were assumed to affect the adoption of microcomputers, it was decided to select LEAs by means of a stratified rather than a random sample, in order to include within the sample LEAs with each of the characteristics which are deemed to be important. LEAs are commonly stratified into metropolitan authorities and county authorities; the importance of that distinction is reflected in the formation separately of the Association of Metropolitan Authorities and the Association of County Councils. That distinction clearly relates to issues concerning local government provision rather than directly to microcomputers or to innovation but nevertheless the stratification may be significant and was therefore used. Bird (1982) found Havelock's (1973) social interaction model a useful description of the means by which information and knowledge about the use of microcomputers for administrative applications diffused; such a mechanism may be more efficient in metropolitan rather than county authorities because the distances between schools, teachers' centres and advisers are less by an order of magnitude. It was felt desirable, then, to include as case studies schools from both county and metropolitan authorities.

Because of the distinction and the possible significance of the two main types of LEAs, and because in England as a whole the numbers of county and metropolitan authorities are approximately equal, it was felt desirable to use a proportional stratified sample and to include an equal number of each, so the size of the sample of LEAs, initially set at three or four, was therefore fixed at four.

(3) Innovativeness of LEAs. A characteristic of LEAs which may be significant is that of innovativeness. It was felt to be useful to include within the sample some authorities which are innovative and some which are less so, both in respect of innovation specifically in relation to microcomputers, and more generally. That characteristic is not easy to measure. But Bolam *et al* (1978) identify advisers employed by LEAs as a significant determinant of innovation, both as facilitators of innovation and as a manifestation of the intentions of the LEAs. Accordingly,

the number of advisers, or more specifically the number of advisers in relation to population, was taken as a surrogate measure of innovativeness at the LEA level. The analysis of data published by the Chartered Institute of Public Finance and Accountancy (1983) allowed the derivation of the number of advisers per 1,000 population for each LEA, and therefore enabled the identification of those authorities with greater and less than the median for the country as a whole on that measure.

Similarly, in relation to advisory support for information technology specifically, the Education Authorities Directory (1983) enabled the identification of those authorities which at the start of the research had appointed advisers with responsibility for computing or information technology. Those admittedly blunt instruments were used as partial, but economical, proxies of innovativeness in the absence of other adequate measures.

(4) Size of LEA. LEAs vary considerably in terms of size, as measured by population. As size may be systematically related to intervening variables which may affect the particular innovation studied, it was felt desirable to stratify LEAs with respect to size and to include within the sample LEAs of a range of sizes rather than include only very small or very large ones. The arithmetic mean population of LEAs in England is approximately 500,000, though county authorities tend to have a substantially larger population than metropolitan authorities. It was felt desirable to dichotomise at the median and to select one county authority of a size larger than the average for counties and one of a size smaller than that average, and similarly one large and one small metropolitan authority.

Using those four criteria a quota sample was selected of four LEAs, which will subsequently, in order to preserve the sometimes confidential nature of the information obtained from interviews and documentation, be anonymised and referred to as Northlea, Southlea, Eastlea and Westlea:

Larger than average metropolitan authority:	Westlea
Smaller than average metropolitan authority:	Northlea
Larger than average county authority:	Southlea
Smaller than average county authority:	Eastlea

More innovative than average metropolitan authority:	Westlea
Less innovative than average metropolitan authority:	Northlea
More innovative than average county authority:	Eastlea
Less innovative than average county authority:	Southlea

The four authorities comprise a population of approximately 200 secondary schools. It was felt to be appropriate to carry out the survey as a census of the total population rather than a sample of it, in order to obtain sufficient responses from the survey to enable some of the hypotheses to be tested using multivariate methods, and to obtain some information about each of the potential case study sites as a basis for choosing the institutions to be subsequently used as case studies.

Having carried out the initial survey, the results of which are discussed in Chapter 5, the preferred case study sites were chosen. It was stated in Chapter 1 that an attractive feature of the education sector as a location for the study of the introduction and effects of microelectronics is that a large number of research sites are potentially available, so criteria other than convenience can be incorporated into their choice. The research design used within this study also enabled information from the initial survey about the potential case study sites to be used and their selection therefore to be more firmly grounded on current information than is sometimes the case. The aim was to achieve a balance of representativeness and diversity within the case studies. Three specific criteria were used in selecting the case study schools:

(i) The four sites should represent different extents of use of the technology. Because of the desire to produce results which are generalisable the selection of only "leading" schools in respect of the use of the technology was deliberately avoided.

(ii) The four case studies should include schools of different size, particularly at least one school of considerably larger than average size and at least one which was considerably smaller.

(iii) The case studies should be from different LEAs - specifically, one from each of the four LEAs of the survey population in order to investigate between-LEA differences.

The research design goes some way towards meeting the criteria of both internal and external validity. As respondents to the initial survey did not know at the time of completing the survey questionnaire that they might subsequently be approached at the case study phase, the correspondence (or lack of) between information provided in the initial survey and that in the case studies helps in establishing the internal validity of the survey data. If that correspondence is found within the four case study sites (as it subsequently was) that engenders greater confidence in the internal validity of the survey data for the remainder of the survey sites which were not subsequently followed up as case studies. And by comparing developments in the four case study sites during the two years of the field work with the changes over that same time of the larger sample from the two surveys, it is possible to determine whether developments at the case study sites are representative of those in the larger sample of two hundred survey sites, and therefore to address with at least some empirical data the external validity of the case studies.

4.4 Research entrée

Johnson (1978) emphasises that the means by which the researcher gains entry to an organisation is important in defining his role there:

"The major reason why the problems of gaining and managing entrée are so important is that their resolution will affect how the observer will be socially defined in the setting. This, in turn, is related to what an observer will be allowed to see and what the members will tell him about their activities. In this light entrée is not something that is relevant only to the beginning stages of the research. Its relevance affects the factual realities of the observations. It is necessary to understand the entrée situation in order to evaluate the observational data." (Johnson, 1978, p212)

Having selected the LEAs to be used, a letter was sent to the Chief Education Officer of each of the four LEAs selected, giving details of the research and requesting access to relevant officers and advisers and permission to carry out the surveys and case studies. The letter is included in Appendix 1.

While Johnson (1978) is rightly concerned that the means by which entrée to research sites is gained may influence the researcher's role and the access obtained within those sites, the protocol of research in schools demands initial clearance from the Chief Education Officer, and the survey and subsequent case studies would be received in schools on the assumption that prior permission had been obtained from the education office. That implied sponsorship could, in some situations, have inhibiting effects. But the fact that it is required for all of the large amount of diverse research carried out within schools results in it being merely a device for filtering the volume of research access rather than encumbering the researcher's entrée with any messages other than that the topic of research is felt within the education office to be one of some importance.

Permission was obtained to use the schools in the four LEAs for the survey and for access to the relevant education officers and advisers and to approach schools in those LEAs as case study sites though, as discussed above, the specific institutions to be used were chosen using information subsequently obtained during the initial survey and were therefore not chosen until that survey was completed. At that stage, permission to use the specific schools was obtained from the headteacher of each of those schools. There are, then, a number of gatekeepers, each of whom has a veto and can decline access to a part or the whole of the school, so the negotiation of entrée is not a single event but a continuous process of renegotiation within the hierarchy of consent of, first, the LEA, secondly the headteacher, and finally the individual teachers and office staff, both in respect of the conduct of interviews and of access to documentation.

The schedule of the research is shown in Figure 3, and the implementation of the research strategy is discussed in the next chapter.

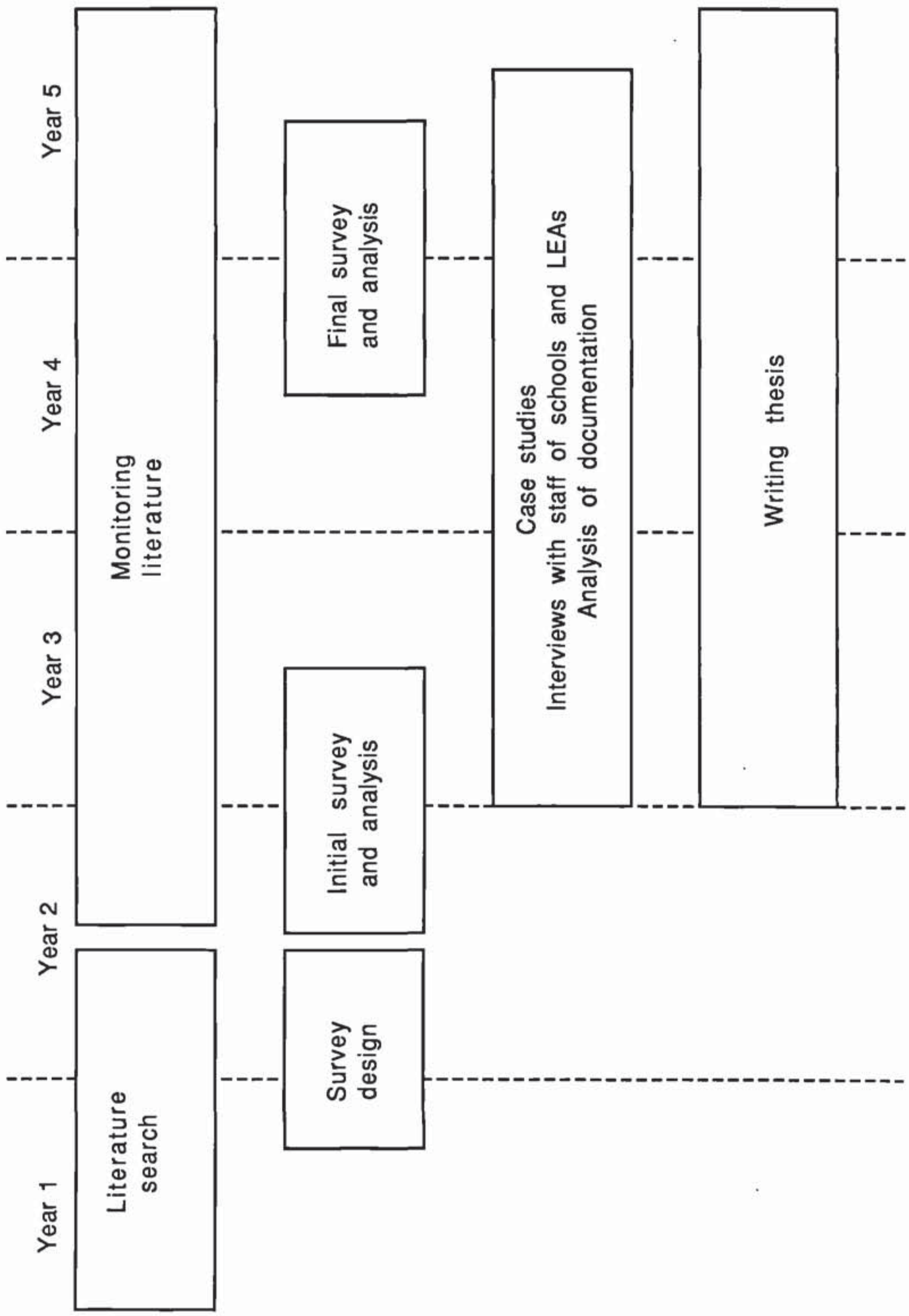

Figure 3: Research schedule

PART B: EMPIRICAL WORK

Chapter 5

FIELDWORK

This chapter takes up the operationalisation of the research methodology designed in Chapter 4, to enable data to be collected to address the key questions and test the hypotheses advanced in Chapter 3. The empirical fieldwork is discussed in the chronological order in which it was carried out: first, the initial survey; secondly, the case studies; and thirdly, the final survey.

In analysing the findings of the case studies a choice of two alternative structural frameworks is possible. The issues can be analysed on a case-by-case basis or within an issue-by-issue format. Each offers different benefits, and has different limitations. The former enables the interaction of different factors at the one location to be addressed to provide a holistic account, but may under-emphasise the extent to which characteristics of the case are particular or general. The latter structural framework gets more directly to the heart of the main research questions but leads to the presentation of cases which are "flat" rather than "round", by focussing not on a whole but on a series of parts. In an attempt to obtain the different benefits of each of those structural possibilities the empirical work of the case studies is presented in this chapter on a case-by-case basis and analysed more extensively in Chapters 6, 7 and 8 in terms of the major issues identified in the literature review earlier.

5.1 Initial survey

A questionnaire-based survey was used to elicit information mainly, though not exclusively, on the extent and type of use of microcomputers, to address primarily the hypotheses concerning the response to the innovation. Issues concerning decision making processes were addressed primarily within the case studies rather than extensively by questionnaire methods. The questionnaire was addressed to, and requested information from, the headteacher rather than other members of staff, for two reasons. First, and of lesser importance, the headteacher was identified within the literature discussed in Chapter 2 as a focal figure in educational innovations, so data from that source was clearly of relevance. The case studies, of course, would enable information to be obtained from a wide range of other people within the schools. Secondly, and of greater importance, it was felt to be necessary, methodologically, to attempt to obtain data that was comparable and consistent in terms of source. That would not be achieved by requesting that the questionnaire be completed by a relevant but unidentified person or post-holder; nor would comparability have been achieved if the questionnaire had been directed to, or been requested to be completed by, for example, "the teacher in charge of computers", whose organisational role, as we shall see later, is very different in different schools.

A draft questionnaire was produced and piloted. Twelve headteachers, who were from schools in LEAs other than those included in the main survey, completed the questionnaire and commented upon it. Their opinions were sought on the clarity and relevance of the individual questions and on the questionnaire as a whole, and on its comprehensiveness. On the basis of the answers provided, and particularly the comments, modifications were made to produce the questionnaire used in the initial survey.

It was known that headteachers regularly complain of being inundated with questionnaires on a wide range of topics from a large number of individuals and organisations, ranging from the DES, the LEA, staff and research students of institutions of higher education, students conducting projects as part of taught masters degrees, other schools, and so on. That scenario has the potential for low response rates to surveys, and indeed response rates from schools of 30% or 40% are commonly reported. In that situation it was felt appropriate to incorporate methods which might increase the response rate. For one of those methods the technology being investigated was utilised to create a personalised covering letter in which the name of the headteacher was incorporated into the header address and salutation, and the name of the school and the LEA was included in the body of the text. A stamped addressed envelope was enclosed with the questionnaire. The number of job appointment advertisements in the press for teaching posts which require interested enquirers to include a stamped addressed envelope is indicative of the importance attached to this seemingly small point, as was the note pinned to a returned uncompleted questionnaire from one school for which the outgoing envelope had inadvertently not been franked: "I would also point out that the Post Office were quick to seize upon the fact that your letter was unstamped. Clearly we are not the only ones under pressure". The offer was also made of a summary report of the findings of the survey to be sent to each school. A number of letters of thanks for the summary report were subsequently received.

The covering letter is included as Appendix 2 and the questionnaire used in the initial survey as Appendix 3.

The questionnaire was sent in April 1984 to all 199 schools in the four LEAs. A follow-up letter, included as Appendix 4, was sent approximately three weeks later to the schools from which a reply had not at that time been received.

Four distinct methods were therefore used to attempt to facilitate a high response rate:

(i) the use of a personalised covering letter;

(ii) the provision of a stamped addressed envelope;

(iii) the offer of a summary report of the findings of the survey; and

(iv) the use of a follow-up letter.

Of the 199 questionnaires, 165 were returned completed, giving a response rate of 83%. A further 6 replies were received declining to complete the questionnaire for various reasons. The response rate from schools in each LEA was:

	response rate
Northlea	68%
Southlea	87%
Eastlea	89%
Westlea	80%
Total	83%

Figure 4: Response rate, initial survey

The responses were coded and the data analysed using SPSS (Statistical Package for the Social Sciences) on an IBM 4341 mainframe computer. A check on 5% of the data after key-to-disc data entry indicated a "punching" error rate of less than 0.05%, which was felt to be acceptable.

The response rate of 83% was substantially higher than is typically achieved in school-based research. But even with a high response rate there is a possibility of non-response bias. The issue of whether non-respondents were similar to or different from respondents was addressed in a subtle way for the final survey, as discussed in section 5.3. For the initial survey that comparison is more difficult to make directly, but the profile of non-respondents was similar to that of respondents in terms of, for example, size of school and geographical location. It is possible to assume, however, that respondents may be those who are more interested and possibly enthusiastic about the technology than non-respondents, and if that is translated within the school into extent of use of the technology the survey may slightly overstate the extent of use for the population as a whole. Whether it also affects the decisional processes within schools is an open question.

A range of statistical tests were used, depending on the particular items of data being analysed, and mainly using the *ceteris paribus* assumption, to test the statistical significance of the findings. The major emphasis was on the use of non-parametric tests. Many texts on research methodology have developed the seminal work of Siegel (1956) in emphasising the appropriateness of using non-parametric rather than parametric tests with data which has the characteristics of much of that obtained within the surveys in this research. Many of the questions in the survey generate data which is, at best, ordinal rather than interval or ratio data. For example, judgements about whether particular applications have been successful have been coded for analysis purposes as 4, 3, 2 and 1, but the data is obviously not on the ratio scale which the numerical values might imply but is, clearly, ordinal. In such cases non-parametric methods provide more stringent tests than their parametric equivalents and reduce the risk of a Type I error (falsely rejecting the null hypothesis).

An aspect of analysis which was used extensively in this study is testing the significance of cross-tabulations (for example, of the extent of use of the innovation cross-tabulated against LEA, or against the extent of involvement of particular individuals). Of the range of non-parametric tests the one which is particularly suitable for such cross-tabulations is the chi-squared test, and for that reason that test figures prominently in the analysis of the survey data. The chi-squared test is appropriate for data which is ordinal and which is not necessarily normally-distributed, and in that sense is a robust test. The main restriction concerns cell sizes, specifically the required minima of expected frequencies in each cell; because of that restriction it was necessary in some instances to aggregate adjacent cells prior to analysis.

The results of the statistical tests are reported in the analysis in Chapters 6, 7 and 8 of the key relationships affecting, and affected by, the innovation. Statistical significance is reported there by quoting the level of significance, which is deemed to be preferable to stating whether or not a relationship is significant at a conventional, but nevertheless arbitrary, level such as 1%, or 5%. Statistical significance, of course, is not the same as substantive significance; the results which are reported are those which satisfy the latter criterion, in addition to being tested by the former.

The remainder of this section comprises a summary of the findings on the extent and type of use of the innovation across the sample as a whole, based principally on simple frequency tabulations of responses to the survey questions.

A major conclusion from the initial survey is that there are substantial differences between schools in the extent and type of their use of microcomputer technology. That is indicated in a number of ways:

All schools had microcomputers, the average number per school being 10.6. But there was great variability between schools (standard deviation = 5.5) with the maximum number in a school being thirty-seven, and the minimum just one. There were a range of different computers in use, with the BBC machine the most frequent but with Apple, PET, RML and Sinclair microcomputers in approximately equal numbers of schools, and small numbers of about ten further makes. All schools used microcomputers for teaching purposes, and in 59% of the schools the equipment was used also for administration.

Although all schools used the technology for instructional purposes the pattern of resource utilisation was markedly different and there were very different priorities amongst the alternative uses. Although a simple prioritisation response in a questionnaire does not fully capture the preferences of the respondents (in this case headteachers) and the possible divergence of the respondents' prioritisation from that of others, the priorities in aggregate, shown in Figure 5, produce a pattern of some importance in the context of resource allocation decisions:

	Highest priority	2nd highest priority	Middle priority	2nd lowest priority	lowest priority
Use for externally examined courses in computer studies	27%	22%	24%	13%	14%
Use for computer appreciation courses	42%	33%	12%	8%	5%
Use for computer-assisted learning in subjects other than computer studies	33%	31%	24%	8%	5%
Use for school administration	2%	8%	21%	40%	29%
Use for computer clubs	1%	4%	20%	27%	48%

The order of priority of different use was therefore:

highest priority	(1)	computer appreciation
	(2)	computer-assisted learning in other subjects
	(3)	externally examined computer courses
	(4)	administration
lowest priority	(5)	computer clubs

Figure 5: Priorities for computer use, initial survey

That rank order is obtained both by reading directly from the above table the percentage of schools which stated each use as the highest priority and also by using a weighting scheme (5 = highest priority, 4 = second highest ... 1 = lowest priority).

There were, nevertheless, great differences between schools in the relative importance attached to the trichotomised curricular uses (externally examined computer courses, computer appreciation and computer assisted learning in other subjects).

The situation in respect of externally examined computer studies courses is particularly interesting, and was stated as highest priority by a substantial number of schools, and of lowest priority by a substantial number of other schools. Computer studies was offered in a variety of different modes:

Course	Offered by % of schools	
A level (69% of schools had sixth forms)	20%)	85% of schools offered
O level	79%)	one or more externally
CSE	76%)	examined course
Computer appreciation for all pupils in any one year group	65%	
Computer appreciation for at least some pupils in any one year group	88%	

Figure 6: Computers as curriculum content

And use for computer-assisted learning was characterised by utilisation in a wide range of subject areas, as shown in Figure 7, with the sciences dominant (despite the emphasis in the educational computing literature on applications in a wide range of other areas), and a significant use in remedial education.

	Used extensively	Some use	Not used now but likely to be used within the next 2 years	Not used now and unlikely to be used within the next 2 years
	% of schools			
English	0%	17%	55%	28%
History	2%	29%	54%	15%
Geography	3%	58%	35%	4%
Mathematics	16%	76%	5%	2%
Physics	5%	70%	22%	3%
Chemistry	1%	61%	35%	3%
Biology	1%	59%	34%	6%
General/integrated science	0%	42%	48%	10%
Foreign languages	0%	26%	48%	26%
Home economics	0%	17%	36%	47%
CDT	6%	32%	52%	10%
Remedial education	15%	53%	27%	5%

Figure 7: Computer-assisted learning, initial survey

The intensity of use, as measured by the number of teachers using microcomputers in teaching subjects other than computer studies was:

Number of teachers	frequency (% of schools)
none	0%
1	1%
2-5	36%
6-10	43%
11-20	16%
more than 20	4%
	100%

Figure 8: Extent of teachers' use of computers

The above four tabulations indicate that in the curricular area the innovation has been differentially adopted, and implemented in very different ways in different schools. Except in respect of the enthusiastic response of pupils to the innovation (as expanded upon also in a number of replies to the open-ended questions) that is reflected also in the headteachers' evaluation of the curricular use of microcomputers on various criteria:

	Very successful	Moderately successful	Of limited success	Unsuccessful
Extent of use	15%	51%	33%	1%
Response of teachers	13%	60%	25%	2%
Response of pupils	57%	40%	3%	0%
Overall	11%	64%	25%	0%

Figure 9: Evaluation of computer use in teaching, initial survey

A similar pattern is evident in respect of administrative use also: microcomputers were used in different schools for different administrative tasks. Although the most common applications were option choice processing, examinations arrangements, timetabling and word processing, and there was an expectation of considerable development into other applications also in the subsequent two years. Figure 10 shows that there was a great diversity of applications in different schools:

	Used now for this application	Not used now but likely to to introduce within the next 2 years for this application	Not used now and unlikely to be introduced within the next 2 years
		% of schools	
1 PUPIL RECORDS AND ROLL	22%	64%	14%
2 STATISTICAL RETURNS			
(i) DES Form 7	7%	70%	23%
(ii) Other LEA/DES returns	6%	61%	33%
3 ATTENDANCE	4%	36%	59%
4 TIMETABLE			
(i) Construction	18%	45%	37%
(ii) Printing	21%	52%	27%
(iii) Staff emergency cover	2%	50%	48%
(iv) Curriculum analysis	10%	61%	29%
5 OPTION CHOICES	52%	36%	12%
6 EXAMINATIONS			
(i) Printing timetables/lists	23%	58%	19%
(ii) Analysis of results	13%	72%	14%
7 REPORTS FOR PARENTS	1%	10%	89%
8 WORD PROCESSING			
(i) Updating/re-drafting reports	12%	59%	30%
(ii) Personalised letters	8%	51%	41%
9 SCHOOL ACCOUNTS & FINANCE	5%	50%	45%
10 MISCELLANEOUS			
(i) Stock control	5%	38%	57%
(ii) School library records	7%	40%	54%
(iii) Parents' evenings timetables	4%	27%	69%
(iv) University/college applications	4%	14%	82%

Figure 10: Administrative applications, initial survey

There is similar diversity in headteachers' evaluatory ratings of use in school administration, as reported in Figure 11.

	Very successful	Moderately successful	Of limited success	Unsuccessful
Extent of Use	15%	35%	40%	10%
Time Savings	32%	31%	29%	7%
Quality of information available	42%	34%	16%	8%
Effects on clerical staff jobs	13%	21%	31%	34%
Effects on teachers' jobs	10%	33%	39%	18%
Overall	18%	44%	31%	6%

Figure 11: Evaluation of computer use in administration, initial survey '

The responses to the survey as a whole illustrate that although some patterns are emerging, there is a great diversity of practice in the schools.

There were some aspects concerning which responses were relatively consistent. For example, use in teaching was seen as of higher priority than administrative use, and most schools offered both externally examined computer studies courses and computer appreciation courses.

There were, however, considerable differences between schools in resource utilisation. For example, different priorities were allotted to the three main teaching uses - computer-assisted learning across the curriculum; computer appreciation; and externally examined computer studies courses, with differences being particularly marked in respect of the latter. And computer facilities were being used in different schools in the teaching of a wide range of subjects in the curriculum and in a wide variety of administrative tasks.

The survey indicates clearly that different schools are using the technology in different ways: the innovation is <u>defined</u> differently from one school to another. The extent to which those differences are systematically related to other potentially explanatory variables, particularly the relative influence of change agents external to schools and key actors within them is the basis of much of the analysis in Chapters 6, 7 and 8.

5.2 Case studies

Surveys can be effective and efficient means of obtaining "position statements", of defining what is happening at a particular point in time. But they are less appropriate devices for identifying why particular features emerge. For that purpose, as discussed in Chapter 4, case studies are more appropriate.

Longitudinal case studies were carried out from 1984 to 1986, involving interviews and the use of documentation in four schools (one in each of the four LEAs), and in those LEAs themselves.

The criteria used in choosing the case study LEAs and schools were discussed above in section 4.3. Having obtained authorisation in each case from the Chief Education Officer or his nominee to carry out a case study within that LEA, and to meet relevant education officers and advisers, access to school personnel and documentation was then negotiated initially with the headteacher and subsequently with each of the interviewees.

To balance the surveys, which used mainly closed, structured questions, the interviews were carried out deliberately using primarily unstructured rather than structured data collection methods. The opportunity was taken, usually during the second half of the interview, to follow up specific points arising from the survey or, more frequently, previous interviews at the same case study site, and an *aide memoire* (rather than an interview schedule), different for each interview, was used to assist that process. But the aim was essentially to enable the interviewee to discuss the innovation as seen from his or her perspective and to seek to understand respondents' perceptions, motives and actions.

The decision was taken to tape record the interviews, where possible, rather than to rely solely on interview notes. The advantages of that action lie in gaining an accurate record and not being distracted from the inter-personal interview process by extensive note taking. It was felt that those advantages outweigh the perceived intrusiveness which may inhibit discussion of sensitive issues. To counter that disadvantage, the researcher's preference for the use of a tape recorder was mentioned when the interviews were arranged and the request was made (and agreed to in all cases) at the start of each interview, with the offer that the tape recorder would be switched off at any point at which the interviewee wished. That offer was taken up on three occasions.

A total of thirty-two people were interviewed, several of them on a number of occasions. The interviews were of a duration averaging approximately one and a half hours, within a range from half an hour to three hours. A variety of locations was used, in most cases with only the researcher and interviewee in an office, though in a small number of cases the more restrictive location of a staff-room had to be used.

In this section, for each of the four case studies in turn, the LEA and its policies on educational computing in the curriculum and for school administration are described, and the case study school in that LEA and the developments in educational computing there are discussed and related to the policies of the LEA. The discussion is illuminated by extracts from the case study interviews, selected on criteria of relevance, clarity and typicality. The information collected in the case studies, together with that from the two surveys, is analysed across the four case studies in Chapters 6, 7 and 8 using the conceptual framework developed earlier.

5.2.1 Northlea and Northschool

Northlea is a small metropolitan local education authority. For many years the Labour party has had a substantial majority in the Council and the Education Committee. The Council and its leaders comprise mainly working class "traditional" Labour councillors and the Council has a reputation locally for spending less on education and perhaps being less innovative than many others.

That reputation, together with the small size of the local education authority, is reflected in the advisory support generally and in relation to computing specifically. Northlea is the only one of the four authorities in the study which does not have an adviser with responsibility solely for educational computing. That responsibility falls on an adviser whose concern is primarily with mathematics, and also careers education. He regards computing as "not my first love, nor even my tenth. I'm a reluctant computer adviser". The absence of an adviser specifically for computing has meant that his colleagues with other subject responsibilities have taken a more direct lead personally than has happened in other authorities. Northlea has, on average, fewer microcomputers per school than the other three LEAs in this study, reflecting, as we shall see later, the LEA resourcing policy.

Northlea is unique amongst the four authorities in that for approximately five years prior to the research there had been a dispute between the local branch of the National and Local Government Officers Association (NALGO) and the Northlea Council (rather than the Education Department specifically) concerning the use of new technology in administration. In the mid-1970s a substantial amount of development work had been carried out on school administration in a number of schools in Northlea, using computer terminals connected to the mainframe computer in the Borough Treasurer's Department. Those developments were largely at the initiative of a small group of headteachers and deputy headteachers who were also the operators of the equipment at that time. The dispute which started at that time involved NALGO imposing a ban on the use of computers by their members, and has officially continued as the technology has changed from computer terminals to microcomputers. The ban has not been totally effective however and has, indeed, been ignored in some schools:

"Because of the education cuts we are running down the number of office staff and so NALGO have stepped in and said 'right, well you are not using computers to get rid of office staff' and although in other authorities NALGO hasn't kicked up the same fuss, in this authority NALGO has a block on the use of computers for school admin. Having said that, a lot of schools have quietly just gone ahead and done it. Because what the head has done - he has got a computer and a typewriter and a word processor and he's installed it either in his room or in the AVA room next to the office and gradually the secretaries have been won over because they can see that they are not going to get any more staff to come and help them and if they use a word processor it's a damned sight easier." (computer adviser, Northlea)

The headteacher of Northschool confirmed that and commented on the extensive use of computers in administration at the school, but said "don't land me in it because we are using it like mad at the moment!"

The ban, then, has been less than fully effective. Nevertheless its existence has meant that the authority has been unable to develop and implement a policy on computer-assisted school administration, so developments have been at the initiative of schools individually.

Northschool is a comprehensive school which, with slightly more than 800 pupils and 50 teachers, is smaller than most in Northlea and the smallest of the four case study schools. The school is located on the edge of a large estate of council houses from which it draws the majority of its intake. It provides for pupils aged 11-16; there are no pupils beyond the age of sixteen as Northlea provides post-16 education in a sixth form college and colleges of further education. Northschool has about the same number of microcomputers as other schools in Northlea, but a smaller number than any of the other case study schools.

The headteacher had been at Northschool for two years at the start of the case study. He regards himself not primarily as a manager or administrator but essentially as a teacher and educationist ("my heart lies in the classroom"), teaches a substantial timetable in foreign languages and likes to spend a considerable amount of time around the school rather than in his office. He is very keen to develop the use of computers to enhance the quality of education of all pupils and to provide an awareness of new technology, but although computer studies is offered as an optional subject at GCE 0-level and CSE, he places less emphasis on computer studies than on computer-assisted learning. That policy is very much in accord with that of the key figure in computer use in the curriculum who has the posts of head of resources (including the library) and head of information studies and who, according to the headteacher, is "a critical person in the whole structure of the school as far as computers are concerned". The two form a powerful alliance. The head of resources believes that computers should be regarded as a resource, similar to the library, on which all pupils and teachers draw. That has influenced strongly both the use and the location of the computer facilities of the school in a way which is a specific example of decisions involving technology being used to address particular issues in ways defined by organisationally powerful individuals. In 1984 and 1985 half of the microcomputers in the school were located in the library resources area and, although they were mobile and could be booked by other teachers, they were used predominantly for an information studies course which followed and related directly to a library studies course taken by all first year pupils: "we have a central resources system - TVs, cassette recorders - and it just seemed logical that computers became a part of that" (head of resources, Northschool).

Many decisions have ripple effects. When a particular decision is made some future options are foreclosed and others become inevitable, or at least more likely; decisions are not events isolated in time and independent of each other, but part of an unfolding process. The decision in Northschool to locate the microcomputers within the physical and organisational territory of the head of resources is one such framing decision which has created boundaries within which subsequent resource allocation decisions were made, and has increased the centrality of the head of resources and diminished that of others, such as the teacher on scale 2 who is head of computer studies. The winners and losers in this case are clear. Despite the headteacher's assumption that "my lady is very happy here", an interview in the same week with that person identified that she has

"... very little to do with computer-assisted learning or information technology. I don't deal with that at all. Mr -------- [headteacher] tends to deal with Mr -------- [head of resources] for that.... After the head was appointed he gave the computer-assisted learning side to Mr -------- [head of resources]; there was no consultation with me or anything. It's basically being stubborn that has made me withdraw more into computer studies and not to want to become associated.... And I'm becoming more bitter about the situation within the school" (head of computer studies, Northschool).

The location of organisational control of the microcomputer facilities with the head of resources provided the context for subsequent developments when in 1986 the decision was taken at Northschool to set up an information technology room, equipped with 10 of the 16 microcomputers which the school then had. The allocative decision about the concentration of information technology resources mainly in a single room or their dispersal around the school can facilitate some curricular developments and inhibit other modes of utilising the resources. For example, the establishment of a computer laboratory can help the development of information technology courses but it can make computer-assisted learning more difficult to organise, as subject teachers may not have microcomputers in their classrooms and it may be inconvenient to move classes into the computer laboratory for the teaching of particular topics. The superficially simple and "rational" question of location is inextricably connected with the symbollically highly important issue of territory. It is also intimately connected with the issue of constituency policy - of which pupils' and staff interests are most directly served by particular resource deployment choices. The decision to establish an information technology room at Northschool was made at the same time as that to extend the information technology course to more pupils in the lower part of the school and to enable it to be offered in the 4th and 5th years as an option to replace computer studies, and thereby further marginalise one of the teachers affected most directly by the innovation:

"I couldn't quite get rid of computer studies this year, but next year it will have gone. We have already taken one group of the fourth year away. We won't have computer studies on the timetable next year; it will be dead as far as we are concerned". (headteacher, Northschool)

The physical location of computer equipment has been found in studies outside the education sector (e.g. Mumford and Ward, 1968; Brink, 1971; Lamb, 1972) to constrain substantially the profile of applications for which hardware is used and their distribution by organisational department or subunit. Early decisions about the physical location of computer equipment were found in those studies to have affected later choices and hence the subsequent range and balance of applications. It is perhaps not surprising that physical location decisions are sometimes made as short-term solutions to long-term problems. Indeed, it is recognised in Northschool that locating most of the computer equipment in one room will inhibit, at least temporarily, the use of computer-assisted learning across the curriculum:

"We agonised over the 'room or free-standing' debate because we wanted as many departments to use the equipment as possible. Eventually we went for the room because we want to extend IT to as many pupils as possible, so a base was essential" (headteacher, Northschool).

The consequences for subsequent decisions of choices made earlier, such as the location of equipment in Northschool, is simply one of a large number of illustrations that the innovation studied here is not one in which implementation takes place after development has been completed; rather, development and implementation (and adoption and adaption) proceed simultaneously, as a particular example of the implementation dominance to which Berman (1981) refers. In such cases, local decisions about resource acquisition and allocation are of major importance in defining the innovation as it evolves.

The volume of resources allocated to computing at Northschool is substantial. To set up the room "cost us rather more than an arm and a leg. We've overspent on capitation for the first time in the history of the school. The reckoning will come later on" (headteacher, Northschool). That illustrates not only the commitment of the headteacher to the introduction of new technology, but also the importance of the control of resource acquisition and allocation decisions.

The teaching staff as a whole were not fully aware of the source of funding for the computer equipment. As the head of resources said:

"The situation has been clouded somewhat because this school was also used by the LEA to decide how much funding was going to be available for GCSE, so GCSE money has come in, other money has come in, and various bits and pieces, so I don't think most people are aware that most of the money came out of capitation. I think most people think that the LEA provided quite a lot of it". (head of resources, Northschool)

The last quotation is very significant. The clouding of decisions about resource control in a school which in other matters, such as the distribution of departmental funds, is more open and involves more participatory decision making than in many schools, highlights the importance in respect of this innovation of the control of financial resources, and of information concerning those resources.

A relatively expensive computer system had recently been purchased by Northschool for use in administration. The headteacher and deputy headteacher were convinced of the potential benefits of computers in school administration but feel they personally do not have sufficient knowledge about how the equipment could be used: "as far as computers are concerned I'm a very great novice ... it's very much the case of the blind leading the blind" (headteacher, Northschool); "my knowledge is only very limited - I'm only dabbling in it.... Two years ago I was sweating buckets if I got near the thing and frightened to even put my hand on it" (deputy headteacher, Northschool).

Despite the ban by NALGO, of which she is a member, the school secretary uses the computer equipment ("anything that eases the load we can do with ... we use the computer because it is quicker"). She is pleased with the results and would like to expand the number of applications; indeed, her husband who works in the computer industry, has helped her to do so by modifying a pupil records program. The headteacher is aware of the NALGO dispute but with no signs of its resolution centrally has chosen, like his contemporaries in other schools, to circumvent it:

"NALGO have got an official dispute but there are obviously a number of gaps which people are turning a blind eye to ... we've gone ahead in the expectation that it's not going to cause too many problems".

The two people in the school with substantial computer expertise have chosen to get involved only to a small extent in administrative applications:

"It's a question of priorities ... admin doesn't seem to me to be the priority. Our priority should be the kids" (head of resources, Northschool); and

"when I first came here I got involved in two years of exam entries on computer, and because I made it known that if I did it again I might like some more money Mr -------- [head of resources] did it. And now Mrs -------- [deputy headteacher] does it. It was hard work because you had to do it in your free lessons and at dinner times and after school. I did set lists one year as well. I wrote the program myself" (head of computer studies).

5.2.2 Eastlea and Eastschool

Eastlea is a county authority comprising a number of medium-sized towns and large agricultural areas. The county is electorally volatile; the political control of the Eastlea Council has changed a number of times during the last two or three decades and at the May 1985 elections changed from a Labour-controlled council to a hung council with Labour and Conservative parties with approximately equal number of seats and the Liberal-SDP Alliance with a small number of seats but holding the balance of power.

The Eastlea Education Committee used the fact that the national Microelectronics Education Programme had been established to persuade the County Council to create and fund a post of adviser for microelectronics, and in 1983 the appointment was made of a person who has since developed a national reputation in computer education. He strongly favours an emphasis on information technology rather than examinable computer studies and sees his role as helping schools to develop their own policy in relation to information technology. The adviser identified his first task as to argue in County Council for the financial resources to establish a central support service. That case was successfully put: the computer adviser obtained for himself a budget twenty-five times larger than that of the next most expensive advisory area, and a Microelectronics Education Centre and four software viewing centres in different geographical areas of the county were established.

The LEA allocated specific responsibility for computer-assisted administration to an education officer. He is one of four members of the Microelectronics Management Group which reports to the Chief Education Officer. That group has established a pilot school administration system in four secondary schools. The pilot scheme uses IBM microcomputers in two schools and Apricot equipment in the other two, though Eastlea recommends BBC microcomputers for use in the curriculum. The LEA has supplied the equipment free of cost to the four pilot schools and has modified a commercially-available database package to the requirements of the schools. The intention is to evaluate the feasibility of developing software which could be used in all the schools in Eastlea and would enable data to be transferred directly between microcomputers in the schools and the mainframe computer in County Hall.

Eastschool is a large (1400 pupils) comprehensive school for the 11-16 age range. It is one of six secondary schools in a town towards the edge of the county of Eastlea.

For several years the school has provided examinable courses in computer studies, the teaching of which is located within an academically strong mathematics department. Computer appreciation courses are being developed slowly but very little computer-assisted learning is undertaken. As the headteacher said:

"Computer studies we introduced five years ago.... That side of things is very successful. We have a very good mathematics department - it's the best mathematics department in the County I'm sure. Computer studies results are very good - we have to fight kids off who want to take it because of our limited resources.... So in computer studies there are no problems at all. As far as computer-assisted learning is concerned we have come across brick walls - absolute brick walls. This was an old grammar school - I'm talking about 17 years ago but nevertheless there are still members of staff here from that time. Many of those who are still here are heads of department. It's still on very traditional lines. I find it very difficult to break down any curriculum barriers to be absolutely honest. And computers across the curriculum - it's going to be a long hard job." (headteacher, Eastschool)

Eastschool is one of the four schools in the Eastlea pilot project on computer-assisted school administration. The headteacher had previously developed a comprehensive administrative system on a microcomputer located in his room.

"I like doing it myself. I like playing. One gets criticised. It's remarkable that if a member of staff comes in and sees me typing at the computer they will go back to the staff room and say 'oh, he's with his computer again', but if I had a typewriter in front of me or indeed if I had a pencil and paper and was scribbling there would be no comment passed. It is simply because it is a computer." (headteacher, Eastschool)

The headteacher was keen to get involved in the pilot scheme to gain access to the resources which it might bring:

"The LEA sent round a circular asking who would be interested. I said I would be. In fact I think I pushed the case a bit because I wanted to get what was going."

There is, however, not a unanimity of view about who will use the new system. The education officer responsible for the project has one view:

"We have been very clear that the basic work is going to be done by the ancillary staff. I'm very conscious of the amount of time that teachers - and quite senior teachers - are spending as data-prep personnel. That seems to me to be an enormous waste of time." (education officer, Eastlea)

The headteacher of Eastschool has another, a competing rationality:

"The authority and I are slightly at odds on this because I maintain for its efficient use teachers should be inputting data as and when necessary, updating, and so on. The authority's view is that that is not an appropriate task for a teacher. My view is that it is, if the teacher is willing to do it. So, the bursar, my secretary, myself, my deputy and a small team of teachers will be the users on a day-to-day basis." (headteacher, Eastschool)

The outcome of the two parties being "slightly at odds" are recognised by both. When the physical resources pass from the LEA to the school the headteacher anticipates and the education officer fears that the control of their utilisation will pass to the school also and the headteacher will have been successful in acquiring further resources and will have considerable influence in their subsequent utilisation.

There has been, then, and is, substantial development work at Eastschool in the use of computers in administration, but much less in the curriculum. That picture is confirmed by the Eastlea computer adviser:

"There is nothing going on. There is a lot going on on the administration side - the head is very keen. It's a good question as to how appropriate that all is, but that is another point. There are some people interested but apart from computer studies it's been dabbling."

5.2.3 Westlea and Westschool

Westlea is a large metropolitan authority which has a declining industrial base and a high level of unemployment, and in which the Labour party has a clear majority on the Council, which has a radical political reputation. The Council is one which is regarded as placing a high value on its educational provision and is amongst the highest spending LEAs in the country, as measured by educational expenditure per pupil. That provision extends to computer resources. Westlea provided ten microcomputers from central funds to each of its secondary schools and there are more computers per school there than in the other LEAs in this study. Most of the schools in Westlea have for some time offered examinable computer studies courses. The adviser for computing is, like many of his opposite numbers in other LEAs, keen to change the emphasis from examinable courses to computer appreciation courses and computer-assisted learning across the curriculum. The LEA has established two posts of advisory teacher for computer education and a software centre staffed by a manager, three programmers, an information officer and a secretary. The software centre provides evaluative information to teachers on commercially-available software and also produces programmes to the specification of small groups of teachers in various curriculum areas. Westlea is unusual, though not unique, amongst LEAs in providing such a service. The recently-retired Chief Education Officer of Westlea was strongly committed to the inclusion of information technology as part of the education service; he was, amongst other part-time appointments, the national chairman of the Education Stream of IT82.

Westlea has initiated a pilot project in computer-assisted school administration and has located managerial responsibility for that project with an education officer rather than a computer adviser. Computer hardware and software for administrative use has been placed in six pilot schools, free of cost to the schools themselves. For some months prior to the start of the pilot scheme, which was concurrent with the case study phase reported here, there had been a dispute concerning new technology between the local branch of NALGO and the Council. That dispute had caused substantial disruption in some departments of the Council, though not in the Education Department. Nevertheless its existence, together with the political sensitivity of the Council towards employment issues and the previous background of the education officer in the personnel department of the Council, combined to ensure that industrial relations issues were treated as more significant in the Westlea pilot scheme than in similar schemes in other LEAs.

Westschool is an 11-18 comprehensive school of substantial size; with 1800 pupils it is amongst the largest 5% of schools in the country. The school, unusually, does not offer examinable computer studies courses but provides computer awareness programmes for 1st, 2nd, 3rd and 4th year pupils. The headteacher and head of computing are in agreement with this egalitarian distributive policy, though in a school with strong academic traditions it is not shared by all staff:

"We made it absolutely clear that it was computer appreciation for all ages throughout the school and all abilities, for hands-on. It's a definite school policy. I'm sure the staff would fully support this." (headteacher, Westschool)

But:

"Staff tend to assume we might be running examinable computer studies courses. I feel pupils are better served by computer awareness courses. I think this is new to many staff." (head of computing, Westschool)

The head of computing has spent a considerable amount of time running courses within the school on computer-assisted learning for staff from other subject areas, and is identified by the headteacher, deputy headteacher and other staff as having played a central part in the development of a computer policy for the school and in generating for his colleagues the information and skills for the implementation of that policy.

Westschool is not one of the Westlea pilot schools for computer-assisted school administration, though the headteacher had requested that the school be included. Very little computerised administrative work has been done at the school. The head of computing is wary about getting involved in that area:

"As a teacher I don't feel that I should spend the time or the effort reorganising the office. And it would be daft in a way to - even if I did make the time - to go ahead myself and write the programs and organise software to do it because it's a full time job to do it properly. And if I got very involved in that it would be to the detriment of work in the curriculum.... It would take more than me, more than the office staff to effect such a change." (head of computing, Westschool)

The headteacher identified further reasons for the slow progress on computerising school administration:

"We foresee - but how we will do it I am not sure because we haven't got the personnel with the knowledge - we would like to put pupil records on it. I can't foresee it because we haven't got the personnel. Keeping the ship running and having the same people computerising - it seems insoluble. You've got resistance anyway from staff - I'm talking about non-teaching staff. We don't have word processing.... I haven't taken the initiative because I suppose I'm a bit scared too - it would be unknown to me.... I think we have a fairly ancient hierarchy at deputy head level - they are imminently retiring or will be here until they retire so there is - not resistance, that would be too strong - but an indifference." (headteacher, Westschool)

Because the head of computing declined to become involved voluntarily in school administration, and with a lack of other resources of expertise the headteacher has had to adopt a gradualist approach, with an emphasis initially on the curricular use of the large amount of microcomputers within the school, with computerised administration postponed until the balance of resources available changes.

5.2.4 Southlea and Southschool

Southlea is a county council in which the political control passed from the Conservative party to the Labour party in 1981. Education is a less politically controversial issue in Southlea than in many other councils. That applies also to educational computing; a computer education policy paper prepared by a working party under the chairmanship of the chairman of the then Conservative-controlled education committee was implemented with little change when the Labour party came into power.

Unlike Northlea and Westlea, where an adviser is concerned with the teaching use of microcomputers and an education officer for administrative use, Southlea has two computer advisers with responsibility for both teaching and administrative use of computers in different geographical parts of the county. The advisers have substantial discretionary funds available to assist schools in the purchase of computer equipment. The Education Committee policy is that the county will provide 50% of the funds for the purchase of approved items of hardware with the school providing the other 50%, though in fact, as implemented, the education department provides 75% and the school 25%. That resourcing policy has resulted in a standardisation of equipment through the supply of a list of approved items of hardware which is very narrow - only the BBC computer and its peripherals. Although a school could choose to purchase a different make of machine it would then have to find the full 100% of the purchase price. A similar subsidised purchase scheme exists for software - Southlea has taken out licences with the suppliers of certain items of software and provides that software to schools, again at substantially reduced prices. Unusually amongst local education authorities, Southlea required each school to develop a school policy paper on computers in the curriculum and submit that policy paper to the Chief Education Officer. The discretion of the computer advisers to fund hardware and software purchases to encourage developments identified in the policy papers and regarded as desirable by the advisers has resulted in rather greater standardisation of hardware and software in Southlea than in many other local education authorities.

Southschool is a former secondary modern school which was reorganised as a comprehensive school in 1973 when the present headteacher was appointed. The intake is drawn predominantly from the mining communities in the town in which the school is located. It is of medium size and has a small sixth form.

The headteacher is enthusiastic about the work done in the school in the computer area though he has not led it; he fully supports the initiative of the head of computer studies:

"In all honesty I haven't got much personal involvement with the computer. I do my best to encourage the various developments but I've not a great personal involvement.... It was a very good appointment when we appointed -------- [head of computer studies]. Not many schools placed the importance on computer education that we did at the time. We knew that we wanted someone who was a real expert in this field and we were lucky - we got --------. We couldn't have found a better person. We've tried to get the best possible mileage out of him whilst he has been with us." (headteacher, Southschool)

The head of computer studies has developed examinable computer studies and computer appreciation courses and encouraged a number of other staff to develop computer-assisted learning in various subjects. He has also spent a substantial amount of his own time on writing programs for computer-assisted school administration. His estimate of the time spent is:

"During term time I would guess I do 10 hours per week and during holidays perhaps 20 or 30 hours per week - about 4000 hours over 7 years I should think. It's a tremendous amount but I do it for fun; I enjoy doing it." (head of computer studies, Southschool)

That balance of interests is criticised by some of his colleagues. A deputy headteacher of Southschool, for example, commented on his being "too interested in admin and not enough in curriculum use". The integrated administration system which the head of computer studies has developed for the school has attracted a considerable amount of outside interest and has generated for him a modest additional income by sales to a number of other schools throughout the country. It has also had a significant initiatory influence within Southlea itself, as we shall see later.

The two advisers for computing in Southlea are primarily interested in the curricular uses of computers rather than their administrative application though their responsibilities cover both. The advisers have set up as a pilot project in four schools in Southlea the use of the computer-assisted administrative system developed by the head of computing at Southschool. In contrast with the LEA-developed school administration projects in Eastlea and Westlea, which are clearly of the "centre-periphery" type identified by Schon (1973), the Southlea scheme originated not in the LEA but in Southschool and diffused from there, and is of Schon's "periphery-centre-periphery" type. It is the hope of the adviser that the system or something similar can be introduced into all the secondary schools in the county. It is possible that the Southschool head of computer studies may move, permanently or temporarily, to the education office to implement that project. The headteacher of Southschool is

"worried that we might have to loose -------- [head of computer studies] at some point in the future if he is taken away from us to be the county adviser or something of that sort." (headteacher, Southschool)

The four case studies illustrate some commonality across different local education authorities (for example the wish of computer advisers to move away from the dominance of examinable computer studies courses and towards computer appreciation courses and computer-assisted learning across the curriculum) and some differences between them (for example in the allocation of responsibilities among advisers or education officers for computer use in school administration, and also in financial arrangements to assist schools in the purchase of hardware and software). Within schools too, similarities have emerged (for example the pivotal role of a key individual) as well as differences (in the degree of involvement of headteachers for example, and the extent of use of computers in school administration). The significant issues identified in the case studies, together with those in the surveys, will be analysed in Chapters 6, 7 and 8 using the conceptual framework developed in Chapter 3.

5.3 <u>Final survey</u>

A major aim of the final survey was to collect data to enable changes in the implementation of the innovation between the initial and final surveys to be detected. It was therefore felt important that the questions in the final survey, and the phrasing used, should be consistent with those in the initial survey and in that way ensure the reliability (even if not the validity) of data across the surveys. A draft questionnaire was produced comprising essentially a sub-set of the initial questionnaire, modified by the addition of a few (particularly open-ended) questions and the deletion of some questions, especially those concerning static face-sheet data. The draft questionnaire was piloted by eight headteachers of schools not involved in the main survey in the hope, and as it turned out the actuality, that it would not be necessary to change the questions which replicated those used in the initial survey. Some modifications were, however, made to some of the new questions, and to the pagination, on the basis of the results of the pilot, to produce the questionnaire used in the final survey.

The final survey was carried out in April 1986, two years after the initial one. A personalised covering letter, included as Appendix 5, again accompanied the questionnaire, which appears as Appendix 6. Again, a stamped addressed envelope was included and a summary of the findings of the survey was offered.

As the aim of the final survey was to detect changes since the initial survey it was not deemed useful to obtain information from schools which had declined to respond to the initial survey. The population for the final survey was therefore defined as those schools from which a completed questionnaire had been received from the initial survey, i.e. 165 schools. Four schools which had closed between the initial and final surveys were obviously excluded, so the final questionnaire was sent to 161 schools.

Approximately ten days after the questionnaires had been distributed a local postal strike occurred, and in those circumstances the follow-up letter, included as Appendix 7, originally scheduled for distribution three weeks after the initial circulation, was sent five weeks after the initial questionnaire.

A total of 136 completed questionnaires were received, giving a response rate of 85% (compared with 83% in the initial survey). In addition, two headteachers wrote to indicate why they felt unable to complete the questionnaire at that time. The response rate from each LEA was:

	response rate
Northlea	75%
Southlea	88%
Eastlea	84%
Westlea	87%
Total	85%

Figure 12: Response rate, final survey

The attrition of the sample between the surveys was therefore not large. But with any survey the question arises as to whether non-respondents were similar to or different from respondents. The research design used in this study enables that question to be addressed directly for the final survey. The characteristics of respondents and non-respondents to the final survey were analysed using t-tests on data provided by those two sub-groups on the 159 variables of the initial survey. It is to be expected, of course, in that kind of blanket analysis that, even if the two sub-groups of respondents and non-respondents are identical, differences will arise, by chance, in approximately 1% of the t-tests if a 1% level of significance is used. In fact, differences were found at that level of significance in two variables (use in mathematics, and use in option choice processing). On the basis of that analysis it is concluded that respondents and non-respondents to the final survey are not significantly different, and for the final survey one can therefore generalise with some confidence from respondents to population. And based on that conclusion, the information presented in this chapter and subsequently on changes between the initial and final survey is calculated from responses in the initial survey by all respondents rather than the sub-group which also responded to the final survey.

The responses were coded and the data file merged with that from the initial survey, and analysed again using SPSS (Statistical Package for the Social Sciences). The analysis again used mainly non-parametric methods, for the same reasons discussed in connection with the initial survey.

Again the conclusions resulting from the statistical analysis, particularly of the significance of the relationship between variables, are taken up in Chapters 6 and 7 in respect of external and internal change agents, and in Chapter 8 in relation to the effects of the innovation. The remainder of this section comprises a summary of the findings of the final survey, derived primarily from simple frequency tabulations from the various questions, and on changes in the direction and extent of the implementation of the innovation between the initial and final surveys.

The final survey provided evidence, on a range of measures, of a growth in the extent of use of microcomputers in both the curriculum and administration since the initial survey. The average number of microcomputers per school increased from 10.6 to 15.6, but still showed a wide variation between schools (standard deviation = 6.4; in the initial survey the standard deviation was 5.5). A typical school had about twelve BBC microcomputers and three older machines of one or more other makes. The number of teachers per school using microcomputers in teaching subjects other than computing increased from an average of 8 to 12. That reflects at least some use in teaching in an average of 8.3 subjects per school in the final survey, compared with 5.7 in the initial survey.

The sample as a whole, however, again indicates substantial differences between schools in resource utilisation, with use in a wide range of subjects across that sample, and increased use in most of them:

	% of schools, final survey (initial survey)		
	Used extensively	Some use	Not used
English	4% (0%)	54% (17%)	42% (83%)
History	7% (2%)	50% (29%)	43% (69%)
Geography	8% (3%)	69% (58%)	23% (39%)
Mathematics	19% (16%)	70% (76%)	11% (8%)
Physics	13% (5%)	73% (70%)	14% (25%)
Chemistry	10% (1%)	56% (61%)	34% (38%)
Biology	8% (1%)	51% (59%)	41% (40%)
General/integrated science	4% (0%)	31% (42%)	65% (58%)
Foreign languages	0% (0%)	34% (26%)	66% (74%)
Home economics	4% (0%)	27% (17%)	69% (83%)
CDT	9% (6%)	55% (32%)	36% (62%)
Remedial education	6% (15%)	45% (53%)	19% (32%)

Figure 13: Computer-assisted learning, final survey

A similar pattern emerges in relation to administrative use. The percentage of schools using microcomputers for some part of their administrative work increased from 59% to 88%, and in user-schools the average number of different applications per school increased from 2.8 to 5.1. But, again, as illustrated in Figure 14, there was wide variation between schools, with a large number of different applications represented in the sample as a whole, and a growth in use in most of them:

	% of schools, final survey	(initial survey)
1 PUPIL RECORDS AND ROLL	56%	(22%)
2 STATISTICAL RETURNS		
(i) DES Form 7	23%	(7%)
(ii) Other LEA/DES returns	22%	(6%)
3 ATTENDANCE	5%	(4%)
4 TIMETABLE		
(i) Construction	26%	(18%)
(ii) Printing	44%	(21%)
(iii) Staff emergency cover	16%	(2%)
(iv) Curriculum analysis	25%	(10%)
5 OPTION CHOICES	79%	(52%)
6 EXAMINATIONS		
(i) Printing timetables/lists	40%	(23%)
(ii) Analysis of results	31%	(13%)
7 REPORTS FOR PARENTS	5%	(1%)
8 WORD PROCESSING		
(i) Updating/re-drafting reports	37%	(12%)
(ii) Personalised letters	37%	(8%)
9 SCHOOL ACCOUNTS & FINANCE	14%	(5%)
10 MISCELLANEOUS		
(i) Stock control	8%	(5%)
(ii) School library records	11%	(7%)
(iii) Parents' evenings timetables	2%	(4%)
(iv) University/college applications	5%	(4%)

Figure 14: Administrative applications, final survey

The final survey, like its predecessor, shows that organisations which are superficially similar are addressing superficially similar tasks in very different ways. The teaching of a particular subject, for example history, is carried out by making extensive use of microelectronic technology in some schools but none at all in others. That pattern is repeated for most of the other subject areas. Similarly, in school administration, a particular application, for example timetabling, is computer-aided in some schools but not in others, as are many other applications also. Those examples are illustrative of the way in which the uses of technology are mediated by choices made within schools.

But although the extent of use changed between the two surveys, the pattern of utilisation did not. For example, the relative priorities attached to the different applications changed little:

	Highest priority	2nd highest priority	Middle priority	2nd lowest priority	lowest priority
		final survey	(initial survey)		
Use for externally examined courses in computer studies	7% (27%)	16% (22%)	31% (24%)	10% (13%)	16% (14%)
Use for computer appreciation courses	39% (42%)	39% (33%)	13% (12%)	6% (8%)	3% (5%)
Use for computer assisted learning in subjects other than computer studies	39% (33%)	32% (31%)	24% (24%)	4% (8%)	1% (5%)
Use for school administration	4% (2%)	7% (8%)	21% (21%)	47% (40%)	21% (29%)
Use for computer clubs	2% (1%)	1% (4%)	9% (20%)	30% (27%)	58% (48%)

Figure 15: Priorities for computer use, final survey

And the reasons reported for using microcomputers in teaching again showed little change:

	Very important	Fairly important	Of some importance	Not important
	final survey (initial survey)			
Increased pupil motivation	46% (37%)	40% (40%)	13% (22%)	1% (1%)
Gives pupils familiarity with new technology	48% (53%)	38% (33%)	13% (14%)	1% (0%)
Provides learning experiences not otherwise available	41% (42%)	39% (39%)	16% (17%)	4% (2%)
Enables more effective learning	41% (31%)	39% (43%)	20% (24%)	0% (2%)
Provides variation in learning methods	41% (28%)	39% (47%)	18% (25%)	2% (1%)

Figure 16: Evaluation of computer use in teaching, final survey

A similar picture - of consistency between the two surveys - emerged in respect of several other variables: for example, the reasons for using microcomputers in administration; the involvement of different individuals and groups in use in teaching and in administration (such as the extensive involvement of computer studies teachers relative to other people within the school, and the greater involvement of computer advisers rather than other subject advisers or general advisers); and headteachers' evaluations of the use of computers in teaching and administration.

Three conclusions, which are supported by evidence from the case studies, can be drawn from a comparative analysis of simple frequency tables of responses to the initial and final surveys:

(i) There was considerable growth in the extent of use of microcomputers between the two surveys (a growth of the order of 50%).

(ii) The pattern of use (as represented by the relative frequency of use in different subject areas, different administrative applications, the relative involvement of different individuals and groups, etc.) did not significantly change between the two surveys.

(iii) There was substantial variability between schools in both the extent and type of use made of microcomputers, in both the curriculum and school administration.

The changes in extent and type of computer use between the two surveys in the sample as a whole is similar to that found, and discussed in Part C, in the four case study schools. Had that not been the case the external validity of the case studies would have been suspect. A feature of the research design in this study was to enable the external validity of the case studies to be tested in that way. That is a particular example of the Popperian challenge to search for refutation rather than confirmation of hypotheses and assumptions. The finding that changes in the extent and type of computer use within the four case studies is broadly similar to that within the survey sample does not confirm the external validity of the case studies, but has subjected that validity to a test which has not produced contrary evidence.

The finding of a simple linear expansion between the two surveys has a second, distinct but similar, implication. It implies, though by itself does not prove (evidence of a different kind from within case studies is required for that), that by the time of the first survey a series of decision making mechanisms had been established, certainly in respect of curricular use, which continued during the time-frame of the research as a linear expansion of resources became available and were deployed within the framework initially adopted. That implication enables the conclusions from the surveys and the case studies to be treated with a greater degree of confidence concerning continuity than would have been the case had changes been found between the two surveys in the pattern of resource utilisation or had findings in the case studies discovered turning points during that time-frame. We shall see later that in relation to the use of computers in school administration the introduction of LEA-designed administrative systems during the course of the research does represent such a turning point and the findings in respect of that area of use are treated with correspondingly greater circumspection.

This chapter has primarily focussed sequentially on a number of single variables, to enable a picture to be built up of the state of the innovation in four case study schools, and at two points in time in a large number of schools.

But the more interesting and policy-relevant questions concern the mechanism of innovation, which hinges on the relationship between variables. Conclusions from the investigation of those relationships are reported in Part C. Using the conceptual framework developed in Chapter 3, the way in which the response to the innovation is influenced by key individuals and groups is analysed in Chapter 6 in respect of change agents external to the school, and in Chapter 7 in relation to change agents and user groups within the school; in Chapter 8, the effect of the innovation on those change agents and user groups is developed.

Before analysing the details of those relationships it is convenient at this point to address and discuss a feasible explanation of the differential adoption of microcomputers in schools - an explanation which is feasible but alternative to that based on resource dependency theory which will be adopted in Part C. Many of the measures used in Part C (relating, for example, to the number of teachers who use microcomputers, the number of subjects in which they are used, the extent of use in school administration, etc.) could simply be a function of school size, with large schools having more extensive use simply as a size effect. It is worth testing for that possibility. Not surprisingly, the larger schools had the greater number of microcomputers - the relationship between number of microcomputers and school size (as measured by group number) was highly significant (sig=0.0007 in the initial survey, and 0.009 in the final survey). In contrast, the association between, as examples, school size and the number of subjects in which microcomputers were used (sig=0.41 in the initial survey, and 0.51 in the final survey) and school size and the number of administrative applications (sig=0.12 in the initial survey and 0.42 in the final survey) were not statistically significant. The extent and type of use are explained, as we shall see in Chapters 6 and 7, not by size effects but by key actors using their resource base to influence organisational decision processes.

PART C: ANALYSIS

Chapter 6

CHANGE AGENTS EXTERNAL TO THE SCHOOL

A number of key individuals, groups and organisations which may affect the response to microcomputers in the education sector were identified in Chapter 2. Some of those are change agents external to the school; others are based within the school.

The major external change agents are located in central government (particularly the Department of Education and Science, the Department of Trade and Industry and the Microelectronics Education Programme) and in local government - the Local Education Authorities and their advisers and officers, particularly those with specific responsibilities relating to computer use for teaching or administrative purposes.

In this chapter the role of external change agents will be analysed, based on evidence from both the surveys and the case studies. In the next chapter an equivalent analysis will focus on internal change agents.

Four major themes are developed in the analysis in the chapter. First, both central government (the DES and the DTI) and local government (LEAs) have strongly encouraged the use of microcomputers in schools and have adopted categorical funding mechanisms to ensure the uptake of the technology. Second, the dependence of schools on such external funding mechanisms for resource acquisition has resulted in that funding directly affecting the extent of use of the technology; different LEAs have provided different volumes of financial support, which have translated into different amounts of equipment in schools, which in turn is related directly to various measures of resource utilisation (numbers of teachers using the technology, number of subjects in which it is used, etc.). Third, the advisory mechanisms used by both LEAs and central government (through the Microelectronics Education Programme) have supported rather than challenged the ideology of teacher autonomy within the classroom, so the way in which the technology has been used for teaching has been determined within schools, and the innovation has been implemented in that applications area within a learning paradigm. But, fourth, in respect of computer-assisted school administration, in contrast, standardised systems developed by LEAs are being implemented in a rationalising, controlling mode.

6.1 Change agents at national level

The Department of Education and Science is clearly a change agent of major importance. The Secretary of State for Education and Science is required by Section 1 of the 1944 Education Act to:

"promote the education of the people of England and Wales and the progressive development of institutions devoted to that purpose, and to secure the effective execution by local authorities, under his control and direction, and the national policy for providing a varied and comprehensive education system in every area".

But that, as Griffiths (1966) remarked, "means less than it says". That is partly because directly elected local authorities have a political legitimacy of their own, and have an independent, though increasingly constrained, source of finance via the rate levy. Nevertheless, in the last decade the balance of power has been moving slowly but consistently away from local authorities and towards central government, as discussed in Chapter 2. Central government, in education as well as in other departments of state, has been increasingly directive, via legislative, regulatory, advisory and financial mechanisms, on issues which were previously decided locally.

Central government has taken a lead in educational computing, particularly through financial support mechanisms administered through both the Department of Education and Science and the Department of Trade and Industry. The main involvement of the DES has been through the establishment of the Microelectronics Education Programme, discussed below. In a period of retrenchment of many aspects of educational provision, central government has committed substantial sums of money, in a manner which was highly visible, to promote, support and legitimise educational computing. Taken along with other structural and administrative mechanisms leading to control increasingly centred on the DES (for example the dissolution of the teacher-dominated Schools Council and its replacement by the School Curriculum Development Committee with members directly appointed by the Secretary of State and the potential for computer-assisted learning using the same computer program in a wide range of schools to result in an increasingly standardised and centrally controlled curriculum), there were reservations in some quarters about the establishment of the Microelectronics Education Programme.

The development of those support mechanisms was not, however, party political. At a time during which education was becoming increasingly politicised educational computing policy generated a greater degree of consensus than most other policy areas. The different political parties all supported the development of computing in schools, albeit for very different reasons. Politicians to the right of centre saw the technology as supporting a more vocationally- and industrially-oriented curriculum, while those to the left who were particularly concerned with youth unemployment saw information technology skills as providing pupils with easier access to employment. The Labour government announced in 1978 a five year programme for what became the MEP, but funds had not been committed by the general election of 1979; after that election the Conservative government formally instituted the programme, virtually unchanged, in March 1980.

Alongside the MEP, which focusses on computer software and the in-service training of teachers, was a scheme introduced by the then Department of Industry (now the Department of Trade and Industry) to provide microcomputer hardware to schools at subsidised prices. The implementation of that "Micros in Schools" scheme through the DTI rather than the DES may be indicative of support for an emerging British microcomputer industry as of major significance in addition to the anticipated educational benefits. At the time there did not seem to be at governmental level a clearly developed strategy of educational computing in schools other than to obtain the assumed benefits to the economy of pupils leaving school and seeking employment being familiar with microelectronic devices. The general view was that computers were likely to be "a good thing" educationally and that "something should be done", the initial something being resourcing by "throwing money into the arena" to buy change rather than to force it or to attempt to get change by persuasion. It was even reported in a discussion with one official of the MEP that a small primary school on a remote island off the Scottish mainland had been supplied with a computer but did not have a supply of mains electricity. Whilst that may be apocryphal, it is indicative of the image of the support policy. The DTI hardware scheme seems to have been based on an educational equivalent of Say's Law - that supply would create its own demand, and that the innovation would be driven, or at least started, on the supply side. Such supply-side policies in respect of this specific innovation are particularly interesting and unusual in being implemented by a government which in other respects is wedded to demand-side economic policies. The funding was initially provided only on a pump-priming basis rather than as the first step of a "grand plan". That is consistent with a number of other governmental funding arrangements. As Christoffel commented in relation to other developments:

"It should not be assumed that national-level planning is carried out neatly and logically prior to actual provision of monies. In reality, planning is often carried out at the same time individual (sometimes uncoordinated) projects are being funded.... The result is a somewhat haphazard and uncoordinated development, with planning activities in some cases trying to rationalise and account for already on-going activities or programmes." (Christoffel, 1984, p7)

Moon and Richardson (1984) identify two different regulatory mechanisms by which governments implement policy programmes. The first is the direct administration of the scheme by the relevant government department; this mechanism has been used by the DTI in the "Micros in Schools" scheme, with the type of equipment eligible for subsidy, and school eligibility, being closely defined. The second mechanism is by operating at arm's length through another agency, as the DES has done via the Microelectronics Education Programme. That structural arrangement gave the MEP a greater independence from DES influence than might otherwise have been the case. It is argued here that that independence has been used to the full by the MEP in devising and implementing policies which have directly affected the relative influence of the key actors discussed in the next chapter and, it has been suggested, led in 1986 to the demise of the MEP and its replacement by an organisation - the Microelectronics Support Unit (MeSU) - under much tighter central control.

The person appointed as director of the MEP was formerly an educationist rather than a civil servant. He established the headquarters away from the Westminster-Whitehall nexus at his former working location at Newcastle-upon-Tyne. The MEP structure was deliberately decentralised, operating through fourteen regional offices, each relating to a group of LEAs. The director appointed as staff of the MEP people who were all former teachers rather than bureaucrats. That is highly significant. The programme was quickly established as teacher-led and as cooperative and supportive rather than directive in its relationship with teachers, and the underlying assumption was that the factor critical to the success of educational computing was the commitment of teachers. As one of the officers of the MEP stated:

"Teachers, we would like to believe, are the main instruments for change in education, and the MEP has focussed its attention very much on the teacher in its initial strategy." (Aston, 1982, p14)

And the director of the MEP regional office covering three of the four case study LEAs stated that:

"What is most acceptable in the classroom has been developed close to the classroom.... Past history must show that to treat teachers as just the passive receivers of materials developed from on high is courting disaster".

Partly for that reason, software which carries the *imprimatur* of the MEP tends to be viewed more positively by teachers than that developed by software houses and commercial publishers.

A "cascade" model of diffusion was adopted with the initial plan being that teachers attending MEP training programmes would return to their schools and be a source of expertise to provide further training for their colleagues.

Some school staff have therefore had considerable contact with MEP and others have had none. Although there are mixed views about MEP they seem to be systematically related to the extent of contact with it - those people who have had extensive contact with MEP are, on the whole, positive towards it while those who have had little or no contact are more negative. For example the following teachers have all been extensively involved with MEP:

"They're an excellent organisation.... Whenever we've sought information we've found them very helpful.... My impression of MEP is very favourable" (head of computer studies, Southschool);

"On Thursday and Friday eight of us from the staff went to the MEP exhibition at the Barbican. I think MEP products are very good. We get literature from them and there is advice" (head of computing, Westschool);

"MEP is only across the road there, which is very handy. So if were talking about important people, MEP would be fairly high on the list" (headteacher, Northschool).

But staff of Eastschool, where very little computer-assisted learning is carried out, have had little contact with MEP and are not impressed by it:

"Well, I have no real involvement with it. A couple of years ago a couple of us went across to -------- (MEP regional centre). I wasn't very impressed" (teacher, Eastschool);

"Its around. I've never been impressed by it. It sends us literature and I've been to see exhibitions, but it's not a glowing success as far as I am concerned" (headteacher, Eastschool).

The policies devised and implemented by the MEP have affected the mechanism of innovation in schools and the relative influence of key actors in two distinct, but related, ways. First, the cascade model has underpinned the role of technical experts in schools, in a way which will be analysed in the next chapter. Secondly, the policies have assisted teachers individually in retaining control of decisions about the ways in which computers will be used in their classrooms and thus, in part, enabled teachers to control the innovation. There was no attempt, unlike in some of the commercial software houses, to produce educational software which was "teacher proof". The model of software development adopted by the MEP has been equivalent to that for textbooks. Just as it is not expected that teachers individually will write their own textbooks but will be able to choose from amongst alternatives rather than be required to use a nominated text, similarly with the computer software developed by MEP; the assumption is that teachers individually will not be required to write software but should be able to choose that which suits their teaching style. Further, the MEP deliberately attempted to produce a range of software within each subject, and in some cases within teaching topics in each subject, so that teachers do not have to use a particular item of software but can choose from a range of alternatives. The implicit assumption within the operation of the MEP has been a Parsonian non-zero-sum concept of control: that the quality of the delivery of the learning experience can be increasingly controlled without diminishing the teacher's control of the organisation of classroom activities.

Thus although the MEP was established and developed at a time of increasing centralisation of the curriculum, and the development of software has the potential for increasing centralisation, the culture, strategy and activities of the MEP staff, almost all of whom are former teachers with many on short-term secondment from their school, ensured that the MEP itself was not a vehicle for such centralisation.

It has recently been suggested elsewhere that in respect of another technological innovation in secondary schools (the Technical and Vocational Education Initiative - TVEI) "when viewed from the perspective of the user, the crucial issue is not where a solution comes from but whether the decision to use rests at the level of the practitioner" (Harland, 1987, p51). That may be so in the short-term, and the MEP has attempted to ensure that it is, but in the longer-term the central production of software may be seen as one further brick in the building of an infrastructure within which the locus of the decision to use may change.

The early MEP focus on teachers individually was only later supplemented by a wider concern with the school as an organisation - for example, the emergence four years into the life of the MEP of their MOMENT (Management of Microelectronics in Education) courses, targeted on headteachers and their deputies. That early concentration on teachers rather than at the organisational level partly legitimised the influence of teachers individually, and that of the technical expert in comparison with the headteacher. That relative influence of actors within the school will be developed in detail in the next chapter.

The MEP was set up explicitly as a pilot project, initially for five years but later extended by a further two years, but in 1986 was replaced by the MeSU (Microelectronics Support Unit) at a level of funding of approximately half of that of MEP. It was much more tightly controlled centrally than was the MEP, through a management body appointed by the Secretary of State.

The central government schemes administered by or through the DES and the DTI have pumped relatively large amounts of money into educational computing at a time when funding generally for the education sector has been diminishing, to an extent to which the development can be described in part as a resource-driven innovation. Such specific funding mechanisms are particularly potent when those dependent on external funding (the schools) have perceived themselves to be starved of resources, as Pearman (1986) discusses. The categorical funding policy has been successful in diffusing the innovation and affecting the extent of use of microcomputers in Britain compared with other countries. To reiterate, it has been possible for government ministers to claim:

"Every secondary school now has some computer facility and we are the first country in the world to achieve this" (Baker, 1982, p283); and "As a result of these initiatives the United Kingdom has a more advanced educational IT programme than any other comparable country. No other country has a similar level of penetration within schools and most experts believe that United Kingdom educational software in particular is the most advanced in the world." (Butcher, 1984, p554)

The fact that the UK is the first country to equip all its secondary schools with computers and has reached that position before other Western countries which spend as much in total on education is evidence that government policy has been significant in getting microcomputers into schools, and is consistent with hypothesis 4. Central government has used specific funding mechanisms to divert funds from existing channels into new ones, and hence alter the resource dependency relationship of schools; it has thereby implemented a resourcing strategy which has encouraged schools to take up microelectronics and has created a climate in which the organisational risks associated with the adoption of the innovation are relatively small, and the risks of not doing so in an increasingly competitive environment are considerable. That resourcing strategy, however, has simply not articulated with the individual risks facing teachers as they confront the innovation, nor with the distribution of costs and benefits across different individuals and groups within schools, with consequences which are taken up in section 7.3.

The resource dependency model explains well the mechanism used by central government in influencing both the direction and magnitude of the innovation. An interventionist strategy based on the direct use of financial resources through specific funding mechanisms, rather than the reliance on advice and persuasion and the operation of market mechanisms funded through the conventional block grant arrangement of the rate support grant, has been applied quite specifically to this innovation. A leverage on change has been obtained by the resourcing of both hardware (through the DTI "Micros in Schools" scheme) and software and teacher training (through the Microelectronics Education Programme and the Microelectronics Support Unit) representing not additional funding, but a transfer of discretionary expenditure from local government, consequent on a reduction in the rate support grant, to central government and operated through specific funding mechanisms.

A danger for the resourcer of such resource-led innovation strategies is that adopting organisations may respond merely opportunistically, and deflect the resources to meet other, perhaps quite different, needs. Anyone working in a school can provide a long list of needs, wants or demands which are unmet at any point in time. When "free" or subsidised resources become available externally the need which most nearly matches the resourcer's purposes can be brought out and paraded in an attempt to persuade the funding body that the resources available (and more) are needed. Once the control of the resources is transferred from the external funding agency to the school itself they may be used for the purposes intended by the funder or they may be diverted for other purposes perceived locally to be of higher priority. The danger of the latter strategy for the resource receiver, at least if it becomes known to the funder, is that funds for subsequent phases of the project may be curtailed to organisations which are seen not to have adopted the innovation as the resourcer intended. The major test of such specific funding mechanisms comes at the end of the external funding of the project when the "soft" external, possibly pump-priming, funds have to be replaced by the organisation's own "hard" money.

Nevertheless, central government policies, and as will be discussed below, local government policies, have affected the current extent of use in microcomputers in schools. It will be argued in Chapter 7, however, that it is teachers individually who control the way in which they are used.

A further group which has a direct interest in the volume of equipment going into schools, but has had a negligible effect on the way in which it is used, is the manufacturers and suppliers of equipment. Although the marketing policies of those manufacturers and suppliers have affected the penetration of microcomputers into the school market they have not significantly affected the way in which the equipment is used and, consequently, the effects of its use. That is in contrast with the influence of manufacturers and suppliers in some other sectors of the economy, as discussed for example by Belaton and Loveridge (1985), for which equipment manufacturers supply turnkey systems. In the schools sector of education, manufacturers simply supply microcomputers; the way in which such equipment is used and its consequences is potentially affected to a greater extent by software suppliers rather than computer manufacturers.

But the software market is substantially more segmented than that for hardware, for which the total market includes primary schools, colleges of further education and institutions of higher education as well as the secondary schools themselves. For software, a total market in the secondary sector of only 5,000 schools means that it may not be financially attractive for the major commercial software houses or educational publishers to invest the development costs of a software series, or even of a single program, particularly when they are competing with those produced by the Microelectronics Education Programme, which has been heavily subsidised to produce low price, high quality educational software. The result has been that many of the publishers who made a tentative entry into the market have since either withdrawn or concentrated their marketing of "educational" software on parents and the home market, within the traditions of the promotion of childrens' encyclopaedia. The result has been that the software market is exceedingly fragmented with a large proportion of educational software coming from a very large number of small suppliers, many of whom are teachers selling for pin-money the programs which they have written. The influence of both manufacturers and suppliers on the content of the innovation has therefore been minimal.

6.2 Change agents at local level

Local education authorities, of course, have a key role in the resourcing of schools. Their influence does not relate simply to the volume of resources supplied to schools, but also to ways in which those resources are to be used and the "strings" attached to their supply. In relation to this innovation the tangle of strings is complex, and the range of discretionary funds available is substantial. Local education authorities and their advisers and officers have three related major mechanisms of influencing developments in educational computing in schools. The first includes advice, requests, persuasion, policy statements and other means of influence. The second is the use of financial mechanisms to provide or to encourage schools to obtain hardware and software. And third is the development of skills via the provision of in-service training for teachers and other staff. Those three mechanisms, of course, are not independent; any or all of them can be used in various combinations.

All three mechanisms were, indeed, used by each of the four LEAs studied, though they were used in different combinations and with different emphases and results.

The major difference between the four authorities was in the extent to which they used financial resources to provide or to assist schools in the purchase of hardware and software. The most extensive use of financial resources to provide equipment was in Westlea which supplied each secondary school with ten microcomputers. Southlea reimbursed schools with 75% of the cost of selected equipment. Eastlea and Northlea made less extensive use of direct financial support and that which was given was more selectively targeted on specific schools by the computer advisers. In Eastlea the adviser provides financial assistance

"... only in the sense that I help schools as much as I can on the basis of the budget that I have available. There are really two criteria. One is that the school is doing good work and needs further equipment to support that. The second is that - they may not be doing good work at the moment but there are people who are willing to do things but the equipment is not there - so put it in and see what happens. So it's those sort of judgements. We don't have a central purchasing policy and I can't see much chance of having one. There is a general thing in

-------- [Eastlea] of putting as much capitation as possible into the schools and letting them make the decisions." (computer adviser, Eastlea)

Northlea had only recently started providing financial assistance:

"Until this year (1985) the authority has not put any money into computers in schools. We have not subsidised in any way.... This year for the first time the authority had in its budget £10,000 but that got whittled down because we had to take out the funding for the computer centre from that. But I was able to let schools know that I had got some money and invite them to ask me for some. I didn't even have to spell it out and say that if you want a Beeb then you pay half and I pay half because they were talking about setting up systems and they wanted some help towards that. At the end of the day I had about £5-6,000 to spread over twenty comprehensive schools and I think every school wanted more than the total I had got. So what they each received at the end of the day was not a lot.... I think the least that any school got was £500 - that's just off the top of my head - I think the most that any school got was £1,200." (computer adviser, Northlea)

The case study schools have been successful to different extents in resource acquisition by obtaining such discretionary funds. Eastschool has, according to the deputy headteacher, had "no help whatsoever" from the LEA in purchasing computer equipment and he was not aware of the existence of the computer adviser's discretionary funds:

"The chances [of getting financial assistance from the LEA] would be next to nil. There's nothing earmarked specifically for computers as far as I know.... A lot of computers which maths have have literally been bought out of fund-raising accounts. It really is a crying shame that this is how we have got to go about getting computers." (deputy headteacher, Eastschool)

And at Northschool, funds for computers

"have **all** come from us - they're all our blood and sweat and tears, and looted out of capitation, filching from other subjects, filching from books.... From the LEA we got £600; we asked for £10,000" (headteacher, Northschool).

Southschool, however, where the computer education work is regarded very favourably by the adviser, has been more successful in obtaining discretionary funds:

"We have had help from County central funds on two or three occasions and various initiatives at various times about computers and it has been the case that the school has put half the amount of money and the County put the other half, and this sort of thing. The PTA [Parent-Teacher Association] helped out on a number of occasions. They paid out half the money on the first computer we ever had and helped out on two occasions since then and we've used general allowance so we've been happy to get money from any source that we can." (headteacher, Southschool)

According to one definition of organisational effectiveness used earlier - the ability of the organisation, in either absolute or relative terms, to exploit its environment in the acquisition of scarce and values resources (Yuchtman and Seashore, 1967) - schools have been effective in respect of this innovation to very different extents.

But the volume of computer resources which schools obtain comprises two components (essentially that from "hard" money and that from "soft" money): those variable, discretionary resources which schools acquire, and second, the authoritative allocation of resources by LEAs as part of an educational computer policy. The different LEAs have provided very different volumes of resource in support of those policies. The extent of financial support from LEAs is related to the number of microcomputers per school in the different local education authorities. At the time of the initial survey, Westlea which provided the greatest financial support had the greatest number of microcomputers per school, and Northlea which provided the least financial support had the fewest microcomputers per school. Southlea which provided the second-most extensive financial support had the third-most number of microcomputers per school and *vice versa* for Eastlea. The average number of microcomputers per school was statistically significantly different in the different LEAs, as shown in Figure 17. By the second survey, when Northlea had started to support educational computing financially, the distribution of microcomputers by LEA had changed, but was again statistically significantly different in the different LEAs.

average number of microcomputers per school

	initial survey
Westlea	16.4
Eastlea	10.0
Southlea	8.6
Northlea	7.6
	sig = 0.0000

average number of microcomputers per school

	final survey
Westlea	19.5
Northlea	15.2
Eastlea	15.1
Southlea	14.0
	sig = 0.04

Figure 17: Distribution of microcomputers by LEA

If the size of schools in the different LEAs was substantially different the simple measure of microcomputers per school might not be a suitable indicator of organisational computer resources, in which case a measure such as the number of microcomputers per 1000 pupils might be preferable. In fact the differences between LEAs in terms of average size, as measured by pupil numbers, are small and not statistically significant (p=0.4), and the rank order of LEAs by arithmetic mean of number of microcomputers and levels of statistical significance are robust in respect of both of those measures.

The number of microcomputers per school is, in turn, consistently related to various measures of the extent of use of computers for teaching purposes: the number of subjects in which computers are used; the number of teachers who use computers in their teaching; and headteachers' evaluation of the success of the innovation, thus providing support for hypothesis 1. The Pearson correlation coefficients in the first survey were highly significant (micros : number of curriculum subjects, p=0.000), (micros : number of teachers using, p=0.000), (micros : headteacher's evaluation of success, p=0.023). In the final survey were again highly significant (micros : number of curriculum subjects, p=0.001), (micros : number of teachers using, p=0.002), (micros : headteacher's evaluation of success, p=0.000). The mechanism of: financial support affects the amount of hardware, which in turn affects the extent of use, implies that the innovation is at least partially resource-driven. It also emphasises the extent to which schools are dependent on external agencies, particularly the LEA, for funding the innovation, and is consistent with the resource dependency model in respect of financial resources.

The resourcing policy of each LEA as implemented through the various specific funding mechanisms has been explicitly tied to specific recommendations about particular makes and models of equipment, and in-service training, as a means of standardising across schools within an authority. In Westlea

"Our schools have a choice to buy what they wish but we make recommendations. We recommend that schools standardise on the BBC. And all central financial support is in association with that policy. There are great advantages in standardisation but if a school, for some reason best known to itself, decided to opt out it theoretically has the right to do so and we would not gainsay them. We might argue with them and say 'have you really thought it out properly?; are you sure that you are going to be able to maintain this?; are the benefits what you really think they are?' but at the end of the day if they choose to go that way and put their own money into it they are free to choose in this authority." (computer adviser, Westlea)

In Eastlea recommendations about hardware are also

"... pretty firm. Although we don't say 'you must buy BBC' the fact of the matter is that all our support services and all our in-service training courses are linked to the BBC. For those reasons we support the BBC. So there is a policy although it's not as black and white as saying 'thou shalt buy BBC', but all schools knew that they've got to talk to me if they want to buy anything else." (computer adviser, Eastlea)

Similarly, recommendations in Southlea are

"very firm indeed. In fact it's a County Council ruling that all hardware has to be approved by the County Computer Manager. But on the classroom side of this the County Computer Manager has delegated responsibility for that to the two of us. So every piece of hardware that is ordered using the normal capitation allowance will have to be countersigned by either my colleague or myself, and we are allowed only - in fact we are instructed quite precisely - to sign only those orders which are for approved models." (computer adviser, Southlea)

The policy of standardisation on certain items of hardware extends in some cases to software provision. In one LEA, Eastlea, £100,000 of the teacher in-service training budget was used to provide training in the use of a single item of general-purpose software, a database, which had been developed within that LEA. And in another LEA licensing arrangements had been used to provide for schools, at a subsidised price, particular items of software identified by the advisers:

"We take out licences on software that we hold in some regard. We also bulk purchase certain pieces of software which again we hold in high regard and for which we see a future" (computer adviser, Southlea).

The acquisition of hardware and software resources is seen by headteachers as crucial and their availability as more critical than other factors in constraining the use of computers in both the curriculum and in administration in their schools. Figure 18 shows from both the initial and final surveys the percentage of respondents who identified developments as "constrained to a great extent" by each of those potential problems:

	Curricular use Initial survey (%)	Curricular use Final survey (%)	Administrative use Initial survey (%)	Administrative use Final survey (%)
Lack of equipment	36	39	49	41
Lack of suitable programs	52	24	38	22
Lack of computing expertise	18	19	24	16
Lack of time of people with computing expertise	44	46	47	45
Resistance from teaching staff	3	3	0	3
Resistance from clerical staff	N/A	N/A	4	5
Overload of other innovations	9	12	11	11
Lack of support/advice from LEA	2	5	14	9

Figure 18: Constraints on computer use

Figure 18 indicates, despite the problems of operationalising the questions, that the respondents (headteachers) identified, consistently in the two surveys, shortages of the resources of hardware, software and time as being critical constraints, though the greater volume of software which became available in the two years between the surveys mitigated one problem to some extent. In contrast, resistance from teaching and clerical staff is not seen as a constraint. The perceptions which headteachers report about the lack of staff resistance to the innovation may or may not be correct; they will be taken up in the next chapter. But the balance of constraints is evident. "Give us the resources and we will get on with it", as one respondent wrote, summarises well the views of headteachers collectively.

That position was taken also by the General Secretary of the National Union of Teachers: "teacher acceptance of new technology is not an issue; teacher and pupil access is the issue" (Jarvis, 1987).

Comments from the case study schools echo that view:

"Two things are slowing us down. We can't afford the software, and there's a limited amount of hardware. There's a lot of interest on the part of staff" (head of computer studies, Southschool);

"On the whole I'm confident that given the resources - and this is the point - if we can get the resources before the enthusiasm goes - while the enthusiasm is there they need to get their hands dirty. I think that is a very real danger. But to make a major transformation quickly it needs an injection of money for hardware" (headteacher, Northschool).

Those comments do not imply that the innovation is seen simplistically as unproblematically determined by the volume of physical and financial resources available; indeed, the analysis in the next chapter concentrates on the intangible resources which to a greater extent determine the course of the innovation in schools. But the implications of headteachers' views on constraints for the control of resources within a resource dependency model are clear. The limited discretionary funds which schools have had, and their reduction during the last few years in real if not absolute terms, means that external agencies can readily identify resource acquisition as a vulnerable pressure point through which change can be, if not bought, at least encouraged. Resource control is used by LEA advisers explicitly as a lever to influence decision making on matters on which schools are formally autonomous. For example, if a school in Southlea proposed to buy something other than BBC equipment:

"then we would go and talk to them and explain the policy, and if they decided out of private funds to go ahead and do it there's little we could do about it except to say you will be on your own - software, in-service training and maintenance are your responsibility - whereas with BBC we offer a maintenance service which is very cheap, we offer in-service training relating to the BBC machine and related matters, should we say. And our software library is essentially a BBC software library." (computer adviser, Southlea)

That dependence of schools on LEAs for a range of back-up services, given that the economics of educational computing is such that in addition to hardware costs the collateral expenses are substantial, can establish a relationship between centre and periphery which is very different from that in which the instructional medium is print, and contributes towards the establishment of an infrastructure which can be justified as economically rational but which nevertheless reduces the autonomy of schools and increases their dependency on the LEA.

The "strings" attached by advisers to the provision of discretionary funds can be used as a means of promoting curricular choices in respect of which schools are formally autonomous. For example, the computer advisers in the four LEAs were consistent in their wish to move provision in schools away from examinable computer studies courses, which they regard of the *bete noir* of educational computing, and towards both computer awareness and computer-assisted learning: "examination work is a relatively low priority in our view, though not in the view of some headteachers of course." (computer adviser, Southlea)

That view is indeed at variance with that of some headteachers. In both the initial and the final surveys, headteachers rated computer appreciation courses as highest priority, ahead of computer-assisted learning, but with a substantial minority of headteachers placing examinable computer studies as highest priority. The relative priority attached to examinable computer studies is of considerable importance. According to one adviser:

"If it didn't exist I think very few schools would want to invent it at this stage. It only exists for historical reasons. But given that it does exist it has all sorts of effects on whatever else goes on." (computer adviser, Eastlea)

Those effects were explicated by another adviser in resource dependency terms:

"Some of the schools face a serious problem in that their computer studies work is very considerable and in some cases very successful and tends to dominate the use of equipment and so it is difficult to encourage the whole-school view because people feel that they are not going to get the resources to do it. So I can go into many departments and find a great interest, a great willingness to be involved, but a reluctance to do anything about it at the moment until they feel they are definitely going to have the resources to do it. And many of them find that the way that the resources are manipulated at the moment is so administratively frustrating that they are very reluctant to become involved. And so the development of that sort of policy depends on the school freeing the resources that are presently dominated by computer studies." (computer adviser, Westlea)

The key individuals within schools who influence those patterns of resource deployment, and their strategies for doing so, will be discussed in Chapter 7.

In addition to the physical facilities of hardware and software being available to teachers, they need the skills to use them. The in-service training provided by LEAs is related directly to the advisers' priorities of the three curricular uses, and has changed in emphasis in the same direction, but preceding, those changes in schools. A further change in emphasis in in-service training which has begun to occur, though is not extensive, is a change from the target of training from individual teachers towards groups of staff with the intention of generating a critical mass and developing school-wide policies within each school. Much of the training, however, has concentrated (and still does) on individual teachers, by offering the courses which would attract teachers, who often attend in their own time, and perhaps at their own cost. So in Southlea

"We have done certain things on the teaching of BASIC because that's what teachers wanted and that's what teachers would come for." (computer adviser, Southlea)

Increasingly, in-service courses are provided for headteachers and senior staff.

In terms of Elliott-Kemp's (1982) classification of innovation strategies this represents a change from simply "enlarging the circle of understanding" towards a strategy of "enlisting the powerful who are presently uncommitted". In one LEA:

"We have had courses for senior staff looking at the role of information technology across the board. In a year, of thirty secondary courses only two are on computer studies." (computer adviser, Eastlea)

The advisory support which is provided to schools is, however, modest. An adviser with subject responsibility for perhaps forty secondary schools and two hundred primary schools can provide little support for each school. One means of addressing that constraint is for the adviser to "adopt" certain schools and target his work on them rather than others. That does seem to have been done in each of the four LEAs. From the initial survey the influence of computer advisers was reported by headteachers as

	Northlea	Southlea	Eastlea	Westlea
Extensively involved	50%	31%	12%	16%
Fairly involved	0%	29%	14%	28%
Some involvement	0%	25%	30%	24%
Little involvement	50%	6%	30%	8%
Not involved	0%	7%	14%	24%

Figure 19: Involvement of computer advisers

Computer advisers have significant patronage available via the budget which they control. *One computer adviser requested that I switch* off the tape recorder being used during the interview while he informed me that the LEA policy was to provide 50% of the funds for the purchase of approved items of computer equipment, with the other 50% coming from the school's budget, but, contrary to that policy, he was able to find means of funding 75% of the purchase price from local authority funds with the school having to find only the remaining 25%. Another stated that his budget was twenty-five times larger than that of any other adviser in that LEA. But even so, he identified his dependence on education officers for that budget: "if you haven't got the support of the officers you can't get anything done because they have contact with the money side of things" (computer adviser, Eastlea).

That budgetary control is important for two different, but related, reasons.

First, it enables the computer advisers to withhold or deliver resources to schools on particular terms and to channel discretionary funds in directions which they feel should be supported. That may result in school policies and activities becoming more similar rather than increasingly diverse. And, secondly, it illustrates the importance for school staff of resource acquisition by gaining access to the discretionary funds which advisers have available. In response to the identification by the headteacher of Northschool of his priorities for the use of computers at the school, I commented that I thought his rank order would be similar to that of the computer adviser. "Would it?", he replied, "then I'll tell him that I agree with him and tap him for some more money!" We saw earlier in this section that schools have been successful to very different extents in doing that.

As a further strategy for influencing the resource allocation process, in one LEA, Northlea, an informal computer advisory group has been established by advisers and teachers with a brief to provide policy advice to the Chief Education Officer, but with the major purpose of acting as a legitimised pressure group at a key point of financial decision making and priority setting - the Education Committee:

"At the moment we are working on producing a document on a policy for computer education for -------- [Northlea] schools. That document will be presented to elected members in the hope that if we can get the policy document passed there might be some more money forthcoming to implement it. Whatever we do in that committee, what it all comes down to in the end is resources - money" (head of resources, Northschool).

A chain of resource dependence is thus established. Schools are dependent at least to some extent on advisers' discretionary budgets; the advisers are dependent on education officers' resource allocations; and officers are themselves dependent on budgetary decisions which they can influence but which are made by the local politicians, both in caucus groups and formally the fora of the Education Committee and the Finance and General Purposes Committee.

In addition to the computer advisers it is possible that advisers with responsibilities for particular subjects are influential in respect of computer-assisted learning in those subjects. That provides a means of testing within-LEA and between-LEA differences in the utilisation of computer resources. In each of the LEAs advisers in some subjects but not in others were reported by the computer adviser to be interested and involved in computer-assisted learning in their subjects.

"Some are very interested indeed - history, modern languages, religious education. Maths less so." (computer adviser, Eastlea)

"Interest in maths and science, special education, music; geography interested. Not much interest in history or in art." (computer adviser, Westlea)

"Our geographer, our historian, our CDT man, our maths and one of our science colleagues - so that's five distinct areas of the curriculum where they have shown a good deal of interest and involvement." (computer adviser, Southlea).

"I know about the geography adviser - he has done quite a lot." (deputy headteacher, Southschool)

In Northlea, where there is not an adviser solely for computing, other advisers have been involved

"very much. I think it's funny really and I think it's a spin-off from the fact that I've not been particularly active myself that at the end of the day they've had to take it up. I get this feeling that if you took somewhere like -------- [Eastlea] where you've got a very good computer adviser, I suspect that -------- [computer adviser] is doing a lot of work himself. But because I've said 'look, I'm not doing the work. If you feel that there should be something going on in CDT then it's up to you to take it on board'. And they have done. They've done it very well. So we've got user groups in home economics, religious education, modern languages, CDT and science, headed by the advisers." (computer adviser, Northlea)

It is very relevant, however, that there are not significant differences between authorities in terms of the extent of computer use in different subject areas. So, in the initial survey, the extent of use in geography was:

	Northlea	Southlea	Eastlea	Westlea
Used extensively	0	0	2	2
Some use	7	32	26	19
Not used now but likely to be used within the next 2 years	4	20	17	10
Not used now and unlikely to be used within the next 2 years	1	1	2	1

sig = 0.81

Figure 20: Computer use in one subject area

A similar pattern - that there are not significant differences between LEAs - was found in the final survey also for geography (sig=0.87), and in respect of other subjects in both the initial and the final survey. That implies that use in the different subject areas is primarily affected by the staff of the school rather than by the LEA, and provides evidence in support of hypothesis 6.

That conclusion is consistent with the way in which advisers state their role - "advisers advise". Although they can exert a "normative dominance", and can use resourcing mechanisms as we have seen, they have no formal authority within the schools other than that based on the ideology of professionalism. The model of innovation espoused is one of professionalism rather than control. The Eastlea policy paper written by the adviser, for example, was produced as a discussion paper, not a directive. It

"doesn't address computer studies, which depends a lot on the school - different schools have got to respond to that in different ways. It doesn't stipulate how a school should deliver these guidelines" (computer adviser, Eastlea).

Similarly

"some of them [the schools] worked out some very interesting ideas actually. But they worked out these things according to the interests and strengths of the schools." (computer adviser, Southlea)

The control by schools, rather than by the LEA through its advisers or by other mechanisms, of decisions about the curricular use of microcomputers is reflected in the pattern of their use in different schools within an LEA. So, in the initial survey, in the LEA with the largest number of schools (Southlea) for example, the pattern of use is very different in the different schools, as the following table illustrates:

	Used extensively	Some use	Not used now but likely to be used within the next 2 years	Not used now and unlikely to be used within the next 2 years
			% of schools	
English	0%	28%	44%	28%
History	0%	31%	56%	13%
Geography	0%	60%	38%	2%
Mathematics	27%	66%	5%	2%
Physics	2%	71%	27%	0%
Chemistry	0%	55%	43%	2%
Biology	0%	62%	34%	4%
General/integrated science	0%	40%	55%	5%
Foreign languages	0%	30%	47%	23%
Home economics	0%	18%	32%	50%
CDT	4%	37%	50%	9%
Remedial education	14%	58%	24%	4%

Figure 21: Computer-assisted learning in one LEA

Thus, although some curricular applications (such as mathematics and remedial education) are more common than others (such as English and home economics), reflecting the distribution of uses in the other LEAs and for the sample as a whole as illustrated in Figure 7, there are for each of the curriculum areas some schools which are already making "some" or "extensive" use of the technology and others in which there are not even plans for its use in the near future. That divergence of practice supports hypothesis 5 that the pattern of curricular use is different in different schools within an LEA, and is indicative of a school-based rather than an LEA-based locus of decision making about the curricular use of the new technology. Further evidence of the decisional location being in the school is that the LEA education officers (and to a smaller extent the advisers) are not fully aware of the curricular use of the technology in schools in the LEA. Indeed, for one of the case study LEAs, Eastlea, I was requested by the education officer responsible for planning and resources to provide information from the survey to enable the education officers to ascertain the extent and distribution of use of microcomputers in the curriculum in schools within that LEA, and with the agreement of the survey respondents I provided that information.

The discussion above has emphasised the role of advisers and officers rather than local politicians. Officers and advisers are far from being simply the passive implementers of policy determined by elected members. Although the agreement of the Education Committee is needed to authorise appointments of advisory staff and to sanction funding for capital purchases the innovation is largely an initiative of officers and advisers rather than local politicians: "this one is certainly not a members initiative" (education officer, Eastlea). The exception is Southlea, where the 1981 policy paper was produced at the initiative of the chairman of education committee. The computer adviser thinks that Southlea "may well be unique in the country from that point of view". The political parties in Southlea are broadly in agreement on computer education policy, and the computer education policy developed by the Conservative administration has been carried forward unchanged by the Labour group who are now in power. The policy paper:

"... was unanimously accepted by teachers, by administrators, by both of the major parties and so any change of government has not basically affected the general principle of forward planning, so that has been an enormous advantage.... There is quite strong support still, it seems to me, from both of the major parties. After all, the then Chairman of Education Committee is now Leader of the Opposition at County Hall and the present Chairman of Education Committee served on the working group, so there has been a degree of continuity" (computer adviser, Southlea).

That policy consensus across the political spectrum applies also in other LEAs and reflects that identified above at national level in respect of educational computing policy:

"As far as I know there has certainly never been any political differences over the issue of computer education.... Right across the political spectrum individuals have very great uncertainties about the information technology future. There is no doubt at all that elected representatives have their anxieties and strong viewpoints, but I would say certainly also in relation to Education Committee they have never really been substantially in doubt that it is a major educational issue. They have divorced themselves from the 'what might be, what might not be' sort of thing of the future to say that this is educationally important for children at the present, it is a major tool within education, it is a major piece of knowledge of new ways of life that children should know about and understand. So, a variety of motives, maybe, but they have come to a fairly strong consensus about the importance of the thing" (computer adviser, Westlea).

Education Committees have generally been reactive rather than proactive as far as computer education is concerned. That applies also in respect of computerised administration, to which we now turn.

The national programmes of the Department of Education and Science, the

Department of Trade and Industry and the Microelectronics Education Programme have focussed on the use of computers for teaching purposes and have explicitly excluded use in school administration. The significant change agents external to the school are therefore solely the LEA personnel. We saw in relation to curriculum use that the policies of the four LEAs were rather similar to each other. But in relation to use in school administration the four LEAs have both different policies and different structural arrangements for formulating and implementing policies. For those reasons and because of the absence of policy guidelines from central government (though that absence is itself relevant, of course) the extent and type of use of computers for school administration in the four case study authorities can illuminate particularly the relative influence of local education authority and school factors.

In two of the LEAs (Eastlea and Westlea) an education officer has been given specific responsibility for computers in school administration. Developments in these two LEAs have been more extensive and different from those in the other two authorities, where responsibility has rested with computer advisers whose prime interest has been in curriculum applications. In both of the authorities in which an education officer has been appointed as project manager the developments have been similar. The computer advisers were pleased in both cases not to have been involved in the school administration project - despite different interpretations about how the division of responsibilities arose: "we are trying to take that [the computer adviser's involvement in school administration] away by saying 'there is a big enough problem with the curriculum without you getting too involved in the administration'." (education officer, Eastlea). On the other hand, the understanding of the adviser himself was:

"It [the division of responsibility between advisers and officers] arose because I made damned sure that it arose. Because this job is so open-ended you can end up doing everything. So I made sure that administration wasn't part of my brief but that I was consulted" (computer adviser, Eastlea).

And elsewhere:

"I'm very glad that this Authority chose to divorce the administration issue from the educational issue because it has caused adviser colleagues in some other authorities that I know of some very serious problems" (computer adviser, Westlea).

In both cases it was necessary initially to convince elected members to vote the necessary funds for the scheme, the disbursement of those funds subsequently being at the discretion of the officers.

"We had first of all to convince key members that it was a good idea. I happened to come back from London on the train with the Vice Chairman. That provided the ideal opportunity to convince her that here was something we ought to be involved with" (education officer, Eastlea);

"We have put forward our proposals and with a little bit of patient explanation we have generally found support" (education officer, Westlea).

The timing of the pilot scheme in Eastlea, where political control was finely balanced, was delicate - just before the local government elections:

"Before the election I was quite hopeful in as much as informal talks with the Chairman of Education [Labour] had showed that he was willing to put money into this area. Certainly the then opposition [Conservative] in their manifesto for the elections had said that all schools should be cost centres and have much more management. The obvious corollary of that was that they needed the tools to manage, so I was quite hopeful there. In a sense we have got the worst of all worlds by having a hung council." (education officer, Eastlea)

In both LEAs the hardware and software is being provided free of cost to the pilot schools and access to those resources partly explains the enthusiasm of schools to be involved in the pilot scheme. The project manager in Westlea had "another twenty-odd schools biting my hand off to get into the scheme". The situation was similar in Eastlea according to the education officer and the headteacher of one of the participating schools:

"The LEA sent round a circular asking who would be interested. I said I would be. In fact I think I pushed the case a bit because I wanted to get what was going." (headteacher, Eastschool)

Schools have responded opportunistically to the computer-assisted administration pilot schemes (as they have to national and local government schemes for the partial funding of hardware for curriculum use, as discussed above). The bargaining strategies - with bargaining viewed as "that specific form of exchange involving concessions by one participant for resources controlled by another" (Rhodes, 1981, p105) - employed by each of the parties are clear. The LEAs have attempted to use the power of the purse to link the resourcing of the innovation with the control of its operation and to ensure that the project was not "corrupted" but was introduced in ways which the project manager wished.

"We said 'well, if the authority funds the equipment the authority has a reasonable right to say "O.K. - you want to come in - it's on our terms".' I haven't had to make any concessions at all. All the schools have said 'fine'. All of them have said 'we'll toe the line'." (education officer, Westlea)

And in Eastlea central funding has been used, as stated earlier, to attempt to specify who will use the equipment:

"We have been very clear that the basic work is going to be done by the ancillary staff. I'm very conscious of the amount of time that teachers - and quite senior teachers - are spending as data-prep personnel. That seems to me to be an enormous waste of time." (education officer, Eastlea)

In both authorities, possibly because of the close involvement of education officers in the project, industrial relations issues and the involvement of relevant trade unions have been seen as central. In Westlea

"We had to be assured that schools were going to operate what I would call good industrial relations principles, i.e. identify the staff who were going to be involved, communicate with them what is happening, nominate people who will take control. Equally, we as central management have got to negotiate a corporate agreement with the unions to cover the introduction of a piece of technology, be it at school A or at school Z. And this would cover such things as the environment, health and safety, time at a keyboard, grades, who had charge of what, job descriptions - so there'd be a full package."

The consultation

"... initially was not at union level; it was with people representing teachers - heads, deputies, whatever, and with officers representing administration. The time when we got round to formal discussions with the unions was when we had got a statement of intent as to what we would like to do in terms of equipment - what, where, how and who would be involved. The teacher unions were very forthcoming, very helpful. NALGO, I think because of the twelve week industrial action we suffered from in housing last October, November and December, were very brittle, but ironically, I don't think that people who represented executive-level NALGO were in tune with the people who are in the schools. And universally when we've gone into a school the first question I have put to a head is 'would you please talk to your Bursar/CAO and see whether or not they feel they want to use technology and when you've talked to them I will come back and we'll continue the dialogue if it is, in fact, positive'. Now in all the schools we've talked to the staff have said 'yes, we'd love to take it on board', but we've said 'well, you're not going to until we can get some formal agreement which will cover you as union members'. -------- [Westlea] has got the particular problem that we have still got the union shop agreement - closed shop agreement - and though Tebbitt's Law may well change that, at the moment it is a very real factor in our negotiations. Consequently what we have then done is to put to the Executive of the -------- [Westlea] branch of NALGO what we want to do. At the moment the indications are that we will get this universal agreement accepted so that would cover everything - system outline, grades, working conditions, use, applications, you name it - it's there." (education officer, Westlea)

And in Eastlea:

"Teachers' unions were represented on the working party, and we had a representative from the ancillary staff who was carefully selected as someone who was very active in trade unions. We also have joint consultative committees and the whole report went to the non-manual JCC and they simply approved it - they had the opportunity to bring forward any questions and any ideas. The report went through the committee cycle - I can't remember whether it was the Schools Sub-Committee or the Development and Resources Committee, the Education Committee, then Computer Committee and ultimately to the Council as a short paragraph. There are representatives of the unions on those various committees." (education officer, Eastlea)

That union involvement and the establishment with relevant clerical staff unions of new technology agreements (by the borough or county council rather than the education department specifically) is significant given the background of previous reductions in clerical staff numbers in the authorities. In Eastlea, clerical staff numbers in schools have been diminishing:

"A couple of years ago we set out a new system of points for ancillary staff and schools could spend these points in a variety of ways. Unfortunately, what happened was, as an economy measure, all schools were brought down to 80% of their points allocation. This probably didn't affect schools too much because they were very badly staffed anyway and there has been a tendency for schools to drift downwards, for staff not to be replaced so that they don't use their full points." (education officer, Eastlea)

Within the schools there is a feeling amongst some staff that clerical staff reductions have resulted from financial cutbacks rather than being associated directly with the introduction of new technology:

"We are at this school working one person under par because it was the policy a few years ago not to replace anyone who left, and unfortunately we had someone who left during that period. It's changed now but because we managed with the two of us on our own we couldn't get the one back then. So I don't think they can cut the staff any more because we are working under a strain now." (bursar, Eastschool)

Within the education offices also the school administration schemes are not justified in terms of staffing reductions and cost savings:

"All the evidence we have suggests that there won't be savings. There might be better use of resources, more efficiency, more job satisfaction, more management information, but cost savings are just a non-starter as far as we can see." (education officer, Eastlea)

And in Westlea

"I don't think there will be any specific benefits to the LEA - certainly I doubt it will save us any money. What I think it will enable us to do is - when we need statistical data - is to ask questions in a format which will enable them to supply the answers easily and the data will be right and it will be current.... Those are the major benefits. I don't see anything particular in terms of costs." (education officer, Westlea)

That availability of information centrally is also seen as important in Eastlea. The education officer responsible for the computer project articulated the classic response to external threat and contraction - of increased centralisation, with its requisite informational base:

"In the past schools were given a lot of autonomy, and perhaps rightly so, to develop in whatever way they saw fit and the LEA exercised very loose control of the management of schools. There was sufficient money from the LEA to allow thousands and thousands of flowers to bloom in different areas. Now we are a bit shorter; the various financial controls of the LEA mean that we haven't got that amount of money. The margins for adaptability and flexibility are much tighter so the LEA itself needs to keep a much tighter control of the management of the system, just to ensure that we are using the money wisely - that we are not squandering the few resources we've got. We are also under pressure to monitor things much more closely and justify ourselves, so we have to have much more knowledge about what is going on now. The political climate is such that people want to know, so we need that information. So that two-pronged historical development has led to a need to ensure that the management of schools is much tighter, that it is under some sort of - not control of the LEA, because there wouldn't be much point in having heads as managers if they were totally controlled - but at least they are under the general policy guidance. I think the analogy with business is much stronger now than it ever was." (education officer, Eastlea)

The availability centrally of current, accurate data for monitoring and control requires that the administrative systems in schools are standardised, and standardisation is, indeed, an important feature of the pilot scheme and its planned extension in both authorities. There is a fundamental tension in systems design between the achievement of the needs of the centre (the LEA), which are best met by a standardised system, and the needs of the periphery (the schools), which may be to some extent idiosyncratic. Those idiosyncrasies may be present both in terms of an "objective" assessment of system design needs and also of the psychological need to be involved and participate in design rather than to be required to use an imported innovation with its attendant "not invented here" problems. That tension has a parallel in many other multi-site organisations, but the traditional autonomy of schools has been such that they might feel justified in demanding systems which are not standardised but particularistic and meet their specific needs. The way in which that tension is resolved, of course, further defines the relationship between centre and periphery. In Westlea the education officer identified the specific case of the "maverick headteacher" who had bought an IBM microcomputer which, in view of the Council's purchasing policy, was "like a red rag to a bull". And in the Westlea schools as a whole rationalisation was a major objective in the LEA scheme:

"Some entrepreneurial people were developing systems for various applications. All of them were little private pet systems. The difficulty was that in the majority of cases they were not in any way chronicled so that if anyone left - they bore no shape or semblance of being corporate in that they could be used widely in all -------- [Westlea] schools. My remit was to try and pull this together and bring some sort of sanity into what was fast becoming a very disoriented, very disorganised situation.... We have now reached the point where if we don't do something in the schools the schools will do it themselves and what we will get is a series of disparate developments going on - which should be resisted." (education officer, Westlea)

The computer adviser there reflected on the project led by his colleague:

"We really want standardisation in this field as well, and, of course, that is what -------- [education officer] is working towards and making such good progress towards" (computer adviser, Westlea).

Again in Eastlea resourcing was seen as potentially a means of ensuring standardisation:

"It's obviously not sensible to have schools running down their own track. So the intention will be to ensure that there is uniformity. How we will ensure that is very problematic. The obvious way is to pay for it. But finding that amount of money is another issue." (education officer, Eastlea)

There is clearly a relationship between standardisation and centralisation. Standardisation does not, by itself, necessarily result in centralisation. But, conversely, standardisation may be a necessary condition for centralisation. Child and Francis (1981), indeed, describe the incremental process through which power is drawn to the centre of organisations through the standardisation of administrative processes. But standardisation is not a sufficient condition for centralisation. Nevertheless, there are reservations within some schools about such standardisation and its implications for the location of decision boundaries. As Schon (1973) pointed out, what looks from the centre like the periphery getting out of control, looks from the periphery like creativity and the use of initiative to meet local organisational needs. There is a concern within the education office also that the project intentions might be deflected as control of the physical resources recedes from the LEA and passes to the schools themselves:

"There is a schizophrenia in schools. It's very difficult to put your finger on this. On the one hand schools will say 'yes, it's very sensible - the LEA ought to have a standardised policy; there ought to be uniformity in software and hardware'. On the other hand schools are very fearful of the LEA becoming the 'big brother', just as LEAs are very fearful of the DES asserting much more control on them and reducing their areas of discretion. So there's a schizophrenia here. It's difficult to know where that will come out and show itself. I suspect at this stage there will be agreement that 'yes, it's a good idea'; as one gets nearer the time that there is a definite policy - however it's put forward; whether it's the LEA paying for the lot or asking the schools to make a contribution - I suspect the other edge of the coin will show itself and there will be a lot of comments about 'is this really such a good idea; the LEA is getting more control of us'." (education officer, Eastlea)

Responsibility for developments in computer-assisted school administration has been located with an education officer in both Westlea and Eastlea and the projects have, then, been similar in both. It is perhaps not surprising that developments have been similar in those two cases. The education officers, having been given responsibility for those projects, clearly have a vested interest, and that interest is likely to be furthered by the development of standardised systems tightly controlled from the centre. The officer in Westlea limited the number of schools in the pilot project to "the number of schools that I can realistically manage to ensure that we do have a success factor". Both projects rest firmly within House's (1981) "technological" perspective on innovation, discussed in Chapter 2, associated with the assumption that the innovation process should be similar in different institutions. The standardised systems were justified in both cases in terms of technological and economic criteria, rather than by personal or non-bureaucratic ones. The different criteria and multiple motives are not necessarily incompatible of course; diverse motives can be served by a single choice. Nevertheless, the two projects managed by the education officers did have much in common.

Developments in Northlea and Southlea, however, where responsibility has been located differently, present a contrast. In Southlea a computer adviser has been given responsibility for both curricular and administrative use, but his interest and enthusiasm relates clearly to the former rather than the latter. And in Northlea the long-standing dispute between the council and NALGO relating to new technology has meant that the education department has been unable corporately to implement a policy to use computers in school administration. In both of these LEAs the impetus for administrative computer use has come from the schools themselves rather than the authority and has resulted in idiosyncratic, incompatible systems being produced. That is much regretted by the computer adviser in Northlea, where the NALGO dispute has largely been ignored at individual school level and the use of microcomputers in administration

"... *has crept into the majority of schools but what it* [the NALGO *dispute*] is preventing is the proper use - the coordinated use of them. I'm trying to think of schools where I don't see them being used. I think the vast majority are using computers. But what I'm not able to do is put on a course for school secretaries - they just won't let me do it." (computer adviser, Northlea)

That is reflected in Northschool where the headteacher reported that:

"NALGO have got an official dispute but there are obviously a number of gaps which people are turning a blind eye to.... We've gone ahead in the expectation that it's not going to cause too many problems." (headteacher, Northschool)

The deputy headteacher there is strongly critical of the lack of assistance from the authority:

"There hasn't been any overall coordinated plan to make sure that it is promoted in a meaningful sort of way. There seems to be no cohesion. There has never been any positive drive to say 'look, we want all schools to have it - you will have X, Y or Z'. I don't think there's any whizz-kid in computers in the authority. I don't feel there is anyone we can go to who you would feel is the absolute expert on computers. Different schools have different systems in administration. If there had been an overall policy that it is good for schools to have certain pieces of equipment for the good running of the administration and that programs would be distributed and everyone was on the same basis I would have thought that that would have been cheaper and more cost-effective.... Each school has got its own system but none of them are compatible - that must be a waste of money. This sort of thing is unsatisfactory. I can't imagine it in industry - a big firm with several branches each having their own little tin-pot private arrangements." (deputy headteacher, Northschool)

In Southlea also schools themselves have taken the initiative and developed computer-assisted administrative systems. Foremost amongst them has been Southschool where the head of computer studies developed a very sophisticated system. The schools in the county pressed for the authority to develop a policy and this resulted in the establishment of a working party on school administration and the Southschool system being introduced into four other schools for evaluation. According to the head of computing at Southschool the LEA has acted too late:

"-------- [computer adviser] has always said that administration is very much a secondary thing - of lesser importance. For the first twelve to eighteen months of this working party I got the impression that the working party was really something that had been put on by this authority to give the impression that we were doing something - to quell the mounting frustration. There were a number of people who were feeling similarly - we had at least one resignation because he felt we weren't getting anywhere." (head of computing, Southschool)

The location of responsibility for computer-assisted school administration with a computer adviser who is primarily interested in curricular use has resulted in industrial relations issues being given less prominence in Southlea than elsewhere, as the following extract from an interview with the adviser demonstrates:

DL: Is there a New Technology Agreement within the Authority - signed presumably by the Local Authority rather than the Local Education Authority - that would cover the use of this kind of technology by school clerical staff?

Computer Adviser: You mean with the unions?

DL: Yes.

Computer Adviser: There have certainly been discussions taking place in general terms between the County Council and the unions on the place of the new technology. Now, I have not been involved in those directly, nor indirectly really. I've only been made aware of them when certain other things have cropped up in discussion. Certainly, I can say that the clerical staff of the four pilot schools did not raise any objections whatsoever. In fact, they were more than keen to get involved in it rather than being conscious of being taken advantage of, or whatever.

DL: And what's happening about the Data Protection Act?

Computer Adviser: We have had some sessions in our working group where we have discussed the Data Protection Act and its importance and relevance, and some of the absurdities included in it as well as the legitimate protection. Absurdities in the sense of implementation within a school situation - implementing something that was not intended to meet school needs - how it can, if it can etc. - that's what I mean.

DL: Has a decision been taken yet about whether individual schools will register as data users or whether it will be the Local Education Authority that registers as the data user?

Computer Adviser: That will be taken at County Hall level, I'm sure, but it is an issue that has been debated in the working group and will continue to be debated at County Hall level.

That contrasts greatly with the way in which the same issues have been dealt with in both Eastlea and Westlea.

Thus, both Eastlea and Westlea have been proactive in the use in schools of computers in administration. That has been reflected in the pilot schools in those LEAs, and in terms of expectations in those schools which will become involved as the project is diffused. In contrast, and providing further support for hypothesis 7, the Southlea and Northlea LEAs have been reactive to different but more limited extents to pressures from schools and the expectations from them that their LEAs will provide support in the use of computerised administration.

At the time of the initial survey those differences had not had time to have effect as the pilot schemes in both Westlea and Eastlea were introduced at about the same time as the initial survey, which therefore captures data relating to developments in schools individually rather than as affected by LEA initiatives. Similarly, by the final survey the pilot schemes were only beginning to be diffused, so the number of schools involved in the LEA schemes was not substantial.

The extent of use in schools, as measured by the average number of distinct administrative applications (pupil records, timetabling, etc.) was:

	Average number of applications per school			
	Northlea	Southlea	Eastlea	Westlea
Initial survey	1.54	1.49	2.57	1.30
Final survey	4.33	4.51	5.13	3.15

Figure 22: Administrative applications by LEA

The initiative and control of computer-assisted administrative systems has moved from schools individually to the LEAs. But it has rested there. There has been no development centred on the DES. The area of school administration was specifically excluded from the remit of the *Microelectronics Education* Programme, and a number of proposals to the DES to fund the development of a computer-assisted school administration system which could potentially be adopted nationally have been declined. The LEAs have therefore operated in isolation from national guidelines and at least one of their officers regrets that "a lot of LEAs are doing a lot of things but the saddening thing is that very few Authorities are prepared to share their talents, joys, sorrows and traumas" (education officer, Westlea).

The initiative taken by LEAs in developing standardised computer-assisted school administration packages has not been resisted by the schools. Indeed, it has been encouraged. In Figure 18 it was reported that 14% of headteachers in the initial survey identified that the use of computers in administration had been "constrained to a great extent" by "lack of support or advice from the LEA". By the final survey that had doubled to 29%. And the comments above from the case studies: "we had at least one resignation [from a working party] because he [a deputy headteacher] felt we weren't getting anywhere" and "each school has got its own system.... This sort of thing is unsatisfactory" are corroborative of that data.

That evidence is not incompatible with a resource dependency model of the innovation. The LEA-developed systems may be seen from within schools as a means of externalising risk, minimising uncertainty and achieving, if not control, at least predictability. Those who perceive themselves as starved of resources may see the exchange process involving the relinquishing of some autonomy as a means of obtaining computer systems without themselves incurring purchase or development costs, and perhaps that when the physical resources move from the LEAs the school's priorities can be superimposed on the system and aspects of it which may be unacceptable to the school can possibly be subverted or simply not used. The education officer quoted above as identifying "a schizophrenia in schools" may have identified the same possibility as control of the physical resources passes from the LEA to the schools.

The models of innovation implied by the actions of LEAs are substantially different in the two major applications areas of the curriculum and administration. In respect of curriculum use a "learning model" is implied; for administrative use a model which can be described as a "product development model" has been applied. In all four LEAs support for curriculum use has been structured by means of the appointment of a computer adviser. Given that all of those advisers are former teachers it is perhaps not surprising that they have implicitly but consistently adopted a learning model in respect of schools and teachers coming to terms with the possible use of computers in the curriculum. That is manifested both in the advice given to schools and teachers and in in-service training provision, as suggested by the statements of the respective advisers:

"We have done certain things on the teaching of BASIC because that's what teachers wanted and that's what teachers would come for" (Southlea);

"it doesn't stipulate how a school should deliver these guidelines" (Eastlea);

"some of them have worked out very interesting ideas actually. But they worked out these things according to the interests and strengths of the schools" (Southlea);

"quite a number of teachers were interested in programming, and it wasn't particularly our policy to encourage teachers to be programmers but as they had the interest and did want to spend the time and effort we did meet this and had some quite extensive courses." (Westlea)

Insofar as control processes have been incorporated into the curricular uses of microcomputers they have focussed on the control of outcomes rather than of processes. They have been concerned with ensuring that pupils meet microelectronics within an implied if not yet an extant core curriculum (the importance of microelectronics within a technologically-oriented core curriculum is currently an important concern of central government, and LEA advisers have been equally keen to ensure that all pupils rather than only an examination élite are exposed to microelectronics as part of their curriculum) and using specific funding mechanisms to ensure that the innovation is resourced. They have been concerned also with the control of the quality of learning experiences (the MEP, for example, as a major source of educational software, has placed a high priority on control of software quality, while being concerned that the choice of particular items of software should rest with teachers).

In relation to the use of microcomputers in school administration, on the other hand, there has been a concern within the LEA-developed systems not only with the control of outcomes but also with the control of processes by defining standardised systems tightly and attempting to ensure, again by specific top-up funding of clerical staff, that the systems are based in school offices rather than being teacher-based. In relation to computer-assisted school administration a "product development model" rather than a learning model has been used. This has involved, sequentially, the stages of: first, obtaining authorisation for development; secondly, the development of a prototype; thirdly the testing of the prototype; and fourthly the modification of the prototype to produce a finished product for schools (which formally can choose whether or not to adopt the product, though the wish of the LEA project manager is that the product achieves the highest possible market penetration). In Eastlea and Westlea the innovation is, in terms of Schon's (1973) classification, clearly a "centre-periphery" type but in Southlea and Northlea it is, by contrast, of the "periphery-centre" (or "periphery-centre-periphery") type. In all four authorities the innovation is, of the models discussed in Chapter 2, closest to that named by Havelock (1973) as "research, development and diffusion" and by House (1981) as "technological", resting on the assumption that it is possible to design a system which potential users will recognise as optimal and therefore implement in the classic rational-empirical mould. Although some potential users have been consulted at the design stage the systems have been built for the users only collectively.

There is a recognition within the LEA school administration projects, as in the information systems design literature, of the need to take users' views into account in systems design. But that MIS design literature assumes either that each system is a one-off, or if it is to be replicated at a number of sites that it is sufficient to take into account the views only of a representative set of users. Those assumptions may not be felt within schools to apply to organisations which have traditionally had substantial autonomy in the arrangement of their affairs and in which that autonomy has a high salience in the organisational culture. The design of a standardised system which is perceived locally to give insufficient cognizance to the idiosyncrasies of each school can meet resistance not on the grounds of the "quality" of the product but on the process by which that product enters the organisation. An individual user may feel that the system is being to some extent forced upon him rather than built for him. The systems have been designed in a way which ignores the precepts of the socio-technical systems literature, and have either attempted to optimise on technology alone or to take into account the views of potential users only collectively rather than on an installation-by-installation basis. And the systems have been designed rather than developed in ways which assume that they will evolve in directions unanticipated at the design stage. That is in contrast with curriculum use where a "problem solving" (Havelock) or "cultural" model (House) is dominant.

The two different models of innovation unfolding in respect of the organisational core (teaching) and the periphery (administration) have direct implications for the control strategies used in each of those two applications areas. The mechanisms of control used will be discussed in section 8.1.4; but two different objects of control relate to the different models of innovation discussed here. A dual system of control exists in schools: first, control of the quality of the service delivered; and secondly, the control of resources, including costs, staff deployment (monitored through class sizes and pupil-teacher ratios) and physical resources. But the two control systems do not come together. They operate quite separately. That lack of articulation is frequently embodied structurally, with one deputy headteacher having responsibility for curriculum matters and quality control, and another for resources. That is one manifestation of the "loose coupling" which Weick (1976) addresses. Because the dual core control system is decoupled, different control mechanisms can be, and are, used in respect of each, as discussed in section 8.1.4, and different mechanisms of innovation can and do apply - the learning model in respect of curricular use and the product development model in respect of administrative use.

The problem solving or cultural model places great emphasis on the individuals and groups who respond or not to an innovation. And even the R, D & D or technological model acknowledges that a decision to adopt the innovation or not is made, even though the alternative of modifying a pre-designed innovation is discounted, so to a greater or lesser extent individual and group adopters or rejectors of change are central. It is those individuals and groups within the school, and their responses to the LEA policies and resourcing mechanisms discussed here, who form the focus of the next chapter.

Chapter 7

CHANGE AGENTS AND USER GROUPS WITHIN SCHOOLS

We saw in the last chapter that agencies external to the school have been able to use the school's dependence on them as a lever for change within an exchange relationship, by the use of categorical funding mechanisms. That allocation of resources has affected directly the extent of use of microcomputers in schools. But in this chapter it will be argued that the way in which the technology is used is determined principally by the use of intangible resources such as information, skill, ideology and control of the labour process by key individuals and groups within the school.

Not only are schools the target for policy initiatives, they are also the source of those initiatives, and of local adaptions of externally formulated policies. This chapter involves a change in the level of analysis from the supra-organisational factors considered in the last chapter to the focal individuals and groups within the schools who influence that explicit, and implicit, policy making process.

The polyarchic nature of schools, discussed in Chapter 2, emphasises the need to consider a range of key actors within schools rather than a single decision maker in analysing this or other innovations. In this chapter the roles of four key individuals and groups - the headteacher, the technical expert, teachers and school office staff - and the interaction between them are developed.

The influence of technical experts (who are often young and of low formal status in the organisation) in controlling critical organisational uncertainties emerges as crucial during the early course of the innovation studied here. In contrast with the findings on many previous studies of educational innovation, the influence of headteachers, in an innovation about which they have relatively little specific knowledge or experience, is found to be correspondingly small. Two different mechanisms of innovation are discerned and discussed. The first relates to the use of the new technology in the curriculum, where teacher autonomy within the classroom has been preserved within a "learning" or "enabling" mode of innovation. The second relates to school administration, where school staff, including secretarial and clerical staff, have had little impact on an innovation which has been implemented within a "rationalising" mode.

7.1 Role of headteacher

The importance attached in much of the recent literature on the uptake of microelectronics to the "managerial prerogative", and to the confirmation or refutation of the managerial dominance hypothesis suggests a focus in this study on the role of the headteacher, and implies a centrality for that role.

It has often been reported in the educational innovation literature, as we saw earlier, that the role of the headteacher is pivotal in respect of innovations within the school. For example, Regan (1977, p5) refers to the "cultural acceptance, indeed expectation, that the headteacher will be a dominant figure" and Her Majesty's Inspectorate (Department of Education and Science, 1977) conclude that the single most important factor which differentiates good schools from others is the headteacher. The importance of the headteacher is reflected again in the extensive studies of educational innovation in North America (for example, Chesler *et al*, 1975; Fullan, 1982), and Berman and McLaughlin (1978, p viii) who conclude that "the importance of the principal to both short and long run effects of innovation can hardly be overstated". That centrality echoes both the empirical (Ross, 1976; Prince, 1975; Lucas, 1975) and prescriptive (McKinsey and Co, 1968; Lamb, 1972; Rowan, 1982) literature from non-educational organisations on the significance of the chief executive and other senior managers on the success or otherwise of computer-based information systems.

It will be suggested here, however, firstly that the role of the head, though important, is not as central as has been implied in respect of other educational innovations; secondly that the headteacher's role may be substantially different in different schools, depending on the presence or not of one or more people with relevant technical expertise and whether or not those people choose to devote their energies to the innovation; and thirdly that the role of the headteacher may be considerably different in respect of the use of microcomputers in the curriculum and in administration.

In Northschool and Westschool the headteachers role was similar. In both the headteacher saw himself as a teacher and educationist rather than an administrator: "my heart lies in the classroom" (headteacher, Northschool). Both saw considerable potential for the microcomputer as a means of providing educational experiences for pupils which were valuable and different from those available without the use of that technology. They both espoused an egalitarian ideology and wanted all pupils of all abilities to have access to the equipment and saw examinable courses in computer studies as a much lower priority. Neither headteacher regards himself as a computer expert: "I haven't taken the initiative because I suppose I'm a bit scared of it too; it would be unknown to me" (headteacher, Westschool); "as far as computers are concerned I'm a very great novice" (headteacher, Northschool).

Those two cases provide illustrations of a management principle which is parallel with current thinking concerning the learning process. There has been considerable debate in education during the last few decades about moving from teacher-centred learning methods towards pupil-centred learning, and that has been reflected to at least some extent in classroom practice. That change is one with which most headteachers would agree. It is possible to draw a parallel with the management process such that headteachers and other senior managers within schools would not be in authority over teachers but act as facilitators, such that managerial activities are carried out by a range of people in ways which are not strictly delegated but are teacher-centred rather than manager-centred. Discussion of such possibilities is not absent from schools but is not as prominent as that on the equivalent curriculum issues and is not as readily accepted or as frequently implemented by headteachers. But the Westschool and Northschool cases illustrate the implementation, almost by default because of the headteachers' stated feelings of a lack of relevant technical knowledge, of the conduct not only of the implementation of an innovation, but also its conception and direction.

The need to become involved in decisions about matters for which headteachers have little experience and perhaps considerably less knowledge than some of their subordinates can be for them an unusual and potentially threatening situation, particularly for headteachers who see themselves as "master teachers" or *primus inter pares* within the "professional leader" rather than the "chief executive" model discussed in Chapter 2. It is substantially different from decisions concerning curriculum provision, methods of assessment, staffing appointments, pupil discipline and the range of other matters concerning which policies and plans are developed and for which headteachers would commonly feel they have a greater knowledge and relevant experience than most of their teaching staff. As one computer adviser said:

"We are talking about an area of the curriculum where many headteachers openly admit they have little information, little knowledge, and certainly no experience within the classroom, so there is a tendency to leave it to the, in inverted commas, expert." (computer adviser, Southlea)

Fortuitously, in both Northschool and Westschool the headteachers' curricular preferences were in accord with those of an individual in each school who had relevant technical knowledge and a similar enthusiasm and was willing to devote to the innovation a considerable amount of his own time and energy. In both schools the headteacher acted as an advocate of the innovation, encouraged the "technical expert" and allocated to the innovation a considerable proportion of the financial resources over which the school has control. That resource support proved to be crucial.

In relation to the administrative use of computers the two schools are again similar. In both the headteacher sees the potential benefits of computer-assisted school administration and has in each school one or two technical experts with relevant systems knowledge, but in both of them the technical experts do not wish to devote their energies to administrative applications:

"If I got involved in that it would be to the detriment of work in the curriculum.... I'm not entirely happy with spending a lot of time dealing with an administrative job" (head of computing, Westschool); and

"admin doesn't seem to me to be the priority. Our priority should be the kids" (head of resources, Northschool).

Although the headteacher in both schools wish to see administrative use develop they do not feel that they have the relevant technical expertise. In both schools, despite the wish of the headteacher to develop computer-assisted administration, progress has been either non-existent (Westschool) or slow and stumbling (Northschool).

The headteacher of Southschool is similarly enthusiastic about the computer as an educational aid: "I think it's vitally important, vitally important" and again has encouraged the technical expert in the curriculum. But Southschool is different from the previous two, because the technical expert there is interested and willing to devote his own time to administrative as well as curricular uses. The headteacher of Southschool, like his opposite numbers at Northschool and Westschool, has been willing to forsake some autonomy in return for the absorption by the technical expert of the uncertainty surrounding both the curricular and administrative use of the new technology. The headteacher of Southschool refers to the head of computing on most matters relating to computer use, as his answers to a range of questions on which headteachers at the other case study schools had a clear view indicate:

"In all honesty I haven't got much personal involvement with the computer ..."
"I don't know quite honestly ..."
"Quite honestly I haven't got any view on this ..."
"I don't thoroughly understand it to be honest ..."
"I really honestly am not qualified to give an opinion on that ..."
"I honestly don't know ..."
"I think you'd better ask -------- [head of computing] about that. He understands it much better than I do."

His role is that of an encourager, legitimator and resource provider:

"I haven't had to have personal involvement and I do see my role as encouraging developments right across the board really." (headteacher, Southschool)

That is confirmed by the technical expert:

"Our head has almost sat back and let things happen. He's not very far off retirement age and I think he's of the attitude that it's a bit late to start learning these things. He welcomes the development but I don't think he is very keen to get directly involved in the things I've been doing so he's had a positive attitude towards it while not being involved." (head of computer studies, Southschool)

A number of headteachers, then, do not have the resource of technical expertise and therefore rely on their subordinates who do. But they do have a range of other resources relevant to the innovation. For example, they have some patronage via their influence on internal promotions and with discretion in the distribution of Burnham scale points, to provide remunerative incentives for certain staff to remain at the school rather than seeking promotion elsewhere, or to provide recognition for computer development work which is not recognised financially via the salary structure. That mechanism to reward innovation may have been used in Southschool. The head of computer studies in a school that size might typically be on scale 2, and the head of mathematics on scale 3 or 4, but at Southschool the head of computer studies

"... came to us on scale 3 as head of computer studies within the mathematics department. He's now promoted to scale 4 - he still has the title of head of computer studies within the maths department so he's head of computer studies, second in the maths department and also assistant to the timetabler, and he has a general responsibility for the development of computer work - helping the other departments and heads of department to arrange their computer work." (headteacher, Southschool)

The managerial style of the headteacher of Eastschool is different from that at the other schools. He could be described as an administrator to a greater extent than as a curriculum leader:

"He's a very good administrator" (teacher, Eastschool);

"I give the heads of department complete autonomy. If they say to me that's the way they want to run the department, as long as I don't see anything wrong in that that's the way they do it. As headteacher I see my role as coordinating. It's not for me to say to the head of, say, special needs department 'you ought to be using computers in the classroom, or you ought to be going to the computer studies department to say "how can we use computers in the classroom?"' All I can do is encourage it. I certainly wouldn't force it." (headteacher, Eastschool)

Although a considerable amount of examinable computer studies courses are provided there is not an identifiable "project champion" amongst the teaching staff who is pushing for the development of computer appreciation courses or computer-assisted learning across the curriculum. As a result, as the computer adviser said: "there's nothing happening there". Some of the staff, though, do feel that there should be some developments more widely across the curriculum:

"I think there is a definite need to give some computer awareness courses.... When it was introduced nearly ten years ago when we had one computer the person that started it was in the maths department so it stayed there. It seems that we have stuck hold of it - I suppose jealously guarding our preserve - but we realise that other people should use them." (head of mathematics, Eastschool);

The deputy headteacher who himself has responsibility for curriculum matters identified a discrepancy between his personal priorities for computer use in the school and what is currently happening:

"I would like to see the emphasis on computer awareness. I believe that all pupils should leave the school at sixteen with a fairly deep awareness of what computers can offer, what they can do. I would put computer-assisted learning as second on the list. The main emphasis at this school, funnily enough, is on computer studies, and that's where the strength lies in this school. I have grave reservations about computer studies. I think it is too narrow for the average and less able, and for the more able I don't think it is particularly valuable." (deputy headteacher, Eastschool)

And the headteacher, talking about the importance of the innovation, echoed that picture:

"I think it's vital and unavoidable because, unlike so many other innovations in education, this one is a social innovation. Like it or not our lives are, not ordered, but are certainly administered by computer, and the power of the computer is such that I can't see us lasting very long in education if we don't take it on board."

But, as we saw earlier:

"as far as computer-assisted learning is concerned we have come across brick walls, absolute brick walls.... I find it very difficult to break down any curriculum barriers to be absolutely honest. And computers across the curriculum - it's going to be a long hard job." (headteacher, Eastschool)

The headteacher of Eastschool has, however, been very active personally in the development of a computerised administration system far more sophisticated than that available in most schools.

How does the evidence from the case study schools compare with that from the surveys? From both the initial and the final surveys the extent of computer use in different areas of the curriculum was not significantly related to the self-rated influence of headteachers on developments in the curriculum (initial survey, sig=0.28; final survey, sig=0.30). It was, however, significantly related to the influence of computer studies teachers, as will be discussed in the next section. The pattern in respect of administrative use showed a change between the two surveys. At the time of the initial survey, by which time computer-assisted administrative use had been developed only by schools individually, the extent of use in that area was related slightly to the headteachers' influence (sig=0.07). But by the final survey, when LEA-developed systems were in place in some schools and in prospect for others, the relationship between headteachers' influence and extent of administrative use had become not significant (sig=0.18). Hypothesis 2 is thus refuted. That finding, which is supported in the case study analysis which follows, is particularly interesting as it challenges a core area of the education management literature.

It is possible that headteachers' involvement in administrative applications will become more important as the standardised computer-assisted administrative systems developed by LEAs become more widespread. With systems produced within schools the software developer has a key role, and from the surveys the software developer was almost always a computer teacher and never the headteacher, to the extent that "sometimes it is exploiting a computer studies teacher in his spare time - when he should be preparing work. That happens a lot actually" (computer adviser, Eastlea). The schemes developed by LEAs, however, are being introduced in such a way that the contacts between schools and the LEA will be primarily via headteachers and will not normally involve computer teachers. Those centrally-developed systems certainly imply a need for a greater knowledge by headteachers than that which is current about issues connected with the introduction of new technology. In both the surveys, for example, many headteachers either admitted that they did not know, or answered wrongly, about whether or not their LEA had a new technology agreement covering the use of microcomputers in school offices. That included many headteachers in whose school such administrative applications were already being carried out.

The case studies and the surveys produced consistent data about the extent and type of involvement of headteachers. A third source of data on the significance of their role is the education officers and advisers of the local education authorities. Substantial differences of opinion emerged from that source; it is worth quoting extensively from their comments to illustrate those differences and the areas of agreement. The computer adviser in Northlea felt that the factor which distinguished those schools which had developed educational computing was

"... in a single word it is the head. I'm sure it is the head. Even with deputies - I can think of a school where people did want to encourage it but the head blocked it. Nothing happened until they got a new head, and now it is a showcase and the head has spent a lot of his capitation on computers. To a greater or lesser extent I'm convinced it's the head - because he holds the purse strings." (computer adviser, Northlea)

The headteacher, according to that view (which is supported from the other case studies) has, in effect, a veto because of his nodal position in the flow of financial resources through the school, and in that way, and others, signalling the importance of the innovation relative to competing claims. He has the power to constrain the innovation or to prevent it becoming institutionalised throughout the school. In that sense the headteacher's support is a necessary condition for the successful adoption of the innovation. But it is not a sufficient condition; the commitment of other staff, including those with relevant technical expertise, is needed also. That point was expanded upon by the other computer advisers:

"I can think of two or three schools where the initiative stemmed from the headteacher but the successes within those schools have still been based on what individual staff can do. I can think of headteachers who have tried very hard to bring about constructive developments which haven't been very successful and again you can say that they were largely due to the lack of personal resources to do the job. We still lack experienced qualified teachers in many schools and no enthusiasm at the top is going to make big in-roads into that until people are better trained and that's where the onus for that rests largely with the Authority. Many heads have made individual efforts within the schools to raise awareness and certainly I think the majority of heads are very conscious of the importance of the development and have succeeded to a considerable extent in making their curriculum development team aware but at the end of the day it is the people within the school and their capability to do the job that decides what is going to be done." (computer adviser, Westlea);

"Within schools, I believe that since, by and large, the headteacher is the ultimate decider of what goes on in his school, it depends upon the attitude and commitment of the headteacher towards the new technology as much as anything else, so I think that is a fundamental problem [sic]. I think the second problem is that because we haven't trained personnel - that is professional computer people - in education, in school, it has depended to a very large degree on the interest and commitment of people on an individual basis. And where you have found a head who could see the way forward, who had one or more members of his staff who were in accord with that view and prepared to do something about it I think progress has been made." (computer adviser, Southlea);

"There are two key personnel. One is the head. The other is the person - it doesn't matter what their status is within the school - the enthusiast, the computer enthusiast. It is the match or mismatch with the head's views which makes the key difference. If you have a head who is prepared to let this person have their way, or has firm views which match that person's, you will then get quite a few developments taking place. If you don't have that - either you have an enthusiast with no supportive head or you have a head who is interested but hasn't got the expertise to go with it, then you won't get the development." (computer adviser, Eastlea)

The surveys provided a picture of headteachers affecting the extent of administrative use but not significantly affecting the extent of use in the curriculum, where other teachers are more influential, as will be discussed in subsequent sections. In respect of curriculum use that reinforces the findings in the case studies of the headteachers encouragement and legitimation being a necessary, but not a sufficient, condition for widespread curricular use. Headteachers could block the innovation by declining to allocate financial and intangible resources to it; they can alternatively support the innovation with the use of those resources, but cannot alone ensure its success: that depends on other key actors whose role is analysed below.

The findings in this study concerning headteachers provide a marked contrast with much of the literature on leadership roles. The extensively quoted classification of leadership styles developed by Tannenbaum and Schmidt (1958) (tells, sells, ...) and similar classifications in the educational literature (for example, Stenhouse (1975): tells, sells, consults, shares) implies a more proactive view of innovation than has emerged from the study. Headteachers have been found in this study to act as advocates of the specific innovation, but less as leaders than as facilitators of innovation. As one of them said "I'm an encourager. When any initiative is shown I try to encourage it" (headteacher, Northschool). It is perhaps not too unkind to describe the attitude of some headteachers as "computers are important; we should be doing something; who can do it?". That may represent a strategy; it may, however, represent simply the lack of one.

The information collected in the surveys and in the case studies from headteachers and others emphasise the incremental nature of decision making within schools in respect of this innovation. For example:

"When the head and I introduced the computer to administration it wasn't done because of any planned overall rational policy for the school. It was done more piecemeal. And as it has been done we have realised the advantages of the computer." (deputy headteacher, Eastschool)

The fluid budgetary position can be used as a reason (or an excuse) for an incremental decision making process by invoking the school's dependence on external sources of funds. One headteacher, questioned about future plans concerning the use of information technology replied:

"I don't know, quite honestly. We tend to live year by year and try to do the best for the priorities that we have at that particular time. I can't really pretend that we do much long-term planning - for one thing because you just have no idea what sort of allowance you are going to get" (headteacher, Southschool).

The case studies are indicative of a garbage can model of decision making (Cohen, March and Olsen, 1976), in which the four streams of problems, solutions, participants and choice opportunities merge. This innovation has been described earlier as partly a resource-driven one. When resources are provided by external organisations (Department of Trade and Industry, LEAs, Parent-Teacher Associations) at a time of otherwise diminishing financial resources, and equipment therefore enters a school in a highly visible way, a choice opportunity - "an occasion when an organisation is expected to produce behaviour that can be called a decision" (Cohen, March and Olsen, 1976, p27) - arises. That creates a problem if there is a feeling that "we ought to be doing something", but where the rational decision making approach (determining goals, evaluating alternatives relative to those goals, and choosing the optimal alternative) is deemed to be impossible or inappropriate. In many such decision arenas goals remain obscure, perhaps by default, but also perhaps by intention; in situations of clashes of values and ideologies it may be possible to arrive at resolutions which are not challenged when goals could not have been agreed. In the organisational context studied here different individuals may have very different objectives but be able to agree that "we ought to be doing something".

There are many reasons, not necessarily connected with the putative purposes of the innovation, for which a school, and the headteacher as the leader of the school, may wish to adopt an innovation; and the headteacher, of course, is in a particularly good position to be able to identify goals for the organisation. Those reasons include, first, the wish to be seen to be responding to environmental (particularly parental and local and national political) expectations; second, the wish to be seen as up-to-date, progressive, professional, efficient, and indeed simply innovative in a cultural climate in which innovativeness is heavily laden with positive value; and, thirdly, to gain control of the resources with which an innovation is packaged. Most, probably all, of those reasons apply to the innovation of microcomputers. And, certainly, an innovation such as microelectronics which "goes with the tide" is attractive compared with others. Some of the reasons may align with the merits of the innovation itself and with organisational needs; others may not. But because of the organisational and personal costs involved in adopting an innovation there is frequently value to the school in adopting an innovation only ceremonially and cosmetically - to have innovation without change - rather than to attempt to engage in an internal transformation of the school in ways which threaten organisational practices and values.

In those situations innovative ideas may be successful in their "search" for problems, and it is possible for solutions ("A-level computer studies", "computer-assisted learning in geography", "a computer awareness course for first year pupils", "computerised timetabling") to emerge which both solve problems and enable goals (perhaps quite different goals for different actors) to be discovered and rationalised *post facto*. The range of solutions available depends on the participants and, as Cohen, March and Olsen emphasise, on the other demands on the participants' time. It is to one of the key participants who may bring forward one or more solutions that we now turn.

7.2 Role of technical expert

It was argued in Chapter 6 that educational computing is to some extent a resource-driven innovation. Specifically, the initial hardware which a school obtained may have been funded fully or partially by the LEA or by central government via the Department of Trade and Industry's "Micros in Schools" scheme. And where the school itself raised some or all of the funds for the purchase of initial computers that was often provided from budgets which are closely scrutinised - "we bought the first one from the tuck shop profits" (headteacher, Westschool) - or via fund-raising events organised perhaps by the Parent-Teacher Association. Its acquisition may have been used by the school to obtain publicity in the local newspaper, which, at a time of falling rolls and increasing competition between schools to attract pupils, was a useful vehicle for schools which were becoming increasingly market conscious. A shortage of resources, of course, is one of the great myths (using that term neutrally, not pejoratively) in schools. It is a convenient means of explaining the gap between the rhetoric and the reality of practice, and legitimising why it is not possible, though it is overtly claimed to be desirable, to do what various stakeholders wish to be done. But, conversely, the cultural acceptance of that myth increases the centrality of the debate about the use of the resources which are available. At a time of a perceived (and real) reduction in funding of schools (except in respect of computer equipment and other technological initiatives) there was in most schools a small or larger core of teachers antagonistic towards the arrival of the computer. "Why are we getting a computer which we don't need when we can no longer afford to buy textbooks for the kids?" was a theme frequently aired.

The control of real resources may be of greater significance within the education sector than in some others. The characteristics of the sector, discussed section 2.2.5, particularly, in the absence of a market mechanism, the difficulty in measuring outputs, and an unclear technology, with minimal understanding of means-ends relationships, results in the evaluation of inputs acting as a surrogate for the evaluation of both outputs and processes.

The arrival in the school of a computer was often a high-profile event, particularly as the technology was considerably more sophisticated than previous technologies which the school may have used. That high profile has made the computer more central than would otherwise have been the case. It is not central in the sense of being immediately recognised as a core technology, but is central in the sense of being a highly visible choice about the allocation of relatively small and diminishing financial resources, particularly where headteachers committed a considerable proportion of the school's capitation allowance to the innovation. As one headteacher said:

"they've **all** come from us - they're all our blood and sweat and tears and looted out of capitation, filching from other subjects, filching from books." (headteacher, Northschool)

When asked whether there was any resistance from teachers about that allocation of resources he replied

"oh yes, absolutely, and quite justifiably too. If you have a book between two pupils you are bound to wonder why the money is going that way. One of the strongest defenders of buying books and not computers is the second deputy head. I have a conscience about it. I have a strong conscience about it. One area which suffers is my own teaching area - modern languages. To buy a computer is a matter of will because you know that you're putting money into a computer that could well go to a department that desperately needs it." (headteacher, Northschool)

And in another school:

"I think that the first time people have felt the pinch has been this year when general allowance was cut quite drastically. I think it was quite a bitter pill to swallow this particular year. There may have been some resentment that we had used some general allowance for large scale capital costs when departmental allowances were being diminished. I think this year is the first year that people have really felt the pinch like this." (headteacher, Southschool)

At Northschool the equipment purchased in 1986 for the information technology room cost about £6,000, from a total capitation of £28,000. An amount of £28,000 represents a discretionary expenditure for teaching materials, consumables, textbooks, etc. of rather less than 3p per pupil per lesson. Expressed in that form, the extent to which schools are dependent on external agencies (particularly the LEA, and in the case of this innovation the DTI and other specific funding mechanisms) for the funding of capital purchases, is clear. It illustrates also the centrality of the control of resources, particularly financial resources, in affecting the innovation, especially given that the malleability of the technology can further generate conflict about the uses to which it is put. The concerns which teachers have about the way in which that limited budget is spent also becomes evident. The expenditure on computers of about 25% of the capitation is therefore a major investment decision which is politically potentially very contentious.

That simple calculation underlines the importance of the control of resources in affecting the innovation. It also emphasises that in such a climate the innovation can be of great symbolic importance and it is vital that it is seen to be successful. The uncertainty about how computer facilities will be used and with what effects needs to be controlled and minimised. That scenario provides a classic opportunity for a "project champion" to emerge - to build, to enhance and to risk a reputation by investing in and promoting the innovation and to use it as a vehicle for empire building. That opportunity has been taken in many schools by a computer studies teacher. That has not occurred in all schools; in some a person other than a computer teacher has emerged as project champion and in others the technical expert has played a responsive, supportive role rather than proactively promoting the innovation. The computer teacher may choose not to get involved in the innovation to a large extent, particularly as that involvement may require a significant amount of the person's own time at weekends, during vacations, and so on. But in many schools the computer teacher has chosen to devote his energy to the innovation.

Unlike some other organisations, schools do not have established staff posts the prime purpose of which is to plan and implement change. Those responsibilities are assumed to be diffused throughout the organisation. The absence in schools of institutionalised change agent roles creates what might be termed an "innovation vacuum". That is compounded by the "receding locus of power" identified by Noble and Pym (1970), which in association with the organisational ethos of collegiality in schools results in a dispersal of power, enabling initiatives to be taken proactively by those in relatively junior positions, in ways which would be much more difficult in rigidly hierarchical organisations. In relation to this innovation the technical expert has often chosen, and been able, to fill that vacuum.

Further, the traditions of departmentalism and departmental independence in schools have created conditions which have facilitated the influence of technical experts. In a number of schools the headteacher has acted as an encourager of the use of computer-assisted learning in the curriculum and has allocated financial resources to facilitate that development:

"The head looked favourably on physics and gave us an extra portion of money to enable us to purchase a computer for the development" (teacher, Westschool);

"I use my influence through finances before I carve up capitation by saying 'if you're going into computer-assisted learning let me know and I'll put away £1,000 to do it'" (headteacher, Westschool).

But beyond such encouragement headteachers typically leave decisions about whether and how to use computer-assisted learning to departments:

"It's a departmental decision. It has to be. I'm convinced of that" (headteacher, Northschool);

"I give the heads of department complete autonomy.... It's not for me to say to the head of, say, special needs department 'you ought to be using computers in the classroom'" (headteacher, Eastschool);

"It's very much left to the heads of department.... There isn't a school policy. Perhaps there ought to be. It's very much left to the grass roots" (headteacher, Westschool).

For those operating at the departmental grass roots, their colleague in the computer studies department is an obvious source of advice and assistance.

The centrality of the technical expert has been institutionalised by various administrative arrangements of organisations external to the school also, which place him in a position from which to control the uncertainty surrounding the innovation. The cascade model of diffusion (including the use of the ISIS (In School In-Service) pack) adopted by the Microelectronics Education Programme, discussed in Chapter 6, involved a "training the trainers" exercise; the computer studies teacher was frequently one of the people officially put in the role of trainer by that process. Second, and concomitantly, a number of LEAs, such as Eastlea, required that schools nominate a link person for communications about microelectronics between the LEA and the school; in many cases the hub of that formalised part of the communications network, with the power that position confers, was the computer studies teacher. Thirdly, computer equipment arrives in schools not as part of a turnkey system with training provided for the users, but is supplied by the manufacturers simply as boxed sets with assembly instructions and operating manuals which appear to many people as complex and daunting. The first person called to help with the problem of "what do we do with the equipment in these boxes" is likely to be the technical expert. And, fourthly, in many schools the role of the computer studies teacher has been formalised. A scan of the job advertisements in one issue of the *Times Educational Supplement* revealed a larger number of vacancies for heads of computer studies than for any other subject. In addition to teaching computer studies the requirements included "a willingness to develop computer facilities on an extensive scale"; "an interest in computers across the curriculum"; "to imaginatively guide our computer curriculum" and "technical skills to operate and maintain our computer room".

Those institutional arrangements are underpinned by the tradition within schools of making appointments at first-line and middle management levels from within the internal occupational (rather than organisational) labour market, rather than by making appointments from the external labour market. Teachers can therefore readily identify a promotion route and the requisite skills and competencies can be ascertained in at least general terms, and the necessary experience and responsibility sought.

The control of physical resources can be used as the base from which to influence the use of those resources and the priorities of the claims upon them. The physical resources can be, in Gyford and James' (1982) terms, resource "weapons" which are bargained with at the next negotiating or decisional forum. Computer studies teachers are frequently given responsibility for the computer equipment on the basis of what Sanders (1974) calls the principle of "assignment by familiarity". They can use that base for enlarging their area of influence, perhaps by succeeding in defining issues predominantly in technical terms. A clear distinction can be made, of course, between the physical location of computer equipment and the organisational responsibility for it. In many cases, as discussed in Chapter 5, the physical location has been by concentration in a room for which the computer studies teacher has responsibility and which meets his vested interests better than a policy of distributing the resources: "I wanted to do computer awareness courses and that really necessitated having the machines together" (head of computer studies, Westschool). It is a dubious but short step, taking the line of least resistance, to decide that organisational responsibility for computing might appropriately rest with a person who knows something about computers, and in a number of schools that step has been taken. And responsibility for the implementation of computer policy is a base from which the technical expert can influence the formulation of policy; and the less precise that policy the more is the room for manoeuvre and the greater the influence he may have. It is commonplace to say that a computer is not just a solution to a problem but is an answer looking for a question; but it can also be a vehicle in a strategy for gaining access to, and influence on, important decisional nodes. Because many issues (such as the potential effects of computers on the labour process, or on organisational structures) have not been directly addressed in schools, many critical organisational choices have been taken by default; and the default option has frequently been the technical expert.

But what are the outcomes of those mechanisms in practice? The involvement of the computer studies teacher in the innovation has been closely associated with the extent of computer use and headteachers' assessment of its success, both in the curriculum and in administration. In some of the case studies a coalition has formed of the headteacher, who wants to see the innovation develop within the school, and the computer studies teacher or other technical expert who may, in terms of scale, be a relatively junior member of staff. That "reformist coalition" (Bacharach and Lawler, 1980) of senior and junior staff operates in, and against, strong traditions of departmentalism with the middle managers (heads of department) having their own vested interests and well-defined territories. Some of those middle managers welcome the innovation while others resist it. But the extent of involvement of the computer studies teacher in promoting the use of microcomputers for teaching purposes is closely related to the extent of the diffusion of the innovation across the curriculum, as shown in Figure 23. From the initial survey there is a close association between the extent of involvement of computer teachers in the innovation and the diffusion of computer use across the curriculum:

	Involvement of computer teachers			
	No involvement	Little involvement	Some involvement	Large involvement
Weighted* number of subjects in which computers are used	3.5	4.8	6.1	7.5

sig = 0.0056

* weighting = 1 for some use, 2 for extensive use.

That association is replicated in terms of the number of teachers in a school using microcomputers in their teaching:

	Involvement of computer teachers			
	No involvement	Little involvement	Some involvement	Large involvement
Number of teachers using microcomputers	5.1	5.7	7.8	10.0

sig = 0.0040

And there is a close association also between the extent of computer teachers' involvement and headteachers' evaluation of the success of the innovation:

		Involvement of computer teachers			
		No involve-ment	Little involve-ment	Some involve ment	Large involve-ment
Evaluation of use in teaching	Unsuccessful	1	1	0	0
	Of limited success	2	13	23	11
	Moderately successful	1	9	45	24
	Very successful	0	1	12	10

sig = 0.0003

Those findings appeared also in respect of administrative use at a time prior to the installation of LEA-designed systems:

	Involvement of computer teachers			
	No involvement	Little involvement	Some involvement	Large involvement
Number of administrative applications per school	0.87	1.51	2.15	3.88

sig = 0.0000

		Involvement of computer teachers			
		No involvement	Little involvement	Some involvement	Large involvement
Evaluation of use in administration	Unsuccessful	3	2	3	0
	Of limited success	4	15	15	4
	Moderately successful	3	6	19	4
	Very successful	1	4	3	6

sig = 0.017

Figure 23: Involvement of computer teachers

The final survey found a similar pattern in respect of the first four of those five relationships, for which the respective levels of significance were 0.05, 0.08, 0.00 and 0.04. By that time, however, coincident with the introduction into a number of schools of sophisticated LEA-designed administrative systems and the expectation in others that they would be involved in a subsequent phase of the diffusion of those systems, the level of significance of chi-squared of the relationship between involvement of computer teachers in school administration and headteachers' evaluation of administrative use had changed to 0.45.

The data collected from the surveys relating to the involvement of computer teachers provides support for hypothesis 3, particularly as, by using "computer teacher" as a surrogate for "technical expert", it under-represents the association found between the involvement of technical experts, who in some schools such as Northschool are not computer teachers, and the various measures of extent and reported success of use.

The extent to which the technical expert can take an initiative, providing that what he or she does is in accord with the wishes of the senior staff, is well illustrated in the Westschool case study. The headteacher legitimated the developments and signalled that the innovation was to be taken seriously, but did not lead or direct it; that was done by the head of computing. The headteacher commented on the "hours of work" put in by the head of computing in providing training courses within the school for other teachers and in other voluntary activities and said that as far as computer-assisted learning across the curriculum is concerned that "it's very much left to the grass roots.... There is no kind of central over-look apart from -------- [head of computing]" (headteacher, Westschool). A deputy headteacher at the school again said that he himself, despite formally having curriculum responsibility, was not involved in computer work but was happy for the head of computer studies to use his distinctive competences and to take the initiative:

"I think the emphasis actually comes from -------- [head of computer studies]. I personally have not moved to try and persuade people to do it. -------- [head of computer studies] certainly does - if you have got someone who is an enthusiast on the staff this is the most important thing. And we have an enthusiast who has, in a way, pushed us. The school's plus is that we appointed people like -------- [head of computer studies] who then pushes us into doing things. So you have got to have someone like that. If you haven't got anyone like that then you can just carry on. Over the last twelve months to find the time, to find the energy, for development at a time when things have not been going well has been extremely difficult." (deputy headteacher, Westschool)

That picture is in agreement with the impression of the technical expert himself. He identifies, as do others, that developments at the school have depended upon his involvement and his initiative, but by itself that would not have been sufficient. The headteacher needed to be, and was, willing to make the necessary financial resources available to enable the innovation to develop, and to place minimal constraints upon it:

"It's left very much to me. The head is very supportive indeed. I've explained the way I feel it should go and the head supports me in that and is very willing to supply money to see it implemented. He doesn't get involved. He hasn't found the time to get involved in it, so he does depend a lot on my opinion." (head of computer studies, Westschool)

The views of the computer adviser about changes in schools as a whole in that LEA are not inconsistent with the development pattern in Westschool:

"The changes have come about because of individuals - individuals with clear understandings, clear determinations, clear capabilities, who have been in a position to apply them." (computer adviser, Westlea)

In another LEA one person who has had access to computer education activities in a number of schools reflected on their differential progress:

"The most important factor, I would have thought, probably would have been how keen the computer staff are. From my experience most of the pushing has gone from that direction." (head of computer studies, Southschool)

And to repeat a comment made earlier by the computer adviser in that LEA:

"We are talking about an area of the curriculum where many headteachers openly admit they have little information, little knowledge, and certainly no experience within the classroom, so there is a tendency to leave it to the, in inverted commas, expert." (computer adviser, Southlea)

And in yet another LEA, at Northschool, the deputy headteacher emphasised her reliance on the technical expert at the school to assist in the introduction of computer-assisted administration:

"I depend a lot on -------- [head of resources].... I've had to use the people we have got who have got some expertise to help me start getting computers into administration.... You have got to have an expert; you've got to have somebody who can do it.... I'm gradually becoming more confident, but I still have to get on to -------- [head of resources] and he will help me out. But it's very limited and I can't instigate anything on my own initiative - much as I would like to" (deputy headteacher, Northschool).

The innovation has provided an opportunity, then, for computer teachers to gain access to aspects of school life with which teachers who are heads of small departments would not normally be involved. Their performed role is typically greater and more varied than their prescribed role.

There is concern in some quarters about the extent to which the computer studies teacher, as technical expert, has been involved in, an influenced, the direction of the innovation. One adviser hinted at that concern:

"We are trying to convince the schools that they should have a computer coordinator - a director of computer education - that it should generally be a senior member of staff and that it should not be the computer studies man." (computer adviser, Northlea)

Where the initiative rests with or is wrested by the technical expert there is a tendency for him (and in each of the case studies it was him, rather than her) to develop expansionist policies for one or both of two reasons. An "empire building" strategy, and an attempt to make computers part of the core of the school rather than the fringe, can be beneficial in this area as in other areas of task and resource control. But secondly, in the meetings and conferences of the *cognoscenti* of educational computing, in societies such as MUSE (Microcomputer Users in Education) and in the journals such as *Educational Computing* and *Computers in Schools*, where a large proportion of the copy is short reports of the "what happens in my school" type, the technical expert makes a name for himself not by developing and reporting on simple systems which work well but by sophisticated technical developments; kudos comes also from reporting experience in a school which has substantially more hardware than other schools.

The access of computer studies teachers to curriculum matters applies in terms of advice to other teaching departments, and insofar as the espoused ideology of teachers is that the curriculum is the *raison d'etre* of schools and the "closed door of the classroom" underlines the traditional independence of teaching departments, that access is to the core of the organisation.

It applied also, prior to the installation of LEA-designed administrative systems, where the computer teacher or other technical expert became closely involved in, or actually carried out, the kinds of tasks such as timetabling and option group processing which were traditionally the preserve of more senior members of staff, typically deputy headteachers. Computer teachers were the most frequent operators of computer equipment at the time of both of the surveys. In some cases that was because the incumbent of the relevant administrative post, often a deputy headteacher, was not willing, for whatever reason, to use a computer in carrying it out. In one school, for example, where "the staff here in the administration are all getting on a bit, they're less keen on it" (teacher, Westschool):

"My main concern is the timetable. I don't use a computer. I can't see me using a computer simply because I'm within two, possibly three, years of retirement" (deputy headteacher, Westschool).

The Southschool case earlier in this chapter also illustrated the extensive involvement of the head of computer studies in school administration. That case emphasises the importance of particularistic criteria; the head of computer studies chose for reasons of personal interest and gratification, and possibly careerism, to devote his energies, discretionary time and resources of skill and expertise to the development of a sophisticated school administration system on which the school now depends.

Friedman (1977), in discussing central and peripheral workers distinguishes between workers who are central as individuals and those who are central as a group. The technical experts have frequently been able to create for themselves as individuals a centrality within the school in terms of both curriculum and administrative matters. Such centrality can be beneficial in terms of teachers' career prospects in that they are carrying out activities which are typically amongst the task set of the more senior posts for which they may be applying. There has been a tradition in schools, rather than being appointed to a promoted post and then carrying out the tasks of that post, of undertaking those tasks in the hope of being promoted into the post. In a teaching career structure in which promotion opportunities are diminishing because of the contraction consequent on the reduced number of people of school age, access to and experience of the task sets of more senior posts, and a move from the organisational periphery to its core, can be very valuable in the career stakes.

The resulting mobility of school computer experts is high, as indeed it is in other employment sectors. The labour market position of technical experts was reflected in responses in the final survey:

"I am petrified that I may lose my Head of Computer Education";

"The head of computer education went to a university job ... it has been difficult to replace his skills";

"One very progressive humanities teacher who already produces commercial software privately and has had great involvement in school developments will move to a new school in September";

"The move of a computer studies teacher into industry (computer software) meant loss of expert program expertise";

"We only have one real 'expert' and have failed to increase this resource";

"Loss of one teacher from computing department whom we couldn't replace - no one suitable or qualified applied";

"The school is experiencing difficulty attracting a Head of Department (Scale 3) to take over the responsibility and coordination of the Computer Education Department.

While benefits accruing in career terms to technical experts are accepted as legitimate, the ideology of education is such that it is not regarded as valid openly to attempt to use influence to further one's own interest; micropolitics has an unacceptable aura in schools, as Hoyle (1982) discusses. The espoused ideology is one of service, achieving the collective good, and promoting the interests of pupils: "our priority should be the kids" (head of resources, Northschool). The espoused ideology, however, may be simply a facade and be translated into actions which are inconsistent with their claimed ideological basis. As decisional behaviour is legitimised by the way it addresses corporate goals and values, the definition of individual or sectional interests as coincident with organisational interests is a tactic which is frequently employed. It is possible, of course, to attempt to define the interests of the pupils in such a way that computer skills and knowledge are central to their education, and the skills of such teachers are therefore more central to the curriculum, as that same teacher did:

"The kids from this area are disadvantaged anyway because of the high unemployment rate, and if we didn't provide them with this technological and informational education we would be making them even more disadvantaged"; and

"I think it's vital that we give all children who go through this school an opportunity to develop the skills which they are going to need and the only way to do that is to have the equipment there, and if it costs a lot of money, that's something you've just got to spend on." (head of resources, Northschool)

He had also successfully defined computer facilities as a resource to be under his control in the same way as other resources:

"We have a central resources system - TVs, cassette recorders - and it just seemed logical that computers became a part of that. So the computers are stored centrally and administered centrally so we keep the software, we keep the booking forms." (head of resources, Northschool)

There is far from agreement amongst teaching staff as a whole, however, that computers should be as central to the curriculum as some computer teachers advocate. As one deputy headteacher said:

"Its importance depends on how you see the future. I personally am not one of those people that see the need for a highly technical society. We are going to need people with high technical ability but the rest of society I see working in person-to-person areas, in those areas where machines can't, so the idea that everyone has got to have a high degree of technical skill I'm not so certain about." (deputy headteacher, Westschool)

Not all technical experts have chosen or had the skills to involve themselves in the use of computers across the curriculum or in administration. At Eastschool:

"When we started in computer studies I think we were ahead of other schools and because we had reasonable success in exams we tended to have kept on that course and not diversified enough. And I believe now we are as good as anyone in teaching computer studies but we have not diversified into using computers in other subjects, where I think other schools might be ahead of us. (teacher, Eastschool);

"We are on a sensitive subject. There is a young woman in computer studies whose original job specification talked about the fostering of computers in the school. But it was very much a paper responsibility. She has worked very very hard but I wouldn't say she has the responsibility to go to people and say 'look, you should be using computers'. She is there for people to talk to rather than going to them herself. She doesn't have the authority, you see." (headteacher, Eastschool)

The Eastschool case provides particularly useful evidence of the importance of the technical expert - evidence of a kind different from that in the other cases. Whereas the Northschool, Southschool and Westschool cases, and the survey results, illustrated the importance of, and the results of, the strategies of technical experts, the Eastschool case illustrates that the absence of that involvement is associated with little diffusion of computer use across the curriculum. As the Eastlea computer adviser remarked about Eastschool: "there is nothing going on ... apart from computer studies, it's been dabbling".

The role of the technical expert could be explained using a political model, with the technical expert promoting as organisational solutions the alternatives which further his own interests, and to attempt to define organisational problems in ways which fall within his area of competence. The innovation studied here is one in which resource control is crucial. The technical expert can use his resources technocratically to increase the school's dependence on him, and thus increase his status within and influence on the organisation. Alternatively, or in other schools, it can be explained with less emphasis on intentionality, with the technical experts either not being involved in the innovation or simply acting supportively and apolitically as *techniciens* rather than technocrats. In one sense it may not matter greatly which is the "right" explanation as the partial views of the centrality of the role for the innovation provided by each of the windows are similar.

In this section it has been argued that the computer teacher or other technical expert is a key figure in affecting computer developments in schools in both the curriculum and in administration. But the technical expert can facilitate developments only if given a mandate by the headteacher. The fact that such a mandate was frequently available does not undermine its importance. In association with the argument developed in the previous section the conclusion is drawn that the involvement of a technical expert, like that of the headteacher, is a necessary but not sufficient condition for development. The commitment of both the technical expert and the headteacher are necessary; without either one the innovation will not develop. It is not suggested that the involvement of the technical expert, or the headteacher, in ways discussed here are the sole influences on the direction of the innovation, only that they are central and crucial. So too is that of the teachers themselves.

7.3 Role of teachers

The ideology of teacher autonomy within the classroom is very strong and directly relevant to this innovation. Although some changes in the content of teaching have been introduced relatively quickly and been widely adopted, particularly where there has been a mechanism such as examination boards and syllabi to effect change, innovations in the teaching process are more complex. That is particularly the case where the change in curriculum delivery crosses subject boundaries - where it is an "encumbered innovation" - rather than change being within the boundaries of a single subject - an "unencumbered innovation".

Despite the lip-service paid to the idea of developing whole-school policies concerning educational computing, the reality of innovation support mechanisms is that they are primarily directed towards individual teachers rather than groups of teachers or schools. For example, all of the early courses and documents produced by the Microelectronics Education Programme, and most of its later work, was targeted on teachers individually, often within a specific subject (a computer-assisted learning package in geography, a course for biology teachers, etc.). But many of the courses provided by LEAs as part of their in-service training were offered during out-of-school time, and there are many individual teachers who attended courses by paying all or part of the cost of the course themselves. That mechanism of resourcing in-service training may result in the teachers who are least committed to innovation remaining isolated from new possibilities while those who are least in need of exposure to innovative practice are those who fund themselves to receive it. Training facilities are available and many are over-subscribed by enthusiastic teachers, but the mechanism of training provision is such that teachers who wish to do so can easily avoid contact with that training.

That point is important in understanding the control of the innovation. Most advisers would agree with their colleague who said "throwing software at schools is pointless. Unless it is supported through in-service training it just won't work" (computer adviser, Eastlea). The dilemma for those who allocate budgets is that it is less costly to provide the hardware and software; training which involves taking teachers out of the classroom and providing supply cover is relatively very expensive because of the cost of replacement supply teachers. The result is that very few teachers have received any more than a general introduction to educational computing. Different designs of in-service training can be conceived, some of which leave discretion about computer use in the classrooms with teachers, and some which attempt to remove it from them. But a lack of in-service training, together with the availability of the wide variety of software identified in the previous chapter, necessarily leaves control of decisions about whether and how to use computer-assisted learning, and the extent of its use, with teachers individually in their classrooms.

The issue of training has been one of the major concerns of the teachers' unions in relation to the use of microcomputers in schools, to ensure that educational computing skills are located primarily within the teaching force rather than with software developers and other external agents, which would have considerable implications for the potential separation of the conception and execution of teachers' work. In demanding more substantial training provision, the teachers' unions are very much in line with the views of teachers individually, though for reasons which are longer-term and more profound than teachers typically articulate. A second concern of some unions (e.g. NAS/UWT, 1980) has been with the potential effects on the labour process, as will be taken up in Chapter 8. The concerns of collectivities, of course, do not necessarily map directly onto those of their members, and that issue has not been reflected in the concerns of many teachers, who view microcomputers in teaching unproblematically as "labour complementing" rather than "labour displacing". That perception, together with the support mechanisms discussed above and the strong ideology of teacher autonomy within the classroom, has resulted in teachers individually seeing themselves, rather than the school or the LEA, as the relevant decision makers in respect of the incorporation or not of the innovation into their teaching. That view is echoed to a larger or smaller extent by headteachers and local education authority staff, who themselves are former teachers.

The historically-rooted ideology of teacher autonomy, which is taken up further in the next chapter in analysing the effects of the new technology within schools, is central also to an understanding of the role of teachers in this innovation. New technology does not enter a school into a vacuum, but via a set of traditions, practices, values and assumptions, to confront an existing technology. Those values and assumptions inform the <u>content</u> of the teaching task (the curriculum) on the basis of values and beliefs, which may or may not be made explicit, about society and individuals within it. They also inform the <u>practice</u> concerning the teaching process itself. Amongst the most potent of those values and practices is that of teacher autonomy within the classroom and the facility of teachers individually to determine the delivery of the curriculum, and to a much smaller extent its content, within their classroom and based on their judgement and experience. The teaching process has been historically accepted as an activity with a high discretionary content, in Fox's (1974) terms, and teachers certainly see the control of classroom processes as part of their psychological contract of employment. Lawn and Ozga (1988) discern in the memoires of a President of the Board of Education in the 1920's, Lord Eustace Percy, that the responsible autonomy strategy can be traced back to and was borrowed from the British colonial experience of "indirect rule", in which potential opponents of the imperial processes were coopted into semi-autonomous local structures. They suggest that an increasing concern in the Board of Education about the working class composition and alliances of the teaching force led to the promotion of professional behaviour through a control structure of responsible autonomy as an antidote to the trend to militant trade unionism.

The teaching process has been carried out over a prolonged period of time prior to the introduction of microelectronic technology with the use of an existing technology around which current practices have been developed. The prevailing technology of education, in its wide sense of means of processing inputs to produce outputs, has used a cellular model - the formation of groups of pupils located within classrooms, encountering areas of knowledge delivered and mediated by teachers, within time-frames structured by a timetable. That historical structure with its spatial isolation of teachers, and the fragmentation of learning through the cellular curriculum has far-reaching consequences for the innovation addressed here.

The technology, in its narrow sense of hardware, which has been developed to assist in those large group meetings comprises primarily chalkboards and other more recently introduced items such as televisions which are used mainly in demonstration mode for whole groups. Recent educational thinking has emphasised the potential benefits of individualising pupil learning and various print-based technologies (worksheets, workbooks, etc.) have been introduced in recent years. But the use of those various technologies has rested firmly on the tradition of teacher autonomy within the classroom, underpinned by an ideology of professionalism. Those deep structural roots mediate considerably the innovation studied here, and define a continuity which the potentially discontinuous event of the introduction of microelectronic technology confronts.

Technologies in most sectors of the economy have moved historically progressively from a handicraft stage through a mass production stage and towards custom tailoring. Within the education sector the handicraft stage was superseded by mass production before, but consolidated by, the introduction of universal free education following the Education Acts of 1870 and 1902. The "production process" within schools is still essentially one of mass production. The chance which microelectronics affords of individualising the learning process through computer-assisted learning to address more directly the capacities and limitations of individual pupils offers the possibility of a quantum change of the kind analysed by Miller and Friesen (1984), from a mass production to a custom tailoring configuration. Whether the education sector is at such a turning point or not depends not only on the potential of the technology but also the individual and organisational behavioural repertoires into which that technology is introduced.

The long term structures and repertoires, particularly the tradition of teacher autonomy, have been of great importance in the introduction of microelectronic technology, and emphasise the importance of long-term as well as short-term influences on the innovation process. The major thesis of this section is that the decision to use microcomputers in teaching has emerged so far as an optional decision of teachers individually rather than as a collective decision, or an authoritative decision by superordinates within the school or external to it. Changes in the teaching process have been at the instigation of teachers individually, rather than the result of practices at local or national level affecting teachers collectively.

There is, however, an important ambivalence in the attitude of many teachers towards the innovation. The ideology of service and of promoting pupils' interests frequently leads to a feeling that "we ought to provide a variety of learning methods and an improvement in teaching effectiveness" (the computer as process) or "we ought to provide pupils with experiences which might assist them in the employment market" (the computer as content). Receivers of an innovation (in this case teachers), however, are not *tabula rasa*. They actively seek some messages and opportunities, and ignore or reject others. Here, the innovation meets the conflicting and competing ideologies of different teachers. There have been various classificatory schemes used to identify teachers' educational ideologies. Cosin (1972), for example, identifies four major ideological clusters: élitist-conservative, rationalising-technocratic, romantic-individualist and egalitarian-democratic. For present purposes a simple dichotomy suffices. The first is that the main purpose of education is to act as an instrument of social and economic policy and to mould young people in the societal interest; the second, in contrast, is essentially individualistic - that education is primarily not for collective purposes but is to provide opportunities for personal growth and development. Those alternative ideologies have different implications for the way in which computers may be seen as beneficial educationally or as threatening; and different individuals may attempt to realise different objectives with the use of the same resources. The first of those two ideologies is associated with an emphasis on the computer as curriculum content and the second with either the computer as a learning device or as a vehicle for addressing equity issues (for example, in terms of gender, for ensuring that access to computers, school computer clubs, and so on are not gender-biased), with, for some people, a rejection of a technologically-oriented educational process seen as potentially dehumanising and resulting in a learning process of stereotyped uniformity. There is a significant minority of teachers who fear that technology will result not in computer-aided learning but in computer-degraded learning. The alternative "doom" or "boom" scenaria present in the debate about microelectronics in general are reflected also in the debate in school staff-rooms. So too is an increasing concern about technological developments and their societal implications which has led elsewhere to, for example, the introduction of Technology Assessment and an interest in Appropriate Technology and Intermediate Technology. A personal antipathy to technology *per se*, and its rejection by at least some teachers, is assumed and accepted. Figure 18, however, indicated that headteachers do not see teacher resistance as a constraint on this innovation. But even an acceptance by the majority of teachers of potential benefits as curriculum content or process involves costs - perhaps financial costs, certainly time costs - in updating skills and developing new teaching materials. Many teachers have contributed to their own training either financially or by undertaking training outside working hours. Some have gone even further than that and financed from their own pockets the equipment which they use in their teaching. One headteacher referred to a teacher in his school who "was so keen that he bought his own computer; in fact he uses his computer here and we provide the software" (headteacher, Westschool).

The opportunity costs of adopting the technology and the personal risks involved, at a time of other major changes such as the introduction of the GCSE examinations, may be considerable. A number of previous educational innovations have resulted in those who advocate change bearing few costs but receiving the rewards of successful innovation, whereas the teachers who have implemented the change have experienced more costs than rewards, as Fullan (1982) discusses. And as Perrow (1970, p58) suggests: "change is expensive.

To resist change until the argument is overwhelming is the better part of wisdom". When the costs to an individual teacher of a change in teaching style are clear but the benefits are uncertain or distant, and the risks of not changing are not perceived as substantial, or when they perceive the costs to be borne by themselves but the benefits to accrue to others, an attractive choice may be to continue with traditional teaching methods. To use a computing metaphor, the "default option" for teaching is "talk and chalk". That strategy has been adopted by many teachers. The slow speed with which teachers as a group have taken to the new technology has resulted in many pupils being more knowledgeable, and certainly more confident and uninhibited, about aspects of computing than their teachers. Evidence is available in many schools to support the headline in one newspaper that "Pupils know more about micros than their teachers!" One computer adviser expanded on that:

"Children are really familiar with how to set up the equipment and how to load programs, and see unusual events on the screen not as a disaster but as a challenge. And the teacher who has not had experience of that is in a very daunting situation. And undoubtedly there are very very many teachers - there is a lot of nervousness amongst teachers - who feel they are not in control of the situation in the sense that the children know much more about the equipment and its functioning than they do.... Some children, particularly boys with a very technical interest in computing, reach tremendously sophisticated levels of knowledge and skills about different aspects of the work. I see children using machine code in ways that, frankly, I don't understand. In terms of real experience theirs outstrips not only their teacher's but also mine." (computer adviser, Westlea)

A second-hand report from within that same LEA addressed also the pupils' knowledge:

"I was talking to -------- at ----school [not Westschool] and asked him why things have happened at ----school in the way they have. He said 'IT82 scared the living daylights out of the teaching profession. When you've got 14-15-16 year olds who know a damned sight more about technology, communications and programming than the people trying to teach them - it frightened them to death'. He said they went to bring themselves up to a level, and beyond, those they were trying to teach" (education officer, Westlea).

There is, then, an expectation that teachers will address the use of new technology. An attractive strategy where there is such an expectation may be adoption which is no more than token. The reasons for which schools may adopt innovations only symbolically - to appear to be responding to environmental expectations and to convey an image of being progressive, for example - apply to teachers individually as well as to schools as organisations, and reasons connected with peer and superordinate approval, and career advancement, are additionally relevant in the case of individuals. For many teachers a superficial and symbolic pseudo-adoption of an innovation - what Ball (1987) has termed "omissive action" - is not only attractive but sufficient. Although the resourcing mechanisms of central and local government have ensured that the organisational risks to the school in adopting the innovation have been minimised, the individual risk to the teacher, his cost-benefit calculus and "investment" over the years in a particular occupational role, have been ignored.

But there may be significant personal benefits and psychic rewards associated with the innovation for some teachers too. If the innovation is received by pupils as making their learning more relevant and interesting that can make the teaching process both easier and more enjoyable and give increased self-esteem and job satisfaction to teachers. In addition to those intrinsic benefits there may be extrinsic rewards also. For example, involvement in a visible innovation can be of benefit to teachers individually in their career progression. Lyons (1982) reported that "familiarity with new ideas and innovation" was rated by teachers as first in importance of thirty-two factors which were perceived to influence promotion.

Different teachers evaluate costs and benefits of the innovation differently, weigh the costs and benefits individualistically according to their own perception of their psychological, rather than legal, contract of employment, and become involved with the innovation to very different extents. As one headteacher reported

"Those individual members of staff interested in computing are getting on with it. We are getting a dichotomy now, I think, of those people who like computers and those people who are, let's say, neutral. I think those attitudes are going to remain. You are not going to convince somebody of, say, thirty-five that CAL is going to help him if he is happy with his own type of teaching." (headteacher, Eastschool)

That was echoed in another school:

"Those people who want to make use of the facilities do so, and those that don't make use of the facilities just ignore that they are there." (deputy headteacher, Westschool)

A specific example of teachers' decisions not to use available technology occurred in that school:

"We had a music synthesiser using computers but when the member of staff left that went by the board because other members of staff who were left weren't able or interested in developing that side (headteacher, Westschool).

Teachers, then, are discretionary users of microcomputer technology. There is a substantial group of teachers who do not get involved in educational computing:

"I think teachers, unless they have gone into computers - I mean the science department are fine and the boys' craft people - but there tends to be a bit of resistance in the subjects where they say 'oh, computers aren't for me, and I'm frightened of computers anyway'" (head of mathematics, Eastschool);

"there's still a lot of resistance on the part of some staff to get to grips, and there's still a lot of fear of new technology.... We've probably got a dozen staff who are pretty adept at using the system and others who just dabble. But there's still quite a large core who just don't go anywhere near it." (head of computer studies, Southschool); and

"Within this LEA we've had a fair amount of support and that has helped those who want to go along that road - but it has been those who want to go along that road. I think that is the biggest factor - having the interest and wanting to go along that road. I think it comes down to personal enthusiasm rather than anything else. I think that's the biggest factor. Teachers are notoriously independent - they want to go down their own road. To some extent they resent interference, even if it's by the Local Authority" (teacher, Westschool).

Some individuals have, explicitly or implicitly, seen the potential benefits of their involvement with new technology as outweighing the costs, while the calculus for others has produced the converse. Teachers have seen the innovation as either threatening or as creating an opportunity which can be exploited for altruistic or personal reasons, and have responded to the change accordingly.

Teachers individually rather than collectively, then, are in a strategic occupational position to decide whether to incorporate computer-assisted learning into their work, and in the absence because of ideological and resource constraints of widespread training and other support, teachers' individual rationalities prevail. As Fullan (1982, p107) said in relation to educational innovation generally "educational change depends on what teachers do and think - it's as simple and as complex as that".

7.4 Role of secretarial and clerical staff

School secretarial and clerical staff have a multifaceted job. Hart (1985) discusses the school secretary as "substitute parent", "the eyes and ears of the headteacher", "a sounding board", "the leader of the school support staff", "financial consultant" and "gatekeeper". Despite that multifarious role, school office staff continue to be regarded as peripheral workers rather than central workers in terms of Friedman's (1977) distinction. And while formal consultative mechanisms of various kinds have been established within schools as a means of facilitating the involvement of teachers in policy formulation, no equivalent formal mechanism exists in most schools to enable secretarial and clerical staff similarly to effect policy in respect of computer-assisted school administration or other issues. The joint regulation of the introduction of new technology by employers and unions at national or local levels has been either absent or token. For secretarial and clerical staff, therefore, by default their influence on policy has been through the extent to which they are prepared to cooperate in the implementation of decisions made elsewhere. School office staff have largely been excluded from decisions about the design of computer-assisted administration systems. They may, at most, have been consulted, but have not participated in systems design and have been able only to decide the degree to which they will accept or reject a proposed system and with the post-implementation adaption of the innovation.

Often that decision has been to get involved with new technology, for two reasons. First, school office staff have been, and are increasingly, suffering from an increased pressure of work and a reduction in staffing numbers and hours. For example, in one LEA, ancillary staff numbers

"... have been diminishing. A couple of years ago we set out a new system of points for ancillary staff and schools could spend these points in a variety of ways. Unfortunately, what happened was, as an economy measure, all schools were brought down to 80% of their points allocation. This probably didn't affect schools too much because they were very badly staffed anyway and there has been a tendency for schools to drift downwards, for staff not to be replaced so that they don't use their full points" (education officer, Eastlea).

And in another, "because of the education cuts, we are running down the number of office staff" (computer adviser, Northlea).

The use of a computer can be seen by office staff as a means of reducing such pressures, as the *cri de coeur* from the bursar in a school in that LEA indicates:

"I'm hoping it's going to cut down the work because we are over-worked as it is. This filing basket as you can see at the moment - it's always like that. The only time that you can catch up is during the holidays. And I haven't looked at a school fund account for about a month. So I'm hoping it's going to give us a little bit more time to really think about things.... I'm hoping that it is going to give us more efficiency and a little bit more time to think about what you are doing. You haven't got time to think because you haven't got the hours. I'm hoping that we can have a little bit more thinking time and perhaps not as much stress and rushing about" (bursar, Eastschool).

In Northlea, where there is a ban by NALGO on office staff using new technology, the demands of the work have in many cases over-ridden the trade union ban. As the computer adviser said

"the woman in ----school [not Northschool] is very vociferous about all sorts of things, but she got to the point where she couldn't keep up, and she realised these things were around and saw them being used in the school. Basically what was happening was the head of maths was wandering around with his lists that he had put on the computer himself and the secretary sees all this and says 'well, why can't I do it?'" (computer adviser, Northlea)

And in Northschool itself the school secretary, who is a member of NALGO, has ignored the NALGO ban on computer use in school offices, citing the benefits of the computer as a means of reducing the pressure of work resulting from previous staffing reductions as a reason for doing so:

"Originally, we had two full-timers and a part-timer. That was four years ago when the first full-timer left and they didn't replace. The second full-timer left and I said I would take over. Although the work has escalated, the staff has been cut.... We are still overloaded, so anything that eases the load we can do with.... I was NALGO rep, but I just haven't got the time now to be a rep as such, but if there are any problems then I do get in touch with NALGO. But NALGO aren't keen on us using a computer because they think we should be paid for it. But when it cuts your work, then you have to.... We are doing it simply because we don't have the staff to be able to cope with all the pressures, so we use the computer because it's quicker. (school secretary, Northschool)

The secretary's decision to use the available computer equipment has not been a passive one. Indeed, the skills of her husband, who works in the computer industry, have been utilised in modifying a pupil records computer program to enable her to carry out her job using one of the school's microcomputers:

"My husband has helped me. He comes in in the school holidays. He's been a big help. If I have a particular problem I say to him 'can you drop in at lunch time and have a look?'.... We are doing exam entries now. My husband is using 'Perfect Filer', creating the format for the data fields" (school secretary, Northschool).

Nevertheless, she claims that the pressures resulting from previous staff shortages have prevented the uptake of other potentially useful applications:

"We have got word processing - Edword - but, unfortunately, we are so busy that we haven't been able to get down to using it. The three of us went on a course at the teachers' centre to learn how to use it, but we just haven't had time to put it into practice.... I would like to use the computer a lot more but I haven't got the time to learn how to use it more fully. It's got a spreadsheet, so we could do the finance - but it's finding someone who knows how to use it to give me the lessons, and the time to learn - there's sort of a brick wall there" (bursar, Northschool).

In the Southlea pilot project:

"Certainly I can say that the clerical staff of the four pilot schools did not raise any objections whatsoever. In fact they were more than keen to get involved in it rather than being conscious of being taken advantage of, or whatever" (computer adviser, Southlea).

A second reason for some school office staff wishing to be involved in computer-assisted administration is that it will give them skills of value in the external labour market:

"If we refuse to use it, if we remain computer illiterate, we are not on the market, are we, if we do lose our jobs at any time. So it's really in our interests to learn in any case" (bursar, Eastschool).

Those comments from the school office staff themselves are consistent with the view expressed in the surveys by headteachers, reported earlier in Figure 18. Computer use in school administration was seen as "constrained to a great extent" by resistance from clerical staff in only 4% of cases in the initial survey and 5% in the final survey, and "not constrained" in respectively 81% and 85% of cases.

The lack of involvement of school secretarial staff in the development of those computer-assisted administrative systems which were produced within schools was highlighted in the surveys, which produced results almost identical to each other, the involvement of secretarial staff being reported as:

	Extensively involved	Fairly involved	Some involvement	Little involvement	Not involved
Initial survey	5%	11%	14%	6%	63%
Final survey	6%	10%	15%	5%	64%

Figure 24: Involvement of secretarial staff

The initiative in developing computer-assisted school administration is passing from schools individually to LEAs, as discussed in Chapter 6. And in those schemes also, although there are mechanisms of representational consent for involving relevant trade unions via the negotiation of new technology agreements, that involvement is again absent in respect of the design of the system, and the effect which that design may have on job tasks; it involves primarily job grading and health and safety issues.

The isolation of school secretarial and clerical staff, with typically two, three or four people working in each of the perhaps fifty secondary schools in an LEA, and the low salience of industrial relations issues, results in many not being aware of the significance, or even the existence, of new technology agreements. One bursar, who is a member of NALGO, referred to the route by which she became aware of NALGO's stance:

"Well, a couple of years ago the headmaster [!] said that we were not allowed to use the computer. I think that's basically why we didn't go on them to start with, but I think they [NALGO] have withdrawn their objection now" (bursar, Eastschool).

In all the LEA schemes studied, school secretarial and office staff have been excluded from influencing the design of systems - their influence is solely in deciding whether or not to become involved in the operation of a pre-designed system.

Braengaard (1982) makes an important and relevant distinction between applying technology in a rationalising mode and in an innovatory mode. In relation to the administrative uses of computers in schools the mode has been explicitly rationalising. That is certainly a major thrust of the LEA-developed schemes. Within schools that rationalisation process has not been resisted; key staff have been willing to exchange some autonomy for the acquisition of resources which will enable them to carry out existing operational management tasks more efficiently. It is worth quoting extensively from the responses to a question in the survey on the effects of the use of computers to illustrate the dominance of that view:

"reduce routine administrative time";
"a considerable improvement in administrative efficiency";
"much greater efficiency";
"speed up many administrative processes";
"removal of some routine administration";
"free me from some routine chores";

"improved administrative efficiency";
"decrease time at the paper mountain";
"relieve the school office of many routine tasks";
"on administrative side, greater efficiency";
"free me from time-consuming administrative tasks";
"more efficient";
"save time in routine activities";
"ease the administrative load";
"save time";
"make administrative aspects more efficient";
"improve efficiency";
"give me more time to deal with other aspects of management";
"free us from the time-consuming rituals of repetitive administration";
"an extra tool to improve efficiency";
"speed up certain administrative processes";
"make me more efficient".

It remains to be seen whether the institutionalisation of "housekeeping" and operational management tasks will be followed in schools by the development of strategic management applications aimed at increasing organisational effectiveness. But the emphasis so far in school administration has clearly been rationalisation and on increasing efficiency.

In terms of curricular use, as we saw earlier, rationalisation has not been allowed on to the agenda; the mode has been innovatory. At the level of the school, partly because of the opportunistic response to external funding, the question about whether to use computers in teaching has rarely been asked; the debate has always focussed on how to proceed, with different solutions emerging from the various garbage cans in different schools. Whatever the "solution" devised at school level, however, teacher autonomy concerning classroom practice has ensured that teachers individually have retained a veto about the incorporation of the technology into their teaching.

Chapter 8

EFFECTS OF THE INNOVATION

Two major research questions were posed in Chapter 1:

(1) What factors affect the extent and type of response to microcomputers in schools?

(2) What impact does the use of microcomputers have on the ways in which schools are organised and managed?

The first of those questions has been addressed in the previous two chapters, firstly in respect of external change agents, and secondly in relation to internal change agents. In this chapter the second of the two research questions is addressed and related to the conclusions of other studies concerning the impact of computers on organisations in sectors other than education.

The effects reported in the literature were discussed in Chapter 2, and focussed primarily on two aspects. One is the effect of the introduction of computer systems on jobs - both job numbers and job content. The second is the way in which computer systems affect organisational structures and relationships, particularly in respect of the location of decision making.

It was suggested in Chapter 3 that the above two major questions studied - the "response" and the "effects" - are not independent of each other but are systematically related. So the relative influence of the main groups and individual change agents and users - central government, LEAs, headteachers, computer experts, other teachers, office staff - is significant both *in* affecting the way in which LEAs, schools and teachers respond to the innovation and the effects which the innovation has.

In this chapter the conclusion is drawn that in respect of curriculum applications the effects on teachers' jobs have been relatively small; but given the potential of the technology to change teaching methods, the fact that the magnitude of the change is small is itself of considerable interest. It will be argued that the effects have so far been minimal because teachers have been able to control the way in which the technology is or is not used in their classrooms. That control has rested with teachers individually rather than collectively, and is consistent with a professionalism model rather than a bureaucratic model of innovation.

The effect on the organisational core task - teaching - has been relatively small; that on peripheral administrative tasks has been more substantial. The effect of the use of computers in school administration is qualitatively different from that in teaching in respect of both the individuals and groups who are primarily affected and also the underlying model of innovation, where a bureaucratic "research, development and diffusion" model is more in evidence. The two types of use - in the curriculum and in administration - provide both contrasts and similarities with studies based in other sectors of the economy. It will be argued that the effects in respect of the two application areas, although different, can be explained in terms of the single variable "control over the labour process" within a resource dependency model and that that variable enables the findings in this study to be integrated with studies in sectors other than education.

The effects on organisational structures which have emerged so far are less substantial than those on job content. Briefly, anticipating the later discussion, the effects on organisational structures of administrative use have been found to be small but with some evidence of a centralisation of monitoring and decision making. The effects on organisational structures of curricular use have been found to be minimal. Those results, though, are again consistent with a "control over the labour process" explanation of the innovation, as will be developed below.

It is recognised that the innovation is dynamic rather than static, and that the study has focussed on an early part rather than the whole of the life of the innovation. That is significant in respect of both curricular and administrative use. In curricular use the "learning model" adopted implies the possibility of changes in the process of the innovations as well as the product. Similarly in administrative use it is possible that, for example, the small magnitude of the effects on organisational structures are simply because the innovation had by the end of the study not had time for the changes consequent on the recent introduction of LEA-initiated systems to emerge fully. The analysis in this chapter is therefore set explicitly within a framework of continuing change rather than on the assumption that a final steady-state has been achieved.

8.1 Effects on the labour process

It is convenient to develop the discussion firstly on the narrower front of effects on job content, which concerns primarily internal change agents and user groups, and then on the broader front of effects on organisational structures, which affects both internal and external change agents and user groups.

It was suggested at the end of the last chapter that educational computing has been implemented in a rationalising mode in respect of administrative use and an innovatory mode in respect of curricular use. If the way in which the innovation is used is systematically related to the effects which it has, then the effects are likely to be, and have been found to be, rather different in respect of the two main areas of use, in administration and in the curriculum. Each will be addressed in turn.

8.1.1 Effects on the labour process: headteachers

Computer use in the curriculum has little effect, according to headteachers, on their job except insofar as they see the purpose of their job as being the provision of effective educational experience: so anything which affects the content of delivery of the curriculum can be deemed to affect that purpose. For example, one headteacher reported in the final survey:

"As headteacher I am most impressed by the contribution that our laboratory of BBC microcomputers can make towards motivating the less academic pupils. A major preoccupation for the headteacher of a fully comprehensive school must be to ensure that the curriculum meets the needs of every pupil. For a large proportion of our youngsters, book knowledge is not easily acquired but I have noticed a totally different interest displayed when the same information is dealt with by the computer. I consider the microcomputer to be the first major breakthrough in this field that we have had since the introduction of fully comprehensive schools over twenty years ago."

What does affect their job rather more, though still not substantially, is the administrative use of the technology. The result reported most frequently by headteachers is an increase in efficiency of the processing of administrative work. This is clearly seen by headteachers as the partial lifting of a burden, enabling them to devote more of their time to pupil-centred, professional matters. From the final survey headteachers reported:

"I don't have to waste so much time searching through files and other records.... It relieves myself and the management team of chores so that we can spend more time on strictly educational activities";

"Heads are becoming increasingly overloaded with administrative problems and a ready means of recording details of courses, teachers and pupils is a considerable aid";

"Education must always be about relationships with PEOPLE not machines. Computers speed processes, thereby enabling me to spend more time with staff and pupils".

Some years ago Mumford and Ward (1968) suggested that computers might be the first technological change to affect senior management because it is the first change to affect the basic commodity in which they deal - information. The technology without doubt has that potential, and the use of information technology in some organisations for purposes such as financial modelling has had effects on strategic management, as Tricker (1982) discusses. Within schools, headteachers have not chosen, or been able, to use the technology for strategic purposes. The distinction between "datalogical" and "infological" perspectives made by Methlie, and reported by Wilson (1984), is particularly relevant and provides a link between the analysis of the use of computers for education management and for general management purposes:

"The datalogical perspective regards the existing data flows as satisfactory representations of the information needs in the organisation. The aim of the change task is to find more efficient ways of processing the existing data. A common solution is to computerize manual procedures and data files. The benefits of this approach are primarily of the cost-savings type. This perspective is the traditional computer application view and is still common in current systems work. The infological perspective of information systems design looks at the organization as an information processing system. Thus communication and control aspects are in focus. Information is the knowledge, communicated between individuals and groups, needed to perform the tasks. The focus of this perspective is to find an effective information system for the whole or part of the organization to which the information is to give service." (Wilson, 1984, pp193-4)

In relation to administrative use in schools the innovation has been implemented conservatively and implicitly from a datalogical perspective; there has frequently been simply a one-for-one changeover from a manual file to a computerised file. Headteachers have not chosen to become involved as users of the equipment, in the way, for example, in which interactive modelling may be used. In the final survey headteachers operated the equipment for all or most administrative applications in only one of the schools, and for some applications in only 2% of the schools. They have simply continued to use the same outputs of the same administrative processes as were previously implemented on manual systems, in the classic "datalogical" manner.

Kanter (1972) suggests that the effects of information technology are more substantial on middle and operational management than on senior management. That is consistent with the views expressed by headteachers. Again from the final survey:

"As an administrative tool it makes it [my job] easier though it affects my immediate subordinates more";

"The introduction of the microcomputer into the office means more accurate data more quickly, but it will have more effect on the work of the clerical staff rather than the management team";

"It should make it easier in that enthusiastic computer users take on tasks in which the computer can be of service. Some of these tasks (e.g. subject options) were performed by me". [The last aspect - the transfer of the point at which certain tasks are carried out - will be developed later.]

The rather limited evidence available from the surveys and the case studies does not support hypothesis 10; evidence has not yet emerged of the use of microcomputers reducing the administrative content of senior manager's jobs within schools or affecting them substantially in other ways.

8.1.2 Effects on the labour process: secretarial and clerical staff

The extensive range of studies and forecasts outside the education sector of the impact of computers on clerical staff jobs point to significant effects on both job numbers and job content. Both research studies and predictions have dealt with issues of de-skilling of clerical jobs and of the polarisation of jobs into those with a high skill content and considerable variety and those which are restricted and repetitive. That polarisation and de-skilling can be related to labour market segmentation concepts, particularly the distinction between the internal secondary labour market and the external market, as discussed by Doeringer and Piore (1971). The internal labour market consists of jobs which are relatively specific to the organisation in terms of skills and job content and with relatively high security and continuity of employment, with the primary segment comprising employees with specific skills, extensive training, favourable working conditions and considerable autonomy, and the secondary segment with jobs which are less stable and well-rewarded but which require organisation-specific skills and which are not filled directly from outside. The external labour market comprises jobs in which the tasks are not organisationally specific, are less secure and well-rewarded than those in the internal labour market, and often with a higher turnover. The effects of new technology as labour-replacing, and changes in job content are particularly manifested in the external labour market. Clerical jobs in schools can be dichotomised into those in the internal secondary labour market (the school secretary) and those in the external labour market (school clerical assistants). In that way there is a potential, and in some quarters an expectation, of significant changes in the employment conditions of school secretarial and clerical staff resulting from the introduction of new technology.

The effects manifested during the course of this study, however, have been relatively small in terms of both job numbers and job content and it is in this respect that this study in the education sector demonstrates the greatest differences from studies in other sectors of the economy.

In terms of job numbers, the effects have been minimal. That may be explained because financial reductions preceding and unconnected with the introduction of information technology had already resulted in a reduction in job numbers. There was an initial expectation that the use of computers might result in further savings. For example, a working party interim report in Eastlea, dated November 1984, identified "a need to create economies in the use of staff time, particularly that of administrative staff" as a reason for introducing microcomputers in school administration. That expectation, however, was rapidly eroded, and an interview six months later with the author of that report illustrated the extent of the change: "all the evidence we have suggests that there won't be any savings" (education officer, Eastlea). The reduction in staffing levels had already happened, as we have seen:

"A couple of years ago we set out a new system of points for ancillary staff, and schools could spend these points in a variety of ways. Unfortunately what happened was, as an economy measure, all schools were brought down to 80% of their points allocation. This probably didn't affect schools too much because they were very badly staffed anyway, and there has been a tendency for schools to drift downwards, for staff not to be replaced so that they don't use their full points." (education officer, Eastlea)

In Eastschool itself:

"we are very badly off for ancillary staff anyway, with cuts and so on. We had to make a cut and we were never able to replace a lady who left, so there are two people in the office doing the work of three." (headteacher, Eastschool)

One headteacher in an Eastlea school responded to a survey question about the number of clerical staff in the school by saying "1.3 - yes, only 1.3 in a school of 720 pupils, and it makes me mad as hell!"

That prior reduction in clerical staff numbers put the school office staff under considerable pressure. In Eastschool:

"We are overworked as it is. This filing basket as you can see at the moment - it's always like that. The only time that you can catch up is *during* the holidays. And I haven't looked at the school fund account for about a month. So I'm hoping it's [the new microcomputer] going to give us a little bit more time to really think about things." (bursar, Eastschool); and

Bursar: "I can keep the teaching staff list up-to-date as teachers come and go and the part-timers change."

DL: "Have you been using the Apple system yourself to do that?"

Bursar: "No. The head has done it for me."

Elsewhere:

"Gradually, the secretaries have been won over because they can see that they are not going to get any more staff to come and help them, and if they use a word processor it's a damned sight easier" (computer adviser, Northlea).

Despite the common expectation that computers can increase efficiency, in the absence of a front-ended investment to ease the transition from a manual to a computerised administrative system, it was said by office staff that the pressure of work was such that they hadn't had time to learn to use the microcomputer-based system developed within the school:

"I just haven't had time. Mr -------- [deputy headteacher] had offered to show me but it's just finding the time - there's never a minute" (bursar, Eastschool); and:

"Mrs --------, our Bursar, knows nothing about computers at all. She hasn't even got time at the moment to be trained." (deputy headteacher, Eastschool)

The expectations about the consequences for clerical staff numbers of the introduction of microcomputers in school administration are similar in the other case study authorities:

"Certainly I doubt it will save us money.... I don't see anything particular in terms of costs." (education officer, Westlea)

Though it is difficult to untangle the confounding of the effects of financial contraction and the introduction of information technology, that scenario indicates a greater potential for using computers to alleviate problems caused by prior financial contraction rather than to be a vehicle for introducing clerical staffing reductions. The evidence on staffing numbers supports that. In the initial survey the number of full-time equivalent clerical, secretarial and administrative staff per school was 3.22; by the final survey it had not reduced but actually increased to 3.32 (an increase which is not statistically significant, using the t-test). Taken together, the case studies and the surveys provide evidence which refutes hypothesis 9. Further, the study has produced no evidence of the technology being associated with the increasing specialisation or segmentation of clerical tasks; the highly fragmented nature of school office tasks, with a large proportion being of short duration, has continued.

An alternative explanation which challenges the above analysis is possible. We have seen that the extent of use of microcomputers in school administration is very different in different schools. Although for the sample as a whole the number of clerical staff increased slightly as the technology was progressively introduced between the two survey points, it is possible that the increase was mainly in those schools which did not use the technology in school administration while those which did witnessed a reduction in the number of full-time equivalent clerical staff. The relationship between changes in the extent of administrative use and changes in the number of clerical staff, school by school rather than simply as averages for the sample as a whole, can be used to test that alternative explanation. The result of such a test of the Pearsonian correlation coefficient of differences between the two surveys in the extent of use in administration and the number of full-time equivalent clerical staff is negative, consistent with hypothesis 9, ($r=-0.08$) but is not statistically significant ($p=0.21$), so that alternative explanation and test does not confound the refutation of hypothesis 9.

There is an expectation amongst headteachers that the use of computers will enable some of the negative results of previous staffing reductions to be mitigated, as indicated in the survey responses:

"In due course clerical staff may be released from repetitive work by the extended use of microprocessing facilities but I should hope to use any gain in time constructively and creatively";

"Ease pressure of workload on clerical staff";

"School office staff are able to give a better service to the school";

"Free office staff to do more clerical tasks now undertaken by teachers because she is unable to accommodate these entirely at present".

The use of computers in administration is not associated by headteachers with negative effects on the clerical labour process. For example:

"I do not think that the introduction of microcomputers poses a threat to jobs";

"It is unlikely to have any foreseeable negative effects";

"I see no adverse effect";

"Fears of being replaced by machines are unfounded";

"Less fear of new technology - they can see some of the benefits it has to offer";

Secretarial staff too are generally positive. For example, "anything that eases the load we can do with" (school secretary, Northschool), and the bursar at Eastschool, commenting on the LEA system to replace the school-designed system, said:

"I'm very open-minded about it. I do like to learn new skills. You can't stay in the past. I'm looking forward to it really." (bursar, Eastschool)

The introduction into administration has been received by school clerical staff as less of a threat and major change than is perhaps the case in some other sectors. That may be partly because most school clerical staff, although union (primarily NALG0) members are frequently not active union members, and their geographical organisation, as small numbers of people at locations isolated from each other, results in their being less easily galvanised around an issue, despite the importance attached to new technology by NALGO at national level. It may also be partly because the incidence of a large proportion of short-run jobs makes school clerical jobs less amenable to rationalisation than clerical jobs in other sectors. For whatever combination of reasons, the introduction has been received as a less critical event in schools than in other sectors. For example:

DL: "Has the introduction of equipment been accompanied by any re-gradings?"

Bursar, Eastschool: "No. It hasn't been discussed."

A number of the comments from headteachers, quoted above, indicate a desire and an expectation that some of the administrative work taken over by teachers should return to the office. That has happened in respect of some of the manual clerical work. But significant amounts of the more strategic computer-processed work is being carried out by computer teachers and other teachers referred to here as technical experts. It is to the effects on the jobs of this third group that we now turn.

8.1.3 Effects on the labour process: technical experts

It was argued in Chapter 6 that the high profile with which computers have been introduced into schools, often funded partially by parents or other external constituencies, thereby increasing the necessity for the innovation to be seen to be successful, has increased the centrality of the innovation, at least temporarily. That has provided the opportunity for technical experts, often computer studies teachers, to become involved in areas of school activity to which people at that level of seniority would not normally have access. Where that opportunity has been taken it has changed - substantially in some cases, less so in others - the job content of the technical expert. It has been argued throughout this thesis that computer use for curriculum purposes and for administrative purposes have different mechanisms and effects; that applies equally to the effects on the technical expert's job. It is convenient to address first the effects of administrative use, thus continuing the line of analysis developed immediately above, before moving into the curriculum area, which leads into the effects of the innovation on other teachers.

At the simplest level, the use of computers in school administration has affected the job of some computer studies teacher as they have taken the role of operator of the technology in school-designed systems. In the surveys the percentage of schools in which the computer studies teacher was the person who operated the computer for all or most of the administrative applications were 37% in the initial survey. By the final survey, when LEA-systems were installed in some schools and expected in others, that had fallen to 23%, but was still a higher proportion than for any other group (headteachers, deputy headteachers, clerical staff, etc.). Similarly, for those systems developed within schools as opposed to those designed by LEAs, the computer studies teacher has often been the systems designer and programmer. In 59% of the schools in the initial survey all or most of the administration programs developed within the school were written by a computer studies teacher (and in 44% of the user-schools all or most of those programs were written within the school). That has involved a workload transfer vertically, both "upwards" and "downwards", onto the computer studies teacher. The traditional division of labour has been affected by the transfer upwards of some of the basic clerical task such as the production of pupil-, form-, set- and subject lists which were previously carried out by clerical staff. The minutes of a computer-assisted administration working group in one school in Eastlea (not Eastschool) for example recorded that "there was a recognition that these processes had already involved ... the transfer of some clerical work to teaching staff. It was hoped that this was temporary and that it would be reversed this year. Such processes should, in future, be more carefully managed".

And in Eastschool itself, the bursar, asked whether the teaching staff would themselves use the new administrative computer, replied:

"I think it will be the teaching staff as well. There are only two office staff for the whole school so really there isn't enough staff anyway, so I think they will be backing us up." (bursar, Eastschool)

The introduction of computer systems in sectors other than education is sometimes criticised for being concerned with improving the productivity and efficiency of inexpensive clerical labour rather than the more expensive managerial time. But a transfer of work from clerical staff to teaching staff goes beyond that and can have a negative effect on costs, possibly on financial costs, and certainly on opportunity costs. The LEA-designed systems replacing those developed mainly by technical experts within schools, of course, are directly addressing that issue.

There has also been a workload transfer downwards of some of the more strategic activities such as timetabling and option choice processing which have traditionally been carried out at deputy headteacher level, as one of the survey responses indicates:

"Enthusiastic computer users take on tasks in which the computer can be of service. Some of those tasks (e.g. subjects options) were performed by me."

It can, of course, be disturbing for staff at senior or middle management levels where particular tasks have been carried out for some time to find that someone who may have much less seniority in the organisation can carry out those activities more effectively or efficiently.

That encroachment on an old strategic prerogative is a particularly interesting development with considerable implications not only for the specific case of technical experts but also in respect of the contribution more widely of staff who have not previously had an input to aspects of school life which were traditionally restricted to senior management.

It also provides a particular illustration of the recursivity incorporated into the conceptual model developed in Chapter 3. The effects on technical experts have depended on the way in which those technical experts have responded to the opportunities which the innovation provides; and conversely, the way in which they have responded to the innovation has depended on both the perceived effects of its adoption and, as the innovation has progressed and been modified during institutionalisation, on its actual effects.

There are two alternative explanations for the workload transfer found. One - a political explanation - is that control of information processing increases power and prestige by increasing the dependency of the organisation on that person. Control of information flows and access can confer considerable power on "lower participants", as Mechanic (1962) discusses, as those people know most about the potential of the system and its areas of vulnerability.

An alternative explanation is based not on political concepts but on problems of systems development. If computer-based school administration applications have been programmed by a computer teacher it is possible that they work but are not robust in incorporating error-trapping and error-recovery procedures. Consequently the program writer may be quite happy to use them but fear that they are insufficiently robust to be used by others. Those two explanations are alternatives, not rivals in the sense of each explanation being correct and the other wrong throughout the population of schools, or the two being synthesisable.

The computer studies teacher has, then, frequently taken a line management role in respect of administrative use. The distinction between "line" and "staff" roles is generally becoming blurred and the terminology unfashionable, but it provides a useful distinction between the effects of administrative and curriculum developments on the job content of computer studies teachers. As Goldsmith (1986) points out, there is a delicate balance at each of the points of interface between autonomy, encouragement, regulation, direction and control, but whereas the computer expert has frequently taken a line management role with respect of administrative use, involvement in curricular matters has been a "staff" function where advice, consultation and persuasion are more prominent. In curricular use the interventions of the computer experts have involved a lateral shift of influence rather than a vertical shift in control. That influence is manifest in many ways. For example, in Westschool the computer studies teacher has provided in-service training in computer-assisted learning for his colleagues across the whole range of the curriculum, and at Southschool the computer expert is the sole author of the school policy paper submitted to the LEA on computer policy across the curriculum, and also scans the journals for potentially appropriate software in all areas of the curriculum and discusses the possibilities of its use with the relevant teachers.

That school-wide role is beginning to be formalised. In one LEA:

"We are trying to convince the schools that they should have a computer coordinator - a director of computer education - that it should generally be a senior member of staff" (computer adviser, Northlea).

A new occupational specialisation is beginning to emerge, reminiscent of the creation two or three decades ago of the post of data processing manager in commercial organisations. The emergent function does not yet have a title attached to it in schools - it is simply what Mr -------- or Mrs -------- does. The title of computer coordinator underemphasises the power of the role incumbent; the currently fashionable business job title of information systems manager and its predecessor of data processing manager suggest too great an emphasis on administrative use, and the term used in this study - the technical expert - is again not wholly satisfactory in describing the new role. The statement by Hepburn and Handy (1985, pp78-79) in considering building societies that "a new occupational layer is emerging, of technical and professional staff with specialist computer and information skills" is suggestive of a similar process, even if on a rather different scale, again without attaching a functional name to the emergent role.

It has been argued here that the technical expert role is advisory in relation to other teachers in the school. It will be argued that the role of other change agents, both internal and external to the school, is also advisory in their relationship with teachers, who have maintained control of whether and how computers will be incorporated into their teaching, and whether, how and to what extent the innovation affects teachers' jobs. We have, then, a re-skilling of technical experts (especially in terms of software development and contribution to curriculum development) without a corresponding de-skilling of teachers.

8.1.4 Effects on the labour process: teachers

A distinction has been made between effects on job numbers and on job content. The simplest to address is job numbers. It is true that concurrent with the introduction of computers into teaching there has been a reduction of teacher numbers. A DES Statistical Bulletin (Department of Education and Science, 1987a) charted that decline:

	Number of teachers in service in LEA secondary schools
January 1982	219,299
January 1983	217,664
January 1984	214,927
January 1985	209,234
January 1986	203,082

Figure 25: Changes in teacher numbers, 1982-1986

That decline in numbers has been, quite simply, the result of applying a policy of maintaining pupil-teacher ratios during a period of falling rolls consequent on the reduction in the birth rate in the 1970s. In fact the reduction in teacher numbers has been rather less rapid than the fall in pupil numbers, as the change in pupil-teacher ratios reported in Figure 26 demonstrates:

	Pupil-teacher ratio (secondary) schools
1982	16.6
1983	16.5
1984	16.2
1985	16.1
1986	15.9

(Source: Department of Education and Science, 1987b)

Figure 26: Changes in pupil-teacher ratios, 1982-1986

That national pattern does not conceal local variations, but is replicated in each of the four case study LEAs, in which the reduction in pupil-teacher ratios from 1983-84 to 1986-87 were: Northlea (16.8 to 16.0), Southlea (15.6 to 14.9), Eastlea (16.8 to 16.6) and Westlea (15.8 to 14.8).

Although a number of authors (for example Douse, 1980; Rushby, 1981; Eicher, 1984) have argued that computer-assisted learning <u>can</u> be used partially to replace teachers, there is no suggestion from reports in the literature that they <u>have</u> so far been so used. There is also no evidence of such effects in this study. For example, there is no evidence of increasing class sizes (quite the reverse, as the above pupil-teacher ratios imply), or of organising pupil groups in such a way that teacher-hours could potentially be saved.

Much previous educational technology, particularly teaching machines and programme learning methods which were introduced two decades ago, was introduced against a background of a shortage of teachers. That context is very different from the position now when a decline in the school-age population has resulted in an excess of teachers, unprecedented unemployment of newly qualified teachers, and a variety of early retirement schemes to induce teachers to leave their employment. Despite that changing labour market context at least one computer adviser is dismissive of the view that computers could be used to replace teachers:

"Any teacher who thinks he is going to be replaced by a computer deserves to be!"
(computer adviser, Eastlea)

The absence of detailed evaluations of the cost-effectiveness of learning with microcomputers lends support to the view that aligning education with the needs of industry is a prime reason for the introduction of microcomputers into schools, and is of greater importance, at least currently, than efficiency concerns. Indeed, by using microcomputers as an additional resource to complement teachers rather than as a substitute for them, as discussed below, they have been introduced in ways which add to costs rather than reduce them. That finding is consistent with that in other countries in western Europe. A recent OECD report on the implementation of microelectronics in member states concluded that in respect of the two prime policy objectives of equity and efficiency "most countries have preferred equity to efficiency whenever there was a possibility of conflict" (Organisation for Economic Cooperation and Development, 1986, p34).

The magnitude and type of effects on teachers' job content rather than job numbers, though not dramatic, has been manifest to a rather greater extent. The teaching function, of course, is the prime function of schools and insofar as microcomputers affect the teaching and learning process it affects the organisational core.

From the educational computing literature and from the evidence in this study there are three main different ways in which teachers' jobs can be affected by computers. They can be used to alter the teaching and learning process by changing and enlarging the teacher's job such that he or she becomes to a greater extent a manager of learning; secondly they can diminish and de-skill the teachers job; or thirdly they can be used simply as a further aid without substantially affecting the job. The first and third of those ways involve the use of the innovation augmentatively or additively; the second, in contrast, incorporates its use substitutively. Those alternatives potentially have dramatically different effects on teachers' jobs. It is useful to enlarge on each of these three modes of use as a background against which to analyse the empirical findings of this study.

Many of the advocates of educational computing and educational technology more generally (e.g. Papert, 1980; Hawkridge, 1982) argue that microcomputers can and should be used to enlarge and re-skill teachers' jobs by emphasising the teacher's role as a manager of learning, with pupils being participants in the learning process to a greater extent than spectators, with the teacher being less didactic, and operating as a facilitator rather than a purveyor and judge of knowledge. For many teachers such a role change is not comfortable, easy, or consistent with their self-image.

The increased use of pupil-centred learning can have substantial effects not only on the mode of learning but also on the "hidden curriculum" - the value system of the school which is implied rather than explicit. By weakening the link between teacher knowledge and teacher authority, and viewing knowledge as an area for discovery and sharing rather than for transmission hierarchically, the use of the technology can alter the social order of the classroom and affect the socialisation function of education. As Grace (1978) says:

"Curricula and pedagogy do not exist in abstraction from social and political contexts. An educational code which celebrates received knowledge, boundary strength, teacher direction, hierarchy and approved stages for initiation and progress enshrines a particular model of man and a particular model of society - its implications for social control are clear. An educational mode which emphasises the learner's own capacity to make sense of the world in notions of 'curriculum as practice' and 'conscientization' and which opposes hierarchy, authority and boundary, postulates a different conception of man and a different social and political order." (Grace, 1978, p54)

A second group of writers, not educational technologists but primarily educational sociologists writing principally from a Marxist perspective, discuss the possibility of the extensive use of pre-written teaching packages resulting in de-skilling, by the divorce of the conception and the execution of the teaching process and the absorption into the technology of the workers' knowledge and skills as part of what Wise (1979) refers to as "the hyper-rationalisation of schooling". Apple (1981), for example, discusses this effect as a result of the increased use of packaged materials, which would include computer-assisted learning packages. It is worth quoting at length from his argument:

"However, one particular institution - the school - provides an exceptional microcosm for seeing these kinds of mechanisms of control in operation.... Given the relatively autonomous nature of teaching (one can usually close one's door and not be disturbed) and given the internal history of the kinds of control in the institution the school has been partially resistant to technical and bureaucratic control, at the level of actual practice, until relatively recently. This 'relative autonomy' may be breaking down today.... The best examples of the encroachment of technical control procedures is found in the exceptionally rapid growth in the use of pre-packaged sets of curricular materials.... Little in what might metaphorically be called the 'production process' is left to chance. In many ways, it can be considered a picture of de-skilling - the goals, the process, the outcome, and the evaluative criteria for assessing them are defined as precisely as possible by people external to the situation. Skills that teachers used to need, that were deemed essential to the craft of working with children (such as curriculum deliberation and planning, designing teaching and curricular strategies for specific groups and individuals based on intimate knowledge of these people), are no longer as necessary. With the large scale influx of pre-packaged material, planning is separated from execution.

"If such technical control is effective, that is, if teachers actually respond in ways that accept the separation of planning from execution, then one would expect results that go beyond this 'mere' separation. One would expect, at the level of classroom practice, that it will be more difficult for teachers jointly to gain informal control over curricular decisions because of their increasing isolation.... The fact that the form taken by these curricular systems is tightly controlled and more easily made 'accountable'; that it is usually individualised, that it focuses on skills in a time of perceived crisis in the teaching of 'basic skills', etc, nearly guarantees its acceptability to a wide array of classes and interest groups." (Apple, 1981, pp16-19)

The third, and less dramatic, way in which microcomputers can be incorporated into the teaching and learning process is by teachers using the equipment as simply another tool, in the way in which overhead projectors, film and television and video have been incorporated into the teaching process. That may involve microcomputers being used largely in a demonstration mode as an electronic chalkboard, perhaps as a replacement for an experiment, a film or verbal explanation. That method fails to exploit the educational potential of the technology, as many educational technologists state. But it is more simple to organise, and despite producing fewer benefits can be incorporated at less cost to teachers individually and to the school as an organisation.

The innovation, then, certainly offers the potential to change the teaching and learning process. That is recognised within the case study schools. For example "it's given us a chance to move away from chalk and talk" (teacher, Eastschool); and

"using computers does need a change in attitude in a lot of teachers ... you've got to sit down and actually get involved with the kids and work with them ... I think you've got to accept that and go with it rather than trying to maintain traditional approaches. I think the computer gives you that chance to alter relationships in a classroom." (head of resources, Northschool)

The empirical evidence from both the surveys and the case studies show that the innovation has been implemented conservatively and incrementally rather than radically, with only a marginal redefinition of occupational roles. New technology is being overlaid onto existing modes of the organisation of teaching and learning rather than by taking the opportunity to address ways in which a different mix of resource inputs might be associated with changes in organisational processes. A distinction was made in Chapter 2 between innovations which are implemented as variations and those which are reorientations. The use of microcomputers in the classroom has been introduced pragmatically by the majority of teachers simply as a variation. The way in which it has been incorporated into schools is primarily the latter of the three means discussed above - the computer is used simply as another tool. That is certainly how it is described by one of the teachers who currently uses computers extensively in one of the case study schools, and in the survey by headteachers:

"I think computers have got to find a niche in the same way that a projector and video have done. I don't think it's going to be the be-all and end-all, the central factor - not to my mind" (teacher, Westschool);

"Settling down and becoming common-place as just another tool";

"Staff have a new tool in their teaching methods";

"It will become a resource which they feel comfortable with and confident enough to use in a positive, imaginative way";

"It will divide them into two distinct groups - those who enjoy the technology and respond to it in a positive manner and those who are cynical about it and show little willingness to attempt to come to terms with it";

"I see the use of microcomputers with relevant software as an additional resource to be used as appropriate in many subjects by staff or pupils or both".

Those comments are consistent with the analysis of one of the advisers:

"Bearing in mind the present approach of most secondary teachers to their work in the classroom, it seems to me that the vast majority of them will use computers if it fits in to some degree at least with their current teaching strategy. To change the method of teaching, and what they teach, and introduce new technology all simultaneously for many teachers is too big a change overnight. And I see examples in a number of schools where teachers will go and use a network situation because then their change is in the new technology, but the method - i.e. all children are doing similar things and they feel they can handle that better in some respects - seems to be working well." (computer adviser, Southlea)

The technology is not seen by headteachers in the survey as replacing teachers:

"We view this positively and not as a threat. They represent additional resources, not substitutes or replacements";

"I do not envisage the computer replacing teachers but providing positive assistance".

It is recognised, however, that the technology can be used in different and more imaginative ways:

"Gradually, teaching staff will have to *reconsider their classroom methodology* if computers are to be used effectively in classrooms";

"Teaching staff have an enormous resource and will need to overcome their in-built resistance to change";

"It can be done, but it's not the way we have worked here. Nobody seems to want to".

Those comments are echoed by LEA computer advisory staff. For example:

"There is little evidence, it seems to me - there is some, but it is little - that people are moving away from the traditional to the more individualised learning." (computer adviser, Southlea); and

"At the moment I see no evidence at all for any change in teaching style, and often it is a step backwards rather than forwards" (computer adviser, Eastlea).

The innovation has been adopted in a way which exhibits what Schon (1973) refers to as "dynamic conservatism"; the technology has been used by the majority of teachers to affect the teaching and learning process only marginally rather than profoundly. Teachers have been successful in ensuring that computer systems have been introduced in ways which result in the direction of dependence being that the system depends on the user rather than the user depending on the system. In terms of the distinction made earlier the innovation has been introduced augmentatively rather than substitutively in relation to teachers' labour process.

If the technology offers the potential for significant change in the teaching and learning process but that potential has not been realised the question of why that is so is of major importance. The question is essentially one of control of the labour process in teaching.

In other studies of technological innovation in a range of sectors of the economy the variables affecting control of the labour process have focussed on task dimensions, particularly task uncertainty and complexity (Perrow, 1970; van de Ven and Ferry, 1980) and ideological factors. The two sets of variables have been brought together by Jamous and Peloille (1970) in relating "indetermination" and "technicality", as discussed in Chapter 2. The concepts of indetermination and technicality are directly relevant to the dispersal of control over this innovation within the education system, and are linked to a further aspect of control over the labour process. Various strategies of control can be used. Friedman (1977) distinguishes between direct control, which minimises individuals' responsibility by providing close supervision, and responsible autonomy, which attempts to harness adaptability by giving people freedom and encouragement to respond to a changing situation in ways which are beneficial to the organisation. Friedman and others discuss the use of different control strategies in respect of jobs of different kinds. There is an implication in much of that writing that a single control strategy is used in respect of one job. That may relate to some of the ambiguities in the extensive literature on the bureaucratic professions and the tension in them between professionalism and bureaucratic control as discussed by Johnson (1972) and Salaman (1979), and specifically in relation to schools by Corwin (1970), Shipman (1984) and Hoyle (1986). It is suggested here that in respect of teachers' jobs both direct control and responsible autonomy operate in relation to different aspects of the job, and that that relates to the indetermination and technicality of different aspects of the job, which in turn explains the relative control over the innovation in question. Specifically, it is suggested that bureaucratic control is emphasised in respect of the <u>inputs</u> and <u>outputs</u> of teaching - via the reification of the timetable and attendance registers, and the implementation of homework policies and internal and external examinations; but that responsible autonomy is applied in relation to the <u>process</u> of teaching. The former involves primarily, though not exclusively, "control before the event"; the latter, recognising the need for on-the-spot decisions to absorb the uncertainty of classroom events, is mainly implemented by mechanisms of monitoring and control "after the event". As Dreeben (1988, p27) puts it "the vicissitudes of the classroom cannot readily be subsumed under general formulas prescribing conduct". The inputs and outputs are essentially the matters with which school administration is concerned and are aspects of organisational life for which indetermination is low and technicality is high. But in the teaching process the accepted ideology is such that the reverse is perceived to be the case, with indetermination accepted as high and technicality as low. A recently published study of the effects of computerised instruction in schools in the United States (Peterson, 1987) came to a similar conclusion:

"The technology of education - the set of activities used by teachers to produce cognitive learning and socialization (the two central goals of schools) - remains largely uncodified.... Teacher beliefs about the technology of teaching and the structure of the curriculum reinforce and support extensive professional autonomy." (Peterson, 1987, pp137-138)

In respect of Perrow's (1970) discussion of organisational technology being determined substantially by the number of exceptional cases encountered within a work task, each individual pupil and his or her abilities and specific needs are identified as an exceptional case and the continual adjustments of the mode of delivery of the curriculum reflect a particular balance of indetermination and technicality which define the ideological core of the teaching craft.

By focussing on addressing the needs of pupils individually, and as individuals rather than as a class, teachers have been able to maintain an indeterminate occupational skills base and a cognitive operational exclusiveness, which would not have been so readily achieved by teachers identifying their skills as located at the level of a class of pupils or pupils in general. The software which has entered schools so far and purported to individualise instruction has simply meant that pupils work individually on the computer sequentially. Some of the software which is currently being developed aims to individualise instruction by taking into account the strengths and limitations of individual pupils. That software will challenge teachers' indeterminate skills base to a greater extent than does the software currently in use.

Although there may be general agreement that information technology will significantly affect jobs concerned with the structuring and dissemination of information, as Peitchinis (1983) and others discuss, teachers see information transmission as only a part of their role and emphasise as of equal or greater importance the socialisation, motivational and pastoral dimensions, and the transmission of cultural values. They see teaching as a social process rather than simply a cerebral one. As Dede (1981) states:

"If machines are simply substituted for people without compensatory shifts in the human teaching that remains, personal contact and the affective skills learned through modelling others' behaviour will be partially lost. In a world daily growing more impersonal the retention of large amounts of human interchange in learning seems important both for socialisation purposes and to enhance the quality of life." (Dede, 1981, p210)

Teachers see their role as a whole as essentially non-programmable and therefore non-computable, with daily interaction with pupils being of high indetermination and low technicality, even if some parts of their job could be assisted by microcomputer technology. The teachers' view is shared by the managers of the education system (education officers and advisers - themselves almost without exception former teachers), and on the whole by local and national politicians. The Secretary of State, indeed, has stated publicly that "new technology could never replace the teacher in the classroom" (Baker, 1987b, p1). The uncontested policy choice has been to introduce microcomputer technology in ways which build upon and develop the skills of the teaching force rather than in ways which are de-skilling. The traditions of professionalism in teaching run strong and deep, and autonomy is seen as a precondition of that professionalism. Teachers claim exclusively to possess the experience and knowledge of how to use the new technology within the classroom situation, and see themselves as the valves controlling technical advice or assistance which they individually have felt free to seek from time to time but without abrogating, influence to the providers of that advice and assistance. That view of the teaching process is associated with the explicit use of a responsible autonomy strategy of control and indeed appeals to professionalism, pupils' interests, and quality of service provision as a justification for innovation. And teachers, like other occupational groups, are keen whenever possible to exploit the ideology of professionalism as a means of control and defence of the labour process.

Within a multi-stage process of innovation (issue recognition, decision, implementation, etc.) the proponents of an innovation need to secure agreement or at least compliance at each stage, but a veto at any stage gives a certain power over the innovation process as a whole and is sufficient to prevent its institutionalisation. In a context of responsible autonomy, central and local government can, and have, provide resources, incentives and opportunities for teachers to adopt new technology, and many teachers have done so. But a reliance on professionality confers a veto onto teachers individually within their classroom, and many have chosen to use the considerable negative power which that veto gives. The ideology of responsible autonomy is sufficiently entrenched so that control over the innovation has been largely impermeable to a changing labour market. In a number of studies of technological innovation in sectors other than education the impetus to introduce an innovation has stemmed from employers, with a variety of motives, and the innovation may have been resisted to a greater or lesser extent by employees or used as a further item in on-going negotiations about conditions of employment, as discussed by Child and Tarbuck (1985) in relation to the banking sector. In such a situation, and particularly where direct control is important, the job market position of employees is of major importance. In the education sector, the job market position of teachers has deteriorated, partly as a declining birth-rate has resulted in a change from teacher shortage to teacher surplus, and that has had effects, for example on teachers' salaries. But the entrenchment of an ideology of responsible autonomy has resulted in teacher control of the teaching process within the classroom being unaffected by teachers' job market position.

Although the teachers' unions have taken an interest in microcomputers and the NAS/UWT (1980) paper entitled *Microelectronics: Is there a future for teachers?* demonstrates a concern about the potential of computers profoundly to affect teachers' job content, the issue of computer use has not figured prominently in negotiations between teachers' unions and employers. As discussed in Chapter 7, issues surrounding the adoption or otherwise of microcomputers in teaching have been dealt with essentially by teachers individually rather than collectively. That applies also to the mode in which computers are used - specifically whether they are used as simply another teaching tool in ways which increase the volume of resources used without changing the resource mix, and without affecting significantly the teaching and learning process, or whether they are used in ways which do affect that process and involve changing the resource mix. Teachers individually have therefore been able to use the new technology in ways which support their activities but such that they individually retain control of whether and how the technology will be used. In relation to this innovation teachers operate essentially as autonomous professionals rather than bureaucratic functionaries. That situation is very similar to that which has emerged in the case of hospital consultants' use of microelectronic technology, as discussed by Child (1984) and Belaton and Loveridge (1985). Indeed, it is very similar to the central distinction made at the commencement of the National Health Service (Bevan, 1952) between the state's role as the provider of resources and the autonomous professional use of those resources by doctors.

Whether the locus of control will remain in the classroom in the longer term remains to be seen. It has been emphasised throughout this study that what has been observed and analysed is the initial phase rather than the complete life of the innovation. The effects of the innovation are assumed to be not instantaneous and permanent but to emerge only slowly, and to change, as individual and organisational learning takes place. Educational innovations are notoriously slow in becoming institutionalised. There is a wide recognition that this innovation, too, may take a considerable time to emerge fully. As one adviser said when discussing changes in the teaching and learning process: "you look for good practice and then you tend to - not ignore - but forget that there's a whole tail behind. I'm hopeful that it will eventually come but I think its going to be a much longer process than colleagues would imagine" (computer adviser, Northlea). One headteacher said "there's inertia in schools; people get on with their job. The demands of teaching your timetable are such that you are not looking for innovation particularly". Another commented on the organisational inertia by referring to "a drip-feed situation" to illustrate the speed of change, a third realised that "we have come across brick walls, absolute brick walls.... It's going to be a long hard job", and a fourth admitted that "it's a fight, a real fight". Similarly, one deputy headteacher stated that "it's been very slow getting off the ground" (deputy headteacher, Northschool), and another, in comparing this innovation with others within schools remarked that "it's taken us ages, it really has, to get to this point", and "it's a hell of a hurdle - much more so than any other development that I've seen in school anyway" (deputy headteacher, Southschool).

The ideology of teacher autonomy is not necessarily permanent. Market forces are moving adversely against teachers as their practice comes under increasing scrutiny from both a central government increasingly committed to formal teacher appraisal and from parents whose voice in educational decision making has emerged as of increased importance by the twin forces of legislation and falling rolls leading to an increased market orientation of schools.

The use of microcomputers has impinged as yet only marginally on the aspect of their jobs which teachers regard as central to their craft - the teaching process within the classroom. That control of the teaching process by an individual teacher, as one level of analysis, can be contrasted with the control of the curriculum as a whole by teachers collectively in comparison with other agencies at a second level of analysis. Further, a distinction can be made between control of the means of instruction (or the delivery of the curriculum) and the ends (or the content of the curriculum). Thus, a four-fold classification can be developed:

	Control of means/ Delivery of the curriculum	Control of ends/ Content of the curriculum
Teachers' control of the curriculum as a group, compared with other agencies	A	B
Teachers' individual control of the teaching process within schools	D	C

Figure 27: Curriculum control

The current intervention by central government concerning the "core curriculum" relates to sector B, where it is clear that teachers collectively are less influential than they were, even recently. The issues with which Apple (1981) is concerned (the de-skilling of teachers consequent on the use of pre-packaged curriculum materials, with their separation of the conception and execution of the teaching process, as discussed above) relate to sector A. That sector is concerned with issues which, as yet, have barely emerged on to the agenda of teachers individually or in aggregate through their unions, but as Apple discusses, are ones where microcomputers are potentially a very significant vehicle for change. The more obvious areas in which the technology has significant effects are those represented by sectors C and D. The promulgation of a core curriculum would clearly have major effects in sector C, but teachers have for long relinquished some control in that sector to the examination boards. The way in which microcomputers are seen by teachers individually and collectively potentially to affect most directly the educational process is that represented by sector D. Teachers view the classroom, and the teaching processes within it, as their territory, with territory having both a geographical and a psychological definition. They have been able to secure workplace autonomy if not occupational autonomy. It is clearly possible that microcomputers may be the "Trojan horse" by which that territory is invaded, and changes in teachers' labour process subsequently take place. So far, however, teachers have retained control unchallenged, indeed supported in their professional demands, and the frontier of control there has remained unchanged. But the development of software packages, and the capability through hardware devices entering the educational system to transmit those packages into schools, together with the development of a core curriculum with its associated monitoring and testing, and the changing employment contract of teachers (particularly if they become employees of the DES directly rather than of the LEAs), creates an infrastructure with a potential for teachers' labour processes to be increasingly circumscribed.

Two potentially significant effects of information technology use were identified in the literature reviewed in Chapter 2. The first - the effect on jobs - has been discussed; the second theme - the effects on organisational structures - will now be developed.

8.2 Effects on organisational structures

Writers in the systems tradition emphasise the possibility, indeed the expectation, of change in technology affecting organisational structures. As Galbraith (1977) and Campbell (1984) discuss, organisational structures may essentially be functions of handling information in a particular way, and as the means of generating, storing, processing and retrieving information change organisation structures may change in response. Papert's (1980) fear that the education system would absorb technological change by using new technologies to reinforce "educational methods whose very existence is a reflection of the limitations of a pre-computer period" is based on similar assumptions about the relationship between technology and structure. There is not, of course, necessarily a unidirectional effect of technology on structure. Extant structures can equally affect the use of technology, and prior to the availability of low-cost microcomputers the structuring of education as an exceedingly geographically, dispersed service excluded the use of certain technologies. A systems model is helpful in viewing the two variables as interdependent. Further, it is possible that new information technology can be used not to change organisational structures but deliberately to maintain existing ones. Pitt and Smith (1984) suggest that is the case in an analysis of welfare benefits system - that information technology has enabled officials to retain a "baroque" benefits system rather than search for alternatives, and by rendering the baroque manageable, information technology may have sustained the structure after it has outlived its usefulness. Nevertheless, the prime interest in the literature has been in the direction of the effects of technological change on structural change.

For at least three decades, studies relating technology and technological change to organisational structures have been carried out (for example, Trist and Bamforth, 1951; Burns and Stalker, 1966; Woodward, 1965; Hage and Aiken, 1969; Hickson, Pugh and Pheysey, 1969; Child and Mansfield, 1972; Pfeffer and Leblebici, 1973). Partly because the various studies have not used the same operational variables it has been difficult to synthesise their often different findings. There would be general agreement, however, that such studies, taken as a whole, do not provide support for a technological determinism thesis. Changes in information technology may have several different effects, at least some of which are mutually contradictory. On the one hand for example, by increasing information processing capacity, the use of information technology may reduce the need for the division of labour, task specialisation, and the decentralisation of decision making. On the other hand, that same information processing capacity may enable and facilitate decentralisation by increasing the capability to monitor, control and co-ordinate at the centre, as Pfeffer (1978) discusses.

It was suggested in Chapter 2 that there are two different ways in which structural changes may be associated with changes in technology. First, the computer may affect job roles and the reasons and ways in which individuals and groups interact with each other, with changes in the formal structure following such changes in the operation of the organisation or, secondly, the opportunities offered by the computer to bring about radical changes in organisational structure may be exploited. Within the schools sector changes in structure have certainly not anticipated changes in technology. There is, though, some evidence of structural change following technological change. Those effects may increase as time passes but as yet they have been only slight.

The speed with which changes in structure follow changes in technology may be very slow. As Whisler explained:

"Information technology may be used initially to make current organisational arrangements work better; the decision to adapt the structure to better exploit the technology and may well come after the technology has been installed and conceivably may not be made for a long time." (Whisler, 1970, p33)

It is convenient, again, to discuss separately effects in relation to the curriculum and to administration, as it will be argued that the effects are qualitatively different in those two domains. The simplest to deal with is the curriculum domain, where few effects have emerged. There are indications in a few schools only of changes in the organisation of the teaching process resulting from an increased use of microcomputers. But the location of those changes is of itself of importance. It is possible for such changes to be located either within existing structures (essentially departments) or to be implemented in ways which cut across existing departmental structures. The mode of implementation so far has been the former; the possible structural implications of technological change have not been allowed onto the agenda. That conservative implementation policy, incorporating minimal changes in existing patterns of organisation, results in total only in changes such as an increased use of team teaching and individualised resource-based learning, as reflected in comments from the surveys:

"The IT coordinator has six 50-minute periods timetabled in three main faculty areas to team teach computer-assisted learning with various subject-based programs";

"Team teaching using simulations in History";

"Circuits of work, as not all pupils can use the computer at once";

"More project-based teaching rather than class teaching";

"Change in Humanities to resource-based learning";

"Low ability fourth year course based on the use of computers as versatile tools to aid projects";

"Supported self-study programme to A-level".

But the changes are few in number. As an adviser reported on the basis of knowledge of all schools in one LEA:

"At the moment I see no evidence at all for any change in teaching style, and often it is a step backwards rather than forwards." (computer adviser, Eastlea)

Although there are a few exceptions, the evidence from both the surveys and the case studies in relation to the sample as a whole is consistent with hypothesis 8. On the whole the use of microcomputers is being superimposed on existing structures rather than being integrated into possibly more efficient learning structures. Traditional organisational forms have persisted. The new technology has affected only inconsequentially the tradition of departmentalism and the importance of subject departments as zones of influence. Outsiders (technical experts) have gained access to, and some influence on, decisions taken within some departments, but the structural integrity of the departments has not been significantly affected by the innovation. And the loose coupling between departments has meant that adoption within a particular subject department has had minimal consequences for other departments. The new microelectronic technology <u>in</u> education has been used so far within the existing technology <u>of</u> education - the compartmentalisation of the curriculum, and its delivery to pupils processed mainly as a group rather than as individuals, within a classroom according to a timetable, with all that implies for the ordering of time and space.

That particular technology of education is but one historically defined solution to the problem of organising the learning process, developed at a time when inexpensive means of individualising learning were simply not available. Dreeben's (1988) assertion that "in recent educational history there have been no innovations in teaching technology of sufficient magnitude to render the self-contained classroom structurally obsolete" has not been challenged so far by microelectronic technology. In the longer term, as many writers have suggested, information technology may have profound effects on the structure of educational organisations, even to the extent of deschooling. A number of radical writers, for example Illich (1973) advocate progressive deschooling on political grounds; others such as Hawkridge (1982) suggest that information technology may be the vehicle by which such a change can be implemented. Yet others, such as Stonier (1983), see the home as the base for cognitive learning via information technology while emphasising that organisations will still be needed for the socialisation function. Whether those changes, or ones similar in direction if not in extent, will come about remains to be seen. The effect so far has been minimal.

That conclusion is consistent with a recently published study by the OECD of educational computing in its member states, which found:

"striking is the attitude of policy towards one of the challenges of the technology to education: that is to its own structure and organisation. By and large this issue is not addressed. So far, all policies have been built on the tacit assumption that education will not change and that the introduction of the new information technology can be planned without altering the structure of the system" (Organisation for Economic Cooperation and Development, 1986, p26).

In respect of administrative use the effects on organisational structure which have emerged so far have been of greater magnitude though still relatively small. As Mumford and Banks (1967) and Child (1975) explain, if computers are used basically to automate existing clerical procedures there may be little effect on organisational structures; such effects are more likely if the technology is used in strategically penetrative ways. As was discussed earlier in this chapter microcomputers have been introduced in school administration in a "datalogical" rather than an "infological" manner. The effect on structures has been correspondingly small. There is evidence of some decentralisation <u>within</u> schools, with decisions relating to timetabling, options choices, etc., which were previously made by senior management, being taken by technical experts using microcomputer technology, as discussed above. Similarly, in the LEA-devised administrative systems, there is a potential for the centralisation of some decisions currently made within schools, and the potential for increased monitoring, control and decision making within the LEA. Currently much of the data about schools used as a basis for resource allocation (particularly of per-pupil capitation allowances and of staffing) is housed within the schools themselves. In a period of falling rolls schools have a vested interest in reporting out-dated or inaccurate information to the LEA about rolls, early leavers, attendance rates, and so on. The LEA-based administrative systems will enable the control of that uncertainty to pass from the schools to the LEA office.

That informational transfer from the periphery to the centre, or at least the central control of information if not its location, has been reinforced by a directive from an unexpected quarter. Because many schools use computerised pupil records (that was the second-most common application reported in Chapter 5 in both the initial and the final surveys) they fall within the provisions of the Data Protection Act. The Data Protection Registrar has decreed that personal data held within schools must be registered by and in the name not of the school but of the local authority. The attractions for the Registrar of dealing with 104 LEAs rather than with 30,000 schools are clear; but the legislative requirements for registration, and the Data Protection Registrar's interpretation of that legislation, provides a further justification for LEA involvement in what schools and teachers previously perceived, whatever its legal basis, as their territory. Following the data protection legislation one education officer was:

"... at the moment trying to ascertain what sort of personal data schools are holding on micros - and it's a bottomless pit. A lot of people have been holding data but because they have developed the data unofficially they are very hesitant about telling you what is going on" (education officer, Westlea).

And in another LEA, Southlea, a directive concerning that legislation from the education office to all schools instructed them that:

"No school should electronically process personal data after 31st May 1986 unless it has a letter from the Authority authorising it to do so.... Do NOT operate any data processing systems after 31st May 1986 unless you have received a letter of authorisation from the Authority, and then you must comply with any restrictions placed on your system by the Authority."

That puts the control of information and of information processing in a prominent place on the agenda of the continuing redefinition of the relationship between schools and LEAs.

The monitoring and control envisaged within the various LEA-developed systems can be achieved partly by connecting school microcomputers by telephone to the LEA office and enable information which had previously been available only in the school, or by the LEA requesting the school to provide it, to be available routinely in the LEA office. The use of such processes will provide a contextual framework within which further decisions will subsequently be made. Such communications provision is deliberately being incorporated, either in phase I or phase II of the pilot schemes:

"I would see it as a natural progression. It's not something that will happen in the autumn of this year but it's one of those things that, when all schools are involved in it, does seem to me to be a fairly natural progression and would have benefits on both sides, both for schools individually and for the Authority receiving the information" (computer adviser, Southlea);

"I understood that it was going to be connected to the Honeywell straight away." (deputy headteacher, Eastschool)

It is recognised within LEAs that schools might have reservations about such developments, and that benefits may be unidirectional:

"I think the majority of heads would feel that they don't really need the mainframe. Maybe the mainframe needs them rather more" (education officer, Westlea).

A structural change which has begun to occur and which may or may not develop was referred to earlier in this chapter - the emergence of a functional area of technical advice. Technical experts are taking an increasing advisory and support role in relation to the curriculum, and an executive role in administration. Pettigrew (1973b) described "occupational specialisation as an emergent process"; it could be that the first stages of a particular occupational segmentation is occurring with a new functional area emerging within schools in a way similar to that in which the pastoral care function emerged two decades ago, grew and became established, and is similar to the change in many organisations from "parallel" to "functional" departments as Weir (1977) discusses in relation to the growth of the information processing function. Examples of such an emergent process can be discerned from the responses in the final survey:

"The appointment of a member of staff responsible for the 'coordination of computer awareness' across the curriculum";

"A head of computer education and IT has been appointed and has spear-headed developments";

"Two teachers given responsibility for computers across the curriculum and use in administration. They coordinate the whole use of computers within the school";

"The appointment of a computer applications coordinator has done much to widen the use of computers in school administration";

"The second in science now oversees the development of computing across the curriculum";

"Appointment of Scale 4 responsible for development of computing and IT across the curriculum".

The evidence which is available so far therefore tends to support rather than refute hypotheses 11 and 12 - that there is some centralisation of strategic control activities to agencies external to the school, but decentralisation within schools of operational control activities. But that evidence is small in extent, perhaps partly because the effects of standardised LEA-devised administrative systems which have been in place for only a short have yet to be fully manifest.

The effects of information technology on organisational structures, both within schools and in the relationship between schools and LEAs, although small, demonstrates the diffuse and varied nature of organisational relationships within the sector. In the curriculum area, the funding mechanisms employed by central and local government have ensured an uptake of the innovation in all schools and in that sense has affected the innovation bureaucratically at the level of the individual school. But there has not been a substantial effect at the level of the individual teacher. The process by which the innovation has been introduced has not incorporated a mechanism for influencing and increasingly controlling the labour process directly in the way which is evident in some other sectors. That reflects an absence of intention of so doing, rather than an attempt which has successfully been resisted. Ironically, nor has it enabled the potential pedagogical benefits of the technology to be exploited in full. Within the school, however, the innovation has been used opportunistically to change relationships and power balances, particularly by increasing the centrality of the technical expert.

In the use of computers in the administrative domain, systems designers have been influential in determining both the response to and the effects of the innovation. In the early systems developed within schools individually the designer was often the technical expert, and the innovation underpinned his centrality. With the more recent LEA-designed systems there is a evidence of a greater bureaucratic control of schools. In the initial phase investigated in this study the systems have been used primarily for administrative tasks which headteachers and other school staff regard as chores and for which they have been willing to relinquish control in return for a system which increases administrative efficiency. The effects of that changed locus of influence if and when the computer systems are extended into managerial rather than administrative applications remain to be seen.

Chapter 9

CONCLUSION

9.1 Conclusions on the main research questions

Two main research questions were posed in Chapter 1:

(1) What factors affect the extent and type of response to microcomputers in schools?

(2) What impact does the use of microcomputers have on the ways in which schools are organised and managed?

A number of operational hypotheses were derived from those research questions and a methodology designed and implemented to test them. It is possible to identify conclusions at two levels of generality. First are the specific conclusions relating to the substance of the study and the operational hypotheses. Second are the more general conclusions related to and feeding back into the conceptual model on which the research is based, and which may relate to studies of microelectronics in sectors other than education, and to studies of innovations other than microelectronics within the education sector.

The more specific conclusions will be summarised first before discussing the more general, higher-order conclusions.

Twelve hypotheses were derived in Chapter 3 from the conceptual model developed there. Those hypotheses have each been addressed individually in Part C of this study and are brought together here.

Hypothesis 1: The greater the volume of resources provided by LEAs to support educational computing, the greater is the extent of use of microcomputers in schools in those LEAs.

Supported: Section 6.2

Hypothesis 2: The greater the support and involvement with microcomputers of the headteacher of a school, the greater is the extent of use of microcomputers in the school.

Refuted: Section 7.1

Hypothesis 3: The greater the involvement with microcomputers of the technical expert(s) in a school, the greater is the extent of use of microcomputers in the school.

Supported: Section 7.2

Hypothesis 4: The policies and support mechanisms used by central government agencies affect the extent of provision of microcomputers within schools.

Supported: Section 6.1

Hypothesis 5: The pattern of use of microcomputers for teaching purposes is different in different schools within an LEA.

Supported: Section 6.2

Hypothesis 6: The pattern of use of microcomputers for teaching purposes is not significantly different in aggregate in different LEAs.

Supported: Section 6.2

Hypothesis 7: The use of microcomputers for administrative purposes in schools in different LEAs depends on the policies of those LEAs in respect of administrative use and the resources provided in association with those policies.

Supported: Section 6.2

Hypothesis 8: The use of microcomputers does not result in substantial organisational changes outside the classroom relating to, for example, the use of teaching assistants or the use of individualised resource-based learning organised other than by teachers individually.

Supported: Section 8.2

Hypothesis 9: The use of microcomputers for administration results in a reduction in the number of clerical posts and increased specialisation of those posts.

Refuted: Section 8.1.2

Hypothesis 10: The use of microcomputers results in a reduction in the administrative content of senior (headteacher and deputy headteacher) managers' jobs.

Refuted: Section 8.1.1

Hypothesis 11: The use of microcomputers, in association with changing government policies, results in increased centralisation of strategic control activities by educational agencies external to the school.

Supported: Section 8.2

Hypothesis 12: The use of information technology results in decentralisation of decision making and operational control activities within schools.

Supported: Section 8.2

The results of the analysis in Chapters 6, 7 and 8 require the elimination of some of the resource dependency relationships postulated in the conceptual model. Consistent with Fisher's (1937) classic canon that statistically significant relationships which emerge in the course of a study but which have not been previously hypothesised cannot be treated as findings but instead provide only the basis of hypotheses for further studies, the model of the significant relationships found in the study, shown in Figure 28, is simpler than that originally postulated.

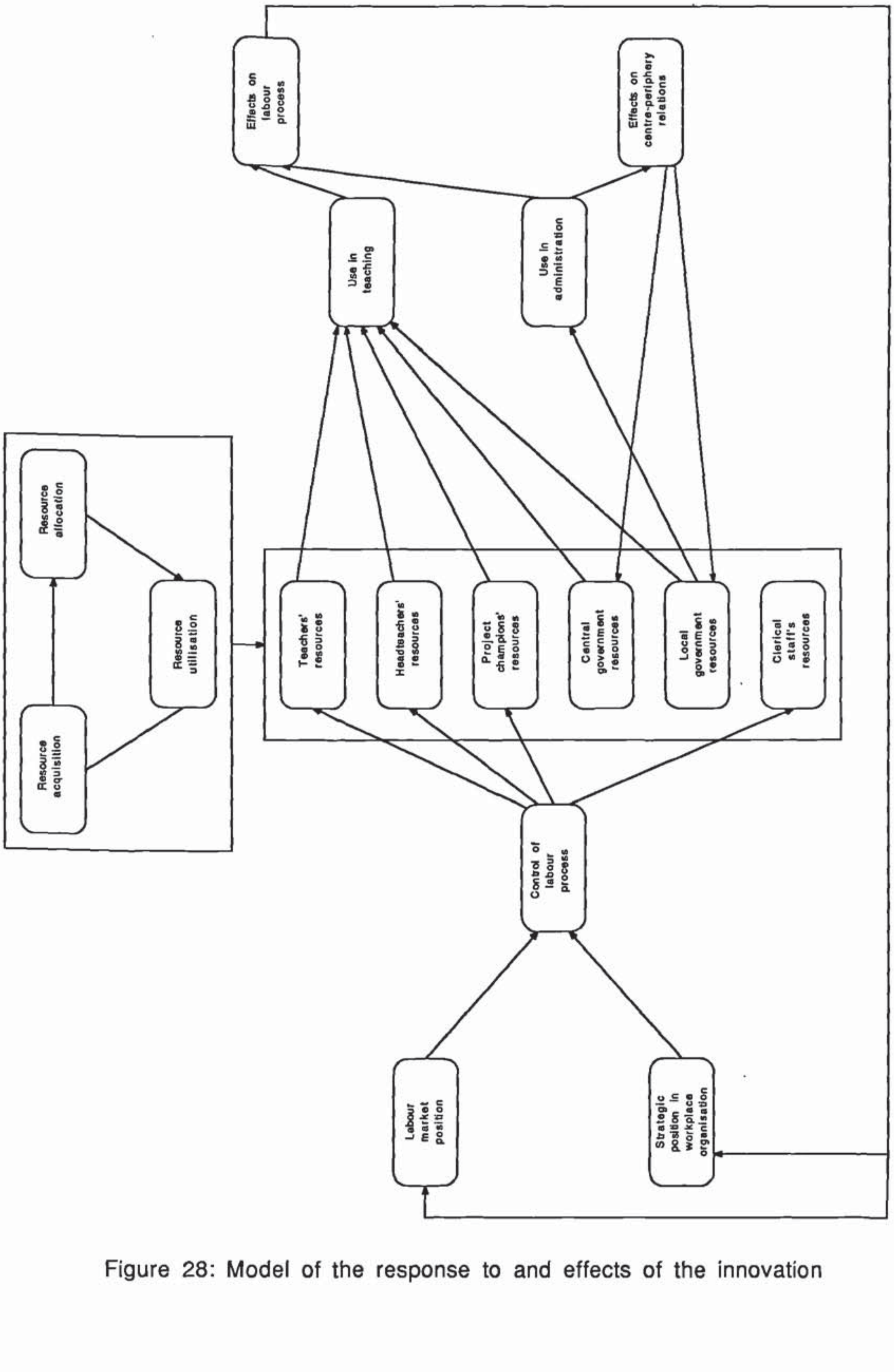

Figure 28: Model of the response to and effects of the innovation

The innovation studied here was identified on the first page of this report as one which potentially has profound implications for the future purpose, content and delivery of an education service. Given that the education sector is one for which a major purpose is the encouragement of the analysis of issues of societal importance, that people employed within the sector encompass a wide spectrum of political opinion, and that curriculum change is typically widely debated, contested and negotiated (some would say to the exclusion of action), it is surprising that the desirability or otherwise of the introduction of information technology into schools has not been more hotly debated and the ends to which the technology might be put have not been more vigorously contested. Like motherhood and apple pie, information technology in education has been accepted as "a good thing". Many educational debates of the past have been about ends. In this case that argument has been won without being fought. The desirability of introducing information technology into schools has been taken for granted. Questions of "why" have been replaced by questions of "how". The debate has been about means of achieving ends and issues concerning means have supplanted issues concerning those ends.

That has possibly been, at least in part, because there has not been an attempt to generate agreement about the objectives of the introduction of microcomputers into education. As a malleable technology, microelectronics can be used to pursue a range of different, and indeed inconsistent, objectives. The blurring of objectives, resulting from the absence, which is characteristic of the British education system, of a "Grand Plan", may well have facilitated the uptake of the technology. Different individuals and groups, both within schools and in the education system more generally, have different objectives in respect of the technology, which has entered schools for a wide variety of purposes, both explicit and implicit, and to promote interests which are neither simple nor unitary. It would have been difficult, divisive and perhaps impossible to achieve agreement on a set of objectives. Some people, for example, place great emphasis on the instrumentality of the technology in respect of employment and its contribution to the national economy. Others reject those aims and emphasise issues of equity and access to enriched learning environments. By <u>not</u> emphasising national, local or institutional objectives different individuals and groups have been able to take up the technology for their own reasons, which may contradict those of other individuals and groups who can simultaneously develop their own definition of the innovation.

Although it has been convenient to use the term "the innovation", the area investigated encompasses not a single phenomenon but multiple phenomena in terms of both the content of the innovation and also the models of change implied by the processes by which it has been introduced. The innovation is defined very differently in different schools, and different aspects are implemented to different extents, or not at all. So what the innovation of educational computing is is interpreted very differently in different schools. The innovation itself has changed, and is changing, as its institutionalisation evolves: what the innovation is is what it becomes.

In respect of the content of the innovation, in some schools computers are regarded primarily as a tool to be used to support teaching in a wide range of subject areas. In others they are regarded as a subject to be taught. In the latter case this may be either a course taught at external examination level, or as an introductory computer appreciation course, or both. Similarly, in the majority of schools computers are used to assist in administrative work, but in a substantial minority they are not currently used for that purpose. So, again, whether the innovation is regarded as currently applicable to the bureaucratic functioning of schools is interpreted differently in different schools. Different patterns of adoption and use of the innovation have emerged, then, in superficially similar organisations. For example, the same administrative task, such as the preparation of pupil lists of various kinds, are being carried out with computer assistance at different levels in the hierarchy of a school - in some cases by a deputy headteacher, in others by a computer teacher of considerably less seniority, and in a few cases by the headteacher, or by school office staff.

Various key actors have been identified in different jobs in different schools. One pattern which has emerged consistently through the study is the importance of the technocrat (the computer expert), typically, though not always, a computer studies teacher. Where the technocrat has been active in promoting computer work in the curriculum, developments in that area of application have occurred in the school, and where he has not there has been less curricular use of the technology. Similarly in school administration, the extent of computer use is closely related to the extent of the technocrat's involvement in that area of application.

Contrary to many studies of other educational innovations, and to the received wisdom from the majority of education management texts, the extent of diffusion of this innovation in the curriculum is not greatly dependent on headteachers' influence and involvement.

Again contrary to the (prescriptive rather than descriptive) literature on computer systems development, little account has been taken of recommended good practice in systems design in relation to the administrative applications of computers, particularly in respect of the potential effects of the new system on school clerical staff. Such systems design principles have been more in evidence in applications development not within schools individually but by regional or national organisations, such as in the computer-assisted learning materials produced through the Microelectronic Education Programme, and in the LEA-sponsored school administration systems.

9.2 Two modes of innovation

The content of the innovation is, then, defined differently in different schools. That has been possible, at least in part, because of the process which the innovation has followed. A number of studies of educational (and other) innovations are assumed to be, or concluded to be, linear top-down or bottom-up innovations. The "research, development and diffusion" (Havelock), "power coercive" (Chin and Benne) and "technological" (House) models of innovation address linear top-down processes of innovation within a managerial prerogative assumption. Conversely, the "problem solving" (Havelock), "normative re-educative" (Chin and Benne) and "cultural" (House) models assume that innovations have bottom-up elements. A number of studies have attempted to identify whether a particular innovation is of one type or another. Many of the studies of the introduction of microelectronic technology have identified primarily top-down processes, where the explicit or implicit assumption is one of senior managers deciding unilaterally to introduce microelectronic devices into a production or service organisation, with employees perhaps resisting that move to a greater or lesser extent, and the innovation subsequently being successfully introduced or not. That description is brief and simplistic but captures the essence of a significant part of the microelectronics literature.

In this study the underlying model has emerged as not linear but more complex, reflecting the diffusion of influence in the education sector. And, not one, but two models of innovation have been identified in relation to, first, the bureaucratic use of the technology at the organisational periphery (school administration) and, second, its professional use within the organisational core (teaching). The processes of influence and decision making are fundamentally different in the two applications areas; they are, of course, inter-related, but are quite distinct.

In respect of school administration, a simple linear top-down bureaucratic model describes well the innovation process in respect of the standardised computer-based administrative systems developed by local education authorities and introduced into schools. The systems have been designed and diffused using a product development methodology in a rationalising or controlling mode, and with a direct control strategy similar to that found in a number of other studies. For those tasks, indetermination is low and technicality is high, clerical staff are fragmented and have not been able collectively (though they have occasionally been successful individually) to influence substantially their labour process; and to the extent which they have, that has been by an acceptance rather than a rejection of the technology as it has been perceived to enable a reduction in the pressure of work which has resulted from prior reduction of clerical staff numbers. The innovation in respect of the bureaucratic functioning of schools is in that sense complementary to rationalisation processes which were already underway.

In contrast, at the organisational centre, a dual core model has been found to operate, with different mechanisms affecting the <u>extent</u> of adoption of the technology (where a top-down bureaucratic model operates) and the <u>way</u> in which the technology is used (where a bottom-up professional model dominates). For teaching purposes, despite the innovation being introduced against a deteriorating labour market position of teachers, the historical ideology of teacher autonomy underpinned by a managerial control strategy of responsible autonomy has resulted in teachers, at least so far, being successful in maintaining their dominant decision making role about the delivery of the curriculum. That locus of decision making is supported not only by those within schools but also by staff of LEAs (who are themselves former teachers) and, at least in public pronouncements, by central government. The innovation has been introduced for curricular purposes in an enabling rather than controlling mode and with the assumption that as a result of individual and organisational learning the innovation will evolve over time rather than having been introduced in a pre-defined programmed way. The differences between the two modes of innovation identified are captured in Figure 29.

	Administrative use	Curricular use
Mode of innovation	Controlling	Enabling
Part of organisation	Periphery	Core
Intention of resourcers	Rationalisation	Innovation
Design philosophy	Product development	Learning
System type	Standardised	Differentiated
Mode of implementation	Programmed	Adaptive
Control strategy	Direct control	Responsible autonomy
Locus of adoption decision	Centre (LEA)	Periphery (teacher)
Magnitude of change	Systemic	*Ad hoc* marginal change

Figure 29: Two modes of innovation

In respect of curricular use, a strategy of responsible autonomy, which teachers have continued to secure as a result of being successful in defining the teaching process and interaction with individual pupils as processes of high indetermination, carries with it both the benefits and the risks of relying on voluntarism. The absence of structural mechanisms through which to implement change enables those who choose to devote their energy to the innovation being able to shape it substantially within a particular school. The result of that voluntarism is likely to be (and was found to be) a wide variety of different activities in different schools, some of which have been judged within the educational computing literature to be excellent and innovative and have been widely publicised, and others which have been deemed to be wasteful by obtaining only minor benefits from a relatively expensive resource. It also leads to wide differences in patterns of provision, locally-defined priorities and working arrangements. The assimilation of the technology has been far from identical in all organisations.

In respect of curricular use it has been found that national and regional managers and politicians, as resourcers of the education system, have been able to use incentives, via funding mechanisms, significantly to influence the extent of adoption of the innovation consistently on a variety of measures of adoption.

Categorical funding has proved to be a powerful mechanism of dependence by establishing new resourcing channels and new resource dependency relations in a context in which the resourcers do not have the means to implement a preferred change in the delivery of a service without the cooperation of the point of service providers. Through the use of specific funding mechanisms the innovation can, in that sense, be described as a resource-driven or a resource-constrained innovation. In contrast with the top-down mechanisms used by central and local government to affect the extent of uptake of the technology, bottom-up processes of innovation have determined the way in which the technology is used in the classroom. The way in which the innovation has been adopted - the relative priority of curricular or administrative use, the relative priority of computer studies or computer-assisted learning, the extent of use by examination-oriented elite groups of pupils or by all pupils, and so on - all of which are major questions of resource utilisation on which national and regional managers and politicians have expressed views, often quite strong views, have been determined within schools. That provides further evidence in support of the non-deterministic thesis of technology. The way in which teachers individually have been successful in implementing their choice of whether or not to become involved in the use of computers for teaching purposes (and particularly in avoiding that use if they perceive the short-term risks of not changing to be low and the costs to them as outweighing the benefits) emphasises control over the labour process as the key variable in determining the effect of the technological change on jobs. That control of the labour process currently rests with teachers.

Those two modes of innovation, though very different in content and process, both involve resource dependency relationships. Three distinct major resource dependency relationships are involved. In the administrative area LEAs have exchanged physical computer resources and software, and the absorption of uncertainty surrounding system development, for the use within schools of standardised systems to produce standardised outputs, and for the first time in the recent history of schools, outputs which make comparisons between schools feasible on a routine basis.

In the curriculum area two resource dependency relationships are involved. In the first, across the school boundary, LEAs and central government departments have exchanged computer equipment and support services for the delivery by schools, within a responsible autonomy mode of control which teachers have been successful in securing, of an increasingly technologically-, vocationally- and industrially-oriented curriculum. That responsible autonomy mode of control has resulted in a further resource dependency relationship within the school, where those who are able to control major uncertainties surrounding the innovation have exchanged advice and expertise for enhanced career prospects, status, visibility and a platform from which to influence the activities of the organisational core.

Thus, what appear to be, and indeed are, two separate modes of innovation with very different mechanisms and products, and are ostensibly different phenomena, are comprehensible in terms of a single, resource dependency, model.

9.3 Dynamic of the innovation

But the innovation is not yet complete and operating in equilibrium. We have seen so far only, as it were, a series of sepia daguerreotype snapshots of the acting out of the tensions between long-term trends and short-term shifts; the denouement is yet distant. In respect of the bureaucratic administrative use of the technology, there have been significant changes even so far. That development - a change from school-produced to LEA-produced school administration systems - emphasises that the innovation is not a static one but is dynamic. Changes such as the introduction of LEA-designed computer-assisted administrative systems are likely to have effects on other issues studied - for example on the relative influence of the technical expert who has often been the designer of school-produced systems, and possibly on school-LEA relationships, particularly in terms of the centralisation-decentralisation dimension. This study has focussed on the early stages rather than the complete life even of that aspect of the innovation.

In one sense, though, use in administration has developed to a greater extent than curricular use. There is a relatively small number of staff in each school who use computers in administration - typically two or three clerical staff and about the same number of teaching staff - so the introduction of one or more sophisticated computers of the kind used in the LEA-developed administrative projects into a school which was previously using one simple microcomputer for administration on a part-time basis represents a large influx of resources into the administrative area. In contrast, in an average sized school which has perhaps sixty teachers, a change from ten microcomputers per school in the initial survey to fifteen per school in the final survey represents a small increment in the resources available to the sixty potential users of the equipment. The volume of resources available is important. A change from one microcomputer per classroom to ten is not only a quantitative change; it enables, and perhaps requires, a qualitative change in use also. The extensive effects on the labour process of administrative users, where autonomy has been reduced considerably by the standardised systems, and the minimal effects on teachers whose autonomy has remained intact, can be related to the extent of resources available as suggested in Figure 30, which is consistent with a resource dependency model in indicating that effects may be at least partly dependent on the volume of resources used.

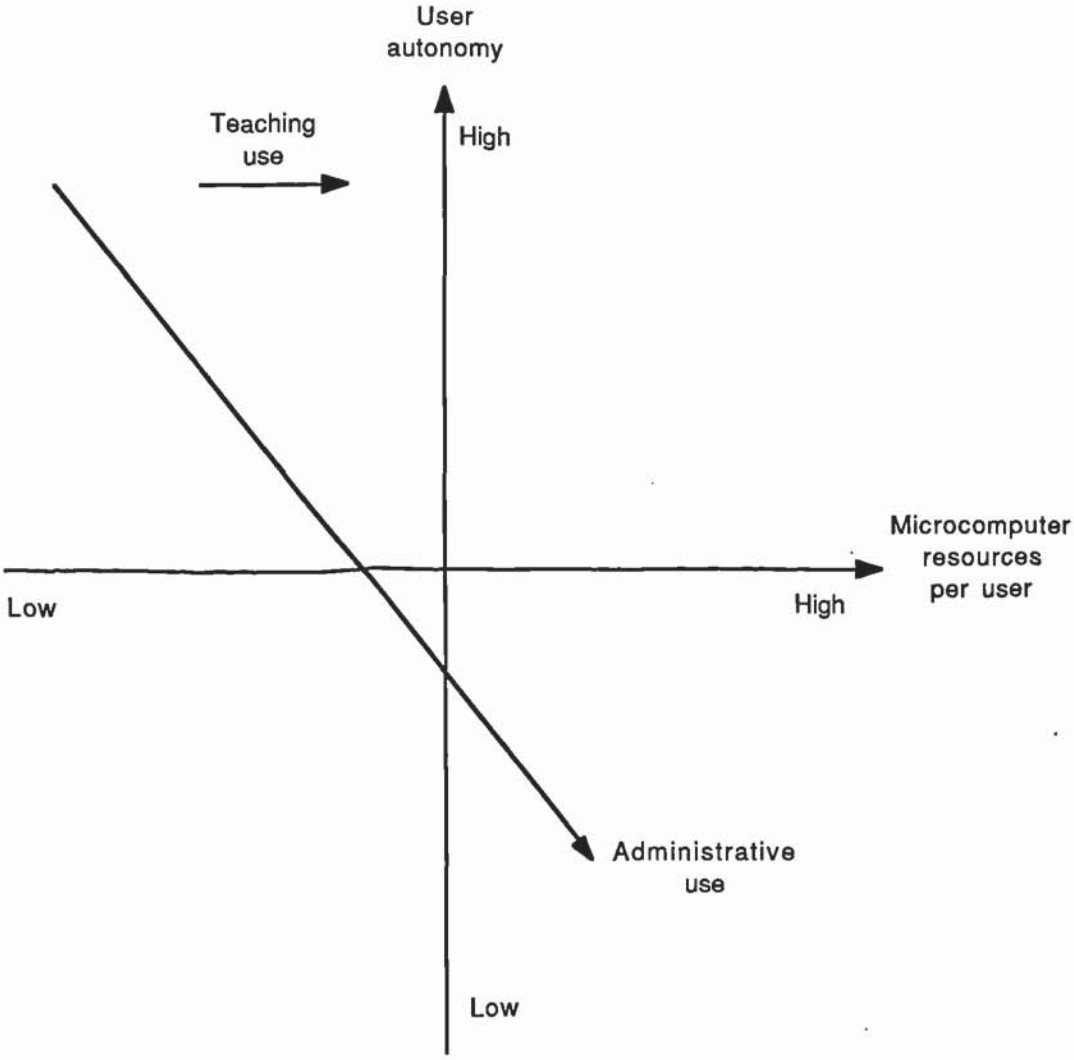

Figure 30: Changes in resourcing levels, and user effects

In respect of the curriculum use of the technology the effects may have emerged less fully than in administration, as suggested in Figure 30, but with an even more interesting dynamic. The role of the technical expert has been identified as of major importance in the evolution of the innovation so far. But as organisational and individual learning takes place, as skills, knowledge and experience become more widely distributed and training impinges cumulatively on a greater proportion of teachers, it could be that that role may be seen in retrospect as having been transitional rather than permanent. So far, the outcomes have borne little relation to the vision of those who advocated the innovation on the basis of its potential for transforming education. The historically-rooted locus of control of decision making about the delivery of the curriculum (teachers in classrooms) has remained intact, and in that sense the long-term structure of the teaching and learning activity has overpowered the short-term innovation event, in the absence so far of a sufficient saturation of resources to make modes of control other than responsible autonomy feasible. Organisational inertia and rigidity has resulted in the innovation being implemented conservatively so far, making minimal use of the potential of the technology, and having, in most cases, little effect on teachers' labour process.

But the tension between the two continues to be affected by two developments outside the education sector. One relates to societal change on a wide front. Toffler (1980), in "The Third Wave", identified the "second wave" as directed towards standardisation, mass production and synchronisation in, and by, central organisations. In contrast, the "third wave" is characterised by individualism, adaptability and diversity in and by small decentralised units. We can see that the current organisation of schooling is a classic example of that relevant to the second wave. Pupils travel to a central institution where they are processed in groups, in a production process which is governed by a timetable which allocates and synchronises a "collection curriculum" into discrete segments in time and space. We can already see demands for that to be changed in ways which recognise more explicitly the individuality and diversity of pupils. The second development which challenges the current locus of control of the labour process relates more directly to the particular technology studied here. Much of the educational software currently being developed, in contrast with the majority of that now in use in schools, aims at individualising learning in the sense of taking into account individual pupils' strengths and limitations, and hence challenges directly the base of teachers' claims of indeterminacy in the teaching and learning process.

Those developments have, of course, been taking place simultaneously with, but disconnected from, proposals and legislative changes which involve the introduction of a core curriculum, teacher appraisal, the more widespread testing of pupils, the further concentration of power in central government and the diminution of the influence of local government with the likelihood that teachers will become employed nationally rather than locally. The factors external to new technology which are leading to the greater centralisation of educational policy making are occurring at a time when the Secretary of State, in discussing microelectronics in a television interview said "I think this [educational computing] is an area where there has to be a strong central lead" (Baker, 1987a). Those changes in educational policy making, together with a *de facto* standardisation on one make of microcomputer (BBC) and software subsidised through the MEP and MeSU are resulting in the erection of an infrastructure within which the existing "enabling" mode of innovation could change to a "controlling" mode, as has already occurred in respect of the administrative use of the technology.

Such a transformation may or may not occur. Thus far the course of the innovation has been determined in relation to both teaching and administrative use by control of particular resources in a manner consistent with that put forward in the conceptual model in Chapter 3. The pluralist model is consistent with the diffusion of influence and changes in the locus of control at different stages of the innovation process. Despite the overlaying of a trend of increasing centralisation, the influence of particular resources, controlled by different individuals or groups, has been critical at different stages of the innovation process. The control of financial resources and the use of specific funding mechanisms have been adopted by both central and local government in affecting the extent of uptake of the technology. But once those resources have been allocated by organisations external to the school, and acquired and allocated internally within the school, control of resource utilisation has depended upon the intangible resources of skill, knowledge and information by those within the school. The technical expert, often a computer studies teacher, has been influential in affecting the extent of dissemination of the innovation within a school, but teachers individually have been able to determine whether or not the technology is used within their classroom. The acquisition, utilisation and control of the physical resources (the resources bargained <u>for</u>) has been used (the resources bargained <u>with</u>) recursively in increasing the centrality of those who control critical resources (that has been seen most directly in respect of the technical expert) so that, although strategies for acquiring resources are decoupled in time from strategies for using them, existing patterns of resource utilisation affect subsequent resource acquisition and allocation decisions.

That dynamic is a major finding in this study. Resource dependency models tend to assume a rather static resource base. This study has overlaid onto that base a dynamic in which different resources become critical at different stages of the resource acquisition, allocation and utilisation cycle and in which the sub-themes concerning "effects" do not simply follow the sub-themes focussing on "responses" but in which they are recursively related.

9.4 Policy implications

What are the implications of that dynamic? It was stated in Chapter 1 that an aim of the research was to produce findings which are policy relevant. A number of policy implications can be discerned from the research; they are relevant primarily in fora other than this thesis, but are addressed briefly here also. Those policy implications are couched explicitly in terms of the resource dependency model adopted within the study. They can conveniently be addressed at the levels of schools, local education authorities and central government.

At the level of the school, a large proportion of the physical resources of microcomputers are, in many schools, concentrated within one or more "computer laboratories" which are used primarily for the teaching of computer studies as an academic, examinable subject. Such a concentration of resources can facilitate the teaching of computer awareness courses also but is not well suited to the teaching computer awareness by its diffusion throughout the curriculum, or to the adoption of computer-assisted learning in a variety of subject areas. Often the concentration of facilities has arisen, almost by default, by decisions which were heavily influenced, or taken, by the technical expert, who typically had a vested interest in the pattern of resource distribution. In most schools the state of awareness in teachers of the range of use of microcomputers is such that it is now feasible and would be appropriate to develop explicitly a whole-school policy about the use of computer resources and for those resources to be allocated in accordance with that policy. It is likely that in many schools such a policy would result in a reduced concentration of resources and their more widespread use, in accordance with the consensus in the educational computing press and of computer advisers concerning ways of maximising learning benefits from a scarce resource. And the very development of such a policy document, providing the process of its production met teachers' expectations of collegiality, might result in a greater proportion of teachers addressing their current teaching strategies rather than dismissing the new technology as peripheral to their concerns. The development of a policy document would also provide a better base from which the school could negotiate in the medium-term with those organisations on which it is partly dependent for resource acquisition, particularly the LEA, but also in some cases local companies with which the school may be linked, and Parent-Teacher Associations and other fund raising bodies.

Local education authorities have, on the whole, been supportive of the innovation to the extent which they have been able to be, within their limited and diminishing resource base. The study has demonstrated clearly that the differential resourcing which the LEAs have made available have been translated directly into the different extents to which schools in those LEAs use computer resources. The financial support mechanisms which LEAs have used have been effective, in that sense. And people within schools have seen LEAs as attempting to be supportive. That is critically important. We have seen in the study that teachers individually, and by implication whole schools, can be successful in "subverting" the innovation if they so choose, and result in the investment being nugatory. The innovation has been diffused only with the support of teachers. If the mechanisms which LEAs use are seen by teachers not as supportive but as attempting to force particular developments those mechanisms can be resisted. There is a danger with the computer-assisted school administrative systems currently being developed by LEAs: they are presently seen from within schools as decoupled from the curricular use of the technology, where an "enabling" mode of innovation is predominant. The "controlling" mode embedded in the schemes for administrative use of the technology is not seen as a threat, or at least schools are willing to pay a price for the absorption by the LEA of the uncertainty surrounding the application of the technology in what is seen as a peripheral area of organisational activity. But the implication of schools perceiving the LEA as attempting to control rather than support the curricular use of the resource are profound.

Similar implications are relevant also at the level of national government. The activities of the Department of Trade and Industry and the Microelectronics Education Programme and its successor have been perceived in schools to be supportive, even if inadequate in extent, and in giving insufficient weight to the establishment of a motivational framework for the local adoption of the technology. The implication of teachers perceiving the innovation being promoted by central government in a controlling mode, as part of a larger package of measures of increasing centralisation, are similar. Central government has an opportunity currently, in the deliberations and negotiations about the content and balance of a core curriculum, to facilitate the implementation of the policy advocated by the professional computer education community of diffusing microelectronics across the curriculum rather than further establishing it as a separate subject area. It is in the area of the boundary between central planning and local discretion where a balance is most difficult to strike. Central government clearly has a role in resource allocation in respect of hardware, software and training in field in which development costs are substantial and will be recouped only if they are spread over a large number of user-sites. Teachers recognise that, but they are prepared to guard strongly what they see as their professional territory of decision making about the delivery of the curriculum. The teachers have a strong weapon currently in enabling them to guard that territory. At the present stage of the innovation the cooperation of teachers is necessary to ensure its successful institutionalisation. That is widely recognised; for example, a Cabinet Office advisory panel recently concluded that "there is no doubt that the enthusiasm of teachers and others involved in the educational use of IT will be the UK's most valuable resource in ensuring that we get the best from IT" (Cabinet Office, 1986, p8), and "the changes need the support of those within education and cannot be imposed from outside" (p10). Conversely, within what is perceived as a supportive environment, much of the creativity in the use of the technology has come from teachers rather than central organisations. The chairman of the Microelectronics Support Unit, who is a chief education officer, used the analogy of a wheel in discussions with me, saying that one gets more movement from the periphery of a wheel than from its hub. The imagery may be suspect but the recognition within the MeSU of the need to work with teachers, rather than coercively, is clear.

The provision of training illustrates well the dilemma of carrying out central initiatives which need to be received as supportive. In-service training of teachers about microcomputers has been carried out largely by conventional means: teachers have assembled in groups at predetermined times at a central location, where they have met a person whom they recognise as adopting the role of "teacher", and have been provided with a course, albeit with some hands-on content. It would be possible, as an alternative, to use the technology itself, within the workplace, as a means of delivering training about the use of that technology. Such a programme would be very expensive to develop and would be economically feasible only if it was followed by large numbers of teachers. That type of training programme could be a double-edged sword if it was seen by teachers as attempting directly to control the mode of utilisation of computer resources in the teaching and learning process and to remove the possibility of trial-and-error learning by teachers themselves, within a learning paradigm.

Although schools have rather different numbers of computers all of them have a considerably smaller volume of computer resources than most commentators assume will be standard at the turn of the century and beyond. Our experience so far is, then, solely with schools which have a relatively low intensity of resource utilisation. To assist in forward planning and policy formulation, it would be worth considering, rather than spreading central government resources equally but thinly, the funding of a small number of schools (possibly as few as five of the five thousand secondary schools in the country) with the level of saturation of computer resources (approaching one per pupil) which may be prevalent in the next two decades. Although current technology is different from that which is likely to be available then, the learning experience from such a scheme would give a better base for policy formulation than is currently available. The pilot scheme approach would be consistent with that adopted in other schemes, such as the Technical and Vocational Education Initiative, which has been funded by central government and received within schools as an acceptable externally-sponsored curriculum change.

9.5 Reflections on the research process

The research was designed partly to enable policy issues subsequently to be addressed within the education sector from a base of knowledge, even if that were to be done primarily in fora other than this one, and partly to contribute to the wider debate on the effects of microelectronics. It is useful at this stage, therefore, to reflect on and evaluate the research design, methodology and its implementation and the ways in which, with hindsight, it might usefully have been modified.

Two major decisions which were made early have framed the subsequent more detailed empirical work. One was the quite explicit choice to use the literature and concepts of both education management specifically (including that which addresses educational innovation), and the organisational literature which has informed the debate on the effects of microelectronics and which draws heavily on labour process theory, and to develop a conceptual model which was based upon both of those. A study which was rooted solely in one of those areas would have been very different from that undertaken. The second decision, which has similar implications, was that the issues identified from the combination of concepts from both of those areas led to a research methodology incorporating both positivist and interpretive strands, rather than being restricted to one paradigm only. Each of those decisions created difficulties in the empirical and analytical phases of the study, and led to a feeling from time to time that the research was falling between two stools. Nevertheless, in retrospect, I would stand by those two decisions for the reasons put forward in Chapter 4; alternative choices would have led to a study which had major omissions.

Having framed the research by those two decisions, a further critical choice had to be made in selecting the sample to be used in the survey and from which the case study sites were subsequently to be chosen. The choice of four LEAs had an element of arbitrariness at the time, and still has. There are not strong reasons for that number rather than for three or five, but the reasons for rejecting a size outside that range still seem valid. One criterion which was not used in selecting the four LEAs in the sample appears, in retrospect, of importance. The political control of the councils was not used in selecting LEAs and led to a sample comprising three Labour and one hung council, a distribution which is not typical of the country as a whole but is representative of the distribution of political control in the geographical region in which the research was carried out. Although I have argued in Part C that, despite the increasing politicisation of education as a whole, the introduction of computer education is not a party political issue, my evidence is limited and is restricted to majority and minority party differences within councils of a particular composition. With hindsight I would have preferred to control for that effect by including one or two councils of a different composition.

And what of the surveys themselves? The initial and final surveys used phrasing which was identical in order to minimise comparability difficulties between the two surveys. Some of the terms used and the choices offered in various closed questions (for example, that relating to administrative applications) of a survey originally distributed in April 1984 would not be appropriate to use now. Both the surveys, however, attracted response rates (83% and 85%) which are about twice as great as those typically achieved in the large number of surveys with which schools are inundated. The response rates indicate, as a minimum, that the recipients found the questionnaire acceptable. Questionnaire design is clearly important in a study of this kind. So too was the design of the empirical work to enable the internal and external validity of the data collected in both the surveys and the case study to be addressed in the ways discussed in Chapters 4 and 5 by relating the data obtained in the surveys to that from the case studies.

The case studies resulted in fewer problems of access than had been anticipated in terms of both institutional and individual agreement to participate. Neither did the potential problem of hesitancy to share information and perceptions emerge more than marginally, though it could be, of course, that the researcher has obtained a less full picture than he thought. The issues addressed within the case studies still seem central, but there was one significant omission. The reasons for teachers choosing particular items of software rather than alternatives were not addressed. Given that different items of software are designed to be used, or are sufficiently flexible to be used, in very different ways (some in demonstration mode to a whole class, others by pupils individually, others in small groups, etc.) that choice does appear in retrospect to relate clearly to teachers' labour process in the classroom, and the issue of software choice now appears as more central than it did during the design or implementation of the fieldwork and leaves important questions unanswered. Information from pupils about the ways, if any, in which the teaching and learning process has changed as a result of particular software choices might also have been used with advantage, to provide additional information of a complementary nature on that issue.

The major questions of research design - the adoption of both positivist and interpretive approaches, implemented through both surveys and case studies which were related to each other - have enabled a broad analysis to be made of the content and process of the innovation studied, at the expense of depth of treatment of some of the issues touched upon. The particular balance chosen between breadth and depth was felt to be necessary in order to set the innovation studied in both its institutional and wider contexts, and to lead to findings which are policy relevant for the education sector.

That aim of the research - to support the policy formulation process within the education sector - was addressed above. A second aim - to contribute to the study and debate more widely on the effects of microelectronics - has been addressed throughout the analysis in Part C. It is useful to take up specifically at this point, however, the extent to which the findings relating explicitly to the education sector may be generalised beyond that sector.

The resource dependency model on which the study is based is clearly applicable beyond the education sector; indeed, it has been applied extensively, especially in the public sector. Within the public sector that application has been primarily in the analysis of the relationship between central and local government. Its use has been extended here and been found to be a valid and helpful model in addressing also both inter-institutional and intra-institutional relationships.

A second way in which the model has been extended in this study is by developing a dynamic in which the different physical and intangible resources become critical, indeed determining, at different stages of the resource acquisition, allocation and utilisation cycle. Further, the "effects" of the innovation (essentially utilisation issues within that resource management cycle) are not static end-points, but the control of that resource utilisation (the resources bargained <u>for</u>) becomes a resource bargained <u>with</u> in a subsequent cycle. The control of critical physical and/or intangible resources at <u>each</u> of the stages of the resource management cycle has been seen to be necessary in respect of a linear bureaucratic innovation. Those conditions have been met, so far, in relation to the use of the technology in school administration which has been implemented in a controlling mode, though it is possible that the resource control embodied in their ongoing utilisation might change the dynamic subsequently. In contrast, for use in the curriculum, teachers and schools are at least partly dependent for their acquisition of resources on the allocation decisions of individuals and groups external to the classroom or the school. But they have been successful, at least so far, in using the intangible ideological resource of professional autonomy, resting on the indeterminate occupational knowledge base in respect of the teaching and learning process with pupils individually, and supported by managers within the organisation (headteachers) and external to it (education officers and advisers) who are former teachers themselves, to secure the implementation of the innovation in an enabling mode.

It is perhaps apposite to conclude, given the sectoral context of this study, by noting the potential relevance of various principles of teaching and learning (active participation, clear tasks, early and frequent success, supportive feedback, etc.) to the implementation of an innovation in an enabling mode, particularly if that leads not only to a regret that many of those principles have been violated, but to addressing as a policy issue their incorporation into the future course of the innovation at national, local and institutional levels.

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Head of Centre L E Watson MA FBIM

Appendix 1

Mr X Y Zed,
Chief Education Officer,
County Offices,
Centretown,
Centrelea,
CE1 1CE.

29 April 1983

Dear Mr Zed,

I am writing to request your assistance in connection with a research project presently being carried out within the Centre for Education Management and Administration at Sheffield City Polytechnic.

The project is concerned with the use of microcomputers for both instructional and administrative purposes in secondary schools, and addresses two questions:

(i) what factors affect type and extent of response to microcomputers in schools?

(ii) what impact does the use of microcomputers have on the ways in which schools are organised and managed?

The project methodology involves the use of both surveys and case studies, preferably in four Local Education Authorities which are reasonably accessible from Sheffield.

I would very much like to include schools from the Centrelea LEA, and would like, with your permission, to:

(i) send one questionnaire now, and a further one in approximately two years time to the headteacher of each secondary school in the Centrelea LEA, to elicit information on, for example, the extent and type of provision, the responsibilities of various individuals and groups, problems encountered and plans for future development;

(ii) discuss the policy of the Centrelea LEA in relation to the use of microcomputers in schools with the appropriate officer(s) and/or adviser(s);

(iii) select, with the approval of the headteacher concerned one school in the Centrelea LEA as a case study organisation in which to monitor developments in the use of microcomputers during the next two years.

I would, of course, be pleased to provide further details of the proposed research. In the meantime, I enclose a brief CV.

Yours sincerely,

David F. Lancaster
Senior Lecturer in Education Management

Sheffield City Polytechnic

Mr A B Cee

Headteacher

Centretown Comprehensive School

Centre Street

Centretown

Centrelea CE1 1CE

Appendix 2

Centre for Education Management and Administration

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Head of Centre L E Watson MA FBIM

8 April 1984

Dear Mr Cee,

MICROCOMPUTERS IN SECONDARY SCHOOLS: THE EFFECTS ON THE SCHOOL AS AN ORGANISATION

I am writing in connection with a research project on the response to microcomputers in secondary schools and how such developments affect the school as a whole. The aim is to study the uses of microcomputers in both teaching and school administration, and with the information gathered by survey and case studies in a small number of schools, to determine the ways in which the potential benefits of microcomputers can most appropriately be exploited.

The study is focussed on the school as a whole, which is why I am writing to yourself rather than your computer studies staff.

I would very much like to include information from Centretown Comprehensive School in the survey, and would be most grateful if you could complete the enclosed questionnaire and return it to me in the stamped addressed envelope provided. Would you please return the questionnaire even if you are unable to complete it fully. I hope that the length of the questionnaire is not disconcerting; one headteacher who completed the pilot questionnaire commented that "the number of pages is a little daunting, but the rate at which one is able to get from page to page is encouraging". I do assure you that the information provided in completing the questionnaire will not be used in ways which would make it identifiable with a specific school. I have, of course, obtained the permission of the Centrelea LEA to distribute the questionnaire to relevant schools in the authority.

I will be producing a summary report of some of the results of the survey including, for example, information on the current extent and types of use of microcomputers in teaching and in administration; I would be pleased to forward a copy of the summary report if you would like to receive one.

I am conscious of the demands which are made on your time, and realise that you receive a considerable number of requests for questionnaires to be completed. I do hope, however, that you feel able to respond to this request.

Yours sincerely,

David F. Lancaster

Senior Lecturer in Education Management

Sheffield City Polytechnic

Appendix 3

This is a photo-reduced version of the questionnaire used in the initial survey

SHEFFIELD CITY POLYTECHNIC

DEPARTMENT OF EDUCATION MANAGEMENT

The use of microcomputers in secondary schools

A. SCHOOL INFORMATION

1. Name of school ______________________

2. How many pupils are there on roll? ________

3. What is the group number of the school? ________

4. (a) How many Deputy Headteachers are there? ________

   (b) Please specify the major areas of responsibility of the Deputy Headteachers (e.g. pastoral & 6th form, curriculum, administration etc)

   Deputy Head 1 ______________________

   Deputy Head 2 ______________________

   Deputy Head 3 ______________________

5. How many full-time equivalent clerical/secretarial/administrative staff (including bursars/registrars) are employed in the school during term time?

   ____

6. Would you say that your school is more or less advanced than others in your LEA in relation to the use of microcomputers?

	Please tick one
More advanced than others	☐
About the same as others	☐
Less advanced than others	☐

- 1 -

This is a photo-reduced version of the questionnaire used in the initial survey

7. Do you offer the following courses in computer studies?

Please tick as many as apply

(i) A level ☐

(ii) O level ☐

(iii) CSE ☐

(iv) Computer appreciation for all pupils in any one year group ☐

(v) Computer appreciation for some pupils ☐

8. As Headteacher, what are your priorities in relation to the following uses of computers?

Please number in order of priority from 1=highest priority to 5=lowest priority

(i) Use for externally examined courses in computer studies ☐

(ii) Use for computer appreciation courses ☐

(iii) Use for computer assisted learning in subjects other than computer studies ☐

(iv) Use for school administration ☐

(v) Use for computer clubs ☐

9. For those teachers who teach computing (either for externally examined courses or for computer appreciation) please give details of their scale (1,2,3,4,ST,DH,H), department (computer studies, mathematics, etc) and the approximate percentage of their total time in which they teach computing

	Scale	Department	% of teaching time teaching computing
Teacher no.1			
Teacher no.2			
Teacher no.3			
Teacher no.4			
Teacher no.5			

This is a photo-reduced version of the questionnaire used in the initial survey

10. To what extent are computer studies teachers involved in developing the use of computing across the curriculum and in administration, and to what extent do you think they should be involved?

	Large involvement	Some involvement	Little involvement	No involvement
(i) Are involved in computers across the curriculum				
(ii) Should be involved in computers across the curriculum				
(iii) Are involved in computers in administration				
(iv) Should be involved in computers in administration				

11.(a) Do any teachers receive timetable remission for computers across the curriculum or in administration?

Please tick as many as apply

(i) One teacher gets remission for computers across the curriculum ☐

(ii) More than one teacher gets remission for computers across the curriculum ☐

(iii) One teacher gets remission for computers in administration ☐

(iv) More than one teacher gets remission for computers in administration ☐

(v) No teachers get timetable remission for this ☐

(b) Approximately how many hours per week remission are given in total for

(i) Developing the use of computers across the curriculum _____ hours per week

(ii) Developing the use of computers in administration ______ hours per week

This is a photo-reduced version of the questionnaire used in the initial survey

B. MICROCOMPUTER EQUIPMENT

1. How many of each of the following makes of microcomputers do you have in the school?

	Number
Apple	
BBC	
PET	
RML380Z	
Sinclair ZX80,ZX81,Spectrum	
Others, please specify	

2. Please comment on the location of the microcomputers (e.g. 6 permanently in one classroom, 1 permanently in each of two other classrooms, 2 portable and 1 permanently in the school office)

3. (a) If you use a microcomputer for administration, which make is that? ______________________

   (b) Does the microcomputer used for administration have either disc or casette storage?

   Disc Yes ☐ No ☐

   Casette Yes ☐ No ☐

   (c) Does the microcomputer used for administration have a printer?

   Yes ☐ No ☐

This is a photo-reduced version of the questionnaire used in the initial survey

C. MICROCOMPUTER PROGRAMS

1. From where are the computer programs obtained?

	For use in teaching	For use in administration
(i) All obtained from outside the school and used without modification		
(ii) All obtained from outside the school, though some are modified before use		
(iii) Most obtained from outside the school, but some are produced within the school		
(iv) About equal numbers obtained form outside and within the school		
(v) Most produced within the school, but some obtained form outside		
(vi) All produced within the school		

2. (a) Of the programs produced within the school for instructional use, what proportion was written by the following?

	All	Most	Some	None
(i) Computer studies teacher(s)				
(ii) Teacher(s) of the subject				
(iii) Others, please specify				

(b) Of the programs produced within the school for administrative use, what proportion was written by the following

	All	Most	Some	None
(i) Headteacher				
(ii) Deputy headteacher(s)				
(iii) Computer studies teacher(s)				
(iv) Other teacher(s)				
(v) Others, please specify				

This is a photo-reduced version of the questionnaire used in the initial survey

D. USE FOR INSTRUCTIONAL PURPOSES

1. In the teaching of which subjects have microcomputers been used within the school?

	Used extensively	Some use	Not used now but likely to be used within the next 2 years	Not used now and unlikely to be used within the next 2 years
English				
History				
Geography				
Mathematics				
Physics				
Chemistry				
Biology				
General/integrated science				
Foreign languages				
Home economics				
CDT				
Economics				
Remedial education				
Others, please specify				

This is a photo-reduced version of the questionnaire used in the initial survey

2. Are there any examples of the use of microcomputers which have involved changes in the organisation of teaching outside the classroom in which the microcomputer is being used? (e.g. use of resource-based learning in a subject, use of team teaching, etc.)

Yes [ ] No [ ]

If "Yes", please give details

3. Approximately how many teachers have used microcomputers in teaching subjects other than computing?

None	
1	
2-5	
6-10	
11-20	
more than 20	

4. How important do you feel the following reasons are for using microcomputers in the teaching of subjects other than computer studies or computer appreciation?

	Very important	Fairly important	Of some importance	Not important
(i) Increased pupil motivation				
(ii) Gives pupils familiarity with new technology				
(iii) Provides learning experiences not otherwise available				
(iv) Enables more effective learning				
(v) Provides variation in learning methods				
(vi) Others, please specify				

This is a photo-reduced version of the questionnaire used in the initial survey

5. Which individuals and/or groups were influential in determining the extent and type of use of microcomputers for teaching in subjects other than computing?

	Extensively involved	Fairly involved	Some involvement	Little involvement	Not involved
Head					
Deputy head 1					
Deputy head 2					
Deputy head 3					
Computer teacher(s)					
Other teacher(s)					
Governors					
Parent Teacher Association					
General advisers					
Computing advisers					
Other subject advisers					
Others, please specify					

This is a photo-reduced version of the questionnaire used in the initial survey

E. USE IN ADMINISTRATION

1. Which administrative tasks do you, or are you likely to undertake using microcomputers?

Please tick as appropriate

	Used now for this application	Likely to be be introduced during the next 2 years for this application
1 PUPIL RECORDS AND ROLL		
2 STATISTICAL RETURNS (i) DES form 7		
(ii) Other LEA/DES returns		
3 ATTENDANCE		
4 TIMETABLE (i) Construction		
(ii) Printing		
(iii) Staff emergency cover		
(iv) Curriculum analysis		
5 OPTION CHOICES		
6 EXAMINATIONS (i) Printing timetables/lists		
(ii) Analysis of results		
7 REPORTS FOR PARENTS		
8 WORD PROCESSING (i) Updating/re-drafting of reports		
(ii) Personalised letters		
9 SCHOOL ACCOUNTS & FINANCE		
10 MISCELLANEOUS (i) Stock control		
(ii) School library records		
(iii) Parents' evenings timetables		
(iv) University/college applications		
11 OTHERS, please specify		

This is a photo-reduced version of the questionnaire used in the initial survey

2. The following reasons are sometimes suggested for using microcomputers in school administration. How important are each of the reasons in your school?

	Very important	Fairly important	Of some importance	Not important
(i) Time saving				
(ii) Easier to provide information required by LEA				
(iii) Better quality information available for use within the school				
(iv) Information available more quickly				
(v) More interesting jobs for clerical staff				
(vi) Can be used to demonstrate real applications to computer studies pupils				
(vii) Others, please specify				

3. Who operates the computer for administrative applications?

	Operates computer for all or most of the applications	Operates computer for some of the applications	Does not operate computer for administrative applications
Head			
Deputy head 1			
Deputy head 2			
Deputy head 3			
Computer teacher(s)			
Other teacher(s)			
Clerical staff			
Pupils			
Others, please specify			

This is a photo-reduced version of the questionnaire used in the initial survey

4. Which individuals and/or groups were influential in determining the extent and type of use of microcomputers in administration?

	Extensively involved	Fairly involved	Some involvement	Little involvement	Not involved
Head					
Deputy head 1					
Deputy head 2					
Deputy head 3					
Computer teacher(s)					
Other teacher(s)					
Secretarial staff					
Governors					
Parent Teacher Association					
General advisers					
Computing advisers					
Others, please specify					

5. Does your LEA have a "New Technology Agreement" with the relevent trade unions in relation to the use of new technology by school secretarial and clerical staff?

Yes ☐

No ☐

Don't know ☐

6. How did the school secretarial and clerical staff feel about the use of microcomputers in administration, initially and now?

	Positive & enthusiastic	Indifferent	Antagonistic and/or fearful
Initially			
Now			

This is a photo-reduced version of the questionnaire used in the initial survey

F. EVALUATION

1. How successful do you feel the use of microcomputers for instructional purposes has been, in relation to each of the following?

	Very Successful	Moderately successful	Of limited success	Unsuccessful
(i) Extent of use				
(ii) Response of teachers				
(iii) Response of pupils				
(iv) Overall				

2. How successful do you feel the use of microcomputers in administration has been, in relation to each of the following?

	Very successful	Moderately successful	Of limited success	Unsuccessful
(i) Extent of use				
(ii) Time savings				
(iii) Quality of information available				
(iv) Effects on clerical staff jobs				
(v) Effects on teachers' jobs				
(vi) Overall				

3. In using microcomputers for instructional purposes, to what extent have developments been constrained by:

	Constrained to great extent	Constrained to some extent	Constrained slightly	Not constrained
(i) Lack of equipment				
(ii) Lack of suitable programs				
(iii) Lack of computing expertise				
(iv) Lack of time of people with computing expertise				
(v) Resistance from teaching staff				
(vi) Overload of other innovations				
(vii) Lack of support/advice from LEA				
(viii) Others, please specify				

This is a photo-reduced version of the questionnaire used in the initial survey

4. In using microcomputers for administration, to what extent have developments been constrained by:

	Constrained to great extent	Constrained to some extent	Constrained slightly	Not constrained
(i) Lack of equipment				
(ii) Lack of suitable programs				
(iii) Lack of computing expertise				
(iv) Lack of time of people with computing expertise				
(v) Resistance from teaching staff				
(vi) Resistance from clerical staff				
(vii) Overload of other innovations				
(viii) Lack of support/advice from LEA				
(ix) Others, please specify				

FUTURE DEVELOPMENTS

1. I would be grateful if you would expand on the role which you see microcomputers playing in your school in the next 5 to 10 years.

This is a photo-reduced version of the questionnaire used in the initial survey

2. How do you feel the introduction of microcomputers will affect your own job?

3. How do you feel the introduction of microcomputers will afffect the jobs of members of your staff?

A summary report of the findings of the survey will be produced for distribution to people who have completed this questionnaire, though no schools will be identified individually. If you would like to receive a copy of the summary report, please give below the name and address to which it should be sent.

Name
Address

Thank you for completing this questionnaire. Your assistance is greatly appreciated.

David Lancaster

David Lancaster

Centre for Education Management and Administration

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Appendix 4

Mr A B Cee
Headteacher
Centretown Comprehensive School
Centre Street
Centretown
Centrelea CE1 1CE

29 April 1984

Dear Mr Cee,

MICROCOMPUTERS IN SECONDARY SCHOOLS: THE EFFECTS ON THE SCHOOL AS AN ORGANISATION

I am writing following my letter of about three weeks ago in connection with the questionnaire part of the above research on the use of microcomputers in teaching and school administration, and how such developments affect the school as a whole. The responses received so far indicate very wide differences between schools in terms of priorities and organisational arrangements for computer use in teaching and school administration. That variability increases the potential usefulness to schools of the outcomes of the research providing that the response rate is relatively high. As of today, I have not received a reply from Centretown Comprehensive School, and while I appreciate that this is a busy time of year, I would be most grateful if you were able to complete the questionnaire, even if not fully, and return it in the enclosed stamped addressed envelope. I do assure you that the information provided will not be used in ways which make it identifiable with a specific school.

I have requested the assistance of yourself as headteacher as the study is focussed on the school as a whole, though it may be necessary to consult other staff in the school, including perhaps staff responsible for computing in respect of sections B and C. I do realise that, in that sense, the questionnaire is rather demanding.

If you would like to receive one, I would be pleased to forward a copy of the summary report of the survey, which will include information on, for example, the extent and type of uses of microcomputers in the teaching of different subjects and various administrative applications, the allocation of responsibilities for such uses, the amount of equipment used and sources of software. Clearly, the greater the response rate to the questionnaire, the more representative the findings will be, and the more useful the summary report may be to you and to other headteachers who have asked for a copy of the report.

I would very much like to include information from Centretown Comprehensive School in the survey, and do hope that you feel able to respond to this request.

Yours sincerely,

David F. Lancaster
Senior Lecturer in Education Management

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Appendix 5

Mr A B Cee
Headteacher
Centretown Comprehensive School
Centre Street
Centretown
Centrelea CE1 1CE

2 April 1986

Dear Mr Cee,

MICROCOMPUTERS IN SECONDARY SCHOOLS: THE EFFECTS ON THE SCHOOL AS AN ORGANISATION

Two years ago you kindly completed the initial questionnaire of the above research project and I forwarded a summary report of the results of that initial survey.

The aim is to study the development of the use of microcomputers in both teaching and school administration, and with the information from the two surveys and case studies in a number of schools, to determine the ways in which the potential of microcomputers can most appropriately be used to the benefit of schools.

A central feature of the research design is to study developments in schools during a period of 2 years. As we are at the end of that 2 year period now, I would be most grateful if you could complete the enclosed questionnaire and return it to me in the stamped addressed envelope provided. Would you please return the questionnaire even if you are unable to complete it fully.

I was very pleased to be able to include information from Centretown Comprehensive School in the initial survey, and given the focus on change over the two year period it is obviously important, if possible, to include the equivalent information at this point in time also.

I am pleased to be able to say that this final questionnaire is rather shorter and more simple than the initial one, and although it may look rather long it has been designed to be able to be completed quickly and easily.

Again, I will be producing a summary report of the results of the survey and would be pleased to forward a copy of the report if you would like to receive one. And again, I do assure you that the information provided in completing the questionnaire will not be used in ways which would make it identifiable with a specific school. I have, of course, obtained the permission of the Centrelea LEA to distribute the questionnaire to relevant schools in the authority.

I am conscious of the demands which are made on your time, and realise that you receive a considerable number of requests for questionnaires to be completed. I do hope, however, that you feel able to respond again to this request at the completion of the surveys.

Yours sincerely,

David F. Lancaster
Senior Lecturer in Education Management

Sheffield City Polytechnic

Appendix 6

This is a photo-reduced version of the questionnaire used in the final survey

SHEFFIELD CITY POLYTECHNIC

DEPARTMENT OF EDUCATION MANAGEMENT

The use of microcomputers in secondary schools

A. INTRODUCTION

1. Name of school ____________________

2. As Headteacher, what are your priorities in relation to the following uses of computers?

Please number in order of priority from 1=highest priority to 5=lowest priority

(i) Use for externally examined courses in computer studies ☐

(ii) Use for computer appreciation courses ☐

(iii) Use for computer assisted learning in subjects other than computer studies ☐

(iv) Use for school administration ☐

(v) Use for computer clubs ☐

3. Do you offer the following courses in computer studies?

Please tick as many as apply

(i) A level ☐

(ii) O level ☐

(iii) CSE ☐

(iv) Computer appreciation for all pupils in any one year group ☐

(v) Computer appreciation for some pupils ☐

- 1 -

This is a photo-reduced version of the questionnaire used in the final survey

4. (a) Do any teachers receive additional non-teaching time for developing the use of computers across the curriculum or in administration?

Yes ☐

No ☐

(b) If "yes", approximately how many hours per week additional non-teaching time are given in total for

(i) Developing the use of computers across the curriculum______ hours per week

(ii) Developing the use of computers in administration ________hours per week

5. To what extent are computer studies teachers involved in developing the use of computing across the curriculum and in administration?

	Large involvement	Some involvement	Little involvement	No involvement
Are involved in computers across the curriculum				
Are involved in computers in administration				

B. MICROCOMPUTER EQUIPMENT

1. How many of each of the following makes of microcomputers do you have in the school?

	Number
Apple	
BBC	
PET	
RML380Z, 480Z, Nimbus	
Sinclair ZX80, ZX81, Spectrum, QL	
Others, please specify	

2. If you use a microcomputer for administration, which make is that? ______________________

- 2 -

This is a photo-reduced version of the questionnaire used in the final survey

C. MICROCOMPUTER PROGRAMS

1. From where are the computer programs obtained?

	For use in teaching	For use in administration
(i) All obtained from outside the school and used without modification		
(ii) All obtained from outside the school, though some are modified before use		
(iii) Most obtained from outside the school, but some are produced within the school		
(iv) About equal numbers obtained from outside and within the school		
(v) Most produced within the school, but some obtained form outside		
(vi) All produced within the school		

2. (a) Of the programs produced within the school for instructional use, what proportion was written by the following?

	All	Most	Some	None
(i) Computer studies teacher(s)				
(ii) Teacher(s) of the subject				
(iii) Others, please specify				

(b) Of the programs produced within the school for administrative use, what proportion was written by the following

	All	Most	Some	None
(i) Headteacher				
(ii) Deputy headteacher(s)				
(iii) Computer studies teacher(s)				
(iv) Other teacher(s)				
(v) Others, please specify				

- 3 -

This is a photo-reduced version of the questionnaire used in the final survey

D. USE FOR INSTRUCTIONAL PURPOSES

1. In the teaching of which subjects have microcomputers been used within the school? (A nil response will be interpreted as "not used in that subject")

	Used extensively	Some use
English		
History		
Geography		
Mathematics		
Physics		
Chemistry		
Biology		
General/integrated science		
Foreign languages		
Home economics		
CDT		
Economics		
Secretarial studies		
Remedial education		
Others, please specify		

2. Are there any examples of the use of microcomputers which have involved changes in the organisation of teaching? (e.g. use of resource-based learning in a subject, use of team teaching, etc.)

Yes ☐ No ☐

If "Yes", please give details

This is a photo-reduced version of the questionnaire used in the final survey

3. Approximately how many teachers have used microcomputers in teaching subjects other than computing?

None	
1	
2-5	
6-10	
11-20	
more than 20	

4. How important do you feel the following reasons are for using microcomputers in the teaching of subjects other than computer studies or computer appreciation?

	Very important	Fairly important	Of some importance	Not important
(i) Increased pupil motivation				
(ii) Gives pupils familiarity with new technology				
(iii) Provides learning experiences not otherwise available				
(iv) Enables more effective learning				
(v) Provides variation in learning methods				
(vi) Others, please specify				

This is a photo-reduced version of the questionnaire used in the final survey

5. Which individuals and/or groups have been influential in determining the extent and type of use of microcomputers for teaching in subjects other than computing? (A nil response will be interpreted as "not involved")

	Extensively involved	Fairly involved	Some involvement	Little involvement
Head				
One or more deputy heads				
Computer teacher(s)				
Other teacher(s)				
Governors				
Parent Teacher Association				
General advisers				
Computing advisers				
Other subject advisers				
Others, please specify				

E. USE IN ADMINISTRATION

1. How many full-time equivalent clerical/secretarial/administrative staff (including bursars/registrars) are employed in the school during term time?

____

This is a photo-reduced version of the questionnaire used in the final survey

2. In which administrative tasks are microcomputers used in the school?
Please tick as appropriate

1 PUPIL RECORDS AND ROLL	
2 STATISTICAL RETURNS (i) DES form 7	
(ii) Other LEA/DES returns	
3 ATTENDANCE	
4 TIMETABLE (i) Construction	
(ii) Printing	
(iii) Staff emergency cover	
(iv) Curriculum analysis	
5 OPTION CHOICES	
6 EXAMINATIONS (i) Printing timetables/lists	
(ii) Analysis of results	
7 REPORTS FOR PARENTS	
8 WORD PROCESSING (i) Updating/re-drafting of reports	
(ii) Personalised letters	
9 SCHOOL ACCOUNTS & FINANCE	
10 MISCELLANEOUS (i) Stock control	
(ii) School library records	
(iii) Parents' evenings timetables	
(iv) University/college applications	
11 OTHERS,please specify	

This is a photo-reduced version of the questionnaire used in the final survey

3. The following reasons are sometimes suggested for using microcomputers in school administration. How important are each of the reasons in your school?

	Very important	Fairly important	Of some importance	Not important
(i) Time saving				
(ii) Easier to provide information required by LEA				
(iii) Better quality information available for use within the school				
(iv) Information available more quickly				
(v) More interesting jobs for clerical staff				
(vi) Can be used to demonstrate real applications to computer studies pupils				
(vii) Others, please specify				

4. Who operates the computer for administrative applications? (A nil response will be interpreted as "doesn't operate computer in administration")

	Operates computer for all or most of the applications	Operates computer for some of the applications
Head		
One or more deputy heads		
Computer teacher(s)		
Other teacher(s)		
Clerical staff		
Pupils		
Others, please specify		

This is a photo-reduced version of the questionnaire used in the final survey

5. Which individuals and/or groups have been influential in determining the extent and type of use of microcomputers in administration? (A nil response will be interpreted as "not involved")

	Extensively involved	Fairly involved	Some involvement	Little involvement
Head				
One or more deputy heads				
Computer teacher(s)				
Other teacher(s)				
Secretarial staff				
Governors				
Parent Teacher Association				
General advisers				
Computing advisers				
Others, please specify				

6. Does your LEA have a "New Technology Agreement" with the relevent trade unions in relation to the use of new technology by school secretarial and clerical staff?

Yes ☐

No ☐

Don't know ☐

7. How did the school secretarial and clerical staff feel about the use of microcomputers in administration, initially and now?

	Positive & enthusiastic	Indifferent	Antagonistic and/or fearful
Initially			
Now			

This is a photo-reduced version of the questionnaire used in the final survey

F. EVALUATION

1. How successful do you feel the use of microcomputers for instructional purposes has been, in relation to each of the following?

	Very successful	Moderately successful	Of limited success	Unsuccessful
(i) Extent of use				
(ii) Response of teachers				
(iii) Response of pupils				
(iv) Overall				

2. How successful do you feel the use of microcomputers in administration has been, in relation to each of the following?

	Very successful	Moderately successful	Of limited success	Unsuccessful
(i) Extent of use				
(ii) Time savings				
(iii) Quality of information available				
(iv) Effects on clerical staff jobs				
(v) Effects on teachers' jobs				
(vi) Overall				

3. In using microcomputers for instructional purposes, to what extent have developments been constrained by:

	Constrained to great extent	Constrained to some extent	Constrained slightly	Not constrained
(i) Lack of equipment				
(ii) Lack of suitable programs				
(iii) Lack of computing expertise				
(iv) Lack of time of people with computing expertise				
(v) Resistance from teaching staff				
(vi) Overload of other innovations				
(vii) Lack of support/advice from LEA				
(viii) Others, please specify				

This is a photo-reduced version of the questionnaire used in the final survey

4. In using microcomputers for administration, to what extent have developments been constrained by:

	Constrained to great extent	Constrained to some extent	Constrained slightly	Not constrained
(i) Lack of equipment				
(ii) Lack of suitable programs				
(iii) Lack of computing expertise				
(iv) Lack of time of people with computing expertise				
(v) Resistance from teaching staff				
(vi) Resistance from clerical staff				
(vii) Overload of other innovations				
(viii) Lack of support/advice from LEA				
(ix) Others, please specify				

G. DEVELOPMENTS

1. In what ways has the use of computers in your school developed or changed in emphasis during the last 2 years?

2. Have there been any staffing changes in the school during the last 2 years which have affected developments? If so, in what way?

This is a photo-reduced version of the questionnaire used in the final survey

3. How do you feel the introduction of microcomputers has or will affect your own job?

4. How do you feel the introduction of microcomputers has or will affect the jobs of members of your teaching and office staff?

A summary report of the findings of the survey will be produced for distribution to people who have completed this questionnaire, though no schools will be identified individually. If you would like to receive a copy of the summary report, please give the name and address to which I should send it.

Name
Address

I would like to thank you for completing this questionnaire. Your assistance is greatly appreciated.

David Lancaster

- 12 -

Mr A B Cee

Appendix 7

Headteacher

Centretown Comprehensive School

Centre Street

Centretown

Centrelea CE1 1CE

Centre for Education Management and Administration

36 Collegiate Crescent
Sheffield S10 2BP
Telephone (0742) 665274
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Head of Centre L E Watson MA FBIM

8 May 1986

Dear Mr Cee,

MICROCOMPUTERS IN SECONDARY SCHOOLS: THE EFFECTS ON THE SCHOOL AS AN ORGANISATION

I am writing following my letter of about five weeks ago in connection with the questionnaire part of the above research on the use of microcomputers in teaching and school administration, and how such developments affect the school as a whole.

The responses received so far indicate very wide differences between schools in terms of priorities and organisational arrangements for computer use in teaching and school administration. That variability increases the potential usefulness to schools of the outcomes of the research providing that the response rate is relatively high. As of today, I have not received a reply from Centretown Comprehensive School, and whilst I appreciate that this is a busy time of year, I would be most grateful if you were able to complete the questionnaire, even if not fully, and return it in the enclosed stamped addressed envelope. I do assure you that the information provided will not be used in ways which make it identifiable with a specific school.

I have requested the assistance of yourself as headteacher as the study is focussed on the school as a whole, though it may be necessary to consult other staff in the school, including perhaps staff responsible for computing in respect of sections B and C. I do realise that, in that sense, the questionnaire is rather demanding.

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I would very much like to include information from Centretown Comprehensive School in the survey, and do hope that you feel able to respond to this request.

Yours sincerely,

David F. Lancaster
Senior Lecturer in Education Management

Sheffield City Polytechnic

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