NOTE

The series of numbers (signified thus: (n)) throughout the study is <u>not</u> a footnote or endnote reference system. These are included only as a personal guide for the author to tape recorded interview material.

Policy-Making in Information Technology:

A Decisional Analysis of the Alvey Programme

by

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ABSTRACT

In June 1988 the five-year, £350 million Alvey programme for advanced information technology is scheduled to terminate. This study is a critical appraisal of the decision-making associated with all aspects of the formulation, approval, implementation and operation of the Alvey policy programme.

The study analyses why a government that preaches public sector disengagement from the market has channelled funds into one of the fastest growing sectors of British industry, why a government committed to competition endorsed a programme based on collaboration between firms, and why a government opposed to picking 'winners' implemented a programme aimed at a few selected technologies. It describes the intricate advisory mechanisms which support decision-making by powerful but technologically ill-informed government departments and the British core executive. The study questions the wisdom of the government insisting that industry should frame industry policy - for when a sector dominated by defence contractors did so, the result was an increased dependence on government.

When the government engaged in a meso-corporatist policy-making arrangement with industry, it did so from a position of weakness. Industry had the technical expertise, operational control of major projects, and a dominant role within the Alvey directorate. The result was a pattern of self-interested and short-sighted policy-making biased towards the interests of large firms in the defence and telecommunications fields. By divorcing itself from the mainstream of information technology developments and concentrating on selected narrow niches, the British information technology industry has set itself a difficult task for survival in the years ahead.

This study is dedicated to the memory

of my brother

Patrick Joseph Keliher

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List of Abbreviations

ABRC - Advisory Board for the Research Councils

ACARD - Advisory Council for Applied Research and Development

ACOST - Advisory Council on Science and Technology

ADMIRAL - Advanced Mega Internet Research for Alvey

AEI - Associated Electrical Industries

AI - Artificial Intelligence

ALICE - Applicative Language Idealised Computing Engine

ANSA - Advanced Network Systems Architecture

APSE - Ada Programming Support Environment

ASIC - Application Specific Integrated Circuit

ASWE - Admiralty Surface Weapons Establishment

ATE - Automatic Telephone Engineering

BNFL - British Nuclear Fuels Limited

BRITE - Basic Research in Information Technology for Europe

BT - British Telecom (also Telecom)

BTG - British Technology Group

CAD - Computer Aided Design

CADC - Computer Aided Design Committee (Alvey programme)

CAM - Computer Aided Manufacture

CAP - Computer Analysts and Progrmmers

CAU - Computer Advisory Unit (of the Ministry of Technology)

CBI - Confederation of British Industry

CBS - Centre for Business Strategy, London Graduate School

CCA - Central Computer Agency (of the Civil Service Department)

CDI - Collector Diffusion Isolation

CGE - Compagnie General Electricite (France)

CII - Compagnie Internationale pour l'Informatique (France)

CIM - Computer Integrated Manufacture

CMOS - Complementary Metal Oxide Silicon

DARPA - Defense Advanced Research Projects Agency (USA)

DCVD - Devices, Components and Valves Directorate (MoD)

DCS - Distributed Computing System

DES - Department of Education and Science

DHSS - Department of Health and Social Security

DoD - Department of Defense (USA)

DoI - Department of Industry

DTI - Department of Trade and Industry

EARB - Electronics Applications Requirements Board

EEC - European Economic Community

EMI - English Musical Industries (also Thorn-EMI)

ESPRIT - European Strategic Programme of Research and Development in Information Technology

EUREKA - European Research Coordination Agency

FMI - Financial Management Initiative

FRG - Federal Republic of Germany

FT - Financial Times

GATT - General Agreement on Tariffs and Trade

GDP - Gross Domestic Product

GE - General Electric (USA) (also GE-Bull)

GEC - General Electric Company (UK)

GIGO - Garbage In, Garbage Out

IAC - Industry and Academic Committee (Alvey VLSI/CAD programme)

IBM - International Business Machines

IBRO - Inter-Bank Research Organisation

IC - Integrated Circuit

I&C - Infrastructure and Communications directorate (Alvey programme)

ICL - International Computers Limited

ICOT - Institute for New Generation Computing Technology

ICT - International Computers and Tabulators

IEC - Information Engineering Committee (SERC)

IEE - Institute of Electrical Engineers

IKBS - Intelligent Knowledge Based Systems

IPR - Intellectual (or Industrial) Property Rights

IPSE - Integrated Project Support Environment

IRC - Industrial Reorganisation Corporation (Ministry of Technology)

IT - Information Technology (also Information Technology Division, DTI)

ITAP - Information Technology Advisory Panel

ITSA - Information Technology Skills Agency

ITT - International Telephone and Telegraph

IT82 - Information Technology year 1982

IT86 - Information Technology inquiry 1986 (known as the Bide Committee)

IT92 - The proposed five-year IT programme to follow Alvey

JANET - Joint Academic Network (also called JNT)

JNT - see JANET

JOERS - Joint Opto-Electronics Research Scheme

LA - Electronics Applications Division (DTI) - a phonetic acronym

LEO - Lyons Electric Office

LSI - Large Scale Integrated circuit

MAP - Microelectronics Application Project

MinTech - Ministry of Technology

MISP - Microelectronics Industry Support Scheme

MITI - Ministry of International Trade and Industry (Japan)

MMI - Man-Machine Interface

MoD - Ministry of Defence

MSC - Manpower Services Commission

NEDC - National Economic Development Council

NEDO - National Economic Development Office

NCC - National Computing Centre

NEB - National Enterprise Board

NEC - Nippon Electric Company

NPL - National Physical Laboratory

NRDC - National Research Development Corporation

NTT - Nippon Telephone and Telegraph

OECD - Organisation for Economic and Commercial Development

PABX - Private Automatic Branch Exchange

PIG - Private Interest Government

PITCOM - Parliamentary Information Technology Committee

PPDS - Product Process and Development Scheme

PREST - Policy Research in Engineering, Science and Technology

PSBR - Public Sector Borrowing Requirement

QGA - Quasi-Governmental Agency

QUAGO - Quasi-Autonomous Governmental Organisation

QUANGO - Quasi-Autonomous Non-Governmental Organisation

RACE - Research and Development in Advanced Communications for Europe

RAF - Royal Air Force

RAL - Rutherford Appleton Laboratory

RAM - Random Access Memory

ROM - Read Only Memory

RSRE - Royal Signals and Radar Establishment (MoD)

R&D - Research and Development

SDI - Strategic Defence Initiative (also known as Star Wars)

SDL - Systems Designers Limited

SE - Software Engineering

SERC - Science and Engineering Research Council

SIG - Special Interest Group

SPRU - Science Policy Research Unit (Sussex University)

SRC - Science Research Council (became SERC)

SSL - Software Sciences Limited

STC - Standard Telephone and Cables

STL - Standard Telecommunications Laboratories

STET - Societa Finaziara Telefonica

TMC - Telephone Manufacturing Company (as in Pye-TMC)

TP - Telecommunications and Posts Division (DTI)

TUC - Trades Union Council

TVEI - Technical and Vocational Education Initiative

UGC - University Grants Committee

UK - United Kingdom

UKITO - United Kingdom Information Technology Organisation

US(A) - United States (of America)

VHPIC - Very High Performance Integrated Circuit programme (UK)

VHSIC - Very High Speed Integrated Circuit programme (USA)

VLSI - Very Large Scale Integrated circuit

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CHAPTER ONE

Introduction

Most politicians who have rubbed the foot of Churchill's statue at the door to the chamber of the House of Commons would not hesitate to offer an opinion on what should be the public policy towards the British coal industry, or policing in Tottenham, or the privatisation of public enterprises. If the same people were asked what should be the public policy for the information technology industry, the answers would not be so readily forthcoming. If those who did answer were then asked whether greater emphasis should be given to the software or hardware sector and why, the number answering would be even fewer. Finally, if the remaining group were asked whether the government should be encouraging the manufacture of general purpose integrated circuits or application specific integrated circuits, only a handful would hazard an opinion.

Yet between 1983 and 1987, the Thatcher Government had a firm and highly visible public policy to support the development and manufacture of application specific circuits and poured more than £70 million of public money into achieving this policy goal. A spokesman for one of the UK's leading software house described this section of the Government's information technology policy as a case of 'the electronics mafia ripping off the public purse' (1). In reply, a senior government technologist described this view as 'Bollocks. Complete and utter bollocks' (2). Clearly opinions differ over the efficacy of the policy.

This study is carried out within the framework of an extraordinary paradox: the case of a self-professed neo-liberal government with its obsession for privatisation and disengagement from the free market joining with industry to develop a strategy of support for one of the fastest-growing and most successful industries in Britain. Such a situation constitutes more than a policy shift or as the popular press terms it, a U-turn. It is a significant repudiation of the philosophy and ideology which radical Toryism proclaims. The Government entered into a corporatist arrangement with a sector of British industry whereby a handful of technological 'winners' were singled out for intensive support under the direction of a government agency staffed by industry and the civil service.

In August 1978, the then ideological guru of the Conservatives and future Secretary of State for Industry, Sir Keith Joseph, made an important speech damning the Labour Government's strategy to increase employment. He said (Joseph, 1978, p.28):

> The industrial strategy depends on the government identifying 'winners' and backing them with the public's money. It is flawed because group pressures force government to back losers rather than winners. Moreover, government cannot identify winners in advance. Anyway, winners do not need tax-payers money - and losers waste it.

Three months earlier Margaret Thatcher had told a group of Tory supporters (Thatcher, 1978, pp.6-8):

> The State should not be allowed, and should not allow itself,

> to spill outwards...as if it were the only institution to be relied upon..The State's concern in economic affairs should be to ensure that as few obstacles as possible are placed in the way of our own pursuit of enterprise, not to try and organise how we should do that...The essence of a free society is that there are whole areas of life where the State has no business at all, no right to intervene.

Four years later, Prime Minister Thatcher and her Cabinet which included Sir Keith Joseph were considering the Alvey committee of inquiry's recommendations for the Government to invest hundreds of millions of pounds mostly into Britain's largest information technology companies.

The information technology industry in Britain has had a chequered history marked by early successes, crises, company mergers and more crises. Government intervention until the late 1970s was either minimalist or manifested itself in the form of support for a 'National Champion'. Despite the Tory rhetoric and the promise 'to reduce government intervention in industry' (*Conservative Manifesto 1979*, April 1979), the Thatcher Government's thrust appeared to be towards a gradual, rather than a radical disengagement from the market. With soaring unemployment and industry dissatisfaction over rising interest rates and a strengthening pound, manufacturers and forces within the Tory party caused a partial reversal of this policy thrust. In an article entitled "Mrs Thatcher's new name for intervention", the industrial policy of 'constructive intervention' was announced (*Financial Times*, 17/10/80). Constructive intervention was to come to the Department of Industry in the form of Kenneth Baker, the new

Minister for information technology whom Hugo Young described as 'a shameless critic of the (neo-liberal) faith' and 'a minister who actually believes in the policy of industrial support' (*Sunday Times*, 11/1/81).

Following the shift of the crisis-prone Sir Keith Joseph to the Department of Education and Science, another so-called 'wet', Mr Patrick Jenkin, joined Kenneth Baker at the Department of Industry (*Guardian*, 21/9/81). Within six months the Alvey committee of inquiry had been established and by late 1982, the *Alvey Report* was published.

This study chronicles the events and circumstances surrounding the development of the Alvey policy proposal, its approval, implementation and operation. The Alvey programme was not the brain-child of Kenneth Baker or Patrick Jenkin. Its origins lie in Swindon and Tokyo, the headquarters of the Science and Engineering Research Council and the Japanese Fifth Generation Computing Centre respectively. It is a policy which involved a joint industry-government administrative body directing collaborative pre-competitive research programmes between government establishments, university departments, and companies. Government was originally asked to provide ninety per cent of the £350 million funding package (*Financial Times*, 6/9/82; 8/10/82). This was gradually whittled down to sixty and then fifty per cent. Eventually the Government agreed to provide £200 million, £110 million from the Department of Industry, £40 million from the Ministry of Defence, and £50 million from the Science and Engineering Research Council for university research.

The programme is aimed at four selected technologies; very large scale integrated circuits (or microchips), software engineering (or advanced software methods), information knowledge based systems (or artificial intelligence), and the man-machine interface (or user-friendly techniques and products). Between April 1984 when the first major collaborative project was announced and December 1986 when the last project was initiated, the Alvey directorate committed £150 million to 115 firms to undertake 198 projects (Alvey, 1987a, pp.17-19). In January 1986, a Confederation of British Industry-sponsored committee of inquiry heavily supported by government departments met under Sir Austin Bide to investigate what, if any, type of programme should follow the Alvey programme.

This study is not a dry, blow-by-blow account of the daily operations of a minor Whitehall bureaucracy. During the course of an extensive interviewing sequence, some intriguing, entertaining and surprising items were brought to light. Examples include the use of the 'Red Jelly Test' by the Treasury to evaluate the worth of a departmental proposal, and the Prime Minister hearing of a major information technology programme involving British firms from a European diplomat over dinner. Within the Alvey programme, there was a deliberate and successful attempt to undermine the Prime Minister's decision that the directorate have a limited number of staff and be overseen by a small steering committee. There were also problems such as the rift between the systems-software supporters and the hardware supporters, and the struggles over sovereignty between the Alvey directorate and the participating departments, especially between the directorate and its parent department, the Department of (Trade and) Industry. The study also documents how a lack of stated objectives in the *Alvey report* allowed the major firms to influence the technical programme strategies to their own short-term ends with a resultant bias towards the defence and telecommunications industries.

Theoretical Themes and Considerations

Since the election of the Thatcher Government in 1979, and notwithstanding the temporary push led by Baker for some intervention, the concept of a systematic government industrial strategy or policy has all but disappeared. The Thatcherite approach to industrial strategy eschews the notion of a government-imposed or corporatist-generated set of objectives and guidelines and argues instead that industry will only prosper if the correct framework exists and companies set their own industrial policies. The role of the Government is to control inflation and reduce taxation, abolish trade barriers, curb excessive union power, encourage competition in the market-place, and disengage government from the market through privatisation. The Government sold its stake in International Computers Limited, and privatised Inmos and British Telecom. The focus of government attention switched from the 'Smokestack' or 'Sunset' industries such as steel, coal, and motor vehicle manufacture to 'Sunrise', high-technology industry and the service sector. The era of the National Champion was over. What was left of government industrial policy was fragmented between the Manpower Services Commission, the Department of Employment, the Department of (Trade and) Industry, the Treasury and other public sector agencies.

Not surprisingly, the concept of corporatism as a theoretical framework within which public policy in Britain may be analysed has become unfashionable since 1979. This is especially the case with macro-corporatism because of the conditions listed above and because Britain does not have 'the capacity' to develop 'adequate corporatist structures' (Streeck, 1984, p.148; Grant with Sargent, 1987, pp.8-10, 256). While macro-corporatism may have fallen from favour, prominent theorists such as Schmitter (1982, pp.259-279), Cawson (1982, pp.90-93; 1985, pp.1-20) and Grant (1985, p.11) are far more sanguine about the value of the concept of meso-corporatism or sectoral corporatism although recently writers such as Grant (with Sargent, 1987, pp.211-212) have questioned the use of meso-corporatism in the British context. There are several problems associated with the idea of meso-corporatism as an analytical tool.

Corporatism (or neo-, liberal, macro-, societal, corporatism$_1$ or corporatism$_2$), as the variety of labels suggests, suffers from definitional and theoretical problems. It finds its clearest expression in the associative and concertative interrelationships that exist between the state, business and the labour movement in countries such as Austria and Sweden. Bi-lateral corporatism is theoretically weaker, less developed and less distinctive than the tripartite model, while the notion of sectoral or meso-corporatism is even less theoretically developed. Therefore it is critical to examine continuing corporatist practices or the development of new areas of public-private sector intervention, intermediation, and incorporation which are 'the essence of corporatism' (Grant with Sargent, 1987, p.16). Only in this way can the theoretical and empirical underpinnings of corporatism be understood and strengthened.

In this study, there are two additional 'wild cards' apart from the potential problems already foreshadowed. The first is the role of the academic information technology community in the policy process. Cawson (1982, p.40) states that 'professions are necessarily corporate groups'. But the interest relationships that exist in the academic sector are clearly a step beyond the associative interest groupings that exist in the 'heartland' of the tripartite corporatist paradigm (Schmitter, 1982, p.262). It is argued here, however, that the academic information technology community constituted a functional grouping within the policy process. Whether the Alvey policy led to an evenly balanced set of programmes in which academia participated on an equal footing with industry, or whether funding for academia was in fact a disguised industry subsidy in an industry-dominated programme is one of the problems that this study addresses.

The second problem is in the area of intermediation. Much corporatist theory developed as an extension of pluralist and neo-pluralist theory, indeed as Schmitter (1979, p.15) acknowledges 'a number of basic assumptions' are shared by pluralism and corporatism. Consequently there is a bias towards the understanding of the interest group structures and the power relationships within these structures. With so much emphasis on the instrumental aspects of decision-making, a crucial area often gets overlooked. This is the notion of 'ideological corporatism' or as Schmitter (1982, pp.262-264) calls it, 'concertation' or 'corporatism$_2$'. This type of corporatism is the result of ideas rather than power struggles between competing interest groups, and the intervention and incorporation that emerge may be the consequence of knowledge-driven networks and linkages.

The existence of alternative interpretations of policy changes, such as the policy community analyses (Jordan and Richardson, 1982, p.94) or networking accounts by pluralist writers which are more 'neutral' in substantive terms than corporatist explanations, poses an analytical conundrum. The 'neutral' accounts are often very descriptive, emphasising that policy systems are constituted around issues and vary greatly over time, across issue areas, and across what is being coordinated (e.g. government/programmes, government/industry, agencies/programmes). This orientation tends to blur the crucial features of public policy-making. It is only by utilising a meso-corporatist framework that the features which are vital to the understanding of the policy and decisional processes can be explicated. These include the concept of reciprocity between the state and interest groups (Cawson, 1985, p.9), the 'unwillingness or inability' of the state to 'assume a directive role, or to rely on market processes to produce desired ends' (Cawson, 1985, p.12), and the notion that as interests are incorporated in the state, the 'price of partnership is some loss of autonomy' (Grant with Sargent, 1987, p.16). Therefore, corporatism in the context of this study refers to a public policy process in which the policy is negotiated between state and non-state interests with neither state nor non-state bodies assuming a directive role; where specific collaborative mechanisms are designated as implementation media; where both state and non-state interests participate in the implementation and operation of the policy programme following policy approval; and where both interests agree to comply with negotiated rules and guidelines.

There is a *prima facie* basis for applying a corporatist framework in the analysis of the Alvey policy programme. Corporatism stresses the role of key sectors (Atkinson and Coleman, 1985, pp.22-23) and information technology is certainly a strategic national industry. The British information technology industry is subject to strong international competition in the domestic market, a condition which tends to lead to associative action. In the early 1980s the British information technology sector was a highly specialised niche market under threat in a small country, a situation which facilitates corporatist collaboration (Zysman, 1983, pp.317-318). The Alvey policy led to the creation of a sector-explicit corporate/government/academic programme which was jointly undertaken by these three groupings. New specific institutions were created, again jointly staffed by all three groups, which blurred the 'traditional distinction between public and private' (Cawson, 1982, p.66). The policy stressed integration and incorporation via a policy culture or ethos which required policy participants to collaborate in the national interest rather than to compete.

The absence of trade unions from the policy process may be seen in some quarters as proof that this was not a 'true' corporatist case. In response it must be pointed out that corporatism without labour has already been chronicled (Pempel and Tsunekawa, 1979, pp.231-270), a situation acknowledged by Lehmbruch (1982, p.25) as fitting the corporatist model. As well as this, the role of the academic community in the Alvey policy is ambiguous. But as Grant (1985, p.10) has noted, corporatist arrangements can exist where groups 'other than organisations represent(ing) capital and labour' engage in policy making. While it is argued that meso-corporatism was in evidence throughout the Alvey programme, this does not imply that meso-corporatism will always be present in the information technology sector. Questions concerning the permanence and degree of grounding of (meso-) corporatism remain to be analysed in this study.

The Methodology and Structure of the Thesis

This topic was selected several years ago. At that time, literature on the subject was restricted to a few journal articles, a handful of mostly technical Alvey publications, and newspaper stories, many of which were simply ministerial press releases. Since then there has been an increase in the number of Alvey publications, journal articles and references to the Alvey programme in monographs and books such as Arnold and Guy (1986) and Jowett and Rothwell (1986). Most of these publications are evaluative studies. Evaluative studies of these types of policy programmes encounter several problems. These include the problem of time lags before policy impacts may be detectable, and the difficulty of identifying the impacts, and in the case of the Alvey programme, the fact that it is not scheduled for completion for some time.

This study, however, fits within the traditional framework of decisional studies of policy processes. A decisional study may yield first approximation insights about the evaluation range where the study is located because it is impossible to study a decisional sequence without characterising its outcomes in some ways. But fundamentally, decisional analysis relies on looking at the policy process for insights into two main areas. The least important of these is the likely policy results. The most important is the capacity of the decision-making system to make these kinds of decisions. Interest in this second area is especially strong because of the acknowledged difficulties and lack of guidelines and routinised institutions in the field of high technology policy-making.

There are particular difficulties encountered when writing about technical decision-making. These include the highly complex and ever-changing technologies and the associated jargon and acronyms; the fragmented decisional process and the problems that it poses in trying to trace decision paths; the almost total lack of documentation regarding many of the decisions; the unwillingness in some cases to discuss sensitive or controversial features of technical policies; and the different interpretations placed on actions and events depending on the technical background of the commentator. It was because of these difficulties, especially the lack of documentation, that extensive use was made of interviews in the data gathering process and in the study itself.

The structure of the study is as follows. The topic is placed in context by examining the history of the three main sectors of the information technology industry, computing, telecommunications, and microelectronics, individually in chapter two. This study highlights the types of policies used to support the industries, the emergence of National Champions in the three sectors, and the problems which beset the information technology industry in the late 1970s and early 1980s. Chapter three provides a detailed account of the major actors and actions which led to the setting up of the Alvey committee of inquiry, the operation of the committee, and the submission of the report to the core executive for approval. It focusses on the emergence of policy networks within the information technology industry, the influence that various sections of the industry had in the policy-making process, and the first signs of the meso-corporatist style which characterised the policy process. Chapter four contains an analysis of the decision-making process associated with the approval and initiation of the Alvey programme. This analysis highlights the problem facing decisionally powerful but technically impotent laymen (and women) in the field of technology policy-making. It also provides some insights into the lack of standard guidelines, formal structures, and routinised procedures in this area. Chapter five examines the role of the joint industry-government body responsible for directing the programme, the Alvey directorate, with special reference to its impact on the other public sector bodies which sponsored the programme, the Department of (Trade and) Industry, the Ministry of Defence, and the Science and Engineering Research Council. It also examines the institution building and generation of a separate ethos that were features of the operation of the programme. In chapter six the interface between the Alvey directorate and the private sector firms is examined by reviewing the operations of the technical programmes. This chapter exposes how certain groupings within the industry dominated segments of the technical programme and the divisiveness this engendered. It also exposes some of the real problems that face technologists and laymen when dealing with technology. Chapter seven contains a review of the final months of the Alvey directorate's operation, the development of the Bide committee of inquiry recommendations for an after-Alvey programme, and the impact of the European high technology Framework programme on the decisional process. This chapter exposes the problems of policy succession in the face of competing programmes and the difficulty in terminating existing policies. As well as this it exposes the ideological dilemma facing a neo-liberal government when under pressure to intervene in an industry. In the final chapter, the various strands are drawn together and conclusions are put forward.

To generate the information contained in this study, it was necessary to conduct a broad series of interviews with the actors involved in the policy process. Approximately sixty people were interviewed over an eighteen month period. Included among those interviewed were eight of the twelve members of the Alvey committee of inquiry including John Alvey, all of the executives of the Alvey directorate, the chairman and several members of the Alvey steering committee, the Minister for Information Technology, and several senior civil servants who were involved indirectly in the policy-making process. As well as these, industrialists were deliberately selected from small information technology firms such as Pye-Unicam and Acorn Computers, from systems and software houses such as Logica and Systems Designers Limited, and from the powerful 'defence' sector of the industry such as GEC-Marconi, British Aerospace, and Ferranti.

Representatives of every major interest involved in the policy-making process were interviewed in an effort to catalogue the facts, most of which have never before been exposed, surrounding the Alvey policy process. Wherever possible throughout the study, quotes from these interviews are used in preference to secondary sources. A complete explanation of the methodology used for this study is provided in Appendix A.

CHAPTER TWO

British Policy-Making for Information Technology: Pre-1982

Information technology is a most crucial policy area whether viewed from a strategic, economic or industrial perspective. Defence, energy, transport, banking, insurance, education, agriculture, manufacturing and leisure have all been influenced profoundly by the information technology revolution. As well as this, the goods and services of the information technology (IT) sector have themselves become a major source of income for their producers.

Information technology encompasses three formerly distinct technologies for the storage, processing and transmission or communication of information, viz, telecommunications, computing and microelectronics. Telecommunications is the technology which enables the transmission of data, images or voice via cables, broadcast, satellites or optical fibres. Computing entails the electronic storage, retrieval and processing of data and information. The first computers were massive machines whose processing power derived from arrays of valves. These were followed in the 1950s and 1960s by transistor powered machines which were in turn made obsolete by the advent of the integrated microelectronic circuit or chip. Computing and telecommunications existed in parallel with each other and the policies relating to one often did not effect the other until the commercial application of the integrated circuit.

The silicon chip developments which revolutionised computing and telecommunications spilled over into other sectors. FIAT produced the car "designed by computers, built by robots". Computers were used to aid in the design and manufacture (CAD/CAM) of numerous products, especially more advanced computers and components. Ownership of cheap and powerful home computers became commonplace. Chips were used in cars as well as in the home in programmable microwave ovens, video cassette recorders, televisions and a host of other electronic devices. Supermarket checkouts began using bar code readers and mark sensing devices. Newspapers adopted new technologies which resulted in the obsolescence of trades such as linotyping. Home banking and home shopping became a reality. Word-processors replaced typewriters and electronic diaries and electronic mail became standard office features. Phonecard, Space Invaders and Oracle became a part of daily life. The IT revolution was all pervasive.

In this chapter the history of the computing, microelectronics and telecommunications industries in Britain prior to 1982 is briefly reviewed. For ease of exposition, the history of each of the industries is divided into three thematic periods which broadly reflect the three basic options in public policies for technology. These are the Minimalist period when governments maintain a stand-off from the industry's problems; a period of support for a National Champion when the government intervenes to target one project or one firm as the flagship for the national interest in the face of overseas competitors; and a crisis period when the 'National Champion' strategy begins to break down in the face of multi-faceted international competition, especially from powerful Japanese and American corporations. A short summary of IT developments in other countries is included for comparative purposes. An overview of research and development into IT by

British universities is also provided with special emphasis on the role of the Science and Engineering Research Council.

In industrial terms, the main features of this period include the convergence of the three previously distinct industries, the relative decline of the British IT industry in the face of foreign (mostly USA) competition, and the birth of the British IT policy community. In substantive public policy terms some recurring themes emerge - including the extent of policy continuity regardless of which government was in power, and the blurred focus of government policy as the result of unclear or conflicting policy objectives.

2.1 The British Computer Industry: A Brief History

The Minimalist Period

Computers as they are understood today were first developed in Britain during World War II by the British Ministry of Defence (MoD) with the assistance of British Post Office and American expertise. These were specific purpose machines mostly used for crypto-analysis. After the War, Britain remained at the forefront of research into computing with Manchester University producing the Mark 1 computer in 1948 while Cambridge University announced the EDSAC computer the following year. Although the Mark 1 patents were exploited by International Business Machine (IBM) Corporation in America and Ferranti in Britain (Lavington, 1980, pp.40-85), it was the use of transistors by IBM and other American companies which gave them a technological edge over British makers. By the mid-1950s seven British companies competed for the small home and export markets. This number shrank rapidly following a series of mergers and takeovers in the late 1950s and mid-1960s. Power Samas and British Tabulating Machines (BTM) merged in 1958 to form Internatioanal Computers and Tabulators (ICT). ICT later absorbed English Musical Industries (EMI) computer group and Ferranti. English Electric took over Lyons Electric Office (LEO), Marconi Computing in 1965 and Elliott Automation in 1967 (See Table 2.1 below).

Table 2.1 Rationalisation of UK Computer Manufacturing 1958-68

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Company                    Year of Amalgamation

                1958    1960    1962    1964    1966    1968

Ferranti---------------------------------)
EMI----------------------------------)   )
Powers Samas---------)ICT____________)___)__________________ICT
BTM------------------)
English Elect.-------------------------------)______________Eng. Elect.
LEO------------------------------------------)    )       )
Marconi                               -------------)       )
Elliott-----------------------------------------------------)
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Sources: Locksley, 1981, pp.32-35: Jequier, 1974, p.215.

These mergers contained hidden costs. For example, by 1963 'ICT was selling ten different computers, often incompatible with each other, where it should have been selling three sizes of compatible computers' (Hills, 1984, p.95).

In 1964 Britain imported more computer hardware than it exported for the first time, a situation that was to become a feature of British trade for the rest of the decade. By 1965 the top five American companies (IBM, Sperry Rand, Control Data, Honeywell and Burroughs) shared 90 per cent of the world computer market (Brock, 1975, p.16) and the dream of Britain as a world power in the computer industry was over.

During the late 1940s and 1950s there was no public policy for the computer industry. It was after the election of the Wilson Government in 1964 that a policy programme emerged. Labour set up the Ministry of Technology (MinTech) within the Board of Trade, responsible for "sponsorship" of the computer industry and the Industrial Reorganisation Corporation (IRC) to monitor and facilitate industry rationalisation and to provide investment funds (Denton, 1976, pp.130-162).

The National Champion Period

The main thrust of the Government's policy became a preferential procurement policy. A National Economic Development Office (NEDO) report was critical of British computers and their software (NEDO, 1965, pp.5-20) and sales of American-controlled computer manufacturers reflect the buyers preference (see Table 2.2 below).

Table 2.2 UK Computer Installations by Country of Supplier 1959-66

Company Origin	1959	1960	1961	1962	1963	1964	1965	1966
Britain	100	96	85	63	55	52	47	46
USA	-	4	15	37	45	47	51	52
Other	-	-	-	-	-	0.2	2	2

Source: OECD, 1968, p.42

Both NEDO and the Government accepted the growing internationalisation of the computer market and believed it would lead to specialisation and a resurgence of the British computer industry would result. Both also realised that the American companies had a huge advantage as a result of US government research and development (R&D) grants in both the space programme and defence. In March 1965 a £5 million research grant was given to ICT and a £1 million grant for university research was announced. At the same time the Computer Advisory Unit (CAU) was set up within MinTech to provide "objective" advice on public procurement of computers. The CAU in fact became a vehicle for promoting the cause of ICT by endorsing an unofficial 'Buy British' policy (Hills, 1984, pp.152-157). During the next twelve months ICT became ICL (International Computers Limited), Tony Benn replaced Frank Cousins as Minister for Technology and the unofficial policy became official with a view to standardising computer hardware purchases in government. So began one of the enduring sagas of British IT policy; that of government support for ICL, the National Champion.

Throughout the second half of the 1960s and into the early 1970s the policy of preferential procurement continued and expanded as did the grants to ICL for R&D. In a burst of technical jingoism, ICL chose to develop a novel computer architecture which was incompatible with and therefore in direct competition with IBM. The final rationalisation of ICL with the computer division of English Electric occurred in 1968 with the Government taking a 10.5 per cent equity in the company. Companies such as Marconi and Ferranti benefitted from a similar standardisation policy in relation to the MoD weapons systems hardware in the early 1970s. ICL was excluded from this sector of the market although it did supply mainframe hardware for MoD data processing requirements. While ICL increased its share of the government mainframe orders, American companies still supplied almost 50 per cent of this market. This was the result of a confusing procurement process, Treasury rules on proven hardware capabilities, and a departmental power struggle between the Civil Service Department's Technical Support Unit and MinTech's CAU.

No-one was happy with these increasingly bureaucratic arrangements. The American companies such as Honeywell which manufactured in Scotland protested that their hardware had more British components than did ICL, while ICL was bitter that it was restricted to standard applications and was not gaining experience on new applications as its US competitors had through US Department of Defense contracts. Both American and British firms made submissions to the House of Commons Select Committee on Technology in an attempt to influence policy which in its efforts to prop up the National Champion, was endangering the good relations between the countries (*The Economist*, Vol.238, 27/2/71, p.56). While the Committee's report was being finalised, Heath's Conservative Government was elected in 1970 and it was expected that the Tory commitment to minimal state intervention would see an end to the procurement policy.

Although the Government was committed to reduced state intervention it was also committed to efficiency through standardisation. Efficiency triumphed over ideology and ICL became the sole tenderer for large scale mainframes and smaller machines where compatibility was necessary. This resulted in ICL supplying two-thirds of all government computer hardware contracts. During this period the Heath Government opposed the takeover of ICL by Burroughs (US). To further improve efficiency and coordination, the confusing procurement process and the interdepartmental power struggle were resolved by the establishment of the Central Computer Agency (CCA) within the Civil Service Department with responsibility for all central government computing procurement. In time the CCA assumed the role of spokesman for and defender of ICL within government (Hills,1984,p.162).

Subcommittee D of the Parliamentary Select Committee on Technology questioned the wisdom of indefitely pursuing a 'Buy ICL' policy but more importantly it pursued the need for a policy on software, computer peripherals and the urgency for significant government investment in R&D, awareness programmes and education. The Heath Government welcomed the report and ignored it. There were changes in the way central government acquired advanced applications software but the only company to be awarded a 'development contract' between 1972 and 1976 was ICL's software subsidiary, Dataskil (Computer Services Association, 1976, pp.5-17). One programme that the Heath Government did implement was the Software Product Scheme. This scheme, introduced under the Industry Act of 1972, was designed to support the cost of developing software packages with 25-30 per cent grants. Conceptually it was ahead of its time and few grants were taken up before the 1980s. The software industry was (and still is) extremely fragmented and during the period 1972-1976, government support for the industry declined in real terms.

Another related area for concern was the computer peripheral market. Prior to the rationalisations of the 1960s it was common practice for mainframe manufacturers to purchase peripherals from outside suppliers. As the range and cost of peripherals increased it became more profitable for mainframe companies to supply both the processing units and the peripheral equipment. The Select Committee criticised this procedure and advocated support for the peripheral industry, however, neither Labour nor Tory governments took action. By the end of the 1970s more than three-quarters of all peripherals sold in Europe were imported from America or manufactured by subsidiaries of American firms (*Computer Weekly*, 18/3/80). This problem is one of the major sources of Britain's balance of payments deficit im IT sector.

The election of a Labour Government in 1974 saw the continuation of the procurement preference policy, however, cutbacks in public spending led to departments leasing rather than buying hardware, thus circumventing the preference policy. The effect of this policy was also being eroded by the expansion of ICL into minicomputers, a category not covered by the policy. When the NEDC and ICL lobbied to have minicomputers covered by the procurement policy, Honeywell, which had a large minicomputer manufacturing operation in Scotland, threatened to close the plant if ICL received preference and its representative on the NEDC resigned. The spectre of severe job losses had little appeal and the Government ignored the pleas of ICL and the NEDC. By 1977 ICL received 50 per cent of its business from export sales of its minicomputer and only 7 per cent from government (*Guardian*, 9/12/79).

The Crisis Period

The next year the Callaghan Government, as with Heath's stance six years earlier, opposed the bid by Sperry-Univac (US) to buy a 30 per cent stake in ICL. The ICL saga continued with the election of the Thatcher Government when the National Enterprise Board (NEB) sold off the Government's stake in the company to institutional investors 'primarily to provide cash to relieve the public sector borrowing requirement' (PSBR) (Hills, 1984, p.179). The long-running public procurement policy was about to end as the GATT (General Agreement on Tariffs and Trade) regulations were due to be applied after January 1981. In December 1980, ICL was struck by a financial crisis resulting in a share price collapse (*Guardian*, 20/12/80).

The Secretary of State for Industry, Sir Keith Joseph, was forced into the humiliating position of announcing a £200 million credit guarantee rescue package in the face of opposition from the Treasury (which feared an overrun on the PSBR), from within the Cabinet Office, and from his own backbenchers. Sperry-Univac stepped in and offered to buy ICL and for a time there was some support within the Government but the Department of Industry and its allies put together a rescue package. This strategy involved replacing the existing ICL management and agreeing to support ICL's R&D and to buying its products. The compounded irony of the whole debacle was that ICL's cash crisis came about as a consequence of the Treasury's refusal to buy replacement ICL mainframes because to do so would affect the PSBR. Two years earlier, the NEB had sold the Government's shares in ICL to reduce the PSBR.

2.3 The British Microelectronics Industry: A Brief History

The Minimalist Period

As with computers, it was America which quickly dominated the British market once commercial exploitation of microcircuitry began in the early 1960s. Britain had four integrated circuit manufacturers in the mid-1960s; Marconi, Ferranti, Elliot (producing under licence from Fairchild of the USA) and Texas Instruments (wholly American owned). In response to an American price-war and subsequent dumping on the British market, the Labour Government intervened in the industry for the first time to impose a 30 per cent tariff in 1966 but this was negated the next year by a devaluation of the pound. The results were rising costs for British importers and a rapid increase in the number of overseas chip manufacturers with factories in Britain. British companies responded by establishing short-term collaborative R&D agreements and MinTech provided substantial funding for public sector R&D bodies such as the Royal Signals and Radar Establishment (RSRE) at Great Malvern as well as some minor funding for Plessey, Ferranti and GEC (General Electric Company). It was at this time that the rationalisation of the electronics industry took place, the outcome of which was the emergence of GEC as leader of the British microchip market with microelectronics divisions of Marconi and Elliott under its umbrella and an 18.5 per cent stake in ICL (Hills, 1984, pp.198-202).

Price-wars continued throughout the late 1960s and by the early 1970s over 50 per cent of chips sold in Britain were imported and and although there had been some improvement in the terms of trade in chips, there was an over-capacity among British standard chip manufacturers. Technological advances such as the microprocessor chip, protection by the US government and reduced costs of standard chip production by American companies in Taiwan and South Korea gave the US manufacturers a seemingly unassailable lead. British manufacturers such as Ferranti and GEC appealed in vain to the Select Committee under both Labour and

Conservative Governments. The chairman of GEC, Arnold Weinstock (now Lord Weinstock) said (Select Committee, Fourth Report, QA. 1293):

> We have no such protection (as they have in the USA) in this country, and if we do not get it, unless we are prepared indefinitely to support huge losses without, so far as one can see, any forseeable prospect of improvement, there will be no integrated circuit industry (in Britain).

The Department of Trade and Industry (DTI) proposed several options, none of which were acceptable to British industry, and the Heath Government was ideologically opposed to a protection policy. The outcome was that GEC and Ferranti, Britain's two largest standard chip manufacturers, withdrew from the standard chip market entirely. Plessey followed shortly after. All three companies concentrated their efforts in this field into the custom and semi-custom microchip market. Government attempted to retain a state-of-the-art capability in microchips by funding research but the level of funding was paltry and was mainly directed to government laboratories (Hills, 1984, pp.200-204). Two schemes for the private sector were started in the early 1970s, namely, the Microelectronics Support Scheme and the Advanced Computer Technology Project. The funding for these was derisory in comparison with the support being given to American firms through government defence and aerospace contracts (Jowett and Rothwell, 1986, pp.12-14). Government policy for microelectronics until 1978 was piecemeal and *ad hoc*.

Defence R&D expenditure in Britain between 1970 and 1978 remained constant in real terms while industrial R&D funding fell from 16 per cent to 5 per cent of the total government R&D expenditure (Bowles, 1981, pp.92-100). This change of policy focus encouraged firms to switch investment and R&D from industry to defence. The rapid increase in defence expenditure since the election of the Thatcher Government has been a source of growth and profit for those companies linked to the defence market and this shall be analysed in the following chapters.

The National Champion Period

The withdrawal from the standard chip market came under increasing criticism in 1978 from manufacturers who used chips and from bodies such as the Electronics Committee of the NEDC. A 17 per cent import duty on chips compared with a minimal duty on finished products meant that British manufacturers faced extreme difficulty in competing against those who imported the finished product especially from a country designated as 'developing'. The Prime Minister was personally keen to stimulate the use of microelectronics in British industry after viewing an edition of the television programme, Horizon, entitled 'And Now the Chips Are Down' (*Guardian*, 12/4/78). His enthusiasm galvanised the Treasury and other department's thinking in this area and in 1978 three major initiatives were undertaken. These were the Microelectronics Industry Support Scheme (MISP), the Microprocessor Application Project (MAP) and most controversially, the National Enterprise Board's (NEB) proposal to support Inmos, a new company seen by some to be a potential National Champion in the field of standard chips.

The Inmos proposal was to perform all pre-production development of a 64K RAM (Random Access Memory) standard chip in the USA and then transfer production to Britain. At the time, the industry standard chip was 16K RAM and so the strategy was to leapfrog existing competition. This immediately drew fierce criticism from British firms such as GEC and from British-based foreign companies such as ITT (International Telephone and Telegraph) and Mullard (a subsidiary of Philips). Despite arguments for and against, the NEB agreed to invest £25 million in Inmos in July 1978. Shortly after, MISP and MAP were announced, some say to placate the the other manufacturers although this seems a cynical view (Hills, 1984, p.210).

MISP and MAP were the first substantial governmental interventions in the microelectronics industry. This strategy had a dual focus: first, to stimulate investment in R&D, production and marketing of microelectronics (known as 'technology push') and second, to encourage the application of microelectronics in industrial processes (or 'market pull'). These schemes were directed at overseas as well as local firms and had an immediate effect. Before the end of the year Texas Instruments, Mullard, Motorola and ITT all announced major expansion to their UK facilities while GEC and Plessey both started new projects with help from the scheme. Neither of the latter two projects were successful due to their inability to compete with similar projects of American and Japanese companies.

The Thatcher Government came to power in May 1979 and in the light of its neo-liberal, monetarist stance exemplified by the new Secretary for State for Industry, Sir Keith Joseph, it was expected that it would immediately stop support schemes and disengage government from ventures such as Inmos. The stated policy position of the Tories was that 'government intervention in industry' would be reduced and a commitment that 'selective assistance' to industry would not be wasted (Wilks in Jackson (ed.), 1985, p.127).

Initially a freeze was imposed on some support schemes, funding for industry was reduced marginally and the second tranche of funding for Inmos was delayed pending the resolution of a dispute over the siting of its new factory. Gradually, DoI purse strings were loosened. Almost £15 million was distributed under the Product Process and Development Scheme (PPDS) by March 1980 (DoI, 1981, p.6), approximately half of which was IT related, while during 1980 a further £28 million was made available. The MAP scheme had committed £21 million of its £55 million budget by March 1980 and MISP was extended in 1981 when a further £30 million was allocated for R&D.

During 1980 there was a a slight shift in policy stance with respect to support for industry, especially high technology industries. As unemployment rose sharply and industry contracted in the face of high interest rates, market interventionists or 'wets' in the Tory party, business organisations, and forces within the Cabinet Office and its support structures put pressure on the Government to adopt a more constructive attitude to industry. The Government slowly shifted ground.

The Crisis Period

One of the problems with segmenting or categorising periods of history is that clear cut boundaries rarely exist. This was the case with microelectronics in Britain which had been in a state of near crisis since its inception. By the early 1980s, however, something was clearly amiss in the UK microelectronics industry. Major British firms were concentrating their efforts in the defence sector where R&D was funded 100 per cent by the MoD and working on technologies that would have very little application in the civil sector. Although Inmos took heart from the fact that American companies were having trouble putting the 64K RAM standard chip into production and the Inmos 16K RAM chip was ahead of schedule (*Sunday Times*, 25/5/80), the threat now lay with the Japanese.

The crisis was in part reflected by the sudden upsurge of Government intervention in the microelectronics field. Rather than the 'Concorde Approach' of years gone by, there was a realisation that the chances of a flyweight National Champion such as Inmos beating international heavyweights such as Toshiba, Fujitsu, Intel, and Motorola depended on a broader, more integrated approach. Inmos lacked the large home markets that the American and Japanese firms had and the resulting economies of scale that accrue to such firms. Government policy programmes such as MAP, MISP and PPDS were joined by the Microelectronics in Education Programme (MEP), introduced in 1981 at a cost of £8 million over two years. Two other schemes, Micros's In Schools and Micro's In Primary Schools also commenced at that time (Moon and Richardson, 1984, pp.91-95). The Confederation of British Industry (CBI) was also active in this area at the time with an awareness campaign "Can you make it?" as well as organising fact-finding missions to Japan and Silicon Valley in the USA (1). It was becoming apparent that if Britain's microelectronics industry was to prosper a coordinated and strategic thrust would be required.

3.3 The British Telecommunications Industry: A Brief History

The Minimalist Period

Telecommunications can be divided into two main areas, namely, switching systems (exchanges) and transmission systems such as cables, telephones, and more recently satellites and optical fibres. Government policy has tended to be mainly concerned with the former. Until the 1940s two types of switching system were available, the Strowger elctro-mechanical switch and the Swedish invented cross-bar switch. The Strowger was adopted as the industry standard for Britain by the Post Office in 1920 and five manufacturers were licensed to supply it. This cosy group known as 'The Ring' comprised the General Electric Company (GEC), Standard Telephones and Cables (STC), Associated Electrical Industries (AEI), Ericssons, and Automatic Telephone Engineering (ATE) (Hills, 1984, p.124). Within this micro-corporatist arrangement, the companies formed a Bulk Contract Committee which authorised the sharing of work on the basis of equal value and with the Post Office they functioned as a technical standards committee.

During World War II telecommunications companies were primarily concerned with the war effort. Not surprisingly, British telecommunications were in a poor state by the late 1940s with a waiting list of half a million potential telephone subscribers and inadequate investment in an already over-extended infrastructure. Some of those who worked on the secret computer projects during the War were Post Office personnel who were later to hold senior technical posts within the organisation. These people saw the advantages of fully electronic switching systems over the cumbersome Strowger systems and the relatively expensive cross-bar systems. The decision was made by them in 1950 to go all out to develop an electronic exchange and in the interim to persist with Strowger. A prototype of the electronic exchange was unveiled in 1951 but it was not until 1956 that the telecommunications manufacturers agreed to a cooperative R&D arrangement with the Post Office (Hills, 1984, p.132). In December 1962 the first electronic exchange in Britain went into service at Highgate Wood. It was a failure (Morgan, 1987, p.16). Technical problems, slow development and prohibitive costs meant that an alternative system was needed. Once again the cross-bar system which was standard equipment in the USA and Japan was ignored in favour of a new semi-electronic technology based on reed relays developed by ATE, AEI and STC. Apparently another case of technical jingoism.

Demand continued to grow throughout the 1960s and the companies manufacturing the reed relay switching system were experiencing major delays and cost overruns. Under severe pressure from politicians and the public, the Post Office opted for cross-bar exchanges as a stop-gap measure. These exchanges were to be supplied by STC, GEC and by Plessey (which had taken over ATE) which meant that AEI was the only company of the original development trio dependent on reed relay systems manufacture. In 1968 GEC, with support from the Wilson-created IRC, took over AEI and closed down the AEI reed relay research establishments (Hills, 1981, pp.75-79) in what was seen as an attempt to guarantee GEC's cross-bar market. This action is believed to account for the cool hearing that Arnold Weinstock recieved from the Wilson Government when he pleaded for assistance for GEC's microelectronics division.The move backfired initially when STC received a large order for reed relay exchanges but Plessey and GEC lobbied the Government arguing that reed relay systems were British specific and therefore non-exportable. What was eventually decided was a compromise. It was at this time the Labour Government passed an Act to convert the Post Office into a public corporation with a monopoly over the telecommunications network.

The National Champion Period

After intense lobbying by GEC and Plessey (*New Scientist*, 7/6/73), the Post Office announced in 1973 a long term plan to rejuvenate the telephone system involving the expenditure of £540 million on cross-bar, reed relay and Strowger equipment with the objective being the eventual standardisation using reed relay TXE4 exchanges. The short-term rejoicing within Plessey and GEC was tempered by the knowledge that they would soon have to get seriously involved in reed relay technology. GEC moved first by signing a ten year R&D agreement with STC with respect to reed relays. Shortly after this it was announced that the Post Office and telecommunications manufacturers were to enter a joint venture to develop a fully computerised digital electronic switching system with the cloak-and-dagger title of System X. The birth of a new National Champion was imminent.

Initiating the project was delayed by a public brawl between the Post Office and the three companies (GEC, STC, Plessey) over the participation of Pye-TMC, a wholly-owned subsidiary of Philips, the Dutch electronics multinational. The three companies protested on the basis that Pye-TMC were 'foreign' and had nothing to add to the project.

This protest was highly ironical insofar as STC was a wholly-owned subsidiary of the US electronics giant International Telephone and Telegraph and none of the three companies possessed any genuine computing expertise. Work on the project did not get fully underway until 1977, four years after the announcement, as a result of bickering, contractural difficulties, suspicion of STC by the two British firms, ill-defined project management, and a failure by the Post Office to place orders for the hardware (i.e. no market pull) (Morgan, 1987, pp.34-37). The Callaghan Government set up a committee of inquiry into the Post Office in 1975 and its findings with respect to public accountability, centralised decision-making, and monopoly were to have a profound effect, though not at the time.

In 1977, a committee from within the Department of Industry and headed by an outside academic conducted a technical audit into System X. This was followed by a private consultants review of the system, thus highlighting the lack of technical strength within the Department. The prototype of System X was shown in 1979 and immediately attracted condemnation and criticism from the computer industry for its ponderous and technically obsolete design (Hills, 1984, p.141) but British Telecom was committed to purchase twenty of these exchanges and installation commenced in 1980.

The Crisis Period

The Conservative Government began to implement the findings of the 1975 committee of inquiry and in its first year in office, it split British Telecom from the Post Office. In 1981 the Government agreed to licence the Mercury consortium which planned to use satellite transmission, thereby breaking the public sector monopoly of telecommunications. At the same time British Telecom entered into a similar agreement with Satellite Business Systems, an American consortium headed by IBM, with a view to competing with the Mercury syndicate. The high hopes which were held for export sales of System X did not materialise and STC withdrew from the project while GEC and Plessey had to rely on government financial assistance to support their export drive. Two further body blows were dealt to Plessey and GEC in 1982 when they were informed that British Telecom were considering an alternative to System X and the Government announced that it intended to privatise British Telecom (Morgan, 1987, pp.8-25).

Computerised exchanges were manufactured and marketed in the USA in 1965 while other countries such as Canada, Japan, France and Sweden had all begun to implement this type of system by the late 1960s or early 1970s. This gave these countries vast advantages over Britain in the area of data communications, a sphere of growing importance given the rapid technological advances in office automation and inter-office communications. By the end of the 1970s almost 90 per cent of British public exchanges were still using obsolescent Strowger equipment while Britain's major international competitors with the exception of West Germany were increasingly using computerised switching systems. The last Strowger exchange was installed in 1986 (British Telecom, 1986, p.23). This situation was a source of embarrassment and a blow to national prestige.

If the encroachment into the public exchange market by foreign companies such as Pye-TMC, STC and in the early 1980s, Mitel of Canada, was a source of anguish for local firms, the effect of overseas companies in the private exchange market was even more pronounced. In 1966 British firms dominated the domestic private exchange (PABX) market taking 75 per cent of sales with STC holding 25 per cent of the market. Within eight years these figures were totally reversed with overseas companies such as Ericsson, STC and IBM accounting for 75 per cent and British companies sharing 25 per cent between them (*Financial Times*, 30/12/75). The major British companies were unable to match the advanced technology of their overseas competitors and eventually GEC and Plessey entered licencing agreements with North American firms to market their equipment in Britain.

2.4 Government Funded R&D for IT Prior to 1982

Public policy for science and technology in Britain has been influenced by two major themes. The first was the Haldane Principle and the second was the Rothschild Principle. The Haldane Principle, named after the Liberal statesman Lord Haldane (1856-1926) who espoused it, was essentially that scientists should be given funds with no strings attached and allowed to proceed with their work. From this grew the myth that British scientists and their research establishments had complete autonomy and that there was a direct correlation between this and their achievements such as Nobel prizes. The Rothschild Principle, named after Lord Rothschild, former head of the British Government's Central Policy Review Staff, was first enunciated in 1971 (Cmnd. 4814) and stated in part:

> However distinguished, intelligent and practical scientists may be, they cannot be so well qualified to decide what the needs of the nation are, and their priorities, as those responsible for ensuring that those needs are met. That is why applied R&D must have a customer.

The customer was to be the relevant government department. In time the customers would also include industries, a vital point in understanding the Alvey Programme.

Of course the Haldane Principle was a myth. Some departments such as the Ministry of Defence had a long history of customer-contractor relationships with R&D establishments in both the public and private sectors. The Labour Government introduced the Science and Technology Act of 1965 which established a Research Council system in which the Council for Scientific Policy was the senior advisory body and five Research Councils (Agricultural, Medical, Natural Environment, Science, and Social Science) were subordinate. All of these were funded by and responsible to the Department of Education and Science. The Science Research Council (SRC), later to add Engineering to the acronym and become the SERC, grew out of the old Department of Scientific and Industrial Research. Several of its major research establishments were taken over by MinTech in the mid-1960s and these were in turn absorbed by the 'super-ministry' created by the Heath Government, the Department of Trade and Industry. Boards based on the Rothschild Principle such as the Computers, Systems and Electronics Requirement Board of the Department of Trade and Industry were constituted shortly afterwards. It was the Heath Government's drive for efficiency and accountability that prompted the Rothschild proposals.

Following World War II many of the scientists who had served returned to research in universities and government establishments and many applied themselves to the topic which had occupied their wartime careers, for example particle physics for those who had worked on the Manhattan Project and radio astronomy for the radar boffins. These two areas of 'Big Science' took the lions share of R&D funding. With no representatives on the SRC board, requests for funding by engineers often fell on the deaf ears of their pure scientist colleagues. It was not until 1973 that the first computer professional joined the newly formed Electrical and Systems Engineering Committee which had been the preserve of university academics (2) and shortly after that, engineering was added to the SRC to make it the SERC. Research into Artificial Intelligence (AI) had received a severe set-back in 1972 with the publication of an SRC-sponsored report into the prospects for research in this area. Sir James Lighthill, the then Lucasian Professor of Applied Mathematics at Cambridge, expressed grave concerns for the future based on the poor past performance of research into AI, particularly the area of robotics (Lighthill, 1972, pp.6-8,13-17).

Alarmed by the growing duplication of effort, poor inter-establishment communication by researchers and lack of interaction, the SERC's Computing Systems Committee decided in 1975 to establish a small group within the Rutherford-Appleton Laboratory (RAL) to co-ordinate the purchase, installation and networking of computer hardware and the use of common software throughout the universities. This became known as the Distributed Computing Systems (DCS) Programme. By the late 1970s this programme, which was intended to be managed part-time by a small group of RAL staff, had eight full-time staff travelling around the UK universities arranging workshops and information exchanges attended by academics and industrialists (3).

At about the same time that the DCS Programme commenced, Derek Roberts then of Plessey (at the time of writing, Deputy Managing Director (Technical) of GEC) who served on the SERC produced an important report (*Proposed New Initiatives in Computing and Computing Applications* also called the Roberts report) which advised the Council of the direction that should be taken in the area of microelectronics as well as influencing the way the DCS programme was to be run. The report was prompted in part by the earlier announcement of a major Japanese R&D programme into Very Large Scale Integrated (VLSI) circuits (4).

The DCS programme research projects such as the Dataflow machine at Manchester University, the ADA compiler at York University, Professor Roger Needham's 'Cambridge Ring' and the ALICE (Applicative Language Idealised Computing Engine) Project at Imperial College. Projects such as these alerted industry to the progress being made within the universities and in their own specific fields put British IT back in the position it had held in the late 1940s as one of the world leaders. It was a result of the influence of the joint industry/government/academic committees that the SERC changed from an application-driven body to the situation where it, through its committees and sub-committees, was driving research in UK universities.

Other initiatives undertaken by the SERC at this time included improving training and research in microelectronics. Courses in integrated circuit design were established at three universities while a year later in 1981, six digital systems laboratories were set up at Brunel, Kent, Heriot-Watt, Bradford, Salford and the Polytechnic of Central London. Prompted by the Roberts Report, facilities were provided for silicon processing at Edinburgh and Southhampton Universities, ion implantation at Surrey University, compound semiconductors at Sheffield University and mask making and CAD at the RAL (PITCOM, 1983, pp.24-28). The Engineering Board of the SERC established an Information Engineering Committee (IEC) in 1979 to direct and support further research in these fields. The IEC was to be chaired by Laurence Clarke of GEC, a person regarded by many as the true 'father' of the Alvey Programme, and was to have a critical influence upon future events.

Historically Britain invested a greater proportion of Gross Domestic Product (GDP) on R&D than its Western European neighbours or Japan and it was only the USA which spent a higher proportion. Because of the size of the GDP in France, West Germany and Japan, these countries spent more than Britain in monetary terms however. Like France and the USA, government in Britain has supplied most of industrial R&D funding with the government proportion falling from 55 per cent of the total in 1963 to 42 per cent in 1978 (Commission of European Communities (EEC), 1979, pp.55-56; Bowles, 1981, pp.82-85; 1982, pp.94-99) then rising once again to around 50 per cent by the early 1980s. During the period 1970 to 1980, the proportion of government expenditure on defence R&D in Britain rose from 41 per cent to 55 per cent of the total government R&D spend. Although the British Empire may have disappeared, Britain's international military presence is second only to that of the USA. Britain has its own nuclear deterrent, its own military satellite, and maintains forces as far afield as the Malvinas/Falkland Islands, Hong

Kong, the Federal Republic of Germany, and the six remaining British-held counties of Ireland. To equip these forces with state-of-the-art weaponry and communications, the MoD maintains its own extensive R&D facilities (see Table 2.3 below).

Table 2.3 MoD Research Establishments

Name	Site
Royal Aircraft Establishment	Farnborough
Royal Signals and Radar Establishment	Great Malvern
Aeroplane and Armament Experimental Est.	Boscombe Down
Royal Armament Research and Development Est.	Kent and Surrey
Admiralty Marine Technology Establishments	Various*
Atomic Weapons Research Establishment	Aldermaston
Chemical Defence Establishment	Porton Down

Note: * - The main sites are at Teddington, Portland and Portsdown.

As MoD spending on defence R&D has risen, the proportion of MoD expenditure spent in the private sector has risen also to the point where almost three-quarters is directed towards companies such as Ferranti, GEC-Marconi, British Aerospace, Racal, and Plessey. This is borne out by the fall in the number of employees in MoD laboratories from 34,000 in 1970 to 23,000 in the mid-1980s (Ince, 1986, p.97).

While defence R&D funding was rising, government funding of industrial R&D fell from 16 per cent of the total to 5 per cent. Of this declining industrial R&D funding, less than 20 per cent was directed into electronics in Britain compared with almost 40 per cent of the French government industrial R&D spend (EEC, 1979, pp.56-59,168-174). Even the 20 per cent figure for Britain is somewhat misleading since of the £312 million spent by the Government in electronics R&D in 1978, an estimated £292 million went to defence research (NEDC, 1982, p.13). The high level of expenditure on defence R&D has been defended in some quarters where it is argued that civilian R&D and commercial applications would benefit from a 'spin-off effect'. The efficacy of this type of funding shall be examined more closely in later chapters.

It is unrealistic to review IT in one country without examining the activities in that field in other countries. As has already been suggested, many of the policy programmes and policy shifts were the result of actions taken by American, Japanese or European governments or firms. The major influences shall now be summarised.

2.5 The Overseas Challenge in IT Prior to 1982

The United States

Although the USA has no specific industrial public policy, the success of the IT industry in the USA has been influenced heavily by government intervention. The two organizations which have had most influence on the IT industry in America are the Department of Defense (DoD) and the National Aeronautics and Space Administration (NASA). As well as this, a series of acts, regulations and amendments referred to as the' Buy America' Act, American companies receive preference when supplying government, running as high as 50 per cent in the defence sector. Another type of intervention by government has been to refuse export licences for 'state of the art' equipment on the grounds of national security (*Computing*, 20/10/83). This type of protectionism was important in maintaining the technical edge of the American companies.

While the transistor (1948) and the integrated circuit (1958) were both invented in the USA and US companies such as IBM, Sperry Rand (Univac) and Honeywell led the world in computing, their initial success was boosted by the investment of more than $1100 million by the US government in computer hardware during the 1950s (Jowett and Rothwell, 1986, p.11). DoD contracts for continued R&D into semiconductors during the 1960s and early 1970s totalled $900 million (Arnold, 1985, p.43). Guaranteed demand from the DoD led to a decrease in costs for the US firms until it was economical to apply integrated circuits into non-military applications. The rate of 'spin-off' is shown in Table 2.4 below:

Table 2.4 US Integrated Circuit Sales Percentages 1962-78

End User	1962	1965	1969	1974	1978
US Government	100	55	36	20	10
Computers	-	35	44	35	40
Industrial	-	9	16	30	35
Consumer	-	1	4	15	15

At the same time as the military were pouring funds into the microelectronics and computer hardware sectors, the Defense Advanced Research Projects Agency (DARPA) was funding research into Artificial Intelligence (AI) at three major centres of excellence in the USA. These were Stanford University and Research Institute, Carnegie-Mellon University and the Massachussets Institute of Technology and three-quarters of all AI funding during the 1960s and early 1970s came from DARPA. Following the Lighthill Report of 1972, several prominent British academic AI experts had joined these teams in America.

Other programmes during the 1970s such as the Integrated Computer Aided Manufacture project sponsored by the US Air Force and the DoD Very High Speed Integrated Circuit (VHSIC) programme of 1978 were further examples of the military-industrial orientation of the US public policy programme for IT. While some industry commentators saw the VHSIC programme as a knee-jerk response to the Japanese VLSI programme of the late 1970s, this was denied by the VHSIC Assessment Committee although it did acknowledge that VHSIC would strengthen the civil semiconductor field (Committee on Assessment of the VHSIC Programme, 1982, pp.2-4). It was not only military funding which kept the American IT sector at the leading edge of technology.

American companies were pioneers in computing, telecommunications and microelectronics and the major companies invested heavily in R&D as well as receiving huge government grants and contracts for R&D. IBM alone spends over £3 billion each year on R&D and many of the standards for computing throughout the world came from IBM's Yorktown Heights laboratories. American Telephone and Telegraph's (AT&T) Bell Laboratories, where the first transistor was developed, had a similar profile and role in telecommunications as well as other facets of IT (Arnold, 1985, pp.60-68). Although the majority of industrial R&D funding in the USA comes from government, as it does in the UK and France, the sheer scale of industry R&D spending dwarfs that of any other country. It was the desire to create a new leading edge that prompted the Japanese to undertake the Fifth Generation computing programme.

Japan

While Britain's public policies for IT during the period up to the late 1970s could be described as disjointed or *ad hoc*, Japanese public policy for IT has been a model of consistency and coherence. In the 1950s Japan lagged behind the USA and Britain in the electronics field. Through a process of technological transfer, protectionist policies, higher productivity and concerted action by government, Japan's ambitions to stand at the forefront of the knowledge-intensive industries has been realised. Between 1962 and 1971 the Japanese Ministry of International Trade and Industry (MITI) and Nippon Telephone and Telegraph (NTT) launched two projects for the development of High Capacity computers (with Fujitsu) and Super High Performance computers (with Fujitsu, Hitachi and Nippon Electric Company (NEC)) (Aoki, May 1983, p.45). This second project which commenced in 1966 developed an IBM-compatible architecture which provided the basis for the Japanese companies to compete against the world leader in this field (Arnold, 1985, p.20). At the same time the British Government had given funds to ICL to develop a computer architecture which was incompatible with IBM. During the 1960s Japan effectively wrested from the USA the technological advantage which the US had held in transistors and by the early 1970s Japan held 51 per cent of the world's transistor output and 40 per cent of the world's electronic goods market (Hills, 1984, p.100). But they were still well behind the USA in the areas of computers and microelectronics.

MITI tried unsuccessfully in 1971 to persuade the six major IT companies to merge into three companies. When they refused, MITI decided to adopt the strategy of grants and subsidies for co-operative R&D based on the six companies grouped into three divisions: Fujitsu-Hitachi, NEC-Toshiba, and Mitsubishi-Oki (Aoki, May 1983, p.45). At the same time an IT Promotion Agency was established and this body distributed in excess of £350 million in loans for software development over the next ten years. About that time the Pattern Information Processing System commenced with MITI funding of £65 million. Throughout the 1970s government continued to support the IT sector through MITI and NTT, especially in the area of Very Large Scale Integrated (VLSI) circuitry, with NTT adopting the role of 'uncle' to medium and smaller firms through its Communication Technology Company (Arnold, 1984, pp.14-17). It was the 1975 Japanese VLSI project which caused concern to eminent British IT figures such as Derek Roberts and others. Fujitsu announced the 64K Random Access Memory (RAM) chip in 1978, followed two years later the prototype 256K RAM chip. This work meant that Japan was clearly the second (if not first) placegetter in the world semiconductor market. During this period British manufacturers had withdrawn from the standard chip market and Inmos was hoping to leapfrog their opposition by producing a 64K chip.

As well as these projects, Japanese public policy included support for their computer peripheral industry, laser research, opto-electronics and in 1979 the Fourth Generation Computer Project. It was this last project and the work carried out by a MITI-sponsored Think Tank under the chairmanship of Professor Moto-Oka of the University of Tokyo that provided the basis on which the Fifth Generation Computer Project was based. It was proposed that the project would run for ten years from 1982 at a cost of £700 million (app.) with the objective being the production of a non-sequential or parallel processing computer with features such as voice input and output and artificial intelligence. This was the spur which generated a flurry of activity in IT around the world.

France

The French government became involved in the computer industry in the mid-1960s as a result of two unrelated incidents. In a market dominated by IBM (75 per cent), the French computer manufacturer, Machines Bull, virtually collapsed and was rescued by General Electric of the USA. At the same time the US government prohibited Control Data Corporation from supplying its latest mainframe hardware to the French nuclear weapons research programme. The response of the French government was 'Plan Calcul', a five year programme costing £40 million designed to establish an indigenous mainframe industry. The result was Compagnie Internationale pour l'Informatique (CII) drawn from the computer divisions of Thompson, Compagnie General Electricite and GE-Bull (which became Honeywell-Bull in 1970). In 1973 the government backed a proposal to form a consortium of CII, Philips and Siemens to design and market a range of hardware to compete with IBM, however, this project called Unidata was unsuccessful and was disbanded in the mid-1970s. Further Plans Calcul followed and embraced minicomputers and computer peripherals and in 1977 the first five year R&D plan in the area of VLSI circuits commenced. About this time Honeywell were invited to take a larger share in the struggling CII while the integrated circuit programme, Plan Composants, subsidised and encouraged French firms such as St. Gobain Pont a Mousson, Matra and Thompson to form joint ventures with American firms like National Semiconductor, Intel and Motorola (Arnold, 1984, pp.61-62).

It was not only hardware that attracted government attention. French bureaucracies were encouraged in the early 1970s to use private sector software houses for applications development, a policy adopted earlier by CII. This policy has resulted in France having one of the strongest computer software industries in Europe. Government purchasing preference was also directed towards CII in its early years. In 1974 the foreign telecommunications firms of ITT and Ericsson were nationalised under the banner of CSF-Bull and spending on the national network was increased dramatically. As well as this, there was concerted government action in the area of education, a sphere long overlooked in Britain. The most ambitious French initiative, 'Informatique et Societe, Premier Plan', was launched in 1979 with a budget of £225 million spread over five years encompassing computing, telecommunications and electronics.

West Germany

There has been an absence of centrally-controlled, directed IT programmes in the Federal Republic of Germany (FRG) because of the federal structure of government and a commitment of varying intensity to neo-liberalism. Universities are not controlled by the Federal Government and this makes it difficult to co-ordinate a national research policy in this area. By the mid-1960s IBM's share of the FRG computer market was almost three-quarters, a similar situation to that which existed in France, Italy and Belgium. From 1967 to 1979, IT public policy was primarily directed towards computing, especially the hardware side, although the third programme (1976-1979) did address software. These were formal multi-year plans announced by the government as were the Japanese and French plans. The total funding for all of these programmes was approximately £1000 million. One outstanding feature of these plans which was the emphasis on education and training with almost one-third of funding being directed to this end. A four-year programme was instigated in 1974 which promoted R&D in the areas of optoelectronics and semiconductors. This was followed by a second four-year programme which concentrated on microelectronics. Government funding for these two programmes was £160 million (app.). While the British policy encouraged foreign semiconductor firms to invest in the UK and the French encouraged joint ventures, the FRG policy was to support licensing agreements between firms such as Siemens and overseas semiconductor manufacturers.

Although the FRG government has no formal policy of public sector preference, an informal preference policy does operate especially in the field of telecommunications. As one prominent British academic said (4):

> If you want to sell butter in Europe, it is a Common Market and not a bad one. But if you want to sell communications equipment, let's say to the German Bundespost, and you imagine you are competing on equal terms with Siemens, you have another think coming.

It was in this climate of growing market hegemony of Japanese and American IT firms and a widening technology gap between Europe on the one hand and Japan and the USA on the other that in 1979 Viscount Davignon, the European Commissioner responsible for industry, conceived ESPRIT (European Strategic Programme of Research and Development in Information Technology).

EEC Policy

ESPRIT is of interest for several reasons. The programme was drawn up and implemented by industry with minimal involvement of bureaucrats. It pre-dates the Japanese Fifth Generation Programme and is therefore in no way a response to it (*House of Lords Select Committee on the European Communities*, Eighth Report, QA.167). Despite a slow beginning, it has an enthusiastic and committed membership. The programme is sharply focussed on five areas, namely, advanced microelectronics, computer-integrated manufacture (or robotics), software technology, office systems, and advanced information processing. Finally it is of interest because the three British companies which were involved from the begining have also had a major influence on the Alvey Programme.

Viscount Davignon was not only worried about the technology gap and the falling market share of European IT manufacturers but also by the need to 'adjust' the European Community's industrial focus and the lack of incentives 'for cross border cooperation' (*Select Committee*, Eighth Report, QA.670) saw the hopes of European IT resting with twelve major manufacturers. These twelve (see Table 2.5 below) became known as The Round Table.

Progress was slow at first with some companies failing to attend the early meetings (5) but by late in 1980 consultants were engaged to examine the areas where research was seen as essential. The Round Table established a steering committee and it in turn set up several technical panels and workshops. These bodies drew up the framework of which companies would participate in the various programmes of pre-competitive research and in May 1982 the final proposal was submitted to the European Economic Community (EEC) Council.

Table 2.5 Founding Members of ESPRIT

Great Britain:	GEC Plessey ICL
France:	CII-Honeywell Bull Thomson-CSF CGE
Fed. Rep. of Germany:	Siemens AEG Nixdorf
Italy:	Olivetti STET
Netherlands:	Philips

2.6 The Lead-up to Alvey in 1981

It was not an initiative by a 'small group of academics' which resulted in the Alvey programme despite views to the contrary (see Jowett and Rothwell, 1986, p.57). With the application of GATT rules impending, several British computer manufacturers banded together in 1980 to form the United Kingdom Information Technology Organisation (UKITO), a pressure group whose aim was to lobby Parliament and the UK government to ensure a fair deal for the British computer industry. A new body for UKITO and the rest of the IT industry to lobby was established in January 1981, the Parliamentary Information Technology Committee (PITCOM).

The Advisory Council on Applied Research and Development (ACARD) released a report through the Cabinet Office calling for an integrated approach to IT. The Thatcher Government appointed a Minister for Information Technology within weeks of this report being released. The new Minister, Adam Butler, 'did not make much of an impact' according to one of his parliamentary colleagues (6) and was replaced two months later by Kenneth Baker. Baker was to have a profound impact on IT in Britain and one of his early coups was to have 1982 declared Information Technology year (IT82). The objective of IT82 was to raise the general level of awareness throughout Britain to the uses, advantages and opportunities that IT presented.

The Department of Industry revamped its requirements board structure in 1981. It disbanded the old Computers, Systems and Electronics Requirements board which had been chaired by Sir Robert Clayton of GEC and established the Electronics and Avionics Requirements board under the chairmanship of Sir Robert Telford of GEC-Marconi. Other members of this Board included John Alvey of British Telecom, Derek Roberts of GEC, and Reay Atkinson and John Major of the DoI. All of these people were later to serve on the Alvey committee of inquiry.

While media attention was directed at Baker, elsewhere trouble was brewing. In September 1981 the SERC's Engineering board was conducting its annual 'five year forward look'. This board consisted of the chairmen of the individual subject committees and some independent members. An interviewee explained 'that each chairman would fight for funds for his area' but the independents adjudicated over the break-up of funds and if the independents 'were all mechanical engineers, then by God, the electronics people wouldn't get anything' (7). As it turned out, the independents said that microelectronics had been well served over the previous five years as a result of the Roberts initiative and therefore the 'forward look' generated showed a 25 per cent decrease in SERC funds for microelectronics R&D over the next five years. It was Laurence Clarke of GEC, Chairman of the SERC's Information Engineering committee (IEC), and Dr David Thomas of RAL who got together to oppose this policy decision. They decided the best way to challenge the proposed cuts was to develop a large national programme similar in style to ESPRIT which would require a vast increase in funding rather than a decrease. This was an idea that Thomas had put forward earlier in 1981 at a press seminar sponsored by Sperry where he had said (Thomas, 1986, p.40):

> A prerequisite for future success in information technology could well be the ability to establish and manage national and international programmes involving massive numbers of staff engaged in cooperative high technology ventures.

In the same year Professor Donald Michie of Edinburgh and Professor Robert Kowalski of Imperial College had lobbied the IEC to establish a special programme in Intelligent Knowledge Based Systems (IKBS). Dr John Taylor, Chairman of the Computer Science sub-committee of the IEC, and Laurence Clarke met with Professors Michie and Kowalski at Imperial

College in August 1981 to discuss the IKBS proposal (8). IKBS is widely accepted as being another name for Artificial Intelligence (AI). With the Japanese now proposing a Fifth Generation Computer System using AI, IKBS was set for a comeback.

In September 1981 the Japanese MITI sent an invitation to the Department of Industry to send a team of observers to a conference to launch the Fifth Generation computer project in October of that year. The DoI team of Reay Atkinson (DoI), Charles Read of the Inter-Bank Research Organisation, Dr Alan Fox of the Royal Signals and Radar Establishment (RSRE-MoD) at Great Malvern, Professor Brian Randell of Newcastle University, Professor Roger Needham of Cambridge University, and Professor Mike Rogers of Bristol University, former Chairman of the SERC's IEC, joined observers from fourteen other countries in Tokyo. What they saw and heard was to have a huge impact in all major Western countries.

While overseas industrial representatives were not invited, the Japanese were keen to enlist overseas academics onto the project. The Fifth Generation computer programme was promoted in Japan as an academic research effort directed for the good of mankind. To the rest of the world's IT community it was seen as an industrial project designed to give Japanese industry world leadership in the IT sector. The invitation to overseas academics to participate was also viewed not only as a bare-faced attempt at intellectual exploitation but also as an attempt to distract attention and criticism from unfair Japanese trade practices such as dumping and their restrictions against foreign entry into the Japanese markets. It was against this background that Britain's IT sector moved into 1982.

2.7 Conclusion

The review of the three industries that make up the IT sector highlighted the emergence of IT from these formerly distinct industries. The origins of a genuine British IT industry began in 1968 when ICL emerged from the parts of eight former producers, GEC and Plessey took over AEI and ATE respectively thus reducing the number of competitors in the telecommunications field, and GEC won control of Marconi and Elliott to become the largest microchip manufacturer in the UK.

The focus of IT public policies throughout the 1960s and 1970s was the promotion and maintenance of National Champions. With the benefit of hindsight, this type of technological jingoism was at best irrelevant and at worst, destructive. The dominant theme of policy continuity was typified by both Labour and Conservative Governments supporting a pro-ICL public procurement policy and backing the telecommunications equivalent to Concorde, System X. Even though the Thatcher Government was committed to disengagement from the market, it still came to the rescue of ICL when it was close to collapse in 1981 and funded Inmos prior to its privatisation. The Thatcher Government's pseudo-liberalisation of telecommunications by removing British Telecom's Labour-given monopoly and its proposed privatisation were examples of policy innovation with a concealed agenda. Ostensibly the policies were designed to allow the free play of market forces in this sphere but cutting the public sector borrowing requirement, curbing union power and energising British Telecom and its prime suppliers, GEC and Plessey.

The IT policy community, like the IT industry, was fragmented in the early years. Technocrats within the Post Office, the Department of

Industry, and the SERC, interest groups and individual firms and their leaders such as Lord Weinstock all impinged upon the policy process in an *ad hoc* manner. As the individual IT sectors began to converge, so too did the fragments of the policy community. With an upsurge in public sector funding for defence R&D, several major IT firms established close contact with the MoD. In the civil IT field, industrialists began to appear as chairmen of tripartite industry/academic/government boards and committees as new forums and new access paths into the state opened up.

In the late 1970s and early 1980s there was a upsurge in the number and scope of joint government-industry IT programmes in Japan, France, and even the USA. At the same time the Industry Minister, Sir Keith Joseph, was espousing a doctrinal neo-liberal approach to markets and the roles that industry should and government should not play in them. Given the fact that many of the participants in the foreign IT programmes already held dominant positions in Britain's computer, microelectronics, and private telephone exchange industries, it is understandable that the British IT sector felt under seige.

While firms such as GEC and Plessey possessed vast economic and industrial resources, contributed heavily to the Conservative party coffers, and wielded considerable political influence, they had difficulty in setting out their agenda of demands and establishing a vehicle or process through which the demands could be manifested. Faced with a technically impotent sponsoring body, the Department of Industry, increasing international competition, and a devastated manufacturing industry as a result of Government neo-liberal policies, there was a pressing need for the IT industry to establish a new mechanism through which its policy demands could be framed and implemented.

CHAPTER THREE

Mobilising the IT Policy Community: 1981-82

By the early 1980s an identifiable IT sector had emerged from its beginnings in three mainly separate industries. It was still fragmented however. This chapter is concerned with analysing reactions to the perceived threat to the British IT sector from the USA and Japan in the early 1980s, the mobilisation of an IT policy community which resulted, and the proposals for government intervention that were put forward.

Three themes run through this chapter. They are the problems of balancing democracy and consensus against power in policy formulation, the emergence of influential IT public policy network, and the increasing public sector involvement in IT. To draw out these themes, the actions which led to the setting up of the committee of inquiry into advanced information technology chaired by John Alvey (known as the Alvey committee and its report, the Alvey report) are analysed. So too are the workings of the committee and the proposals contained in the report. The analysis focusses on the views of the decision-makers, the technologies selected and emphasis placed on them, and the inputs of other organisations in the policy formulation.

3.1 The Consequences of the Tokyo Mission

When the British team returned from the Japanese fifth generation computer system conference in October 1981, the team members expressed their concern informally to colleagues that the Japanese were very serious in their attempt to create a totally new paradigm in computing quite unlike anything in existence. A debriefing was arranged 'for industry' for January 29 and 30, 1982 at the Westmorland Hotel near Lords cricket ground (1).

At the same time, Laurence Clarke of GEC and his co-members of the SERC Information Engineering Committee (IEC) were determined to resist the proposed funding cuts which had been forced on them by the Engineering Board of the SERC. He and his co-members tried various approaches but were unsuccessful. The SERC finally did agree that the IEC could have more money but only if the SERC could get the money from the Advisory Board for the Research Councils (ABRC which replaced the Council for Scientific Policy in 1972 as a result of the Rothschild proposals). To get the money from ABRC, it would be necessary for the IEC to put forward a national initiative rather than simply request more money. Laurence Clarke wrote to Reay Atkinson, then Under Secretary of the IT Division, Department of Industry (DoI) in November 1981 and suggested that the DoI should organise a workshop to develop a national programme for IT (2). Coincidentally, Brian Oakley, the then Secretary of the SERC, and Dr David Thomas of the SERC's Rutherford Appleton Laboratory (RAL) visited Reay Atkinson in November with the intention of securing an invitation to the industry debrief in January. In the course of the conversation, Atkinson admitted that 'the DoI did not have the resources to organise' the Clarke-proposed workshop. Oakley quickly suggested that the SERC would host the workshop, an arrangement confirmed in a letter from Atkinson to Clarke (3).

A series of one-day workshops and brain-storming sessions were held during November and early December 1981, then on January 4 1982, a four-day workshop took place at Coseners House, Abingdon under the chairmanship of Laurence Clarke. The main attendees are listed below in Table 3.1.

Table 3.1 Attendees at the Abingdon Workshop January 1982

Attendees Name	Where From	Representing
Reay Atkinson	DoI	Tokyo Team
Dr Allan Fox	MoD (RSRE)	Tokyo Team
Charles Read	Inter-Bank Research Organisation (IBRO)	Tokyo Team
Prof. R Needham	Cambridge U.	Tokyo Team
Prof. B Randell	Newcastle U.	Tokyo Team
Prof. M Rogers	Bristol U.	Tokyo Team
Laurence Clarke	GEC	SERC Information Eng. C'tee
Prof. Stephenson	Univ. College Bangor	SERC Solid State Device C'tee
Dr John Taylor	MoD	SERC Computing & Comms. C'tee
Clive Foxell	British Telecom	SERC Silicon Steering Group

As well as all of the members of the DoI team to Tokyo, there were three DoI staff, Dr Hywel Davies of MoD, six SERC officers (including Dr David Thomas and Brian Oakley) and two consultants to advise on existing EEC initiatives. After four snowbound days, the main conclusions were (DoI Summary Report IT87, 19/1/82, p.2):

> A major UK research initiative in IT should be launched immediately, directed at a single focus, Intelligent Knowledge Based Systems. A preliminary estimate of the cost of the programme is £250 million over 5 years, this being seen as additional expenditure over and above that already committed by government and industry...Long-range research should certainly be funded 100% by government...The workshop also fully endorsed the conclusion...that the UK must integrate the

> efforts of its own IT organisations before considering... collaboration with the EEC, with the Japanese or with others.

The IEC's original struggle for funds was now subsumed into a UK response to the Japanese fifth generation programme. The general feeling among the attendees was that Britain had long since lost the battle for standard products such as home electronics, and standard chips and the new IKBS focus would, like the Japanese proposal, break the IBM-led mould. This was not, however, a 'crib of the Japanese programme' (4). As a part of the £250 million collaborative programme, additional developments such as specialist software, novel hardware architectures, and design of special VLSI circuits would also be necessary. The proposed programme and its costs are listed below in Table 3.2.

The attendees were not so sciolistic as to assume they had finalised the UK response to the Japanese challenge. They said (DoI Technical Report IT87, 19/1/82, p.3):

> It is important for the reader to recognise that the intention at this stage is not to present a polished proposal, but simply to stimulate discussion which could lead later to a coherent and universally acceptable project plan. Clearly a week of workshop activity, vigorous though it was, could only produce a superficial view of an initiative potentially involving nine figure expenditure. Since also participants were drawn mainly from universities and government bodies, <u>the industry view must be added before an authoritative national consensus can emerge</u> (emphasis added).

Table 3.2 Abingdon Workshop - Proposed Programme

Technology	Estimated Cost (£M)
VLSI Circuits	65
CAD for VLSI	45
IKBS Research	30
IKBS Demonstrators	30
Software Engineering	30
Distributed Computing	10
Communications Network	8
Man-Machine Interaction	5
Silicon Brokerage	2
Project Management	25
Total	£250 Million

Source: DoI Technical Report IT87, 19/1/82, p.22

The proposal was presented to the IT industry representatives at the debrief meeting in late January, 1982. It is not possible to over-emphasise the importance of the debrief meeting. Here, for the first time, senior representatives of the major British IT companies met as a community. Chairmen and directors of software, hardware, office automation, telecommunications, microchip and 'defence' IT companies sat together for two days to listen to and question the report of the DoI Tokyo team and the Abingdon workshop proposals. The import of the occasion was not lost on the IT Minister, Kenneth Baker, who officially opened the briefing. He said (Tape transcript, 29/1/82):

> I am delighted that this conference exists at all. I am also delighted that there are no press because it is very important that British industry should meet together in this sort of meeting and be absolutely frank in trying to determine what our policy should be in this area. This is really quite a unique

> meeting. I do not believe that in any area of industrial development in Britain in our past that we have had a meeting quite like this with Government representatives, with many of the best of the brains of British industry and from some of our universities meeting together to try to determine a common policy. (emphasis added)

He went on to describe the necessity for collaboration between companies and between companies and government since no one company had the resources to undertake such a massive project. While Government could 'provide finance and expertise', he did not believe that Britain's long-term IT problems could be solved 'by government research in government laboratories'. He believed a partnership was required but one with a heavy private sector input (Transcript, 29/1/82). The Minister was not the only one to hold this view, for as one senior civil servant remarked later that day (5):

> We think that solutions have to be taken (sic), not by the (Tokyo) team, not by the SERC, not by academics, but by all of us, in particular by industry.

Baker divulged that he was presenting a paper the following week to a meeting of the NEDC to be chaired by the Prime Minister, 'setting out the position of the IT industry in Britain in the context of its strengths and weaknesses' and he hoped that the debrief could produce 'quite specific recommendations' (Transcript, 29/1/82). The conference went on to discuss various issues ranging from government funding, industrial property rights and project orientation, to how the programme should be administered. The major 'specific recommendation' that came out of the meeting was that the whole area required a closer investigation and that a committee of inquiry be established to do this.

A civil servant who was closely involved recalled (6):

> It was about lunch-time. Baker had left (the debrief). I was approached by Derek Roberts of GEC and John Pickin of Ferranti - and I think Sir Herbert Durkin (Plessey) as well...They said "We want to recommend someone who would be very good for this (inquiry) - his name is John Alvey"...Other people put other names forward for people to chair that group also. So it was some days later, maybe ten days later, I had a session with Baker and he thought it was a good idea to have such a committee. He only knew John Alvey vaguely but he agreed and so John Alvey was the first name on our list. I rang up John Alvey and made an appointment to see him the next day. That was a Friday afternoon when I went around to see him at the Post Office and asked him if he would like to chair it. He asked for some time to go and talk to Sir George Jefferson, Chairman of British Telecom, and then rang me very early the following week to say "Yes".

Shortly after, Alvey met with some senior DoI staff to draw up a list of potential committee members and working party members. The first meeting of the committee of inquiry took place in April of that year. It is worth considering the basis on which this committee was selected and the processes that were followed in formulating the policy programme which finally emerged.

3.2 Setting Up the Alvey Inquiry

The selection of John Alvey to head the committee was a choice which was to influence the process profoundly. As one member of the committee said (7):

> The Government were looking for someone to chair an independent committee, not government chaired committee because on the whole they wanted industry to be totally committed to this programme. Whereas if it had just been chaired by government, I think they would have looked upon that as...to some extent inflicted upon them, rather than something that they had structured themselves. So they wanted somebody who knew how government worked but also had some feeling of how industry worked.

John Alvey was ideally qualified having served in the Royal Navy, worked in the Components, Valves and Devices Directorate (DCVD) of MoD placing contracts with defence suppliers, worked on naval systems design at Admiralty Surface Weapons Establishment and before moving to the soon-to-be-privatised British Telecom, was Chief Scientist to the RAF in the MoD where he was heavily involved in RAF procurement. He was a technical administrator of high repute with an extensive network of contacts in Whitehall, in the IT defence-avionics field which had seen a rapid increase in Government R&D funding since 1979, and in telecommunications. A senior IT industrialist said that after the Westmorland Hotel briefing (8):

> It was obvious something had to be done and several of us got together and agreed that John Alvey would be a suitable person to chair any proposed committee of inquiry...most of us had known him in that role (MoD procurement) and had dealings with him. There was nothing sinister about it, we simply knew him and how he worked and thought he would do a good job.

Another authoritative source named the prime mover behind Alvey's nomination as John Pickin of Ferranti (9). The full membership of the Alvey committee and the working group is listed in Table 3.3 below.

Table 3.3 Membership of Alvey Committee and Alvey Working Group

Alvey Committee		Alvey Working Group	
John Alvey (Chairman)	British Telecom	Mr C Barrow	Plessey
Ian Barron	Inmos	Dr I Benest	SERC (RAL)
Charles Haley	ICL	Dr P Collins	GEC
Phillip Hughes	Logica	Mr G Haley	ICL
Prof. Roger Needham	Cambridge Univ.	Mr W Holt	Plessey
Charles Read	IBRO	Mr V Maller	ICL
Derek Roberts	GEC	Mr J Pearson	Ferranti
Brian Oakley	SERC	Mr D McCaughan	GEC
Hywel Davies*	MoD	Dr K Sparck Jones	Cambridge
Keith Warren	Plessey	Dr D Stanley	Logica
Alistair Macdonald	DoI	Mr J Tucker	Logica
John Major	DoI	Dr M Underwood	ICL
		Dr R Witty	SERC
		Mr R Yates	Br.Telecom

Note: * - Dr Davies was succeeded by Dr A Johnson (MoD)

The fireworks started at the very first meeting. One of the eminent industrialists on the committee recalled (10):

> I looked at the MoD man who was there and said 'What the hell are you doing here? It's got nothing to do with you. This is supposed to be an industry programme!

Also at this meeting the committee members debated the anomoly that although universities were to be major participants in the programme, they were not represented at all. A committee member suggested that this was a consequence of the Abingdon workshop report which,'although interesting, was produced by the wrong sort of people' (i.e. mainly academics) (11). Professor Roger Needham was invited to join the committee the next day. Regardless of whether this was a deliberate slight or not, it indicated a lack of status and power, possibly as a result of the fragmented nature of the tertiary education sector.

The make-up of the committee was not only determined by what the programme was to be but also from where the funding was coming. As a result, the SERC's view was that if it was putting up funds, it 'wanted a seat at the top table' (12). The MoD had been convinced that instead of establishing its own programme for Very High Performance Integrated Circuits (VHPIC), it should integrate it under the Alvey umbrella. This probably accounts for the surprised and angry outburst of the industrialist on the first day since the VHPIC programme would presumably have been funded on the normal MoD 'cost plus' basis. The industrialist may have realised that there was little hope of such lucrative funding arrangements under the proposed programme.

Although the Department of Industry was not responsible for all branches of industry (Grant, 1982, pp.29-32), as the government agency responsible for 'sponsorship' of the IT industry it was always a prime mover within the project. Since VLSI circuitry was one of the major strands, it was no surprise that GEC and Plessey were represented since both had close links with MoD research in this area. As will become more and more evident, the influence of the MoD and the 'defence' IT firms was profound. With software, hardware, communications and IKBS expertise it was generally thought to be a 'well balanced group' (13) although some of the larger IT companies complained of small company bias (14, 15) while smaller companies complained of large company bias (16, 17). The main area on which the committee divided was the debate between the systems and software supporters, led by Phillip Hughes, and the hadware/components supporters led by Derek Roberts. A committee member said 'that was a never-ending battle and one that was never resolved either' (18).

Alvey's Strategies for Technology

The committee started work at a frantic pace, one factor being that the Government had gone beyond the half-way point of its five year term and if the report took too long to produce, there would be little hope of getting a major item approved with an election looming. This point was not lost on the IT Minister who expressed the wish that the report be ready 'by the middle of summer so they (Government) could have a bash at it during the closed season' (19). Before the Alvey committee even met a deputation from the Confederation of British Industry (CBI) went to see John Alvey. A spokesman said (20):

> Our role which had involved prodding at the margins during this period was then to immediately go and see John Alvey which we did within a few days of his appointment and spent an entire afternoon having a brainstorming session as to what sort of things ought to be covered. We therefore established a direct contact with him straight away.

Debate within the committee initially centred on whether the programme should be 'market led' (pulled) or 'technology driven' (pushed). Paradoxically, it was some of the bureaucrats who favoured a 'market led' strategy but the companies won the day with a 'technology driven' argument (21). The 'push versus pull' debate was to become one of the continuing points of criticisms of the programme. The technologies (known as the 'enabling technologies') which would underpin the British programme were discussed informally before the committee sat and it was decided that the four main groupings identified by the Abingdon workshop (IKBS, software engineering, man-machine interface (MMI) and VLSI) would be the key technologies. The decision to concentrate on these technologies was crucial and to some extent highlights the difficulty that technologists face when making decisions. In many cases, they can only see solutions in technical terms.

These advanced technologies can be best explained in the following way. Information Knowledge Based Systems (IKBS) encompasses specialist computer programming languages and novel computer processing and storage devices such as non-sequential microchips. The hope of the IKBS fraternity, largely university based, is that these systems will be able to imitate human thought process by using inductive rather than deductive processes. For this reason, IKBS is often referred to as Artificial Intelligence (AI). Software engineering is a product of the formalisation of computer programming and systems analysis practices over the past thirty years. Its objective is to make software operations a precise science like engineering by the use of built-in formal methodologies, re-u sable software, and other integrated programming support tools.

The man-machine interface (MMI) is a broad category which embraces all aspects of the interaction between humans and machines such as word-processors and computers. The scope of MMI covers machine operator comfort, or ergonomics, the ability of computers to understand and respond to normal speech, and the design of improved display devices. In fact, any area in which the objective is to make life easier for the operator of IT devices and processes falls under the MMI umbrella. Very Large Scale Integrated (VLSI) circuits are advanced microchips with massive capacity in comparison to the chips of the mid-to-late 1970's. These microchips may be memories or microprocessors of a high volume, standard type or custom/semi-custom chips, the category in which most British chip manufacturers specialise.

Listed below in Table 3.4 is a dissection of the companies represented in the Alvey inquiry and the stake each one has in each technology. The rating is on a scale of nought to ten, with ten signifying the company to be one of Britain's foremost participants in that field. These ratings are estimates and should only be seen as a guide

Table 3.4 Company Rankings in the Alvey Technologies

Company Name	VLSI	IKBS	MMI	Software Eng.
British Telecom	6	3	10	3
Inmos	9	3	1	1
ICL	1	8	6	9
Logica	0	4	4	10
GEC	10	6	7	5
Plessey	10	7	5	2
Ferranti	10	1	1	2

Clearly, the VLSI industry was well represented. Although the other technologies each had one or two leading spokesmen, they did not have the strength of the VLSI group.

Several working group sub-committees were set up to assist the committee. The pool that these groups were drawn from reflected the committee's membership with all members bar one coming from the same organisations as the committee members. This tended to reinforce the views and beliefs of the dominant groups. Dr Karen Sparck Jones was the only woman involved in this phase of the policy process. The industrialist to whom the task of preparing the VLSI section of the Alvey report observed (22):

> The one thing I was not going to do was to start from scratch again by getting a team of experts together, a blank sheet of paper, and writing a programme down. I said 'We've already bloody well done this in the context of Europe, so what we will do is use the draft (European) report'.

As a result, the Alvey VLSI programme was largely an 'editing job of what became the ESPRIT programme'. The team already had 'an idea' of what funds would be available and since there were only 'five or six companies' with any genuine capability in VLSI in the UK, it was simply a matter of soliciting their views and the views of the MoD, especially representatives from the Royal Signals and Radar Establishment at Great Malvern (23).

The other programmes were not as straightforward. A prominent IT industrialist identified the dilemma thus (24):

> One of the problems with Alvey all the way through has been a sort of egalitarian approach. Drag anybody who had ever had anything to say about (a topic) in so then he's silenced ...Alvey bent over backwards to try and satisfy the little companies in terms of software and systems...They felt they had a mission to bring technology to a lot of small companies

Focussing on small firms had several aspects. It mobilised consensus and encouraged democracy as well as coinciding with stated Government policy but it challenged the power of the major IT firms. The Thatcher Government's view was that by encouraging small innovative companies, economic growth and prospects for employment could be significantly enhanced. The committee was sufficiently aware of the importance of the small business sector to the Government and singled it out (Alvey report, 1982, p.18) for special mention. Consensus-building became a hallmark of the Alvey policy process. An IT research chief saw it as a 'reversion to the true-blue British sense of fair play' (25). There was a general view that all parties had been fairly represented. Academics had been widely consulted before and during the inquiry (26) while the civil service and the small IT firms may have been over-represented according to some (27, 28).

Consensus policy-making, especially with small firms, struck a raw nerve with several industrialists from large IT firms. One said (29):

> Politically there was a sort of attitude that 'Small is Beautiful' and we must encourage the creation of one-man companies. Pointing out to them that the British economy was under threat from bloody large Japanese companies - I didn't know that we were being screwed by any small ones - just didn't have any influence on them...The idea of discussing the report with every two-bit software house in the country which is what was going on was a nonsense.

While this may have peeved some of the large IT companies and consumed scarce time and resources, it was an important factor in the creation of an IT sectoral identity and establishing policy communities. Once established, groups within the policy communities may then become clearance points especially if policies are altered after implementation (Pressman and Wildavsky, 1973, p.xv; Dunsire, 1978, p.85).

Alvey's Strategies for Implementation

The committee recognised the need for collaboration between companies and between companies and universities/government research establishments. This recognition was based on the acceptance that no single research centre had the resources (money or staff) to attack the problems, collaboration would lead to synergy from the application of varied perspectives, and the belief that while the UK had technical excellence, this expertise was too diffused and needed to be brought together (Alvey report, 1982,p.16). This was undoubtedly the most paradoxical and novel aspect of the programme. While joint agreements and cooperative projects were not a new thing, an industry-wide application of this approach was unheard of in the UK. No-one would have believed or contemplated a few years earlier that scores of British companies and universities would be agreeing to the notion of collaboration and sharing of research. Nor would many have believed that such a radical set of proposals would be considered by the champions of competition and free market forces.

The committee believed that collaboration 'becomes easier the further it is from the product to be sold' and that collaboration was 'consistent with a fiercely competitive approach thereafter' (Alvey report, 1982, p.17). At no stage was the term 'pre-competitive' defined. The closest the committee came was to refer to 'basic research' (Alvey report, 1982, p.18). A prominent scientist said in reference to this question (30):

> (The Alvey report) went on about pre-competitive R&D but nobody knew what the hell they meant. Did they mean 'blue sky' research or research into areas where no products or markets existed? No-one knew.

This question was raised by many interviewees.

What the committee was also diplomatically silent on was the possibility that, as with System X, collaborative research might lead to collaborative exploitation and increased cartelisation. A major, though unintentional by-product of the collaborative process would be a strengthening of the IT sectoral identity from the laboratory work-bench right through to the boardrooms by providing the industry with a focal point.

Prolonged debate took place within the committee as to how the programme should be managed and staffed. The first debate was whether there should be a centralised research establishment for the whole programme such as the Japanese fifth generation centre had at the Institute for New Generation Computer Technology (ICOT). This notion was quickly dismissed as being socially, politically, culturally, and industrially impractical. One committee member said that a centralised establishment would lead to the rejection of the technology developed there since the 'Not Invented Here' syndrome would override any advantages it may have (31).

The next problem to be addressed was the management of the programme. A committee member recalled (32):

> During the deliberations of the Alvey committee there was a very strong view...a strong view that I did not participate in, I thought they were bloody nuts and I kept on telling them that. The majority of the Alvey committee was saying the only way the Alvey programme could run was to find a real brilliant whizz-bang manager or director. He would probably have to be an

> American. Pay him a lot of money and bring him over here and on the day he arrives, say 'There's the pot of gold, you've got five years to spend the money. You tell industry what to do, you monitor the programme and control it.

Other industrialists also decried this 'MacGregor-style' management proposal and one IT expert said (33):

> I think it is an aspect of this current fad for self-denigration in the UK. I don't think it has always been around but particularly over the last couple of decades there has been all this self-questioning - our industry is no good, our managers are no good, our only hope is to get someone from outside.

It was finally agreed that a 'slim and compact' directorate should be established within the Department of Industry, led by a director of 'at least' under secretary rank on a five-year contract, and accountable to a restructured Electronics and Avionics Requirements Board (EARB) which would form a steering committee (Alvey report, 1982, pp.51-52). As one SERC executive pointed out, this type of administrative arrangement was pioneered by the SERC 'in the Seventies' for short-term programmes (34). Staff were to be drawn mainly from outside the civil service, although 'some might well be seconded from SERC and MoD' and a civil servant with experience of administering 'publicly funded projects' would be needed. Other aspects covered were the issue of contracts and the matter of industrial property rights.

Finally, the committee proposed a funding package of £350 million over five years, an increase of £100 million on the Abingdon workshop proposal. The increased cost was said to be the result of the increased scope of the technologies selected, although one civil servant pointed out that the report said that the 'Government should contribute roughly two-thirds of (the £350 million)' and two-thirds of £350 million is 'near enough to £250 million' (Alvey report, 1982, p.47; 35). The Abingdon proposal for 100% government funding for industrial research was watered down to 90% for research which required 'wide dissemination' and 50% for all other industrial research. The committee pointed out that although the Government would bear most of the costs of the programme, it would be industry which would have to pay to translate the inventions into 'marketable products' (Alvey report, 1982, p.47). What the committee did not broach was the likelihood of industry lobbying for a follow-up programme to facilitate product 'pull-through'. Universities were to receive 100% funding for research projects, however no arrangements were made with the University Grants Committee (UGC) for taking overheads and infrastructural costs resulting from the programme into account. This was to cause problems later.

The overall programme funding estimates are listed in Table 3.5 below. It is important to note the change in emphasis between this set of recommendations and those of the Abingdon workshop (See Table 3.2). Even though an extra £100 million was added by the Alvey committee, there is an obvious bias away from IKBS. Every other technology except computer aided design (CAD) was given an increase in estimated expenditure. Software engineering rose by a massive £40 million, man-machine interface went up by £39 million, demonstrators rose by £28 million, VLSI went up by £25 million while CAD fell by £20 million and IKBS fell by £4 million.

Table 3.5 Advanced Information Technology Programme - Funding Estimates

		Cost per Year					
Programme	Total (£M)	0	1	2	3	4	5
VLSI	90		11	18	21	20	20
Software Eng.	70		8	13	14	18	17
Demonstrators	58		5	10	13	15	15
MMI	44		3	8	10	12	11
IKBS	26		2	5	5	6	8
CAD	25		3	4	5	6	7
Education	20	1	3	3	4	5	4
Communications	19	1	3	3	3	4	5
Total	352	2	38	64	75	86	87

As was mentioned earlier, the IKBS or artificial intelligence community was largely university based. Some of the most powerful decision-makers in the Alvey policy area were strongly opposed to the IKBS thrust and the fact that only one academic was on the committee, and then only as an after-thought, indicates a lack of influence on behalf of the academic community in the policy formulation process. Nor did the presence of SERC representatives further the cause of academia at the time. However, as will be shown, once the programme was fully implemented, the proposed expenditure levels of the Alvey committee and the actual expenditure on each technology did not coincide.

A prominent IT journalist saw the recommendations as a case of 'jam for everyone' (36) but while that may have been true in part, there were many people dissatisfied. The VLSI proposals were for customised rather than standard or general purpose circuits with the result that Inmos, which manufactures standard circuits, barely took part in the programme at all. Both IKBS and MMI were seen as overly academic. And in a scarcely veiled reference to the role of GEC, Plessey, and Ferranti, one of the Abingdon team remarked (37):

> Some of the VLSI people crept into that (Alvey committee) in a bigger way than they should and so the concept of having it 'pulled' by IKBS as a technology was lost.

Nevertheless, the Alvey report bore 'a pretty good resemblance to the input that Laurence's (Clarke) four-day (Abingdon) meeting prepared' (38) and it was generally agreed that despite disappointments and criticisms, there was something in the report for everyone. It was submitted to the Minister in September 1982 and was widely circulated through the IT community for comment.

3.3 Inputs to the Alvey Committee

The organisations which provided inputs to the Alvey committee accurately reflect the nature of the IT sector at the time as much as they do the type of policy under discussion. The Alvey inquiry was announced as an investigation aimed at drawing up 'proposals for a research programme into advanced computers and information technology' (*Financial Times*, 7/4/82). It was never intended that the inquiry or any subsequent programme would be of interest to the small software consultancy with a turnover of £1 million and six or eight staff or to the microcomputer retailer in the High Street. This did not stop small firms from accusing large firms of dominating the formulation of the Alvey policy or the programme that followed.

The Alvey committee made the following note in its report (Alvey report, 1982, p.68):

> Listed below are those organisations which provided substantive inputs to the Committee. In many cases inputs were provided by more than one department within an organisation, but these are not separately identified. (emphasis added)

There are two unfortunate by-products of this note. The first is that 'substantive' is not defined and no record exists of those who gave non-substantive evidence. This is doubly unfortunate since it could be reasonably assumed that some of those giving non-substantive evidence would include interest groups whose evidence would be of the 'Alvey is a good idea'-style rather than detailed submissions on what technologies should be developed or how the programme should be administered. The second problem is that despite the *caveat* concerning the single entry for multiple submissions by one organisation, this rule is not strictly followed. For example, there is an entry for the Joint Network Team of the Rutherford Appleton Laboratory (RAL), the RAL, and the SERC, the parent organisation of the RAL. There are entries for Plessey's Allen Clarke Research Centre at Caswell, and Plessey Research. There is also an entry for the MoD, one of its directorates, and four MoD research establishments. This inconsistency made analysis of the submissions difficult.

The Government departments, sub-departments, agencies, quasi-governmental agencies, and QUANGO's (excluding universities) which made submissions to the Alvey committee are listed below in Table 3.6

Table 3.6 Public Sector Bodies Appearing Before the Alvey Committee

Department of Industry	Atomic Energy Research Est. Harwell
Ministry of Defence	British Technology Group
Scottish Development Agency	Central Electricity Gen. Board
Cabinet Office	Joint Network Team (RAL)
National Computer Centre	Rutherford Appleton Lab. (SERC)
National Economic Dev. Office	National Physical Laboratory (DoI)
Components, Valves & Devices (MoD)	British Telecom
Science and Engineering Research Council	
Medical Research Council (App. Psych. Unit)	
National Hospital for Nervous Diseases	
Royal Aircraft and Radar Defence Est. (MoD)	
Royal Signals and Radar Est. (MoD)	
Royal Military College Shrivenham (MoD)	
Admiralty Surface Weapons Est. (MoD)	

Source: Alvey report, 1982, pp.68-71

By far the greatest number of submissions were from universities, polytechnics and their associated computer processing departments. Of the 115 organisations which supplied 'substantive inputs', no fewer than fifty were from this quarter. A dissection of the fifty shows that thirty were universities, eleven were university colleges such as Birbeck, and Imperial colleges, six were polytechnics and three were computer centres associated with universities or colleges. The inability of the tertiary education establishments to speak with a united voice reflects a lack of associative structures. Historically, universities have had to compete with each other for R&D funding and this, their geographical dispersion, and their diverse technological orientation resulted in a diffusion of their influence. Because universities were to receive 100% funding under the proposed programme, an attitude that they 'had nothing to complain about' was evident in interviews with both government and private sector bodies.

Although the Confederation of British Industry, the peak national business interest association 'made contact' with the Alvey inquiry, it is not listed as having made a submission. This tends to confirm what was said previously about non-substantive inputs from interest groups. The interest groups and professional bodies which are listed as having given evidence include the British Computer Society, Computer Analysts and Programmers, and Consultants in Information Technology. There is no mention of prominent IT interest groups such as the Electrical Engineers Association, or the United Kingdom Information Technology Organisation.

In a sector dominated by a small number of large firms, it is not surprising that they were all well represented. For example, Plessey, ICL and GEC all had representatives on the Alvey committee and supplied seven of the fourteen members of the working group assisting the committee. As well as this, GEC and Plessey made multiple submissions through their subsidiaries listed below:

GEC Submissions	Plessey Submissions
GEC Computers	Plessey Research
GEC Hirst Research Centre	Plessey Office Systems
GEC Marconi Research Centre	Plessey Digital and Networks Systems
GEC Telecommunications	Allen Clarke Research Centre (Caswell)

Hardware manufacturers other than those represented on the committee or the working group which gave evidence included Sinclair, Comart, Foxboro Yoxall, IBM (UK), STC, STL, and Microfocus. There was no proposal for a components programme in Alvey except for the VLSI microchip programme. This proposal was generated by Derek Roberts of GEC, Dr Keith Warren of Plessey, Ian Barron of Inmos in conjunction with the other major chip manufacturers and MoD experts.

Software was heavily influenced by Logica, one of the largest software companies in the UK, which had a member of the committee and two members of the working group. A senior Alvey figure, referring to the software engineering proposals in the Alvey report, said 'Phillip Hughes of Logica, Rob Witty of the SERC, and another Logica guy from the working group put that together' (39). Logica also made a submission to the committee. Other specialist software houses such as Systems Designers Limited, Software Sciences Limited, ERA Technology, ISIS Systems, and Leasco Software also made representations.

The three major IT users who made submissions were Unilever, Imperial Chemical Industries, and the Central Electricity Generating Board. The absence of users from the programme has been one of the most constantly criticised features of it. The failure of a solid group of user support and demand meant that the technical programmes were developed by the technologists, mainly from the companies, with no set goals in mind or as a prominent scientist described it, 'technology for technology's sake' (40).

Trade unions were not represented either except in the most tangential way. While it may be true that 80% of employees in the IT industry who work for large companies such as ICL, GEC and Plessey are unionised (41), the former IT Minister, Geoffrey Pattie, pointed out in an interview 'there are a lot of very highly skilled people need convincing that they need to be in a union'. A submission by NEDO was as close as labour got to having an input to the process. One IT industrialist was baffled at the suggestion that perhaps trade unions could have been involved in the Alvey policy process. He said (42):

> I really don't follow the point you are making. I mean this (Alvey) was all about pre-competitive R&D for information technology. It has got absolutely nothing to do with unions.

A trade union spokesman, commenting on the previous quote said (43):

> I disagree that the unions don't have a role to play because you have got to be asking 'Research for what?'. We would have argued that Alvey should not have been so defence related. We would have argued that Alvey should have had 'new money' put into it...We would have argued that Alvey's main weakness was and still is, that it had no specific targets. There is no national strategy such as you have in Japan or France.

The Alvey policy programme was developed with no inputs from labour or consumer groups and with minimal inputs from IT users. A distinct impression came from those who were interviewed that the programmes which emerged in the Alvey report would have done so if no submissions were made at all. All of the programmes were developed by members of the steering committee and the working group and while extensive consultation took place in some cases, there was no suggestion by those interviewed that any major initiatives came from this process. The systems and software experts got on with developing the software engineering and IKBS proposals while the hardware and MoD experts worked on the VLSI and parts of the MMI proposals. A senior figure involved in the process said (44):

> Now Derek Roberts for example, he was balanced between both software and hardware but the vast majority of the others were biassed in a software/sytems sense and that unbalanced the programme and it unbalanced the directorate too in my opinion. I'm not gain-saying it or anything because in fact we came out with a fairly substantial hardware programme. Nevertheless, there was far more effort put into the systems/software area both during the preparation of Alvey and during the implementation of the programme. That in fact didn't matter because the hardware people knew where they were going anyhow. So they were very easy to organise. The problem was I still had an uphill battle. If somebody said 'Hey. We're over-spending. Let's cut something', it was always the bloody silicon (VLSI). Oh, you know, we don't need silicon, we can take Japanese chips and run our work on that. I immediately had a battle on my hands. I'd say 'Now wait a minute. You don't know what you're talking about. You're a software house.'

From the other side, a software/systems supporter said (45):

> The directorate had the VLSI strategy forced on it by the industry. I mean, they were such a powerful lobby - the Alvey

> directorate just had no answer. Of course we've got the situation with VLSI of 'How do you use what we've got now?'. And you see they recommended a cut-back in the CAD programme - there is not enough spent on CAD...Just look around - GEC, Plessey, Ferranti, STL - they have never made a high quality microelectronic product in their history!

The systems/software versus VLSI/hardware battle led to civil servants within the Department of Industry taking sides. One explained (46):

> During the course of the Alvey committee sitting, there was a recognition that there needed to be some assessment of the markets and some assessment of the economics. It wasn't at all clear who was going to do that. I mean the Alvey committee was made up of all sorts of interest groups. We were asked to submit a paper on this to the Alvey committee - I think by Electronics Applications division which was then run by John Major. We had a bit of difficulty with this because it wasn't clear to us that what was emerging from the Alvey committee was necessarily totally defensible. We had our doubts about some aspects of the programme...We took the view that - well we were very less certain about the VLSI part of the programme than the other parts. We thought this (VLSI) work was the sort of work the major companies would be doing anyway - either off their own bat or funded by MoD...We regarded the software engineering programme as the most important, as the glue that held the whole programme together...We knew the Alvey committee

> was a compromise solution basically reflecting the conflict that existed between the hardware merchants, namely the Plesseys', the Ferrantis', the GECs' and the software merchants such as Logica - I mean everyone knew there was that tussle going on and the judgement of my division was that Logica etc. should have won the day rather than the hardware merchants.

Regardless of who won, there was a double irony in the Alvey policy-making process. The first was the attempt to generate consensus in the IT community through consultation and taking evidence while at the same time irreconcilible differences existed within the committee over the 'correct' thrust of the policy. The second was that the basic plank of the Alvey platform rested on the notion of collaboration. In the light of what had gone on between the two major factions, this concept was also under challenge.

3.4 Conclusion

While the Japanese fifth generation computer programme may have been 'The catalyst to the formation of the (Alvey) Committee' (Alvey report, 1982, p.5), there can be no doubt, to continue the analogy, that the likes of Derek Roberts, Roger Needham, David Thomas, and Laurence Clarke as representatives of sections of the IT industry, academic research, and a fusion of the two, had prepared the laboratory and put the reactants in the flask years before. Information technology policy was an esoteric hybrid of industrial policy and science policy that rarely featured on the political agenda. The turning point for IT was the Heath

Government's implementation of the Rothschild proposals which resulted in the establishment of closer cooperation between industry and the academic community and the strengthening of scientific expertise in the civil service by the creation of Chief Scientist posts, often filled by non-civil servants.

The origins of the IT community's policy networks can be traced to two prime sources. The IT industry is one of the most rapidly growing in the developed world and there have always been shortages of qualified personnel. As a result of this, there is a great mobility of staff, especially the best staff, between companies. So intense has this movement become that it has recently been seriously suggested that a transfer fee system similar to that which operates for professional footballers be implemented (*Observer*, 23/10/87). Add to this the movements that take place as a result of company mergers, takeovers and collapses and it is not surprising to find people who are 'ex-Elliott, ex-GEC, currently Plessey'. This type of personal contact networking was augmented in the 1970s with the presence of academics on industry advisory boards and and industrialists on SERC committees.

Typically these SERC committees had between ten and fifteen members, about half of whom were industrialists. While most of them came from the major IT firms such as GEC, Ferranti, Plessey, ICL and Racal, there were also representatives from the smaller firms such as System Designers Limited, ERA Technology and Information Technology Limited in the early 1980s. At least seven of the twelve Alvey committee members had served together on SERC committees in the past. The committee structure was important for both the academic-company linkages and also for the company-company linkages. Examples of this were brought to light during interviews with prominent IT people. One industrialist said (47):

> You should talk to Clive Foxell about this. He chaired an SERC sub-committee that I was on and is very knowledgeable in this area. He has also just taken over John Alvey's old job at British Telecom.

On another occasion an industrialist said (48):

> Have you spoken to (Professor) Eric Ash? He has just recently taken over as chairman of the (SERC) IEC (Information Engineering Committee) from (X). He's very good, a very special kind of academic.

The team that went to Tokyo and the Abingdon workshop group had a heavy SERC and DoI element. A collaborative public sector/private sector/academic programme could not be implemented if only two parties had inputs into the policy formulation process. That was why the Westmorland Hotel debrief was so important. The lead-up to the debrief, the meeting and its aftermath were good examples of the 'osmotic process' that Schmitter (1979, p.27) refers to whereby interest groups and the state 'seek each other out'. The SERC people sought out the DoI and the Tokyo team, Derek Roberts and John Pickin sought out the senior civil servant, the senior civil servant sought out John Alvey. No-one directed or led this process.

Once the Alvey committee was set up, the hardware and components sector of the IT industry held the upper hand. The technical focus and overall strategy changed from a programme 'pulled' by IKBS to one 'pushed' by VLSI which was earmarked to receive more than twenty-five per cent of all funds. The academic sector was fragmented and the Government was clearly unwilling to assume a directive role in the formulation of policy. Even if it had been willing to dominate the policy process, grave doubts exist as to whether the Government had the capacity to do so. Despite rhetoric to the contrary, the Government was unwilling to depend simply on market forces to achieve the desired ends.

When Kenneth Baker addressed the NEDC meeting which the Prime Minister chaired shortly after the Westmorland Hotel debrief, he clearly demonstrated the ideological dilemma his Government faced. He stated that the role of government was to provide 'the infrastructure and domestic environment in which IT industries can achieve growth' but followed this by exhorting the business community, fund managers and procurement bodies 'to take investment and procurement decisions with the long-term objectives of the UK (IT) industry in mind' (*Computer Weekly*, 11/2/82). It was Baker's task to sell a policy which entailed the circumvention of the market mechanism through collaboration and Government support to the Prime Minister and her Cabinet colleagues.

Public policies for IT highlight one of the major problems facing modern governments. A senior Conservative backbencher said (49):

> I think this is one of the major problems of the age...How do you maintain the credibility of the electoral democratic process with elected public figures theoretically in a

> position of power and theoretically responsible for all the decisions? It increasingly becomes clear that those elected individuals don't know or more importantly, are incapable of acquiring an understanding of the issues involved. Then you are in a very, very dicey situation, and sooner or later the credibility of the institution collapses. I don't think it has quite reached that stage yet but in an increasing number of areas, certainly within the UK, the credibility of our Parliament as a governing institution is declining. And it is declining in my judgement for the very good reason that more and more areas of policy-making have a complex technological component of which the vast majority of members have no hope of understanding.

One reason that the 'credibility of the institution' has not collapsed is that governments shift 'decision-making sites towards state units that are less susceptible to a loss of popular support, such as the bureaucracy, independent agencies, (and) planning committees' (Nordlinger, 1981, p.71).

While it may be true that the role of the student of public policy is to 'take up a central observation post and catalog the passing traffic at a selected institutional junction' (Hofferbert, 1974, p.93), it is also true that what is observed is both a function of keen eyesight and where the student stands. In the case of the Alvey policy, two clearly separate scenarios of the policy-making process emerged: a *Broederbond* of components manufacturers facing the software hordes on one hand, and the small software houses facing the might of the IT giants such as Ferranti, GEC, and Plessey on the other. The irony of this is that so much of the policy appeared to be based on consensus, while within the heart of the policy-making body, no such consensus existed. The answer to the problem lay in log-rolling (Tullock, 1976, p.41). The VLSI proposal that came out of the Abingdon workshop called for £65 million expenditure while software engineering 'only' received £30 million. To make the software people happy, their vote was increased to £70 million while the VLSI vote was 'only' increased by £25 million. The end result was that VLSI still received more funds than any other programme but the software supporters had the pleasure of seeing their champion almost catch up. These types of trade-offs became more common once the programme was approved and implemented.

In summation, while the SERC committee connections, the Abingdon workshop, the Westmorland Hotel briefing and the Alvey committee did not constitute unification of the IT industry, they were vital steps in the mobilisation and activation of the IT policy community and networks.

CHAPTER FOUR

Policy Approval and Initiation

The public policies for IT during the period in which Sir Keith Joseph was Secretary of State for Industry was characterised by a form of political schizophrenia. On one hand Sir Keith was still espousing the doctrinaire neo-liberal position of government disengagement from the market while on the other hand, the Department of Industry was still supporting industry with Labour-inspired initiatives such as MAP and MISP. This almost covert form of policy continuity (Rose, 1984, pp.190-192; Grant, 1982, pp.49-50) gradually attained a measure of legitimacy under Joseph's successor Patrick Jenkin and his junior IT Minister, Kenneth Baker. But clearly the Alvey committee of inquiry and its proposals were more than a reinforcement of the interventionist policies that had survived Joseph's tenure at the Department of Industry.

This chapter focusses on the role of the core executive, the bureaucracy, and the policy communities which made up the IT policy network in the approval and initiation of the policy programme. The core executive is defined by Dunleavy (1987, p.2) as 'the complex web of institutions, networks and practices surrounding the Premiership, Cabinet, cabinet and official committees, and the co-ordinating departments (such as the Cabinet Office (and) the Treasury)'.

The 'decision game' approach of the core executive (Allison, 1971, p.145), the way in which the state bestowed 'legitimacy' upon the policy (Schmitter, 1985, pp.59-62), and the problems of co-ordinating and administering the initiation of such a 'Balkanized' policy process (Self, 1976, p.293) are all explored in this chapter..

Two major themes emerge from this review. The first is the paradox of the political power of the core executive balanced against its technological impotence. The second is the economic and technological power of the IT sector (especially the small number of very large firms) offset by its relative lack of political expertise and adroitness in putting its views to the core executive. To explore these themes in detail, the actions and views of the main interests involved in the Alvey policy during the period of August 1982 to August 1983 are examined.

4.1 Core Executive Decisionmaking: Understanding the Steamroller

The title of this section came from an interview with a former core executive official who referred to the 'steamroller of decision-making in government'. From the moment Kenneth Baker agreed to establish a committee of inquiry, the Alvey policy became a part of the steamroller process. The former official described the process as follows (1):

> The steamroller of decision-making in government is very poorly understood by industry. Industry is able to be really rather relaxed in many cases about its pace of decision-making whereas in government there is a steamroller. There are a whole lot of decisions to be made today and if you don't make them today, you will have twice as many to make tomorrow. This steamroller affair...people just don't see that, so much of it is unknown, not because it is secret but it is just unknown to the outside

> world. The sheer steamroller of the red boxes each night, the ministers - the decisions that have to be made..the efficiency of the administration that is required to make that even semi-tolerable, which is all it is, I don't think industry recognises that at all.

Allison (1971, p.145) made the same point when he said:

> Hundreds of issues compete for players' attention every day. Each player is forced to fix upon his issues for that day, deal with them on their own terms, and rush on to the next. Thus the character of emerging issues and the pace at which the game is played converge to yield government "decisions" and "actions" as collages.

Once the Alvey report reached the core executive, it went to the Cabinet Office for strategic evaluation. Here the questions tended to be 'Why information technology rather than biotechnology and why collaborative research rather than the way we have always done it in the past?' rather than questioning the technical details (2). The style of the report was not seen in a positive light and this may have affected its progress and acceptance (3):

> The Alvey report was slightly amateurish...this report by a distinguished and experienced set of people did not sufficiently clearly state the objectives and the benefits of (the programme). I mean, I think it was very qualitative and

> somewhat ill-defined. Amateurish is perhaps rather a strong word to use - I might be playing with words - but I think in certain respects it lacked professionalism. I think it was actually quite professional in terms of the subject areas but as a pure report to a board of directors who were being asked to spend £500 million or whatever it was...I thought it lacked professionalism.

The view that the report was 'amateurish' was taken up by another core executive source who said (4):

> They would not get away with it these days, not since the FMI (Financial Management Initiative) has been implemented...We would be worried (by an Alvey-style submission) about the likelihood of...generating subsidy addiction, nice cosy relationships between the funders and the private sector. So we would be concerned to know who would be receiving the funds, why they need such funds, is it for a part of their core programme. <u>We wouldn't ask much about the technicalities because we wouldn't be able to judge even if someone told us</u> (emphasis added).

While understandable, the lack of technical expertise within the core executive was one of the major stumbling blocks in the policy approval process. As was noted previously, several prominent technologists disagreed with the technologies selected or the relative emphases they were given while others such as Professor Frank Land questioned the strategic thrust of the proposals (Land, 1984, pp.121-125).

The shortcomings of the Alvey report were in contrast to the 'normal' submissions which came from within the bureaucracy (5):

> The quality of the paperwork and the background is phenomenal, much better than it is on average in industry because the problems are very, very complex and a whole range of points of view and facets of the problem have to be explained to people who aren't experts and I think the intellectual quality of some of that is superb... So I gained an enormous respect for the professionalism of the civil service and I think it is very much underrated by industry. I think the average paper that goes to the average board...is well below the quality of the average paper that goes to the average minister.

Nowhere in the report is there a cost-benefit analysis and while some programme areas do have technical objectives identified, many were couched as in the following example (Alvey report, 1982, p.27):

- Establish a programme aimed at the quantification of software quality and productivity
- Create arrangements for collaboration and information interchange with Ada/APSE developments
- Support research in a number of areas, including:
    - very high level languages
    - language theory

Members of the Alvey Committee defended the style adopted quite strongly. One said (6):

> You are writing the report for a wide range of people ranging from the Prime Minister and politicians, for the experts themselves who had to see something in there that they felt reasonably comfortable with, and then one was writing it for the civil servants, one was writing it a bit for the interested public, certainly for the press on their behalf, and to all of those people it had to make some kind of credible sense. Therefore, my view was you did have to spell out programmes ...you wouldn't get away with it, if I can put it that way, unless you spelt out the programmes because people would say 'What the hell are they talking about? What's all this waffle?'...but it must be flexible...life goes on. As we said many times to Government actually, I think the example was Ian Barron's (Inmos), was that while the Government were considering this report, about four months or so, the Japanese put 50 per cent more transistors on a chip. So life goes on. You have to be dynamic and flexible.

The fact still remains that the Alvey committee did not clarify objectives beyond the statement that 'The aim of the programme is to mobilise our technical strengths in IT. This is essential to improve our competitive position in world IT markets.' (Alvey report, 1982, p.9). Little wonder then that eyebrows were raised and as will be shown, this lack of clear objectives 'meant that people were left with a whole lot of different ideas of what the object of the exercise was' (7).

The second aspect of the report which caused initial concern within the core executive was the attempt to imitate the Japanese practice of collaboration. A former official said (8):

> The second point which I was very much concerned with and which the Prime Minister was very much concerned with was: 'Is collaborative research and development at a so-called 'pre-competitive' stage - (a) is it a sensible thing and (b) can it be fitted into the British culture of doing things which is obviously very different from the Japanese culture where the invention of pre-competitive collaborative research really occurred?

The Prime Minister sought advice from various quarters. The IT policy unit in the Cabinet Office which had been set up in 1981 on the recommendation of the then chief scientific advisor, Professor John Ashworth, a member of the Central Policy Review Staff, had already been consulted. Another mechanism was the information technology advisory panel (ITAP). A well-placed source explained (9):

> ITAP consisted of half-a-dozen luminaries from the outside world - one academic, one sort of generalist, and about four industrialists... We deliberately didn't - and this was controversial - we deliberately didn't go for the really big boys - GEC, STC, and Plessey. We went for smaller firms partly

> because the Prime Minister herself was very keen to get entrepreneurs in rather than what were in some senses bureaucracies like the civil service...We are in touch every day with Plessey and GEC, so we didn't want that kind of input - the Ministry of Defence knows all there is to know about GEC. ...So this panel was formally established to advise the Prime Minister on IT matters.

The ITAP included Charles Read of the Inter-Bank Research Organisation, a member of the Atkinson mission to Tokyo, Colin Southgate, then of Software Sciences Limited (SSL), Mike Aldridge of Reddifon Computers, Tony Davies of Information Technology Limited, Ivor Cohen of Mullard, and David Hartley of the Cambridge university computer centre. This committee was 'serviced by the Cabinet Office' and in turn, the same committee 'serviced Kenneth Baker' (10). There were informal as well as formal consultative mechanisms. One industrialist stated (11):

> It really needed that (high) degree of commitment from industry to persuade Mrs Thatcher that the programme would go ahead in the first instance. I recall one crucial time when it (the report) was in for Cabinet discussion as to whether the Alvey programme was going to go ahead and she phoned Lord Weinstock and said something like "I want to see evidence that GEC and others - you know, will you second people." Luckily I had a word with him before replying because his natural response would be "What the bloody hell has it got to do with her? You get on with your work and we'll do ours." But luckily I had a

> word with him and he said "She's asked me to go around and talk about this", so I gave him a briefing and said "Don't just be nice about this, say yes we will (cooperate) because it is important and we don't want to screw the thing up at this stage by saying 'No we won't'."

An official defended this informal consultation which is a part of the policy clearance process (12):

> I think it is absolutely inevitable that they (Ministers) have advisors on all these things. I mean the Chancellor of the Exchequer doesn't understand the details of economic policy any more than the Minister for Trade and Industry understands the details of information technology. In my view there is no difference between those and they have to rely on outside experts and I think...they have all had to move as life has become more specialist to getting specialist advice and I think they are very adept at doing this. It was always one of the things that impressed me about Whitehall, coming in from an industrial background, was how adept Ministers become at receiving expert advice and being able to assess it...One of the things I have always said since I've come out is that for most of us, you divide the things that are said to you into facts and opinion. Facts are facts and opinions are opinions. Ministers treat everything as opinion and are pretty wise to do so in my opinion.

He went on to specifically address the Prime Minister's style (13):

> The Prime Minister feels very uncomfortable if she's getting advice only from one quarter, particularly if it is only from the civil service. She had a group of advisors over a wide range of issues and she is, contrary to popular supposition, she is actually a very good listener and a lot of her time at Number Ten Downing Street, at Chequers on weekends, at dinners and so on, she listens hard to what people say. So yes, she listened to Lord Weinstock but he was one of many on this issue...But she certainly believes very strongly that many past governments have failed because they have listened to too few people over too narrow a range, and particularly because they listened to the civil service only.

Another aspect of the report which encountered stiff opposition from within the core executive as well as the departments was the recommendation that the Government should fund 90 per cent of the cost of industrial research 'where very wide dissemination of the results is required' (Alvey report, 1982, p.47). The qualification on 90 per cent funding was primarily included to 'keep (the companies) around the table' during the early days of the Alvey committee but later was aimed at 'software houses which are fairly small operations, low capital businesses' (14). One Alvey committee member said (15): 'We had briefly discussed and dismissed the idea of a sliding scale of funding (for Alvey R&D) based on company size, turnover *etcetera*' because of the potential problem with a company such as GEC which has numerous subsidiary companies, some of which are small with low turnovers.

Ninety per cent funding was rejected by the Department of Industry, although that was where the suggestion originated (16), by the Treasury (17; *The Times*, 29/4/83), and by the core executive. Civil servants and politicians alike were worried that the 'wide dissemination' criteria would be used by ICL or Plessey or other major companies to acquire 90 per cent funding for research. These details did not escape the attention of the Prime Minister (18):

> As a Prime Minister she became involved in the details of everything where there was decision-making. Her management technique, like many chairmen of major industries, is to ask - to make an assessment of a particular case by asking quite detailed questions and then judging the strategy which is being proposed, not only on its own merits but also by the quality of the answers given to her detailed questions. It is a well known management technique and she applies it whether it is Trident submarines or the Alvey programme or detente with the Russians or the ANZUS pact or whatever. She will always do it that way.

Much to the chagrin of the small firms, especially the software houses, she applied this strategy to the 90 per cent funding. It was not just the Prime Minister who jibbed either (19):

> All of the key senior ministers involved in this decision didn't like the proposal on principle. They argued that if a

> company is only putting in one tenth of the resources, it doesn't then bring to the project the kind of financial discipline which you would expect from the private sector... 90 per cent I think was over the top and I suspect it was knowingly over the top but I think they...to some extent the small companies reaped their rough-justice desserts. I think if they had gone in and said 'For small companies, it ought to be up to 75 per cent', I think they would have probably won that. By going in and saying up to 90 for small companies, they just irritated Ministers and it went against their deeply held convictions about commercial discipline and they said 'No, 50 per cent only.' And the Prime Minister certainly felt that way.

Although ninety per cent funding was recommended for projects with results requiring 'wide dissemination', the Alvey report said that other industrial projects should be funded at fifty per cent with the result that overall government funding for industry 'would be roughly 60 per cent' (Alvey report, 1982, p.47). The sixty per cent compromise figure was endorsed by the Treasury as was the Alvey proposal 'in principle'. One official explained what happened (20):

> I remember that the DTI started off by asking for eighty or ninety per cent funding. We argued for sixty through the Treasury. And I have a feeling that it was the Prime Minister who said "fifty or nothing" and got it...I remember how devastating that was because, we're supposed to be the tough

> people, you know, and I'd argued at official levels with Ministers, you know - "If we can get sixty we'll have done very well. Because after all, this isn't going to be the private property of the company paying the money in"...The Prime Minister said "fifty or nothing" and got it. It was very humiliating.

Regardless of the various levels of funding discussed, it is ironical that the small innovative enterprises which the Thatcher Government pinned so many hopes on were almost totally excluded from participating while firms such as GEC and Plessey received millions of pounds. Despite broad opposition by the core executive and the bureaucracy to the funding level requested the belief lives on that it was the Prime Minister alone who was responsible. A senior industrialist said (21):

> The original proposal (Abingdon workshop) suggested a 100 per cent government subsidy - no I don't like the word subsidy - 100 per cent support funding for the research programme. This became 90 per cent. When Maggie saw this she dug her heels in and refused on the grounds that scientists would be receiving funds to do all kinds of research with no relevance to the marketplace. What she didn't consider was by refusing this level of funding, she automatically excluded all small firms and most medium-sized firms. So if you hear small companies complaining about the 'Big Firm' bias in Alvey, it's not John Alvey or Brian Oakley or the major companies who are to blame. It's her and her alone.

Another example of the decisional pressures within the core executive was the case of the ESPRIT programme. Although the ESPRIT pilot programme began before the Alvey report was approved, this was not widely known within the core executive. A well-placed source recalled (23):

> Speaking from the centre of the Government, Alvey as an idea pre-dated ESPRIT. The Government had very nearly made a decision on Alvey when the Prime Minister happened to sit next to somebody from the European Commission at a dinner and was told all about the ESPRIT programme. The next morning I was sent for and asked 'Why are we doing the same thing twice'. The answer of course was that we weren't but that shows the perception of ESPRIT following on (from Alvey).

It also underlines the problem of overload within the core executive. ESPRIT was a five-year £900 million programme with the three largest British IT firms participating and to which the Thatcher Government was contributing approximately £40 million, yet the Prime Minister had never heard of it. This also helps put the Alvey programme's impact on the core executive into perspective. Many of those interviewed spoke knowingly of the interminable debates that went on within Cabinet regarding the Alvey report and the programme initiation but a senior official was adamant that Alvey 'as a subject came to Cabinet or Cabinet Committees on half a dozen occasions' during the period between 1982 and 1985 (24). As Allison says 'Most "issues"...emerge piecemeal over time, one lump in one context, a second in another' (1971, p.145). In the case of Alvey, the first 'lump' resulted in the Prime Minister looking at the questions of collaboration and funding. There was to be a second 'lump' as well.

Apart from the blow to the small-medium IT firms, the major outcome of the change to the recommended funding level was the Government's overall funding for this programme fell from £250 million to £200 million while industry had to supply the 'lost' £50 million. This was particularly galling for the major participants in the VLSI segment of Alvey. If the MoD had implemented the Very High Performance Integrated Circuit (VHPIC) programme, the R&D costs would have been 100 per cent MoD funded. It also highlights the problem of technical decision-making by non-technical actors. The core executive did not challenge the technologies selected and once it had accepted the concept of a pre-competitive collaborative IT programme, was then reduced to tinkering at the margins. There were no alternative proposals put forward by the Adam Smith Institute or the Centre for Policy Studies or, indeed, by the Labour Party. This theme was taken up in *The Times* (29/4/83) under the heading 'MP's and Whitehall Technicallly Ignorant' and later by the former Chairman of PITCOM, Ian Lloyd MP (1984, p.96), who said:

> Nuclear power, biotechnology, telecommunications and medicine are good examples of massively capital intensive developments which affect investment, employment, education and economic expectations. Parliament has tended to avoid these subjects... We have preferred to debate unemployment levels, inflation... subjects where there is a familiar stereotype and political indignation appropriate to the occasion can be triggered.

During the eight months that the report was with the core executive, various bodies such as NEDO and the CBI continued to push for the early acceptance of the proposals. NEDO released *Policy for the UK Information Technology Industry* in mid-February 1983 (*The Times*, 16/2/83) and a week earlier had made a call for the adoption of the Alvey report under the heading 'NEDO Backs Plan For Information Technology' (*The Times*, 9/2/83). The CBI were also active as one spokesman recalled (25):

> In the meantime we took the opportunity to push Ministers towards approving the (Alvey) programme. And there is a thing we do every year which is to put in a technical and a policy document prior to the Budget. These are what are called the CBI Budget Representations. Now I managed to get in a reference - although in principle the CBI is against profligate government spending and always has been, we nevertheless have supported additional expenditure other than what the government have been planning to do on the infrastructure and on programmes of urgency and of broad importance. We highlighted Alvey as one such (programme) and we said in a very brief reference that Alvey was the sort of programme where government expenditure was inarguably justified, it was urgent, and we supported that being approved. Now we know from the inside that the Secretary of State who had to argue the case before the Cabinet referred to the fact that even the CBI who are rather against government spending has selected this programme as one we should push.

When the Alvey report was published in October 1982, the Department of Industry sent 'well over a hundred copies' to IT firms throughout the UK and asked for their comments. This had the effect of raising the IT community's awareness to the status of the report and increasing pressure on the decision-makers. As one civil servant said 'It wasn't just us who got the feed-back. People contacted their MPs and so on' (26). One IT industrialist took a more jaundiced view. He said (27):

> When the (Alvey) report was published, the DTI sent out - well it must have been two or three hundred copies to companies asking for their comments. Of course, they all wrote back and said 'What a good idea' or 'Maybe more emphasis should be given to this or that' but the joke of it was that after all this consultation and asking people what they thought, very bloody few of these firms took part in the programme.

Another civil servant who was involved in the consultation process commented on 'the remarkable level of consensus' among the respondents (28). In December 1982, the Government announced that an additional £100 million would be made available by the Department of Science and Technology for information technology support (*Financial Times*, 17/12/82). During this period home banking via Prestel was mooted, and a Data Protection Bill was introduced (*Financial Times*, 22/12/82) and these helped to keep information technology high on the political agenda.

When the Budget was brought down in March 1983, there was no mention of the Alvey Programme. An article in *The Times* (22/3/83) commented as follows:

> The Budget was a great disappointment for the computer industry because the Chancellor failed to implement or even mention the Alvey Report on Advanced Information Technology. The Government has been sitting for six months on the Alvey recommendations...and the industry had hoped for action last Tuesday. Apparently the Treasury are still not happy with the funding system proposed by John Alvey and his team...and the Prime Minister has not yet given the proposal her full personal attention...Alvey is one report that the Government cannot shelve quietly. Too many people are too concerned about the need for action.

The Alvey funding arrangements had been negotiated between Treasury and the Department of Industry in the Autumn public expenditure round of 1982. A source who was very critical of the Alvey proposals described one facet of the negotiating process within the Treasury (29):

> We often subject what the DTI submits to us by way of these key technology proposals to a 'Red Jelly Test'. If we can substitute 'Red Jelly' for, say, optoelectronics without any damage to their case, then we don't think DTI has presented a very good case because it doesn't discriminate between one technology and another...It's a good exercise to go through because you come up with statements like 'We should support Red Jelly because the Red Jelly producers are risk averse' or 'There are fantastic externalities from Red Jelly'. Bullshit. We want to know precisely what it is you are claiming for this

> technology as opposed to any other technology...I mean don't tell me that GEC is risk averse and needs support. For Christ's sake, it's sitting on a cash mountain. Why do we need to support GEC in this particular technology ?

Apparently the Alvey proposals passed the Red Jelly Test. The MoD's contribution of £40 million spread over five years was catered for out of its massive annual vote of £18,000 million (app.). One civil servant described the £40 million contribution as 'chicken-feed to the MoD' (30). And the SERC had negotiated its funding with the Advisory Board for the Research Councils. The crucial agency was the Department of Industry. A senior insider explained what had happened (31):

> In the main Budget in the Spring, in addition to the tax and monetary and other measures, it is not unknown for Chancellors of the Exchequer to slip in a few extra spending proposals. You know, a few extra lollipops to appease this or that lobby...The DTI at that time hoped that they might be able to persuade the Chancellor to put in a few R&D things in the Budget. Very often Chancellors will take a little theme like 'Helping the Disabled' or 'Modernising Britain' or something like that which provides a little chapter in the Budget and sometimes, for a relatively modest amount of additional spending, you can appease a number of lobbies and get a lot of kudos and lighten the Budget up...the DTI probably hoped to persuade the Chancellor to cough a bit more up as a part of the '83 Spring Budget.

Not surprisingly, this came to the attention of the Prime Minister. Thus ensued second 'lump' of attention by the core executive to the Alvey programme. As Allison said, the policy issues emerge in different contexts. In the first instance, the Alvey proposal was being examined as a potential scheme for revitalising the British IT industry and beating off the threatened dominance of the Japanese and American IT giants. The major decision was whether the programme be approved and once it was agreed to, the next decision was about levels of funding. In the second context, the attention of the core executive focussed on the administrative and management details of the programme such as who would head the programme, who should run the steering committee, and what should the staff levels be. The result was that references to Alvey were removed from the Budget entirely. The Department of Industry did not get its 'lollipop'. Once the Budget had been brought down, the Prime Minister's attention returned to the details of the Alvey report. One civil servant who was closely involved said (32):

> The (Alvey) steering committee was unfortunately set up without a proper balance due to the direct interference of our glorious Prime Minister...at the moment we have a quite incredible form of government where the Prime Minister makes decisions and sometimes remembers to tell her colleagues. It is, to an old civil servant, quite incredible...the thing that amazes me is why the men put up with it. You know, I really do not understand. Sometimes I think they must be a lot of bloody sheep although nobody could call Norman Tebbit a sheep...She required a great deal of convincing that Alvey was the right

> way to go, but there was a considerable number of Ministers, not just Kenneth Baker, who really did believe this was the right way to go...I was very surprised when Norman Tebbit became Secretary of State (for Trade and Industry), finding he knew all about the Alvey programme and had taken a personal interest in the battle in Cabinet. Michael Heseltine had too. ...The remaining legacies of that (direct interference) and there are two...One was that Mrs Thatcher said the programme should be run by one man and a girl, I mean she really did believe the programme could be run by two or three people, which was of course absolute nonsense...The second thing she wanted was the steering committee to be extremely small. She wanted the steering committee to consist of three or four people - and that was directly written in by the Cabinet Office. The result was that when they came to form the committee, they did so - the Secretary of State made the appointments and so on - I think she probably did approve the appointments herself. I'm not sure now but anyway, it was too small. It was a body which didn't really represent the industry, it was an idiosyncratic body of a few individuals.

Clive Cookson writing in *The Times* (3/5/83) said:

> the delay (in announcing Alvey) turned out to have been caused entirely by indecision about funding and management rather than the programme's content...Apparently the Government tried and failed to persuade several high powered figures from within the

electronics industry to take the Directors job.

After a month of detailed attention from the core executive, the Secretary of State for Industry, Patrick Jenkin, announced the Government's approval of the amended Alvey proposals to Parliament on the twenty eighth of April 1983. Almost eighteen months after the Reay Atkinson-led team had left for Tokyo, a policy programme had been developed, a public inquiry had been held, and core executive and parliamentary approval had been secured for the IT policy. This was remarkably swift in comparison to many public policy processes in the UK and much of the credit must go to Laurence Clarke's team which put a solid framework in place for John Alvey and his committee to work from.

Jenkin, in announcing the decision in the Commons, said (*The Times*, 29/4/83):

> 'The Alvey Committee was set up last year at the request of the IT industry...and after detailed consultation with industry I am now able to announce the Government's response...Its theme is the need for collaboration between industry, academic institutions and other research organisations in order to fully mobilise our potential...The task is beyond the resources of any single enterprise...Industry has realised the need for collaborative research in these (four) areas and has agreed to take part in such a programme. This positive involvement of industry in the funding, management and execution of the programme is crucial to its success...This is the first time in our history that we shall be embarking upon a collaborative

> research project on anything like this scale. Industry, academic researchers and government will be coming together to achieve major advances in technology which none could achieve on their own...Information technology is one of the most important industries of the future and therefore one on which hundreds of thousands of jobs in the future will depend. Collaboration will ensure the results of the research will be widely disseminated, particularly into smaller firms which have had such an important contribution to make to the industry.

The announcement was strongly criticised. The Opposition Spokesman on Industry, John Garret, attacked the failure to grant 90 per cent funding as 'penny-pinching' and said, '(this) means that many small companies will not be able to join the programme, yet much innovation comes from these companies'. He further criticised the lack of co-ordination with the education system and called for expanded university IT posts and undergraduate places (*The Times*, 29/4/83). In the announcement, the Minister had confirmed the appointment of Brian Oakley, Secretary of the SERC and member of the Alvey Committee, as Director of the Alvey Programme and Sir Robert Telford of GEC-Marconi, Chairman of the Department of Industry's EARB, as Chairman of the Steering Committee.

The selection of Oakley was a great coup, especially from a bureaucratic 'political' viewpoint. He had worked at the MoD's Great Malvern Research Establishment and had been head of the Research Requirements Division of the Department of Industry in the early 1970's before becoming the Secretary of the SERC. He was also described as a 'buccaneer' (33), 'an entrepreneur' (34), and a person who 'was not afraid to stick his head above the parapet' (35). He was not, however, the first choice. One industrialist suggested Oakley 'was not even the third choice' (36).

The fact that the core executive played the role of a personnel agency and attempted to engage in 'headhunting' is not surprising. The power to appoint, promote, and demote is one of the key features of retaining control over policy once it is implemented. The core executive did not have the technical expertise to challenge the details of the Alvey proposals. It could only agree to the whole technical programme or reject it entirely. It could and did make up for this deficiency in the administrative sphere. In this way the core executive legitimised the policy process. Oakley was to head a Directorate which the core executive deemed should have a 'five strong full-time' staff (*The Times*, 3/5/83). It was to be Oakley's responsibility to initiate the implementation of the policy programme.

4.2 Initiating the Alvey Programme

Policy initiation was extremely problematical. Some steps were taken to set the programme in motion prior to formal approval by the core executive. This is not surprising given Kenneth Baker's confidence that the policy would be approved (37: *The Times*, 22/3/83). On the whole, however, the initiation procedures were a fiasco.

Development of the Information Knowledge Based System (IKBS) strategy was initiated before the Alvey committee met. Following on from the meeting at Imperial College in August 1981 between Professors Kowalski and Michie and Laurence Clarke and Dr John Taylor of the MoD, another meeting took place in November 1981 at which Taylor presented a paper calling for an inquiry into the IKBS area. This was not taken up at the time because of the focus on the Tokyo team and its findings, and the formation of the Alvey committee of inquiry. While the Alvey committee was sitting, the 'SERC got in contact the Department of Industry - it always seems to be this way around that if anything innovative happens it is the SERC that contacts the DoI' and suggested a joint approach to the IKBS inquiry (38). When the Alvey report was with the core executive, a study group with John Taylor as chairman was established under joint sponsorship of SERC and the DoI. This group had a heavy academic membership including Professors Jim Howe, Aaron Sloman, and Robert Kowalski, Dr Karen Sparck Jones, and Dr Ronan Sleep of the University of East Anglia. The study took six months to complete and the findings were published in August 1983 (Alvey, 1983b, 3 Vols.).

If the IKBS developments were successful, the remainder were far less so. One senior civil servant recalled (39):

> It all began when the programme was approved, Brian Oakley was appointed and the Prime Minister said she did not want a bureaucracy, she wanted the whole thing to be run by 'one man and a boy'. Brian Oakley had considerable problems in the few days before he was appointed persuading the DoI to put in ten people, the SERC to put in ten people and the MoD to put in ten people: thirty in all. And the Prime Minister was not to be told about it and she still doesn't know about it as far as I know.

On the first of June 1983, Brian Oakley, Laurence Clarke of GEC and Dr David Thomas moved into their new headquarters in Millbank Tower (40):

> There was not even a paper clip. There had been no preparation at all. It was the fault of someone in the Government that they had not had enough confidence that this would go ahead, to begin preparing it. So there were no guidelines of what the grants should be, no guidelines on collaboration or anything then everyone had to have a mad scramble to get the administration in place. If we only knew, if they had only appointed the director six months ahead...we really tried to arrange all aspects of the programme starting from nothing and that ended up in bureaucratic chaos. Our biggest delays were caused by a lack of staff and Brian (Oakley) had tremendous problems in the early days getting around that. I'm no expert in these matters but I do know that you can't run a £200 million programme over a five year period with only three or four people. So the bureaucratic delays that occurred were because we couldn't get the people.

The ESPRIT programme, on the other hand, was set up in the full knowledge that these problems would occur and for that reason a one year pilot programme was run before the main programme was initiated. This pilot year gave the bureaucrats a breathing space in which all of the administrative problems could be ironed out and funding could be approved.

For the Alvey programme to get underway, two important steps needed to be taken immediately. It was vital that directors for each technology or programme area be appointed and it was also critical that detailed strategies be developed for each programme. While GEC had made Clarke available, just as Lord Weinstock had promised the Prime Minister, some companies showed a reluctance to make staff available (*Financial Times*, 21/2/84). Others offered staff who were unsuitable. One person involved said (41):

> for industrial people, we went to the obvious top firms and British Telecom and we asked them who they had and they offered us possible people...After a few weeks (we) might say to a firm 'Yes. But we don't actually want a man in that area, we want a man in this area. What can you do there?' So there was that sort of playing to get the right people...it was a bit *ad hoc* but we tried to get some sort of a balanced team covering the industry - the manufacturing industry.

The role that industry played was crucial. One source said that Oakley had 'refused to accept' his appointment 'until all the large firms' said they wanted him and would back him. He described it as a 'form of blackmail because thereafter they couldn't very well not try to play the game' (42). An objective of encouraging industry to provide staff was to minimise the bureaucratic taint that industry would perceive if the directorate was staffed only by civil servants and to bring it closer to the aims of industry. It also helped to overcome the staff ceiling of five set by the Prime Minister. As one observer said (43):

> With the sort of government we have at the moment, it is absolutely vital that the thing (Alvey programme) be seen to be what the industry wants and avoid accusations that we are carrying out government policy and so on. Because it must be remembered that (the) current ministers have no policy for industry at all...So it would, I think, be right (to say) that it be seen purely as the industry's policy.

The view that the Thatcher Government has 'no policy for industry at all' was disputed by a former senior civil servant who said (44):

> I think the Government's market policy is often mis-interpreted. People say 'The Government does not want there to be an industrial strategy'. Actually that's not true in my view. The Government doesn't want the Government to decide the industrial strategy. The Government is perfectly happy for the chemical industry of the UK to develop a strategy for the chemical industry of the UK. It just doesn't want to have to do it itself because it believes it will get it wrong and all the past records of government intervention in industry in this country, and indeed in others, indicate that that is correct... The Government sees programmes like Alvey as oiling the wheels of an industrial strategy without being involved in determining what it is...the basic form of the Alvey programme was

determined by groups of people, largely from the private sector, and Government did not change it except for fine details such as the 90 per cent problem.

Although the core executive had no input to the details of the programme, it is incorrect to assume that the government in the form of the civil service did not influence the detailed programme strategies. As will be shown in the following chapters, the MoD played a key role in the policy process. Civil servants and private sector employees who were key actors in strategy developments were as follows:

Table 4.1 Alvey Programme Directors 1983

Name	Employer	Programme Area
B.W.Oakley	DTI(ex-SERC)	Overall
T.E.H.Walker	DTI	Administration
D.B.Thomas	SERC	IKBS
W.Fawcett	MoD	VLSI
S.L.H.Clarke	GEC	Large Demonstrators
D.L.A.Barber	Logica	Communications
D.Talbot	ICL	Software Engineering
C.W.M.Barrow	Plessey	Man-Machine Interface

In the same month that the Alvey programme swung into action, the Government initiated one of its few major administrative reforms when it amalgamated the Department of Industry and the Department of Trade into the Department of Trade and Industry with Cecil Parkinson as its first Secretary of State.

The directors set about preparing their strategies as soon as they arrived. The VLSI and CAD strategies were developed by Dr Bill Fawcett with the help of Mr B D L Wilson of Plessey's Caswell research centre, who co-ordinated the industry view, and they were published in December 1983 (Alvey, 1983e). The fact that there was a large scale demonstrator programme partially implied a strategy of 'market pull' and by August 1983, Laurence Clarke, who was deputy director to Brian Oakley as well as responsible for the large demonstrator programme, had received proposals for eight projects and a further nine were notified. From this group, four large projects were finally selected for implementation (Alvey News 1, September 1983, p.5).

The Alvey report acknowledged that communications and infrastructure would incur costs without designating it as a research area. Derek Barber had little trouble making arrangements for inter-office communications and support facilities (Alvey, 1983a). The software engineering strategy, which was announced in November 1983, was co-ordinated by David Talbot with the assistance of Dr Rob Witty of SERC after extensive consultation with industry, academia and government (Alvey, 1983c; 1983d). The Man-Machine Interface programme strategy was far more difficult to generate. The topic was divided into two areas, pattern analysis and display technologies, and three prime sets of input were provided. These were a survey of academic views from SERC, a review of requirements of defence contractors conducted by Logica, and a survey of non-defence companies supplied by another consultancy firm (Alvey News 1, Sept.1983, p.8). The final strategy document was not published until August 1984 (Alvey, 1984b).The real problems, however, occurred in the administrative area.

One of the most pressing problems was that of industrial (or intellectual) property rights (IPR). A joint working party, comprising Alvey directorate staff and six industrialists, three nominated by the

Electrical Engineering Association and three by the Computer Services Association, was set up to develop rules to govern terms of contract, the granting of money by the directorate, and the IPR question. Those wishing to make submissions to the working party had to do so through these sectoral trade associations (Alvey News 1, Sept.1983, p.5). Collaborators were to negotiate licence fees, exploitation rights and other factors among themselves within the guidelines set out by the working party and published in February 1984 (Alvey, 1984a). This was not the end of the IPR problem.

Staffing continued to be a problem. Although the MoD, DTI, SERC and industry had promised staff, the numbers available in the early days were 'too small', especially in the lower clerical grades (45). The result was senior personnel of Assistant Secretary levels doing their own filing and photocopying. There were some advantages to this according to one observer who believed that 'a culture was built up' by involving senior staff in both 'the detail and policy sides' (46). Another who was involved was more scathing, describing the situation as 'chaos' (47). Industry was 'keen to get its hands on the money' early and applications for project approval and funding poured in as one civil servant recalled (48):

> In the early days, we were getting so many applications in... We tried to mould it into a programme but essentially the speed at which we were being driven along meant we were almost operating saying 'good, bad, or indifferent'.

This added to the pressure on the directorate staff. To alleviate some of the pressure on the staff, advisory committees were set up to assist in evaluating proposals and to monitor each programme's progress. There were eighteen of these committees eventually.

Alvey Project Selection and Approval Procedures

The selection of projects was initially based on the following criteria (Alvey News 1, Sept.1983, p.4):

1. The relevance to the objectives of the Programme.
2. The benefit of co-operation demonstrated by the proposal.
3. The quality of the participating teams.
4. Background knowledge and experience brought to the task.
5. The ability of the participants to exploit the work.

There was no formal structure for project selection. In the man-machine interface programme, proposals were often considered and evaluated by the various advisory committees which made recommendations regarding certain proposals, while in software engineering, David Talbot and his directorate staff made the selection (49). The software engineering advisory committees were restricted to monitoring the strategy and advising on areas where they perceived shortcomings. All of the final decisions of which proposals should be funded were taken within the directorate. This was one of the features which made Alvey unique; private sector secondees approving funds for projects, sometimes in which their company was a participant. This does not suggest or imply any impropriety, for although programme directors had personal expenditure approval levels up to £250,000 with Brian Oakley being able to approve up to £5 million without further consultation, the reality was that in many cases the approval of the full board of Alvey directors was sought. The directorate was not simply an 'application driven' body. Once the initial scramble to submit proposals had died down, the directorate staff analysed the proposals it had received and then went and actively solicited further proposals. One result was a very high level of proposals being accepted. An Alvey staffer explained (50):

> We have always believed in working interactively with the people who are going to put a proposal in...When they come in to discuss it, we tend to say 'Look, that isn't strictly our strategy...Equally, we may say to them 'Look, you haven't got the right partners here. You need a human factors man. Why don't you go to this group'...or we may say 'We have had a similar proposal to this from another group recently...Finally we get the final proposal. By then we have massaged it so heavily that the number of those final proposals that get through is really quite large.

Some of these 'shotgun weddings' were a source of trouble as the directorate tried to get direct competitors or producers and their customers to collaborate. Most collaborative agreements were based on complementary technological positions but the mismatches arranged by the directorate led to endless contractural disputes. Insofar as the directorate had an overall strategy and the programme directors solicited proposals on that basis, it was a directed programme. It was not, however, simply a case of a government bureaucracy forcing companies to do its bidding since the strategy was developed, implemented and administered with a substantial private sector input.

Project selection was a contentious area. If the private sector secondees had disqualified themselves, they would have been seen to be 'passing the buck' and the decisions would have been made by civil servants or academics who are divorced from the commercial realities of the proposals. On the other hand, if employees of GEC, Plessey and ICL are selecting projects without any overseeing authority, they may be open to accusations of bias towards their own company, industrial espionage of opponent's proposals, or could be accused of approving proposals on a 'fair share' or 'Buggins Turn' basis. It was to avoid these types of allegation that the full board of Alvey directors ratified any contentious proposal after taking advice from eminent members of the support mechanisms where necessary (51, 52).

The ESPRIT programme avoided these allegations by having a panel of experts consider the proposals solely on the merits of the application, with a vital part of the application being a section which asked 'What is the state of the art?'. The problem with this method is the judges do not know if the applicants who submitted the proposal have the ability to carry it out or whether they have simply read the most up-to-date journal articles and conference papers. Brian Oakley highlighted this problem when he pointed out that although British companies had submitted a 'fair share of proposals' for ESPRIT's advanced information processing programme, they had 'failed to win a proportionate share of approved projects'. He went on to add: 'I do not believe that the

Italians are markedly better in this field than we are...However, they appear to be, based on the judgement of the evaluation.' (Owen, Sept. 1985, p.138). The result was that the ESPRIT project selection was accused of being 'too academically biased' (Owen,1985, p.138).

Once the technical side of project selection was complete, the non-technical aspects of the project had to be examined. This included items such as costs, manpower levels and contracts. Contracts were a major problem from two viewpoints. Although sectoral trade associations in conjunction with the directorate had developed IPR agreements, the companies had little experience in applying them (53). In some cases, negotiations dragged on for months. Since the Alvey directorate had stipulated that funding was only available to those 'who are ready to collaborate and accept the rules on intellectual property rights' some projects were in danger of being cancelled since staff could not wait around indefinitely while lawyers haggled (Alvey, 1984a, p.5). As well as this, the directorate had amended the original project selection criteria between September 1983 and February 1984 which meant some proposals had to be resubmitted. The Alvey directorate agreed to back-date funding once the contracts were signed (Alvey, 1985a, p.13).

The second and perhaps more serious problem in the contracts area was their administration. Because of staff shortages within the directorate, potential battles over sovereignty, and because it had been recommended in the Alvey report, it was decided that the Components, Valves and Devices Directorate (DCVD) of MoD would administer all contracts associated with VLSI, the SERC would administer all academic grants, and the Alvey directorate would handle the rest (54). This arrangement was to prove to be an administrative nightmare for the Alvey directorate. One actor involved said (55):

> I think that (it) was probably a mistake. It seemed the obvious thing to do. DCVD was very popular with industry - they'd always liked working with them, they understood their problems and all the rest of it. It would have caused a lot more difficulty to have created a central body to look after those contracts in the short run...In the long run I think it would have created a more coherent set-up because with the best will in the world, we constantly got differences of administration resulting from the differences of the bodies.

The major administrative difference was that (56):

> (In the Alvey directorate), we are prepared to say we will make payments for ongoing work after the instruction to proceed but we don't make our payments until we've actually got the collaborative agreement in our hands because that's the main pressure we have...Now DCVD didn't actually follow that. What DCVD did was to give instructions to proceed and then started to pay. They have a clause which says 'We will cease payment if you haven't produced the collaborative agreement in a year' or something like that.

Little wonder that DCVD was 'very popular with industry'. An MoD official explained (57):

> The DCVD has been in existence since the First World War, involved in making sure the military get devices, first it was valves, then transistors and now it makes sure the silicon processes are there for the military to use. So there has been a long history of interaction between MoD, industry and universities on devices. That meant when Alvey came in, and when the processes of interest to the military...went into the Alvey programme, all the connections and relationships were (already) established by other methods. A lot of that went across into Alvey. As you may know in the VLSI part of Alvey, the contracts go through CVD and the guy who used to run that (VLSI) was Bill Fawcett who used to head a group at RSRE (Royal Signals and Radar Establishment - MoD). So all that sort of 'mafia' was in place. Everybody knew each other and people knew which way they were going.

Although firms with a 'defence IT' background had experience dealing with DCVD, many of them were involved in more than just the VLSI programme. This meant they had to cope with several types of procedures and contracts. The SERC problem, however, was 'very much more obvious'. It was described thus (58):

> We've had endless jealousy-type frictions where the Alvey directorate makes a decision the the SERC petty administrators get very close to remaking the decision if they don't like it. The SERC have...some quite rule-of-thumb instructions such as 'We will reduce all overheads by twenty per cent come what

> may.' These things have been built up over the years and they are not necessarily stupid in the environment to which they apply but they became extremely painful for the Alvey directorate to put up with because if you make a decision... then it is infuriating to have some petty administrator from the SERC questioning that decision. In the end, the directorate can always get its way but it has a sort of constant fight to do so.

As one eminent IT personality said (59):

> You must have heard from other people by now...that the DTI and the SERC are not naturally good friends. I mean there are all sorts of jealousies and rivalries between them.

Alvey was a part of the DTI with Brian Oakley appointed as a deputy secretary, participating in normal executive tasks with other senior DTI officials (60). Its role in recommending grants to academics alienated certain SERC officials. Another feature which may have caused some jealousy was the level of expenditure approval within the directorate. At the time, the council of the SERC was only allowed to approve £400,000 per contract per year, the next level down, an engineering board, only had a £300,000 approval level while a body such as the Information Engineering Committee of SERC could only approve £200,000. Yet David Thomas, an employee of the SERC could approve more in his own right than a SERC committee and almost as much as the board which had recommended funding cuts for IT two years earlier (61).

Alvey Directorate Management and the Steering Committee

Once the Government had initiated the Alvey programme, Brian Oakley was left to contend with an 'unrepresentative and idiosyncratic' steering committee which had been foisted upon the programme at the Prime Minister's insistence. While the directorate and the IT industry recognised the quality of the chairman and members of the steering committee, Oakley especially recognised the need to broaden its industry representation. Some saw this as a continuation of the process of endless consultation with industry in an attempt to gain consensus, while others saw it more as a public relations exercise. As one official said (62):

> It was really very important that industry felt that this directorate was their body...I believe that that is enormously important in the way of doing things. I would think that for the large firms, (the directorate) very largely succeeded in that. The large firms...think that the policy of the Alvey directorate is the policy that the large firms wanted because they have a very direct input into it. I think some of the smaller firms almost by contrast get worried because of that. Whether they feel that the large firms have captured the policy and therefore they have not had a fair deal - or whether they just feel their normal feeling that government has failed to notice the small firms, I wouldn't care to say.

One way to make the IT industry feel that the directorate 'was their body' was to expand the steering committee. One civil servant saw the problem in very Thatcherite terms (63):

> If you are dealing with industrial matters, who actually knows best about the thing? It is very difficult for civil servants to have a culture which understands what is the competitive position on this particular thing (Alvey). So just to get the right ethos of whether to support this or that, one tends to need industrial people to do it. I am most unhappy when one has the civil servants dominating an area for fear that they don't really understand the commercial imperatives.

From the outset, the firms represented on the steering committee were 'defence IT' companies whose primary expertise lay with VLSI. Regular six-weekly meetings were held in the early days but the feeling persisted that the committee was not 'balanced enough and...didn't meet often enough to get on the inside of what the issues were all about' (64). As a result, important deliberations were kept from the steering committee and they were regularly presented with final decisions for ratification. This was one of the legacies of the Prime Minister's involvement. One of those involved at the time recalled how the problem was overcome (65):

> We gradually extended the steering committee by one trick and another so that it became a more representative body. I mean it was done with the connivance of everybody but without getting

> ministers to realise too clearly what was happening because it's not too embarrassing then if Mrs Thatcher should ever notice what had happened...what we did was to have representatives from the other major committees which look after electronics (join)...so we got it up, I suppose to seven people, possibly eight and that was much more balanced. You could then ensure that you didn't just have representatives of VLSI, you also had representatives of software and so on.

For twenty years the systems and software fraternity had been pushing the message that it did not matter how sophisticated the hardware was or how fast the chips were, if the instructions fed into the hardware were nonsense, the information coming out would be nonsense also. This argument is called Garbage In Garbage Out or GIGO. The proponents of the hardware/VLSI industry saw the argument in more international-industrial terms. They believed that unless the UK industry was at the leading edge of technology, they would have grave problems trying to sell inferior quality or technically obsolete goods. Without a strong indigenous hardware industry, they believed the GIGO argument would become irrelevant since it would be all performed on foreign technology. This schism split the steering committee.

A commentator said (66):

> I still think we pay far too much attention to the components, principally because that is where people came from and organisations in the UK are slow to change...but that was a very important issue for the Alvey steering committee, to get

> that balance right and we got a dead-set conflict in the middle of the steering committee between those people who represent the VLSI industry, the few firms who are in that game, and those who represent the systems and software industry. They disagreed entirely about what the programmes should do. It was a split disguised within the Alvey committee (of inquiry) itself - it wasn't disguised, it was covered by simply allowing both sides to have their way. But you couldn't do that within the Alvey programme itself...and to be honest, the split was papered-over rather than being properly resolved.

Undeterred by the split (or perhaps in an attempt to further paper it over), the plan to expand the steering committee went ahead. By 1984-85 the committee had fifteen members, seventeen a year later (Alvey, 1985a, p.128: 1986c, p.105). Membership of the committee is listed in Table 4.2 below. The most outstanding change was the departure of Phillip Hughes of Logica and his replacement by Geoff Holmes of Systems Designers Limited (SDL) and the addition of Mr G D Speake of GEC. There was also a strengthening of DTI's representation. Notable for their absence are the SERC and some of the major participants in the programme such as British Telecom and STC.

One long-serving committeeman said (67):

> There is no question about one thing: the decisions were taken at a directorate level...I mean there is a supervising board that I sit on, the Alvey steering committee, and I can honestly say with my hand on heart that we decided nothing...If I had

> been in (Sir Robert Telford's) shoes, I would have insisted on some of the key decisions being left to the steering committee.

Table 4.2 Alvey Steering Committee Membership

1984-85 Name	Organisation	1985-86 Name	Organisation
Sir R. Telford	GEC-Marconi	Sir R. Telford	GEC-Marconi
Prof. E. Ash	Univ. College	Prof. E. Ash	Imp. College
Dr K. Warren*	Plessey	Dr K. Warren	Plessey
Mr J. Pickin	Ferranti	Mr J. Pickin	Ferranti
Mr J.M.Watson	ICL	Mr J.M.Watson	ICL
Mr J. Leighfield	Istel	Mr J. Leighfield	Istel
Dr H. Hauser	Acorn Computers	Dr H. Hauser	Acorn Comp.
Mr P. Hughes*	Logica	Mr G. Holmes	SDL
Mr C. Fielding	MoD	Mr C. Fielding	MoD
Mr O. Roith	DTI	Mr O. Roith	DTI
Mr A. Macdonald*	DTI	Mr A. Macdonald	DTI
Mr J.H.Major*	DTI	Mr W.B.Willot	DTI
Mr B.W.Oakley*	Alvey	Mr B.W.Oakley	Alvey
Mr S.L.H.Clarke	Alvey (GEC)	Mr S.L.H.Clarke	Alvey (GEC)
Mr R.L.Hird	Alvey	Mr R.L.Hird	Alvey
		Dr J. Thynne	DTI
		Mr G.D.Speake	GEC

Note: * Denotes member of the Alvey committee of inquiry.

While expanding the committee may have helped to build consensus and extend democracy in the IT community, several members found the whole exercise frustrating and time-wasting. One said (68):

> I reckoned that the steering committee should effectively have been a strategic board. Not in detail but in general terms. As a result, all of the things that have happened with the Alvey directorate are entirely Brian Oakley's fault. Entirely. He

> only put things to the committee when they got so out of hand that you couldn't do much with them anyhow or when he wanted endorsement for something he already knew the answer to. That doesn't mean to say that I don't think Brian was a good director because I happen to believe that he kept Alvey alive.

While the members of the steering committee may have been excluded from the decision-making process, the chairman was not. The major decision-making forum was a meeting of the Alvey programme directors held every Monday afternoon and it was accepted practice for Sir Robert Telford to 'sit in on that in an advisory role' (69). Apparently this arrangement suited Sir Robert for as one of those involved pointed out 'The chairman reports directly to the Minister and he could have gone to the Minister and complained' if he was unhappy (70). He did not.

In April 1984, Kenneth Baker proudly announced the first major contract under the Alvey banner, a software engineering project known as ASPECT (*Financial Times*, 7/4/84). This was a three-year, £3.6 million project involving SDL, GEC Computers Limited, ICL, MARI Advanced Microelectronics, and the Universities of York and Newcastle upon Tyne (Alvey News 4, April 1984, p.8). With all strategies except the man-machine interface in place and all director positions filled, full implementation of the Alvey programme was underway

4.3 Conclusion

The implications of the findings in this chapter fall under two headings: (i) The role of the core executive in technology policy-making; and (ii) the part played by the policy community in policy initiation.

(i) The notion of the Prime Minister as an omniscient and omnipotent control agent and central policy-maker is shown in this case to be implausible. The 'steamroller of decision-making' ensures that no one person can understand or even know of all issues. The fact that the Prime Minister received her first briefing on the ESPRIT programme from an EEC Commissioner over dinner, months after the ESPRIT policy had been initiated, supports this view.

The belief that the Prime Minister operates as the central policy-maker on all key issues is equally incorrect in this instance. The Alvey policy was made by industry, the bureaucracy and academics, but mostly by the large IT firms. The importance of industry was emphasised by Patrick Jenkin who used the word 'industry' at least seven times in his short speech to the House of Commons in late April 1983. The insistence of civil servants that industry should see the Alvey programme as 'their policy' and the Alvey directorate as 'their body' also highlights the source and focus of the policy.

Another feature of the Prime Ministerial supremacy model is the potentially high level of control exerted over the apparatus of the state. Although Mrs Thatcher actually stipulated staffing levels and set the size of the steering committee associated with the Alvey policy programme, the bureaucrats quickly got around these restrictions. Her detailed and systematic analysis of a few aspects of policy proposals is in stark contrast to the broad-gauge, intuitive, and authoritarian action-orientation posited by the supremacy model. Although the Cabinet was shown to be willing to criticise the policy proposal for its emphasis on collaboration and request for a high level of government funding, the Cabinet members still shared the Prime Minister's views.

The core executive accepted the view that the threat to the long-term viability of the British IT sector from Japan was real and something had to be done. Unlike most policy processes, there was no alternative programme offered to the core executive. Moreover, the policy proposals were framed in such a complex and intertwined way that it was not possible for laymen to endorse parts of the programme and reject others. The role of the core executive was restricted to final approval or disapproval of the policy proposal. Parliament merely applied the rubber stamp of endorsement.

That Patrick Jenkin and the DoI urged the inclusion of Alvey in the 1983 Budget and failed in the face of Prime Ministerial opposition warrants further attention. It is apparent that the Alvey programme had been approved 'in principle' by all parties concerned prior to the Budget session. By trying to use a back-door method to get additional funds, the DoI alienated the Treasury and once the matter was brought to the attention of the Prime Minister, she once again focussed on the proposals. Although the core executive provided no substance at all to the policy under review, by enforcing the 'norms and procedures of political democracy' (Schmitter, 1985, p.60) the policy and the process were legitimised. Reports in the 'quality' press helped to maintain the chimera that the Prime Minister and the inner executive were debating another policy issue much like any other. By announcing that the Prime Minister had stipulated items such as staffing levels, the charade of the core executive as the policy-maker supreme was played out.

The most important decision made by the core executive, apart from the approval of the programme, was to reduce the level of funding to fifty per cent for industrial projects. The strictures concerning staff levels and steering committee size were easily circumvented. The funding rule was critical. By insisting that industry put up fifty per cent of the funds, the core executive damaged one of the fundamental planks on which the Alvey edifice rested: the notion of a directed programme. The greater the level of funding provided by government, the greater is its potential to direct. The idea was that the Alvey directorate would direct industry and if, say, GEC refused to accept the rulings of the directorate, it would not receive funds; Plessey or ICL would be funded instead. Once that power was removed, the companies were placed in a much stronger position to dictate the direction of the policy. An interesting feature of this funding decision is that much of the literature on incremental decision-making stresses the point that by making small adjustments, serious lasting mistakes are avoided (Lindblom, 1959, pp.83-85; Dye, 1975, pp. 30-31). As will be shown in the chapters that follow, this small reduction in funding had serious and lasting implications for the Alvey programme.

(ii) The policy community that emerged during the policy initiation process did so without a clear dominance of interest associations. The presence of only a few of these groups is indicative of both the fragmented nature of the industry and perhaps the 'incoherence of the British system of business interest associations' (Grant with Sargent, 1987, p.14). The policy network activated in the period immediately prior to and following the setting up of the Alvey directorate assured the dominance of the large firms. It was during this period that the winnowing out of the lesser members of the policy community took place. Many of those who were involved in the Abingdon workshop, attendees at the Westmorland Hotel and actors associated with the Alvey inquiry were passed over in favour of the largest firms who could afford to make good staff available. As well as the representatives of the large firms, the MoD was represented by Dr Bill Fawcett and the SERC by Dr David Thomas and it was this core group which was to have such a profound influence on the programme.

The reciprocity of the Alvey policy is noteworthy. Cawson (1985, p.9) has pointed out the absence of reciprocity in pluralist accounts of policy relationships. In the case of Alvey there were two prime examples. First was the case of civil servants and representatives of interest groups negotiating an agreement on intellectual property rights which meant that researchers had to make their findings available to their collaborators, and in some cases to all members of the particular Alvey club. The second was the fact that companies had to agree to work in specific technological fields, to collaborate, and to conform to evaluation and monitoring criteria laid down by the directorate. In return, the participants were given a large amount of money, a major say in formulating the policy and a share of responsibility in implementing the policy (Atkinson and Coleman, 1983, p.8 quoted in Grant (ed.), 1985, p.14).

CHAPTER FIVE

The Alvey Programme: Its Impact in the Public Sector

From the first day when there 'was not even a paper clip' to the day when Kenneth Baker announced the ASPECT collaborative project, the primary thrust of the Alvey directorate was to get the programme in place and implemented. There was, however, a secondary emphasis that has only been alluded to so far; the generation of an Alvey 'culture'.

The 'policy consciousness' that was generated within the Alvey directorate and throughout the Alvey programme had a profound impact on the content and style of the strategies adopted as well as affecting the relationships between the directorate and the public sector bodies which funded the programme. The Alvey programme was unusual in several ways but it was the spirit or atmosphere or community that it created which ensured that Alvey was different from the JOERS programme or the ESPRIT programme. Understanding the influence that the Alvey community spirit had on the directorate staff, the civil service 'partners' (DTI, MoD, SERC), academic participants, and (ultimately) the companies is crucial to any understanding of the way in which the policy was implemented and maintained.

There are two main strands explored in this chapter. On the one hand there is the anti-bureaucratic/entrepreneurial style of the Alvey directorate which shaped the programmes and created a quasi-private-sector enclave within the DTI by fostering a consensual or club-like climate which permeated the programme and its participants. On the other hand there is the way in which the Alvey programme achieved a measure of autonomy denied to other IT programmes such as MAP and MISP, and in so doing created administrative tensions and divisions, especially between the directorate, the DTI, and the SERC. To draw out the themes of consensus and tension, the emergence of the Alvey ethos and 'team spirit' within the directorate is analysed. This is followed by an examination of the impact the Alvey programme had on the DTI, the SERC and the MoD.

5.1 Generating the Alvey Ethos

There were two major strands in the development of the Alvey ethos. The first was the building of a policy network or community and this was set in motion during the Alvey committee's deliberations. The other was the development of an organisational culture within the Alvey directorate. The thrust to develop an organisational culture began in the very earliest days of the programme's initiation. Staff in the directorate made an effort to distance their unit from the mainstream of the DTI. One source said that within the directorate there had been an 'attempt to maintain the fiction that it reports equally to all three bodies (DTI, MoD, SERC)' and that 'there were a fair number of occasions' where DTI officials had to be reminded of 'these other reporting channels' (1). Another employee, explaining the administrative status of the Alvey directorate, said (2) 'Since I am employed by the DTI - I get my salary from the DTI - then I think formally the DTI is, if you like, the lead department in this thing'. He went on to say (3) 'Nevertheless I'm aware, although I think the industrialists in the directorate probably aren't to the fullest extent, that the thing is accountable through the parliamentary chain, through the DTI'.

An interviewee, discussing administrative arrangements, suggested that the directorate should have been set up as a QUANGO rather than the governmental agency it was and said (4):

> I had a feeling that in the long term the Alvey directorate would be better set up as an industry body but receiving a large grant from government, doing the government's will in certain respects, and having people from the government in the body. It certainly wouldn't work if it didn't have civil servants seconded in, <u>not so much the DTI ones but particularly the MoD and the SERC ones would be very necessary</u>...Now if we could get it outside - a QUANGO - if you could get it that step further remote, then you could avoid some of the stupid bureaucracy that has accumulated because of parliamentary government (emphasis added).

This confusion led one steering committee member to assert that 'it is a kind of QUANGO really' (5) while another described it as 'autonomous within the DTI' (6). A very senior IT industrialist with close contacts with the Alvey programme was even more adamant. He said (7):

> He (Oakley) did not report in the normal DTI chain, he reported right to the top. As a result, the DTI did not approve of him one little bit. And it was the only good thing we got. We got that right. We didn't want him a part of the DTI, actually

built into the DTI.

It was no accident that this perception was put abroad. By deliberately clouding the issue of accountability and administrative command structures, the impression was created within industry especially that the Alvey directorate was some kind of maverick industry-government body which did report to the Minister occasionally but was ultimately under the control of industry. This distorted view of the Alvey directorate helped to create a spirit of independence and autonomy within the programme which was one of the elements in its ethos.

Another feature was the way in which the Alvey staff saw themselves as different from 'normal' civil servants. One said (8):

> I would not describe myself as a civil servant, I would regard that as a disparaging remark...I do think that the culture in Whitehall (is such) that your career will progress very nicely if you never make a mistake. So the thing you had better do is to keep your head below the parapet and if necessary don't do anything. But if you get anything wrong you will never be forgotten for it. I mean ministers resign for speaking up for Westland helicopters or whatever and that's a cultural thing. And that is totally inconsistent with risk-taking technologies. I think it was the sort of romance if I could use that term, of a new start in which the Alvey directorate tried to do new things in response to international competition that attracted a group of people who, far from administering the civil service rules, ignore them.

This was not an isolated view. Another civil servant who was involved expressed a similar belief (9):

> It is very difficult for civil servants in general to have a culture which understands what is the competitive position on a particular thing. So just to get the right ethos of whether to support this or that, one tends to need industrial people to do it. I am most unhappy when one has the civil servants dominating an area for fear that they don't really understand the commercial imperatives.

The way in which the directorate dealt with the press typified the difference between Whitehall and Alvey. An interviewee said (10):

> If you talk to the press they will say 'The thing we like about the Alvey directorate is that if you ring somebody up, you'll be put right through to one of the directors - to whoever you want to talk to and he'll tell you exactly the way it is...When they ring up other parts of the civil service they are told 'You must speak to the press office'. There is a culture (in the civil service) where we are told all the time, 'Whatever you do you must tell the press office' but there are just not enough hours in the day. So the press ring through and you give them the answer and hope it's all right. The civil service can't handle it but they can't stop us. We're here. We exist. But it would like us to go away...the strain is beginning to show.

The view that Alvey was 'more co-operative' and 'very accessible' was borne out by journalists who were interviewed (11,12,13). The directorate also ignored standard civil service practices on occasions such as calling tenders for equipment. A commentator explained (14):

> We have people in the contracting area who say 'Well you have to go out to tender.' We say 'Thanks very much for telling us.' and we keep doing it - you know, not going out to tender. Because if there is only one company in the country that you believe can do it, what the hell is the point in producing a great tender document to show you're being fair when you know damn well if you're being honest with yourself, that's the only company that can do the piece of work. You're just making administration.

This type of action was more the exception than the rule. As one senior Alvey officer explained, 'We normally go out to tender when we're trying to buy something on a 100 per cent payment basis' (15). The fact remains, however, that administrative short-cuts were taken. There was another side to this apparently conscious rejection of the formal Whitehall approach to programme administration in favour of a more informal private sector style. Because the directorate was badly understaffed and of the staff that was there, many were from the private sector, it was almost inevitable that short-cuts would be taken or that incorrect procedures would be followed. This was highlighted during a staff inspection conducted by the Management Services and Manpower

Division of the DTI in March 1986. The report said in part (DTI, 1986, 1.3(f)):

> f) the perceived autonomy of each of the technical directorates did not promote smooth development of co-ordinated procedures. Some of the directorates had committed the Directorate to expenditure without conforming to normal practice for procuring services or equipment out of public funds.

Another feature which was a part of the Alvey style was the already-mentioned practice of soliciting and 'massaging' project proposals. Schemes such as MAP and MISP were reactive in comparison to the proactive style of the Alvey programme. The Alvey directors achieved a much higher profile within the IT industry by adopting these practices than civil servants administering schemes normally achieve. As a result, the individual programmes were very much identified with their director. For example, one industrialist from a major software house said (16): 'From our point of view the most significant individual was David Talbot who did a really super job in the area of software engineering.', while another industrialist singled out Rob Morland of PA Technology, Dr Bill Fawcett's successor in the VLSI programme. He described Morland as 'bloody good, in fact excellent' (17). By establishing a close relationship with technologists from both industry and academia, directors were able to forewarn them of potential problems and advise them what to say and how to frame proposals (18). This was a most unusual approach for a public sector body to adopt.

Alvey Decisionmaking and Political Insulation

The fact that Brian Oakley was appointed at a deputy secretary level answerable directly to the then permanent secretary of the DTI, Sir Brian Hayes, insulated the directorate from many of the day-to-day bureaucratic struggles that are a feature of civil service life. As well as this, the directorate was housed in Millbank Tower, well away from the major DTI administrative centres. Being thus cocooned, the directorate developed an autonomy not achievable by other divisions and sub-departments within the DTI. An example of this autonomy was evident in the area of IT architecture. This broad classification which embraces aspects of IKBS, VLSI, and MMI is primarily concerned with ensuring the interaction of processors which control speech, vision, robotics, knowledge representation and inferential decision-making by developing appropriate interfaces, standards and concepts, the most important of which is parallel processing (as opposed to serial processing).

Initially the emphasis within the IKBS programme had been towards expert systems rather than architecture while many universities which were working in the field of architecture were still being funded by the SERC's DCS programme. Within a year of the Alvey programme's commencement, it became obvious that the need for a separate architecture programme was emerging. In July 1984 a meeting was held at Warwick University where 200 of Britain's leading academic and industrial experts in the field came together 'for the first time ever' to discuss a possible strategy (19). The strategy guidelines were developed largely as a result of the work of Dr Ronan Sleep and Mr Alan Bagshaw, a consultant to the Alvey directorate and former ICL employee who canvassed industry opinions on the topic. The decision was made within the directorate to mount a programme with a 'notional £19 million budget' (Alvey directorate, 1985a, p.47). There was no political intervention whatsoever.

A senior Alvey officer when asked if this decision was referred to Cabinet replied 'Certainly not. There was nothing in the thing which would have required that.' (20). A senior DTI staffer, referring to Brian Oakley's role in this decision, suggested that if Oakley 'had been a better civil servant', he 'probably would have consulted with ministers on the issue' but in general, Oakley 'kept clear of ministers' (21). Once the Alvey programme was fully implemented, only 'one decision went up to the Cabinet' (22). This in part exemplifies the way in which the directorate distanced itself not only from the DTI but also from its ministers, the core executive and Parliament.

Another factor which contributed to the independence or autonomy of the directorate after policy initiation was the strict adherence, with architecture being the exception, to the proposals contained in the Alvey report. Several members of the Alvey committee of inquiry commented on this conformity describing it as 'remarkable'(23), 'strange'(24), 'noticeable'(25), and 'inexplicable'(26). The reason these interviewees all remarked on this factor was because when framing the proposals in the committee of inquiry, the proposals 'were only ever put forward as a 'For Instance', they were not inscribed in stone' (27). There was an expectation among this group that once the programme had been approved, the directorate and the steering committee could then generate programmes as they saw fit, a view described by one Alvey source as 'naive' (28). Apart from the staffing and infrastructural constraints and the pressure from industry to start distributing funds, the directorate felt it did not have a mandate to revise what had been agreed to by the British IT community, reviewed and approved by the core executive and endorsed by Parliament (29). It is not difficult to imagine the outcry in the IT press if the directorate had announced a major cut in funding for the VLSI or software engineering programmes in favour of IKBS or the Man-Machine Interface programmes. By only deviating slightly from the original proposals of the Alvey report, the directorate avoided attracting unfavourable attention.

Some aspects for which the directorate has been criticised have turned out to be factors which have strengthened its insulation and autonomy. One example of this was its lack of clearly stated objectives.

During the course of an extensive interviewing sequence, there were many and varied statements of what the objective(s) of the Alvey programme were. Potential objectives included 'reducing the cost of R&D by collaboration and making Britain's IT industry more competitive' (30), 'maintaining a viable IT industry in the UK' (31), 'meeting the Japanese and American threat head-on' (32), and 'develop(ing) an enabling technology in IT on which an effective industry could be built' (33). Others singled out individual programmes and spoke of the 'strategic importance' of the VLSI industry (34), the need for 'security of supply' (35), or in the case of the software engineering programme, concentrating resources where Britain 'has a leading edge' (36). The Alvey report had failed to identify specific policy objectives, and the Alvey directorate even had great difficulty in setting technical targets for all of its programme. This was a curious policy insofar as the programme was directed but it had no overall goals. Nobody knew what the objectives were.

This was acknowledged as 'a bad thing' although in defence of the Alvey committee, one member said 'it was not possible to get a coherent set of objectives except in a hand-waving way' (37). Not only were there no clearly stated objectives, the Alvey directorate did not have a strategic plan. One observer said 'Plans might be okay for a clearly defined operation but they would be useless for a programme like this.' (38). It seems clear that both the Alvey committee and the directorate were reluctant to commit themselves in print to hard and fast objectives. If specific objectives were set it would be much easier for critics or evaluators to highlight failures when shortfalls occurred. By restricting the objectives to vague 'hand-waving' gestures, the Alvey programme effectively spiked some of the guns of its opponents in advance and thereby ensured that its leadership would not have to spend time explaining the failure of the programme to meet objectives.

An important aspect of the development of an Alvey ethos was the minimising of disagreements (or the promotion of consensus). This took many forms. The most obvious were the large public meetings with industry and academics during the development of the individual programme strategies, and the removal of all contentious decision-making powers from the steering committee. Another example was that the break-up of funds between the programmes 'was never allowed to be published and therefore fought over' (39). The official funding arrangements were only ever publicly stated in the original Alvey report but there is a difference between what the Alvey committee of inquiry recommended and Parliament ratified and what the directorate proposed to spend in each area. An analysis of Alvey funding and expenditure is in the following chapter. The figures are irrelevant to the analysis of the Alvey ethos but the reluctance of the directorate to publicly announce its intention in this area is indicative of the 'keep the peace at all costs' attitude that prevailed.

From the preceding pages it is apparent that the directorate set out to insulate itself from bureaucratic politics and the political process in general as well as attempting to achieve a consensus in most areas. These goals it largely succeeded in meeting. There was another side to the Alvey ethos however. This was the fostering of a spirit of camaraderie or community. One of the most striking features was the cordiality which existed between most of the civil servants, industrialists and academics associated with Alvey and the esteem in which they generally held each other. This was evident in interviews, within the Alvey directorate and at conferences and 'town meetings'.

The origins of this community spirit can be traced to four main sources. The first was the SERC's Distributed Computing System which brought industry and universities together on joint projects for the first time in most cases. The second was the joint industry-academic-civil service committees which exist in the public sector. For example a review of the membership of the Computers, Systems and Electronic Requirements board of the Department of Industry in 1976, the fore-runner of the Electronics and Applications Requirements Board, shows that three of its ten independent members served on the Alvey committee (Philip Hughes of Logica, Derek Roberts then of Plessey, and Dr Roger Needham (now professor) of Cambridge) while two of the remaining seven (Professor Randell and Charles Read) joined Roger Needham on the Reay

Atkinson-led mission to Tokyo (DoI, 1976, p.45). The third was the consensus building process of consultation engaged in by the Alvey committee of inquiry and the Alvey directorate when generating the programme strategies. The fourth source was the highly mobile nature of employment in the IT sector. Given all of these pre-conditions, the task of generating an Alvey *esprit de corps* was made simpler.

One of the early manifestations of the attempts to develop a team spirit was the the announcement of the formation of Alvey 'clubs'. These clubs comprised 'representatives of all partners engaged in contracts within a single Alvey category' which met regularly to 'review progress and provide constructive feedback' (Alvey News 1, Sept. 1983, p.4). They were also a primary vehicle for facilitating the transfer of technology by bringing 'together the community in each field' (Alvey Directorate, 1986c, p.7). By mid-1986 there were six Alvey clubs (one for each programme) with sixteen sub-clubs, nine IKBS community clubs, and numerous special interest groups. In most cases the clubs were only open to participants in Alvey projects but in the case of the IKBS community clubs and special interest groups, non-Alvey organisations were encouraged to join. The IKBS community clubs were of particular interest. For a fee of £10,000 which was matched by the directorate, a firm could join an industry-related club and participate in the expert system. Apart from engendering a team spirit, the clubs helped to spread the Alvey gospel as well as giving Alvey researchers an opportunity to apply their research.

While all projects were supposed to be collaborative, there were some (mostly academic) that were not. These were known as 'uncle' projects. If a university researcher wished to carry out work that was considered too long-term or divorced from commercial reality, the directorate would often fund the project and appoint an industry expert to take an avuncular interest in it 'to keep their (the researchers) feet somewhere near the ground' (40). This was an important feature of the Alvey policy climate as it helped dispel the view that only the big universities and companies would get funding while at the same time it gathered more converts to the Alvey fold. One hundred and sixteen of these projects were approved at a total cost of almost £12 million.

Although the Alvey committee did not identify communications and infrastructure as a separate programme, the directorate initiated one in an attempt to generate greater interaction between participants. The main features of the programme were an office automation system within the directorate with links to SERC's RAL and head office at Swindon and MoD offices near Earls Court, an Alvey electronic mail system linking most UK academic sites and the DARPA community in the USA which cost the directorate £60,000 per annum, and a high speed network (Alvey, 1986c, p.89). The Alvey directors hoped that these systems would be heavily utilised with all Alvey participants receiving and sending messages. Their hopes were not realised because the system adopted was inefficient and most use was made of it within the directorate. Perhaps its greatest benefit was as a symbol.

Except for the electronic mail system, the directorate had an excellent record in communications and accessibility. As well as the bi-monthly newsletter, Alvey News, the directorate published approximately fifty documents ranging from brief strategy overviews of five or six pages to the 420 page supplement to the 1987 annual report. Each programme also held regular workshops and seminars which were widely advertised in advance via the newsletter and in June 1985 the first Alvey conference was held at the University of Edinburgh with over 550 attendees. Further annual conferences were held at the University of Sussex in 1986 and at the University of Manchester in 1987. As a result of the successful 1986 conference, Brian Oakley confidently stated 'there really is now a coherent Alvey community from industry and the academic world, working together with common aims' (Alvey News 18, August 1986, p.5), thus reiterating the view Sir Colin Fielding of the MoD expressed at the 1985 conference when he spoke of 'the great collaborative spirit that has been gained from the Alvey programme' (Alvey News 12, August 1985, p.16). What these 'common aims' were is a moot point.

Another feature was the openness of the directorate to outside evaluators from the Science Policy Research Unit (SPRU) at the University of Sussex and the Policy Research and Engineering Science and Technology (PREST) group from the University of Manchester as well as various academic researchers. One Alvey director described the programme as 'over-evaluated' and said, 'I don't think any government scheme has ever been put under the microscope to the degree that the Alvey programme has' (41).

Within the directorate as within the projects, the success was heavily dependent on goodwill and cooperation between actors. An Alvey director said (42):

> The relationships within the directorate have been ideal. I mean it is a happy bunch of people and we get on remarkably well together. I can honestly say that I do not know - we have

about fifty people working here - of one serious row there has been in three years. That is unusual in any organisation.

The cordial relationships were crucial to the successful development of an organisational culture, especially in the early days of the programme. The DTI staff inspection noted the heavy workload of the Alvey staff, secretaries working 'up to 12 hours a day' while others were unable 'to take the time off owing' to them (DTI, 1986, 3.5; 3.12). It is not difficult to imagine the hours that management were working in light of the hours the staff worked. At a more superficial level, the directorate adopted a symbol or logo in its first weeks of operation and this too signalled the intent to create a separate identity. Unfortunately the symbol is a pentagon, a poor choice perhaps in view of the criticism levelled at the IT industry's close association with the defence industry and the MoD. This symbol was displayed prominently on all Alvey publications, on Alvey stationery, even on neck-ties, and so became a part of the Alvey culture.

It seems highly unlikely that the Alvey programme could have succeeded if it had been administered simply as another DTI programme for the IT industry according to Whitehall rules. Alvey was a directed programme, unlike MAP and MISP, which relied on collaboration to attain its unstated objectives and as such it required a different style. The Alvey style was organismic rather than mechanistic and was characterised by accessibility, anti-bureaucratic methods, consensus, co-operation, and operational independence. While it encouraged a positive spirit or policy consciousness, it was not always viewed in a positive light by the directorate's parent department, the Department of Trade and Industry.

5.2 Alvey's Impact on the Department of Trade and Industry

The Department of Trade and Industry should have been the most important organisation in the Alvey initiative. It was the DTI that sent the Reay Atkinson mission to Tokyo, organised the Westmorland Hotel debrief, was involved in setting up the Alvey committee, provided over half of the government funds for the programme, and was the department with ministerial responsibility for the Alvey directorate. Despite this, the DTI staff inspection of the directorate noted (DTI, 1986, 2.1):

> DTI's participation in the Alvey Programme compares oddly with that of MoD and SERC. There is little direct participation of the corresponding sponsor divisions (of DTI), notably IT and LA (a phonetic acronym for Electronic Applications), or of the Research Establishments. Links are only achieved through the requirements board and advisory committees and by substantial personal contacts between postholders in Alvey, IT and LA, and NPL (National Physical Laboratory). In contrast, through the VLSI and IKBS programmes, the respective technological and administrative divisions of MoD and SERC, notably the DCVD of MoD and the Rutherford Appleton Laboratory of SERC, are key participants in the programme and form part of the Alvey complement.

One senior DTI official gave some background to this curious situation. He said (43):

> You've got to look back at what happened between 1980 and 1983. We had a minister in the form of Ken Baker who was hyperactive in the IT area - you know, he has been accused of 'a gimmick a day' by the opposition in the educational field - he certainly had an initiative a week when he was here including IT82, a huge programme. Now that very much absorbed the efforts of a lot of the division in driving all the activities - there was a tremendous amount of activity going on - there was no way they could have handled the Alvey programme as well and achieved anything like the Alvey programme did do. It just wasn't feasible. So it was only when the peak of activity with IT82 passed that things began to return a bit more to normal.

By time things returned to 'normal' the Alvey programme was up and running, strategies had been developed, and projects were being evaluated. This happened with minimal involvement from the DTI. The same official explained (44):

> The task of handling the relationship with Alvey has obviously not been a terribly easy one, especially in the begining, because they had a very high profile and they were handling the research programme for a big chunk of my industries and therefore they sort of cut across, if you like, what we should have been doing if we'd had a longer term view of industry.

> They were - obviously being composed largely of businessmen brought in - they didn't know very much about how the government machine works. So they put their heads down and charged off and did things. And it took quite a long time - about a year-and-a-half - to gradually get the relationship onto a more satisfactory and cooperative plane.

Another senior DTI staffer describing the main differences between his division and the Alvey directorate said (45):

> It's certainly an oddball...for example, all of my staff are professional full-time civil servants whereas a very high proportion of the Alvey directorate are not civil servants. They are on loan or secondment or whatever from industry or from other departments like MoD or SERC. So the staffing is much more cosmopolitan if you like...There is also far more freedom I think for the Alvey directorate to take decisions which ought to have made things quicker. In fact I don't believe that they neccessarily have been quicker. I think that they have quite often got bogged down on exactly the same sort of things that we would have got bogged down on had we done the job here: contracts, property rights and so on. You see at the Alvey committee stage...one of the things that most of the industrial people wanted, quite naturally, was that they should be able to get their hands on the money very quickly. I and my colleagues pointed out that if you were spending public monies, things didn't happen that way...So I guess the staffing was

> different and the amount of freedom they had, especially in the early days. I suspect that as time went on those freedoms became infringed. They would find that the system begining to close around them, they would have the auditors move in and that sort of thing. So yes, they did have a different organisational culture in that somewhat free and easy way in which they can operate. But I think that's perhaps temporary. They're now talking about the possibility of an 'Alvey II' or whatever it is called. I don't think if there were an 'Alvey II' programme it would be run in the same way 'Alvey I' was run. I think there would be a tightening of procedures...The moment you have another organisation involved in the system, you've got the problem of communication and integration, underlap and overlap and so on. But I don't think the nature of its different culture has caused any problems at all...the irritations when they come are that you suddenly discover they are doing something that you didn't know about.

A senior DTI source explained the auditing arrangements for the Alvey programme as follows (46):

> First of all, because it spends government money it is audited by Parliament just like anything else - I think it is called the National Audit Office and they can come along and look at your figures any time. Secondly, right at the begining Brian Oakley invited two organisations to review the programme as it was going along, one from PREST and the other from SPRU.

While the Alvey directorate was subject to some of the same restrictions as 'normal' departments, it was the differences that pre-occupied many of the DTI staff who were interviewed. One explained (47):

> There were real problems in coordinating our approach to IT. For example the Alvey directorate would do something and we wouldn't find out about it until weeks or sometimes months later. At the same time, we might have started work in the same area. So there was that coordination problem. That was the main problem. It's very hard when you have a directorate like that for a government to actually decide policy issues in the IT area simply because you've got two voices. You've got the Alvey directorate which is basing its policy recommendations on its experiences in the programme and then you've got the IT division and the LA division who have got quite a different perspective, rather a broader view of the industry. So the interrelationship between the three is quite complicated and you've got telecoms in there as well, another joker in the pack...<u>I believe the Alvey directorate should be absorbed into the department because, at the end of the day, it is nothing more than a funding mechanism</u> (emphasis added).

Such a dismissive note highlights the tensions between the directorate and its parent department. A senior civil servant from the DTI identified some of the differences between the bureaucraticly 'correct' DTI and the free-wheeling independence of the Alvey directorate. In this official's view, the directorate's methods were not entirely without merit (48):

> They (Alvey) probably would not have been able to achieve the same profile and impact if they had not had the independence and used it in the way that they have. There is no doubt that Alvey has become known throughout the industry and academic world and is a symbol to them and has a profound effect on people. The other side of the coin is a slight envy - you know, that grass is greener - that as civil servants and strictly accountable for the way money is spent and constrained by procedures, in particular by the way that one is a servant of ministers and all public actions of the Department are done through ministers - one is more constrained. I guess that it would have been difficult to have got a programme off the ground as effectively without the sort of autonomy it has had. Certainly the fact that it was composed of and driven by industrial secondees meant that it was not very good - whether deliberate or unconscious I'm never quite sure - it was not very good at coordinating and collaborating with the other bits of Whitehall i.e. the other divisions (of DTI) in particular. I mean we find it extremely annoying and frustrating to find that they are doing something which cut across what we did either in ignorance or deliberately and couldn't care less. We found that quite annoying. Also it's pretty clear that quite a lot of the organisation is pretty shambolic. I mean it was not as buttoned down as say a division within the Department would be.

> We would be hauled over the coals. So I think they had a degree of protection against the oversight that allowed them to do that. But were they more effective as distinct from efficient as a result of that? I think quite possibly they were. They spent money in a way which was less strictly controlled but they achieved more as result of doing it.

There was an undercurrent of condescension tinged with antagonism among the DTI staff interviewed. The condescension seemed to stem mainly from the feeling that the Alvey directorate was staffed by people who were administrative amateurs in the Whitehall league. The antagonism appeared to be a result of the view that Alvey was invading a DTI policy fiefdom and getting favourable press coverage when doing so. Alvey was seen more an annoyance than a threat however.

The DTI were also tardy in providing sufficient administrative and secretarial staff to the Alvey directorate. Ten DTI staff in Alvey's administration branch had responsibility for the support and coordination of Alvey's administration, control of the DTI's financial input to Alvey, and the coordination of the ESPRIT policy and programme on behalf of the DTI. Given that several of these officers were typists or clerical assistants, the workload was very heavy. As the staff inspection pointed out (DTI, 1986, 2.1):

> As the programme has gathered momentum the resources in the Administration Directorate have become inadequate: in comparative terms the Alvey Directorate is considerably less well resourced in manpower than a major DTI sponsor division

> having responsibility for an annual budget of £40-65 million, yet it has the additional complexities of multi-sourced funding to contain as well.

A DTI official dismissed this complaint saying that 'hindsight always provides you with the best strategy' and declared that staff shortages are 'a good discipline' (49).

The staffing and organisational problems suffered by the directorate were a reflection of similar problems within the DTI. As one senior DTI officer complained (50):

> There have been seven major staff reorganisations in the past three years - well, two major and the rest were not so major... It is a perpetual problem. It is obviously a fairly time-consuming problem and it is continually developing.

He also conceded that there were general 'problems of morale' in the divisions of the department which dealt with aspects of information technology (51), a view with which another senior DTI official agreed (52). Much of this arose as a result of the confusion that existed prior to and as a result of the reorganisations as to which section or division was responsible for which aspects of policy and decision-making. A high-ranking DTI staffer explained (53):

> Even in the department you have two basically electronics divisions, IT division and Electronics Applications division. Electronics Applications looks after electronic components, the

> technology and the industrial applications electronics generally. That is the sort of bracket around us. The other division tends to look after the computer sector, office equipment and the more business side of things. Then you have Communications which is in TP (Telecommunications and Posts) division. The moment you have more than one - if you had one it would be huge and that would cause problems anyway - is that you've got these difficulties of knowing who is doing what and who isn't doing what. The obvious problem arises when you have something that's on the borderline between communications, and IT and electronics and all three parties are involved in some way.

If senior administrators were confused, it is not surprising that operational staff had 'problems of morale'. This type of problem was a manifestation of a much broader malaise that afflicted the DTI. As a senior IT figure stated (54):

> The Department of Trade and Industry is not a top department. People do not regard it as the acme of their career to go there. A minister would not regard it as the peak of his career. It is a transition post. I don't know how many ministers I've had in the past five or six years but it is five or six. However good or well meaning or well briefed they are, their decisions are in essence short-term decisions.

For administrators in the industry divisions of the DTI, the situation is even more dire with seven ministers in the eight years from 1979, five since the amalgamation of the Departments of Trade and of Industry in 1983 (see Table 5.1 below).

Table 5.1 Secretaries of State for Trade/Industry Since 1979

Sir Keith Joseph	May 1979-April '82	Secretary of State for Industry
Patrick Jenkin	April '82-June '83	
Cecil Parkinson	June '83-October '83	" for Trade and Industry
Norman Tebbit	October '83-September '85	" " "
Leon Brittan	September '85-January '86	" " "
Paul Channon	January '86-June '87	" " "
Lord Young	June '87 -	" " "

There were other problems besides that of a lack of ministerial continuity. One such problem was a lack of in-house expertise and a growing reliance on advice from outside the civil service. An interviewee from the DTI said (55):

> We actually have a bit of a problem in the UK at the moment. I think the public sector as a whole and certainly the civil service as a whole, and not the least the DTI, is going through a difficult patch where politicians find it difficult to accept that they do have expertise or if they don't, they ought to have expertise within their own camp. To rely on experts from industry without having a means of cross-checking what they say within your own ambit is putting yourself in some difficulty.

The lack of in-house expertise within the DTI was also commented on by others. One commentator said (56):

> DTI is a very, very peculiar department and I had little regard for it and very little concern when I was at MoD. I supported Alvey because I believed the MoD was necessary to push it along. I would hate Alvey to end up like the DTI...Now, there again you see, there is this fundamental difference between the MoD and the DTI. The Ministry of Defence has got this very substantial organic scientific technology infrastructure. Therefore if I have people like Alvey coming along and lobbying me, we can put forward a fairly good response. Now I think this is an essential problem with DTI. They haven't got that expertise. So the real question is: 'Haven't DTI been excessively dependent, or been seen to be excessively dependent, on external expertise?' - I think the answer is 'Yes!' in the sense that there has not been strong enough counter-weights in-house. (emphasis added)

Another senior DTI officer tried to explain the situation (57):

> We use people from outside. We have to. If you're talking about an area, any area that has got technical issues whether it's technical in the technological sense or technical in the legal sense, we have to rely on outside help. We have to rely on lawyers, on merchant bankers for advice on privatisation and so on. At the end of the day you have to use your judgement and

> make up your mind and advise ministers...I think that occasionally the wool may be pulled over the eyes but not very often.

A member of parliament was far more critical. He stated (58):

> The DTI to my mind are living at least five years behind the times, the industry is well ahead of them. Wholly inappropriate policies are being foisted upon industry...I would rather see a private sector man (in the Alvey directorate) than I would the DTI. My experience of the DTI - I cringe when I see the dead hand of the DTI touching on new technology policy because it is generally pedestrian and out of touch.

A major IT company spokesman saw the problem somewhat differently (59):

> When Alvey was set up we had two people - in charge overall was Patrick Jenkin and under him was Kenneth Baker. However both of them, well it seemed to me, both of them were seen to be far too good or far too knowledgeable and they were gotten rid of bloody quickly. I got the impression that Her Majesty's Government does not rate competence as one of the high issues. There's nobody on the Government who would know the bloody time of day in information technology. Poor old Geoffrey Pattie tries hard. He's another hard trier...He's got the dear old DTI at his arm telling him the way it ought to be. He's thoroughly confused...We get unfortunately what we elect which is a

> shambles and the DTI and the civil service generally doesn't help. Their motivation seems to be indescribable. The people in DTI - there are many of them who are very good people - there are a number there, who, given half a chance I would employ any day. Really. No, I mean it. But the problem there is the environment - it's an appalling environment. You can put good people into a lousy environment and get a lousy mess. The environment quite often puts them in a competitive situation with their colleagues when they're not. Encourages that competitive situation and in fact the objectives that many of them perceive have nothing to do with the good of the country or the good of the industry.

This last part of the quote underlines a point that a previously-quoted DTI official was making. The IT division looks after office equipment, the LA division looks after microelectronic applications, and the Telecommunications and Posts division looks after telecommunications devices. Who is responsible for a micro-chip specifically designed for an office telephone system ? Battles for sovereignty are waged along both divisional and industry lines.

The one small part of the Alvey programme that the DTI had most influence over, the displays projects within the MMI programme, was not seen as a success. The Electronics Application division of DTI 'were keen' to take these projects on and in the face of 'the few large companies that kept writing to the ministers and saying that' the Alvey directorate 'had got it all wrong', the project went ahead against the better judgement of the directorate (60). An official explained the situation (61):

> I have never believed that we should have been doing displays in the programme. We did it in a peculiar way - we did it in association with the department, the DTI itself. I think it was a mistake. I am prepared to lay a small bet that none of it ever gets exploited.

What this spokesman failed to add was that the origins of the DTI's involvement in the MMI displays programme can be directly linked to the DTI's role in the JOERS programme. Perhaps this was a case of envy on the part of the directorate. Because JOERS pre-dated Alvey and DTI had sponsored JOERS, the DTI was unwilling to surrender sovereignty over it.

With the type of situation exposed in the preceding pages, it is little wonder that the relationship between the Alvey directorate and the DTI was strained. The DTI was suffering from internal problems as a result of reorganisations, confusion over policy responsibility, ministerial discontinuity, and had undergone a major upheaval with the amalgamation of the Departments of Trade and of Industry at the time the Alvey progamme began. Staff in the DTI harboured animosity towards the directorate for the high public profile it adopted, to the fact that private sector amateurs were doing work best done by professional civil servants, and to the addition of another policy body to an already crowded and confused field. Add to this the move by the directorate to distance itself from the day-to-day running of the DTI and tensions seemed almost inevitable.

5.3 Alvey and Its Impact on the SERC

As with the DTI, the Science and Engineering Research Council was closely involved with the Alvey programme from its inception. It was as a result of the SERC-inspired Abingdon workshop that the 'IKBS pulled' programme proposal was developed and presented at the Westmorland Hotel debrief. It was not surprising once the Alvey programme was approved and IKBS was identified as one of the major enabling technologies, that SERC was approached to take responsibility for the IKBS programme. The Alvey initiative was welcomed by the SERC in a politically astute, pro-industry way (SERC, 1984, p.6):

> The collaborative activity inspired by the Directorate should result both in innovations of immediate interest to British industry and in an improved research capability on which industry can rely for future advances.

An SERC officer recalled (62):

> Because SERC accepted responsibility - major managerial responsibility - for one of the four enabling technologies, IKBS, SERC had to find a director in that area. We tried to talk a lot of prominent academics into taking the job but no-one wanted to leave research to do something that is a management job. We tried to get people back from the States but we couldn't match salaries and they didn't want to come.

Finally Dr David Thomas agreed to take the post on a temporary basis until a permanent director could be found. He held the post for almost three-and-a-half years. Thomas was director of IT for the SERC, director of the IKBS programme, and responsible for all liaison with SERC during this period. The Alvey directorate was greatly advantaged by having such a senior and respected figure on the staff and the generally smooth operation of the SERC-Alvey interface was largely due to his efforts. On the other hand, the SERC also gained from this situation. An SERC spokesman said (63):

> We are especially fortunate in having Brian (Oakley) and David (Thomas) and with the information we can feed in through both those individuals, we have had as much influence as we could hope to have had.

The Information Engineering Committee (IEC) was responsible for monitoring the SERC's involvement in the Alvey programme 'retrospectively; it doesn't take any decisions about projects' as one source explained (63):

> Since the money is still, as it were, in the SERC pocket and the chairman of the SERC is responsible in the eyes of the Public Accounts Committee for spending that money, then he has to be assured that things are alright. So he surrendered sovereignty and let the Alvey directorate make decisions but once a year he gets this group of academics to overview the programme.

Although the composition of the SERC and Alvey committees changes over time, twelve of the twenty-one members of the IEC during 1983-84 were also members of various Alvey committees with the immediate past chairman of the IEC, Laurence Clarke, serving as deputy director of the Alvey programme while his successor, Professor Eric Ash, served on the Alvey steering committee (SERC, 1984, p.92; Alvey, 1985a, pp.128-135). With such close communication and liaison it is not surprising that there were no disputes or criticism of the SERC's involvement in the programme from the IEC.

There were problems however. An Alvey staffer explained (64):

> The problem with SERC has been very much more obvious. Now here we said 'Any academic grants which appear throughout the programme we will leave to the SERC to administer'...Now that didn't seem unreasonable because SERC is the body that puts out grants to academic bodies and there are obvious advantages in using the same people for Alvey grants since you could ensure common standards of behaviour and so on. So you don't get the situation where the directorate gives one set of overheads and the SERC gives another. In fact it has caused us endless trouble, unlike the MoD one. We'd have had a different sort of trouble if we had done it all centrally but it was a mistake. I have a feeling that it is a human mistake - if we had the SERC administrators working up here in London - they happen to be in Swindon - within the ethos of the directorate, then I think a lot of the problems would have disappeared...I think it was a mistake to have the administration devolved. I think we should

> have had the administrators working here who came from SERC so their instinctive outlook would have been that of the SERC but who, if they had been within the group here, would have taken the ethos from the central directorate...It is easy to say that now, but in setting up the directorate we had to cope with the problem that bodies like SERC and MoD were losing sovereignty over what they were doing. Therefore the minimum extent to which we disturbed their usual way of working, the better.

Another source confirmed this problem (65):

> There always is a sort of tension between those people who are administering grants where, after it has been approved here (the directorate) then the only thing these people can say is 'No'.They can't be positive about it, they can only say 'That is an inadmissable cost' or something like that. So that sort of bureaucratic thing has caused resentment on occasions. Also last year the SERC thought it was going to get into a cash-flow problem and it was witholding grants. In spite of all the pressure applied, there is a finance officer in the SERC who sets himself up to be the financial conscience of the SERC and makes sure they don't overspend. But in six months we went from a situation where the Alvey grants were being held up and everybody was screaming about it at the Alvey conference in July (1985), to a situation at the end of the calendar year where there was a big underspend.

The cash-flow problem was serious enough for Brian Oakley to single it out for special reference at the 1985 Alvey conference and to address it in the August edition of the newsletter (Alvey News 12, August 1985, p.3,5). By holding up grants for academics, joint industry-academic projects were delayed as well as 'uncle' projects. The problem was resolved in the short-term by the transfer of funds from DTI and MoD to SERC. The cash-flow problem should not be entirely laid at the feet of the conscientious finance officer. As one interviewee said (66):

> Financial control is very difficult when you've got all your money out in universities and you're reliant on people putting in bills. You have to chase them and we've had a lot of people making this happen so we can balance our books. I suppose that was the most difficult thing we've had.

There was an added problem in that the cash-flow was estimated using a computerised forecasting program and when the actual expenditure trend-line approached the estimated expenditure, funding was halted (67). A case of misplaced faith in the infallibility of computer systems.

Except for the witholding of grants to universities during 1985, the problems between SERC and Alvey were mostly minor and at an operational level. One of the factors that facilitated the effectiveness of the partnership was that Alvey was able to utilise substantial staff resources at SERC's Swindon headquarters and at the Rutherford Appleton Laboratory. One source said that Dr Thomas had 'forty technologists' he could call on for support as well as six people 'helping with coordination' (68). The other reason for the generally warm relationship between Alvey and the SERC was that the SERC gained enormously from the Alvey programme. During the 1980 s when SERC research grants to universities and polytechnics were declining, static or only slightly increasing in most areas, IT received a massive injection of funds (see Table 5.2 below). The Alvey committee estimated that £50 million needed to be set aside for university research but this proved to be too low although the Alvey directorate has never publicly stated exactly how much was put into the academic sphere of the programme.

Table 5.2 SERC Research Grants to Selected Categories (£M)

Category	1981-82	1982-83	1983-84	1984-85	1985-86
Information Technology	23.6	28.5	34.1	50.5	71.5
Physics[a]	21.9	23.5	20.8	19.7	22.7
Biological Sciences[b]	21.1	19.9	20.1	19.6	19.5
Chemistry	19.9	19.0	19.1	17.8	19.2
Astronomy	14.9	14.5	13.6	18.4	19.0
Environment	6.6	6.9	2.3	10.1	10.5

([a] - Includes nuclear physics and physics but not nuclear structure costs
[b] - Does not include biotechnology)
Source: SERC *Annual Reports* 1981-82 to 1985-86

By 1986 almost £70 million was handed out in Alvey grants by the SERC to add to the annual funding grants of the Information Engineering Committee and the Distributed Computing System or Roberts initiative (see Table 5.3 below). This windfall not only led to close support for Alvey by the SERC but also by the academic community in universities and polytechnics across the UK. Many of the academics who served on SERC committees fed their views back into the system through these committees.

Table 5.3 SERC Information Technology Funding Dissection (£M)

Funding Source	Total	1981-82	1982-83	1983-84	1984-85	1985-86
IBC	135.9	19.8	26.7	25.3	32.8	31.3
Alvey	68.5	-	1.8	8.8	17.7	40.2
Roberts	3.8	3.8	-	-	-	-
Totals	208.2	23.6	28.5	34.1	50.5	71.5

When the figure of £50 million was put forward, the proposal was for the ABRC to provide £37.5 million and the SERC to find the remaining £12.5 million from its own resources. The ABRC found the £37.5 million 'by robbing other research councils. For example research into new strains of raspberries was cut back - seriously - by the agricultural research council' (69). The SERC's contribution came by 'cutting back on 'Big Science' such as high energy physics and astronomy' and since the SERC use a system of inflation-indexation on unspent balances, 'that £50 million became something like £54 million' (70). In this way an additional £3.6 million was added to the SERC's Alvey budget and when it became apparent that 'universities were proving more useful than was first expected' and a cash-flow problem was encountered, a call for additional funds was made. The DTI and MoD jointly transferred £6.4 million bringing the SERC's allocation up to £60 million. Controversially, the remaining £8.5 million was taken from unspent balances from various boards within SERC (71). Many university researchers in areas which are short of funds would be very bitter to know that such a heavily funded topic was taking funds from other subjects. Listed below is a ranking of the top ten universities with a dissection of the SERC/Alvey grants each received (see Table 5.4)

Table 5.4 SERC/Alvey Grants (£M) - Top Ten Universities

Institution	Funding Total	VLSI Total	Soft. Eng. Total	IKBS Total	MMI Total	Large Demo.* Total
Edinburgh U.	5.3	1.5	.9	1.4	-	1.5
Imperial Coll.	4.7	.8	.4	2.2	.6	.7
Manchester U.	3.9	.6	1.0	1.4	.9	-
Loughborough U.	3.7	.4	-	.3	1.3	1.7*
Cambridge U.	3.0	.5	.3	.5	1.3	.4
Univ. College	3.0	.1	-	.4	1.7	.8*
Oxford U.	2.3	1.4	.5	-	.4	-
York U.	2.2	.3	1.8	-	.1	-
Strathclyde U.	2.0	.4	.3	.8	.5	-
Surrey U.	1.6	.4	.2	-	.2	.8

Note: * - Includes grant for Infrastructure and Communications.

The SERC was so keen on the Alvey programme that the engineering board set up a working party in 1985 to prepare a report on what should follow Alvey. The working party (see Table 5.5 below) presented the first draft of its report at:

> a 'Town Meeting' of over 300 representatives of the UK academic community in information technology held on 22 October 1985. The report was favourably received and there was uniform enthusiasm for continuing to work in the highly collaborative way proposed (SERC, 1986a, Introduction).

The major recommendations were an extension of the Alvey programme to embrace broader technologies such as optoelectronics, an additional £25 million per annum for academic research, and closer integration with the European programmes (SERC, 1986a, p.16). The report was published in March 1986.

Table 5.5 Membership of SERC After-Alvey Working Party

Chairman:	Professor Eric Ash, Rector of Imperial College of Science and Technology
Members:	Lord Gregson, Executive Director, Fairey Holdings
	Prof. C Hilsum, Director of Research, GEC
	Prof. R Needham, Head of Computer Laboratory, Cambridge Univ.
	Dr D B Thomas, SERC Director, IT and Alvey Director, IKBS
	Dr M A Wilkins, SERC Secretary.

Although one Alvey source referred to the 'almost endless running war' with SERC, the fact remains that the war was not fought at a policy or managerial level (72). While some of the Alvey directors would have preferred to have the SERC staff working in the directorate at Millbank Tower rather than the Swindon office, the relationship was generally smooth and 'cordial' (73). While the academic IT community within SERC was keen on the Alvey programme since IT research received more funds in 1985-86 than astronomy, biological science, chemistry and environment research combined, some SERC staff 'certainly resented' the Alvey involvement (74). The close inter-networking of academics, former SERC staff, and Alvey led one industrialist to complain that the Alvey programme 'was too academic' (75).

5.4 Alvey and Its Impact on the Ministry of Defence

Like the SERC, the Ministry of Defence gained enormously from the Alvey programme. The MoD's involvement in Alvey can be traced to three sources. Originally the MoD had proposed to set up the VHPIC programme under the usual defence research arrangement of 100 per cent funding in response to the USA Department of Defense programme VHSIC, which Sir Ronald Mason, a former Chief Scientific Advisor to the MoD, described as 'a programme, incidentally, which was effectively insulated against any

European/British collaborative contributions' (Mason in Alvey, 1985a, p.3). Another source was the growing pressure from within the MoD, especially the research establishments, and from the 'defence IT' firms outside the MoD to continue to increase military R&D expenditure, already the largest component of government R&D in the UK (Ince, 1986, pp.89-97). The third source and closely related to the others was the involvement of MoD staff in the SERC/DTI thrust to mount an national IT programme in the UK. For example Dr Alan Fox of RSRE at Great Malvern was a member of the Atkinson mission to Tokyo in October 1981 while Dr John Taylor of the Admiralty Surface Weapons Establishment was chairman of the SERC's computing and communications subcommittee and a prime mover with other prominent IT figures such as Clarke, Thomas, and Kowalski in formulating the IKBS-led SERC response to proposed funding cut-backs.

Although one industrialist member of the Alvey committee wanted to know 'what the hell' the MoD's Dr Hywel Davies was doing at the inaugural meeting of the committee, an MoD presence was important for several reasons. The MoD promised funds and staffing and its endorsement of the programme gave it an added dimension of political clout and legitimacy which lesser departments could not deliver. A former MoD employee recalled (76):

> I thought it was very important (following the Tokyo mission) that the Ministry of Defence kept up with the running. I thought that was very important to the ministry. It was also very important to Alvey because I was very clear that unless you had quite specific MoD support, and I obviously don't mean

> cash, I didn't believe that DTI alone could manage the programme. So when Alvey was begining to compile his final report, we met in my office and we were discussing what kind of financial support the Ministry of Defence would provide. I'm sure that the £12 or £18 million that the MoD chipped in - no, £50 or £60 million - whatever it was, that to me was less important than getting the MoD involved in the process. We had in the end, some of the most significant players at RSRE and it was that more than the sheer cash value because I was absolutely convinced that we had to do something. The broad background as I'm sure you must know was, in and around that time the Government was considering whether to go ahead with Alvey and there was very much a sort of on-off, on-off, on-off. MoD hung in there very, very strongly. There were criticisms that we were running scared of Japan but in the end, after all the in and out of the Cabinet Office, off we went.

Eventually, the MoD promised £40 million of the £200 million goverment was providing as well as funding 25 per cent of the cost of managing the programme. A core executive source described this level of funding as 'small change' (77). Just as SERC agreed to managerial responsibility for IKBS, the MoD agreed to manage the VLSI programme and most aspects of the CAD programme and provided Dr Bill Fawcett from RSRE to perform that role. With the MoD spending in excess of £2000 million each year in the 1980's on defence R&D, its Alvey contribution of £40 million over five years constitutes less than four-tenths of one per cent of its R&D budget for the five years ending 1987-88. Not surprisingly then, the Alvey programme did not have a major impact upon the MoD.

One example where problems did occur was when an Alvey staffer 'forgot' to invite MoD to a meeting between university, industry and Alvey representatives to discuss standard contract conditions. An industrialist recalled (78):

> We then got MoD contracts (staff) to do the work on the contracts for the VLSI programme whereas DTI did the contracts for everybody else. So when the companies actually got their sample contract for a VLSI project they then found it bore no resemblance to the terms and conditions they had been led to believe to expect. They found a number of them unacceptable. MoD said 'These are the standard conditions', we (Alvey) said 'They are not' - all because someone forgot to invite MoD to a meeting.

At an operational level one Alvey source said 'The MoD administered their things their way and we administered the rest our way' (79). This situation was not seen as a problem or a threat to the success of the programme by the Alvey directorate. A second interviewee said (80):

> To be honest, I don't mind very much about the MoD side of it. I don't think that is any real problem. It is the sort of problem that bureaucrats notice but I don't think it is a problem which has affected the programme in its running in the slightest.

The MoD also provided 'three or four contract staff, some excellent, some not so excellent' to assist with administration as well as providing the bulk of the VLSI programme staff within the directorate (81). Confusion later surrounded the MoD's promise to provide 25 per cent of the cost of managing the project. The DTI staff review of the Alvey directorate noted (DTI, 1986, 1.10):

> Disagreement has since arisen on what precisely should be included in this 25%. MoD maintain that the percentage of time that their personnel in various MoD locations, particularly HQ contracts branch, and RSRE, some of whose work is Alvey-related, should be counted towards their 25% contribution, whereas DTI and SERC who have similar advisers *(sic)* do not count them towards their allocation.

This was a minor problem which seemed to worry the DTI review team more than it did the Alvey directors.

While the Alvey operations may not have had a major impact on the MoD, the MoD and the 'defence IT' industry certainly had an impact on Alvey. One industrialist dismissed the criticism that Alvey was too defence oriented. He said (82):

> I had not noticed it (Alvey) was oriented towards defence at all actually. They're just enabling technologies. No. By and large it had very little orientation towards defence. In fact I'd say our defence side of the business has always been inclined to think it has been a bit too little defence oriented

> by some considerable degree. The MoD was very good - I mean Colin Fielding played a very, very strong part in making sure that the MoD did not bugger up Alvey, which it could have done.

Sir Colin Fielding, responsible for all MoD research establishments, was singled out for praise by others, one of whom described him as 'the key figure - absolutely vital to the MoD role in Alvey' (83). Speaking at the 1985 Alvey conference, Fielding acknowledged that at the start of Alvey the main MoD interest was 'in faster integrated circuits' but added that 'IKBS was another highly important area for defence' (Alvey, 1985a, p.122). It was not only VLSI/CAD and aspects of IKBS that were of interest to MoD. An interviewee spoke of the 'importance of display technology and image processing' as defence technologies (84). Both of these are part of the MMI programme. Another source from a defence-related industry 'was disappointed that more emphasis was not given to communications' by the Alvey committee, an area that he saw as 'vital to the future of British defence' (85). An executive from a major software house thought that MoD should have been more involved (86):

> With the software engineering programme, it had deficiencies because it was technically oriented towards the aerospace and defence industries. Certainly in our case we make no bones about that, that's mainly our customer base. But for the programme as a whole that looks like rather a selective choice. The next programme should be much more general but from our point of view it was good news. But MoD separated themselves from the content of the programme and the objectives of the

> programme. I think they could have been more supportive of the companies doing the R&D which after all will end up, sooner or later in their supply base. They should have supported the Alvey directorate in a much more active way - as a customer.

Although MoD had only contributed one-fifth of the Alvey funds, had only one member of the twelve-man Alvey committee, and had staffed only one programme (VLSI/CAD), much of the Alvey programme appeared to be slanted towards the defence-IT sector. This is explored in detail in the following chapter. Perhaps this is what led one MoD spokesman to declare that 'there is a different style, a different atmosphere, in the way DTI does things to the way MoD does things and the style of Alvey was more the MoD style. And that mattered a hell of a lot.' (87).

5.5 Conclusion

The objectives of this analysis were to (i) examine how the Alvey ethos was developed and (ii) to see what impact, if any, it had on the major public sector participants in the programme.

(i) There were several prime facets to the directorate's spirit or operational style. They included an anti-bureaucratic element typified by a 'shambolic' administrative system, and by the actions of senior civil servants, one of whom regarded that title as 'disparaging' and another who typified himself as an 'entrepreneur' and a 'buccaneer'. There was a pro-industry bias and a climate of independence displayed by the lack of contact with the DTI and Ministers. And a tendency towards consensus, manifested by the refusal to set policy goals and by avoiding dissension.

The exact break-up of funds 'between the different areas' was suppressed to avoid 'dissension'. Secrecy or suppression of debate and consensus may appear strange bed-fellows in a democratic sense but both were present in the Alvey programme. Large meetings, conferences, and extensive consultation were common. The implication appeared to be that solidarity equated with legitimacy and therefore the decisions which followed were necessarily correct. This was also a key element in developing and nurturing the policy community.

(11) The effect that this pro-industry/anti-bureaucratic, semi-autonomous, consensual body had on the DTI, the MoD, and the SERC varied considerably. The most problematic relations were with the Alvey directorate's parent department, the DTI. The resentment and jealousy felt towards the directorate by DTI personnel was not as crucial as the problems of policy co-ordination and integration that arose as a result of another policy source being added to the already confused policy network. There was a feeling that a policy fiefdom had been invaded and captured, and it was the task of the DTI policy barons to recapture it.

Problems also occurred between Alvey and the SERC and the MoD but they were of a different kind and a lesser nature.

The Alvey programme was an organic policy process which provided the major IT firms with a bridgehead into the state decisional apparatus, thus confusing the 'traditional distinction between public and private' (Cawson, 1982, p.66), and allowing a closer relationship to develop between the IT industry and government.

CHAPTER SIX

The Alvey Technologies and the Influence of the Companies

In this chapter the role that the IT companies played in shaping and dominating the Alvey technical programmes is analysed. This is not an evaluation of the programmes. No consensus exists regarding the success or failure of many of the Alvey programmes. There are three main reasons for this. They are that some of the technologies are still in the experimental or research phase; each of the programmes typically has three or more areas, some of which are more successful than others; and finally, different groups have vested interests in each technology and so opinions vary widely on success or failure.

At the crux of the Alvey policy lies a *quid pro quo.* Government agreed to inject substantial funding for IT research and development into private firms and in return, the firms were required to undertake collaborative, pre-competitive research into selected technologies in the national interest. The crucial feature of the technology programmes is the interface between the firms and the Alvey directorate. The nature of this interface varied strikingly from programme to programme. The objective here is to examine the operation of each of the Alvey technology programmes, especially the interaction between the participants and the directorate, so that further light may be shed on what decisions were made, and how, and with what consequences. By describing the different interrelationships programme by programme, two secondary objectives are achieved. First, a fresh perspective of the detail of the Alvey projects is generated and second, the outline of a preliminary evaluation of each programme is sketched. Detailed evaluation of the Alvey programmes is beyond the scope of this study, however, this review can at least sketch the broad outlines or range of outcomes within which more detailed evaluation will need to be undertaken. It is clear that the Alvey programme has not succeeded in restoring Britain's international competitiveness in most areas of IT. But whether it has had a modest beneficial impact or has had no long-term favourable effect at all must remain an open question.

Three themes emerge: the lack of clearly defined objectives in most Alvey areas and its consequences; the problems confronting technical decision-makers when technical excellence is not the only criteria to be considered; and on the positive side, the success of collaboration.

The reviews are grouped into cases as follows; (a) VLSI/CAD and VLSI Architecture, (b) Software Engineering, (c) IKBS and Large Demonstrators, and (d) MMI and Infrastructure and Communication. An expanded review is presented of the VLSI/CAD and VLSI architecture section of the Alvey programme since it was the most heavily funded, consuming almost forty per cent of Alvey funds, it provides clearest example of the complex interrelationships, and it is the best documented programme. The other programmes are then reviewed in less detail.

6.1 The Alvey Programme for VLSI/CAD and VLSI Architectures

The integrated circuit (IC) market is divided into two broad categories, digital and analogue, and these categories contain sub-categories of products. Digital ICs account for approximately 80 per cent of the IC market and its share continues to grow at the expense of analogue ICs. (see Table 6.1 below).

Table 6.1 Estimated UK Digital IC Consumption - 1986

Product Category	Volume of Market(%)	Value (£M)*
Standard Logic Families	36	131
Memories	29	106
Microprocessors/Microcomputer Chips	16	60
Semi-customised Logic Chips	16	60
Customised/Special Purpose Chips	3	11
	100	368

Source: *Electronics*, 13/1/86
* - US$ to Sterling converted at £1 = $1.50

The Standard Logic Family chips are mass-produced, pre-programmed circuits which convert and process electronic signals. These chips are non-data storage devices which perform arithmetic functions as well as switching and timing. Their major uses are in the computer and communications industries (40 per cent) and consumer electronics (33 per cent) such as digital watches, video cassette recorders, and audio equipment. Memories, usually either Random Access (RAM) or Read Only (ROM), are mass-produced data storage devices whose market includes the computer and office equipment (e.g. word processor) industries as well as certain consumer areas. The combined RAM and ROM storage capacity defines the overall computer storage capacity, normally categorised by the number of logic function devices or 'gates' per chip. This market is dominated by large Japanese firms. Microprocessor chips combine RAM, ROM, custom logic, and input/output circuitry into one integrated processing unit, normally measured by the number of 'bits' per chip.

Improved technological and mass-production techniques have slashed the price/perfomance ratio of these chips. Once dominated exclusively by US firms, the market has increasingly been shared between them and Japanese firms producing under licence. Home computers, pocket calculators, and cash registers are the more obvious examples of the use of these chips.

The Alvey 'Niche Strategy' for VLSI

The two remaining types of digital ICs are custom and semi-custom chips, which account for approximately 20 per cent of the UK digital IC market. This is where the Alvey VLSI programme focussed its efforts.

Customised chips, as the name suggests, are normally designed for one customer and one application. For this reason they are usually known as Application Specific Integrated Circuits or ASICs. The major markets for ASICs are military systems, the aerospace industry, and telecommunications signal processing. This is mostly a result of the specific requirements imposed by military-style applications such as the ability to withstand extremely high or low temperatures, immunity to radiation, shock resistance and the need to perform high speed, complex logic functions. The UK market is characterised by vertical integration with companies such as Ferranti and Marconi often engaged in the R&D, the production, and marketing of both the ASIC and the equipment into which the chip goes. The ASIC sector is a rapidly growing and high profit segment of the IC market and is especially suited to smaller firms engaged in any of the three markets named above (OECD, 1985, p.14).

Semi-custom chips are produced as standard devices with the customers' specifications added in the final stages. This gives semi-custom chips the advantages of being able to be produced more quickly and cheaply than custom chips. As a result, many custom chip users have switched to semi-custom chips in recent years giving the semi-custom market an annual growth of 25-30 per cent in the UK (*Electronics*, 13/1/86).

Alvey's strategic objective for VLSI was 'internationally competitive VLSI processes suitable for custom and semi-custom integrated circuits' (Fawcett, 1984, p.7). To achieve this objective, the programme was 'concerned exclusively with silicon technology with no work on, for example, III-V compound semiconductors, optoelectronics or microwave devices'. The technical goals were one-and-a-half micron feature size circuits 'demonstrated by the end of 1985' and one micron feature size circuits 'demonstrated by mid-1987 and ready for transfer to production by 1989' (Alvey, 1985a, p.17). One micron (or 10^{-6} metres) feature size refers to the width of the lines etched on the chip. This niche strategy has attracted both support and opposition.

The supporters point out that standard circuit manufacture is extremely competitive, it requires massive capital investment, and is more technically complex than ASIC production. As one industrialist said: 'We lost that race (standards) to the Japanese and the Americans a long time ago and there is no use pretending we can ever get back in' (1). A prominent Conservative politician said (2):

> I think we can confront the US and Japan provided that we have got a niche strategy. For example I believe we have got...a

> very competent 'specials' (custom chip) industry in the semi-conductor field...This may well be the way we have to go. What we cannot do on a UK-scale is attempt to compete with either the USA or Japan, putting in one case ten times the resources and in the other case four times the resources, into the same area (i.e. VLSI).

Since the VLSI programme was heavily influenced by the MoD's strategic requirement and since its prime requirement is for ASICs, it is not surprising that the general thrust was in this area. Other factors which influenced the strategy profoundly were the powerful lobby of the 'defence IT' companies, the prior generation of the ESPRIT VLSI programme and the presence of powerful pro-VLSI voices on the Alvey committee in the form of GEC's Derek Roberts, Inmos' Ian Barron, and Plessey's Dr Keith Warren.

It does not follow that a niche strategy was necessarily the best strategy. One of Britain's most eminent IT personalities stated (3):

> The problem is that we have never adopted an intercept strategy. If you know this is the way the world is going and this is where you are and you've got limited time, then you've got to adopt a strategy that says not only are you going to improve but that you're going to improve faster so that at the end of your ten or five years or whatever, you've intercepted the rest of the world and caught up. An intercept strategy. Now we've never done that in the UK and nor - with the possible exception of France - do I know of anywhere else in Europe

> that has. The net result has been spending too little, too late.

Another suggested a leapfrog strategy which involved the further narrowing of the already narrow niche. He said (4):

> The VLSI programme involved itself in really almost everything to do with circuit technology. I think they would have been better off to have spent their £70 million either on one particular bit of silicon technology, say a particular bit of CMOS (Complementary Metal Oxide Silicon) or just say on microlithography or just on gallium arsenide which is actually excluded...if they'd had about £700 million their (existing) programme would have been about right.

This last quote exposes one of the the main criticisms of the Alvey VLSI programme, namely, the charge of spreading funding too thinly by attempting too many facets of circuit technology. In all, Alvey funded research into six VLSI whole processes and 44 layer processes (5).

Whole processes incorporate dozens of steps ranging from conceptual design and circuit layout, an area in which CAD is vitally important, production of the mask or stencil of the circuit patterns, manufacture of the silicon wafer from raw sand, etching of the circuit patterns using gasses or chemicals into the glass coating on the wafer, lithographical imprinting of the circuit patterns on the silicon layers of the wafer using electron beams or X-rays, ion implantation or doping of the wafer with impurities such as phosphorus atoms, circuit isolation by depositing layers of silicon dioxide, and circuit connection via an etched aluminium layer. Once completed, the wafer is tested, cut into chips with the faulty chips being discarded, and each good chip is then wired using gold or aluminium fibres, insulated and bonded, packaged, tested and graded (Hobday, 1986, pp.8-13). As a senior executive of one of the largest IT companies in Europe said 'This is the most complex area ever addressed in human history' (6).

The six whole processes undertaken did not involve 'blue sky' research and development. All of these processes already existed and the Alvey VLSI strategy was aimed at further refining them by subsidising the firms involved . For example GEC's Silicon on Sapphire substrate CMOS process pre-dated Alvey by some years as did Ferranti's Collector Diffusion Isolation (CDI) process to a greater extent. One commentator described both of these processes as 'Seventies technologies' (7). Therefore the strategy appeared to be aimed at reducing the lead that international competitors had rather than filling technological gaps which existed in the UK. One MoD spokesman said (8):

> People just don't understand what an important issue silicon is. I mean, it's not up to Bill (Fawcett) to say 'I'm not going to fund GEC on silicon or Plessey on silicon' or to say 'I'm going to cut your roots away'. MoD has done that in smaller areas...quite often the decision is made at this level on technical grounds. But when it comes to saying that certain companies are not going to stay in the silicon business, well that's a pretty major issue and it just gets stalled in the system. That should be a DTI decision.

As has already been shown, DTI did not have staff technically qualified to make that decision. They would have to rely on outside expertise. While Alvey had the technical staff, the presence of employees from GEC, Plessey, and ICL on the ultimate decision-making body, the Alvey board of directors, precluded that option. Among the UK semi-conductor firms there was no consensus on the 'best' approach to adopt. This dilemma was resolved in the directorate by the decision to fund all of the whole processes (see Table 6.2 below).

Table 6.2 Alvey VLSI Whole Process Projects

Alvey Project	Cost(£M)	Collaborators	Duration
1 Micron Bulk CMOS	8.60	GEC / Plessey	36 mths.
1 Micron CDI	7.00	Ferranti	48 mths.
1.25 Micron Whole CMOS	6.29	STC / Racal British Aerospace	30 Mths.
CMOS-Silicon on Sapphire	5.63	GEC / RSRE	38 mths.
1 Micron Bipolar	2.88	Plessey / Oxford U. Southampton U.	60 mths.
1 Micron Analogue CMOS	1.78	GEC / Plessey	36 mths.

Source: *Alvey Conference 1986 Posters*, 1986, pp. 41-51

While the VLSI programme had the one micron chip as a technical objective, the policy aims were not at all clear. The strategy said it was to make the UK 'internationally competitive' in the 'custom and semi-custom devices' market. Since these devices have wide usage in the military, aerospace, and telecommunications/signal processing sector of the market, remembering that the latter two of these three categories are closely tied to the defence sector, it seems that the unstated objective may have been 'to make the UK's defence and military equipment manufacturers more internationally competitive'. Despite one authority's insistence that 'the technology had to be common to defence and civil applications' (9), it was widely accepted by interviewees that the programme was essentially militarily oriented.

Of the six whole processes, by far the most contentious was Ferranti's CDI. Once a world leader, commanding 30 per cent of the world market in this field, Ferranti had slipped to holding 'about three per cent' (10). A senior executive from a large IT company described the situation as follows (11):

> Ferranti have done a very good job in the past and they will continue to work hard and service their customers and so on but if CDI disappeared today, it wouldn't leave a big gap in the electronics industry because the things that CDI was able to do reasonably uniquely five to ten years ago, CMOS today can do. At one stage, if Ferranti could have afforded it, they would have liked to adopt CMOS technology but they couldn't afford it. So commercially, Ferranti have been forced to stay with their CDI commitment. Now the attitude, if you like, of the politicians and the civil servants was - 'Well we can't really put funding into GEC and Plessey and not Ferranti because there would be a great political outcry and so we'll have to fund Ferranti's work on CDI. So that was the reason for funding so many (whole) processes rather than any rational thing.

This was not an isolated view. Another leading technologist was even more critical. He said (12):

> With all due respect to Ferranti, their CDI process is not competitive on a world stage - it goes nowhere - CDI is very clever, they've done an awful lot with it but it's bankrupt now. You have to go back and invest in real technology and the moment you do that, you are not talking about Ferranti's capabilities. They have never had those kind of capabilities... It really was bloody silly. It was crazy. We should have had a 'UK Inc.' policy. Alvey know very well - we say to them every time we see them, 'If you're going to be sensible, you'll just stop it all and focus, and if you think that will cause you an uncomfortable time, well that's what your job is.' Now there's a perfect example of - where a steering committee with teeth would never have let that happen. There would have been a hell of a row but it would not have happened

Perhaps a steering committee with 'teeth' would not have allowed the CDI process to be funded, but the implication was that the funds would have been diverted to a more worthwhile VLSI project at, say, Plessey or GEC. A Ferranti spokesman saw the question of Alvey funding in a different light. He said (13):

> Anyone who sells research as a major activity doesn't complain if somebody wants to spend quite a lot of money on research. So the principle (of Alvey funding VLSI research) we've embraced.

> We love it. In our case, where we've put in for an Alvey project, we've been very anxious to ensure it is one that carries us forward, that we aren't just paying half the costs of a research project that is not meaningful to us commercially.

A second feature of the Ferranti project was that it was the only 'non-uncle' Alvey project without collaborators. Several interviewees saw this as conclusive proof that the VLSI strategy was based on 'Buggins turn' (14, 15, 16) or as one industrialist said, 'Plessey got £X million for their projects, GEC got £Y million for theirs, so they had to give £Z million to Ferranti!' (17). This was rejected by a senior Alvey source (18):

> No. That wasn't the case. There is a lot of nonsense talked about the VLSI programme and I think if one tries to analyse why that is, I think it is because it is a very visible programme and I think a lot of people fancy that they understand VLSI whereas with MMI or software, perhaps they don't...The issue with Ferranti was very much a stand-alone issue. Because Ferranti are going to exploit CDI. They are exploiting their technology. They're doing it extremely well. There are applications for it. It should be supported. And it was really as straightforward as that...The Ferranti case is an interesting one because if you say 'What is Alvey about: is it about making technology available for exploitation?' and you have at look a the range of products that Ferranti incorporate

> their technology in - the Black and Decker drills, toys, and goodness knows what else - exactly what they should be doing. Whereas Plessey and GEC are very much tied into the MoD scene. At one time Plessey's Caswell research centre was 90 per cent funded by MoD. And so the real issue is - are Plessey and GEC going to make their technology available to their customers? They all say they do but the history is that they haven't.

The influence of the MoD on the IT industry in the UK concerned many of the interviewees. As one source said (19):

> We did need an indigenous source of silicon technology. One has to make printed circuits, to have them available. I couldn't see a guaranteed supply from other countries. Things of course change. I'm not convinced of the intention or capability of UK firms to make available silicon technology in the way they should. They will make their own products but whether we're getting our act together to allow the design and fabrication of 'specials' on UK lines - well I don't see that happening. I also see the Japanese setting up design centres to supply application specific circuits and certainly, at the end of the day, if a microprocessor (chip) becomes as readily available as a transistor did or a resistor did, then I see no reason why an application specific circuit can't be supplied in exactly the same way by an independent (i.e. foreign) supplier. Now if one could see a secure source from an independent supplier of ASIC's, then our strategy may well be shown to be wrong. At the

> time it was a question of security of supply...If the VLSI programme fails, it will be because of a failure to exploit the technology.

This theme was seldom alluded to by the industrialists interviewed. Few wanted to acknowledge that if ASIC's are the fastest growing sector of the market, it is highly likely that the Japanese and Americans will turn their attention there once the lucrative standard circuit 'cash cow' has been milked. Not only was there a danger of the already lagging ASIC industry in the UK being swamped by foreign competition but also by restricting research funding to refining those areas of technology where British firms already had expertise and markets, the defence sector, there was a danger that Britain's woeful record of technology transfer from military to civil applications would be reinforced. An MoD source said (20):

> It is our policy, so far as it is possible, to hold a competition among companies to carry out our work...in that sense it's a replication I suppose, of the government's market philosophy. We see ourselves as a purchaser in the market, but wanting to do what we can within that to try and take forward and further industrial prosperity. But we don't really see ourselves on the basis, if you like, of using defence money to secure some particular industrial objective. That's basically for the DTI to do...There are many examples of items that started off in the defence sector which have been applied more widely in the civil sector and we recently took a new

> initiative with our Defence Technology Enterprises, which is a company in which a number of banks joined with us in setting up ...and that's deliberately aiming to - not just confined to information technology, it covers all our research - it's deliberately aimed at getting industrialists into defence research so that they can take out of it things of commercial application.

By late 1986, three years after the first moves were instigated to improve defence-to-civil technology transfer (*Guardian*, 14/8/86) and two years after the first steps were taken to set up Defence Technology Enterprises, one suite of computer software had been transferred (Defence Technology Enterprises, 1986, p.11). While the MoD claim to be keen to encourage 'spin-off' from military research and development to civil applications, the complacency of major defence contractors as well as the problems of over-specification, over-supervision of contractors and secrecy are the main stumbling blocks to transfer and exploitation (Maddock, 1983, pp.5-22). A politician related the following story (21):

> Two or three years ago, one of the most important areas of IT development was voice interface. The people who were ahead of the world were the Royal Aircraft and Radar Defence Establishment in Berkshire. However British industry could not obtain any information that they had - they actually led the Americans. Nevertheless, the US military were able to get their hands on it through NATO agreements and they spun it off into Silicon Valley. So the result was, we were actually

> getting our voice operated techniques on the commercial side, although they started in Berkshire, we were getting them from Silicon Valley.

He further criticised the 'spin-off' theory in the UK, saying:

> I am prepared to accept the 'spin-off' theory in more open societies like the USA and places where there is a Freedom of Information Act. But my view of the 'spin-off' in Britain is that, to all intents and purposes, it doesn't occur. The military get their hands on something, they crawl back into their coocoon, keep it all secret, won't let anything out. Usually when they do produce it, it is heavy, ponderous, over-ruggedised and over-endowed with fail-safe back-up systems.

This was not an isolated view. A core executive source said (22):

> I think the companies have had their markets distorted, their own commercial markets have been distorted and twisted towards defence over the past ten years or so. I also suspect their internal organisation is such that they have difficulty thinking about transferring from their defence business to the civil sector...In the case of both GEC and Plessey for example, there is a lot of work that's been funded by MoD that locks those companies into the defence business but not in a way that enables them to get very much civil 'spin-off' from it. Now there are two ways to overcome this problem. One is to make the

MoD contracts that much tighter. The other is to try to use a bit of other government money to lever out from the defence part of the business, some civil applications. That kind of argument was being used in the case of Alvey.

The importance of the MoD to the seven firms which were involved in the six whole process is starkly illustrated in Table 6.3 below.

Table 6.3 IT Firms and the Influence of Defence

Company	Total Defence Sales (£M)	Profit (%) From Defence Sales	Proportion of Total Sales to MoD (%)
British Aerospace	1786	100	72
GEC	1100	45	61
Plessey	448	31	43
Racal	320	46	30
Thorn-EMI	260	12	60
Ferranti	230	45	61
STC	118	11	89

Note: All figures quoted are for 1984
Sources: *Annual Report and Accounts* (various)
Arnold and Guy, 1986, p.117

Recently released figures give an insight into the industrial-academic participation in the VLSI/CAD programme (see Table 6.4 below) and provisional estimates of Alvey funding allocations.

Table 6.4 VLSI/CAD Programme - Industrial and Academic Rankings

Rank	Company	Projects	Funds(£M)	University	Projects	Funds(£M)
1	GEC	34	9.67	Edinburgh	9	1.48
2	Plessey	28	5.15	Oxford	9	1.38
3	Telecom	20	2.53	Southampton	8	.97
4	STC	17	2.09	Warwick	7	.75
5	Ferranti	14	5.61	Cambridge	7	.48

The importance of the CDI project funding is readily evident from this table. Although Ferranti participated in only half as many projects as Plessey, it received substantially greater funding. It is also clear that universities played a very secondary role in this programme in terms of both participation and funding.

It was not only Ferranti which came in for criticism in the VLSI area. The STC/Racal/British Aerospace 1.25 micron CMOS project also had a chequered history. One source recalled (23):

> Originally our intention was to have one major CMOS project. The partners in that were to be Plessey, GEC, STC and Inmos. Inmos was not interested, STC never really got involved in the debate and so we went ahead with Plessey and GEC. This was the one micron (CMOS) programme with an intermediate step at one-and-a-half microns. Although there was quite a long lead-time, once this was established (1½ micron) it was then only a matter of scaling it down. STC then came along with the one-and-a-quarter micron programme using old-fashioned isolation techniques and we said there was no way they could do one micron technology the way they were proposing to do it. It was sensible to do it their way for one-and-a-half or one-and-a-quarter. Their original proposal was to reach one micron in a very short timescale and we said 'You can't do it using those techniques'. So I put forward the argument that since the Plessey/GEC programme had a much longer timescale, there was a good argument for supporting STC in the old-fashioned technology as a relatively low-risk approach to getting one-

> and-a-quarter micron processes in place very quickly. There was a very ambitious timescale of twelve to fifteen months put on that but with a clear understanding that there would be no further funding for that approach. The only way they would get any more funding would be to collaborate with Plessey and GEC on the new techniques. Racal and British Aerospace involvement was as no more than users to get design tools, demonstrator chips and so on. It was also important to try to get Inmos involved but that didn't work. Now of course what has happened since then is that STC lost their new plant because of financial difficulties, I believe that there has been real problems at the University of Leuven which sub-contracted some of the work and when I spoke to Rob Morland (Alvey VLSI), I got the impression that there were real problems there and the programme had slipped some six months behind. Had we known that would happen, the argument for doing that may not have been so strong.

The importance of the MoD as a source of sales to British Aerospace and STC would have been a significant spur to their participation in the VLSI programme.

It is impossible to state exactly how much of the Alvey programme was defence-related. By analysing the project descriptions and examining the lists of collaborators on each project, some rough estimates can be made (see Table 6.5 below). These percentage estimates should only be seen as a guide rather than an exact breakdown.

Table 6.5 Defence Orientation Estimates of Alvey Programmes*

Programme Area	Totally Defence	Principally Defence	Semi Defence	Principally Civil	Totally Civil
VLSI/CAD	20	30	25	15	10
Software Eng.	10	10	15	15	50
IKBS	5	5	10	20	60
MMI	10	15	20	15	40
Large Demo's.	-	-	-	15	85
Inf. and Comm.	-	-	5	5	90

Note: * - Percentage estimates based on project values taken from *Alvey Conference 1986 Posters*

Dr Gary Vanstone of Racal reported at the 1986 Alvey conference at the University of Sussex that all of the whole process programmes had slipped behind their schedules. In the case of the GEC/Plessey one micron CMOS project, a five month delay was announced while the military-intended one micron bipolar project involving Plessey/Oxford University/University of Southampton had slipped sixteen months. In the case of GEC's Silicon on Sapphire process, a four month delay in release of the prototype was admitted which meant a nine-to-twelve month lag overall. The average slippage was approximately nine months. Given that the UK started two-to-three years behind Japan and the USA according to Professor Broers (1985, pp.11-13), as much as four years in some areas according to Professor Hoselitz (1985, p.27), and maybe even five years (Barron quoted in Hobday, 1986, p.37), these 'mid-programme' problems were worrying for the Alvey directors. One Alvey director said (24):

> In terms of our overall standing *vis a vis* the Americans and the Japanese, we are probably at the end of our programme here going to still be two-to-three years behind them in terms of

> absolute technology. But there can be no doubt we would be significantly further behind without programmes such as Alvey and ESPRIT.

Figures released at the 1986 Alvey conference indicated that almost one-third of all VLSI projects were behind schedule. While these slippages were a blow to the programme, there were positive outcomes as well.

The VLSI strategy was cleverly laid out with work on the layer processes fitting mosaic-like into the whole process system in most cases. One source described the progress in areas such as mask making, microlithography, dry etching, doping and ion implantation as 'quite outstanding' (25). The most striking success, however, was collaboration. One head of a major research laboratory said (26):

> It was very important that we had a new mechanism for professional interaction. Twenty years ago you could go to the Institute of Physics or the IEE (Institute of Electrical Engineers) two or three times a month and compare notes with your peers and be more or less up-to-date. These institutions have not been able to continue as a really effective means of communication. These new links set up as a consequence of collaboration have taken over in a big way. Last year for example, we had 14,000 visitors to the research centre and I would guess that 5,000 or 6,000 of those would have been collaborators. Literally every day of the week there would be people from AEG or Olivetti or Plessey or ICL.

A senior industrialist from one of the UK's biggest IT conglomerates stated (27):

> I think Alvey has been tremendously successful in two ways. First of all in the stimulation of close contact between industry and universities. I think that it's distinctly possible that if somebody is writing the history of this area of technology in twenty or fifty years time, it's just possible that they will say the most important result of the Alvey programme was the way it drew universities and industrial laboratories together. Taking an overall view, I think that has gone extremely well, not just in the context of the Alvey programme but because of the relationship that will go on developing. Equally one can say that industrial collaboration has worked well. By and large, the relationships that have developed between the UK companies in Alvey and the wider relationships under ESPRIT, I regard that already as a major success and something to shout about.

Another industrialist said he was 'pleasantly surprised' to find that academics 'could produce something other than papers' and went on to say that his company regarded collaboration as 'the cornerstone of Alvey's success' (28). Only one of the industrialists interviewed was critical in any way of the collaborative aspect of Alvey. He said (29):

> Alvey's real success has been to stimulate partnerships between companies and academics. That has been a real achievement. On

> the other hand, this is not true of collaboration between companies and companies, especially big and small companies.

An MoD source, concerned with threats to academic integrity, said he 'deplored' the situation of university researchers 'jumping into bed with companies' and described it as 'quite wrong' (30). Collaboration struck a sour note with the Treasury also. An official described the position in the following way (31):

> Treasury was prepared to accept it at the so-called pre-competitive research level although nobody was really very sure what that meant. The worry that was voiced here was that this collaboration would not confine itself to the pre-competitive stage, that you'd be getting deals struck between the producers (e.g. price fixing, tendering rings, or market share agreements)...Certainly we are now concerned about the DTI's emphasis on collaboration almost for collaboration's sake - because there's no doubt about it that Alvey has been a springboard to all sorts of other kinds of collaborative ventures. Of course the notion of collaboration is quite appealing but - Treasury's view is that competition is much more likely to breed innovation and hard-nosed attitudes in the market-place than collaborative deals.

Apart from the classical economic views of the Treasury, it is not difficult to understand why industry was so taken by the notion of academic-industry collaboration. Industry was given access to some of the best and brightest minds in the UK and instead of the academics and post-graduates doing research for a journal article, they were applying their expertise to help solve the problems facing Plessey and GEC. All of this cost the firms nothing since the universities were 100 per cent funded by the SERC. In many ways this was a disguised industry subsidy.

Collaboration was said to be 'really flourishing' in all projects and this is borne out in the case of VLSI in Table 6.6 below (Alvey, 1986c, p.8), although the case for software engineering where almost sixty per cent of the projects were rated average to bad is not clear.

Table 6.6 Alvey Collaboration Ratings (%)

Programme	Excellent	Good	Average	Poor	Bad
VLSI	20	42	29	7	2
MMI	18	45	15	18	4
IKBS	13	33	31	20	3
Software Eng.	11	31	31	19	8

Source: *Alvey Programme Annual Report 1986*, p.25

By late 1987, it was apparent that technical progress was being made in the VLSI programme and at least one commentator believed the target of one micron circuit geometry by 1989 'will be reached' (Hobday, 1986, p.6). One source commenting on the VLSI programme said (32):

> I am convinced now that too many whole processes were attempted. That really was a mistake. If we had to start again I would push for a programme on optical memories, something that John Fairclough (Chief Scientific Advisor, Cabinet Office) mentions every time I see him. The other area where I'd put a lot more resources is CAD.

The Alvey CAD and VLSI Architecture Strategies

The CAD programme was specifically tied to the VLSI programme and is usually referred to as 'CAD for VLSI' since the objective of the CAD strategy was develop 'CAD tools capable of cost-effective design of VLSI circuits' (Alvey, 1986c, p.32). Once again, this is a narrow, low-risk strategy limited to the enhancing the ASIC niche while ignoring some of the more challenging frontiers of CAD. This programme, for which the Alvey committee had recommended a budget of £25 million, was seen as crucial to the success of the VLSI programme since ASICs are far more design-intensive than standard integrated circuits. Computer Aided Design is also a facilitating agent for the transfer of technology and so the allocation of a subordinate and minor status to CAD will inhibit technology transfer further. In the limited Alvey sphere of CAD, 'good progress' has been made in some areas despite 'problems of resourcing and in reaching agreement on achievable goals' (Alvey, 1986c, pp.32-33). In late 1986, an extension programme was generated and approved in the VLSI/CAD area, thus achieving a commitment to the 'planned £130 million VLSI/CAD programme' (Alvey News 21, Feb. 1987, p.4). Out of this came a major new CAD project involving ICL, STL, GEC, Plessey, Racal, Ferranti, Praxis Systems, RSRE, RAL, as well as Oxford, Newcastle, and Brunel universities.

The final section of the VLSI review is the VLSI architecture programme. The strategy here was aimed at investigating new ways of interpreting and processing information, signals, and data with consideration being given to parallel processing techniques. As was mentioned earlier, the architecture programme started after the other

Alvey programmes and comprises fifteen projects with expenditure of less than £10 million by late 1986. Architecture is of high potential significance to the future of fifth generation computing in the UK and it is here that Inmos have made progress with the transputer, a novel microprocessor which incorporates parallel processing features. Some see this as a potential National Champion (McLean and Rowland, 1985, p.183):

> The transputer, if it only achieves a fraction of its designers' goals, may well do more for the British economy than the entire £350 million Alvey research programme, also intended to revitalize the economy through an injection of electronic wizardry.

Unlike the VLSI strategy, the architecture programme involved quite a deal of 'blue sky' research. Its results may take years to emerge.

Decisionmaking in the Alvey VLSI/CAD Programme

One MoD source was in no doubt as to where the power lay in the administration of the VLSI programme. He observed (33):

> The idea of a government industry policy didn't exist. Because you're market driven and so on - you react rather than having a policy. Now Alvey, certainly in the area of silicon, had its own idea of what should happen and certainly in the VLSI area there was heavy MoD influence. We had Bill (Fawcett) there, the chairmen of the two technical committees, money was

> administered and contracts were administered through the MoD system and so on...Quite clearly Bill Fawcett had enormous influence. When you look at the details of the CAD and the VLSI and the silicon programme, then he was getting an enormous amount of advice from here...because there was a huge amount of experience here which was sort of independent - independent sounds as if we don't have any views which isn't the case.

The other main sources of input to the decision-making processes were the various committees which advised the directorate in the VLSI/CAD sphere. These included the VLSI/CAD Industrial and Academic Committee (IAC), the VLSI Architectures Committee, the VLSI Technical Advisory Committee, and the Computer Aided Design Committee (CADC). These committees were dominated by MoD staff.

For example, the CADC in mid-1986 had ten members, one from the DTI, two from SERC and seven from MoD while the VLSI Technical Advisory Committee had fifteen members, ten of whom were from the MoD. Both of these bodies were comprised entirely of civil service technocrats. The private sector was represented on the IAC however. This committee, whose membership totalled twenty-seven in 1986 (see Table 6.7 below), was seen as 'far too large' with 'everyone pushing for their own interests' (34). As with the Alvey steering committee, the IAC grew into an unwieldly and ineffectual body. Ostensibly the size of the committee was meant to reflect democracy and consensus but the outcome, intended or not, was impotence and sectionalism. This tendency to encourage a proliferation of committees and to allow them to expand was a feature of the Alvey operational style.

Table 6.7 Alvey Industrial and Academic Committee 1986

Chairman : Mr Geoff Lomer — Racal

Mr H G Adshead	ICL	Dr G R Jones	RSRE (MoD)
Mr D Baker	British Telecom	Dr A L Mears	RSRE (MoD)
Mr R E Hayes	Plessey	Dr T L Thorp	RSRE (MoD)
Mr W Holt	Plessey (Caswell)	Mr D Colliver	DCVD (MoD)*
Dr J S Heeks	STL	Mr J C Vokes	DCVD (MoD)*
Mr D E Hooper	GEC (Hirst)	Dr J A Grimshaw	DCVD (MoD)*
Mr I R Pearson	Inmos	Mr R E Aistrop	DCVD (MoD)*
Mr J D Pearson	Ferranti	Mr R J Morland	Alvey Dir.
Dr G F Vanstone	Racal	Mr G V Gieger	Alvey Dir.
Prof A N Broers	Cambridge Univ.	Dr D M Worsnip	SERC
Prof H A Kemhadjian	Southampton Univ.		
Prof D J Kinniment	Newcastle Univ.		
Prof G Nudd	Warwick Univ.		
Dr G Dearnaley	Atomic Energy (Harwell)		
Mr J Hobday	DTI/LA Division		
Mr D A Saunders	DTI/LA Division		

Secretary: Dr K D Crosbie — Alvey Directorate

Note: * Representing the Alvey Directorate
Source : *Alvey Programme Annual Report 1986*, pp.105-6

This type of decision-support system was clearly ineffectual. Decision-making power lay within the directorate with the VLSI director approving projects up to £250,000, while the final decision-making body was the board of Alvey directors. One Alvey source said (35):

> The decisions on VLSI were made by the directorate, just like any other part - but the influence of the MoD on the VLSI area was considerably larger than on other areas simply because Dr Fawcett as the director...used the MoD experts rather more in that area than in others.

While this was the case, it was the MoD and the major 'defence IT' firms which developed the VLSI/CAD programme within the Alvey committee and the strategy once the programme got underway. The board of Alvey directors ensured that projects and funding were distributed fairly.

6.2 The Alvey Software Engineering Programme

A common misapprehension is that the UK has special talents in the software field 'rather like middle distance running' (House of Commons, 1987, p.21). A similar view exists of software engineering. In the *Alvey Software Engineering Strategy* the authors said 'the UK does not lag behind other countries in software engineering, except perhaps the USA. The UK is certainly regarded as the leader in Europe in this field' (Alvey, 1983c, 1.1). By 1986, David Talbot, the Alvey software engineering director had to admit that the UK's leadership was undergoing a 'very active challenge from France' (Alvey, 1986c, p.42).

Software engineering places emphasis on methodological systems design and development using pre-fabricated re-usable components with the objective of creating 'user-friendly', reliable, and secure systems that are both efficient and effective. The trend towards software engineering (SE) accelerated as hardware costs fell and the proportional cost of existing software development rose. A recent ACARD report described software as 'the most costly and difficult component' of IT applications, often incurring seventy-five per cent of the life cycle costs of 'a large bespoke application' (ACARD, 1986, p.12) while others suggest 'software accounts for some 90% of cost in embedded systems' developed for the US DoD (Arnold and Guy, 1986, p.44).

The software sector in the UK had followed a familiar path. Once a world leader, the software industry expanded rapidly to support large numbers of small companies. These companies which concentrated on bespoke systems rather than pre-packaged systems grew more slowly (20 per cent per annum) than their overseas counterparts (30-40 percent) and could not match their competitors' marketing strength and technical know-how. Other factors such as embargoes on the export of the most up-to-date operating systems and programming languages, state subsidies, and nationalistic software procurement policies also militated against the UK industry. The result according to the ACARD report (ACARD, 1986, pp.12-14) has been:

> too many small companies which cannot afford this (R&D) investment and too many large companies who will not make the investment unless forced to by public purchasing pressure or government subsidy. Too many companies are reliant on government bespoke programming contracts (for example MoD work) which is somewhat sheltered from competition.

It was a recognition of these problems that spurred the development of Alvey's SE strategy to follow on from the recommendations of Logica's Phillip Hughes in the Alvey report. It was also based on the belief that software development would become capital rather than labour intensive and the need for software development to become a more precise science like engineering rather than a craft. The ultimate goal of the SE strategy was an Information System Factory which itself would be the outcome of three generations of Integrated Programme Support Environment (IPSE) and would incorporate features of the CAD and IKBS programmes.

The Alvey SE niche strategy was primarily oriented towards the large, capital-intensive, complex systems tools such as are found in the defence and telecommunications sectors. As a result, only a few of the estimated 15,000 firms that make up the UK software industry participated in Alvey with fewer industrial projects than any other major Alvey programme (see Table 6.8 below). The other reason for a low participation rate is 'because there is not that tradition of research work in the software engineering part of the software and systems industry' (Alvey, 1985a, p.10).

Table 6.8 Alvey Programmes - Academic/Company Participation*

Programme	Collaborative Projects	No. of Firms	No. of Universities
VLSI	61	31	31
IKBS	55	46	27
MMI	40	37	28
Software Eng.	35	34	25
Large Demos.	5	12	8
Inf. and Comms.	2	4	3

Note: * - As of June 1987.

With SE receiving the second largest block of funding and such low levels of participation, it was not surprising that a spokesman from a major software house said 'there hasn't been a problem with the availability of funds' (36). Although there were 66 projects undertaken overall in the SE area, the thirty-five collaborative projects in Table 6.8 took over ninety per cent of Alvey funds by mid-1987 with less than ten per cent of the funds to be shared among the remaining 31 projects, mostly of the university 'uncle' type. The ranking of the top five companies and universities in project participation order in the SE programme and provisional estimates of Alvey funding received is listed in Table 6.9 below.

Table 6.9 Software Engineering - Industry/Academic Rankings

Rank	Firm	Projects	Funds(£M)	University	Projects	Funds(£M)
1	ICL	12	2.16	Edinburgh	6	.93
2	STC	8	1.70	Cambridge	6	.32
3	GEC	6	1.08	York	5	1.74
4	SSL	5	3.01	Manchester	5	1.02
5	SDL	4	1.34	Imperial College	5	.42

Note: Standard Telecommunications Laboratories received £1.5 million for three projects

Although firms such as SSL (Software Sciences Limited) were funded heavily, some members of the IT community queried the general thrust of the SE programme. A member of the Alvey committee saw the problem of niches and strict adherence to the narrow strategies as a result of a misunderstanding of the intent of the committee's report. He said (37):

> Not mentioning something in the Alvey report was not intended to mean that that didn't need research done on it. It was intended to mean that it didn't require a tremendous shot in the arm at that point. And there have been two bad effects from this misinterpretation. Bad effect number one was in data bases. There has been damn little money available for research in data bases and it was certainly never the intention of the Alvey committeee that that be reduced. It was thought...that the area didn't require a highly specific push. The other bad effect was in communications.

Appropriately, the example of data bases was raised by an Alvey source when discussing project proposals. He said (38):

> For example if people come to us with a proposal we tend to say to them 'Look, that isn't strictly our strategy. We are not interested in data base working. If you put emphasis on getting the integrated programme support environment (IPSE) through there, well OK. But if you come to us with something on large data bases, well it's up to you, but I regret to say it won't get through if you do.' Then they may say 'You've got it all wrong. Data bases are terribly important.' Usually they take our advice.

Another academic criticised the direction of the SE programme and singled out data bases for special mention. He said (39)

> The software engineering strategy laid down a sequence of events which to my mind was an absurd one. It was directed, but directed far to low down. It was over-directed...In the software engineering strategy it said something about data bases, if I remember rightly, it said the first type of IPSE's will use data bases, the second and third type won't. But there were already on the market products which were far ahead of that.

By taking the recommendations in the Alvey report as holy writ rather than the 'for instance' they were intended as, the Alvey directors in their haste to get the programmes up and running framed their strategies too narrowly. A senior software industry source conceded as much. He said (40):

> What was badly judged, with the advantages of hindsight, was the scope of software. The scope of the software content in this programme, with hindsight, is too narrow. It looks only at a narrow segment of the data processing software problem. We haven't tackled commercial users, the biggest single sector. None of this technology in its present form will be of any use to a bank, say. Very little...It might well be of great interest to the defence market. Some interest - well great interest to telecommunications and some interest to industrial process control. But not to conventional information systems.

This view was expanded on by an academic who said (41):

> Alvey has a simple-minded view of what information systems have to do and the kind of environments they have to work in...The idea on the software engineering side of software factories and IPSE's is largely conditioned by the kind of systems which are being built for military use but which don't, by and large, deal with the problems of industry and commerce. The environment is totally different. For commerce the most important single characteristic is that it should be adaptable, whereas for the military, the most important characteristic is that it is safe and secure.

An industrialist was recently quoted as saying (Jowett and Rothwell, 1986, p.67)

> When the (Alvey) strategy paper was put forward an software engineering, I was puzzled as to whom it was aimed at. I wasn't sure whether it was only the MoD and BT that it was serving, or whether it was genuinely supposed to have a wider remit.

This theme was taken up in the trade press under the heading "Alvey Shows a Defence Bias" (McCrone, 1985), and a spokesman for a prominent software house said (42) 'the software engineering programme...had its deficiencies because it was technically oriented towards the aerospace and defence industries'. When prominent academics, industrialists, and journalists agree that the strategy was skewed, it is important to find out how and why this happened.

Software engineering had the information systems factory as its operational objective, just as the VLSI programme had the one micron chip as its goal, but in both cases no-one clarified the policy aims underlying these goals. The unstated policy goal appeared to be 'The enhancement of design tools for the major defence/telecommunications software contractors'. This strategy was generated mainly by the industry, especially the leading companies, although one MoD source said that the Royal Signals and Radar Establishment (RSRE) had an 'enormous influence' on 'software engineering - particular aspects of software engineering' (43).

As with the VLSI programme, the software engineering strategy was based on the perceived self-interest of the dominant actors rather than any altruistic or nationalistic feelings. A software industry source was quite candid about his company's participation. He said (44):

> R&D funding in a labour intensive industry is nothing to do with access to cash. It's to do with how much of your profit you'll lose this year in a resource constrained industry if you do the R&D. If you can get revenue funding, not loans, revenue funding to help you do the work then you can count that as income in the current year and you can back-off some of the write-offs you have made to cover the costs of doing the R&D in that year. So government funding of revenue nature - 25 or 50 per cent grants - are very important and we get them where we can...So number one, we were in the technology area the Alvey programme was moving towards when it was set up. Number two, we were accustomed to using government funding, not in any kind of protectionist way but in a self-interested way. So the reason we got into the Alvey exercise was because we saw it as producing an environment where we could get on and do the R&D we thought we wanted to do anyway.

Another interviewee, explaining the large firm-large project bias in software engineering, said 'they knew it (Alvey) was coming over the horizon and they had their mega-projects on the launching pad' (45).

Within the directorate, one source saw the software engineering programme in a different light. He said (46):

> It is not an area that is going to depend on large capital

> investment or a highly disciplined workforce. It is going to depend largely on bright people who can think well and work in innovative ways...Now we are in the primitive stages of software engineering.

In light of the recent ACARD analysis of the UK software industry which saw the typical software house as too small and therefore prone to takeover, too isolated from IT manufacturers, and over-reliant on government contracts (ACARD, 1986, Ch.3-4), this view is not encouraging. The report also predicted that the UK software industry would be in deficit by £2000 million per annum by 1990, a view that has been criticised by software industry representatives (*Daily Telegraph*, 20/12/86) and refuted by other observers (*Financial Times (FT)*, 15/7/86; 1/12/86)

The SE director, David Talbot, was held in high esteem within the directorate and by the industrialists interviewed who were associated with the programme. The advisory committees which assisted the SE director were generally better balanced than those in the VLSI area with numbers evenly spread between private sector, academic, and research establishment/public sector representatives. The one exception was the reliability and metrics advisory panel which had no public sector representatives (Alvey, 1985a, p.131). Another notable feature was the absence of major software houses from these committees. Only Logica, ICL, and Imperial Software were represented (Alvey, 1985a, p.131).

The software engineering programme, like VLSI, was outstanding compared to the other programmes in the area of exploitation (E) but only average in the area of project progress (P) (see Table 6.10 below).

Table 6.10 Alvey Projects - Progress

Programme	Excellent Progress	Good Progress	Average Progress	Poor Progress	Bad Progress
VLSI	4	20	62	9	5
Software Eng.	-	15	58	27	-
IKBS	7	17	56	17	3
MMI	-	14	54	32	-

Alvey Projects - Exploitation

Programme	Excellent Exploit	Good Exploit	Average Exploit	Poor Exploit	Bad Exploit
VLSI	5	38	41	11	5
Software Eng.	8	31	46	15	-
IKBS	3	23	51	13	10
MMI	4	18	69	9	-

Source: *Alvey Programme Annual Report 1986*, pp.24-26.

These ratings were generated from the reports of monitoring officers responsible for 185 industrial projects. The view expressed by some interviewees that the software engineering and VLSI strategies were commercially oriented towards the objectives of the major IT contractors is borne out in part by the high level of good/excellent exploitation half way through a supposedly pre-competitive R&D programme.

The software engineering programme had the worst record in the area of collaboration but what was of more concern was the absence of some of the major software houses entirely from the programme. Companies such as Compower, ISTEL, Hoskyns, and Centre File did not participate at all in the software engineering programme yet all of these companies were of a comparable size to firms such as Systems Designers and Scicon at the time. This situation was thought to be a consequence of the orientation of the Alvey strategy, the lack of collaborative experience, and an unwillingness to invest in future technologies (Owen, 1985, p.135).

While the software engineering programme was open to criticism, it was attempting to break new ground in the most fragmented sector of the IT industry and this made the task more difficult. On a positive side, it is possible that information systems factories may yet be proved to be viable and that the UK may recover its former position as a world leader. The strategy helped to establish standards for formal methods and languages as well as creating a general awareness of new technologies and the need for improved software reliability and measurement. It also spread the message of the importance of software quality through its clubs and special interest groups and through contacts with the British Computer Society, the Institute of Electrical Engineers, and groups such as the ACARD Working Group on Software and the British Standards Institute (Alvey, 1986d, p.102).

6.3 The Alvey Information Knowledge Based System Programme

The Information Knowledge Based System programme differed in several major respects from the programmes previously discussed apart from its technical content. The first was that the Clarke-led Abingdon workshop suggested that IKBS research should be a ten year programme (DoI Management Report IT87, 1982, p.11), a view endorsed by the Alvey committee which said 'We propose a ten-year programme of research and development of IKBS' (Alvey report, 1982, p.34). The second difference was that IKBS was a subject with few champions in the private sector , unlike VLSI or software engineering. After the devastating impact of the

Lighthill Report of 1972, artificial intelligence, as IKBS was formerly known, was seen as a fanciful subject with little or no prospects for commercial success. The Japanese Fifth Generation project and the USA's Department of Defense DARPA programme played a major role in changing this view. Finally, much of the IKBS programme was aimed at genuine 'blue sky' research although some refining or enhancing an existing technology base did occur. There was a key similarity however.

As with other programmes, no policy goal or underlying rationale was provided. The Alvey report was extremely vague about the IKBS objectives. It said they were (Alvey report, 1982, p.34):

a. To promote research in all aspects of IKBS

b. To ensure development from the research results

c. To stimulate production of development prototypes.

Unlike VLSI or software engineering, the IKBS operational objectives were unable to identify a product or tool and were extremely vague. They were (Alvey, 1985a, p.31):

> Handling within computer systems logical relationships and heuristic forms of knowledge such as codes of practice, rules of thumb and even 'best guesses'...(and) to encapsulate these wider forms of human knowledge in computer systems, and to employ methods of solving problems which model human reasoning processes.

It was never clear why this was necessary or what was its end. Cynics might point to the fact that prominent academics such as Professors Michie and Kowalski had approached SERC representatives before the Tokyo conference to urge a SERC-led thrust in this area and when the Abingdon workshop took place, the workshop team proposed a national IKBS-led programme thus killing two birds with one stone.

The Alvey report neatly summarised the basis on which IKBS operates. It said 'an intelligent knowledge based system is a system which uses inference to apply knowledge to perform a task' and went on to add 'the way forward appears to lie in the use of natural languages and machine processes more akin to human thought processes' (Alvey report, 1982, pp.32-34). The Alvey strategy for IKBS was generated by a team of academics jointly sponsored by DoI and SERC and led by Dr John Taylor of the Admiralty Surface Weapons Establishment and chairman of the SERC computing and communications subcommittee who later joined Hewlett Packard (47). It recommended a four-pronged programme which incorporated (a) IKBS demonstrator projects, (b) IKBS research themes, projects and clubs, (c) IKBS support infrastructure, and (d) IKBS awareness. The IKBS demonstrators had links with the large demonstrator programme while the IKBS research themes and projects strand was linked to the architecture programme.

As mentioned previously, SERC provided the director of the IKBS programme, Dr David Thomas, and support staff at the directorate, at SERC headquarters at Swindon, and at the Rutherford Appleton Laboratory. The fact that the Alvey report had downgraded IKBS from the position of the leading programme as proposed by the Abingdon group to a lowly status did not mean that IKBS was a backwater or lacked activity. In fact IKBS had more projects than any other programme (see Table 6.11 below). The many support staff supplied by SERC were certainly needed.

Table 6.11 Alvey Project Dissection

Programme	No. of Projects	Academic Only	Industry Only	Full Collaboration
IKBS	103	49	7	47
VLSI/CAD	82	21	19	42
Software Eng.	66	31	7	28
MMI	55	15	0	40

The other point supported by the figures above is that IKBS has a very large academic following. Although the participants in the IKBS programme comprised 46 firms, 36 universities and polytechnics, and 13 establishments ranging from the Imperial Cancer Research Institute to the Henley Centre for Forecasting, it is worth noting that 25 of the 46 firms only participated in one project, the greatest number of one project participants out of the four main programmes. Many of the one-project firms were involved in the IKBS demonstrators. The ranking of the top five academic and private sector participants by number of projects are listed below (see Table 6.12).

Table 6.12 IKBS Projects - Academic and Industry Rankings

Rank	Firm	Projects	Funds(£M)	University	Projects	Funds(£M)
1	ICL	10	4.90	Imperial Coll.	18	2.17
2	GEC	8	1.85	Edinburgh	14	1.39
3	Logica	6	.40	Sussex	10	.63
4	SDL	5	.90	Cambridge	8	.53
5	Plessey	4	2.98	Manchester/	6	1.34
				Strathclyde	6	.81

Note: Alvey funding estimates as of September 1987 are provisional.

Two features of the IKBS strategy which made the programme more coherent were the emphasis given to awareness and the demonstrator projects. The awareness scheme was vital insofar as it both alerted those who worked in this and related fields to new developments while facilitating the transfer of technology from the laboratories to the marketplace. It also featured a 'journeyman scheme' which involved mainly private sector employees attending either the Turing Institute at Strathclyde University or Imperial College for six months to acquire IKBS skills by working on projects relevant to their company's needs. By May 1987, thirty-six journeymen representing twenty-nine organisations had been trained (Alvey, 1987, pp.261-2). The demonstrator projects were also useful vehicles to which IKBS research could be applied during the life of the programme as well as fulfilling the obvious role of demonstrating progress made.

In November 1984 Brian Oakley expressed reservations about the success of the IKBS programme. He said (Owen, 1985, p.137):

> I am getting very worried about IKBS. I would guess that we have 40-50 per cent committed, but it is very scrappy. I think the blunt fact of the matter is that the amount of research that is going in on IKBS in industry is just too small. I think we are going to have difficulty in completing a decent programme there, particularly on the research theme side.

This pessimism was premature. At the 1985 Alvey conference Dr Thomas reported a heavy flow of applications for grants to work in the research themes areas with 158 applications received of which 72 were approved, 60 rejected and the rest pending (Alvey, 1985a, p.32) and by 1986, 88 research theme projects had been approved (Alvey, 1986c, p.57).

There were also cases of early commercial exploitation in the IKBS programme. One example was the case of System Designers Limited (SDL) and the POPLOG language, a high level software development tool originally developed at Sussex University prior to the Alvey initiative and marketed worldwide by SDL. Two collaborative projects were allocated to SDL and Sussex University to develop enhancements to POPLOG at a cost of more than £280,000. With over 600 licenced sites using POPLOG around the world, SDL would surely have regarded these projects as a good investment. Another example was a collaborative project between High Level Hardware and Cambridge University which attempted to adapt a High Level Hardware 'Orion' computer for use as a high performance sequential inference machine at a cost of almost £130,000 of which £97,000 came from SERC. Unfortunately nine months after the project started, the research assistant and the microcoding assistant both left and the project was terminated.

Despite the professed interest of senior MoD figures in the IKBS programme, only one of the MoD research establishments took part in the programme. There were projects which had a distinct defence flavour however. A collaborative project between British Aerospace, GEC, Plessey and Queen Mary College costing £1.25 million was aimed at enabling a computer vision system to develop three dimensional descriptions by:

1. Obtaining accurate low-level visual motion data from the changes in the image irradiance.
2. Interpreting the observed visual motion in terms of the

position and motion of the points, edges and surfaces in view.

3. Organising the description obtained wherever possible into partial object representations and unifying these over a sequence of images.
4. Matching the partial object representations to stored object models (Alvey, 1987,p.222).

It should be remembered that at this time GEC was having enormous problems with both its Nimrod and Tornado radar systems. Another project costing £2.1 million between Solartron Simulation, Rediffusion Simulation, and Smiths Industries Aerospace and Defence Systems which aimed to develop techniques to assist operators working under heavy workloads and stress. The applications for these techniques were flight simulation, naval trainers, and tactical decision aids for use in aircraft cockpits. Solartron Instruments, Ricardo Consulting Engineers, and Westland Helicopters also had a joint IKBS project to develop a system to monitor the condition of helicopter gearboxes at a cost of £1.4 million (Alvey, 1987, p.241). While all of these project partners would rightly point out that each of these projects could be equally applied to civil applications, the orientation of this work did appear to be biased towards the defence sector. On the other hand, there were also projects couched in commercial terms which had the potential for military use.

Another feature of the IKBS programme was the research clubs. These were knowledge based systems, logic based environments, declarative architectures, speech and natural language, and vision. The last two of these were joint IKBS/MMI clubs.

Although it is far too early to assess the overall success or otherwise of the IKBS programme, especially in some of the areas where fundamental research was attempted, progress appears to be patchy. An Alvey source said (48):

> How do we think the work on knowledge based systems compares with the rest of the world? Well I'd say that it's reasonable. How do I think it compares in logic (based environments)? I would say that despite all our efforts in the UK and in Europe, we still end up buying American tools - knowledge representation systems like KEE and ART. In speech, we seem to be doing, as far as we can tell, as well as anybody else, considering the tightness of resources. In image we've got some particularly good people, several very good people came back from the States, so that got off to a very good start and that seems to be going OK. Now the architecture work is probably the envy of the world. There's been some very good work done in the universities here...It's as good as anything you'll see in the US and the Japanese are always trying to get prominent researchers to go to ICOT to help them out. So overall I'd say it's gone reasonably well.

It was in the IKBS systems architecture area that the ICL, Plessey, Imperial College, and Manchester university Flagship project led the way. This £16 million project was Alvey's most expensive.

The main support body in IKBS was the IKBS advisory committee which in mid-1985 had twelve members. The breakdown of membership shows there were five academics, two MoD technologists, with the rest coming from the private sector. Oddly, the two major companies in the field, ICL and GEC, did not have representatives on this committee although the two leading universities, Edinburgh and Imperial College, did. There was also an Alvey/SERC special interest group in AI (Artificial Intelligence) whose membership was broken roughly into one-third academic, one-third SERC/Alvey, and one-third private sector which advised on that facet of IKBS.

The IKBS directorate was the first area of Alvey to publish a comprehensive account of its expenditure. At the 1986 Alvey conference, Dr Thomas announced that Alvey had spent £43.3 million on IKBS but official Alvey figures for IKBS only relate to project funding and awareness and in April 1986 the official total was £33.9 million (Alvey, 1986c, p.15). At the 1987 conference official figures released showed Alvey expenditure to be £34.7 million, however a confidential report issued in June 1987 by Alvey claimed a total IKBS spend of £32.9 million. These figures (see Table 6.13 below) highlight the difficulty in evaluating the overall Alvey programme in the face of official coyness at releasing a proposed funding dissection and conflicting figures. They also raise an interesting question concerning the IKBS expenditure in light of the estimated £26 million in the Alvey report. One source suggested that money earmarked for IKBS work in the large demonstrator programme was diverted into the IKBS area (49).

The Thomas figures raise a point which has only been alluded to elsewhere, namely, the intangible costs to the Alvey programme such as infrastructure and project management. If the Thomas figures are correct, it appears that IKBS had overhead costs of approximately twenty-five per cent of programme expenditure.

Table 6.13 Alvey IKBS Expenditure Dissection

1986 Conference	
Topic	Cost(£M)
Projects	32.6
Infrastructure	6.3
Awareness	1.9
Management	2.5
Total	43.3

	April 1986	1987 Conference	June 1987
Topic	Cost(£M)	Cost(£M)	Cost(£M)
Demonstrators	3.2	3.1	3.1
Research Syst.	8.8	9.6	7.9
Architecture	16.8	16.9	16.9
Logic Prog.	3.8	3.7	3.7
Awareness	1.3	1.4	1.3
Total	33.9	34.7	32.9

Although a final statement on the success or failure of the IKBS programme may be years away, another insight to its potential can be analysed by examining the area in which it was intended to have important applications, the large demonstrator programme.

The Alvey Large Demonstrator Programme

The large demonstrator programme was the part of the Alvey programme that was intended to provide 'market pull' to the enabling technologies, especially IKBS and the Man-Machine Interface. The other aspect of this programme was that it was the only individual Alvey programme without a heavy military input. The objective of this programme was to provide projects which straddled programme boundaries 'which would open new markets in 5-7 years' by utilising and demonstrating the products and processes developed in the other programmes (Alvey, 1985a, p.50).

The large demonstrator programme differed from the other programmes insofar as a 'number of large companies were specifically invited to make proposals' (Alvey, 1985a, p.50). By September 1983, the programme director, Laurence Clarke, had received 'proposals for eight projects' and had been 'notified of the topics of a further nine' (Alvey News 1, Sept. 1983, p.5). Twenty-two proposals were received from which a short-list of seven was compiled. These were subjected to a feasibility study and four were selected for implementation (see Table 6.14 below).

Table 6.14 Alvey Large Demonstrator Projects

Project	Collaborators
Knowledge Based Decision Support System for the DHSS	ICL, Logica, DHSS, Surrey Uni., Lancaster Uni., Imperial College
Mobile IT Terminals For Cellular Radio Systems	Racal, Electricity Council, Surrey Uni., Loughborough Uni., Sussex Uni., Cambridge Uni., Transport and Road Research Lab., Thames Polytechnic
Design to Product	GEC Avionics, GEC Research, GEC Electrical, Lucas CAV, National Eng. Lab., Edinburgh Uni., Leeds Uni., Loughborough University
Speech Driven Word Processor	Plessey, Edinburgh Uni., Loughborough University, Imperial College
Replacement of Man Underwater	GEC Avionics, Britoil, Shell, Off Shore Engineering, Strathclyde University
Airborne Tactical Decision Aid	British Aerospace, SPL, GEC Avionics Royal Aircraft Estab. (Farnborough)
Alarm Evaluation in Real Time	BP (Scicon), Admiralty Surface Weapons Estab., Ferranti, Oxford Instruments Royal Free Hospital, City University

Note: The four projects above the line were chosen for implementation.
Source: *Alvey Programme Annual Report 1985*, p.57.

The four selected demonstrator projects were joined by a fifth which was not one of those on the short-list. This was the Advanced Networked Systems Architecture (ANSA) project. Two points made this project radically different from the others. One was the inclusion of three non-British IT companies, Olivetti of Italy, Digital Equipment Corporation of the USA, and Hewlett-Packard of the USA, in the project. The other was the decision to locate the team in a central laboratory at Cambridge.

The ANSA project was mooted as early as 1984 and by January 1985 the original consortium of British Telecom, GEC, Plessey, Ferranti, Racal and ICL/STC had formed what was then seen as an architecture project (Alvey News 12, August 1985, p.6). The project was held up initially by the SERC funding crisis discussed in the previous chapter. There were also problems regarding intellectual property rights which resulted in a collaborative agreement not being signed until early 1986 and at the 1986 Alvey conference it was announced that there would be a 'broadening of the participative base with establishment of European participation' (Alvey, 1986d, p.344). The final membership of the project team was British Telecom, GEC-Marconi, Plessey, ICL, Racal, Information Technology plc, Olivetti, Digital Equipment, and Hewlett-Packard with Ferranti withdrawing.

The aim of the ANSA project was to develop a networked systems architecture which would facilitate the development in international standards for distributed multi-computer processing (*FT*, 15/3/85). To a layman this means developing a 'black box' containing hardware devices and specialised software which will allow a large number of different computers (e.g. CAD, parallel processors, standard serial processors) manufactured by different companies to work together on a large complex process. It transcends the relatively straightforward problem of transferring data from one machine to another by looking for ways to electronically integrate and channel the diverse tasks that make up a process. This project was estimated to cost the Alvey directorate £4 million over four years.

The most controversial project was the Department of Health and Social Security (DHSS) demonstrator. This project was intended to provide various knowledge bases which would combine to form a decision support system which encapsulated the whole of the social security benefit rules and practices on a computer system. Staff in the DHSS have seen this system as a threat to their future (*FT*, 12/8/86) in the same way bank officers viewed automatic tellers. A recent newspaper article must have confirmed some of their worst fears when it was announced that National Insurance and social security benefits computer systems were to be developed and privatised with an estimated job loss of between 16,000 and 20,000 (*Guardian*, 2/11/87). The large demonstrator was to cost Alvey £3.5 million over five years with a total project cost of £7 million. The project was partially demonstrated in Oxford in July 1987 and project leader, Charlie Foreman, was quoted as saying (*New Scientist*, 23/7/87, p.32):

> The basic dream is that people could find out what they are entitled to from the DHSS by using machines in public places like libraries and hypermarkets. It would have to be a robust machine, but with a simple interface, like an arcade game.

The mobile information systems were a series of sub-projects with a joint objective of bringing 'the benefits of information technology to the mobile user' (Alvey, 1986d, p.341). The sub-projects were an advanced cellular radio hand-portable unit for voice and data transmission, an IKBS system which could analyse traffic incident reports and prepare messages for broadcast automatically, a fault diagnosis IKBS to assist electricity board engineers, and a mobile end-to-end secure multimedia electronic mail network. While Racal had started research on the cellular radio-telephone, it also began marketing an imported 'hands free' car-telephone for £2000 (*New Scientist*, 12/3/87, p.26). During 1987, advertisments appeared for a 'mobile office' which allowed data exchange using multimedia. Both of these points indicate that the original intention of conducting research into technologies which would become pervasive in 5-to-7 years was foreshortened in this case. Since both of these products were widely available within three years of the £7.5 million project commencing, it appears that this demonstrator was much more commercially oriented than some of the others.

The GEC/Lucas CAV design to product project was the largest demonstrator in terms of cost with an estimated budget of £8.9 million. The objective was to apply IKBS techniques to the computer integrated manufacture of 'light electro-mechanical devices'. Most of the IKBS work was carried out in the universities which took part and although the four main knowledge bases were not fully integrated by early 1987, a detailed plan had been produced for this purpose. The project did not commence until February 1985 and was scheduled to take five years to develop. This means that it will not finish until almost two years after the Alvey programme has officially ended. Despite this, the project team announced that 'specific aspects of the project are begining to be considered for exploitation' (Alvey, 1987, p.413) which indicates good progress being made.

The final large demonstrator was the Plessey-led speech driven word processor. This project was a very ambitious, high-risk one with enormous sales potential. With an estimated cost of £7.5 million and a five year development span, it incorporated aspects of IKBS, MMI and architecture. By April 1986, eighteen months after the project started, various simulation tests had been carried out and a lexicon of 5,000 words was embedded with a target of 20,000-plus words by 1989 (Alvey, 1986d, p.343). The project continued to achieve targets and by June 1986, several of the software modules had been linked, with one software package produced at Edinburgh university being marketed. Disaster struck in 1987. In June 1987, an Alvey document was produced which said in part: 'Due to reconsideration of their commercial priorities the Plessey Company is negotiating to transfer the project leadership to another major company' (Alvey, 1987, p.414). A report in the *New Scientist* said (2/7/87, p.35):

> After spending three years and £700,000 in grants from the Alvey programme on work, Plessey downed tools because it could not raise the cash needed to continue from the City. Plessey also blamed its lack of marketing skills and the absence of a suitably powerful computer to run the system on *(sic)* its decision to stop the project, which had cost the company £500,000.

This was a major blow to the large demonstrator programme and to Alvey. All was not lost however, and negotiations were still taking place in late 1987 between Plessey and GEC, who had expressed interest in taking over the project. One noteworthy feature of the project was that it had been going for more than half of its estimated time and yet less than twenty per cent (£1.4 million) of the proposed funding had been invested. This pattern might indicate that problems were anticipated before the project went as far as it did.

Administration of the large demonstrators was different from the administration of the other programmes because of the small number of projects. It was not necessary to have a large support staff within the directorate to administer and monitor the programme and almost all of this fell to Laurence Clarke alone. There was a large scale demonstrators advisory panel comprising one DHSS official, one MoD official, and six DTI personnel but this appears to have become defunct recently as it is not mentioned in either the 1986 or 1987 reports although it is mentioned in the 1985 report (Alvey, 1985a, p.135).

The strategy adopted for the large demonstrators had one major drawback to offset the positive notion of 'market pull', namely the belief that British IT firms would undertake major research programmes with a 5-7 year horizon which may not have commercial relevance to them. The Plessey programme was an honest, if over-ambitious, example of a genuine 'frontiers of technology' exercise and it fell by the wayside. The ANSA project, the Racal mobile information project, the GEC computer integrated manufacture project, and the DHSS decision support system were all examples of projects much closer to the market. The consequence of this is that the technologies attempted do not make the fullest use of the technical achievements in the other parts of the programme. One industry source said (50):

> One thing I do know, looking back, is that the large demonstrators have not been as successful as the other parts of the programme. So I would regard that as maybe something Laurence (Clarke) could have done something about. I don't know. Maybe he had other problems. Maybe the industrial chemistry for good demonstrators wasn't around.

The view that the large demonstrators have not been an outstanding success is also borne out by the low profile accorded to this programme by the directorate. If they had been successful, the Alvey publicity machine would have made sure the IT world was told.

The large demonstrator projects were a limited attempt to bring together some of the UK's major information technology firms with some of the users of IT systems to provide an application base for the new developments. The importance of these types of arrangements are made most clear in the following chapter since they were an key part of the Bide committee's recommendations.

6.4 The Alvey Man-Machine Interface Programme

The earliest form of man-machine interface (MMI) studies were known as ergonomics. This concentrated on the physical comfort aspects of the interaction between man and machine with the emphasis on human comfort external to the machine. This type of work resulted in visual display units with tilting screens, better designed seating for operators, and movable keyboards. In more recent times, MMI studies have broadened to include what goes on inside the computer and how that impacts upon the operator, mainly in the areas of image and speech analysis. Research in MMI now brings together practitioners from the fields of linguistics, psychology, organisational methods, mathematics, medicine, computer science, systems analysis, and electronics.

The rationale for including an MMI programme in Alvey was based on the belief that 'MMI research and development is needed to ensure that UK products maintain competitiveness in the IT marketplace' (Alvey, 1984b, p.3). There was a firm belief that as home computers and office automation became more commonplace, purchasers and users would be more attracted to 'user friendly' equipment and the UK should 'play a leading role in these markets, rather than merely copying American and Japanese designs' (Alvey, 1984b, p.3). As with the rest of the programme, the MMI objectives were couched in broad terms (Alvey, 1984b, p.4):

> The objectives of the Alvey MMI Programme...are twofold:
>
> (1) To raise the level of UK user interface design, in terms of innovation and design methodology, so that industry can compete effectively in world markets.
>
> (2) To improve UK capabilities in pattern analysis to make possible the use of advanced speech and image techniques in the user interface.

The major industrial and academic participants in the MMI programme are listed in order of project participation below in Table 6.15. The amount of Alvey funding (provisional estimate) is also given.

Table 6.15 Alvey MMI Programme - Industry/Academic Rankings

Rank	Company	Projects	Funds(£M)	University	Projects	Funds(£M)
1	GEC	7	.54	University College	8	1.73
2	STL	6	1.00	Loughborough	7	1.27
3	ICL	5	.53	Queen Mary College	5	.81
4	Telecom	4	1.32	Cambridge	4	1.31
5	Logica	3	.52	Imperial College	4	.59

Note: RSRE (MoD) took part in six projects (Alvey funding £1.09 million)

Source: *Alvey Programme Annual Report 1987*, pp.20-23.
Financial estimates provided by PREST, Manchester.

To generate the strategy, Alvey sponsored a survey 'of 110 of the major IT companies in the UK in both defence and non-defence work' which found that one-third of the companies did no MMI research while a further third had groups of 'between 1 and 5' researchers usually 'scattered throughout the organisation' (Alvey, 1984b, p.4). The major finding was that 'a substantial amount of MMI work is conducted in government and industrial defence laboratories' (Alvey, 1984b, p.4). In other words one-third of the major IT companies and the MoD research establishments provided most of the non-academic input to the programme.

The MMI programme was divided into four sub-programmes. These were speech, image, displays, and human factors. Of these, the two most controversial were displays and human factors. One source said (51):

> I can't really name another area I would have liked to have had in the programme. I can name two areas I would have liked to have had out of the programme. We've already mentioned the human factors thing and I have never believed that we should have been doing displays in the programme.

A member of the Alvey steering committee said (52):

> I think there was real disagreement about the displays side. Some people thought that displays were the single most important thing in the MMI area. Other people said 'Maybe it is but British industry has never yet succeeded in picking up anything on the display side and so on against the Japanese, so we should concentrate on things we do better, like software for example in the MMI area'.

There was a feeling among the critics of human factors research that while it was important to take them into account, human factors as a discipline did not warrant its own sub-programme. One said (53):

> We failed to pull that community together into a coherent

> community who knew their own mind and their own priorities and so on. To give you an example, in the early days of that part of the programme it was terribly easy to get reports written by human factors people which said 'We must make a model of the human being and put it into a computer'. Well I don't know whether it was a practical suggestion or not but my whole instinct tells me that it's just a little bit difficult to say the least...I actually believe that it suggests some very premature, some very *jejeune* thinking on the part of the human factors community who are just not mature.

Another interviewee saw the problem lying with the committee structure that surrounded the MMI programme. He explained (54):

> Some of the so-called advisory committees dominated proceedings in that area (MMI). They behaved as though they were a management committee for human interface activities. They had been dominated by academics and that's a bad thing too. Now it sounds as if I'm blaming Chris (Barrow, director of MMI) but I'm not because he had a very difficult furrow to plough. There was no established community, the absolute antithesis of what I was saying about VLSI at the beginning, and couple that with the fact that human interface isn't really an enabling technology...So while VLSI has been - I wouldn't say a cosy club - has been a place where the companies have got together and agreed on a course of action which has made the directors job very much easier, there are very, very few people in

> industry who will stand up and say 'Work on human interfaces is of vital importance.' (Human interface) is very ill-understood, there isn't any theory, or very little, behind it, it's all mixed up with these bloody psychologists who can't speak the right language and they say 'Oh these bloody engineers. They talk gobbledegook' - and they do. So it is a difficult job and as I say, there are very, very few people in industry who are really turned on by the need for - I mean I had a campaign in the steering committee, it must be a year ago now, to try to get them to make more noise about it (human interface) and I failed totally. One member who shall remain nameless said very firmly 'If it won't help sell my products today, I'm not interested. Period'

While agreeing with some of these views, one industrialist saw the MMI problem somewhat differently. For him it was not so much a case of problems of technology as it was a case of personalities. He said (55):

> I think MMI is one of the programmes that represented the Alvey directorate's heritage - the Alvey directorate to me always tended be a little too academic. They really got in out of their depth. What Brian Oakley should have done is said 'OK Chris, this is a problem'. He should have got the academics in and said 'We are the Alvey directorate. We are going to do what we think is right. You may not agree with this and where that is the case, we will not fund you. Bugger off'. And it's surprising what they would have done...but nobody would back

> Chris to tell them to get stuffed. Actually Chris should have said 'OK. You don't want to play - zero funding' and they'd have all come running after that...The trouble was Brian (Oakley) didn't want confrontation with anybody in any area.

Despite all of these problems, the MMI programme did have its share of successes. Ironically, one of these was in the display programme. A consortium that included GEC, RSRE, EEV-LUCID, and the universities of Cambridge and Liverpool developed a liquid crystal display based on polycrystalline silicon transistors which had the 'lowest operating voltage ever produced' thus giving the group 'a clear advantage over the foreign competition' (Alvey, 1987, p.397). Both the display and the image programme had a significant bias towards defence.

The human factors and speech programmes had a broadly civil orientation, mostly towards telecommunications and computing with only the odd project in the defence sphere. An example of this was a project between Logica, National Physical Laboratory, RSRE, Smiths Industries Aerospace and Defence Systems, and University College London. The project had the innocuous title 'Speech Technology Assessment' and the objective was to assess the performance of speech recognition devices. The first test was 'made in a high performance helicopter flown in such a way as to allow high levels of vertical vibrations to be transmitted to the speakers' (Alvey, 1987, p.393). The participation of Smiths and RSRE point to a defence application at least in part.

The MMI strategy listed estimated funding. The actual expenditure to date is remarkably close to the initial estimate (see Table 6.16 below).

Table 6.16 Alvey MMI Expenditure (£M)

1984 Estimate		1986 Official		1987 Official
Human Interface	9.0	Human Interface	10.8	11.1
Displays	4.7	Displays	2.3	6.5
Pattern Analysis	12.4	Image	10.0	9.4*
Contingency	4.7	Speech	4.1	4.5
Infrastructure	4.4			
Totals	31.8		27.2	31.6

Note: * - No explanation was given for this downward revision of expenditure.

As mentioned in the previous chapter, the DTI was closely involved in the displays programme of MMI and as a result, the DTI was well represented on various committees associated with this programme. The DTI involvement may also account for some of the antagonism towards this subject apart from the alleged 'airy-fairy' nature of MMI generally (*Computer Weekly*, 2/2/84). There were six committees supporting the MMI directorate, more than in any other programme. They ranged in size from the eleven-man image processing appraisal advisory committee to the twenty-two man human interface committee. An examination of their chairmanships show that university professors headed four while the other two were led by John Pickin of Ferranti, the man reputed to have suggested John Alvey to lead the committee of inquiry, and Mr J M Watson of ICL. None of the committees had a preponderance of academics although six served on the human interface committee.

Criticism of the MMI programme's academic bias needs to be examined carefully. For many, perhaps most, engineers and computer scientists, the most tiresome and frustrating facet of information technology is dealing with the often non-technical users of the systems. The academics who allegedly distorted the MMI programme were trying to make the technology more humane. They took the hardware versus software argument one step further. These academics believe that it does not matter if the hardware is perfect and the software highly sophisticated if the technology is alien and does not give the user what he or she wants. This area was heavily oriented towards the users of IT systems, the only part of Alvey that had this bias. In the following section on infrastructure and communications, the point being made will become much clearer.

The Alvey Infrastructure and Communications Programme

The infrastructure and communications (I&C) programme was not established as a research programme. The Alvey report did not mention the need for extensive research in the communications area and although at least one committeeman believed the committee's intentions to be misunderstood, the report was quite specific regarding this programme. It said (Alvey report, 1982, p.45):

> The need for the programme in the first place derives in large measure from the fragmented state of the UK Information Technology research community...The objective is therefore to link participants together by means of a network, to create a new community...As they will come to depend heavily on the network, it must be based on proven technology, rather than on experimental implementations.

Despite this clear statement, the directorate commissioned a joint study to be carried out by Logica and Computer Analysts and Programmers to 'determine any consensus view' on what R&D should be undertaken by Alvey (Alvey, 1984c, p.3). The view was determined by interviewing sixteen organisations including users such as British Petroleum and Ford, suppliers including Plessey, Racal, GEC, British Telecom, and Mercury communications, as well as government research establishments such as RSRE and RAL. The survey team concluded that 'considerable collaboration' already existed 'between BT and its 'ring' of suppliers' and as a result of Project Universe, an SERC-funded project under the DCS banner (Burren and Linnington, 1983, pp.28-30). It also concluded that 50 per cent funding was 'unattractive to small companies' and that only two areas warranted R&D support: high speed networks and secure communications (Alvey, 1984c, pp.3-6).

The result was two research projects, Unison (i.e. Son of Universe) and Project ADMIRAL (ADvanced Mega Internet Research for ALvey).

Project Universe was aimed at using satellite links for data communications and involved RAL, GEC, British Telecom, Logica, University College, and Loughborough and Cambridge universities. The new Unison project, without GEC, British Telecom, and University College but joined by Acorn Computers, was aimed at developing high speed communications-networking products and services to interconnect local area networks with multimedia information exchange requirements. With a total cost of just over £2 million, the Unison project has been a major success for Alvey. It was successfully demonstrated at the 1987 Alvey conference at Manchester, a patent is pending for an area of primary rate Integrated Services Digital Network, and the project drew extensively on new key technologies such as the Inmos transputer, the Needham-pioneered Cambridge Fast Ring, and the latest Acorn computer hardware (Alvey, 1987, p.406).

Project ADMIRAL was primarily oriented towards secure network communications. British Telecom, GEC, University College, and the University of London computer centre collaborated on a £3.2 million project which interconnected microcomputers, minicomputers and a super-computer (Cray) at five separate sites using encryption hardware and specialist software to ensure secure access control. This project too has made good progress and is nearing implementation (Alvey, 1987, p.407).

The main work of the I&C directorate was not these two projects. It was the provision and monitoring of common infrastructure and support services within the Alvey directorate and throughout the programme. The results were highly unsatisfactory.

In the Alvey report it was noted that electronic mail should be established as the first priority 'followed rapidly by file transfer facilities for interchange of data and programmes between participants' systems' (Alvey report, 1982, p.46). At the 1986 Alvey conference, three years after the programme commenced, the I&C director conceded that 'one further reason why the Alvey Mail system does not carry as much traffic as might be expected is that <u>it does not properly support file and document transfer</u>(emphasis added)' (Alvey, 1986b, p.89). Although the Alvey community embraced almost 2,000 participants, only 600 ever registered as users of the Alvey electronic mail service and only forty messages per day were sent, mostly by a 'kernel of enthusiastic and frequent users' (Alvey, 1986b, p.89). Several explanations were offered for this. One was that suitable equipment was not available. Another was that there was 'an absence of a sense of community'. The third was that 'a poor user interface discourages all but the most determined from learning to use it' (Alvey, 1986b, p.89). The director, rightly, acknowldged that the first excuse was unlikely since such systems have been operating worldwide for some years. Based on the research conducted and the findings in the previous chapter, it is suggested that the second excuse is not correct either. The answer lay with an appalling man-machine interface.

Academic participants in Alvey had an SERC-created packet switching network which existed prior to Alvey called JANET (Joint Academic Network) located at RAL. In June 1984, a network system for industrial participants was set up at the National Physical Laboratory (NPL) at Teddington. This system had inadequate directories of users and services on offer. In other words it was not user-friendly. In 1986 this system was transferred to the RAL on the advice of the advisory group for Alvey network. This eight-man committee was chaired by the director of I&C and apart from one RAL and one RSRE representative, was made up of industrialists. At the 1986 Alvey conference, Professor Sloman of Sussex university acknowledged that academic users of the mail service were fortunate to have access to JANET but went on to add that 'the technology existed and so adequate communications should be possible' (Alvey, 1986e, p.22). A representative of Solartron plc, Mr Wakeling, replied that 'a lot of angry and hungry users' wanted access to a system that allowed off-line file transfer and referring to the changeover from NPL to RAL, he noted that it was 'paticularly galling to have facilities changed without notice' (Alvey, 1986e, p.22). Perhaps there was some justification for the I&C director to complain bitterly at the 1985 Alvey conference that the US DARPA strategic computing programme spent twenty per cent of its overall budget on support and communications (Alvey, 1985a, p.65) while Alvey spent less than two per cent.

The other major role for I&C was managing the directorate's computer system. An Alvey source described it as a 'disaster' (56). The DTI staff inspection report noted (DTI, 1986, 1.3):

> d) the computer systems were inefficient, not wholly implemented and data recording specifications did not conform to DTI needs. There was no cohesive implementation policy because responsibilities for IT support facilities fall to both the IC (Information and Communication) and Administration Directorates.

The report also said that 'many problems had been experienced by users' including 'frequent' system breakdowns which not only caused all work to cease until the 'fault was identified and rectified' but also resulted in a loss of all work being input to the computer when it broke down, a printing system that was 'incredibly slow', and the electronic mail system which was 'slow and insecure' (DTI, 1986, 1.22). Another point raised was that 'at the close of the inspection (March 1986) the Directorate was still without a centralised system for recording project information and fiscal control' (DTI, 1986, 1.23). At the 1986 conference, the then director of I&C admitted that the directorate had no 'Management Information System' or 'appropriate databases', mainly as a result of an 'inability to develop a clear user requirement' (Alvey, 1986b, p.88).

Terms such as irony or paradox are hardly necessary in light of these findings. A shiver of *schadenfreude* will pass through many of the academics who saw the major IT problems in terms of users unable to satisfy their requirements because of inflexible, unfriendly systems. While the Alvey directorate was in the vanguard of Britain's quest for the fifth generation computer, the directors were unable to produce statistics or forecasts for management information. Researchers might achieve the one micron barrier on their VLSI project but they could not tell anyone about it via their terminal; terminals did not talk to each other. At this point, the systems/software supporters would point to the necessity for better software tools, the hardware proponents would claim that smarter machines are the answer, and the 'soft science' MMI supporters would rest their case.

6.5 Conclusion

The objective of this chapter was to describe the private sector/Alvey interface and to examine the individual Alvey programmes and their attendent support structures in an attempt to shed more light on the decision-making processes which fell within the Alvey ambit.

(1) The private sector/Alvey interface

By refusing to state policy objectives, the Alvey committee and the Alvey directorate avoided criticism of their objectives being too attainable, too easy, too ambitious, or not met. There were none. Because there were no firm objectives, there was an operational aimlessness and lack of direction. Into this vacuum stepped the major companies and sectional interests. The Alvey strategies that were generated were the strategies favoured by the major interest blocs. Far from being a *quid pro quo* situation where a government agency directed companies to work in specific areas in the national interest in return for R&D subsidies, the companies, professionals, and a narrow group of civil servants defined the national interest, staffed the government agency, and disbursed funds.

The VLSI strategy was compiled by the handful of major ASIC suppliers and the MoD. The MoD supplied the management, infrastructure, and much of the technical support to the VLSI programme. The results were heavily oriented towards Britain's two big IT markets, the defence and telecommunications industries. The software engineering strategy was developed mainly by the major software houses with important inputs from the MoD. As a result this programme too was closely tied to the defence and telecommunications sectors. The IKBS strategy was compiled mainly by academics and SERC representatives. Consequently, the IKBS programme had more academic projects than any other programme and the bias tended to be towards existing or proposed university research projects. The MMI programme really divided into two camps. Speech and human factors on one hand with image and displays on the other. The former was heavily influenced by academics and researchers from outside the 'normal' IT fields while the latter was very much the child of the large IT firms and the MoD. The result was a somewhat disjointed speech/human factors strand with a civil orientation towards computing and telecommunications research and a defence orientation to the displays/image programmes. The dissection of overall Alvey funding for industry in Table 6.17 below helps to put the dominance of the large firms into perspective, and when compared to Table 5.4 highlights the differences between industry and academic participants. These figures are provisional estimates.

Table 6.17 Alvey Funding (£M) - Top Ten Companies

Company	Funding Total	VLSI Total	Soft. Eng. Total	IKBS Total	MMI Total	Large Demo.* Total
GEC	18.6	11.8	1.1	1.9	.5	3.3
Plessey	15.6	6.8	-	3.0	.4	5.4
ICL	11.9	1.7	2.2	4.9	.5	2.6
Br. Telecom	10.3	2.8	.5	.2	1.3	5.5
Ferranti	8.2	7.7	.3	-	-	.2
STL	4.5	1.7	1.4	.4	1.0	-
Racal	4.2	1.2	-	-	-	3.0
STC	3.9	2.2	1.7	-	-	-
SSL	3.3	-	3.0	.3	-	-
SDL	2.3	-	1.3	.9	.1	-

Note: * - Includes funding for Infrastructure and Communications.

By allowing the participants to shape the programme strategies to their own ends, the Alvey programme became in many cases, a form of industry support scheme. Many interviewees from the private sector were quite candid in admitting that they would only participate in projects where it was in their commercial interests to do so. Most firms took the safe option and developed products or processes for the two prime markets of defence or telecommunications. There can be little dispute that as well as the firms, the MoD , British Telecom, and the SERC also gained enormously from the programme. The MoD contributed £40 million, yet more than £130 million was spent in total on VLSI/CAD alone (see Table 6.18 below).

Table 6.18 Alvey Expenditure to June 1987 (£M)

Programme Areas	Alvey Report Recommended	Total To Date	Government Funds	Industry * Funds
VLSI/CAD	115	132	74	58
Software Eng.	70	54	33	21
L. Demonstrators	58	43	26	17
MMI	44	48	32	16
IKBS	26	51	33	18
Infra. & Comm.	19	5	4	1
Education	20	-	-	-
Totals	352	333	202	131

Note: * - Industry funds are always taken as being equal to government funding less SERC funding. There is no way of proving or disproving these estimates

Another point to emerge from this review is that problems arise when technological excellence is not the only criterion for selecting technical projects. Many interviewees were adamant that projects were allocated on a 'fair shares' basis. The other side to the allocation of projects problem is that during the early days of the programme, projects were allocated on a 'first come, first served' basis. It is debatable which is the worse way to allocate projects. Several expressed anger or disgust that certain firms were given funds to enhance 'outdated' technologies. To the question of large firm bias, an Alvey defender may say that 115 firms are involved in the programme and there are not 115 large IT firms in the UK. The response to that is there are over 15,000 software firms alone in the UK (Alvey, 1985a, p.69).

(ii) The Alvey programmes: some observations

Alvey was proposed as a pre-competitive, collaborative research and development programme. It appears from the review of the programmes that much of the work was not pre-competitive at all, regardless of how broadly 'pre-competitive' is defined. Less than three years into the programme, approximately forty per cent of VLSI and software engineering projects reported good exploitation. This should be examined in the light of the claim that it takes 'several years' to transfer a new technology into production (Hoselitz, 1985, p.17). Examples such as the SDL/Sussex university POPLOG projects which were enhancements to an existing technology for which SDL held a worldwide licence suggest that some of the alleged 'research' was simply refining existing products. Nowhere was this more in evidence than in the VLSI projects where some projects were described as using 'old technology' and in one case, it appeared that it was not even necessary to be collaborative either.

The Alvey programme had no overall policy objectives except in a 'vague, hand waving' sense. None of the technical programmes had clearly specified policy aims. Some of the individual programmes had operational objectives such as the development of software factories and one micron VLSI chips, others did not even have these. The lack of policy aims and objectives is not the result of a lack of imagination or vision either. It is possible that this feature of the programme is a consequence of the failure of any the groups involved to direct a corporatist policy process. The policy process concentrates on mediating differences, in this case technical, and seeking consensus but without a well 'developed associational system', the 'centralized autonomous state bureaucracy' is incapable or unwilling to assume control (Atkinson and Coleman, 1985, pp.28-29).

The programme produced some outstanding successes as well as some spectacular failures. Apart from the technical successes of which there were many, the most outstanding success was in the area of collaboration. Only three of the sixty-odd people interviewed had any criticism of collaboration and some of Britain's most repected IT industrialists believe it will be the great and positive legacy of the Alvey programme. For every criticism levelled, at least as much praise could be bestowed and as even the harshest critics pointed out, Britain would have been worse off without Alvey.

In summation, the Alvey directorate became a corporatist agency which responded to the demands of the IT industry and the professionals while also directing. The directing, however, was only in those fields selected by industry and the professionals, and often done by employees of the same firms involved in developing the strategies. The strategies were aimed at selected niches where it was believed that Britain had some advantages and technological leads. Without objectives, however, the programmes were distorted by experts with their own technical obsessions or firms with an eye to their safe markets. One administrator put the most jaundiced interpretation on Alvey: 'It turned out to be an exercise for technology wankers'(57).

CHAPTER SEVEN

After Alvey : Policy Termination or Succession?

In this chapter the primary focus is on the decision-making processes and the decisions made since 1985 and their effect on the future of IT public policy in the UK. During this period, all of the Alvey programme funds were committed; the DTI's Support for Innovation programme was cut to £280 million, down from £378 million in 1984 (*Guardian*, 26/3/86); Lord Weinstock was no longer a member of the 'Kitchen Cabinet' following an almost complete breakdown in relations between GEC and the Government; Kenneth Baker's replacement, Geoffrey Pattie, was in turn replaced by Kenneth Clarke; and moves were set in train to develop ideas for a programme to follow Alvey. All of these developments had an impact on public policy for IT and the IT policy network.

To weave together the strands which make up the post-1985 IT policy tapestry, four different, yet over-lapping, topics are examined. The first is the final stages of the Alvey programme scheduled to terminate in mid-1988. The second is the push from within the British IT community, spearheaded by the committee of inquiry headed by Sir Austin Bide, for a national IT programme to succeed Alvey. Third is the emergence of the European IT programmes and their impact on UK public policy for IT. And finally, the aftermath of the Bide report proposals, especially the response of the major interests, and the impact of the Government's failure to make an early announcement on its attitude to the Bide recommendations.

The themes that link these four topics are the growing pressure from the IT community for policy continuation in the face of possible policy termination, in tension with a government trying to distance itself from an industrial policy role, and the increasingly important part played by interest groups in the policy-making process.

7.1 Alvey Winds Down

It was never clear what the long-term future of the Alvey programme would be. The Abingdon workshop and the Alvey committee of inquiry both recommended a five-year commitment in the first instance, yet both also emphasised that areas of the programme such as IKBS and communications required a ten year period of government involvement. The reasons given were feeble or non-existent. A ten year IKBS programme was 'needed because the research required is difficult' (Alvey report, 1982, p.35) while the communications proposal simply stated 'provision of very high bandwidth 2nd Gen(eration) network' in years '6-10' (Alvey report, 1982, p.46). Most of those interviewed believed that there would be a follow-up programme. As one IT industrialist said (1) 'It's inconceivable that they (the Government) would let all the good work of Alvey go down the drain'. No-one was sure, however, whether the Alvey directorate and programme would be extended for a further five years or if a different policy and mechanism would be used.

The Alvey directorate had committed ninety per cent of its £200 million budget allocation 'in the space of 21 months' of the programme's commencement (DTI, 1986, 1.5) and by February 1987, sixteen months before the programme was due to terminate, 'the last of the Alvey funds ha(d) been committed' (Alvey News 21, Feb. 1987, p.4). Two main reasons were given for this situation. The first was the pressure from industry to get the programme up and running quickly and the second, which involved the distribution of funds (as opposed to committing funds), was a fear of the 'Treasury clawing back unspent balances' (2). The consequence was an unprecedented level of funding flowing into the engineering and computer science faculties of universities across the UK, especially during 1985-86 (see Table 5.3), and into the IT industry. The realisation that this bonanza would cease in 1988 or earlier prompted some far-sighted academics through the SERC to push for a follow-up programme before Alvey had passed the half-way point. This effort was the first formal input to the post-Alvey policy process.

The pattern of the Alvey directorate's workload changed after 1985. Until then, the emphasis had been on director-level appraisal and approval of project proposals. By 1986 with most projects approved, there was a sharp increase in administrative tasks associated with grant allocations, progress reports and so forth. The hectic pressure under which the directors had been operating for the previous two years began to abate and they had more time to visit project teams, attend workshops, and generally monitor their programmes. An area which also occupied a growing amount of the directorate's energies was the co-ordination of the ESPRIT programme and providing support to firms making applications for ESPRIT grants. This task also entailed providing ministerial support for the negotiations associated with the European IT programmes.

As with other policy areas mentioned in chapter five, this facet of the IT policy workload was the subject of problems between the directorate and DTI. The DTI staff inspection recommended that responsibility for co-ordinating Britain's role in ESPRIT should lie with the directorate and called for a redefinition of the roles that the directorate and four DTI divisions had adopted towards ESPRIT to minimise 'duplication or confusion in effort' and to ensure 'continuity should the Alvey interest not be compatible with ESPRIT stage II or if the Alvey programme should terminate' (DTI, 1986, 2.11). The report later noted that 'there had been a reluctance on the part of the other DTI Divisions involved to agree to (Alvey co-ordinating) and there was some difficulty in achieving coherent policy' (DTI, 1986, 10.40). This added to the directorate's tasks.

Another aspect of the directors' workload after 1985 was ensuring that wherever possible, the projects under development would be demonstrated (Alvey News 21, February 1987, p.4). At the 1986 Alvey conference there were thirty such demonstrations and by 1987 ninety were on display at the Manchester conference (*New Scientist*, 2/7/87, p.45).

It was during this period that some of the 'old hands' who started in the earliest days of Alvey began to leave (see Table 7.1 below). The most interesting case was that of the MMI programme. When the director, Mr Chris Barrow left the directorate to return to Plessey, the MMI programme was dismembered and component parts were handed out to various other Alvey directors. Laurence Clarke assumed responsibility for the controversial human factors programme, Keith Bartlett took over the image and speech programmes, and Rob Morland took the displays projects. This Balkanisation of the MMI programme was seen as a means of controlling the power of the 'soft science' academics who had allegedly taken control of much of it.

Table 7.1 Changes of Alvey Programme Directorships

Programme	Old Director	New Director	New Director From (and Arrival Date)
Admin.	Dr Tim Walker	Mr Roger Hird	DTI - April 1985
Inf.& Comm.	Derek Barber	Dr K Bartlett	DTI - October 1985
VLSI	Dr Bill Fawcett	Mr R Morland	PA Tech.- Mar. 1986
MMI	Chris Barrow	(Distributed)	July 1986
Software Eng	David Talbot	Mr D Morgan *	Plessey Dec. 1986
IKBS	Dr D Thomas	Dr D Shorter	SDL October 1986

Note: * - In September 1986, Dr Robb Witty of SERC replaced David Talbot as a stop-gap until Morgan arrived.

None of these changes dramatically altered the distribution of power or responsibility within the programme areas. Although the four main programmes ended up under the control of private sector secondees, this was not significant since most of the funds had been committed and projects approved by then.

Within the directorate there was no firm view of what was to become of the programme after its five years were up. One Alvey source, speaking about fixed-term projects such as Alvey, said (3):

> I believe that these sorts of programmes should have a time-bomb built into them, so that they just explode and disappear when their time is up. If you don't have something like that, they take on a life of their own. There are many examples of institutions and establishments that started up during the War or for some specific purpose, and twenty or thirty years later they're still going and growing. That shouldn't happen. So, for example, if you have a new problem, say superconductivity, then I think there's a lot to be said for generating fast a government research programme or establishment. But our

> difficulty in the UK, unlike Japan, is that having built it, you can't destroy it. Well, we can but we don't.

This raises the question posed by the title of Kaufman's 1976 study, *Are Government Organizations Immortal?*.

There were no plans or guidelines drawn up for the termination of the Alvey policy programme. When the Alvey programme was being negotiated with the Treasury in the Autumn of 1982, one source said (4):

> One of the questions that we knew the Treasury would ask was 'This is terrific. Fine. But when is this going to stop? How long are you going to carry on demanding money? In other words, at what point will the private sector be able to carry this programme on its own'.

There were no laws or statutes enacted which stipulated a set life-span of five years for the directorate. As one senior DTI officer said 'Oh no. No. That's purely notional'. He then went on to explain that although all funds had been committed, the 'very important...though less sexy' work of monitoring projects would continue 'for some time' in conjunction 'with other parts of the DTI' which were responsible for disseminating information on the 'fruits of the Alvey projects' (5). He took up the question of policy termination and said (6):

> There is always an inclination for people to say 'Well something has been around for some years, it may as well continue for a bit longer'. There is an inclination that if a

> policy has been around for some time that it should go on. And it requires a certain amount of courage to say 'Well that was worth doing, and indeed there might even still be fruits from continuing, but we are going to stop'. I think the ministers had in mind when they established the Alvey programme, a five year programme. But a very hard look should be taken during that programme as to what should take its place - if anything. I would say the Bide committee was an input into that discussion and from their reaction to the Bide committee, the ministers will say whether they felt Alvey should be five years then stopped or whether it should be five years or so and then either more of the same or something rather different.

Another senior civil servant, speaking about the possible termination of the Alvey programme, said (7):

> If there is a follow-on programme then I would expect a form of the directorate to carry on. Yes. If there isn't a follow-on programme, then I think, probably the sooner the directorate is wound down, the better...So, I think that if there is no follow-on programme, the directorate will dissolve back into the three departments that sponsored it. I think that some of the industrialists may actually go into those three departments to finish their secondment.

The confusion was understandable since no-one knew whether there was to be a follow-up programme or if it would involve any facet of the Alvey directorate. One senior Alvey source saw it as 'inevitable' that 'something' would follow Alvey but he did not know what this 'something' might entail (8). The Bide committee submitted its report in November 1986 and many organisations throughout the IT sector were hoping for a prompt announcement from the government. No such announcement was forthcoming.

In August 1987, the directorate was forced to abandon the relative isolation of Millbank Tower and move into one of the DTI's several administrative centres in Westminster's Victoria or as one jaded observer called it, the 'Morbid Mile' (9). This was a part of the DTI's programme to 'consolidate' its offices and staff, and instead of being 'an outpost', the Alvey directorate was now housed with the DTI's information technology division (10).

A DTI staffer explained that Brian Oakley had been 'eligible for retirement in December 1986' but had continued at his post 'with some reluctance' since the Department (DTI) wanted him to 'stay on', but it was not 'an enjoyable experience' (11). On the ninth of October 1987, Oakley retired to take up the post of research director of Logica, although 'he is not in theory able to take up such a job without consent from Number 10. The Prime Minister, apparently, is also dilly dallying over that.' (*New Scientist*, 15/10/87). With Oakley gone, Laurence Clarke assumed the role of acting director, 'answerable to Alastair Macdonald (deputy secretary, DTI)' (12, 13). At last the DTI had recaptured the policy fiefdom they lost years earlier. By late October 1987, the staff of the directorate still had no firm knowledge of what was to become of them or the programme.

7.2 The Bide Committee

In February 1986, a committee was set-up under the chairmanship of Sir Austin Bide to consider and recommend cost-effective ways of making the IT industry in the UK more competitve at home and abroad, to make recommendations on the balance of funding between national and European programmes, and advise on manpower and trainig implications of the above. In this section, the origins and membership of the Bide committee, the submissions made, and its recommendations are reviewed. The objectives are to highlight the changing focus of IT policy, the growing domination of the private sector as the source of policy advice, and the influence of the Alvey spirit on the recommendations made.

Origins and Membership

Despite the fact that academics and industrialists from within the SERC Engineering Board set up a working party in April 1985 to examine what should follow Alvey, Sir Austin Bide seemed keen to give industry the credit for this policy initiative. In his foreword to the Bide report (1986, p.3), he said:

> At the beginning of 1986 the Alvey 5 year programme of pre-competitive research in IT was past the halfway stage and the money allocated to it was largely committed. <u>Representatives of industry decided that the time was ripe to examine what further steps would be needed</u> to use the output of the programme to best advantage and to apply the most recent advances in IT to

> the benefit of industry and the population as a whole (emphasis added).

There was another important source for the idea of an after-Alvey policy. At the 1985 Alvey conference in Edinburgh, the IT Minister, Geoffrey Pattie said (Alvey, 1985a, p.1):

> Important decisions will soon be required, not only on the future of the Alvey Programme but also...on the shape of European collaboration through ESPRIT and...Eureka...To assess what needs to be done I am quite sure that industry must play a leading role. I hope that an industrial working group will be set up, to which officials of my Department as well as MoD and SERC will be prepared to contribute.

While industry cannot claim responsibility for the notion that there should be an IT programme to follow Alvey, it can claim a major stake in the decision to establish a committee to advise the Minister (*FT*, 12/8/86). The choice of Sir Austin Bide to chair this committee seemed unusual since he is the chief executive of Glaxo plc, one of the UK's outstanding pharmaceutical companies. Some of those interviewed thought that it was his background in this sector, one that is often cited as a model for British industry to follow (*New Scientist*, 6/8/87, p.19), that brought about his appointment (14, 15). One source explained (16):

> During the period of the Alvey operations and from before that, the committee - the CBI committee on research and technology -

> was chaired by Sir Austin Bide, well even before he was Sir Austin, and he gave up the chairmanship only in 1986 I think. By that time, although he started from a pharmaceutical base, he was a chemist, he had - by dint of information technology being on the agenda all the time - he had become somewhat knowledgable in terms of, not the detailed application, but the scope for utilisation right across other sections of industry. And so the government chose him as the chairman of the committee set up at the end of '85 or early '86 to look into what is needed to follow the Alvey programme. I think he was the automatic choice for that both because of his experience (on the CBI committee) and in his own company.

These views on the origins of the Bide committee need to be examined in the light of what one authoritative civil servant had to say (17):

> It was a very deliberate decision by the Government not to have the same people as we did on the Alvey committee. But I would say that all the people that were on the Bide committee were very high quality. In no sense were they slouches who only played a small part. But everyone was anxious, particularly the industrialists, that the Bide committee should be a committee of people from industry making the proposal. <u>The general assumption was that their word would carry greater weight if it wasn't a civil service and industrial initiative</u>. You see the Bide committee was set up by industry, it was not set up by government - (Q. So the Minister didn't ask them to report).

> No. The Alvey committee was set up by us...The Bide committee was set up by the people in the IT community. They went to Austin Bide and said 'Will you be chairman'. Admittedly Geoffrey Pattie in his speech at the first Alvey conference in 1985 said 'Would it not be a good idea for industry to set up a committee to look into what's going to happen in the future' but there was no formal statement and the Minister never called Austin Bide into his office and said 'Would you chair a committee?' No, definitely not. (emphasis added)

The same source had earlier conceded that this matter may have been discussed 'in the margins', a Whitehall euphemism for informal and unrecorded meetings (18).

The governing body of the CBI, the council, is serviced by twenty-eight standing committees with the two of most importance to the IT sector being the production committee and the research and technology committee (19; cf. Grant and Marsh, 1977, p.83). These committees served as facilitators for a series of CBI-sponsored conferences or seminars. A spokesman explained (20):

> Another strand from within the CBI to influence events and keep up-to-date with events has been that we run, as a matter of course - we have conference facilities in the building - we therefore run a series of conferences continuously or fairly continuously - between one and two hundred per year - and I have slotted into that ongoing programme, a series of conferences on the whole information technology area: different

> angles at different times, and I have involved in those conferences all the major people whom you will have met or heard about in the course of all this. I mean - Alvey himself, Brian Oakley always, the ministers who have been responsible Kenneth Baker and Pattie, people like Sir Austin Bide and Robert Telford and so on. They've all figured in these programmes. There have been influential conferences in that the issues being discussed have always been policy issues and there has always been in the audience, either one or two ministers and their senior officials, so that the message has got across.

It was against the background of an industry-dominated policy network that Sir Austin Bide was asked to chair the committee also known as the IT86 committee with a request that the report to be presented by October 1986.

The IT86 committee differed from the Alvey committee in several important ways. As already mentioned, none of those who served on the Alvey committee or its working groups were included on the IT86 committee. An informed source said 'Austin Bide deliberately chose a fair number of younger people, not using just the same people on his committee (as Alvey had)' (21). The Alvey committee had twelve members while IT86 had twenty-six. Five of the Alvey twelve were civil servants (four if John Alvey from the almost-privatised British Telecom is excluded), the same number as served on the IT86 committee. Academics were better represented on the Bide committee with three professors appearing while Alvey started with none and then invited Professor Roger Needham. A major difference was the presence of IT users on the Bide committee, such as representatives of Barclays Bank and J Sainsbury plc, whereas none served on the Alvey committee. The other major difference was the sub-committee and working party structure associated with IT86.

The IT86 committee had three sub-committees; ways and means, applications, and research, with Sir Austin chairing the powerful ways and means sub-committee. Servicing the applications sub-committee were six working parties ranging from the three-man security and control party to the twenty-two member clinical data/health care group. Three working parties were attached to the research sub-committee; systems, hardware and components, and an eighteen man human interface group that boasted no less than six professors as members, a galling prospect for some of the IT community. In total, one hundred and thirty-five people serviced the Bide committee, sub-committees and working groups (Bide report, 1986, pp.60-63). This is a major increase when compared with the total of twenty-six who comprised the Alvey committee of inquiry and its working group and again highlights the emphasis placed on consensus.

It was in the working parties that the IT users had their greatest representation. For example, the group which examined the area of electronic transfer of funds at point of sale had five members, one each from Tesco, Marks and Spencer, and Sainsbury, one from Granada Services, and one from Thorn-EMI. There were other High Street companies such as Trustee Savings Bank and K Shoes in these groups but IT users embraced bodies as diverse as Imperial Chemicals, the London Residuary Body, Kent County Council, Cadbury-Schweppes, Rolls Royce, British Petroleum, and United Engineering Forgings (Bide report, 1986, pp.59-65).

QUANGO's, QGA's, trade associations, and interest groups also participated in the IT86 committees and working parties . For example, representatives of the ICL Computer Users Association, the IBM Computer Users Association, the Association of British Pharmaceutical Industries, the British Computer Society, the National Computing Centre, the Central Electricity Generating Board, NEDO, and the Civil Aviation Authority all served on working parties or attended user workshops. Again there was no trade union involvement.

All of the major IT firms such as GEC, Plessey, British Telecom, Ferranti, STC, Racal, British Aerospace, and ICL had membership of the main committee as well as providing many of the members of the sub-committees and working parties. Although Sir Austin had injected new blood into his committee, there was still a strong bond between his group and the Alvey programme. Nine of the twenty-six members of the main IT86 committee were either members of the Alvey steering committee or the Alvey advisory committee structure. Ten of the eighteen members of the IT86 human interfaces working party served on Alvey MMI committees. Senior Alvey figures such as Laurence Clarke, Dr David Thomas, and Rob Morland served on the sub-committees. Sir Austin Bide singled several of the participants out for special thanks. He said (Bide report, 1986, p.5):

> Most especially, I am indebted to Nigel Horne (STC), Cameron Low (PACTEL) and David Speake (GEC and Alvey steering committee). David, ably supported by Laurence Clarke (GEC and Alvey directorate) and Caroline Varley (Alvey directorate), was tireless in his efforts to help me and gave unsparingly of his expertise.

Evidence Given to Bide

If the Bide committee and its support structures differed from Alvey by the inclusion of IT users, even greater differences are detectable when the lists of those who gave evidence to both committees are examined. With Alvey, the preponderance of evidence was given by universities (and polytechnics), and by IT firms. Both of these groups gave evidence to the IT86 committee but there was a massive upsurge in the number of interest groups, trade associations, and professional bodies which gave evidence (see Table 7.2 below).

Table 7.2 Dissection of Evidence - Bide and Alvey

Representational Category	Bide		Alvey	
	(No.)	(%age)	(No.)	(%age)
Interest Groups & Trade/Profess. Groups	26	29	4	3
University & Poly.	20	23	52	46
Govt. Departments & establishments	19	22	15	13
Companies	12	14	39	34
QUAGO's & QGA's	7	8	5	4
Other*	4	4	-	-
Totals	88	100%	115	100%

Note: * - Includes two private citizens, one doctor representing several health authorities, and Dr B E Carpenter of the European Organisation for Nuclear Research.
Sources: *Bide Report*, 1986, pp.66-68; *Alvey Report*, 1982, pp.68-71.

Two of the three interest groups which gave evidence to the Alvey committee also appeared before the IT86 committee, the exception being Computer Analysts and Programmers. The breakdown of the twenty-six 'pressure' groups which gave evidence shows that nine were professional bodies (e.g. the Institute of Chartered Accountants, the Institution of

Chemical Engineers, the British Psychological Society), ten were trade associations (e.g. the British IT Export Organisation, the British Microcomputer Manufacturers group, the Confederation of Information Communication Industries), and seven were interest groups (e.g. CBI, the Trade Union Congress, the Ergonomics Society, and the British Computer Society). Some of these bodies such as the British Computer Society have a dual role, serving as a professional body and an interest group.

The statistics for the evidence given by government departments and agencies are misleading. In the case of Bide, multiple representations from one organisation are each counted separately while with Alvey, only those departments and organisations which 'provided substantive inputs' are listed, and where more than one 'department within an organisation' provided evidence, only one entry is made (Alvey report, 1982, p.68). As pointed out in chapter three, this ruling was not adhered to. In the case of the Bide committee, the nineteen government submissions were made up by eight submissions from the Alvey directorate, six from the DTI, two from SERC, and one each from the laboratory of the Government Chemist (DTI), RSRE (MoD), and the Central Computer and Telecommunications Agency of the Treasury. Although representatives of the Ministry of Defence and of the Department of Health and Social Security served on Bide working groups, departments such as the Treasury, the MoD, the DHSS, and Education and Science did not make representations in their own right.

Of the academics who gave evidence, several were closely associated with Alvey, either working on Alvey-funded projects or serving on Alvey committees. These included professors Needham and Sloman, and Dr Karen Sparck-Jones. Some large IT firms made submissions in their own right

(GEC Electrical Projects, British Aerospace, IBM (UK), and ICL) but most of the remaining eight company submissions came from small firms.

Bide's Recommendations

As with Alvey, there is a delightful paradox underlying the Bide inquiry' recommendations. The Alvey report (1982, p.9) said 'The aim of the programme is to mobilise our technical strengths in IT. This is essential to improve our competitive position in world IT markets' (emphasis added). The Bide report said (1986, p.9):

> The terms of reference which were adopted at the outset of our study emphasised the need for improved international competitiveness of UK industry, including both suppliers and users of IT. (emphasis added)

Both reports emphasise the absolute importance of competition. The Bide report goes further than its predecessor. It proclaims (1986, p.9):

> As more countries industrialise and more industries operate in truly global markets the competition faced by UK industry and commerce is growing rapidly more intense. No one owes the UK a living. UK industries will have to fight to become and remain as tough and competitive as the best of their foreign competitors; otherwise they will gradually - or rapidly - go under. (emphasis added)

Apparently the best way for Britain's IT industries to 'fight' and become 'tough' was to ask a neo-liberal government for several hundred millions of pounds worth of subsidies. As well as this, it would be necessary for these potentially 'tough' competitors to collaborate with each other.

The Bide report recommended a three-pronged 'Plan of Action' which involved (p.17):

1 A programme to stimulate exploitation of IT research, the key elements of which would be a scheme of collaborative application projects.
2 A focussed collaborative research effort to support IT market needs.
3 The development of IT skills and awareness.

The application projects scheme was recommended as a collaborative process to 'maximise the effectiveness of the IT product development process' and to 'ensure the development of internationally competitive products'. The ultimate goals would be 'competitive systems for sale in the UK and worldwide' while 'users are helped to greater competitiveness' by systems designed with 'their needs in mind' (Bide report, 1986, p.21,19). The report went on to say (1986, p.21):

> Collaboration, not only between users and suppliers but also between IT users themselves, is critical, since it enables them to share the growing cost and complexity of IT systems development. Groups of users who normally compete with each

other may have a common interest in a sub-system capability.

This proposal went beyond the pre-competitive notion put forward four years earlier by Alvey. The Alvey doctrine envisaged a situation where scientists from, say, GEC, STC, and Racal could collaborate in a laboratory to invent a process or an object which each company could then use in its own application; GEC might use it in a high-resolution radar system, STC might apply it to a weapons guidance system, and Racal could perhaps instal it in a high-frequency, field telephone encryption device. What Bide was proposing was not only joint systems development between say ICL, Logica, and Barclays Bank but also collaboration between, for example, Barclays, Midland, National Westminster, and Lloyds banks to develop an interactive funds-transfer system.

This idea was a truly revolutionary proposal which goes beyond any national collaborative schemes which apply in the USA, Japan, or Europe. The Prime Minister and several of her Cabinet colleagues were concerned about the notion of pre-competitive collaborative research as proposed by Alvey (22). The Bide strategy effectively involved asking the most avowedly neo-liberal government in Europe to fund a programme which endorsed the cartelisation of IT development and applications in the UK.

The Bide report proposed eight 'specimen projects', very much in the mould of the Alvey large demonstrators. They included 'provably safe software for railway signalling', 'electronic funds transfer at point of sale', a security/control system for domestic and commercial premises, and control system for manufacturing in mechanical engineering (Bide report, 1986, p.21). The tools with which these demonstrators would be built were all available as outputs of the Alvey programme and ESPRIT.

The second feature of the Bide programme was a 'research effort' which was to be 'pulled' by the applications scheme or demonstrator projects. It was not intended that the research effort would 'imply a detailed product specification' or in any way attempt to second-guess or pre-empt a freely operating market mechanism. Industrial research would only be undertaken as a result of

> perceived market trends, opportunities presented by technical breakthrough to enhance current products, recognised user dissatisfaction, and possible extension to product ranges (Bide report, 1986, p.26).

Academic research, on the other hand, 'must, at least in part, be free to follow interesting (i.e. non-commercial) lines of inquiry' (Bide report, 1986, p.26). Research was to concentrate on the following areas:

- Human Interfaces
- Systems and Software
  - Software
  - Intelligent Knowledge Based Systems
  - Systems Architecture
  - Speech Signal and Image Processing
- Hardware

Human interfaces was 'used in preference to "Man Machine Interface" to emphasise' the role and needs of the user. This programme, combined with the speech, signal and image processing programme, was almost the same as Alvey's MMI programme (Bide report, 1986, p.29). The software programme referred to the IPSE (integrated project support environment) and the need to 'build on the UK's world lead in the scientific and engineering foundations of software engineering'. In that respect it was very much a continuation of the Alvey software engineering programme. The IKBS proposal acknowledged that IKBS was already a 'significant activity' within Alvey 'which will yield many expoitable tools' (Bide report, 1986, p.32). Systems architecture proposals encouraged further research into areas such as parallel processing and declarative systems. Finally, the hardware programme was aimed almost exclusively at VLSI circuits and advanced CAD systems with a brief endorsement of a proposed DTI/industry venture in the field of gallium arsenide circuitry.

In a statement very reminiscent of the Alvey programme, the Bide report said (1986, p.33):

> For the UK based work on silicon we recommend concentration of resources on the development of Application Specific Integrated Circuits (ASICs) in both CMOS and bipolar technologies, to lead to industry standards where appropriate. Novel circuit techniques and radiation hard processes for use in severe environments are also important.

What in fact was being recommended here was an extension of the Alvey programme. There was one major difference however. As well as the large demonstrator applications pulling the research, the report identified three market segments where research would be applied, namely, communications such as high definition television, advanced information processor systems or user-friendly hardware and software packages, and workstations primarily because of the potential market size and the scope offered for applying human interface research (Bide report, 1986, p.28). It is ironical that high definition television was cited as an application for British technology when the last surviving British television manufacturer was sold to the French firm, Thompson, in July 1987 (*New Scientist*, 9/7/87, p.18).The report also recognised that technologies such as opto-electronics, advanced storage elements such as optical memories, and advanced display devices should not be excluded from proposed research programmes where 'short or medium term benefit to the UK' was likely (Bide report, 1986, p.33).

The final strand of the three-pronged Bide strategy was education, training and communications in the area of IT skills and awareness. This programme too drew heavily on work which had gone before.

A common opinion expressed by interviewees was that Alvey programme was constrained by skilled manpower shortages rather than by lack of funds. One Alvey directorate source said 'Perhaps we could have used fifty per cent more funding - I don't know. I do know we could not have used three or four times as much. We just didn't have the people' (23). It was estimated by a prominent IT industrialist that in the early days of Alvey there were 'perhaps 700 or 800' IT specialists available to work on the programme. This number, he said, had risen 'to about 2000 or maybe 2200' by 1986. He concluded that it was 'pointless to talk about twice as much funding' since 'the skilled staff were not there' (24).

The SERC had addressed the problem of skill shortages well before Alvey was considered. Its early efforts were limited and fragmented with emphasis on training chip designers and providing practical experience for post-graduates in microelectronics (*PITCOM*, Vol.2 No.1, p.24). While the Alvey report was under consideration by the core executive, the Government announced a major injection of funding for educational aspects of information technology. The Department of Education and

Science (DES) was to invest an additional £100 million during the three years to 1985-86 (*FT*, 17/12/82). This funding was aimed at trebling the number of specialist IT graduates and achieving a ten-fold increase in the number of 'conversion' graduates (to 800 per year). The conversion courses were designed to provide one year's post-graduate IT training to graduates 'with good quality degrees' in non-IT disciplines (SERC, 1984, p.38).

There were numerous initiatives about this time at a non-tertiary level such as the DTI's 'micros in schools' scheme, the Manpower Services Commission's technical and vocational education initiative (TVEI) in 1983, and the joint DTI-Manpower Services Commission programme for information technology centres (Moon and Richardson, 1984, pp.91-95). None of these programmes would solve Alvey's pressing manpower problems.

One source suggested that the major initiative regarding IT-manpower question came from the CBI. He recalled (25):

> The first (CBI-sponsored) conference after the Alvey report was out, was talking bravely and with lots of enthusiasm about the technology involved. But when Alvey himself introducing the afternoon session said 'All this is very fine' - ended his speech by saying 'All this is very exciting and positive and so on' and he just ended with the question - 'But where are the people coming from?' Now that was the urgent question that was debated for the rest of the day. So important did it seem to us that we wrote immediately to the minister - he had left the conference by that time - and simply said 'This is an issue we

must address ourselves to outside the framework of Alvey' since Alvey had to get on with the research and so on...So we badgered the minister until we finally had a meeting with him in the April of '84...and we had a large deputation of industrialists - I think it was twenty-nine in total - who went in to argue the toss with the minister who was still then Kenneth Baker - and a couple of other ministers from the other departments concerned - three in fact; one of his (Baker's) own junior minister, a minister from the Department of Employment, and a minister from the Department of Education and Science. After a very considerable amount of pressure being exerted on him by this deputation, he finally turned to his junior minister and said 'Right. We had better set up a committee to look at this. You chair it.' and that became the Butcher committee.

The Butcher committee (or IT Skills Shortages committee) produced three reports between July 1984 and July 1985. The first report called for a new mechanism whereby industry and education collaborated to 'produce more graduates with relevant IT skills' (Alvey, 1985a, p.123). In response to this call, the CBI through its CBI education foundation established the information technology skills agency (ITSA). The CBI education foundation was described as 'a benevolent neutral who could command the allegiance of government and industry' (Alvey, 1985a, p.123). Sir Robert Clayton of GEC was appointed chairman of the company-funded ITSA although GEC is not a member of the CBI (26). One of the main roles of ITSA was to 'introduce and extend conversion and updating courses, including open and long distance learning' (Alvey, 1983a, p.123). The second Butcher report broadly examined and made recommendations concerning skills shortages below the technologist/IT graduate level, while the third report called for a partnership between industry, especially IT users and suppliers, and the education system to define, develop, and implement the means by which skill shortages could be overcome.

The Bide recommendations in this area were vague except for two proposals. One was the recommended expansion of the initiatives that followed from the Butcher committee and the other was the development of a sample application or demonstrator for distance learning for senior management similar to that already undertaken by ITSA (Bide report, 1986, p.36). While realising that 'responsibility for implementing' these proposals 'lie clearly with no particular body', the report believed the 'collaborative culture' between companies and academia would facilitate the implementation of the proposals (Bide report, 1986, p.37).

The final section of this part of the report considered the links between any future UK programme and the European programmes. European links were seen as desirable insofar as they reduced research costs and provided 'potentially useful partnerships for eventual European market exploitation'. It went on to note that the UK companies could not 'sell' themselves as effective partners without the support of a UK programme (Bide report, 1986, p.39):

> This is the key reason for continuation of a UK research programme. Without this support the UK may be unable to secure

a fair return from programmes like Esprit.

The notable omission from the consultative process associated with Bide as with Alvey was the trade union movement. A union official said (27):

> I'd say that on a regular basis, the only union involvement or input to the policy process for IT was through the NEDO and the NEDC. I've been present at some Alvey seminars - mainly related to manpower, skills, and that kind of thing...We weren't included on the Bide committee which the TUC protested about.

The TUC general secretary, Mr Norman Willis, in a letter to the then Secretary of State for Trade and Industry Paul Channon 'made a formal plea to the government to lift its unofficial ban on union representatives serving on' the numerous committees such as Alvey, Bide, and JOERS which examine and make recommendations on 'the future of the UK's technology and research' (*Guardian*, 21/4/86). An eminent academic thought that 'R&D isn't one of the areas where we should necessarily be involving union participation in forming policy. It is the later consequences...where they should be involved' (28). A politician said (29):

> Union involvement is a problem. I think the best union involvement is at the company or establishment level rather than nationally and if the unions organise themselves right, they would get around this problem but it's not easy for them.

The IT Minister, Geoffrey Pattie, said (30):

> We just haven't felt that the unions have had a particular contribution to make in these fields although they may well do in the future...There are one or two unions, of which the electricians union under Eric Hammond is a sort of spectacular exception - or example, are coming forward and realising that there are whole new industries being developed where, unless they are very careful, there will not be an automatic case made and perceived for union representation.

Unlike the 'paternalistic' exclusion of Japanese unions from corporatist policy processes (Lehmbruch, 1982, p.25; Pempel and Tsunekawa, 1979, 231-270), their exclusion from the Alvey/Bide processes was a form of punishment for the 'sins' of Arthur Scargill and others.

Funding and Administration Proposals

Much of the thinking behind Bide, as with Alvey, was based on what other countries were doing in the IT sphere. The Bide report referred to the 'growing support which competitor nations are giving their IT industry to enable it to seize the competitive advantage' (Bide report, 1986, p.43). This 'growing support' to competitors and the difficulty in balancing the amounts which were needed for each of the three strands of the strategy meant that the committee 'were faced with a dilemma' (Bide report, 1986, p.43). Finally the committee recommended expenditure of £550 million on the research programme allocated as follows:

Hardware	£250 million
Systems and Software	£200 million
Demonstrators	£ 75 million*
Human Interface	£ 25 million
Total	£550 million

Note: * - Demonstrators refer to the three market areas identified, viz., communications, advanced information processors and workstations.
Source: *Bide report*, 1986. p.44

The government was expected to provide £300 million (including £50 million to universities) of the £550 million and support was to be on the 'same basis as the current Alvey programme - 50% for industry and 100% for academia'. Of the government's £300 million, it was estimated that £135 million would go towards the UK's contribution to ESPRIT. (Bide report, 1986, p.44).

The second strand of the strategy, the applications progamme, would also require government support. The committee explained (Bide report, 1986, p.44):

> Whilst the application projects will be much closer to the market, the collaborative work envisaged will imply an element of risk-taking such that individual firms are unlikely to make it their first priority. They will require an incentive and in our view it is in the UK interest for Government to provide it in the form of a lubricating financial contribution to projects.

This 'lubricating' contribution was recommended to be £125 milllion which the committee 'expected to stimulate' an industry commitment of at least £375 million, thus bringing expenditure on the applications scheme to 'in excess of £500 million' (Bide report, 1986, p.45). The government's participation in this part of the programme comprised the third strand of the strategy, the awareness and education aspect. Although there is no mention of funding for this part of the programme, the report does mention that government participation in the applications programme would 'stimulate' the projects and 'develop awareness' (Bide report, 1986, p.45). This combined with government support for ITSA and other Butcher-CBI initiatives in the skills shortage area would make up the awareness programme.

Like the Alvey proposals, there was no detailed costing provided below the level of tens of millions of pounds and no attempt to quantify benefits. The recommendation for a five-year programme with a total budget in excess of £1050 million including government contributions of £425 million had a multi-faceted rationale. The three main considerations were: (i) British industry could not afford to engage in R&D investment because of high interest rates in the UK; (ii) that unless British IT firms were supported, the UK would not have a guaranteed and secure supply of strategically vital IT products; and (iii) government support was vital because of 'the very large assistance given by foreign governments to their own industry' (Bide report, 1986, pp.10-11).

The committee examined three alternative administrative structures to oversee the proposed programme. These were an organisation outside of government wholly staffed by industry, a joint industry-government organisation within government, and no organisation at all, simply relying on existing industry-government mechanisms such as committees, deputations and so on.

The first option, 'attractive though it sounds because of its emphasis on industry', was rejected. The committee did not consider that competing firms would be able to manage a collaborative secretariat, small firms would find the large firm dominance 'unacceptable', and finally, such a structure 'would ignore the importance we attach to Government'. The third option was also rejected since it 'would fail to preserve the features of the Alvey structure to which we attach considerable importance' (Bide report, 1986, p.49). The committee recommended a virtual extension of the existing Alvey directorate.

When taking evidence, the committee noted the 'favourable comments' on the Alvey programme's management stucture where a directorate with 'executive authority is advised on matters of strategy by a Steering Committee'. It also received 'a number of comments' about the highly effective relationship between universities and industry and between companies which the Alvey programme 'stimulated and facilitated'. These successes were made possible, said the committee, because the Alvey directorate had two outstanding features (Bide report, 1986, pp.48-49):

1) A distinct identity, and clearly defined responsibilities which, after an initial familiarisation period, were well understood by industry, Government and academia.
2) A staff made up of industrialists and civil servants seconded from their firms and from relevant Whitehall Departments (MOD, SERC, DTI).

These views tend to coincide with many of the opinions expressed in chapter five.

There were some changes proposed. The proposed Board (equivalent to the Alvey steering committee) would be responsible for strategic decision-making and 'establishing major precedents', something the Alvey steering committee did not do. The Executive Group (equivalent to the directors of the Alvey programmes) would be led by an executive director, 'preferably drawn from industry', who would sit on the Board. The Executive Group's primary role would be to implement Board decisions and 'monitor progress for the Board'. All of the projects proposed under the applications scheme would be approved by the Board. The research scheme strategy would be set by the Board with the Executive Group making decisions on the research project proposals, just as had been done under Alvey. So keen was the Bide committee on the Alvey mechanism and style, it saw it as 'highly desirable that some Alvey staff make the transition to the new organisation' (Bide report, 1986, pp.50-52). The final major difference was that Bide proposed that 'funding should be derived not simply from those Agencies of Government (DTI, MOD and SERC) that supported the Alvey programme' but from all departments 'actively involved' in the proposed programme (Bide report, 1986, p.57). This would include the DHSS and the Department of Education and Science.

The Bide report had framed its recommendations in such a way that it was necessary for the Government to address IT policy at both a national and a European level. Since the European programmes were scheduled for funding approval shortly after the Bide report was submitted, the success of the Bide proposals could be reasonably gauged by the stance

Britain adopted towards the European high technology programmes, collectively known as the Framework.

7.3 The European Dimension

The number and scope of pan-European IT programmes increased dramatically after 1983. ESPRIT was joined by EUREKA, RACE which is a pan-European telecommunications project, the factory automation programme, BRITE, and two IT educational programmes. These IT programmes were bundled together with a biotechnology, a medical research, and a Third World science and technology aid programme to make up the Framework.

ESPRIT was the flagship of the European Community programmes with the governments of the member states contributing £450 million (app.) over the five calendar years, 1984 to 1988. The programme was established as a result of micro-corporatist negotiations between Europe's twelve largest IT firms and the European Commission (Sargent, 1985, p.244). The overall aims included broadening the technology base and encouraging co-operation through collaborative pre-competitive R&D projects funded on a 50/50 basis. There was a third strand to ESPRIT's goals also; the establishment of common standards for IT in Europe.

The programme's start was delayed by British arguments over funding. Some of those interviewed singled out Mrs Thatcher as the culprit (31, 32), another said it was the DTI (33), and Jowett and Rothwell (1986, p.51) say it was the Treasury. After it was approved in late February 1984, proposals were called for and of the 441 proposals received, 106 were approved at a cost to the EEC of £110 million with the successful applicants contributing an equal amount. British firms fared well in the first round of project allocations (see Table 7.3 below).

Of the British firms, GEC was the most successful with 20 projects, followed by Plessey (13), ICL (8), STC (7), and British Telecom (6) in the initial round (Alvey News 15, Feb. 1985, pp.4-5). As well as the big firms, 24 other UK companies were successful participants. In the 1985 round, 79 projects were approved with a further 19 proposals being accepted in the 1986 round. By April 1987, 59 UK firms, 40 academic institutions and 13 research establishments were involved in 145 of the 204 approved projects of which 201 actually started.

Table 7.3 National Participation in ESPRIT - 1984 Round

Programme Area	Number of Projects	Britain	Germany	France	Italy
Microelectronics	28	18	17	18	6
Office Systems	23	14	16	15	15
Inf. Processing	22	13	11	12	12
CIM	19	13	13	10	9 *
Software Tech.	14	9	10	9	7
Totals	106	67	67	64	49

Note: * - CIM is the acronym for Computer Integrated Manufacture.

Apart from funding, there were other benefits as a result of ESPRIT. One IT laboratory director said (34):

> What is important is not what the head of GEC and Siemens think of one another, but whether the scientists and technologists in the labs have a mutual respect and trust for one another and that has emerged very, very strongly. It is amazing how much

more intelligent the French have become in the last few years for example - the Italians too (laughter).

There were costs as well as benefits. A prominent industrialist spoke of the 'language problems and the endless travelling' (35) while an academic remarked on the 'enormous problems' of coordination which resulted. He said that 'to try to pull (the researchers) together makes it highly inefficient research' (36). Another cost was the integration of research in industry with firms such as GEC, Plessey, ICL, and others involved in national as well as transnational programmes.

Some of the ESPRIT technology programmes produced significant results and brought about linkages between British and European firms. Examples include the common software development tool project involving GEC, ICL, Bull, Nixdorf, Olivetti and Siemens which has had a 'wide industrial impact' and the office document architecture standard project for defining multi-media document handling standards which has been demonstrated at technical exhibitions (EEC, 1987, pp.4-5). There was a sharp increase in the number of collaborative agreements between British and other European IT firms during the first half of the 1980s although it is impossible to conclude whether these were facilitated by ESPRIT or despite it. A joint research centre was established at Munich by ICL, Bull, and Siemens. GEC entered into telecommunications collaborative deals with CIT-Alcatel of France and also with Siemens while Racal entered into collaborative work with Philips on mobile telephones (Jowett and Rothwell, 1986, pp.54-85).

The EUREKA (European Research Coordination Agency) programme was suggested as a European civil response to the US Star Wars or Strategic

Defence Initiative (SDI) by the French President Mitterand in the first half of 1985. This programme, while pan-European, was not under the control of the EEC. With an estimated budget of £1400 million overall, fifty per cent of which came from the governments of the participating countries, this programme had a wider remit than IT. Robotics, medical research, transport, manufacturing processes and information technology were all supported under the EUREKA banner. Perhaps it was because of the attempt to cast its net too widely that EUREKA did not enjoy the support of the IT industry that ESPRIT did. One leading industrialist described it as 'confusing and wasteful' (37) while a highly respected IT journalist said (38):

> I've heard many of the IT companies speaking very badly of EUREKA - Siemens for example, Bull from France, Olivetti - all have been extemely scathing about EUREKA because they don't know what it's for...I certainly got the impression from a lot of companies that there was a lot less enthusiasm for EUREKA than there was for ESPRIT.

In July 1986, sixty-eight projects were announced and British firms secured participation in twenty-eight, of which only nine were IT projects (*New Scientist*, 3/7/86, p.18). Like the ESPRIT programme, EUREKA was administered by a small secretariat (seven in EUREKA's case) in Brussels while funding was nationally administered. In Britain's case by the DTI through its Support for Innovation programme. Presumably EUREKA would not have been regarded as 'confusing or wasteful' if all of the funds had been allocated to IT companies exclusively.

Like the previous two programmes mentioned, RACE (Research and development in Advanced Communication technologies in Europe) is primarily an R&D support scheme, in this case aimed at the telecommunications suppliers. By setting the objective of a fully integrated, EEC-wide broadband communications network, the RACE scheme hopes to provide economies of scale to the fragmented European telecommunications suppliers while providing improved access to and services from advanced networks (39). Dr Ian Mackintosh, often referred to as the Father of RACE, extended the notion in his recent book *Sunrise Europe: The Dynamics of Information Technology* (1986) to include a fibre-optic cable network linking every home and office in Europe but to achieve this he suggests that work must start immediately (i.e. 1986) and complete the project within ten years, equipment to be purchased from European suppliers, and a massive investment of the order of £100,000 million. As Peter Large said in a review of this proposal, 'What hopes?' (*Guardian*, 14/8/86).

With this proliferation of high technology programmes under the EEC banner, there were growing problems of co-ordination. During 1986, the EEC commissioners put forward an umbrella programme called Framework which embraced all of the EEC high technology programmes. Initially the commission requested more than £7000 million to fund Framework and this was gradually whittled down, first to £5400 million (*Guardian*, 1/12/86), and later to £5000 million. Then the serious political negotiations started.

During the second half of 1986, Geoffrey Pattie was chairman of the committee of European ministers responsible for R&D and in December of that year he chaired the meetings at which the final decision on the

Framework proposal was to be made. Two forces were working against a successful conclusion to this question. First was the chairman 'carrying instructions from the Treasury and wielding a veto, (who) refused to accept a programme worth more than around £3 billion' (*New Scientist*, 11/12/87, p.17). Second was an intransigent group of commissioners. One of Europe's most eminent IT journalists explained (40):

> The commission is almost certainly going to get less than it asked for. I think the commission has played its hand with extraordinary ineptitude. I mean, to take a stand of constitutional principle on a spending issue is just very, very naive and stupid. They seem to think that because they got it into their heads that these programmes were important and that they'd had some early success...in getting governments on board that somehow the governments thought these programmes so sacred that no way - no way that they weren't going to vote them through on the nod...I think they have slightly lost touch with the realities of the member states.

No compromise was reached and another meeting was arranged for the twenty-second of December 1986 where a three-year, £2500 million version of Framework was to be discussed. Pattie, with the agreement of France and West Germany, cancelled the meeting. One source suggested this was done 'because the Treasury and Cabinet had given (Pattie) no flexibility to reach a compromise' (*New Scientist*, 18/12/87, p.4; 25/12/86-1/1/87, p.3). As the months passed, France fell into line with the other nine countries and by April 1987, it was only Britain and West Germany which were holding out. Reinforcing the West German position, the responsible minister Heinz Riesenhuber claimed that Europe's international scientific standing depended 'only a little on the EEC commission' (*New Scientist*, 2/4/87, p.15). A senior British civil servant took a rather jaundiced view of the negotiations. He said (41):

> We have been in the forefront of trying to put a rein on the Community budget and in particular on the growth of the CAP (common agricultural policy). The facts are well known and there is general agreement that it is utterly scandalous... even our good friends, the Germans, will agree with us in principle but when it comes to offending Bavarian farmers who vote for Chancellor Kohl - they're not so eager to support us when it comes to the crunch. So on one hand you had the runaway CAP which is squandering resources...and on the other hand, you have people in Brussels saying 'Please we are desparately short of resources, would you please agree to a bigger R&D programme.

By late April, there were claims that more than 3000 researchers were waiting for funds and (as in Britain) the danger of a 'brain drain' was looming. A senior civil servant explained the UK's position (42):

> The decision not to go ahead with the compromise at this stage was reached by the Prime Minister and not Mr Pattie. Mr Pattie wanted to go ahead. Everybody in Whitehall except the Prime Minister - well, including the Prime Minister - knows the only way forward is at the compromise figure. The Treasury has faced

> up to the compromise figure. Essentially all the plans are based around the compromise figure. But the Prime Minister chose not to go ahead because of her firm conviction that the agricultural programme (CAP) of the EEC, which is where most of the EEC money goes, is a scandal and that the only way to control this was to say 'No more Community expenditure'. When she says a thing like that, she tends to sweep everything else out of the way. So along comes an R&D programme which involves increased expenditure and she says 'Not a penny more than the expenditure that used to be on that programme'. Now that's a very black and white situation which is nothing to do with the programme...So because of the peculiar politics that reign in the British government at the moment, nobody dares go back to her and say that she has made the wrong decision. And who am I as a civil servant to say that she's wrong? Her tactics over Europe are extremely black and white and they're not subtle in the way that the Foreign Office is used to - but they are at least unambiguously clear...I think the most likely outcome... is that a payoff will be found at the next (EEC) summit which is in June, when Mrs Thatcher will slam the table and say 'No more Community expenditure' and she will finally say 'Alright. If you reduce the milk subsidy by three per cent then I'll give in to the Framework programme'.

The shifting of blame from the Treasury to the Prime Minister needs to be seen against the accusation that another civil servant made when he said 'The whole thing (Framework negotiations) is being held up by the DTI. They're scared that approving the European programmes will mean a cut in their budget' (43). The parallels between the original ESPRIT negotiations and these are striking.

As it turned out, the civil servant who saw it in terms of the milk subsidy was very close to the mark. Mrs Thatcher did go to Brussels, she did slam the table, but 'amid the bluster, she came close to agreeing to a compromise on Framework that Britain has vetoed since last December' (*New Scientist*, 9/7/87, p.14). By this stage, Britain was on her own in opposing the compromise. In late July 1987, the final compromise negotiations were almost sealed. The EEC was to allocate £3700 million to the Framework with a further decision to be taken over an additional £285 million at a later date. This was approved by the European Parliament in mid-August and ratified by the twelve relevant ministers in late September. However, because of the 1987 *Single European Act*, the Parliament has to approve each proposal twice with the result being that funds will not flow into programmes such as RACE until November 1987, and 'that will be too late for some scientists' who have already taken their talents elsewhere (*New Scientist*, 1/10/87, p.17).

Britain had succeeded in cutting the final compromise figure from £5000 million to just under £4000 million but that success has to be measured against the year of research that was 'lost', the loss of many scientists who had hoped to work on the project, and the loss of international prestige by Britain for the apparently neo-Luddite stance taken.

7.4 The Aftermath of Bide, 1986-87

The Bide report was presented in November 1986. There was pressure from the beginning to secure an early favourable decision. The committee of vice-chancellors and principals urged an increase in the Bide proposals for university funding from £10 million per year to £25 million per year or £125 million overall and demanded that the Government 'act soon' on the Bide report (*Guardian*, 16/2/87; cf. *New Scientist*, 30/10/86, p.14). There were several reasons behind the high expectations of the IT community.

In March of 1986, the Government had announced the extension of the JOERS programme and this raised some hopes in the IT community for an extension to Alvey or some form of follow-on programme. It was reported as follows (*Guardian*, 4/3/86)

> The Department of Trade and Industry is providing £4.5 milion (*sic*) more, with anotehr (*sic*) £2.25 million from the Science and Engineering Research Council. It is a slum (*sic*) which will need to be matched by £4.5 milion (*sic*) from industry. It was the first scheme involving Alvey-style research collaboration between indsutry (*sic*) and accademe (*sic*).

There was a growing belief that unless urgent steps were taken to solve the funding problem, research teams would break up thereby dissipating much of the energy and spirit built up by the Alvey programme. There was also a danger of a new 'brain drain' from Britain, something that Alvey had partially reversed in the early 1980's. Some thought the decision on

Bide would be announced 'by the end of January 1987, although this time scale might be over optimistic' (*New Scientist*, 27/11/86, p.18).

Several factors militated against an early decision. The first was that a post-Alvey programme being implemented while Alvey was still running seemed unlikely. The second influence was the impending general election. It was not expected that a major policy programme would be rushed through before the election since the policy did not enjoy bipartisan support at that stage and even without a change of party control, a new minister would almost certainly be appointed in a post-electoral cabinet shuffle. It would not be seen as acceptable to impose such a major policy decision on an incoming minister so soon before the election. The third feature was the potential impact of the the Framework negotiations discussed previously.

The lack of an immediate response on Bide was softened somewhat by the announcement of the Link programme, a £420 million collaborative programme, half of which was to be funded by government over five years. Although not specifically an IT programme, Geoffrey Pattie did identify subjects such as molecular electronics and robotics as areas of interest. The chairman of the SERC declared that he was 'delighted' with the scheme whose government funds were to come from redirected departmental research budgets, a situation described by the heading 'Link robs Peter to pay Paul' (*New Scientist*, 18/12/86, p.4).

In early December 1986 the CBI announced a conference to be held in late January 1987 to discuss the implications of the IT86 report. This served the purpose of keeping the policy proposal on the political agenda and by inviting prominent figures such as Hugh Armstrong, the deputy director of the stock exchange, the message of Bide was spread to a wider audience than just the IT industry.

It was appropriate that the stock exchange was invited since the City was singled out for criticism during the course of interviews. Each interviewee from the IT Minister, Geoffrey Pattie, to the research scientists at the work-bench had some criticism of the way the City reacts to the IT industry. Prominent industrialists, senior civil servants, politicians from the Labour and Liberal parties, eminent academics, and a trade union official poured scorn upon the 'short termism' of the stock brokers and analysts and also the fund managers. The IT Minister, however, saw the problem largely in terms of the amateur investor. He said (44):

> Yes. It (short termism) does concern me...I think that if we want to encourage investors to take a longer term view, we have to actually educate the investor. This what I meant by the culture - we have to actually make people in schools realise how important profit is. How important the capitalist system is and how important the mixed economy is.

Convincing investors to take a long-term view of the market may have been made much more difficult in the light of the disastrous collapse of the stock market in late October 1987.

There was no response from the Government in January or February and when interviewed, Geoffrey Pattie said (45):

> We (at DTI) are at the present time co-ordinating our response

> to the Bide committee and we will make our response - it will probably actually be the end of April - we are recording this (interview) now on the second of March, so I think it will take a few more weeks yet to trawl together all the various responses we have and I would be cautiously optimistic that we will be able to continue on the research side certainly, pretty well at the same kind of levels we've had up till now.

There was no announcement in April. A senior civil servant suggested, tongue in cheek, that Pattie may have meant 'the end of May'. He went on to explain (46):

> We have a meeting with him (Pattie) due on the first of May when he will make his decision. Now that decision doesn't necessarily mean that he will announce it. They've all gone into election fever and that is the simple fact of the matter...Obviously there are three answers he can give. There is 'No'. There is 'Maybe. But let's get the election out of the way'. And there is 'OK. We will now go ahead and build it up afterwards'. 'No' I think, is virtually unthinkable now. I don't think that is likely... I'm quite certain that that is not what he (Pattie) would want to do and the department (DTI) has put a certain amount of money aside. The only reason it would be 'No' would be if Number Ten, the Prime Minister, intervened and said that such expenditure was to be used for some other purpose or something like that. That I think is extremely unlikely. On the other hand, with election fever

> around, they are not actually making terribly coherent decisions at the moment...If they go ahead it would be a partial 'Go ahead' in that there isn't proposal money at the moment to launch the whole programme and they won't, before the election, find the extra money. That really would cause trouble in the Cabinet... I think it's extremely likely that if they did go ahead now on a sort of limited scale programme, then they'd find the extra money after the election when they settled down to sensible business.

The belief that it was simply a matter of getting the election out of the way and then the Bide proposals would be approved was expressed by other interviewees as well (47, 48). In the Cabinet shuffle which followed the Conservatives victory in the general election, Geoffrey Pattie was replaced by Kenneth Clarke and to soften the blow, Pattie was knighted. Clarke was to give the DTI, and more importantly, the IT segment of the DTI, 'a second Cabinet seat' while his junior minister became John Butcher (*Guardian*, 18/6/87). The first Cabinet seat was for Lord Young, Secretary of State for Trade and Industry.

In late June, an Alvey source said that he 'expected an announcement' on the future of the Bide proposals to be made 'at the forthcoming (Alvey) conference at Manchester' (49; cf. *New Scientist*, 2/7/87, p.25). Kenneth Clarke did make an announcement at the Alvey conference. He 'reiterate(d) the view that the closer R&D gets to the market, the more industry should pay' (*New Scientist*, 23/7/87, p.15) and announced that the Government did not intend to make an announcement on Bide 'at this stage' (*Guardian*, 16/7/87) despite William Keegan's view that the Bide recommendations were 'heavily influenced by what was thought to be "acceptable" to Mrs Thatcher and her colleagues' (*Observer*, 1/2/87).

Clarke's first statement received qualified support from Brian Oakley who said (*New Scientist*, 23/7/87, p.15):

> we must not fall into the real trap of feeling a programme necessarily needs government money, and we do have to get beyond the point that, because one programme is successful this is a reason for carrying on support - it's rather the reverse in some ways.

But the *New Scientist* leader-writer went on to ask:

> Will industry play ball? Perhaps, as we see in an exaggerated form with the defence contractors, Britain's industrialists have not been listening to the Thatcher strictures on risk and enterprise. They still want government to take all the risks.

The apparent assumption that the Bide programme was in danger of being shelved was premature. In a surprising revelation, a Treasury source stated 'to date the DTI have not made their submission on the Bide report' (50). Rather than some Machiavellian plot within the core executive, or an attempt to cut government R&D expenditure, the programme had been delayed while the DTI settled on the appropriate stance to adopt. This source of delay was later confirmed in a more oblique manner by a senior DTI official (51).

A former civil servant said that the DTI's tardiness 'wouldn't surprise him' and went on to add (52):

> The departments work under very tight constraints and budgets and there is probably enormous debate going on...everyone would be fighting for their own corner and funds are limited...So it is possible that there is tremendous debate going on, it doesn't mean that nothing has happened, it simply means they haven't put anything to Treasury and they can't do that until they've got agreement within the department...You see, they don't want to put in something that is patched-up, they want to put in something that they believe in and can argue. I mean, they'll have the scepticism of the Treasury and the scepticism of the Prime Minister and they've got to be sure what they are doing.

There was another factor which impinged upon the proposed IT programme. This was the debate over the future of scientific R&D in Britain which intensified as a result of the publication of the House of Lords Select Committee on Science and Technology report entitled *Civil Research and Development* in January 1987. The report painted a grim picture of R&D in Britain during the 1980's and called for the Prime Minister to be more closely identified with science and technology. As well as this, the report urged that a Cabinet minister be designated as the spokesman on science and technology and that the advisory council on research and development (ACARD) within the Cabinet Office be replaced by an advisory council on science and technology (ACOST).

On the twentieth of July, the Government released a White Paper outlining its response to the 'stinging rebuke' delivered by the House of Lords committee. It announced that there would be 'collective ministerial consideration, under the Prime Minister's leadership, of science and technology', that ACARD was to be replaced by ACOST, and that the committee of departmental chief scientists was to be expanded (*New Scientist*, 23/7/87, p.16). Science and technology's voice in Cabinet was Kenneth Clarke.

Collective ministerial consideration was taken to imply the creation of a Cabinet committee, something that the core executive traditionally refuse to confirm or deny. A well-connected source confirmed its existence and explained (53):

> I think if you examine the text (of the White Paper), you won't actually see an explicit admission quite in those terms. By convention, I think we only acknowledge the existence of three Cabinet sub-committees: one to deal with economic affairs, one to deal with foreign and defence affairs, and one I think to deal with legislation - and that is as far as we go publicly. But I think if you look at the - this was revealed in a White Paper which I think was a reply to the House of Lords report on R&D - and if you look at the actual wording of the reference I think you will see that it doesn't actually say in terms that the Prime Minister will chair a committee of the Cabinet. I think you'll find that that's what everyone inferred from it but it doesn't say that. I think if I remember rightly that (X) redrafted John Fairclough's (Chief Scientific Adviser, Cabinet

Office) piece on that for public consumption.

Another Whitehall source also confirmed its existence (54):

> Previously, if there was a dispute over the funding of a programme say, like Alvey, it would be referred to the Star Chamber (Cabinet sub-committee) or to Cabinet itself. Now it would go to the Cabinet committee on science and technology.

This strengthening of the core executive's machinery was the first major shake-up in the IT area since Professor Ashworth established an IT unit in the Cabinet Office headed by Sir Robin Nicholson in the early 1980s.

Bide, Alvey and IT Generally: Some Final Observations

By early November 1987, the Government had still not announced its intentions regarding an after-Alvey programme. Two factors point to the possibility that a follow-on programme will be announced. Since the DTI had not put forward any submission on Bide for 'the ministers collectively' to consider by mid-September, it appears that the Bide funding requests will be catered for within the normal public expenditure discussions with the Treasury (55). The second point is that Lord Young, Secretary of State for Trade and Industry, was being tipped as being one of the members of the Star Chamber cabinet committee due to meet in mid-October to resolve public expenditure disputes between Treasury and 'Mr John Moore on health, Mr Kenneth Baker on education, and Mr Nicholas Ridley on housing'(*Guardian*, 5/10/87), which suggests that there is no major dispute between the DTI and the Treasury.

A final clue to an early announcement was given in an interview with a senior DTI official who suggested in mid-October 1987 that the author should 'keep an eye on the trade press or the *FT* (Financial Times) or perhaps the *Times* over the next month or so' regarding the announcement (56). The first hint was revealed in the *New Scientist* (22/10/87, p.23) which said that DTI officials will 'urge their ministers to propose formally in the Cabinet' a follow-on programme based on the Bide recommendations. The article went on to suggest that the Bide recommendations would 'be cut heavily' with the DTI only providing £150 million, the SERC £50 million and the MoD providing funds 'only very selectively'. Meanwhile, the Alvey evaluation teams from SPRU and PREST have both issued warnings that Alvey research teams are 'already breaking up' and that a 'substantial part of the potential benefits' of Alvey 'could be lost' unless the Government acts promptly (*Guardian*, 2/10/87).

There was a second major shock in store for the Alvey directorate following the Plessey announcement that it had suspended work on the speech-driven word processor demonstrator. On the twenty-sixth of August 1987, Derek Roberts 'GEC's technology overlord' announced that GEC was abandoning several of its Alvey VLSI projects, including the £8.6 million one micron bulk CMOS project, because 'GEC was faced with the uncertainties about what the Government intended to do post-Alvey' (*Guardian*, 27/8/87). Roberts went on to point out that GEC would continue its silicon on sapphire Alvey project which had wide applicability in 'defence, aerospace, and high-performance industrial uses' but was pulling away from the more mass-production end of the chip market.

Shockwaves continued to rock the British scientific R&D community in the wake of the Government's proposal to adopt an ABRC report, *A Strategy for the Science Base*, which recommended sweeping changes to funding for science research in universities. This report proposed the creation of three tiers of academic institutions. The top centres of academic excellence would receive funding for a broad range of advanced research activities, the second division would be funded for selected areas of research, while the third division would receive no funding for advanced research facilities (ABRC, 1987, pp.3-10). A proposal along these lines for geology departments in UK universities has already been rejected by the University Grants Committee (*New Scientist*, 24/9/87, p.19).

Another initiative which came from ACOST was the setting-up of a centre for exploitable technology, a centre where it is hoped that market research into current R&D projects will identify long-term market opportunities. The steering committee overseeing its establishment, chaired by Sir Robin Nicholson, is preparing recommendations on its siting and who should head the centre. A recent report said that the Prime Minister, while chairing a meeting of the Cabinet committee on science and technology in early September 1987, 'blew her top' and 'thumped the table' when told of 'delays in both establishing the centre and making reforms to the University Grants Committee'. This was denied by Sir Robin Nicholson (*New Scientist*, 24/9/87, p.19).

The Government's intention to trim its civil R&D expenditure during the two years ending 1989 while increasing the share of military expenditure of government R&D from 51 to 54 per cent of the total has also come under attack(*Guardian*, 14/8/86; *New Scientist*, 18/12/86, p.4). The recently created Technology Requirements Board of the DTI which replaced the Electronics Applications Requirements Board issued a report, *Focus on Innovation*, calling for a rapid increase in industrial R&D funding from government, the compulsory disclosure by companies of their annual R&D expenditure, and a reversal of the DTI's trend of funding collaborative ventures in favour of single-company projects (DTI, 1986a, pp.3-5).

With this ever-increasing availability of funding from the MoD for R&D, it was not surprising to see a traditionally commercial IT company join the ranks of the 'defence IT' sector. A consortium led by ICL in partnership with Computer Sciences of America and two smaller British firms defeated such battle-hardened campaigners as Plessey, GEC, and Thorn-EMI for a £37 million MoD contract (*Guardian*, 21/8/87). This followed on the heels of other recent defence sales to the Royal Navy and the Royal Air Force of command-and-control systems by ICL. Perhaps the UK's last major commercial IT company has realised that there are relatively easier pickings away from the cut-throat, internationally-competitive free market.

7.5 Conclusion

There seems to be little doubt that the Alvey programme in its present form will end in 1988 with monitoring and evaluation of projects continuing for some years. This result does not necessarily constitute policy termination however. As Streeck (1984, p.154) notes, once established, corporatist institutions impede attempts by the 'constituent parts to regain their previous autonomy'. If the Bide recommendations are accepted, whether in their current form or in a diluted version, the general policy stance will remain similar to that of Alvey. The Bide programme proposes a major R&D focus in the fields of software, IKBS, human interface, and VLSI application specific circuits. The programme will be overseen by an 'independent' joint industry-government directorate within the DTI using existing Alvey staff with a small executive and a steering committee. Funding will be supplied largely from the same sources as Alvey, grants will also be on the same basis and if the recent *New Scientist* story (22/10/87) is close to the mark, the level of funding will also be similar. Research and development will be collaborative although it will be much closer to the market than it was thought Alvey would be. In this sense, the Bide proposals constitute policy succession. Unlike Alvey, Bide also took the needs and views of major private sector users into account. The other notable changes between Alvey and Bide policy formulation were the sharp rise in the number and variety of interest groups making submissions, perhaps indicating a maturation within the industry leading to greater 'associative order' (Bonnett, 1985, p.100), and the influence that the CBI had throughout and the legitimacy this added to the policy process. The mobilisation of the IT industry and related interest groups could be seen as evidence of an attempt to defend the hard-won gains achieved through the Alvey policy, a key feature of policy succession (Hansen, 1985, pp.79-96).

In contrast to Alvey, the Bide public policy-making process was largely handed over to industry. Although this does not constitute private interest government (PIG) as defined by Schmitter (1985, pp.47-50) some might see this policy mode as being close to the PIG-style. On the other hand, the Government's tardy response to Bide and the replacement of Geoffrey Pattie might be seen be seen by its critics as indicative of an anti-rationalist element in Conservative party thinking. After all, Sir Alfred Sherman, himself a former policy aide to Mrs Thatcher, observed that:

> The Tories are known for being The Stupid Party. Trying to get a minister to think about a new policy "is like trying to sell condoms to an impotent man". (*Guardian*, 6/10/87)

There is little room to doubt that when finally forced to face up to political decisions which involve intervening in markets, the Government's response has been reluctant. The experience with the EEC Framework proposal was that a predictable compromise was reached but with considerable offense to other EEC countries and disruption for the programme.

While adopting a neo-liberal stance regarding competition and markets and reiterating familiar neo-liberal truisms (such as 'no-one owes the UK a living'), the rationale behind the Bide proposals is similar to the arguments advanced for government support world-wide. Other countries subsidise their industry, high interest rates and small home markets reduce the incentive to invest in new technology, and there is a strategic need to maintain the indigenous industry. Only with the help of government subsidies will local industry survive. The former IT

Minister, Geoffrey Pattie saw no contradiction or paradox in an avowedly neo-liberal government adopting this type of policy. He said (57):

> No. It's perfectly straightforward. Because there is nobody in this - ah - Government from the Prime Minister on down who believes - ah - in - totally in market forces and that government has no role whatsoever...We still have a role in a catalytic sense in programmes like Alvey, like the Link programme, like JOERS which have tried to foster partnership and encourage companies to do their own thing but we will try to help them where we can. It's a balance - the whole thing. But we are fundamentally of the belief that companies know their own business best and that what we have to do is to say 'If you guys are competing in a very tough foreign market, we will try and help you with a certain amount of credit or political support - all of course compatible with GATT and all that kind of thing - we don't just say 'Well it's entirely up to you chaps really. Just let us know how you're getting on'. We do work with them. But we don't try and smother them with help. We don't stuff them full of subsidies, give them captive little markets because that just means when they go out to try and take on the world, they perish.

CHAPTER EIGHT

Decision-Making on the Alvey Programme: a Review

Analysing any policy-making sequence involves numerous complex judgements. This chapter reviews the overall findings of the study from three main perspectives, in order to bring out different levels and types of judgements about decision-making on the Alvey programme. The first section summarises the evidence in terms of the stages of the policy cycle used to structure the sequence of earlier chapters. The second section reviews the role played in the whole cycle of Alvey decision-making by different interest groupings, both private sector and governmental. The third section briefly considers how the evidence uncovered here relates to and advances our understanding of contemporary theoretical debates and controversies, especially as they concern state decision-making over 'productive' interventions, the role of corporatism and meso-corporatism in contemporary policy-making, and the importance of professional occupations in shaping public policies.

8.1 The Alvey Policy Process

'The human condition is small brain, big problems' according to Lindblom (1977, p.66). The British IT industry, the Government, and the academic community faced enormous and complex problems in the early 1980s. This section traces the path of the policy cycle and the steps taken to overcome these problems.

The Alvey Policy: Origins and Formulation

In the 1960s and 1970s, IT policy was fragmented. In telecommunications, long-running arrangements persisted between the Post Office and an oligopolistic 'ring' of suppliers, a situation which continued and strengthened into the System X era. In the computer industry, once the industry had rationalised, British computer firms settled into a quite similar arrangement with government. While ICL was the National Champion, Ferranti and GEC-Marconi also had preferred supplier status with the Ministry of Defence. In microelectronics, the industry faced strong international competition, a weak home market, and a lack of government support, resulting in the disappearance of the indigenous standard chip industry in the early 1970s. Firms concentrated on custom chips for the narrow niche market of defence and telecommunications. Close links were already in place in these two fields. In the late 1970s, government supported the revival of standard chip manufacture through Inmos. Like the National Champions before it, Inmos too was soon on the ropes.

By the early 1980s, the British IT industry was under seige. International firms dominated the home market, the GATT rules were applied, the Thatcher Government promised a liberalisation of the market and moved to privatise British Telecom, and overseas, countries such as Japan, France, and the USA were mounting major national IT programmes. At the same time, ICL almost collapsed and was only saved by the reluctant intervention of the Government, Inmos was in deep trouble and awaiting Government funding, System X was achieving the international sales of Concorde, the SERC was proposing a 25 per cent cut-back in support for IT in universities, and a Department of Industry team arrived home from Tokyo with the news that the Japanese were poised to take the lead in the IT race. These were all catalysts which inspired action.

The origins of the Alvey policy process which are analysed in chapter three demonstrate the 'osmotic process' whereby state and interests seek each other out (Schmitter, 1979, p.29). The SERC approached the DoI, the DoI approached industry and hosted a debrief conference at which industry representatives sought out civil servants, and the DoI approached Kenneth Baker who approved the idea of approaching John Alvey. Neither the state nor industry issued a directive on what needed to be done: rather, a network of professionals and technocrats interacted with each other. A committee of inquiry was set up to formulate the policy.

The committee was dominated by the hardware/VLSI sector and the systems/software sector of the IT industry with the former being the most powerful. Other interests represented included academic researchers and government with the academics having the least influence. Through a process of log-rolling, trade-offs, consultation, and papering-over of disputes, a consensus was arrived at. Agreement on goals was easily achieved since they were so vague and nebulous to be almost meaningless. Consensus on instruments was more difficult given the technological rift that existed between hardware/VLSI and systems/software interests. But in the end, both groups realised that they had 'more in common with each other than they' did with potentially competitive interests (Cawson, 1985, p.5).

Policy Approval, Initiation and Implementation

Decision-making within the core executive focussed on the non-substantial aspects of the policy. With a policy whose subject matter was highly technical and framed in such a complex and intertwined way, administrators and politicians alike were faced with three viable choices. They could reject it entirely, approve it as presented, or tinker at the margins. Other alternatives such as calling a second inquiry or shelving the Alvey report were not genuine options. Outright rejection seemed unlikely given the Government's focus on 'sunrise' industries, the fact that it was information technology year (IT82), a special IT Minister had been created who argued the case well, and similar programmes were springing up in other countries. Outright approval would de-legitimate the authority of the core executive, and so the core executive reduced the level of funding, appointed a director, set staff levels, and imposed a steering committee of its choice. At the same time, policy negotiations took place between the DoI and Treasury, between the MoD and its Minister, between the CBI and the core executive, between Kenneth Baker and Patrick Jenkin and their colleagues 'in the margins', and between the Prime Minister and senior industry figures such as Lord Weinstock. This last feature was more a case of reassuring the Prime Minister and policy clearance than it was incorporation in the decision-making process. Bearing the *imprimatur* of legitimacy, the policy received the formal approval of the Parliament.

The initiation and implementation of the policy were characterised by a close working relationship between the Alvey directorate and sectoral interest groups in the case of intellectual property rights, and agreements between the directorate and individual firms which led to the incorporation of the interests in the implementation and operation of the policy. Both cases highlight the way in which interests are 'necessarily drawn closer to the state' (Grant with Sargent, 1987, p.16). Once again, individual technical strategies were formulated in a segmented manner along interest lines and while some of the resulting strategies had operational objectives and others did not, none had well defined strategic aims or ends.

Policy Operation and Succession/Termination

An important feature of the operation of the policy was the generation of an ethos. The Alvey ethos focussed upon pre-competitive research, collaborative projects, closer university/industry linkages, and a wider use of university talents. In the case of the technical programmes, the focus was on large IT firms in the VLSI sphere, on defence and telecommunications suppliers in the software engineering field, while universities held a prominent position in both the MMI and IKBS programmes. With respect to the Alvey directorate, the ethos manifested itself in the form of a pro-industry/anti-bureaucratic, independent organisational culture, a hard-working friendly climate, and a relaxed administrative system. Other features included the burgeoning steering committee, a complex web of advisory panels and sub-committees, clubs, conferences and workshops. It also involved complex bureaucratic negotiations with its public sector 'partners'.

The policy succession process commenced before the programme had completed half of its expected five-year span. Once again, the formulation of a follow-on programme was characterised by the osmotic seeking-out of actors and interests. The government did not direct this reactivation of the policy network. Policy-making incorporated a much wider field of interests the second time around and had a different overall focus. A different and more mature associative structure was in evidence both on the supply and the demand sides. The resultant consensus policy was in fact two policies; one was a policy of sucession for the Alvey programme and the other was a market-oriented applications programme. This double-barrelled policy proposal did not encounter the same, relatively smooth passage as Alvey had and twelve months after its presentation was still in limbo.

The failure to announce a follow-on programme raised the spectre of policy termination. As with policy implementation, no plans were drawn up in advance as to how this would be achieved. Many Alvey projects were not scheduled for completion until well after Alvey's notional termination point in mid-1988, and there were still funds to be paid out and projects monitored. This meant that the policy agency was likely to survive in some form for some time.

8.2 Alvey: Interests and the Programme

Another way of summarising the empirical findings of this study is to review how each of the main interested parties was engaged in the policy process, the roles that they played, and what each one got out of it.

Private Sector Interests

The private sector interests which were incorporated in the Alvey policy-making process represented various sectors or market niches. This facilitated the 'process of closure' (Cawson, 1985, p.9) whereby the ASIC manufacturers were included but despite the presence of Inmos' Ian Barron, general purpose or standard chip manufacturers were not. Suppliers of large embedded software systems such as command and control systems were included but commercial bespoke systems suppliers were not. Suppliers were included, users were not. Capital was represented, labour was not. This resulted in a narrow supply side strategy being put forward. The few sectoral interest associations such as the British Computer Society which made substantive representations did not change the thrust of the proposed policy at all.

The success of the industry representatives was dependent upon their technical expertise, the economic strength of the firms they represented, and their personal network of contacts built up over the years in the industry and on SERC and DTI boards on which they had served. Industry's weakness lay with the absence of well-developed sectoral interest structures and the inability of its representatives to present an integrated and cogent case. Although the CBI recommended the adoption of the Alvey policy in its pre-Budget submission, industry was represented during the approval process by individuals such as the chairmen of firms.

It was not until the policy was initiated and implemented that interest group representation achieved any semblance of coherence and even then, when discussing the intellectual property rights question, the MoD were ignored and administrative confusion ensued. During the operation of the policy programme, representation was conducted on a personal or company basis. Private sector firms dominated the technical programmes, especially the VLSI and software engineering programmes where the bulk of Alvey funds were allocated. It was not until the move to generate a successor policy began that interest representation achieved a measure of associative influence. It was the peak industrial representative body, the CBI, which arranged conferences and arranged deputations to ministers which proved important. The CBI committee structure provided the chairman of the policy-making body and in sharp distinction to the Alvey proceedings, numerous peak sectoral interests submitted evidence on behalf of their members.

Academic Interests and the SERC

Academics also came to the negotiating table armed with expertise but unlike the industry representatives, they possessed no economic clout and were more poorly organised in an associative sense than industry was. Representation on the Alvey committee was minimal and the incoherence of the tertiary education sector is borne out by the massive number of individual submissions made. Except for the lone academic voice on the Prime Minister's information technology advisory panel, universities had no say in the policy approval process and little say in the initiation of the programme.

During the implementation and operation of the policy, however, the importance and influence of the universities became more pronounced. Academics had a powerful influence on two of the four main programmes, the Man-Machine Interface and Intelligent Knowledge Based Systems, and their value to industry in all programmes was widely acknowledged. This value is borne out in part by the fact that the original £50 million set aside for academic participation was supplemented until it reached almost £70 million. In the case of generating an after-Alvey policy, the SERC and universities again took the lead but their lack of influence and associative structures blunted their thrust. Universities representations to the Bide committee once more showed the fragmented character of tertiary education, although not to the same extent they had during the Alvey deliberations. They were also much better represented with three members of the Bide committee as well as on the various working parties and sub-committees associated with the Bide deliberations than they had been in the case of Alvey.

The SERC played an unusual role in the original policy process. On one hand it played the part of an avuncular controller in relation to the universities while on the other hand, it was a participant through its Rutherford Appleton Laboratory and a principal source of funding. Apart from submissions to the committee by the SERC, the RAL, and the RAL's joint network team, the SERC view was represented by Brian Oakley, a figure who played a key role once the programme was approved.

During implementation and operation of the policy, the role of the SERC became one of behind-the-scenes support as well as providing more visible participants such as Oakley, Thomas, and Vitty. The element of reciprocity was epitomised in the case of the directorate and the SERC by the way in which the SERC handed over to the directorate the right to select projects for support and in return, it received a major funding boost and retained the right to review procedures.

The influence of the SERC was more pronounced during the after-Alvey policy-making process. Not only did the SERC provide the first formal inputs to a post-Alvey policy, but it was also well represented with a member on the main committee and several members on the supporting committees. As well as this, there was an overlap of membership between the SERC after-Alvey committee and the Bide inquiry with Lord Gregson and Dr Hilsum of GEC appearing on both. With the move of Dr Thomas from the Alvey directorate to Imperial College and the subsequent retirement of Brian Oakley, the SERC lost two of its most powerful voices.

Governmental Actors

Apart from the SERC, there were three main governmental actors: the DTI, the MoD, and (more loosely) the core executive.

(a) The DTI, of all the participants, was the most enigmatic. Its presence was in evidence throughout the policy process, it provided more than half of the state funding, and yet it had less influence on the policy-making and implementation than any group including academics. The answer lies partially with the fact that the DTI, while organisationally and financially powerful, was technically bereft and inadequate. The result was that the DTI was thwarted at every turning. The core executive refused to provide 'new money' for the programme and when the DTI tried the back-door method, the door was rudely slammed by the Treasury and the Prime Minister. Following implementation, its primary role was to supply administrative support and infrastructure and although the directorate was just as much a part of the DTI as, say, the IT division, this was so only on paper. The directorate divorced itself to a large extent from the DTI and operated in a largely independent manner. It was only well after the programme was underway that the DTI tried to re-assert its influence and by then it was too late to substantially influence it.

In the after-Alvey policy-making process, the DTI was only as well represented as the SERC if the Alvey directorate is excluded. The IT Minister, Geoffrey Pattie, had made it clear that industry was to lead the way in the post-Alvey process and the result was a further dimunition of the DTI's status as 'sponsor' of the IT industry.

(b) The Ministry of Defence played a low-key but enormously powerful role in the policy process. Although it had only one representative on the Alvey committee, the MoD had several *de facto* representatives in the form of the large 'defence IT' contractors. During the policy approval process, the MoD 'hung in there' and lent its weight through Michael Heseltine to the voices of Jenkin and Baker who were urging the adoption of the policy.

Following the approval of the policy, the MoD participated strongly in the implementation of the programme, providing staff and funds, as well as dominating several of the advisory panels and committees. Such was its strength in the VLSI programme, that VLSI almost became to the Alvey programme what the Alvey directorate was to DTI, an autonomous entity. During the generation of the after-Alvey policy, the MoD had the same number of representatives as the DTI, and the SERC and only one MoD spokesman from the Royal Signals and Radar Establishment made a submission to the Bide committee as opposed to eight submissions from the Alvey directorate. Once again however, the 'defence IT' firms were well represented and from some of the recommendations made such as the need for radiation-hardened microchips, it was apparent that the MoD view was sufficiently well represented.

(c) The core executive's role was minimal in the Alvey policy-making process. Apart from representations by the Cabinet Office and the Treasury's Central Computing and Telecommunications Agency, which hardly qualifies for inclusion under the banner of core executive, this most decisionally powerful group had virtually no input into the formulation process. Once the policy proposal reached the core executive, marginal albeit important alterations were made and the core executive once again withdrew from the policy process. During the operation of the policy only one decision went to Cabinet for consideration.

Following the protracted negotiations over the EEC Framework, criticism by the House of Lords Select Committee on Science and Technology, and faced with the Bide proposals, the core executive set about strengthening its decision support structures for science and technology. Its role in the Bide policy-making proposals was no different, however, from its role in Alvey policy-making.

8.3 Theoretical Issues and Perspectives

The case study of Alvey decision-making presented here is interesting as a narrative in its own right, as an example of industrial policy-making, and as an illustration of the weaknesses and strengths of the British policy-making apparatus. However, apart from the empirical insights garnered in the past 300 pages, the Alvey study also contains some important insights and questions relevant to contemporary theoretical debates. These involve: contrasts between 'allocative' and 'productive' modes of state intervention; the role of corporatist intermediation in policy areas most relevant to business interests; the importance of universities and professions in technical policy areas; and the ambiguities which remain in characterising the Alvey experience.

'Allocative' and 'Productive' Interventions

Claus Offe (1975) has suggested that there is an important distinction to be made between two fundamentally different types of government intervention. 'Allocative' interventions essentially involve government in disposing of resources already under its own control (such as taxation revenues, legal powers, or organisational resources) in such a way as to produce outputs which are definite and capable of being directly quantified and assessed. When a government uses legal powers to compulsorily acquire land, spends tax receipts on building a road on the land, using its own engineering staffs to design and supervise construction, then it is engaging in an allocative form of intervention. In the nineteenth century, Offe suggests, most governmental activity took this form, and it was not until late into the twentieth century that these kinds of governmental programmes began to play a less important role in policy-making.

'Productive' interventions have increasingly displaced allocative policy-making as the focus for governmental anxieties and academic attention. Productive policies involve governments trying to influence societal development in a much more extended and thorough-going way than the traditional, limited tasks of government. These types of interventions cannot be realised simply by using resources which are already under governmental control. Instead the capacities, skills and commitments of external social interests need to be actively engaged in securing beneficial outcomes. Productive interventions may not necessarily produce any defined intermediate outputs, any specific products or services or easily quantified results which can serve as an index of government performance. Instead the government becomes involved in trying to change the behaviour and expectations of outside actors and organisations, in order to achieve diffuse outcomes judged important in terms of a 'public' or 'national' interest. Effectively government is trying to secure more or less 'piecemeal social engineering' outcomes (Popper, 1957, p.222). For example, when state agencies try to tackle inner city problems or curb rising crime rates, they quickly acknowledge that results cannot be achieved simply in terms of governmental programmes alone.

Offe goes on to suggest that different mechanisms for organising government's operations are associated with these distinct modes of intervention. Allocative interventions are relatively easily handled using conventional bureaucratic solutions, such as hierarchically structured line agencies, routine decision rules, and standard operating procedures. They are also relatively easily subjected to the scrutiny of external representative institutions. Party competition, interest group lobbying, and politicians' activism can all play important roles in shaping the ways in which institutions are designed and policies are implemented. By contrast, productive interventions require quite separate styles of decision-making, since the ability to engage external interests in searching for co-operative solutions and outcomes, and the need to forecast and plan ahead for future contingencies, cannot be easily accomodated within conventional bureaucratic solutions.

Decision-making about technology policy can be fitted into the Offe dichotomy fairly easily. When the government spends public money on developing a particular piece of hardware for a defence system, then it may be able to handle the matter in a basically allocative way - issuing a product specification, going out to tender, and accepting and monitoring a particular bid in a very routine way. But when the government intervenes in an industrial policy fashion, to try to accomplish a particular restructuring of companies in some product area (Atkinson and Coleman, 1985, pp.43-44), or seeking to ensure that a given industry is appropriately positioned in international markets, then it is acting in a productive mode. There are undoubtedly some special features of this latter kind of technology policy-making which intensify the problems which productive decision-making poses for governments. The rate and pace of change in technical policy areas can be very rapid, as it certainly has been in information technology since the advent of the microprocessor in the early 1970s. The uncertainty attached to different policy choices in technological areas may be very high, making it especially difficult for governments to discriminate between policy options in terms of their consequences several years down the line. The internationalisation of industrial and technical developments further complicates issues, since strategies which may make perfect sense in domestic policy terms can be rendered unsuccessful by developments elsewhere which are beyond the scope of any government or national industry to control. International competition has played a dominant part in increasing the uncertainty and difficulty of British decision-making for IT since the 1960s. Finally the scale of resource commitments demanded of companies or governments anxious to preserve their own or their country's position in advanced technology areas has continually increased, and the lead times involved in measuring success or recognising failure in policy initiatives have lengthened.

The entire Alvey policy seems to fall squarely within the category of productive interventions. The whole rationale for the programmes selected was not to produce outputs for government, but to effect far-reaching changes of attitude and behaviour among a great diversity of actors and organisations who together compose the British IT sector. Alvey was a 'catch-up' programme, designed to recognise and respond to a continuing decline in the international position of the UK industry, and to reposition it so that firms and IT professional could hope to compete successfully in areas where they would otherwise fall further behind. The key to effecting this change was the creation of a new IT ethos, the direct analogue of the concept which appears throughout corporatist literature in various guises as 'sectoral consciousness' (Cawson, 1985, pp.13-14), shared assumptions, policy culture, and the 'distinctive value system of (a) bureau' (Atkinson and Coleman, 1985, p.30).

The hope of the Government was that by planning ahead and attacking the problems in a particular way, they might be able to control or modify the perception and the reality of the industry. This process is what Vickers (1968, p.15) referred to when he said:

> Judgement and decision...are taken within and depend on a net of communication, which is meaningful only through a vast, partly organized accumulation of largely shared assumptions and

> expectations, a structure constantly being developed and changed by the activities which it mediates.

Elsewhere Vickers states (1973, pp.176-178):

> The policy maker, whatever the level at which he operates, is also an artist in the creation of a coherent and viable form in human behaviour...And even beyond this, he is an artist in shaping the norms and values from which his policy is made.

To shape or engineer this change, the decision-makers relied on new style of implementation mechanism. Many of the sources quoted in chapter five, both industry and public sector, experts and laymen, referred to the 'different' or 'unique' nature of the Alvey programme and/or the directorate. One senior DTI staffer referred to the Alvey programme as 'a symbol' that had a 'profound effect' upon the IT industry and academic participants. Industrialists and civil servants together were involved in a planning capacity in the day-to-day management of a policy which influenced the well-being of the IT industry. While the core executive could only focus on the peripheral issues, the directorate shaped the policy operations in a vital, albeit mainly indicative, way.

It may be that the Alvey solution was the only viable option open at that time. The bureaucracy, especially the DTI, was woefully short of technically qualified manpower, and the civil service was being squeezed for manpower by its political masters. The incorporation of the private sector served a dual purpose; it solved the manpower problem and gave industry a meaningful role in the policy process. This corporatist mechanism may have been the consequence of the impossibility of using more conventional means.

Corporatist Policy-making

In Offe's original discussion of how different institutional mechanisms match up against the demands of allocative and productive interventions, corporatism plays a key role as an alternative to centralised bureaucratic solutions which are most appropriate for allocative interventions. Unlike pluralist solutions, corporatist intermediation runs little risk of allowing policy areas critical to business interests to be controlled by socialist or social democratic parties with radically different policy priorities. Particularly as developed in the dual state thesis (Cawson and Saunders, 1982), corporatism is seen as well adapted to the problems of allowing central government to plan ahead, cope with high levels of uncertainty, and engage external social interests in actively securing government objectives. Corporatist arrangements at the central state level and meso-corporatist arrangements at the sectoral level deliver a whole bundle of benefits as an integrated package, which could not be secured by purely governmental attempts at technocratic planning.

By vesting policy control in some form of quasi-governmental agency, it is possible to operationalise the dual representation and control flows of influence on which corporatist theory has always concentrated. Industrial or professional or union interests can be given an active role in shaping how government resources are disbursed, in exchange for their collaboration in achieving 'public interest' objectives. Atkinson and Coleman (1983, p.8) state 'As a distinctive policy network, (meso-) corporatism promises to deliver consensus on the goals and instruments of policy'. Administrative structures can be created which are more dynamic, flexible, task-orientated and forward looking than conventional bureaucratic agencies. These new agencies can also be more effectively insulated from political interference and control, and vested with a degree of autonomy from the general development of governmetal policies. Corporatist institutions can also accord a full quota of influence to specialist and professional staffs, in a way which would be far more difficult to achieve in mainstream of central government departments.

There are plenty of grounds for regarding the Alvey directorate as a classic instance of a meso-coporatist institution. It insulated itself against political as well as bureaucratic interference from its parent body, the DTI. By developing a specialised functional agency, political control was vested in experts as opposed to generalist administrators. Industry was incorporated in the policy-making and implementation processes and the empirical observation of Cawson (1985, p.11) that 'producer/provider' groups engage in the reciprocal intermediation process held true in this case. The directorate engaged in generating an ethos and institution building. The effectiveness of the institution building process is partially borne out by comparing the associative structures involved in the Bide policy process and those associated with Alvey policy-making. A note of caution should be added because of the involvement of the CBI in the Bide process. Some interest groups which made representations may have done so at the request of the CBI.

Professions and Policy-making

Corporatist solutions are not the only possible methods of handling the interface between specialist expertise and lay politicians. In many social policy areas, professions play a critical role in constituting policy communities with government, or with central and local government tiers. Here the development of an occupational group identity which is distinct from people's organisational allegiances helps to create a climate of opinion and a set of professionalised organisational structures within which a relatively disinterested and knowledge-based debate about policy options can take place. In such well-specified policy communities, government may not need to create semi-detached or quasi-governmental agencies to process the details of policy-making. Rather, the integration of key specialist staff into a relatively autonomous profession provides a basic guarantee to government (acting as proxy for the consumer) against misapplied advice or over-supplied outputs. And government can make policy quite effectively by periodically summing up changes in professional opinion in an authoritative fashion, and then embodying them in legislation or operational guidelines.

In areas of technology policy, the development of technical professionalism rarely proceeds this far. Although professional bodies, institutions and networks exist and play an important role in disseminating knowledge and forming opinion, technical professions are less useful from government's point of view as devices for coping with policy problems. Technical professions tend to be much more fragmented into specialisms and sub-specialisms than is the case with the social professions (Massey, 1986). Employer allegiances are much more strongly developed in technical areas than in the social professions, since access to research equipment and other capital intensive tools may be a *sine qua non* for operating in a given area of knowledge. The development of a professional identity or interest distinct from simple criteria of success in serving the employing organisation is more difficult.

In the technical professions there is no very developed analogue of 'social responsibility' or 'responsibility to the client' which in the social professions provides at least some basis on which a professional may dissent from the policy of their employing organisation. Respect for technical excellence, unbiased testing and adequate public disclosure may come close to matching the 'social responsibility' ethos in some areas of the technical professions' work, for example in designing new types of passenger aircraft. But in other fields, such as many areas of information technology, even these criteria may provide a rather insubstantial basis for the emergence of a professional identity. And in the technical professions the central occupational institutions often have no code of ethics or regulatory role. Finally because of the capital equipment base needed for scientific or technological work, there is little by way of a private practice sector in most technical professions. Instead universities (and to a much lesser degree, polytechnics) take on the role of a surrogate private practice sector, providing the only locations (apart from working for private corporations or for government agencies) where technical knowledge is developed in a relatively disinterested or academic mode. But in their normal mode of operations, university academics are typically rather individualistic and fragmented, and may not provide a defined or cohesive occupational group to whom governments can turn in search of relatively impartial advice.

The last point is particularly the case in the IT industry where an IT professional can be in any one of scores of occupations and sub-specialities within the broad field. By establishing the Alvey programme and setting up an agency in which IT professionals played such a major role, the concept of an IT community was promoted. Within the technical programmes, especially the software engineering programme, there was an attempt to standardise procedures through formal methods. The process of collaboration was also important to the development of institutions and the promotion of an IT community. This was critical in the case of the universities and polytechnics. By boosting the funding for universities, they were given access to state-of-the-art technologies and processes which allowed them to participate more fully in the programme. Almost two hundred of the three hundred and thirteen projects attempted were joint industry/academic projects. The increased level of contact between industry and academia gave both parties a chance to reappraise previously held beliefs and biasses about each others abilities, motivation, and so on. Collaboration, according to most interviewees, was the most outstanding achievement of the Alvey programme. From a government viewpoint, the most immediate positive result of strengthening the professionalism of the IT sector would appear to be a better-defined, more independent professional body, more capable of supporting and servicing future governmental decision-making and advisory committees.

Alvey as Meso-corporatism: Problems and Ambiguities

Real life is rarely as clear-cut and well organised as theoretical frameworks and models suggest. So far this section has stressed the features of the Alvey programme which run with the grain of theories of 'productive' state interventions and the importance of corporatist mediation in such policy processes. However, there are three main grounds for doubting the extent to which the Alvey experience can be taken as providing support for the ambitious claims of corporatist models to capture a general (albeit still emergent) pattern of state policy-making in the contemporary period. These ambiguities concern: (i) some exceptional characteristics of the Alvey programme in industrial and technology policy terms; (ii) the question of whether the Alvey programme indicates only a temporary or transitional period of government involvement in the IT sector; and (iii) the problems of deciding whether or not the internal operations of the British IT industry/policy community have been effectively changed.

(i) It could be argued that the distinctive style adopted for Alvey policy-making and implementation was exceptional and unnecessary. It was never clear that supporting the niches identified in the Alvey report would require a semi-autonomous agency staffed by three departments and industry. Neither was it clear why there had to be one central programme. There was no reason why support could not have been offered through conventional purchasing policies, tax incentive policies for R&D such as exist in the USA and Australia, or why there could not have been several smaller specific programmes for each technology in the style of the JOERS programme. Other branches of science and technology policy seem to be able to operate effectively without a meso-corporatist agency, so perhaps it was a mere coincidence or accident that the Alvey policy emerged as it did.

(ii) The second area of ambiguity looks at the possibility that Alvey was a one-off abberation which is a transitional stage in IT policy development. Certainly the conditions which existed in 1981 and 1982 when the policy was first mooted were exceptional for the British economy generally. Interest rates were extremely high, the British currency was heavily over-valued, unemployment had doubled in the previous year, and countries such as Japan were announcing major government-sponsored IT programmes. Add to this the fact that IT had acquired a special status as a 'sunrise' industry and attracted favourable government attention, and the bases for an untypical government response appear clearer. The problems of policy succession and policy rivalries provide another indication that Alvey may be transitional. It may be that the Government would be more in favour of British companies joining in the EEC's IT programmes in an effort to develop linkages which would help them be involved in larger scale projects which would be more effective in making them internationally competitive. Finally, the widely rumoured scaling down of the Bide recommendations may indicate that the Government has finally decided to end the Alvey corporatist 'experiment'.

(iii) The final problem lies with the question of whether there have been real and lasting changes to the operation of the British IT industry and policy community, or whether the changes are merely superficial. It is still quite possible that much of the euphoria and support for Alvey, collaboration, and the IT community will wane when the Government cash input runs out and no more is forthcoming. Other unanswered questions concern how autonomous the university sector can be in its relations with domestic manufacturers or with foreign IT firms, and the way in which their collaborative involvements will affect their own decision-making about the future of university computer science departments. As and when university researchers are held in high esteem by industrial firms, problems of salary differentials and staff poaching seem likely to intensify, with potentially major effects in refragmenting the tenuously built-up IT 'community'.

Some of these basic ambiguities may be resolvable with hindsight as future decisions unfold. But other questions about the overall thrust of the Alvey policy programme seem certain to remain.

Appendix A

Research Appendix

The policy initiative which forms the focus of this study has not previously been analysed from a decisional perspective, although parts of the programme have been the subject of technical evaluation and study. Six sometimes overlapping groups influenced the formulation, implementation, and operation of the Alvey policy. These included public administrators from the Ministry of Defence, the Department (of Trade) and Industry, the Science and Engineering Research Council, and the core executive. As well as the public sector representatives, academics from the quasi-governmental universities and private sector industrialists were also closely involved throughout. This diversity of interests and influences in the process demanded a systematic, detailed and comprehensive data collection process. The approach chosen was designed so that an accurate picture of the role, the relative influence, and the objectives of each major interest group - industry (and its various sub-groups), academia, and the bureaucracy - could be painted.

The methodology used for conducting research for this thesis comprised two analytically distinct but chronologically overlapping parts. The first consisted of a series of interviews conducted over a period of almost eighteen months with sixty-one individuals representing the key organisations and interests involved as well as other eminent observers. The second was a literature search of all material relevant to either the policy programme itself or to any of the key interest groups involved in the formulation, implementation and operation of the policy. A brief review of both of these methods and their outcomes follows.

Interviews

Personal interviews were a vitally important facet of the research work, in fact, it would have been impossible to write this dissertation without them. Interviews were arranged following a period of reading recent relevant literature at intervals during the Spring and early Summer of 1986 and as the pace of the research increased, they became more frequent. The majority of the interviews were held in the Summer of 1986, October-November 1986 and February-March 1987. The selection of interviewees was undertaken deliberately and an effort was made to give each interest an amount of time roughly proportional to its involvement in and influence on the programme, especially the decisional aspects. Unlike some other policy processes, identifying which interest actors represented was sometimes difficult because of interchanges of key personnel from one type of organisation to another. Among those interviewed there were cases of academics who had served in senior government posts and then moved into industry, senior bureaucrats who had taken up academic posts, and industrialists who had served as chairmen of the Science and Engineering Research Council committees and had served in the civil service on secondment. By occupation at the time of interview the dissection is as follows: six Members of Parliament (including the then Minister, Geoffrey Pattie), fifteen civil servants (one retired), twenty-six industrialists (four of whom were on secondment to the Alvey directorate), eight academics, four journalists, one trade union spokesman and one spokesman for an employers interest group. A full list of interviewees in the order in which they were originally interviewed can be found in Appendix B.

All of the public administrators interviewed were closely involved with some events described in the case study. In the case of the Department of Trade and Industry, a conscious decision was taken to interview former, as well as current, officials including secondees from the Department who served in the Alvey directorate. These interviews were deliberately spaced over a fifteen month time span with two interviews in the second half of 1986, one in early 1987, and three in late Summer 1987, one of which was a follow-up interview. Care was taken to interview generalist as well specialist administrators from the Department and its sub-organisations. Generalists included divisional heads of deputy secretary and under-secretary rank while specialists included a scientist originally from the National Physical Laboratory and an economist.

In the case of the Ministry of Defence (MoD, three generalist administrators and two specialists, both experts in the field of silicon microchip technology, were interviewed. Two of the five interviewed had taken up positions in the private sector which provided an added dimension to the information supplied. A deliberate decision was taken not to conduct interviews at a 'research bench' level because of the lack of influence and contact which most of these actors had at a decisional level, the focus of this dissertation. Two of the MoD interviewees had spent time as secondees in the Alvey directorate.

Listed below is shortened version of the various categories of people interviewed.

INTERVIEWEES

Members of Parliament

Geoffrey Pattie(C)
Jeremy Bray (Lab)
Paddy Ashdown (Lib)
Sir Ian Lloyd (C)
John Marshall (C)
Stuart Randall (Lab)

Alvey Staff

B W Oakley
S L H Clarke
K A Bartlett
R J Morland
C W Barrow
W Fawcett
D B Thomas
D Talbot
R L Hird

Alvey Committee of Inquiry

John Alvey (BT,ex-MoD)
Prof. Roger Needham (Cambridge U.)
Derek Roberts (GEC)
Keith Warren (Plessey)
Mr C Haley (ICL)

Civil Servants

Arnold Lovell (ex-Treas)
Geoff White Treas. (ex-DTI)
Brian Unwin (ex-Cabinet Off.)
Alastair MacDonald (DTI)

Civil Servants (inc. ex-Civil Servants)

J H Major	DTI
W B Willott	DTI
C Blundell	DTI
J Bourn	MoD
A L Mears	MoD
Sir R Mason	ex-MoD
D Colliver	MoD
Sir R Nicholson	ex-Cabinet Office
D Worsnip	SERC

Academics and Journalists

Prof. Eric Ash	(Imperial Col.)
Sir James Lighthill	(Univ. College)
Dr Jill Hills	(City Univ.)
Prof. Frank Land	(LBS)
Dr John Hendry	(LBS)
David Fishlock	(Fin. Times)
Peter Large	(Guardian)
Mary Fagan	(New Scientist)
Guy de Jonquieres	(Fin. Times)
Dr Mike Hobday	(Sussex Univ.)
Dr Kevin Morgan	(Sussex Univ.)

Industrialists and Others

Sir Robert Telford	GEC-Marconi
Sir Derek Alun-Jones	Ferranti
Sir Frank Knight	ex-CBI,NEB
Mr G Holmes	SDL
Dr I MacKintosh	Consultant
Mr J B Saunders	Plessey
Mr Anton Poot	Philips
Dr Stanley	Logica
Dr D Hooper(dec.)	GEC
Mr C Foxell	BT
Dr Davies	Pye-Unicam
Mr Horton	Acorn
Mr Metcalfe	B Ae
Mr J Yates	B Ae
Mr A Cox	Racal
Mr Webb	ASTMS
Mr Etoe	CBI

Difficulty was encountered in arranging interviews with officials of the Science and Engineering Research Council (SERC). On two occasions interviews were arranged only to be cancelled at the last moment. On another occasion, a trip from London to Swindon proved somewhat disappointing when one of the interviewees was indisposed on arrival. This did not cause a major problem since the director of the Alvey programme, Brian Oakley, was an ex-Secretary of the SERC and a senior technical administrator from the SERC's Rutherford Appleton Laboratory also served in the Alvey directorate. Both of these people helped fill in some of the gaps regarding the SERC's involvement in the programme. As well as this, several senior industrialists and academics had served as chairmen or members of SERC committees and boards and had a broad knowledge of its operations. If the SERC was the source of some difficulty in the area of interviews, it was far more helpful in the literature search.

All of the directors of the Alvey directorate during 1986 were interviewed as was the ex-director of the VLSI programme, Dr Bill Fawcett. In the case of three of these officials, multiple follow-up interviews were held to test various hypotheses generated during the course of the study and to further monitor events which had developed during the course of the research programme. Of the nine executives (in one case, past executive) interviewed, four came from industry while the remainder had a public sector background. Their varied background, both specialist and generalist, and their detailed involvement with the programme made this a most rewarding source of information and for literature as well. As with the Department of Trade and Industry, the spread of interviews was conciously planned with the most important actors, the director and deputy director, in mind. Some of the private sector secondees were very reticent to put their views forward on some of the more contentious areas of questioning but proved valuable in explaining the technical structure of the programmes, reporting channels, and advisory support systems.

The most difficult sphere in which interviews were held was the core executive. This area, however, provided some of the most rewarding interviews. Two senior Cabinet Office officials and two Treasury officials (one of whom was retired but had been involved in the Alvey negotiations), gave an insight into the policy approval process that no-one from outside this closed world could provide. In all cases, the names of the interviewees were provided by other senior civil servants who had been involved in the policy process. Numerous attempts were made to interview the Prime Minister and the former Minister for Information Technology (currently Minister for Education and Science) Kenneth Baker. These proved fruitless.

Industrialists also proved a rich source of information. The first step in the private sector interviewing sequence was to draw up a list of firms who were active in the Alvey programme, taking care to include a broad cross-section of the industry. To this end, small firms, specialist firms such as software houses, and defence contracting firms, and the major information technology firms were identified. Additionally, interviews were arranged with the British chief executive of a major European electronics multi-national company and a retired managing director of a large industrial firm who had also been chairman of the National Enterprise Board. These interviewees provided an interesting contrast to those involved in the day-to-day activities of the Alvey programme. In most cases the private sector interviews were conducted with senior executives of the company division responsible for research and development, several of whom had been members of the Alvey committee of inquiry (including John Alvey after whom the programme was named). In two cases, GEC-Marconi and Ferranti, the chief executive of the company was familiar with the programme. Many of the other interviewees held the rank of director in some of Brtain's major information technology firms. In this bracket should be included a spokesman for the Confederation of British Industry who provided valuable insights into the Bide inquiry, an investigation into what should follow the Alvey programme. In the case of GEC and Plessey, the two biggest participants in the Alvey programme, interviews were held with two representatives of each company apart from their representatives seconded to the Alvey directorate.

Finally, interviews were held with five politicians (excluding Geoffrey Pattie), four journalists, eight academics, and a trade union spokesman. Dr Jeremy Bray of the Labour Party and Paddy Ashdown of the Liberal Party as party spokesmen on science and technology, gave valuable insights into alternative proposals for information technology as well as providing stimulating critiques of current Government policy. Other useful contributions came from Sir Ian Lloyd MP (Conservative), former chairman of the Parliamentary Information Technology Committee, and Stuart Randall MP (Labour). Generally the response from members of parliament was poor. Several did not answer requests for interviews, many prominent backbenchers such as Tam Dalyell (Labour), Michael Heseltine (Conservative), and Leon Brittan (Conservative) were 'too busy' and two, both Labour, made several appointments, cancelled at the last minute, and when firm appointments were finally fixed, failed to turn up.

All four journalists provided extremely valuable background information and, being privy to sources not normally available to research students, provided names of other potential interviewees, all of whom proved worthwhile. The academics interviewed ranged from senior administrators such as Sir James Lighthill, Rector of University College and author of the 1972 Lighthill report on Artificial Intelligence, Professor Roger Needham of Cambridge, a researcher and administrator, and Professor Eric Ash, Rector of Imperial College, to lecturers, participants in Alvey projects, critics, and post-graduate researchers. Finally, Mr Tim Webb of the Association of Scientific, Technical and Managerial Staff provided an important perspective from a group which was totally excluded from the decisional process, the trade union movement.

With all of the interviews, subjects were given guarantees that the interviews were non-attributable except in the case of the Minister, Geoffrey Pattie, who asked for and received no such undertaking. This was crucial to the success of the process as many of the disclosures made would not have been made without such a promise. Numerous interviewees made this point. Strong passions were aroused by this policy programme and these flowed over into the interviews. Some civil servants poured scorn on others for their organisational shortcomings, industrialists castigated the Alvey directorate, the civil service and academia, civil servants criticised industry, and sections of industry took sides against each other. Such was the feeling aroused that several interviewees shouted, thumped tables, and resorted to unseemly language.

Wherever possible, an attempt has been made to convey this feeling into the dissertation. For this reason, extensive use is made throughout of *verbatim* quotes, some of which contain strong language. It would be dishonest and censorious to attempt to paraphrase the statements that many of the interviewees made with such passion and intensity.

A variety of interviewing techniques were utilised during the course of the research. Representatives from different groups required slightly different 'treatment' as a general rule. Some of the public sector administrators, especially the less senior officials, required quite a deal of sympathetic coaxing to elicit responses. Senior civil servants, on the other hand, were remarkably open in most cases and surprisingly willing to critically analyse personalities and processes. Private sector industrialists were also very open and responsive. None of the answers to interview questions lend themselves to statistical analysis however. A deal of difficulty was encountered in obtaining financial information regarding the dissection of funds between the various technical programmes, and concerning how much companies and universities had received. This was eventually uncovered through other sources.

A diary was maintained during the two years of the research programme. This was used to record all interviews, telephone conversations, conferences attended and meetings attended. A log was also maintained of all questions which were outstanding and all outstanding interview requests. All interviewees were briefed in advance of the general topic areas to be covered and in four cases, a list of questions were supplied to the interviewee in advance. Interview questions were compiled on an interview guide and all interviews were tape recorded except in three cases. In these cases, only information noted during the interview has been quoted while other notes made immediately after the interview have been used as secondary references.

At first a complete transcript of each interview was typed on a word-processor. This proved extremely time consuming since some of the interviews ran for over one-and-a-half hours and transcripts ran to 35 pages (A4 single spacing). The method then adopted was to replay the tape and note points made using the timing mechanism on the tape recorder to indicate where the statements were on each tape. These points were retained under headings such as 'criticised Alvey directorate', 'praised collaboration' and so on. A complete list of these transcript notes were then cross-indexed under relevant headings such as company names, prominent actors names, technologies, and organisations on a word-processor. In this way a balanced analysis of interview results could be accessed rather than relying on one or two opinions which may not be representative. All tapes of interviews have been retained except in four cases where tapes were 'shredded' in the tape recorder when being replayed.

Overall, these interviews provided an original and critical source of information and used in a properly structured way, they can successfully constitute a reliable primary source.

Literature Search

Although some preliminary research was conducted in Australia, the bulk of the literature search was carried out in London. The most seminal source of Alvey-related literature has been the Alvey directorate. Since the Alvey directorate has a vested interest in publicising their programme, there is a tendency in this literature to take a pro-Alvey stance, emphasising successes and playing down failures. This presented something of a minefield for the researcher since it requires a closer analysis of what is not said in some circumstances, than of what is said. The directorate, in conjunction with the Institute of Electrical Engineers and the British Computer Society, publish a bi-monthly news-letter, *Alvey News*, as well as annual reports, annual poster supplements in which each of the individual projects are reviewed, strategy statements, programme supplements, workshop reports and the like. A complete set of all of these documents was collected as well as copies of the Alvey report (1982) and the recent Bide report (1986).

The Alvey directorate commissioned the Programme for Policy Research in Engineering Science and Technology (PREST) at the University of Manchester and the Science Policy Research Unit (SPRU) at the University of Sussex to conduct real-time evaluations of the Alvey programmes's operations. As well as these, a team from the Centre for Business Studies at the London Graduate School of Business School was to participate but disbanded after a short time. Of the forty-one publications relating to information technology produced from these three sources up to March 1987, twenty-one related specifically to Alvey. Copies of these were obtained from the SPRU library, from SPRU researchers who were interviewed, Alvey directorate staff, and off-prints of the PREST evaluations were also obtained. Most of the publications are evaluations of technical aspects of the Alvey programme or comparative evaluations of national information technology policies.

None are decisional studies, however, all provided useful background and information that proved useful in the interviewing process.

Information on opinions and views of the successes, failures, strengths, and weaknesses of the Alvey programme and the information technology sector generally were also found through the careful monitoring of *Information Technology and Public Policy*, and *The Journal of Industrial Economics* although, as with other Alvey-related articles, very few addressed the administrative, decisional or policy aspects of the programme. The 'popular' journals such as *Science, Datamation,* and *New Scientist* were carefully reviewed and they provided general coverage of key issues and events while *Electronics and Power*, the official journal of the Institute of Electrical Engineers offered insights into technical developments. The other prime source in the 'popular' field was the trade press. Detailed searches were made of *Computer News, Computing,* and *Computer Weekly*. While these covered similar areas to the popular journals, the coverage was not as useful or detailed as that of the journals. Occasional pamphlets and papers were published by relevant professional bodies and institutes. These were also reviewed.

Newspapers were another source of information. A key-word index search of *The Times* and related publications, *The Guardian*, and *Financial Times*, was conducted for the period 1981 to 1986 using the names of prominent actors such as Oakley, Alvey, Baker, Weinstock, GEC, and Plessey and terms such as information technology and research and development. Several important articles were brought to light using this method. Once a list of references was compiled, newspaper files or microfilm copies were then searched at the British Newspaper Library at Colindale. This was a very time consuming exercise which did not reward the efforts expended since, often the same stories appeared in various papers under different headings and many of the stories were simply ministerial press releases which said little about the Alvey programme.

A variety of position papers and policy statements regarding information technology and research and development were collected from the Labour, Conservative, and SDP/Liberal Alliance parties. A systematic search of *Hansard*, various Select Committee reports, and reports by other governmental and semi-governmental bodies such as the Advisory Committee on Research and Development, the Advisory Board for the Research Councils, and the National Economic Development Office and its Council was also undertaken. These all proved useful. A complete set of the SERC's annual reports from 1980-81 to 1985-86, corporate plans, and occasional reports were also collected. Numerous industrialists provided copies of company annual reports, press releases and other documentation of varying degrees of relevance.

By far the most interesting and most useful 'literature' collected was confidential in nature and provided directly by contacts within the various groups involved in the process. For example, one contact supplied a photocopied set of confidential memoranda addressed to the Department of Industry which provided invaluable information on the lead-up to the Alvey programme. Another example was a confidential staff review which exposed some of the weaknesses and problems with the organisation and running of the Alvey programme. Others supplied confidential financial accounts and on more than one occasion allowed departmental files to be read. Although these documents are not publicly available, they have been cited in the study because of the insights they offer to the analysis of this controversial policy programme.

Appendix B

List of Interviewees

Name	Position	Date of Interview
Brian Oakley	Director, Alvey Programme, member of the Alvey committee, ex-Secretary SERC	24/ 4/86 22/ 4/87 30/ 4/87
Sir Ian Lloyd MP	Chairman, Parliamentary IT C'tee	13/ 5/86
Prof. Eric Ash	Rector, Imperial College, Chairman of SERC after-Alvey inquiry, member of the Alvey Steering committee, chairman of the JOERS inquiry	22/ 5/86
Derek Roberts	Deputy Mg. Director (Tech.), GEC, member of Alvey committee, SERC committeeman author of the Roberts Report (SERC)	19/ 6/86
Darryl Hooper(dec.)	Director, GEC Hirst Research Centre, member SERC Microelectronics Sub-C'tee	19/ 6/86

Laurence Clarke	Deputy Director, Alvey Programme, past chairman of SERC Information Eng. C'tee, Asst. Technical Director (GEC), visiting professor in Computing Sc. Univ. College	24/ 6/86 13/ 5/87
Roger Hird	Director (Admin.), Alvey Programme	24/ 6/86
	senior DTI staffer on MAP Programme	22/ 4/87
David Talbot	Director (Soft. Eng.), Alvey Programme Strategy Manager for ICL mainframe systems in Product Marketing Div. (ICL)	24/ 6/86
Chris Barrow	Director (MMI), Alvey Programme head of Advanced Systems, Plessey Office Systems and member of ESPRIT Office Automation panel	24/ 6/86
Keith Bartlett	Director (I&C), Alvey Programme head of IT Standards unit, DTI ex-National Physical Laboratory	24/ 6/86

Rob Morland	Director (VLSI), Alvey Programme senior executive Lattice Logic and PA Technology	24/ 6/86
Dr David Thomas	Director (IKBS), Alvey Programme head of Technology Div. SERC, member SERC after-Alvey C'tee	24/ 6/86
Michael Marshall MP	Member, PITCOM	25/ 6/86
Sir Robert Telford	Chairman, Alvey Steering Committee chairman, GEC-Marconi and Life President of GEC-Marconi, Chairman of DTI's Elect. Applications Req. Board	27/ 6/86
Anton Poot	Managing Director, Philips (UK)	8/ 7/86
Sir Derek Alun-Jones	Managing Director, Ferranti and Chief Executive since 1975	8/ 7/86
Charles Haley	Member, Alvey Committee and director of product line planning, ICL	9/ 7/86

Dr David Stanley	Member, Alvey Working Group and Deputy Director, Logica	11/ 7/86
John Major	Member, Alvey Committee and Steering C'tee, Under-Sec. LA Division DTI	17/ 7/86
Clive Foxell	Chief Exec. (Procurement) and Director of British Telecom, chairman SERC Sub-C'tee on microelectronics	8/ 8/86
Dr L B Davies	Member, Alvey MMI C'tee (Pye-Unicam)	12/ 8/86
Mr J Horton	Acorn Computers	12/ 8/86
Mr J B Saunders	Director, Strategic Planning (Plessey)	13/ 8/86
Geoff Holmes	Member, Alvey Steering C'tee, member Bide committee, deputy chairman of Systems Designers Limited (SDL)	14/ 8/86

Hugh Metcalfe	Deputy Chief Executive, Operations, British Aerospace	19/ 8/86
Ivan Yates	Deputy Chief Executive, Engineering, British Aerospace	19/ 8/86
Peter Large	IT Editor, *The Guardian*	3/10/86
Dr Bill Fawcett	Director (VLSI), Alvey 1983-86, head of physics group at RSRE (MoD), visiting professor in electrical engineering at Univ. of Sheffield, director Thorn-EMI Protech research	6/10/86
David Fishlock	Science Editor, *Financial Times*	10/10/86
Prof.Roger Needham	Member, Alvey C'tee & Steering C'tee Director of Cambridge Computer Lab. pioneer of the Cambridge Ring network	17/10/86
Ms Mary Fagan	Journalist and IT feature writer *New Scientist*	23/10/86

Charles Blundell	Civil Servant attached to Minister's Office, DTI	23/10/86
Mr Colliver	Civil Servant (ex-Alvey secondee) DCVD, Ministry of Defence	24/10/86
John Alvey	Chairman, Alvey Committee, ex-chief scientist to the RAF 1977-80, deputy controller of all MoD research estab. Chief Exec. (Procurement) and Director of British Telecom	24/10/86
Dr Jill Hills	IT Author and Lecturer, City Univ.	4/11/86
Dr David Worsnip	SERC and Alvey Liason, SERC secretary of the SERC after-Alvey C'tee member of two Alvey VLSI committees	7/11/86
Alan Cox	Racal, Alvey secondee for 2 years	13/11/86

Paddy Ashdown MP	Liberal Party spokesman on IT	2/12/86
Prof. Frank Land	London Business School	5/12/86
Sir James Lighthill	Provost, University College 1979- author of the Lighthill report on artificial intelligence.	15/12/86
Dr Jeremy Bray MP	Labour Shadow Minister for IT ex-Minister and author	15/12/86
Dr John Hendry	Industrial historian and author London Business School	11/ 2/87
Sir Arthur Knight	Chairman, National Ent. Board 1979-80 chairman of Courtaulds 1975-79	12/ 2/87
Guy de Jonquieres	European Science Ed., *Fin. Times*	13/ 2/87

Tim Webb	National officer (ASTMS) and member of the IT economic dev. C'tee of NEDO	23/ 2/87
Geoffrey Pattie MP	Minister for IT 1985-87 and junior minister at MoD 1983-85	2/ 3/87
Dr John Bourn	Under-Sec. (MoD) and visiting professor in government at LSE	2/ 3/87
Stuart Randall MP	Member of PITCOM	3/ 3/87
Sir Ronald Mason	Chief Scientist (MoD) 1977-83, chairman of Hunting Engineering	6/ 3/87
Dr Keith Warren	Alvey Committee and Steering C'tee and Technical director of Plessey	9/ 3/87
Dr Tim Thorp	Chairman, Alvey CADC (RSRE - MoD)	11/ 3/87
W B Willott	Under-Secretary IT Division (DTI) member of the Alvey Steering C'tee	25/ 3/87

Dr Ian MacKintosh	IT Consultant and Author of *Sunrise Europe*, 'Father' of the RACE programme	25/ 3/87
Sir Robin Nicholson	Chief Scientific Advisor, Cab. Office (1983-85), Chair. ACOST Steering C'Tee Central Policy Rev. Staff 1981-83	26/ 3/87
Dr Mike Hobday	IT Researcher, SPRU (Sussex U.)	10/ 6/87
Dr Kevin Morgan	IT Researcher, SPRU (Sussex U.)	10/ 6/87
Owen Etoe	IT Spokesman, CBI	12/ 6/87
Alastair Macdonald	Deputy-Secretary, DTI, member of the Alvey Committee	30/ 6/87 13/10/87
Geoffrey White	Economist, Treasury (1985-) and DTI	11/ 9/87
Arnold Lovell	Former Under-Sec. (Treasury) to 1985	17/ 9/87
Brian Unwin	Permanent Head (Customs and Excise) 1987 ex-Deputy-Secretary and head of the IT Unit (Cabinet Office (1985-87), ex-Dep.-Secretary (Treasury) (1983-85)	6/10/87

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