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The effects of new information technology on the less-favoured regions of the Community

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The effects of new information technology on the less-favoured regions of the Community

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PREFACE

This report is based upon a study commissioned by the Directorate-General for Regional Policy of the Commission of the European Communities. The study had three main objectives:

1. To provide a statement of the existing distribution of new information technology within the regions of Europe, including the influence of Community policies on this distribution, and to make a reasoned assessment of the impact of these technologies on the less-favoured and particularly the peripheral regions.

2. To provide guidelines that the Commission might follow in the formulation and execution of Community policy in the field of new information technology in order to take account of the specific problems of the less-favoured regions of the Community.

3. To put forward proposals on what measures might be taken in relation to new information technology for the Community's regional policy especially the non-quota section of the European Regional Development Fund (ERDF).

The study commenced in February 1982 and was completed in November 1983. It was directed and co-ordinated by the Centre for Urban and Regional Development Studies (CURDS) at the University of Newcastle-upon-Tyne, UK. The study comprises work undertaken by experts and consultants in the Member States, as well as by CURDS, and was divided into three phases of work.

Phase I of the study examined the infrastructure of New Information Technology (NIT) in each country, the manufacture of NIT, and its applications within user sectors such as manufacturing, services and agriculture. Particular attention was paid to the regional aspects of NIT. Also reviewed were existing Community and national policies towards NIT. The findings from this phase of the work, drawn together into a report which attempted to provide a European-wide synthesis, were submitted to the Commission in October 1982.

Phase II of the study went on to examine the impact of NIT and its potential contribution to the development of selected less-favoured regions of the Community. Case studies were undertaken in Greece, Italy, Ireland, France and the United Kingdom, with regions selected within them so as to represent regional problem types and potentialities ranging from relatively under-developed agricultural regions to regions undergoing major industrial decline. An additional case study was undertaken to explore telecommunications tariff variations between European regions. The findings of Phase II of the project were submitted in report form to the Commission in October 1983.

Phase III of the project involved providing policy options and recommendations for the Commission (i.e. objectives 2 and 3 above). These were presented in the project final report (November 1983), which also summarised the findings of the previous phases of the project. The current report is based upon the material generated in Phases I and II of the project - it is concerned with the present and likely future impact of new information technology on the less-favoured and particularly the peripheral regions of the Community.

The experts who contributed to the study are indicated below:

Expert	Contribution
'Prognos', Basle.	- Provision of technical advice to CURDS and review of NIT impacts in France and Germany (Phase I).
Professor C. Antonelli, University of Turin.	- Review of NIT impacts in Italy (Phase I and II).
Dr. A Foley, N I H E, Dublin and Mr. N. Marshall, University of Birmingham	- Review of NIT impacts in Ireland (Phase I). - Case Studies of Mid West and North East Regions of the Republic and the border Region of Northern Ireland (Phase II).

Communication Studies and Planning Ltd., London.	- Review of NIT developments in Denmark, Netherlands, Belgium and Luxembourg, and assistance to CURDS in connection with the review of the UK situation (Phase I). - Telecommunication tariffs variation study, in collaboration with CURDS (Phase II).
Centre for Planning and Economic Research, Athens	- Review of NIT impacts in Greece (Phase I). - Case Studies of Heraklion, Crete and Salonika, Macedonia (Phase II).
Dr. L. Gille, IDATE, Montpellier.	- Case Study of Languedoc - Roussillon region (Phase II).
Dr. P.M. Mura, University of Reggio Calabria.	- Case Study of Reggio Calabria, Calabria and Catania, Sicily (Phase II).

All other work including the UK Phase I Report, Phase I Synthesis Report, UK Phase II Case Study (Northern Region of England), Phase II Synthesis Report, Phase III Final Report and the present Research Series Report have been undertaken by CURDS.

Acknowledgement

We would like to thank Mrs Olive Teasdale of the Drawing Office, Department of Geography at Newcastle University for her help in re-drawing a number of the maps and diagrams for publication.

CHAPTER ONE

INTRODUCTION

New Information Technology (NIT) is developing rapidly and consequently its definition is still fluid. In a broad sense, the term comprises the use of modern technology for the collection, storage, processing and transmission of information in digital form and covers a broad field of mechanisms, equipment, capabilities and technologies (See Table 1.1). The core area embodied by the term is the coming together of advanced, high-speed telecommunications with the enhanced and more flexible computing powers made possible by the microprocessor. Progress in the new technologies has led in the telecommunication field to the creation of multiple new services, such as teletex (remote printing of texts), videotex (data base interrogation), telefax (facsimile document transfer), and in the field of microprocessor applications, to the development of new products such as programmable robots, word processors and mini- and micro-computers.

New Information Technology affects, directly and indirectly, a very broad spectrum of economic activities and agents : private enterprises and public administrations, industry and services, hardware and software, production and consumption. Changes brought about by the new information technologies are becoming a major factor influencing economic development in the Community and their role will continue to increase in the future. These new technologies will clearly have a differential impact on the various regions in terms of employment, output and productivity. Furthermore, the fundamental question arises whether they will strengthen geographical concentration of activities and population or, on the contrary, encourage decentralisation and deglomeration.

1.1 Approaches to impact analysis

Any attempt to assess the impact of developments in information technology must take account of its very wide range of applications; it will affect what goods and services are produced and how they are produced and delivered. In employment terms it will therefore affect the industries in which people work (i.e. production classification of employment) and their

Table 1.1 : Field Covered by Information Technology

Functions	Mechanism	Equipment	Capability	Technology
1. Acquisition or input of information	- Signal and Image Processing - Sensing	- Sensors - visual, Tactile, Thermal. - Speech Recognition - Word Processors - Work Stations etc. - Videotex	- Handling of complex data at high speed	- Optoelectronics - High Speed low power consumption IC's - Intelligent Parallel processing and software
2. Transmission of Information	- Wide Band Transparent Networks Local Area - Networks	- Electronic Digital Exchanges - Optical Fibre Links - Satellite Links	- Secure High Speed Transmission	- Low cost low power digital IC's - Optoelectronics - Reliable microelectronic Components - Software
3. Storage of Information	- Data Base Management Systems - Knowledge Base Management Systems	- SC memories - Magnetic discs - Optical discs	- Contents addressable - Easy to access with unstructured requests	- Advanced software - High speed logic circuits - Magnetic - Optical
4. Processing and Analysis of Information	Intelligent systems that analyse and recommend decisions based on knowledge	- Data flow machines - Inference machines - Multipressor machines	Ability to handle text, data, voice, or image and interface with the non expert user on a basis of equality	- New architectures - Advanced software - High speed logic circuits - Optical circuits
5. Derivation of consequential management systems	- High definition display systems for data, text and images - Speech generation	- Work Stations - Flat Panel Displays	Recognition of the fact that the man and machine will be intelligent partners in operation of the systems	- Intelligent processing - Advanced software - Low cost complex digital circuits - Optoelectronics

In each of the above functions there must be provision for the interchange of information between the human and the machine when the functional tasks are shared through adequate communication channels and language translators.

Source : IT-NEWS - Edition 12, 20 May 1983 - An internal publication of the Information Technologies Task Force of the Commission.

occupations (i.e. process classification of employment). Some effects will be positive in job terms, others negative.

Figure 1.1 is an example of such a matrix of possible job gains and losses associated with microelectronics (Pastre et al, 1981)[1]. It suggests that certain occupations (e.g. secretarial occupations) are particularly vulnerable to displacement because they are largely involved with information processing, an area where NIT offers considerable scope for productivity gain. It also suggests that such information occupations occur in all sectors of the economy; as a result their future will be influenced not only by their own productivity but by the success of the particular sectors in which they are found. Thus while the future of particular occupations can to some degree be anticipated, the interaction of occupational and sectoral effects is much more difficult to ascertain.

In reality of course, these changes occur in particular places, with job creation and job displacement being indissolubly linked. For example, in localities where industries fail to introduce new products and processes, jobs will be lost indirectly to industries in competing areas which are able to produce existing products at lower prices or provide more attractive competing products. Such sectorally based job losses may be greater than those resulting from the direct displacement effects on particular occupations of introducing new process technology.

As the EEC's FAST team have argued:

> "The implications of rejecting IT are doubly negative. Loss of competitiveness (and eventually the job 'defended') and lost opportunities for job creation elsewhere... The absolute job creation potential of a technology can never be measured even with hindsight and a fortiori when it so profoundly affects economic activities. It is therefore more useful to concentrate upon the adaptive efforts

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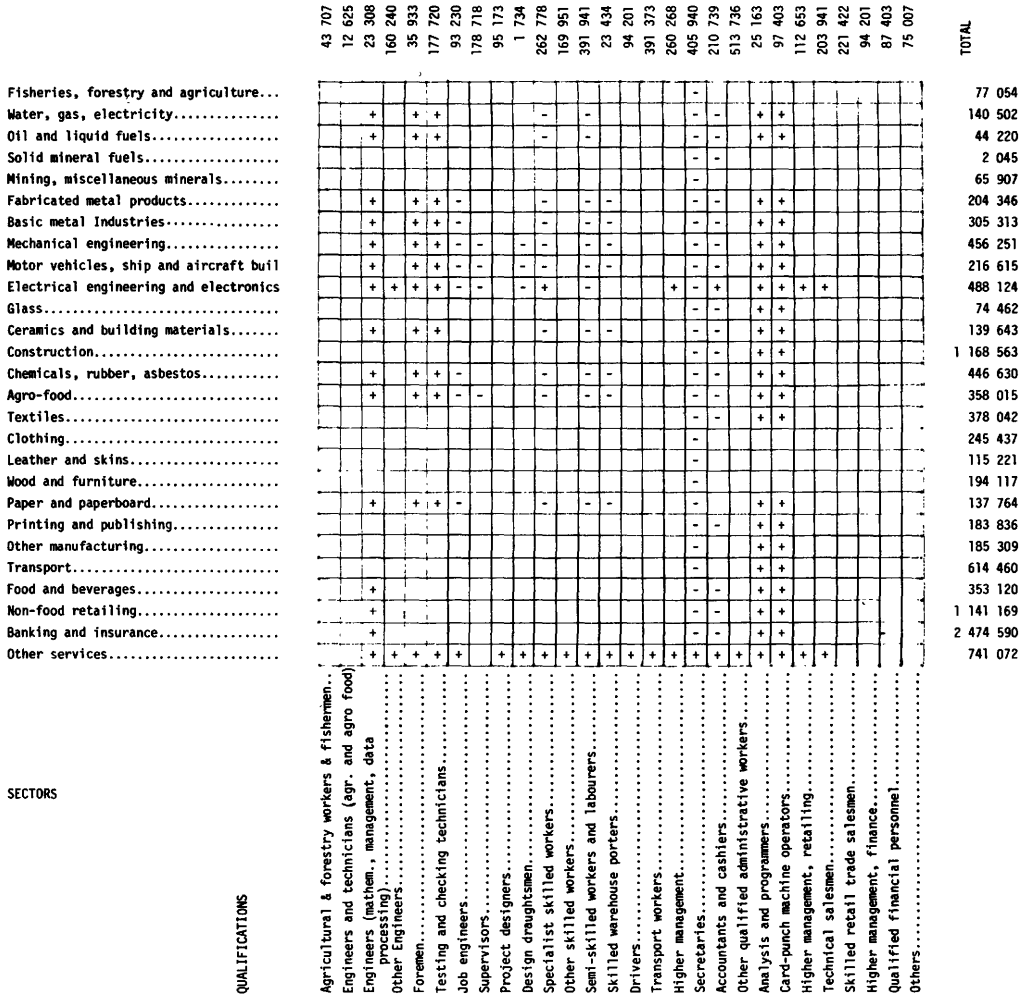
1. O. Pastre et al (1981) "L'impact de l'information sur l'emploi en France a l'horizon 1985 in Informatisation et Emploi : Menace ou Mutation". Documentation Francaise, Paris.

Fig. 1.1 : Projected impact of microelectronics, France



Key : + foreseeable increase in employment
- foreseeable decrease in employment

Source : Pastre et al., 1981.

necessary within the whole economy to realise the potential of the technology and thus promote full employment in Europe."[2]

This reads like an agenda for regional policy, for the adaptive effort required will be much greater in some regions than in others, and the nature of this adaptive effort will be deeply conditioned by the structure of Europe's cities and regions.

1.2 Peripherality, new information technology and the less-favoured regions of Europe

The context within which the present study has been commissioned is one of growing regional economic disparities in Europe; in the 1970s the more prosperous regions increased their national domestic products at a faster rate than the less prosperous regions, and the gap between them consequently widened. At this European scale, a clear association exists between peripherality and relatively low incomes per head (Keeble, 1981; Table 1.2). Not only do the core regions of the Community possess more dynamic and buoyant economies, but for a variety of structural reasons they seem likely to derive the main benefit from the new information technologies, thereby further increasing the gulf between Europe's prosperous core areas and its less-favoured periphery.

Such structural reasons include their existing greater specialisation in higher technologies, their concentration of decision-making units and research and development capabilities, market concentration, better levels of education, and greater degree of economic integration. In this sense then, new information technology developments could be like many others which have served to perpetuate and reinforce economic disparities between European regions.

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2. EEC-FAST B2 'Information Technology and job creation potential', Brussels, 1982.

Table 1.2 : Aggregate Regional GDP per Employee, 1973-1977

	1973		1977		1973-77	
	EUAs per empl.	INDEX (EEC=100)	EUAs per empl.	INDEX (EEC=100)	EUAs per empl.	CHANGE (%)
Central Regions (35)	10,563.8	118.8	17,146.5	122.1	+6,582.7	+ 62.3
Intermediate Regions (39)	8,250.5	92.9	12,844.3	91.5	+4,593.8	+ 55.7
Peripheral Regions (31*)	7,252.3	81.6	11,172.0	79.6	+3,919.7	+ 54.0
TOTAL EEC9 Regions (105)	8,885.8	100.0	14,039.9	100.0	+5,154.1	+ 58.0

Based on : LFS data from Eurostat

* includes single value for Danmark

Source : Keeble

In one very important respect, however, new information technologies are different from those that have gone before and offer different possibilities. One of the characteristics of peripheral and less-advantaged regions is their poor information environment; being remotely located in relation to the centres of economic progress imposes constraints upon their access to information; information, for example, on markets, or contracts, or patents, or new technologies, or new forms of organising business. As the pace of economic change increases, societies in the developed world are becoming increasingly dependent upon information as the key economic resource - indeed, many commentators would argue that the 'information society' is already with us. Certainly, information activities have expanded very rapidly in the post-war period and now employ approximately one-third of the workforces of advanced western nations (OECD, 1981). We can reasonably argue that regions which are weakly integrated into the information society, or are weakly linked with the centres of information generation and dissemination, are increasingly going to become disadvantaged in terms of their ability to share in technological and wealth-creating organisational advances.

New information technology, however, holds out considerable potential for peripheral regions to become better integrated with core regions, and for their 'information environments' to become enriched by this integration. Our emphasis in this study is not information technology per se but the uses and application of information and knowledge which the technology can facilitate. Consequently we focus more upon the uses of NIT and how these will be regionally differentiated than we do upon the actual production of NIT itself; for it is in the explicitly 'distance-shrinking' application of NIT that the transformation of core/periphery relationships is made possible, and considerable opportunities are afforded for the economic development of Europe's less-favoured periphery. The role of physical resource endowments in limiting or creating a region's development potential has declined markedly over time; increasingly the key to development is access to information coupled with the existence of economic and organisational structures which are able to assimilate and apply the information. Information technology can prove considerably access to information and economic integration in the wider sense, but this potential can only be realised if the appropriate institutional and organisational structures are in place or can be encouraged to grow. Any regional policies then that are directed towards new information technology need to

be framed within the context of a region's strengths and weaknesses, and seen as a way of facilitating a region's achievement of its development potential. As we will demonstrate in the following chapters, this potential, and the economic sectors upon which it is based, vary considerably between different types of region.

1.3 Organisation of the report

The present report begins by reviewing the developments in telecommunications, which can in many ways be regarded as the basic infrastructure for the application of NIT. Chapter 2 contrasts the experience of European member states in their attempts to modernise telecommunication systems and to provide new services. Chapter 3 goes on to consider regional variations in telecommunications infrastructure provision and in the level of demand for telecommunication services. Chapter 4 explores in more detail one of the important issues to emerge from this review with respect to the less-favoured regions of Europe, namely the extent to which the structure of telecommunications tariffs serve to disadvantage peripherally-located regions.

In Chapter 5, the focus shifts away from telecommunications to the actual production of NIT. The most obvious job-creating effects of NIT are in the manufacture of NIT products and in the software activities upon which the products and subsequent applications are dependent. The chapter reviews the evidence on the location of NIT production, distinguishing as far as possible between hardware and software activities.

Chapter 6 moves on to consider the use of NIT. The generic nature of the technologies results in their very wide-ranging applications across industrial sectors. The chapter reviews in turn the present and likely future use of NIT in the agricultural, manufacturing and service sectors of the economy. In each case, our emphasis is upon the geographical dimension to any differentials between enterprises in their use of NIT or in the impacts of use upon organisation, employment, etc.

Chapter 7 then takes a number of specific regional case-studies to demonstrate the varying impact NIT is having and the varying potential it offers to less-favoured regions.

Finally, Chapter 8 raises a number of policy issues arising from the study. It concludes that there is a need to introduce an explicit dimension into the Community's regional policy if the benefits of NIT are not to be concentrated in the most prosperous core regions of Europe.

CHAPTER TWO

TELECOMMUNICATIONS : THE INFRASTRUCTURE FOR NEW INFORMATION TECHNOLOGY

2.1 Introduction

The transition from the industrial to the post-industrial society is, according to Bell (1974), characterised by the fact that information and knowledge are becoming the dominant factors of production. The access to and ability to use information are increasingly becoming dependent on ever more efficient systems of information and communication. Those societies which succeed better or faster than others in modernising their communicative (or informational) infrastructure, are going to attain vital advantages in international competition. Although this infrastructure is a permissive factor in economic development (i.e. it is a necessary but not sufficient condition for the latter), any shortcomings in national or regional infrastructure relative to others may inhibit the economic development prospects of the territory concerned.

This factor is particularly important at the present time of rapidly increasing demand for telecommunication services. To meet this demand, there is a need for telecommunication systems which can support a wide range of evolving facilities and services:

- Highly reliable telephonic communication with extended facilities (e.g. autodialling, store-and-forward voice).
- High and very high speed data communications.
- Electronic mail (Teletex).
- High speed electronic transfer of diagrams/documents (Telefax).
- Information broadcasting (Teletext).
- Interactive information transmission systems (Videotex).
- Instantaneous moving picture transmission (Videophone).

These services could eventually be provided through a single Integrated Services Digital Network (ISDN), avoiding the plethora of separate networks

and network attachments. Expert opinion would suggest the development of a wide-band, high-speed, end-to-end digital network to be highly desirable if efficient, low-cost services of the type outlined above are to be provided.

While it is clearly desirable to develop optimal systems which will fully satisfy projected future demands for telecommunications, the present systems and the past investment decisions they embody impose considerable constraints upon the freedom of action of telecommunications administrations (PTTs). Because of the large amounts of undepreciated capital tied up in present systems, PTTs are unable or unwilling to replace them over short periods of time. The almost inevitable result of such constraints is to encourage strategies whereby long-term goals are approached incrementally, through the maximisation of performance of current systems, phased infrastructure replacement programmes, the gradual development of new overlay networks possessing interfaces with the old networks, and so on. As we will see later, these long-term modernisation programmes may vary in their impact between countries and within countries, with the result that variations exist in the range and quality of services offered in particular locations and particular times. Additionally, the sheer size of investment required to modernise telecommunications infrastructure[1] means that balance-of-payments and domestic industrial technology policy issues will frequently impinge upon investment decision-making.

The interconnection between telecommunications infrastructure and economic development potential has been recognised by political authorities and the national PTTs in each of the EEC countries; accordingly, each nation plans an accelerated development of telecommunications systems. Divergencies exist among the EEC countries mainly with respect to:

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1. In the case of the UK, for example, Cripps and Godley (1978) estimate that telecommunications investment averaged around £700m annually over the period 1963-78, a figure equal to about 20% of total manufacturing investment. In 1983, British Telecom spent just under £2bn on new plant and equipment. **(Meegan, 1982)**

-The state of development of telecommunications achieved so far.
-The future strategies for further development and modernisation (network extension and the introduction of new services).
-The political/legal conditions prevailing (scope of PTT monopoly, regulations, etc.).

Below we consider in turn each of these aspects of variation at the national level.

2.2 The present level of development of telecommunications

The telephone remains by far the most important telecommunication service to both business and domestic customers. As a means of information provision, gathering and exchange it is obviously essential to businesses, but it is also becoming a consumer necessity as living standards and expectations rise. Considerable variations exist between countries in their ability to provide the infrastructure (both the network infrastructure and the installation of telephones) to meet the demand for telephonic services. As Table 2.1 shows, France and Ireland have for sustained periods of time been unable to meet the demand for new telephone connections. In the French case, a major drive to install new infrastructure has subsequently reduced the waiting lists, but in Ireland the waiting lists grew steadily through the 1970s and stood at 20% of installed lines by 1981 (Foster et al, 1981).

Variations between countries in the present state of telecommunications development, incorporating both supply and demand elements, can be seen in Table 2.2. This shows the 1981 level of penetration of telephones, telex machines, data network terminating points and data terminals, each standardised by population. In terms of the number of telephone lines per 100 inhabitants, Denmark with 45 has by far the highest level in Europe. The Netherlands, Germany and the UK have penetration levels in the 33-34 range, France has 30, and Belgium, Greece, Italy and Ireland display the lowest levels, all with fewer than 25 lines per 100 inhabitants.

Table 2.1

Telephone Waiting List (Applicants as % of exchange lines) in Selected Countries in the EEC

Year	Belgium	France	Germany	Ireland	Italy	Nether-lands	U.K.
1968	0.6	8.7	3.5	2.9	2.3	6.2	1.1
1969	0.5	8.1	4.4	3.5	2.9	6.0	1.3
1970	0.5	8.5	6.8	4.9	3.0	6.4	1.3
1971	0.5	10.0	6.3	7.0	3.7	5.2	2.2
1972	0.5	13.1	3.6	9.8	3.3	3.8	1.8
1973	0.9	13.1	2.0	12.0	2.4	3.8	0.9
1974	1.2	15.3	0.7	13.4	4.4	4.0	0.8
1975	1.0	11.5	0.4	12.9	2.1	4.3	0.4
1976	1.0	11.7	0.6	11.2	2.8	4.9	0.3
1977	0.9	10.5	0.6	11.3	n.a.	5.0	0.7
1978	n.a.	n.a.	n.a.	15.3	n.a.	n.a.	n.a.
1979	n.a.	n.a.	n.a.	18.4	n.a.	n.a.	n.a.

n.a. = not available

Sources: International Telecommunications Union; Department of Posts & Telegraphs - in Foster, Segal, Durgan and Dewar (1981)

Table 2.2 Levels of Telecommunication penetration in member states 1981

(a)	(b)	(c)	(d)	(e)	(f)
	Telephone lines/100 inhabitants	Telephone sets/100 inhabitants	Telex machine/100 inhabitants	NTPS/100 inhabitants	Terminals /100 inhabitants
U.K.	33.1	50.1	0.16	0.21	0.33
Germany	33.9	46.4	0.225	0.10	0.16
Netherlands	34.4	50.9	0.23	0.12	0.18
Belgium	24.8	36.7	0.21	0.09	0.23
Denmark	44.7	67.4	0.20	0.24	0.41
France	29.5	N/A	0.16	0.10	0.15
Ireland	20.9	N/A	0.15	0.03	0.03
Italy	22.8	33.7	N/A	0.08	0.11
Greece	30.4	28.1	0.15	0.007	0.009

Source: Columns b,c, & d National Reports

Coulmns e & f Eurodata Reports (1980)

Telephone penetration levels are of course heavily dependent upon domestic users; a better indication of the state of supply and demand for business telecommunications can be gained by examining telex connections and data Network Terminating Points (NTPs). Italy is seen to be particularly low with respect to telex connections, while Greece and Ireland are deficient with respect to NTPs and data terminals, indicating low levels of data communication and limited potential for data base searching. The extent of national variations in data communication equipment penetration levels is considerably wider than for either telephone or telex connections. While data NTPs are expected to grow rapidly in all countries, it seems certain that without considerably greater investment levels Greece and Ireland will continue to lag far behind other countries, even if high growth rates are attained. In the following section, the rapidly changing situation with respect to telecommunications networks and services in Europe is summarised.

2.3 The modernisation and future development of telecommunications in Europe

2.3.1 Digitalisation

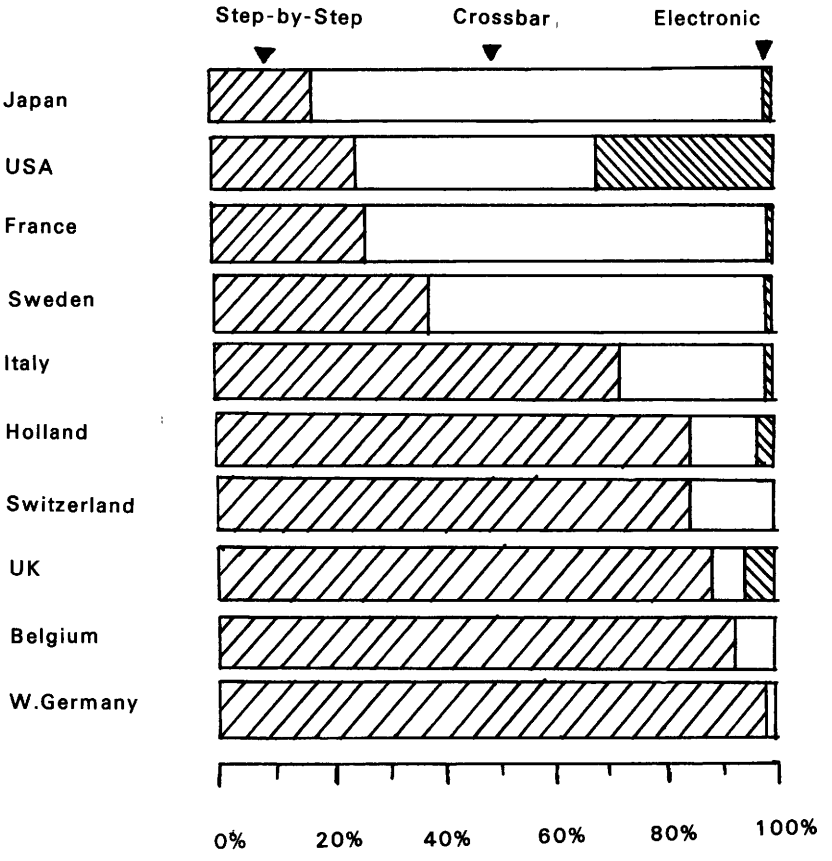
Within the network sector, the main issue is the modernisation of existing networks through the digitalisation of transmission and switching technologies. The history of telephone communication has seen a shift from manual telephone exchanges to automatic ones, based first of all on electro-mechanical technology, and then on successive applications of electronics technology. The basic purpose of these different pieces of equipment is to allow the connection of pairs of telephone lines ("switching") having first checked all possible permutations within the network ("route selection"). Cripps and Godley (1978) provide a description of why new electronic technologies are such an important development within telecommunications:

"The essential feature of the new approach is what is called 'digital' transmission and switching... It means that messages are transformed into the binary code used by computers; all communications - whether signals, speed, numbers or pictures - are coded into strings of ones and noughts. These strings of digits, represented in the form of high-speed pulses, are handled by 'solid state' devices which, since they contain no moving parts at all, can sort and process digital strings at incredibly high speeds.

...It is not merely that solid state devices can process messages at enormous speed; the whole logical structure of the network, and the types of use which may be made of it, come up for question. Previous techniques have transmitted communications in the form of signals which were direct analogues of sound waves, a procedure which is convenient enough for telephone conversation, but which requires conversion of coded messages into the equivalent of pulses of sound. In a digital system, coded messages can be communicated more directly than before, but telephone conversation has to be decomposed into exceedingly long strings of digits. A digital system thus offers a much greater improvement of efficiency for coded messages than it does for telephone conversation. Digital networks will offer huge message-carrying capabilities; if they are used intensively, individual coded messages could be communicated at extremely low cost, making telephone conversation relatively expensive in comparison" (Cripps and Godley, 1978, p 35).

Today, telecommunications finds itself in the middle of a transition process from analogue to digital technology, a process of massive dimensions that will take decades to complete. In Europe, the PTTs have decided to build up digital transmission networks during the 1980s, firstly adopting digital technology for trunk connections and then gradually installing digital exchanges. Some idea of the extent of the task can be gained from Fig.2.1, which shows for a range of advanced countries the percentage of connections on different types of switching system in 1976. Of the six EEC countries shown, five had more than three-quarters of their total connections made by Strowger exchanges, which were invented in the

FIG.2.1 PERCENTAGE OF CONNECTIONS ON MODERN SWITCHING SYSTEMS, 1976



Source: POEU (1979)

nineteenth-century. By 1981, first-generation electronic exchanges were becoming well-established (accounting for 18%, 31% and 22% of the respective UK, Netherlands and Belgium totals).[1] However, in one sense the older systems offer greater opportunities as they are frequently fully depreciated and form no barrier to investment; more problematic are the undepreciated systems of outdated technology introduced in recent phases of investment, such has occurred in southern Italy (see 3.1 below).
Advanced, fully electronic exchanges have only recently passed beyond their experimental stages to become part of planned investment strategies. There are therefore only a few currently operating in each country; in 1982 for example there were only two such exchanges in Italy, three in Ireland and three in the UK (Project National Reports, 1983). In the area of investment, however, there is considerable unanimity in objective, and each country has plans over the remainder of the century to bring about a transition from existing switching mechanisms to advanced electronic exchanges.

Less certainty is evident in the European-wide pattern of modernisation and development of transmission media. The potential of digital electronic exchanges for handling vastly increased amounts of spoken and manuscript data is being strengthened by parallel developments in technologies designed to increase the traffic carrying capacity of transmission lines. According to Branscomb (1976), the shift from paired cable to microwave, coaxial and wave guide transmission, while not involving any radical change in cost per mile, dramatically increases the band width or traffic carrying capability (Meegan, 1982). The most dramatic increase in transmission capacity, however, is that currently offered by developments in fibre-optic technology. Crisp (1981) argues that "optical fibres can seem as miraculous as the micro-chip in whose wake they follow. Tiny strands of very pure glass as thin as human hair can carry up to 8,000 simultaneous

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1. NB The electronic exchanges shown in fig 2.1 are the first generation of electronic exchanges which evolved from the electro-mechanical crossbar switches. See Cripps and Godley (1978) for a description of the different types of telephone exchanges.

telephone calls in a core just 1/200ths of a millimetre across". Meegan (1982) outlines how, because of technical developments in the quality of glassware in the early 1970s, "it is now possible, using a laser (or light emitting diode) to transmit light in binary code through 'optical fibres'. Spoken and written messages and television pictures can be relayed literally at the speed of light through these fibres and the use of 'time division multiplexing' (the filling of gaps in voice/data transmission with other voice/data messages) combines to mean a huge increase in traffic carrying capacity - by a factor eventually approaching 1000" (p 8). Unsurprisingly given these qualities, the use of fibre-optic technology is being investigated by a number of European countries (as well as by AT & T in the United States and also in Japan). The German PTT runs lines in Berlin and Frankfurt and put four more into operation in 1981/82, while the UK plans to replace their metallic telephone trunks by fibre-optic cables. The optic fibre network in the UK is expected to expand considerably with the introduction of a rival network - Project Mercury - in 1984 (See Section 2.4 below), and fibre optics have also been given priority in French modernisation plans.

While it is then fairly safe to presume that at the trunk level copper cables will be replaced by optic fibres in the foreseeable future, far less certain is if and when individual subscribers in Europe will be connected by a fibre optic loop. This depends very much on the development of prices and field engineering technology, and on the user demand for services requiring high speed and bandwidth (e.g. the video-telephone). But there are experiments in this direction, too. For example, the German PTT announced in 1981 that they were to establish a broadband integrated fibre optic local network (BIGFON) available in seven large cities in Germany for a test with several hundred users. A local wide-band network is also being set up in Biarritz (France). These initial experiments notwithstanding, it is obvious that integrated services digital networks (ISDN) for domestic users are not in sight except in the very long term.

A further transmission technology with increasing application is Satellite, which is currently used in international and particularly inter-continental communications. France launched Telecom 1 in 1983 and both the UK and the

Netherlands are contemplating the use of satellite communications to provide additional services to particular (specialist) users for transitional periods whilst digital terrestrial networks are developed and extended. One of the main attractions of satellite telecommunication systems is that they make possible digital end-to-end services, with the avoidance of the digital-analogue digital signal conversion being particularly advantageous for high-speed remote processing and data transfer. This facility, coupled with the globe-spanning potential of satellite linkages, has also attracted the interest of the largest global corporations, who generate sufficient traffic to warrant investment in their own private satellite telecommunication systems.

2.3.2 The development of data communication networks

With the growing importance of electronic data processing, data communications too are growing rapidly in importance. Estimates by the EUROPA Foundation (1980) suggest that the number of data network termination points in Western Europe will grow by a factor of 4.1 from almost 400,000 in 1979 to 1.6 million by 1987, while the number of transactions/day and bits transmitted/day will grow even faster, by factors of 5.5 and 7.1 respectively. Existing networks are no longer able to meet these requirements, particularly with respect to transmission speeds, and new data networks are being built up.

In the 1960s, the first decade of teleprocessing, remote job-entry stations began to emerge as a use pattern and data communication services were made available on European public switched telephone networks (PSTN). As Table 2.3 suggests, there was a five-year lag between the facility becoming available in France, Belgium and Luxembourg and its introduction into the less prosperous nations of Greece and Ireland. Similar lags are apparent with respect to faster data transmission rates becoming available on the PSTNs (Table 2.3). However, it becomes meaningless to compare nations solely on the basis of their PSTN data transmission characteristics, for alternative 'dedicated' switched data networks are established or are

Table 2.3 Year of introduction of data transmission services on the Public Switched Telephone Network (PSTN) of each country.

Country	Low speed	Faster speeds 2400b/s	19200b/s
U.K.	1966	1973	1975
Germany	1968	1972	N/A
France	1965	1977	1983
Netherlands	1967	1978	1985
Belgium	1965	1974	N/A
Luxembourg	1965	1974	1981
Ireland	1970	1976	N/A
Italy	1969	1973	1984
Greece	1970	1970	1984
Denmark	1968	1975	1981

N/A : Data not available

Source : Eurodata Report Vol. 4 (1980)

Table 2.4 Year of introduction of data transmission services on Circuit Switched Data Networks (CSDN) and Packet Switched Data Networks (PSDN)

Country	CSDN	PSDN
U.K.	1986	1982
Germany	1976	1982
France	1973	1980
Netherlands	1986	1982
Belgium	1983	1982
Luxembourg	N/A	1982
Ireland	1984	1983
Italy	1984	1984
Greece	1984	1984
Denmark	1981	1984

N/A : Data not available

Source : Eurodata Reports Vol. 4
Services & Tariff Scenario. 1980.

becoming established in all EEC nations. These networks, which are either Circuit-Switched or Packet-Switched,[1] are designed specifically to carry data traffic; they consequently substantially reduce error rates, and the much faster speeds attainable on these dedicated networks both reduces the cost per bit of data transmitted and makes possible data processing applications which are impractical at lower speeds. Another major advantage of these specialised networks is their much reduced call-connect times.

Table 2.4 indicates that in the provision of systems dedicated to data transfer, France has been in advance of the majority of other European nations in offering a choice of networks to French industry and commerce. At the other extreme, Italy and Greece are currently only able to offer data communication on the PSTN, at relatively low speeds. However all countries are committed to introducing at least one dedicated network for data transmission by 1986. An important impetus for technical harmonisation in Europe with respect to packet-switched networks has been provided by EURONET, an international data transmission network set up with financial support from the EEC and with the co-operation of national PTTs (Figure 2.2).

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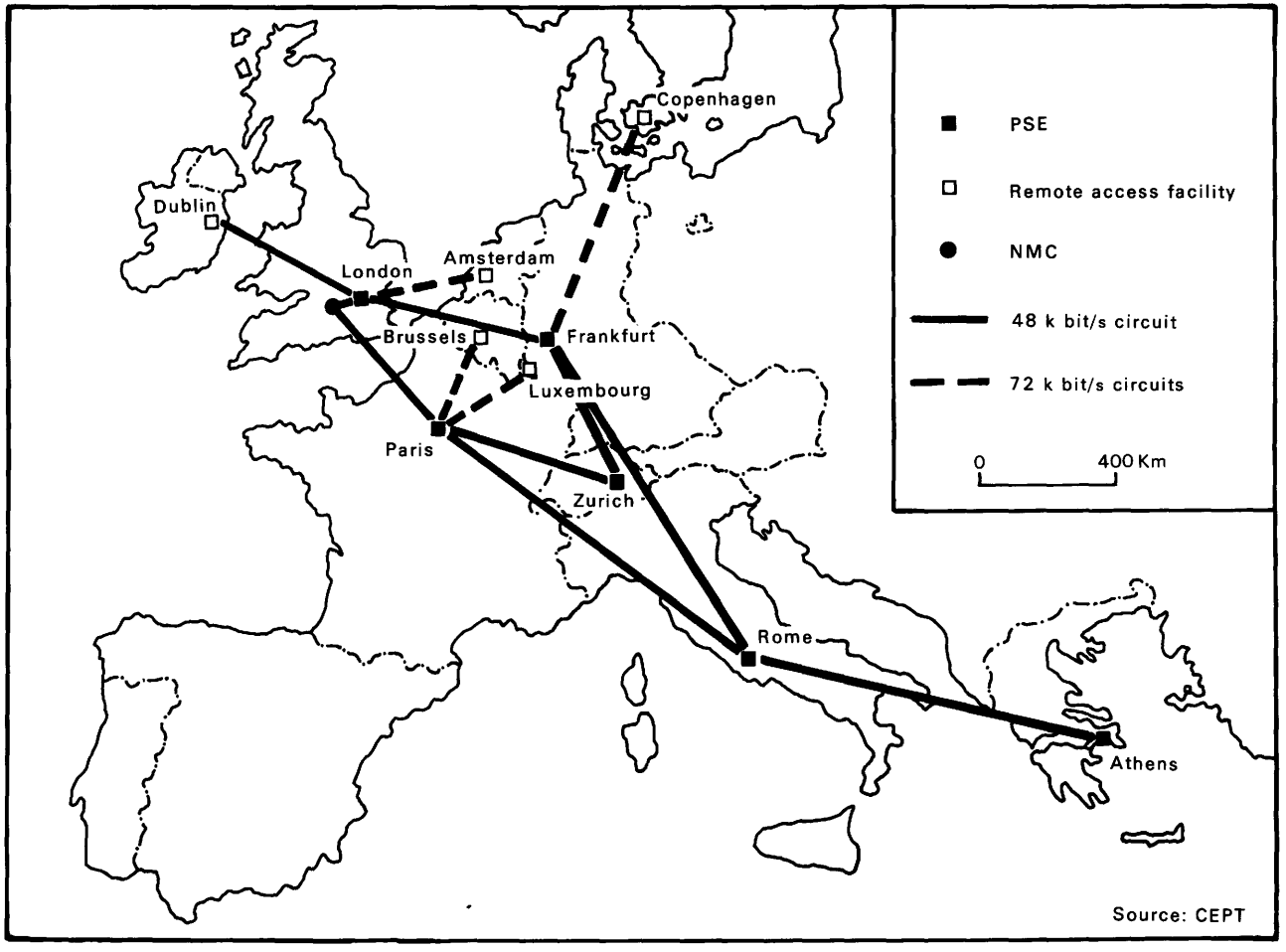
1. Packet switching is a technique whereby data to be transmitted over existing lines are assembled into small packets for transmission so that the limited transmission capacity can be optimally utilised by interleaving distinct and individually flow-controlled packet streams. The significance of packet switched networks rests on their increased throughput over message switched networks, their efficient line utilisation and their cost-effectiveness due to volume-oriented tariffs. The distance-independence of packet switching, reflected in their tariff structures, makes them particularly interesting from the geographical point of view - i.e. it is effectively the <u>volume</u> of data transmitted that determines the cost rather than the <u>distance</u> over which the data is transmitted.

FIG.2.2 EURONET LAYOUT



As national systems (e.g. Transpac in France, IPSS/PSS in Britain and DATEX-P in Germany) develop and link with one another, it is envisaged that Euronet will eventually be phased out, having served its catalyctic purpose. This development of national and international data networks is likely to reduce in relative terms the use of leased circuits; these enable large users to take advantage of public infrastructure to provide their own private telecommunications systems. Table 2.5 indicates the proportion of data communication modems connected to leased circuits and to the PSTN in 1979. This suggests that on average half the lines utilised for data transmission were leased. The inadequacies of the PSTN for data communication purposes in Greece and Italy is reflected in the very high proportions of users taking advantage of leased lines. As new networks are introduced, improving the availability, reliability and cost of service, then leased lines can be expected to play a less important future role in data traffic.

2.3.3 The development of new services

An increasing range of services are expected to be provided by PTTs, reflecting the development of particular technologies and the strong level of demand for more sophisticated telecommunications services. The majority of EEC members have committed themselves to at least experimentation with these new services on a limited trial basis, while some countries are already providing or are planning to provide full services. The situation with respect to the most important new services is summarised below:

Teletex: permits the transmission of typewritten texts at a reasonable price directly from one terminal to another, hence the popular description of the service as 'electronic mail'. A recently completed survey evaluating possible future service developments, commissioned by the PTT administrations of all European countries, concluded that teletex is one of the most important new services. The report predicted that teletex will be used by 780,000 subscribers by 1987.

Table 2.5 Percentage of data communication modems attached to Leased Circuits and to the Public Switched Telephone Network (PSTN) in 1979

Country	Leased Circuits	PSTN
		%
U.K.	53	47
Germany	53	44
France	68	29
Netherlands	48	52
Belgium	65	35
Luxembourg	88	12
Ireland	54	46
Italy	79	21
Greece	95	5
Denmark	54	46

Source : Eurodata Reports Vol. 4 (1980)

Table 2.6 Year of Service Introduction to National Networks and Services

	Teletex	Videotex	Access to US data bases
U.K.	1983	1980 Prestel	1978
Germany	1981	1983	1979
France	1982	1983	1979
Netherlands	1985	1980 Viditel	1978
Belgium	1984	1984	1978
Luxembourg	1984	1984	1978
Ireland	N/A	N/A	1980
Italy	1983	1983	1979
Greece	1984	1984	1980
Denmark	1983	1982	1979

Sources : Eurodata Reports Vol. 4 (1980)
National Reports
5th Annual Survey of Computing Services Industry in Europe (1981)
European Computing Services Association (ECSA)

Telefax: makes possible the transmission of documents (e.g. texts, plans, diagrams) by means of telecopiers via the public telephone network. Germany (Telefax) and France (Telecopy) were the first to introduce such facsimile transfer services. One of the main constraints to overcome with public facsimile services has been the need to make compatible transfer between makes and models of machine.

Videotex: is an interactive system linking telephone and television set with each other with the aid of an intermediate device, and offers the potential of giving the user access to a practically unlimited supply of text, graphic and data information. The British videotex Service - Prestel - was introduced on a general basis in 1980. It can be accessed through various forms of equipment: a TV set fitted with an integral modem; a TV set via word processor or personal computer fitted with an adaptor. By mid-1982, Prestel offered over 200,000 pages of information provided by 900 separate sources. It offers limited interactive services such as teleshopping and electronic mail and has now been provided with gateway access into other computer databases not on the Prestel computer. However, it has achieved little success measured by the number of users (only 14000 in the whole of the UK by 1982). Although originally aimed at the mass consumer market it failed to make an impact, partly because of its high usage costs.

Teletext: is the transmission of texts and diagrams within the television signal from TV broadcasting station to the TV sets of subscribers. Although teletext is non-interactive (i.e. transmission is only one-way) and the range of information is limited to 80-100 pages, the much lower costs make it an attractive service option for the domestic market. In the UK, for example, teletext services had 500,000 users by mid-1982.

An attempt is made in Table 2.6 to show the time-lags between countries in their introduction of new services. The estimated time-lags for bringing these new services into operation would seem to be shorter than those for new network developments, but Greece and Ireland appear to lag behind their neighbours in service provision. The final column of the table, for example, shows the year at which access to US data bases could be obtained; access to remote data bases held on host computers is, for many industrial

and commercial enterprises, a service of considerable importance, providing access to information on patents, international engineering standards, market trends, and so on. Until comparatively recently these data bases were US oriented but there has been spectacular growth in European bases. Although the time-lags are short, again the data suggest that Greece and Ireland were the last countries in the Community to be able to access these importance sources of technological and business information.

2.4 The regulatory and market environment of telecommunications

The market environment in which telecommunications services are provided in Europe ranges from the oligopolistic situation in Denmark to the more usual monopoly situation, most strongly evident in Ireland and France. One common feature is the strong influence of governments on PTT activities, through total or majority ownership of operating companies, which serves to distinguish the European model from that prevailing in the United States, in which operating companies are privately owned. In the UK, however, the present government intend to 'privatise' (i.e. to sell to the private sector) British Telecom, the PTT monopoly.

The generally monopolistic market position which European PTTs possess gives them considerable control over all aspects of telecommunications; they not only control the telecommunications system itself but also the standards of supply of attachments to the system, the services provided and in most cases they prevent such services being resold. In addition, they act as a monopolistic purchaser of equipment, particularly transmission and switching equipment, which it has been argued can be to the detriment not only of the individual companies unable to gain access to the market for these products but also to the Community as a whole because of the lack of competition in protected markets inhibiting price reductions and technological progress.

The debate today is whether or not these PTT monopolies should continue in their present form or be subject to some liberalisation. The debate is overtly ideological, reflecting the different political perspectives of the member states; thus the United Kingdom's laissez-faire government are adopting a policy of de-regulation, somewhat similar to that which took

place in the United States in the early 1970s (Langdale, 1983), while the Socialist government in France have attempted to strengthen and extend the monopoly position of the state-controlled PTT.

The de-regulation argument has at least three levels: (a) the network level; (b) the attachment level; and (c) the sale of service level.

(a) the network level: Only the UK has removed the monopoly of the PTT at the level of network provision. 'Mercury' is a rival digital network to BT licensed under the 1981 British Telecommunications Act and backed by three private companies (Cable and Wireless, BP and Barclays Bank International). Its fibre-optic network will link the UKs major business centres and offer date communications, speech and video conferencing facilities on leased lines and specialised value added network services (VANS) for businesses.

(b) the attachment level: The UK and Ireland have recently liberalised their restrictions on network attachments so that permission can be obtained to attach any equipment to the network as long as it meets basic electrical and safety standards. In the UK equipment approval is to be monitored by a body independent of the PTT. These countries have formal liberalised systems, while a number of other PTTs take a flexible informal approach to attachment. This may be increasingly necessary as technology is advancing very rapidly and any slow or unnecessary approval delays may disbar potential customers and revenue generators from the early benefits of these techniques. Additionally, approval delays have an inhibiting effect on indigenous suppliers, although the converse can be argued; delaying the approval of non-European attachments could provide indigenous suppliers with a 'breathing space' sufficient for their products to be brought to market.

Certainly the United States experience would suggest that de-regulation results in new competitors and a flood of new products. After the US PBX (Private Branch Exchange) market was de-regulated, AT & T lost 30 market share points between 1972 and 1978, with both smaller American companies and Japanese competitors gaining ground at their expense. There is little doubt that this increase in competition (from 12 to 38 companies) was beneficial to the user, for the newcomers introduced PBXs with considerably

enhanced features (e.g. call forwarding and automated least-cost routing) and at lower prices (English, 1983). In the UK, the intended opening of the telecommunications markets has put intense pressure on British Telecom to quickly obtain modern products, frequently obtained from overseas via UK suppliers acting as agents (Camrass, 1982). The slow rate of innovation displayed by UK firms operating in previously protected environments has, for example, forced BT to buy PABXs from Mitel of Canada (Locksley, 1982).

Understandably, European PTTs have expanded their activities to try and avoid deregulation and protect themselves against any reduction in monopoly powers (English, 1983). In Germany, for example, the Deutches Bundespost has made changes to its type approval process which should have opened up the subscriber equipment market; in practise, however, only a few large national suppliers have managed to gain approval.

(c) the sale of service level: Only the UK and Italy permit VANS, although Ireland is expected to follow suit shortly. These provide customers with a wide range of specialised services which may be but are generally not currently provided by the PTT itself. In the UK, Unilever Computer Services has been licensed to operate a value added network service including electronic mail and protocol conversion (EIU, 1983). In the United States, deregulation encouraged a wide range of new VANS, including packet-switched data networks (Tymnet, Telenet), electronic mail, document distribution and teleconferencing (Langdale 1983).

One final regulatory issue of some importance is data protection. The information and data communications which cross national borders are frequently of a highly confidential and commercially valuable nature. It is therefore necessary to provide generators of such information/data with adequate protection under national and Community law. At present such harmonised data protection does not exist in the Community, which may itself inhibit the free flow of information within Europe.

In conclusion, we have demonstrated that considerable variations exist between the nations of the Community in terms of the level of their telecommunications, the essential infrastructure for the diffusion of new information technology. These variations exist with respect to present and anticipated future levels of service provision; although all nations

are attempting to modernise their infrastructure by installing or planning to install electronic exchanges and by building up digital networks, the scale of investment needed to achieve such a transformation, coupled with the very different starting levels of infrastructure provision, means that almost inevitably the quality and quantity of telecommunication services will continue to vary markedly between countries. The peripheral least-favoured nations in Europe, Greece and Ireland, would seem to be likely to continue to lag substantially behind the rest of the Community in terms of a number of aspects of infrastructure provision.

CHAPTER THREE

REGIONAL VARIATIONS IN THE SUPPLY OF AND DEMAND FOR TELECOMMUNICATIONS

3.1 Regional variations in telecommunications infrastructure

Telecommunications infrastructure developments have rarely been introduced within countries uniformly over space and time. Time-lags for a new network or facility or service to become universally available within a national territory can run into years, for many such improvements require the phased replacement or introduction of new infrastructure which is both expensive to undertake and demanding of manpower resources. It is consequently of importance to the present study to determine whether such service-introduction time-lags have a clear spatial expression; that is, do the "diffusion paths" of new facilities becoming available divide regions into 'early' or 'late', and if so what is the basis of this differentiation. The question is important to the present study because so many of the user benefits of new information technology are dependent upon advanced telecommunications facilities; it is consequently of relevance to regional development objectives to ensure that enterprises in peripheral or less-favoured regions are not 'losing out' to core region enterprises in terms of their potential access to the benefits which NIT can bring (in the form of better information, enhanced competitiveness, etc.).

3.1.1. Network Modernisation

Investment decision-making within the sequential process of modernising telecommunication networks is based on a mixture of amortisation, marketing and technical grounds. Initially new equipment may be tested in areas where demand is low to reduce the risks of service disruption but subsequently modernisation is generally demand led; it therefore usually proceeds from the large cities and/or core regions of national territories.

One example of a slowly-diffused network improvement which conforms to this pattern is subscriber trunk dialling (STD), which made possible easy long-distance communication at low user cost. In the UK, STD was first

introduced in 1958, but it was not until the late 1970s that national coverage was achieved. The spatial pattern of introduction is shown in Fig. 3.1 (taken from Clark, 1975). The first locations with the STD facility were the major conurbations of London, Birmingham, Manchester, Liverpool, Glasgow and Bristol. From these points STD spread outwards from the conurbations and also 'jumped' to the other big cities, with the remote rural areas such as the Highlands of Scotland being the last to experience the benefits of STD. This pattern of introduction came about because STD was installed on the basis of circuit congestion, hence the largest, mostly densely populated conurbations were the first to be connected. This differentiation between urban and rural regions is also seen in the automisation of the French telephone network; in 1974, only Paris, Lille and Strasbourg had fully automated (i.e. 100%) telephone services, with the level of automisation being below 70% in the rural regions of Dijon (Bourgogne) and Dijon (Franche-Comte).

As outlined in the previous chapter, all EEC countries are now working towards the digitalisation of networks, affecting both transmission and switching, as a means of reducing capital and running costs and improving the speed, quality and range of services provided. The speed of technological change, the nature of capital investment and the starting-point of each country has produced a range of regional effects:

- Netherlands : the replacement of electro-mechanical and crossbar exchanges by first-generation SPC electronic exchanges began in 1972. At first, SPC exchanges were installed mainly in the major cities, but now there is no marked regional or urban/rural bias in new installations.

- Ireland : the western most rural part of Ireland will be the first local exchanges to be digitised. This is because the oldest technology in most urgent need of replacement is currently installed there, a number of exchanges indeed still being manually operated. The peripheral parts of Ireland will consequently be leaping over intermediate technologies straight into the electronic age.

- Italy : A rather different type of 'leapfrogging' is revealed by the Italian example. Because of the slow diffusion of the telephone network from core regions in the north of the country (Lombardia,

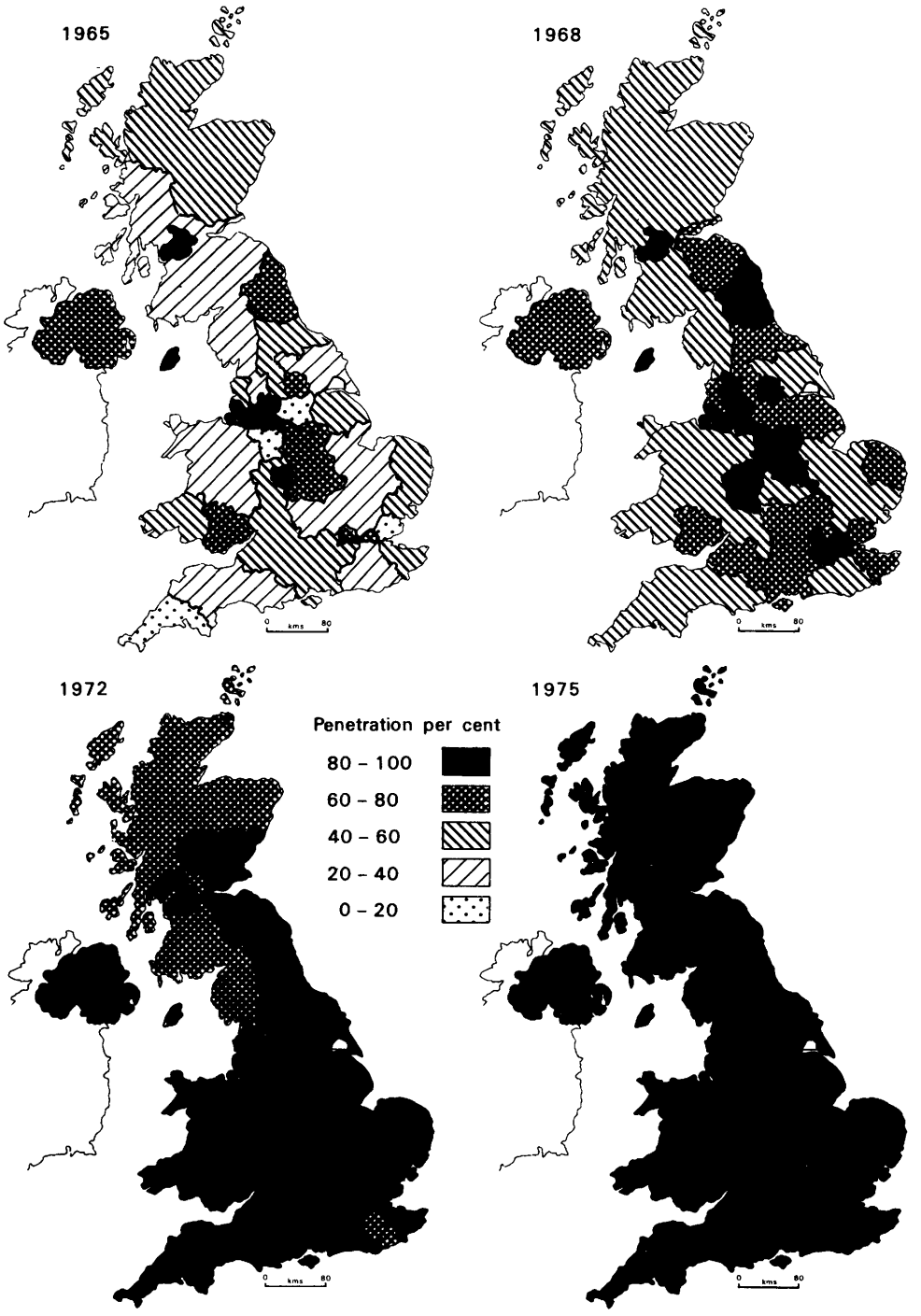


Figure 3.1 The diffusion of STD telephone in the United Kingdom, 1965-75

Note: Hull Corporation operates, under licence, a local telephone service independent of the Post Office Corporation. Hull is therefore excluded from this map

Source : Fig. 4.5 of Clark (1978), in DOE Research Report 24.

Piemonte and Emilia Romagna) and from the major cities (Rome, Naples) to the rural south, it is the core areas that have the oldest switching technology which is fully depreciated. The south has more recent electro-mechanical equipment, a situation exacerbated by the excess switching capacity installed in the Mezzogiorno in the 1970s as part of a strategy to move ahead of demand. The switch to electronic exchanges will consequently take place first in the nation's core and most urbanised regions; fully electronic digital exchanges are already installed in Rome and Milan, with Turin, Naples and Bologna to follow. The Mezzogiorno, however, will not be able to make use of the new services which demand digital switching for many years to come.

- United Kingdom : Some 10% of total exchanges in the UK are first generation electronic (TXE 4). The proportion varies widely between regions, however, generally to the benefit of the periphery. Thus in Wales and Northern Ireland 17% of exchanges are electronic compared with only 3% in London and 7% in the South East. However, it should be noted that the more sophisticated second generation electronic exchange - System X - is now beginning to be introduced as a separate overlay network. This overlay network, providing all the benefits of an Integrated Services Digital Network (ISDN) will be available in about 30 major business centres by 1985-6, centering on London. The relative telecoms cost and service benefits of the core region will thus be accentuated by System-X.

3.1.2 The introduction of new services

More so than even for network infrastructure modernisation, new services are generally pilotted and introduced firstly in core regions, particularly the largest cities. A number of examples of new services being introduced in member states will serve to illustrate the extent of 'big-city bias'.

(a) New text and videotex services

- Public facsimile services are usually introduced first between big cities where demand area will be greatest. The Irish PTT for example are to open a Telefax service in 1983 between Dublin and Cork.

- Bureaufax, the British PTTs international facsimile service, was initially available only in Central London. Eleven more locations now have Bureaufax over-the-counter services (which are particularly valuable for small firms), but all are in the Southern half of the country.

- Trials of public videotex services, which make use of the PSTN, also frequently display a bias towards the largest cities. Thus Bildschirmtext has been tested by the German PTT in Dusseldorf and in West Berlin, while a Belgian videotex service may be established on a trial basis in Antwerp. Italian field trials have also begun, with their Videotel service to be tested with 1000 predominantly business users from the telephone areas of Milan, Turin, Venice, Bologna,Rome and Naples.

- In contrast, pilot videotex projects in France are taking place in a range of environments. The major Teletex experiment - the "3V" community test in Velizy, a suburb of Paris, has now been successfully completed. An experiment with an electronic telephone directory service is underway in the Ille-et-Vilaine department around Rennes in Britanny, and is next year to be extended to the Picardy region in the north of France. 'Municipal videotex' experiments are taking place in Nantes on the Atlantic coast and Grenoble in the Alps. Following on from these trials, the French PTT have recently announced plans to establish a national viewdata service available throughout France via Transpac, which will make the cost of accessing the service independent of distance.

- The Netherlands videotex trial service - Viditel - is also to be extended as a full national service with local call access from all locations.

- The UKs national videotex service - Prestel - is also intended to be a distance-independent charged service, but the coverage of access points - the Information Retrieval Centres (IRCs) - is not sufficiently dense to make possible universal local call charging. British Telecom estimated that in 1982 that 60% of telephone subscribers could have local call rate access to Prestel, but this proportion will be considerably lower in the peripheral regions of the

country where the IRCs - located in the big cities - are less densely spaced.

(b) New data communication services

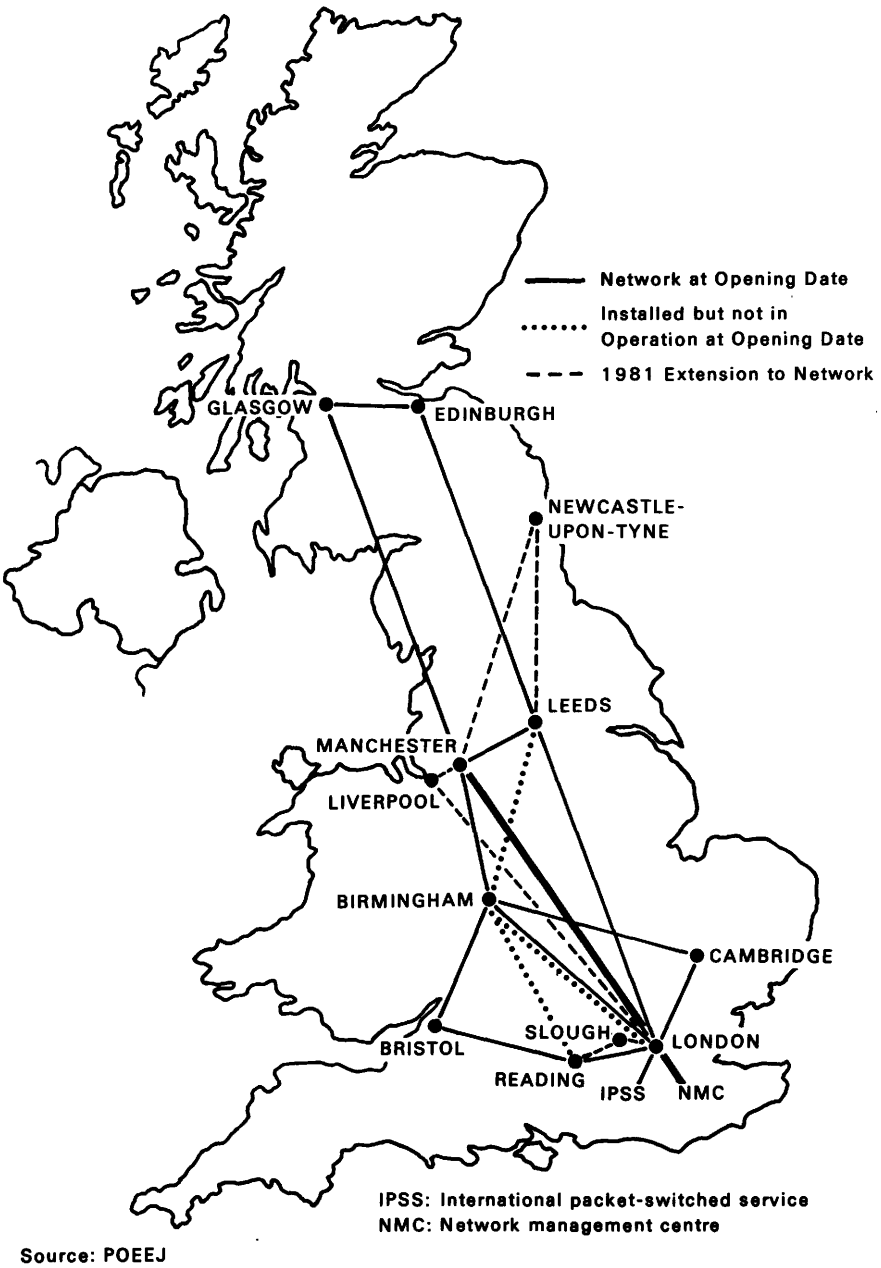
As outlined in the previous chapter, the majority of Community countries have introduced, or are preparing to introduce, dedicated data networks, and new services based upon them, which are able to achieve much higher reliability and transmission speeds than are possible on the PSTN. Packet-switched data networks are particularly important from the point of view of peripheral regions within countries, for the tariff structure of packet switching is distance independent. They consequently offer peripheral regions a substantial reduction in the relative cost of data communication with national core regions. For this improvement to be fully realised however, access to the networks needs to be available from all locations on a local-call charging rate. This is mostly the case - France's Transpac Service, for example, has a comprehensive coverage of network nodes across the country, while the Datanet 1 service in the Netherlands is available for exactly the same charge (connection, rental and call) for all locations in the country. In countries where the network nodes are widely spaced, however, access to the network via the PSTN can vary in cost because of the latter's distance-related tariff structure. In the UK, for example, the PSS network opened in 1981 with only nine access nodes (Fig. 3.2); although the network is being built up and the number of nodes increased, much of the less-urbanised periphery of the country (South West England, Wales and Scotland) is beyond the local-call charging rate for access to a PSS node and therefore has to pay more for using the service than does the remainder of the country.

(c) Wide-band video services

The future development of wide-band video services, whether of a national or local nature, will almost invariably be big-city based.

. The British conference-video service - Confravision - has been in operation for a number of years, but is still only available in six

FIG. 3.2 THE UNITED KINGDOM'S PACKET-SWITCHED SERVICE



Source: POEEJ

cites. The French service - Visioconference - is available only in Paris, Lyon, Nantes and Rennes.

- The Danish PTT are about to introduce a video-conferencing service linking main centres. However, the relative disadvantage of peripheral and rural regions will be minimised by mobile conference studies.

- Experiments in Germany with BIGFON (wide-band, integrated local fibre optic networks) commenced in 1983. A number of companies were selected for system experiments with DM150 million of federal government funding, with wide-band networks to be set up in seven large cities; Berlin, Hamburg, Hanover, Dusseldorf, Stuttgart, Nurnberg and Munich.

- A test fibre optic cable network initiated in Birritz in 1983 gives 1500 private and institutional customers access to new services such as video telephone.

The major capital investment involved in fibre optic cabling helps explain why all of the local experiments are in urban contexts. Even if the experiments prove successful from technical and user reaction points of view, dispersed rural communities are unlikely to be cabled in the future unless costs fall drastically.

3.1.3 The regional dimension to liberalisation and competition issues

There are implicit and frequently explicit regional impacts associated with changing the competitive environment in which PTTs operate and under which telecommunication services are provided. While the net positive and negative balance of these changes at national levels is the subject of considerable controversy and debate, the balance with respect to the impact upon peripheral and/or rural regions within countries seems unlikely to be favourable.

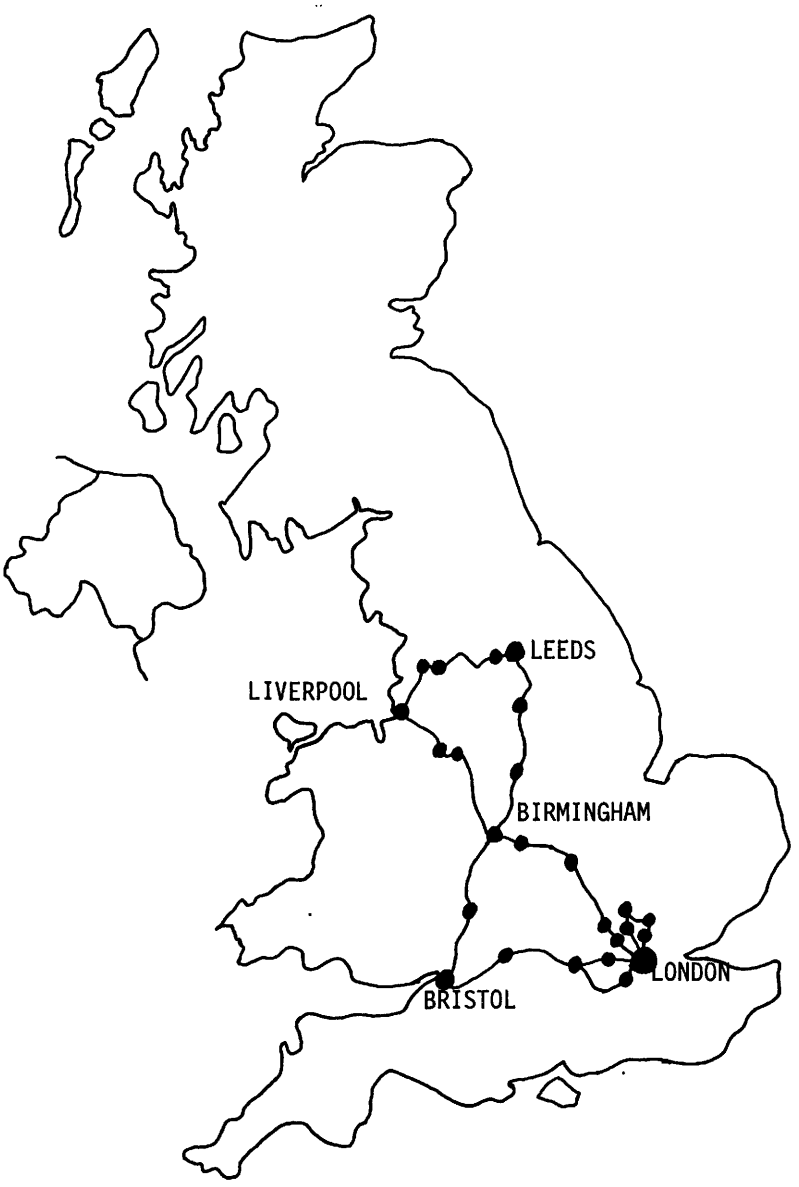
The most extreme example is provided by Mercury, the UKs newly-licensed competitive network. Mercury's initial plan is to provide medium and wide band services to the business communities of the City of London (which

commenced in 1983) and to provide links with Bristol, Birmingham, Manchester, Liverpool and Leeds over the following two years. The basic network, costing £50m to implement, is shown in Fig. 3.3. In addition to rural areas, the industrialised but disadvantaged regions of Wales, North East England and Central Scotland are thus excluded from access to the new services which will be provided, with the decision on network configuration being justified by the shortfall between the cost of extending Mercury to these outlying regions and the revenue that they would provide.

From the viewpoint of the licensed operator, this is a rational commercial decision; the highest density routes obviously possess the highest profit potential. It is not only, however, a case of peripheral regions being unable to take advantage of any services provided; the reaction of the PTT, again commercially rational, has been to pre-empt Mercury's arrival by reducing charges on its highest routes by 20% - 50% (thereby decreasing the level of cross-subsidy from high to low volume routes). Similarly, new investment in sophisticated infrastructure is also likely to be concentrated on the high-volume routes so that the PTT can compete on grounds of quality as well as price. The net result of these impacts is that peripheral regions and most rural areas will be disadvantaged not only in relative terms but quite possibly in absolute terms as well.

Even in cases less extreme than this, peripheral regions seem unlikely to benefit from de-regulation; Value Added Network Services (VANS), for example, will be introduced according to commercial criteria such that market potential is the dictating factor. Certainly the experience in the United States following de-regulation was that services were introduced firstly into the largest cities; as the market grew and economies of scale in provision were realised, smaller cities were connected to the networks (Langdale, 1983). Not only does such a pattern of introduction mean that less urbanised or remote regions are likely to 'loose out' on the benefits to the user of new services, but the direct job-generation aspects of providing VANS are also likely to accrue to the core regions. Although enterprises located in peripheral regions of the Community could provide such services for a very large market, particularly with the new locational equality opened up by distance-independent charging on certain networks, our expectation is that with PTT network development occurring first in core regions and with such regions having the largest concentrations of local demand, enterprises providing VANS will initially develop in core

Fig. 3.3 : The UK's proposed Mercury Network



Source : CS & P London

areas and subsequently expand their activities into the periphery if network developments and market factors permit such expansion.

3.2 Regional variations in the demand for telecommunications

Variations in the supply or availability of telecommunication services, and in the networks and infrastructure through which they are provided, is of course only part of the explanation for regional differences in the level of penetration of telecommunications and of NIT more generally. The demand also varies substantially between regions, reflecting differences in income, the structure of economic activity, social and cultural considerations, and so on. While variations in patterns of demand can be inferred from the decisions of PTTs on where to introduce new services, it can be quantified more explicitly by examining variations in the uptake of basic services that are universally available - the telephone provides the most obvious example, although telex and data communication are more indicative of business rather than social demand.

In this section we will examine regional variations in the rate of adoption of these telecommunication services, firstly within individual countries and secondly at the aggregated European-wide scale.

3.2.1 Variations within countries in levels of telephone penetration

Although regional variations in demand for the telephone will be reflected in different telephone penetration rates (standardised by population size), the influence of supply constraints in distorting the picture should not be ignored. While in Germany waiting lists for telephone installation are short (0.5% of the installed base), in Ireland a considerable portion of total demand remains unsatisfied (the waiting list in 1981 being 20% of the installed base). The extent to which regional bias may be introduced is indicated by the example of France. Table 3.1 shows the average telephone connection time in months for French regions in both 1974 and 1979. Although all regions recorded substantial reductions in waiting times, substantial variations between regions are evident at both dates. In 1979

Table 3.1

Average Telephone Connection Time in Months

France and the Netherlands

FRANCE: Connection time in months			NETHERLANDS: Connection time in months	
	1974	1979		1979
Amiens	18.2	4.6	Groningen	4.6
Bordeaux	20.5	8.3	Friesland	4.5
Chalons	8.0	3.5	Drenthe	3.7
Clermont	10.3	3.5	Overijssel	4.3
Dijon (Bourg.)	22.3	5.1	Gelderland	4.0
Dijon (F. Comte)	23.4	7.1	Utrecht	3.2
Lille	18.0	10.1	Noord Holland	1.6
Limoges	7.6	4.5	Zuid Holland	2.5
Lyon	18.7	3.7	Zeeland	4.3
Marseille	17.3	5.4	N. Brabant	6.3
Montpellier	11.8	2.2	Limburg	5.1
Nancy	10.1	6.0		
Nantes	20.3	7.2	Total	3.7
Orleans	14.5	4.4		
Poitiers	13.2	8.3		
Rennes	16.4	8.3		
Rouen (B.N.)	12.6	4.9		
Rouen (H.N.)	11.4	4.4		
Strasbourg	8.3	3.2		
Toulouse	21.0	7.3		
Province	15.8	5.8		
Paris	17.4	0.6		
France metro	16.3	4.6		

Source: Netherlands: EEC Discussion Note 16, Final report on Regional Development and Infrastructure : The Netherlands, H. de Graaf and P. Nijkamp

the average waiting time was shortest in Paris (0.6 months), while in Lille, Bordeaux, Poitiers and Rennes telephone connection was subject to a delay of 8 months or more. Similarly, waiting times in the Netherlands are shortest in the core region of Noord Holland and longest in the depressed regions of Brabant and Limburg.

With this proviso, telephone penetration rates provide a reasonable indication of the variation in levels of demand between regions. Table 3.2 shows the inter-regional variation in telephone penetration rates within each country,[1] information which is summarised in Table 3.3 by showing each country's highest and lowest penetration regions. Considerable similarities in pattern exist, with the least-urbanised and/or less-favoured regions having below national average levels:

- UK - highest number of subscribers/100 inhabitants is found in the London region, with other Southern regions also above average. Lowest rate in Northern Ireland, followed by other peripheral regions of the North East and Wales.

- Germany - highest in West Berlin and other major centres such as Hamburg and Dusseldorf, lowest in rural regions such as Munster in the north and Regensburg in the south east.

- France - Paris has a considerably higher telephone penetration rate than any other region, with the Cotes d'Azur region a distant second. The lowest levels are found not in the rural west but in the north east of the country in regions such as Nord Pas-de-Calais and Lorraine which have sizeable mining and industrial sectors.

- Netherlands - regional variations are slight, although the largest cities of Amsterdam and Rotterdam are above the average.

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1. The regions used are, where possible, NUTS level II regions. However, data supplied by national PTTs is frequently for the PTT's own regions (e.g. this applies in Belgium and the Netherlands).

Table 3.2 LEVELS OF PER CAPITA TELEPHONE AND TELEX PENETRATION FOR REGIONS WITHIN EACH MEMBER STATE[1]

	Telephone lines/100 pop.	Telex Machines/ 1000 pop.
France		
Ile de France	40	30
Alpes Cotes	35	18
Rhone Alpes	30	16
Alsace	28	16
Haute Normandie	27	15
Aquitaine	28	13
Centre	29	11
Languedoc	30	10
Champagne	25	14
Bourgogne	28	11
Midi Perenees	27	11
Bretagne	26	10
Payd de Loire	26	10
Picardie	24	11
Limousin	28	8
Lorraine	23	11
Pas de Calais	19	12
Poitou	26	9
Auvergne	27	8
Bas Normandie	26	8
Franche Comte	23	8
Ireland		
Ireland	21	15
Luxembourg		
Luxembourg	36	52
Greece		
Eastern Continental Greece and Islands	34	25
Central and W. Macedonia	22	12
Eastern Agean Islands	18	12
Crete	16	9
Peloppenese & West Cont. Greece	18	5
Epirus	15	7
Thessaly	15	6
Eastern Macedonia	15	5
Thrace	9	5

	Telephone lines/100 pop.	Telex Machines/ 1000 pop.
Italy		
Liguria	36	10
Lombardia	28	13
Lazio	29	8
Friuli	28	9
Toscanna	28	9
Emilia	26	10
Piemonte	28	6
Trentino	22	10
Val D'Aosta	29	1
Veneto	19	6
Umbria	20	3
Marche	19	4
Campania	17	3
Sicilia	18	2
Abruzzi	17	2
Sardegna	15	2
Puglia	15	2
Molise	13	1
Calabria	12	1
Basilcata	12	1
Denmark		
Sealand/Mon	49	(20)
South Jutland & Furen	41	(20)
Mid & Northern Jutland	41	(20)
United Kingdom		
London	42	41
South East	36	15
Eastern	34	15
North West	32	12
Midlands	31	13
South West	33	11
Scotland	31	12
North East	30	10
Wales	29	8
Northern Ireland	23	9

	Telephone lines/100 pop.	Telex Machines/ 1000 pop.
Netherlands		
Amsterdam	43	47
Rotterdam	38	37
The Hague	38	24
Utrecht	35	25
Breda	33	20
Haarlem	35	17
S'Hartogenbosch	31	20
Arnhem	32	17
Groningen	34	13
Maastricht	31	16
Hengelo	30	16
Zwolle	31	14
Leeuwarden	32	10
Belgium		
Brussels	36	56
Antwerpan	28	33
Verviers	26	16
Kortrijk	23	19
Brugge	27	14
Gent	25	15
Namur	28	10
Liege	27	10
Mechelen	23	11
Libramont	26	6
Charleroi	24	8
Mons	22	9
Hasselt	19	9

	Telephone lines/100 pop.	Telex Machines/ 1000 pop.
Germany		
Hamburg	45	43
Dusseldorf	39	30
West Berlin	53	19
Frankfurt	34	30
Munchen	33	26
Koln	34	23
Dortmund	35	19
Stuttgart	32	25
Freiburg	32	23
Hannover	35	16
Bremen	32	18
Karlsruhe	31	20
Nurnberg	29	19
Koblenz	31	16
Kiel	33	12
Munster	28	17
Saarbrucken	29	15
Regensburg	24	13

Notes :

1 The ordering of regions within each country is according to their position on a combined telephone and telex penetration ranking for all regions of the community (See Section 3.2.3 (d) below).

2 NUTS Level II Regions have been used wherever possible. For the Netherlands, United Kingdom, Denmark, and Belgium, data supplied by the PTTs was only available for their own regional definitions; these do not correspond to the standard regions.

Table 3.3 : EEC Nations: Summary of Regional Variations in the Number of Telephone Subscribers per 100 Inhabitants (1980 and 1981)

Nation (number of regions)	Region		telephone subscribers per 100 inhabitants	As % of national average
United Kingdom (10)	highest:	London	42	127
	national average:		33	
	lowest:	Northern Ireland	23	70
Germany (18)	highest:	West Berlin	53	156
	national average:		34	
	lowest:	Regensburg	24	71
France (21)	highest:	Paris	40	133
	national average:		30	
	lowest:	Franche Comte) Lorraine)	23	77
Italy (20)	highest:	Liguria	36	156
	national average:		23	
	lowest:	Calabria	12	52
Netherlands (13)	highest:	Amsterdam	43	126
	national average:		34	
	lowest:	Hengelo	30	88
Denmark (3)	highest:	Sealand/Mon	49	109
	national average:		45	
	lowest:	Mid and N Jutland	41	91
Belgium	highest:	Brussels	36	133
	national average:		27	
	lowest:	Hasselt	19	70
Greece	highest:	Athens Region	35	141
	national average:		25	
	lowest:	Thrace	9	38
Ireland	national average:		21	
Luxembourg	national average (1982 end)		36	

Source: Project national reports

- Belgium - telephone penetration varies widely for such a small country, being highest in the Brabant region centred on Brussels and lowest in the older declining industrial areas of Limburg and Hainaut.

- Denmark - regional variation is extremely narrow, although the region including Copenhagen has slightly higher telephone penetration than the other regions.

- Italy - regional variation is substantial, and is considerably higher in the north-west core regions around Genova, Torino and Milano and also Rome than in the Mezzogiorno, where very low levels predominate - even in the city of Naples.

- Ireland - substantial variation exists between Dublin and the rest of the country, particularly the rural west.

- Greece - again, the core region dominates the pattern, with Athens having almost double the phone penetration of the next region and four times the level of the lowest region (Thrace).

In general, there is a negative relationship between a country's overall level of telephone penetration and its degree of inter regional variation (see final column of Table 3.3). Thus Denmark and the Netherlands have the highest penetration and the lowest regional disparities, the UK and Germany occupy intermediate positions on both variables, France and Belgium have below-average phone penetration and above-average inter-regional disparities, while Italy and Greece (missing data for Ireland) have the lowest national levels and the greatest disparities between regions.

As for the balance between broad inter-regional and urban-rural discriminants of telephone penetration, the evidence varies from country to country. In the UK, both elements are important; the capital has higher penetration than the non-metropolitan regions around it, but the lowest levels are found not in the most rural regions but in the depressed industrial regions. To an extent, this mixture of explanatory elements seems also to apply to France and Belgium. In Germany, the main discriminant would seem to be between urban and rural areas, while in Italy at the other extreme the broad division between north and south is much more important than any urban-rural contrasts.

Are these inter-regional disparities converging or diverging over time? The answer is not straightforward, for although in each country the highest penetration region has recorded in recent years less rapid subscriber growth than the lowest penetration region (see Table 3.4), these high growth rates in the lagging regions are taking place from very low bases in many instances and, because all regions are recording subscriber growth, the trend towards convergence is purely relative. In absolute terms, levels of disparities between regions are stable over time (and are actually widening in Greece and Italy), and the core regions of each country are continuing to display much higher levels of telephone penetration than their peripheral counterparts.

3.2.2 Variations within countries in the demand for business telecommunications

In terms of the demand for telecommunications by business enterprises, concentrating upon non-domestic services, such as telex and data communication, enables us to filter out some of the more general societal and cultural considerations which impinge upon telephone penetration.

(a) Telex penetration : Levels of telex penetration - measured as the number of machines per 100 inhabitants - accentuate the differences between core and peripheral regions. Table 3.2 shows for each country the 1981 level of each region, while Table 3.5 presents a highest and lowest penetration region summary. A comparison between the final column of Table 3.5 and its telephone equivalent (Table 3.3) shows that regional disparities in telex penetration are substantially wider. To take the example of the Netherlands, Amsterdam's telephone penetration is 26% above the national average, while its telex penetration is more than double the national average. In addition to a wider range, there are also differences in the types of inter-regional disparity when comparing telephone and telex.

. UK - the gradient between London and all the remaining regions is more noticeable for telex - i.e. regions like the South East fall

Table 3.4 : EEC Nations - Relative Convergence/Divergence Trends in Regional Levels of Telephone Penetration

Nation	Period	Percentage Growth in number of Telephone Subscribers/100 Population			
		Highest penetration region		Lowest penetration region	
		Total %	Annual rate of change %	Total %	Annual Rate of change %
United Kingdom	1971-81	45	3.79	138	9.06
Germany	NA	NA	NA	NA	NA
France	1975-80	60	9.86	171	22.1
Italy	1978-80	9	4.40	18	8.62
Netherlands	1971-81	84	6.29	135	8.92
Denmark	1971-81	53	4.34	93	6.80
Ireland[1]	1970-80	80	6.05	215	12.2
Belgium	1971-81	41	3.50	157	9.90
Greece	1970-78	80	7.62	149	12.08

1 Ireland: highest penetration assumed to be Dublin, lowest Limerick. Not standardised for base population change.

NA: Data not available

Source : National PTTs

Table 3.5 : EEC Nations : Summary of regional variations in the number of telex subscribers per 100 inhabitants (1980 or 1981 unless stated)

Nation		Region	Telex subscribers per 100 inhabitants	As % of national average
United Kingdom	highest:	London	0.41	256
	national average:		0.16	
	lowest:	Wales	0.08	50
Germany	highest:	Hamburg	0.43	146
	national average:		0.23	
	lowest:	Kiel	0.12	48
Netherlands	highest:	Amsterdam	0.47	204
	national average:		0.23	
	lowest:	Leeuwarden	0.10	57
France	highest:	Ile de France	0.30	188
	national average:		0.16	
	lowest:	Bas Normandie	0.08	50
Italy[1]	highest:	Lombardia	0.14	175
	national average:		0.08	
	lowest:	Basilicata	0.01	13
Greece	highest:	Athens	0.25	166
	national average:		0.15	
	lowest:	Thrace	0.05	33
Belgium	highest:	Brussels	0.56	254
	national average:		0.22	
	lowest:	Libramont	0.06	27
Denmark	national average:		0.20	
Luxembourg[2]	national average:		0.52	
Ireland	national average:		0.15	

1. 1982 figures
2. 1982 figures

Source : National PTTs

considerably behind the capital. Of the peripheral regions, Wales does comparatively worse and Northern Ireland and the North East of England (both branch-plant dominated regions) comparatively better.

- Germany - the extremely high level of telephone penetration in West Berlin is not repeated for telex - indeed, it falls behind the national average. Instead it is the major business and commercial centres which have the highest penetration levels, with Hamburg markedly higher than the other centres. The lowest penetration regions are also somewhat different from the telephone example; the Kiel region has the lowest level of all (inspite of being contiguous to Hamburg), perhaps because of its poorly developed commercial function and its lack of a major urban centre.

- Netherlands - the major cities of Amsterdam and Rotterdam have the highest levels of telex penetration, and a markedly more steep gradient exists between them and the rest of the country than was the case with telephone penetration levels.The lowest uptake of telex is in the Leeuwarden area (the rural Friesland region) rather than in the areas bordering with Germany as was the case for telephone.

- France - a rather different pattern of telex penetration emerges when compared to that considered earlier. Although the industrial north-east regions - such as Pas de Calais and Lorraine - are still below the national average, their levels of telex penetration are higher than those prevailing in a broad sweep of western and rural central France, including Bretagne, Pays de Loire, Poitou, Limousin, the Auvergne and Languedoc.

- Italy - the pattern of telex penetration in Italy too is different in a number of respects from the telephone pattern. The highest levels are still of course found in the north of the country, but Liguria (the Genoa region) drops down the ranking while Lombardia (containing the country's major commercial centre of Milan) emerges as the highest penetration region. The Mezzogiorno again has the lowest levels, with Basilicata and Calabria having less than 10% of the per capita telex penetration of Lombardia.

. Greece - a similar pattern to the telephone prevails, with Athens having the highest telex penetration.

Just as regional telex levels accentuate the core-periphery differentials that were observed earlier for telephone subscriber levels, so trends over time present a more polarised pattern. While there is consistent evidence for relative convergence in levels of telephone penetration, this is not the case for telex. As Table 3.6 shows, the recent growth rates of telex machines per 100 inhabitants vary hardly at all between high and low penetration regions, and in the case of Greece is actually favouring the core region of Athens. When the different starting points are taken into account, the gulf between core regions and peripheral regions are seen to be without exception widening over time. The major business centres are maintaining and extending their positions of dominance at the hub of national and international business information flows.

(b) Data communication equipment penetration : A 1980 study by the Eurodata Foundation contains much information on present and projected future levels of regional demand for data communication equipment. The basic unit of analysis is the Network Terminating Point (NTP), or data modem. In most countries NTPs are heavily over-represented in capital cities. As Table 3.7 shows, the primacy of Dublin and Athens within Ireland and Greece respectively is very marked, while even in the UK, France and Belgium the capital cities account for between 40-50% of NTPs. In Italy, the situation is rather different - the economic core of the country encompasses much of north-west Italy as well as Rome in the centre, and a number of regions have concentrations of NTPs; nevertheless, Lombardia (centred on Milan) has 30% of the national total. In the Netherlands, the division of functions between the cities which make up the 'Randstat' lessens the dominance of any one, Amsterdam having only 25% of the total.

Table 3.6 Percentage Growth in Number of Telex Machines per 100 Population

Nation	Period	Highest penetration region		Lowest penetration region	
		Total	Annual rate of change %	Total	Annual rate of change %
United Kingdom	1971-81	153	9.73	163	10.15
Germany	N/A	N/A	N/A	N/A	N/A
Netherlands	1971-81	124	8.40	156	9.86
France	1975-80	50	8.45	60	9.86
Italy	1970-78	165	12.96	244	16.70
Greece	1970-78	170	13.22	125	10.67

N/A : Data not available

Source : National PTTs

Table 3.7 Share of National Network Terminating Points Accounted for by the Largest Region, 1979.

Nation	Highest Share Region	Share of National Total
France	Paris	43%
Belgium	Brussels	48%
Denmark	Copenhagen	37%
Germany	Dusseldorf	10%
Ireland	Dublin	79%
U.K.	London	43%
Netherlands	Amsterdam	25%
Italy	Lombardia	30%
Greece	Attika	93%

Source : Eurodata Foundation Reports - "Data Communication in Western Europe in the 1980s".

Finally, the least centralised distribution of NTPs is found in Germany, reflecting its lack of primate conurbations and its federal system. Such concentrations of NTPs as exist are located in the commercial centres, including Dusseldorf, Frankfurt, Munich and Stuttgart, each with between 8-10% of the national total, while West Berlin and Hamburg have only 5% and 6% respectively.

The Eurodata Foundation's forecasts of NTP growth by region over the 1979-87 period suggest that some convergence in relative terms will take place, with the core regions recording lower rates of NTP growth than non-core regions within each country (Table 3.8) and very fast rates of growth in the most backward nations from a data communication point of view, Ireland and Greece. Nevertheless, major regional variations in NTP populations will persist well into the 1990s, reflecting the underlying persistent disparities in economic structure and levels of economic well-being.

3.2.3. Regional variations in telecommunications penetration at the European scale

(a) Levels of telephone penetration : When the number of telephone subscribers per 100 inhabitants are compared on a standardised basis across all European regions, two main elements to the pattern stand out (Table 3.9 shows the highest and lowest penetration regions). Firstly, Europe's major conurbations all emerge as high penetration regions. Thus the European 'top 20' (out of a total of 108 regions) includes Berlin, Hamburg, Amsterdam, London, Paris and Brussels - of capital cities, only Rome is not in the 'top 20' (Lazio being ranked only 48th, some way behind Liguria at 12). Secondly, and notwithstanding the capital city effect, clear national variations in telephone penetration find their reflection at the individual region scale. Thus all three Danish regions are in the European top 20, with German and Netherlands regions also well represented. At the opposite end of the spectrum, Italian and Greek regions dominate the list of low penetration regions. Ireland is also one of the lowest

Table 3.8 Projected growth in Network Terminating Points between 1979 and 1987 for regions with the highest share in 1979 and their national remainder

	Projected growth in NTPs (%)	
	Highest share region[1]	National remainder
France	219	435
Belgium	581	633
Denmark	238	346
Germany	289	274
Ireland	774	759
U.K.	117	302
Netherlands	338	353
Italy	238	369
Greece	769	3011

[1]The highest share region in 1979 is named in Table 3.7

Source: Eurodata Foundation Report on 'Data Communication in Western Europe in the 1980s. Model predicting NTP growth.

Table 3.9 : Number of telephone exchange lines/100 inhabitants

1980 or 1981

Top Rankings	West Berlin	(G)	53
	Copenhagen region	(D)	49
	Hamburg	(G)	45
	Amsterdam	(N)	43
	London	(UK)	42
	South Jutland	(D)	41
	Mid and North Jutland	(D)	41
	Ile de France	(F)	40
	Dusseldorf	(G)	39
	The Hague	(N)	38
	Rotterdam	(N)	38
	Liguria	(I)	36
	South East Region	(UK)	36
	Brussels	(B)	36
	Dortmund	(G)	35
	Alpes Cotes D'Azur	(F)	35
	Haarlem	(N)	35
	Eastern Continental Greece	(Gr)	34.5
	Lorraine	(F)	23
	Franche Comte	(F)	23
	Trentino	(I)	20
	Umbria	(I)	22
	Central & W Macedonia	(Gr)	22
	Ireland	(Ir)	20
	Hasselt	(B)	19
	Veneto	(I)	19
	Pas de Calais	(F)	19
	Marche	(I)	19
	Eastern Agean	(Gr)	18
	Peleponese	(Gr)	19
	Sicilia	(I)	18
	Campania	(I)	17
	Abruzzi	(I)	17
	Crete	(Gr)	16
	Thessaly	(Gr)	15
	Sardegna	(I)	15
	Puglia	(I)	15
	Epirus	(Gr)	15
	E. Macedonia	(Gr)	15
	Molise	(I)	13
	Basilicata	(I)	12
Bottom Rankings	Calabria	(I)	12
	Thrace	(Gr)	9

Source : National PTTs

telephone penetration regions, and three French and one Belgium region are also found in the bottom 20 ranking (the latter all being depressed mining/steel regions). With these few exceptions the lowest telephone penetration levels are found in the least industrialised Atlantic and Mediterranean peripheries of Europe.

(b) Telephone penetration, per capita GDP and peripherality :

At the international level a very strong positive relationship exists between per capita Gross National Product and per capita telephone density. At the regional level within Europe, the relationship is weaker because of the marked national variations in the GDP/telephone penetration relationship. Figure 3.4 shows the pattern of residuals from a regression of regional per capita gross product in Europe on the number of telephone subscribers per 1000 population[1].

Some countries display consistently positive residuals - all but one UK region, all but two Netherlands regions and Denmark - indicative of high levels of telephone penetration given their per capita regional GDPS. France and Belgium have predominantly negative residuals (Paris and Brussels being the only exceptions) indicating lower phone penetration than would be expected on the basis of GDP. Italy provides a different situation again, being the only country with a balanced mix of both positive and negative residuals - the prosperous north western regions and Rome have above expected telephone penetration, while all of the Mezziogiorno regions (with the interesting exception of Sicily) have lower telephone penetration levels than their GDPs would predict.

A very similar relationship to that described above applies to telephone penetration levels and economic potential per unit area.

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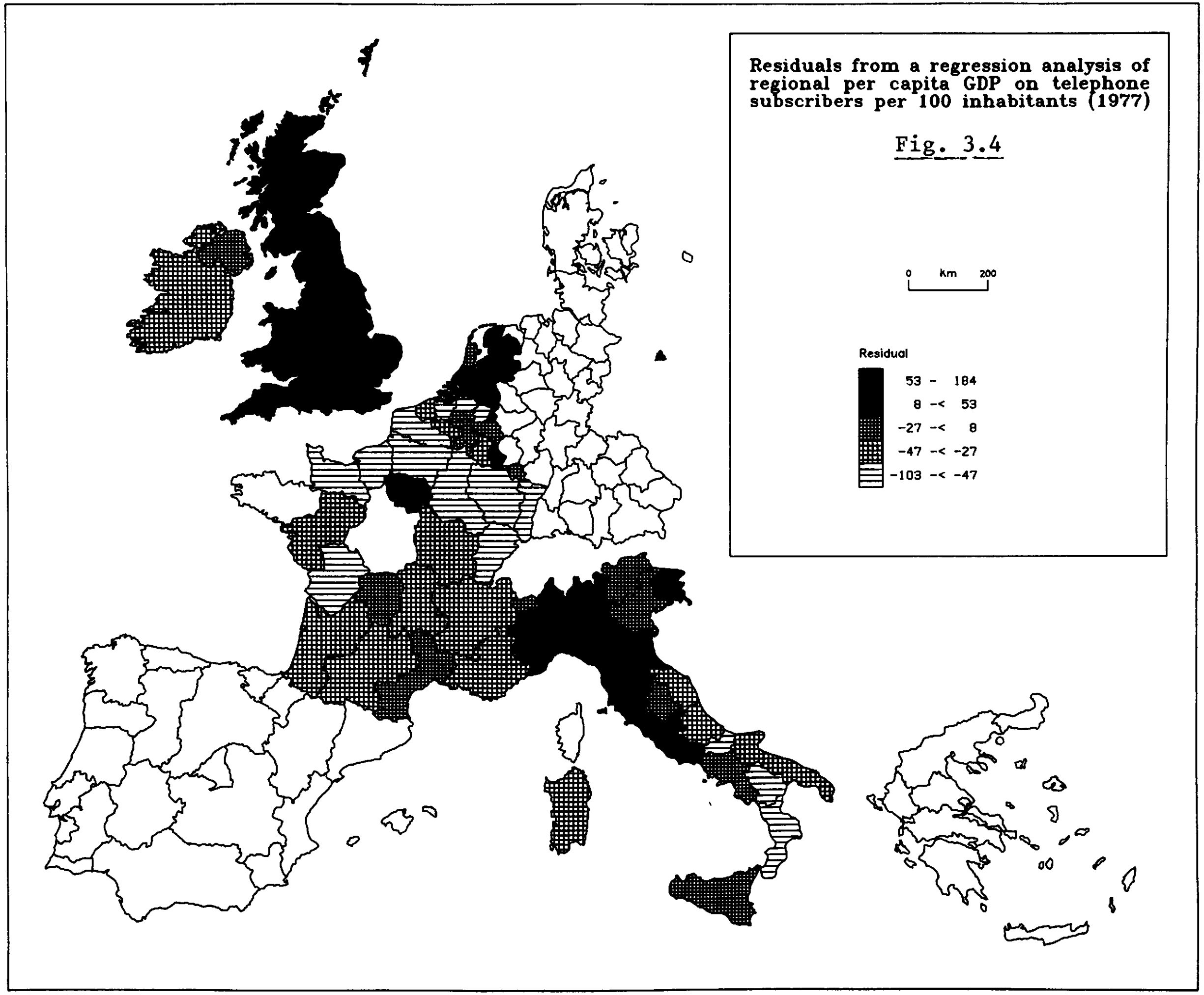
1. Data problems exclude Greece, most of Germany and Denmark from the analysis, which is undertaken on 1977 data. The Netherlands region of Groningen is also excluded because of its gas-inflated GRP.



Residuals from a regression analysis of regional per capita GDP on telephone subscribers per 100 inhabitants (1977)

Fig. 3.4

Keeble's (1981) measure of peripherality in relation to the economic heart of Europe is itself quite strongly correlated with p.c. GDP of course. Areas which do worse in terms of telephone penetration in relation to economic potential than they do for p.c. GDP include Limburg and North Brabant in the Netherlands, Paris, Brussels and South East England, while areas doing better in terms of telephone penetration include a number of French regions such as Aquitaine, Languedoc and the Cotes d'Azur, and the most peripheral UK regions of Northern Ireland and Scotland.

(c) Levels of telex penetration:

In comparison with telephone density variations, telex variations tend to accentuate the importance of business, commercial and administrative centres within the European ranking. Thus Brussels (1st) and Luxembourg (2nd) occupy much higher positions in the telex penetration ranking (Table 3.10) than they did in the telephone ranking. Overall, the 'top 20' is dominated by German and Netherlands regions, with no representation of UK or French regions other than their capital cities. The lowest telex machine densities are found in Greece and particularly in Italy (much more so than for telephone); indeed, the highest penetration Italian region, Lombardia, is ranked only 49th in European terms. A number of French regions also occupy low positions in the ranking; instead of the depressed industrial regions which featured as having low telephone density, however, it is the more rural regions without major cities which have the lowest telex machine densities, such as Franche Comte, Limousin and the Auvergne.

(d) A combined index of telecommunication penetration :

Combining the ranking of each region on both telephone and telex penetration provides a very simple composite index of telecommunications usage. Fig 3.5 plots the index in quintile groups, which shows clearly the extent to which relatively low telecommunications usage is dominated by Southern European regions, specifically in Greece and the Italian Mezzogiorno. A number of Belgium and French regions are also highlighted. Noticeably absent from the low penetration regions are German, Netherlands and Danish regions.

Table 3.10 : Number of Telex machines/1000 inhabitants

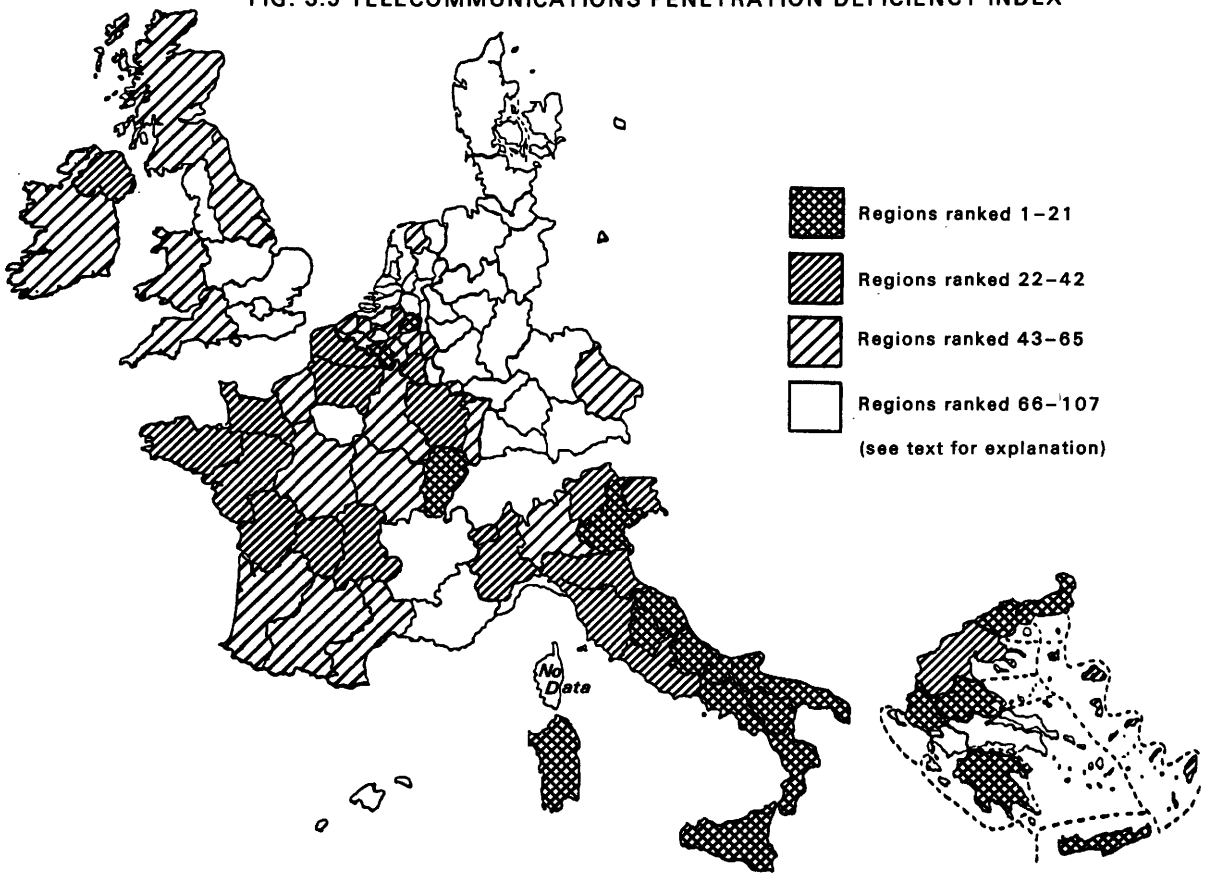
(1980 or 1981)

Top Rankings	Brussels	(B)	56
	Luxembourg	(L)	52
	Amsterdam	(N)	47
	Hamburg	(G)	43
	London	(UK)	41
	Rotterdam	(N)	37
	Antwerpen	(B)	33
	Dusseldorf	(G)	30
	Frankfurt	(G)	30
	Ile de France	(F)	30
	Munchen	(G)	26
	East Continental Greece	(H)	25
	Stuttgart	(G)	25
	Utrecht	(N)	25
	The Hague	(N)	24
	Freiburg	(G)	23
	Koln	(G)	23
	Breda	(N)	20
	Denmark	(D)	20
	Karlsruhe	(G)	20
	S'Hartogenbosch	(N)	20
	Epirus	(H)	7
	Libramont	(B)	6
	Piemonte	(I)	6*
	Thessaly	(H)	6
	Veneto	(I)	6
	Peloponese & W Cont. Greece	(H)	5
	Eastern Macedonia	(H)	5
	Thrace	(H)	5
	Marche	(I)	4
	Campania	(I)	3*
	Umbria	(I)	3*
	Abruzzi	(I)	2*
	Sardegna	(I)	2*
	Sicilia	(I)	2
	Val D'Aosta	(I)	1*
	Basilicata	(I)	1
Bottom Rankings	Calabria	(I)	1
	Molise	(I)	1

* Missing data : Estimates produced from 1977 data with a 1982 national correction factor applied.

Source : National PTTs

FIG. 3.5 TELECOMMUNICATIONS PENETRATION DEFICIENCY INDEX



3.3 Summary : telecommunications infrastructure and up-take of services

This and the previous chapter have been predicted on the assertion that modern telecommunications infrastructure is a prerequisite for the widespread adoption, and attendant commercial benefits, of new information technology. In spite of the attempts by each country to up-grade and modernise their telecommunications infrastructure, the present level of European attainment is by no means impressive by American and Japanese standards. At the same time, national and regional disparities within Europe in terms of the supply of infrastructure are showing little signs of convergence. The poor nations find the scale of investment which modern telecommunication systems demand a major drain on their resources, and frequently balance of payments as well. At the regional level, the introduction of more specialist telecommunications networks and services is highlighting the gap between advanced and less-advanced regions in terms of their market potential and hence ability to justify new investment; however, the state monopolistic supply of telecommunications which prevails in most European countries has to the present prevented any major intra-national division between regions on the basis of their supply of telecommunications infrastructure and services. Nevertheless, early evidence from the UK, which has gone furthest down the de-regulation route and which is embarking upon a major privatisation programme, suggests that the supply of telecommunications could in future be far more regionally differentiated, to the inevitable detriment of less-favoured regions, particularly those of a rural nature.

Variations between regions in the supply of infrastructure are reflected but also amplified in the up-take of telecommunications, particularly of those services and their associated network attachments such as telex machines and data terminals, which are used primarily by non-domestic customers. At the European scale it is the southern periphery of Europe which lags most noticeably behind the Community average; within each country it is the least-urbanised regions which display the lowest relative levels. Peripherality on both national and European scales is thus strongly associated with low levels of up-take of business telecommunications equipment. We believe that this differential between core and periphery is likely to pose a growing constraint on balanced regional growth, for the communication and information-gathering and

processing benefits which accrue from the adoption of NIT will themselves be regionally differentiated between core and periphery in favour of the former. Some aspects of the problems of peripheral less-favoured regions - such as their remoteness from national and international markets and from sources of specialist technical and commercial information - would seem to demand a compensating above-average up-take of 'distance-shrinking' communication technologies; the reality, however, is that such regions make the least use of telecommunications services, thereby accentuating and serving to perpetuate their remoteness from the centres of economic development and progress.

CHAPTER FOUR

EUROPEAN TELECOMMUNICATIONS TARIFFS AND THE LESS-FAVOURED REGIONS

4.1 Introduction

The level of supply of telecommunications infrastructure and the level of demand for telecommunication services cannot of course be understood without reference to price and to the structure of telecommunications tariffs. The income so derived provides investment and working capital for the PTT, while the level at which tariffs are set, and the structure of such tariffs, determine to a considerable extent the usage patterns of particular services. Tariffs usually comprise a number of elements:

- initial connection charges
- rental charges
- time/distance/volume charges

The balance between these fixed and variable costs elements will influence different types of user in different ways; for example, small firms with relatively low volumes of telecommunication traffic are likely to be deterred from using services with very high initial or fixed rental charges. Similarly, the nature of the tariff structure may also differentially affect users and use levels in different geographical locations. In the present chapter we attempt to examine whether there are any systematic geographical variations in telecommunication tariffs which operate to the detriment of Europe's peripheral and/or less-favoured regions.

4.2 Geographical variations in telecommunications tariffs

Variations between locations in the costs of telecommunicating can arise both because of national variations in the levels at which tariffs are set and also because of the operation of tariffs which are related to communication distance.

As there is no common tariff-setting body in the EEC, each PTT sets its charges entirely independently; as a result, tariffs vary substantially between countries. Examples of the variable cost element of using the telephone and telex for intra- and inter- national telecommunication are shown in Table 4.1 for a number of North European countries. For long-distance internal telephone calls, West Germany and the UK have considerably higher tariffs than do the Netherlands, Denmark and Belgium. For international communication within Europe, far less variation between the five countries is apparent; this effectively means that, relative to the cost of making long-distance internal calls, international calls from, say, Denmark appear very much more expensive (stressing in relative terms) than do international calls from Germany or the UK. The inescapable conclusion that tariffs can bear little relationship to real costs is borne out by the costs of telephone communication with the USA, which is more than four time more expensive from Germany than from the UK. For the same level of communication, enterprises in different countries are then paying widely differing tariffs. In 4.3 below we attempt to determine the net effect of these variations, having also taken into account fixed cost as well as variable cost elements.

As for variations within countries in the costs of using various telecommunication services, a number of factors are combining to reduce over time the cost-penalties associated with peripherality. Firstly, as we have seen in Chapters 2 and 3, some new telecommunication services are being charged on a volume-of-information rather than a distance-transmitted basis - examples discussed above include packet-switched data services and emerging videotex services which have distance-independent charging. Secondly, the cost of making long-distance telephone calls has tended to fall markedly in real terms, reflecting technological advances and economies of scale (Fig. 4.1, for example, indicates the long-term fall in the cost of long-distance telecommunication within the UK).

Nevertheless, the cost differential between long-distance and local telephone calls remains substantial in most countries, with the former being between four and fifteen times more expensive than the latter (Table 4.2). This serves to disadvantage in cost terms businesses in peripheral areas, especially those with non-local orientation. Taking the UK as an example, a firm located in London can reach 30% of all other firms in the country on a local call rate. This figure drops considerably in

Table 4.1 Tariffs for telephone and telex calls for selected countries

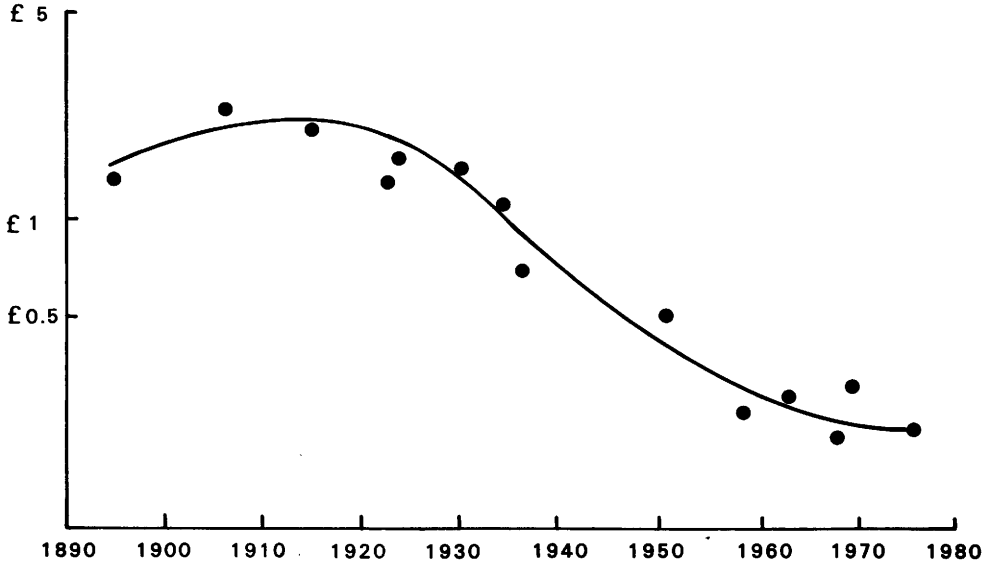
(Rates in ECUs*)

	Netherlands	Denmark	West Germany	Belgium	U.K.
Telephone					
Long-distance intra-national 3 min call	0.209	0.277	1.41	0.450	1.36
Europe	1.06	1.37	1.41 1.59	1.53	1.90
U.S.A.	7.27	4.50	12.3	8.64	2.84
Telex					
National	0.186	0.188	0.736	0.360	0.477
Europe	0.727	0.752	0.979 1.99	0.984	1.06
U.S.A.	6.29	9.02	4.05	5.83	2.12

Source: National Reports
Eurodata Yearbook 1982

*Exchange rate as at 5.1.1982

FIG. 4.1 COST TO CUSTOMER OF 3 MINUTE LONDON-GLASGOW TELEPHONE CALL



Source: C S & P Ltd. London

Table 4.2 Comparison of call tariffs for local and long-distance telephone and telex connections

	TELEPHONE	TELEX
	Ratio of cost of a local call to a 100 km call (3 minutes, peak rate)	Ratio of cost of a local call to a 100 km call (3 minutes, peak rate)
	1982	1982
Belgium	1:4	1:1
Denmark	1:8	1:1
France	1:15	1:2
West Germany	1:15	1:15
Greece	1:9	1:1
Ireland	1:9	1:1
Italy	1:10	1:2
Netherlands	1:4	1:1
U.K.	1:9	1:3

Source: Eurodata Foundation Yearbook 1982

peripheral regions, and in some areas is under 1%. The same pattern of contact will thus be very much more expensive if undertaken from a peripheral as opposed to a core region. The differential is less apparent for telex communication, as the distance/charging rate gradient is much more even (Table 4.2). Indeed, in Belgium, Denmark, the Netherlands, Greece and Ireland, a 100 km call costs no more than a local call.

4.3 An index of telecommunications costs for European regions

In order to examine more systematically the extent of regional variations in telecommunications costs, an attempt was made to devise a measure of what can be described as market accessibility via telecommunications. A previous research report in this series (Keeble, 1981) has defined the concept of peripherality in Europe on the basis of relative accessibility to economic activity - i.e. an economic potential measure (Harris, 1954; Clark, 1966; Rich, 1975 and 1980), with geographical road distance as the exponent of transport cost. Geographical distance is of course just one of a number of measures of accessibility, a surrogate in this case for the cost of transporting goods. In the present study we are concerned with communication in the sense of the conveyance of information rather than with the physical transport of commodities; telecommunication is the main channel for communicating information between different locations, and here we are fortunate in having readily available information from PTTs on the precise costs of telecommunicating between any two places. We are consequently able to derive a telecommunication cost measure of regional economic potential.

4.3.1 Methodology

The main methodological issue was to design an index of telecommunication costs which would be measured for each region of the EEC. In principle, the index for each region was defined as the average cost of communicating within the region and to each other region, although certain simplifying assumptions were necessary to produce commensurable measures. The costs index represents the costs of the three most commonly used telecommunications services, namely telephone, telex and data. Two sets of costs were calculated for each of these services, representing the fixed

costs associated specifically with using the telecommunications service and the variable costs of making average length calls (Table 4.3). In calculating the average cost of making calls to other regions, the regions have been weighted according to their respective populations, irrespective of the distances involved. This means that the results are illustrative of tariff differences, rather than representative of expenditure under actual traffic patterns (about which we have no information).

As well as producing separate average cost indices for telephone, telex and data communication, an overall cost index is produced by combining the costs of using each service so as to represent a hypothetical 'Eurofirm' with 5 telephone lines, one telex machine and one data terminal with appropriate annual usage levels and hence variable costs.[1] In the results summarised below, we concentrate on this overall telecommunications cost index.

4.3.2 Variations between countries

Table 4.4 (Column a) shows the overall cost index for each country expressed in relative terms such that the 'worst' (i.e. most expensive case) is given the value of 100.

The variation is considerable; Luxembourg, the best case, has costs amounting to only 43% of those found in the worst case, the Republic of Ireland. Ireland and Greece have noticeably higher cost indices than the remaining countries, with Germany, the UK and Italy also being above the average.

There is then a clear tendency for Europe's peripheral and less-favoured nations to have higher telecommunications costs than those located centrally. These higher costs arise from a combination of geographical and technical/economic effects; the simple geographical effect is because a large part of (variable) communication costs depend on the transmission distances involved, and peripherally located countries must, ceterus

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1. The assumptions were that 19,000 telephone calls would be made, 1850 telex calls and 1000 data calls.

Table 4.3 : Costs Used to Represent Telecommunications Costs

Telephone		Telex		Data	
Fixed Costs	Variable Costs	Fixed Costs	Variable Costs	Fixed Costs	Variable Costs
Rental of one telephone for a year and connection charge amortised over five years	"Smoothed" cost of a three minute call	Line rental and Terminal rental and Annual Maintenance Costs	Smoothed costs of a three minute call	Rental of low speed data line and Modem rental and Amortised connection charges and Amortised Registration fees	Cost of a 15 minute call and cost of transmitting 560 segments of data and Access cost to packet-switched network, where appropriate

Table 4.4 : Summary of comparative telecommunication costs : a - Overall costs index; b - Telephone costs; c - Telex costs; d - Data costs.

(Costs are expressed as percentages of the highest cost in each column)

COUNTRY	Overall Costs		Telephone Costs		Telex Costs	Data Costs	
	Low	High	Low	High		Low	High
Belgium	67.2	67.5	65.1	65.3	71.4	30.9	30.9
Denmark	46.5	46.6	44.3	44.4	66.5	18.5	18.5
France	60.5	62.0	55.8	57.9	81.7	34.9	34.9
FR Germany	77.7	79.9	78.1	80.6	80.9	22.2	22.2
Greece	89.8	90.3	77.1	77.6	64.3	99.2	100.0
Ireland	100.0	100.0	100.0	100.0	98.1	33.1	33.1
Italy	71.8	72.8	70.7	71.5	96.6	19.7	21.0
Luxembourg	43.2	43.2	40.3	40.3	56.0	22.7	22.7
Netherlands	52.2	52.2	46.4	46.4	62.8	40.4	40.8
U.K.	72.1	75.7	69.9	72.0	100.0	24.0	33.1

Source : CS & P/CURDS Tariffs Case Study

paribus, therefore set higher international tariffs to cover costs. A compounding effect is that the centrally located countries in Europe tend also to be the wealthiest, and have the most modern equipment, thereby enabling them to offer cheaper tariffs. The main exception to the inverse relationship between level of wealth and telecommunication costs is provided by Germany, which has both high GDP and high costs. The reason for this lies in the DBP's policy of excellence, with considerable investments in new technology, partly in the hope of setting new standards which other PTTs would follow. Whether these export markets will in fact materialise remains to be seen however.

The overall index disguises some rather different patterns when telephone, telex and data are looked at separately. Table 4.5 shows the countries ranked according to their overall communication costs and to the cost of each service (1 = cheapest, 10 = most expensive). The table indicates that a country does not necessarily perform equally well in each service. The national average telephone cost indices are similar to the pattern of variation in overall costs, reflecting the weighting used in producing the overall costs index. Variations in telex costs are very different from the pattern which applied to the telephone figures, in that the peripheral countries are not disadvantaged. This is because the variable costs of telex transmission are cheaper than for telephone transmission, but telex terminals are a more expensive fixed cost item. The variation in telex costs must be assumed to be largely due to national PTT policies. It should be noted that although the UK emerges as the country with the highest telex costs index, a different pattern would result if tariff costs to the USA were taken into account, for the cost of telex calls from the UK to the USA is extremely low, as shown in Table 4.6.

Variations between countries in the data costs index are comparatively narrow (Table 4.4, Column d), with Greece providing the major exception; its data index is between 2 and 5 times higher than the other Community countries. The reason is that Greece is the only country of the 10 from which an international packet-switched service is not yet available (at the time of writing), and the costs measured in the data index are consequently the costs of using the Public Switched Telephone Network (PSTN) as a data network. This is much more expensive than packet-switching over long

Table 4.5 : National average of telecommunication costs

(1 = cheapest, 10 = most expensive)

Country	Overall Costs	Telephone Costs	Telex Costs	Data Costs
Belgium	5	5	5	6
Denmark	2	2	4	1
France	4	4	7	8
FR Germany	8	9	6	3
Greece	9	8	3	10
Ireland	10	10	9	7
Italy	6	7	8	2
Luxembourg	1	1	1	4
Netherlands	3	3	2	9
U.K.	7	6	10	5

Source : CS & P/CURDS

Table 4.6 : Costs of Telex Calls to the USA

Country	Cost per minute (ECU's)
Belgium	1.7
Denmark	1.5
France	1.2
FR Germany	1.4
Greece	2.2
Ireland	2.2
Italy	1.6
Luxembourg	1.7
Netherlands	1.9
UK	0.7

Source : CS & P 1983

distances, as packet-switching tariffs are independent of the distance over which a call is made. With the exception of Greece, there is no tendency for outlying countries to have higher costs. The variations in the index figure for the nine countries using packet-switching are mainly due to variations in the tariffs charged by the PTTs for access to the International Packet Switched Services or Euronet. These variations must be ascribed in the main to PTT policies.

4.3.3. Variations within countries

Regional variations within countries are considerably less substantial than are the national differences. It should be stressed that this is entirely expected given what we are actually measuring; i.e. the average costs of telecommunicating from one region to all other regions in Europe, weighted by population size. Since it costs the same to ring a foreign country regardless of which 'home' region the call originates from (with a few exceptions for certain border zones in which lower rates apply), then the only source of regional variation within a country is the varying costs of intra-national communication, which in the overall index are swamped by the international cost elements, uniform to each region.

Considering the overall telecommunication cost index, only 4 countries have an internal difference in excess of 1.0 index point. The UK has the largest internal cost differences, with the most peripherally located region being 3.6 points more expensive than the South East, while Germany, France and Italy also have significant internal differences (reflecting essentially the greater relative importance, due to their size, of intra-national tariff costs within the overall index). Because of the service weighting used in the overall index, the regional variations found are due primarily to the geographically differentiated costs of using the telephone service. Because of distance-related variable cost tariff structures, the more distant a community is from the country's urban areas, the higher the tariffs that members of that community must pay on average for calls to other subscribers. Thus, the peripheral regions of a country tend to be disadvantaged relative to the central parts. The disadvantage is made more severe if the PTT has a policy of subsidising local call charges by setting long-distance tariffs disproportionately high.

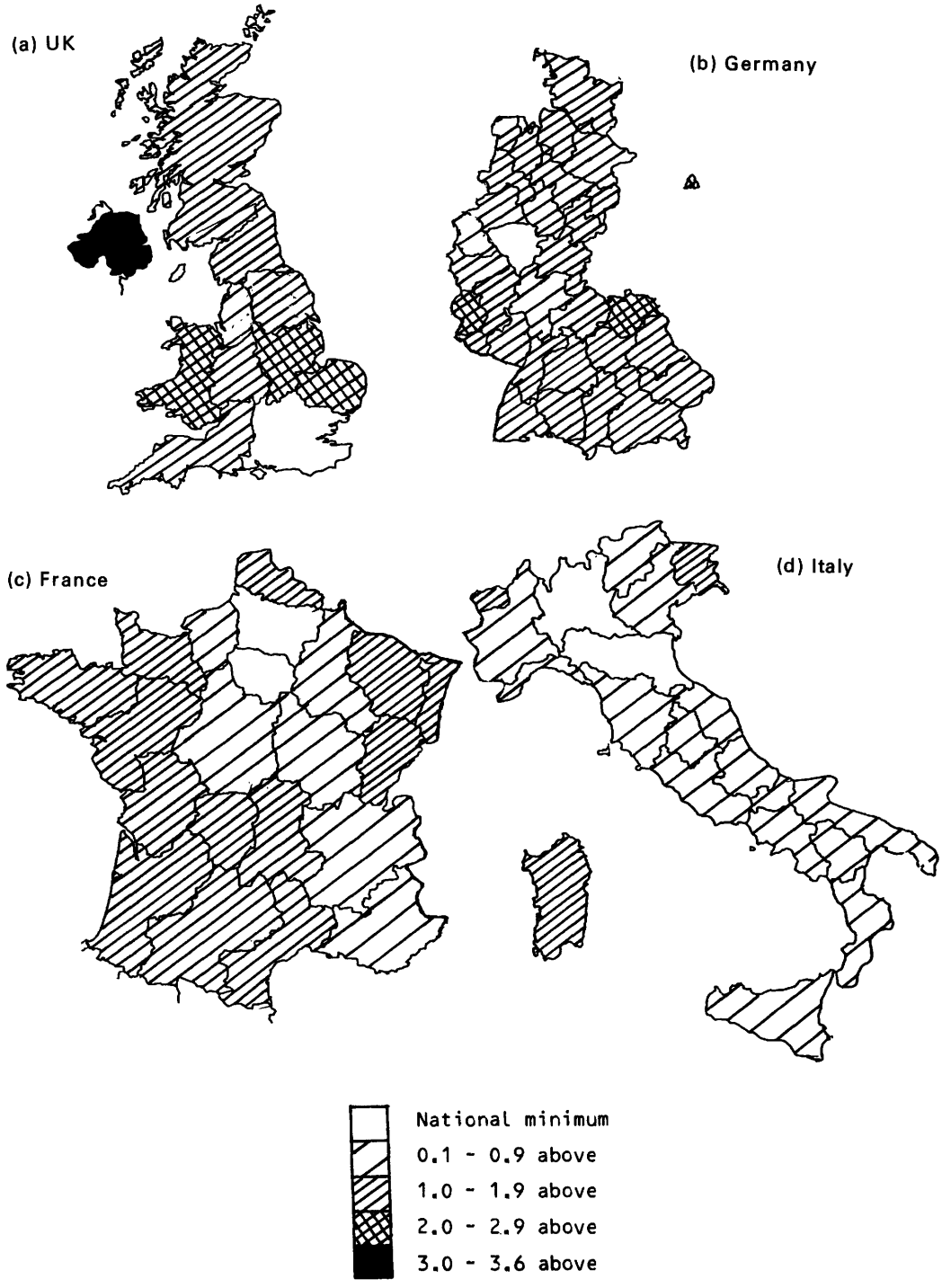
The pattern of variation within the UK demonstrates the effect, and is shown in Fig. 4.2 a). The cheapest region is the South-East, where a large proportion of businesses can call the London area at the cheapest tariff. The regions further from London are progressively more disadvantaged, the worst case being Northern Ireland. There is a local minimum in the North West, where there is the secondary centre of industrial Lancashire/Cheshire and Manchester.

Germany shows a similar effect (Fig. 4.2 b), where the centre is the area around the Ruhr. The differences between centre and extremities are more marked for German telephone costs than for any other country's. The pattern of local minima is more complex than was the case in the UK. France shows a similar pattern (Fig. 4.2 c), centred on Paris and the North, and Italy has a pattern (Fig. 4.2 d) which is less marked, centred on the main industrial areas in the North.

It is worth noting that with the decreasing importance of transmission costs (compared to costs of switching and local distribution equipment) the countries with the most modern equipment should be able to operate with the least regional discrimination. The large regional differences within the UK, for example, are generated to a large extent by the PTT's policy of subsidising local calls with profits made on long-distance calls.

With respect to the data communication cost index, in most countries there is little if any internal variation, because of the distance-independent tariff structure of packet-switched services. For different reasons, Greece, Italy and the UK provide exceptions (see Table 4.4, Column d). In Greece and Italy, all internal data calls are made by the PSTN and the regional pattern of variation is consequently as pronounced as it is for telephone calls. The UK is unusual in having a packet switched service with considerable internal variations in the cost of using it; in order to access the network, the user must make a telephone call to the nearest Packet Switching Exchange (PSE); since there are no PSEs in Northern Ireland, the East Midlands or Wales, these regions are disadvantaged in costs terms by having to make long-distance calls to their nearest PSE.

FIG. 4.2 INTERNAL VARIATIONS IN TARIFF INDEX FOR SELECTED COUNTRIES
(number of points above national minimum)



4.3.4 Estimating the economic significance of tariff variations

The study did attempt to assess the importance of the range of tariff variations between countries and regions summarised above. The approach adopted was basically micro-economic, looking at the effect of variation in telecommunication costs on profitability. As a generalisation, most accurate for smaller firms in the commercial and service sectors, a firm can be expected to spend up to 5% of turnover on telecommunications, or around one-third of net profits. Thus, and very crudely, a given percentage variation in telecommunication costs should be translated approximately into a percentage change in profits of one-third of the magnitude.

For the hypothetical 'Eurofirm', which is equally likely to communicate with firms in any part of the EEC, and which uses telephone, telex and data services in the proportions used in our cost indices, ceterus paribus a location in Ireland could affect profits by - 13% while a location in Denmark could have an effect of +12%. For such a firm, the location within a given country would be far less important; in the UK, which has the widest internal variation in the overall costs index, a location in Northern Ireland might have an effect of only -2% on profits compared with a location in the South East (again with the ceterus paribus assumption). In reality of course, most firms will be telecommunicating much more within their country of location than with other countries, and thus the importance of intra-national cost variations will be considerably greater than in our hypothetical 'Eurofirm'.

In conclusion, there is clearly a need for further work in relation to the effect of telecommunication cost variations on firm profitability in different locations; we may conclude at this juncture however that substantial variations in costs do exist, with peripheral and less prosperous parts of the Community having to bear higher tariffs than their centrally located and more prosperous counterparts. To the extent that developments in information technology and in its applications necessitate the use of telecommunications services, therefore, the existing situation with respect to tariff structures would seem to disadvantage the peripheral regions of the Community by imposing cost penalties on their use of NIT.

CHAPTER FIVE

THE PRODUCTION OF NEW INFORMATION TECHNOLOGY

5.1 Introduction

One of the most crucial issues concerning new information technology is where the actual production of the hardware and software will take place. The perceived importance of this in national terms is exemplified by a statement by Kenneth Baker, Minister for Information Technology in the UK, who said:

> "Without doubt [Information Technology] will be the engine of economic growth for at least the rest of the century. Britain's economic prosperity depends on the success with which we manufacture its products and provide and exploit its services" (quoted in English, 1983).

Certainly the scale of the world market for NIT products and its projected growth record would lend support to this view. The world market is projected to double in constant price terms between 1980 and 1985, from £54 billion to £105 billion, an annual growth rate of 14% (PACTEL, 1981). The Western European share of this global market is expected to rise slightly over the period, from 29% to 32%. In employment terms, it has been estimated that currently 5% of the EEC's workforce are engaged in the manufacture of NIT (CEC, 1984).

The sectoral breakdown of the world IT market is shown in Table 5.1. Computer equipment accounts for more than one half of the total market, with computer services having a further sixth of the total. Telecommunications equipment is also a major market segment in its own right, although it is recording slower growth than the other segments of the market. It is possible to draw a distinction, by no means clear-cut but still of some validity, between the hardware aspects of IT production - primarily the manufacture of computer and telecommunications equipment - and the software aspects, subsumed within the broader heading of computer services. The sections below maintain then a separate treatment of the IT manufacturing industry and the computer services industry, and proceed to examine some of the geographical aspects of the production of NIT.

Table 5.1 : IT market: summary of worldwide annual shipments (constant 1980 prices)

	£ Billions per Annum 1980	1985	Average annual growth rate
Computer Equipment	31.1	62.0	14.8%
Computer Services	8.5	17.3	15.3%
Word Processing	1.0	4.3	34.7%
Business Communications	3.3	5.4	10.0%
Data Transmission Equipment	0.6	1.2	14.8%
Public Network Equipment	9.9	14.5	7.9%
TOTAL	54.4	104.7	14.0%

Source : PACTEL (1981)

Obviously from the point of view of the regional development objectives of the less-favoured regions of the Community, there is a desire that such regions should share in the production of NIT and in the attendant wealth and job creation. Against this understandable desire, however, it must be remembered that the key battle over the geography of NIT production is being waged not between different regions within Europe but between a comparatively small number of Japanese, American and European companies, in which the former have clear ascendency. As it has been recently starkly put in a report prepared for the Joint Economic Committee of the US Congress (1982),

> "the competitive battle for leadership in this industry [the semiconductor industry] has become a fight between American and Japanese producers fought out in American and European markets" (quoted in English, 1983, p 17).

Thus it may be concluded that the issue of where within Europe production will be located is secondary to the prime concern of whether Europe will be able to maintain, in any meaningful sense, an IT manufacturing industry at all.

5.2 The manufacture of new information technology

5.2.1 The competitive position of European manufacturers

Only two European companies (Philips and Siemens) appear in the world's top ten IT producers in terms of turnover, and even in the top fifty only sixteen are of European ownership (Pactel, 1981). English (1983) has reviewed the current situation in European and world data processing, semiconductor and telecommunications equipment markets, and we can do no better than to extensively quote from him below:

(a) Data processing

"IBM dominates world data processing markets with 60% of total value, and Burroughs, Honeywell, NCR, CDC and DEC have substantial shares. These firms set price levels, standards and performance.... A powerful de facto standardisation exists, principally IBM but CDC and DEC standards exist in

limited areas. Peripherals market competitors must conform to these standards or expect a minimal market share. IBM has the first place in every European EDP market and in some cases well over half the total... The major Member States have national champions, each strong and comfortable on home markets, each weak outside, even in European markets, once they are exposed to the cold winds of the real world in which Japanese and American products demonstrate, all too frequently, their greater competitivity. With the exception of Olivetti in France no European firm is in the top three outside its home country... West Germany has failed to develop a strong computer industry in spite of $1.6 billion in government support 1967 - 1982. The eight main German-owned computer manufacturers accounted for less than 40% of the 1980 domestic production... [Siemens] computer business is less than 3% of IBM's revenue and is still losing money... In France, CII Honeywell Bull, the heavy loss-making state controlled computer group has said it will remain in the red until 1986 at least".

(b) Semiconductors

"The European electronics industry in this strategically critical area is basically extremely weak, particularly in the mass markets vital for many applications and electronics products. The United States and Japan together can control about 90% of the world integrated circuit production... European companies have had to invest heavily in US semi-conductor companies to gain access to technology and leadingedge customers... Despite 64K RAM production by Sieman's and INMOS, we should have no illusions; Europe's production levels are miniscule and far behind the learning curve which foresees a 30% reduction in production costs for each doubling of production."

(c) Telecommunications

"In today's increasingly competitive world markets established positions are being challenged... European PTTs have neither aggressively stimulated IT technology and applications nor served as demanding leading edge customers of European IT companies. Rather than contributing to the development of a competitive European telecommunications industry, the policies have generally slowed progress and fragmented the European market... Most European PTTs are well behind the US in introducing new technology in their networks... Individual national markets are not large

enough to cover the development costs of a number of telecommunications products. The cost of new lines of digital networks, including software development and maintenance costs range from $700 million to $1 billion. At the normal 7% of sales devoted to research, the sales required to justify the research and development are almost $16 billion. That is well over the size of the largest European national market (McKinsey & Co, 1983). These figures emphasize the importance of creating an effective 'European' market for these products, particularly if they are to be price competitive on international markets" (English, 1983).

5.2.2 The potential for small and medium-sized enterprises within new information technology manufacturing

It can be argued, notwithstanding the need to develop companies of a sufficient scale to compete with their non-European counterparts, that NIT will lead to a more equitable 'division of labour' between different companies (and by implication different regions) because of the opportunities created for highly innovative small firms to grow rapidly by developing new products. Under this scenario, one of the main impacts on NIT production industries will be to make markets more competitive (with the single exception of the telecommunications industry, in which a marked increase in technical economies of scale is expected to reinforce existing oligopolies). The following factors are thought likely to have the effect of reducing entry barriers in NIT production industries:

- The reduced role of manufacturing in relation to R & D and commercial activities, which reduces the relative importance of production scale economies.

- The increased rate of technological innovation, which makes it increasingly difficult for any one firm to maintain technological leadership for any length of time.

- The redefinition of markets, brought about through the convergence of information transmission and processing technologies, which has led to a considerable overlapping of interests of firms in previously distinct market areas.

- New opportunities for small and medium-sized firms, through a reduction in the optimal scale of production, brought about by a reduction in fixed capital requirements.

In spite of these influences, evidence indicating the growth of more competitive market structures in NIT manufacturing industries is notably lacking. Evidence from the UK does point to the declining concentration in telecommunications and electronic computers during the 1970s, but only in the latter industry does this appear to be primarily the result of the entry of new enterprises. In telecommunications, concentration declined primarily as a result of a higher level of rationalisation undertaken by the five largest firms in the industry (Table 5.2). Evidence from the United States (Lamborghini and Antonelli, 1981) suggests that it is only in the small business computer market that the entry of new enterprises has produced a more competitive situation; in mini- and mainframe computer markets concentration has continued to increase during the 1970s.

These trends suggest that important countervailing tendencies are at work which modify the impact of the factors listed above:

- increased specialisation by small companies resulting in higher concentration in individual product markets

- oligopolistic reaction to increased competitive pressures,including more intensive R & D spending, monopolisation of sales outlets and absorption of new products from small firms through takeovers. An example is provided by Olivetti's entry into the Italian micro-computer market by means of a three-pronged strategy:

  (i) intensified R & D spending to produce a more competitive product

  (ii) construction of a nationwide marketing network

  (iii) external technological growth through acquisition of small innovative companies

- monopsonic situations prevailing in most national telecommunications markets where PTTs control the investment strategies of major firms and effectively exclude SMEs from important sections of IT markets.

Table 5.2 : Changes in Five Firm Concentration Ratios of Telecommunications (363) and Electronic Computers (366), 1971-78 in the UK

	Establishments		Employment (000)		Net Out £m	
	N	%		%		%
363						
1971	31	20.5	90.4	92	185.5	93
1978	29	20.1	57.5	85	373.3	84
71-78		- 0.4		- 7		- 9
366						
1971	14	14.7	19.4	83	63.7	84
1978	8	5.2	16.6	69	347.9	81
71-78		- 9.5		- 14		- 3

Source : Census of Production, PA1002, Table 13.

5.2.3 The regional concentration of new information technology manufacturing

NIT Manufacturing industries are highly concentrated in national metropolitan regions (e.g. Greater London and Greater Paris) or major industrial agglomerations (Northern Italy and West Germany). The following indicators graphically illustrate the high degree of localisation characteristic of these sectors:

- in the United Kingdom, approximately half of all establishments manufacturing electronic computers and telecommunications equipment were located in the South East planning region in 1979 (Table 5.3).

- in France, Greater Paris accounts for 80% of innovations in IT industries, and 60% of computer and component manufacturing employees.

The reasons for this high degree of geographical concentration are considered to be:

- the high levels of industrial concentration prevailing in these sectors resulting in a high degree of centralisation of corporate headquarters and research and development activities in national core regions.

- the introduction by major firms of production hierarchies into their manufacturing operations with new, technologically advanced products produced in close proximity to R & D facilities in core regions and more mature products in more peripheral regions which often have capital or labour cost advantages for mass production. One clear example of the 'R & D proximity' factor is seen in the location in the UK of the emerging satellite industry (Fig. 5.1; Meegan, 1982). Production is concentrated in the South East/South West 'high technology' belt near to London in close proximity to the R & D laboratories not only of the major companies (British Aerospace Space & Communication Division, and Marconi Space & Defence Systems) but also the major public-funded research centres into satellites (at Oxford and Farnborough). As Meegan (1982) puts it, "the peripheral regions and the older industrial areas within them, do not feature".

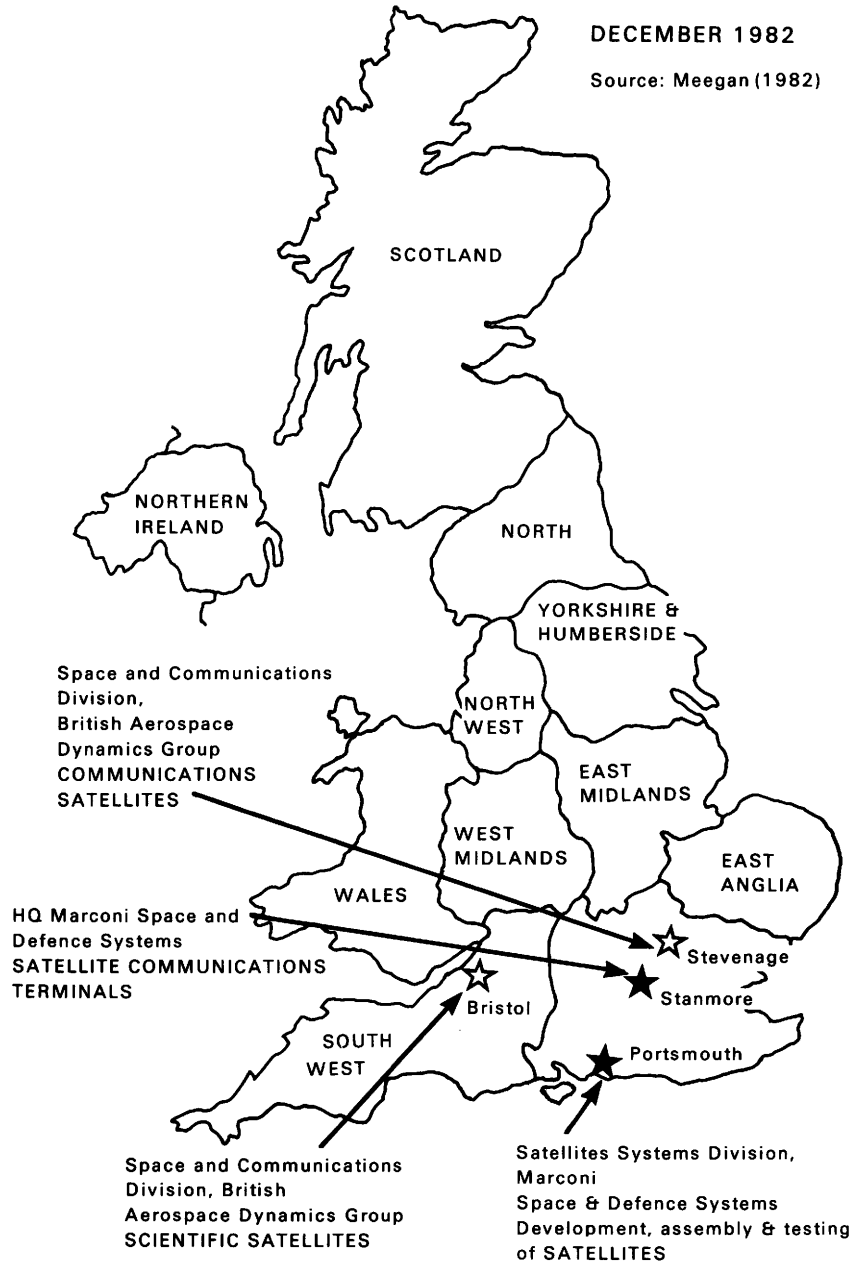
Table 5.3 :Ownership Structure of the Telecommunications (363) and Electronic Computer (366) Industries by Region, 1979 (in the UK)

Region	SMEs*				UK Branches				Foreign Branches				Total			
	363		366		363		366		363		366		363		366	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
South East	13	(62)	9	(69)	21	(37)	15	(54)	15	(56)	7	(54)	49	(47)	31	(57)
Other Non-Assisted Areas	7	(33)	4	(31)	11	(19)	8	(29)	4	(15)	2	(15)	22	(21)	14	(26)
Assisted Areas	1	(5)	0	(0)	25	(44)	5	(17)	8	(29)	4	(31)	34	(32)	9	(17)
Total UK	21	(100)	13	(100)	57	(100)	28	(100)	27	(100)	13	(100)	105	(100)	54	(100)

Sources: Census of Production List of Classified Businesses, 1979.
Who Owns Whom 1978/9.

Note: * Defined as enterprises with five or less subsidiaries in the United Kingdom where a manufacturing plant is in same region as headquarters.

FIG. 5.1 : THE LOCATION OF MAJOR SATELLITE-MANUFACTURING PLANTS



. resulting from the concentration of corporate R & D, purchasing and marketing activities in central regions, greater external economies are available to small firms in these regions. Peripheral regions dominated by production-only branch plants are characterised by weak development of SMEs in these industries (Table 5.3) partly because of the external linkages of larger enterprises.

Concerning the issue of whether NIT manufacturing industries are becoming more or less concentrated over time in the central regions of national economies, more evidence is needed before any generalised conclusions can be drawn. Certainly as far as the first manufacture of new products are concerned, the available evidence suggests that the core regions, with their existing R & D infrastructure and the greatest pools of highly qualified professional, scientific and technical manpower, are likely to maintain their pre-eminence. We can see no likelihood that peripheral regions of national economies are likely to participate in any major sense in the 'high-tech' end of NIT, unless they already have an established capacity in NIT (such as Scotland within the UK, in which the concentration of electronics firms has given rise to the label 'Silicon Glen') or unless they have other particular combinations of features which enables them to attract the professional and scientific staff to live there (such as the 'sun belt' growth of the South of France).

However, not all jobs involved in NIT production are of this highly specialised sort; once products have passed their development stages and enter their mature production phase, other types of labour are required and different locational determinants can come into play. In the pre-electronics era such labour requirements were frequently for highly skilled manual craft workers; in the UK, this led to the growth of employment in the assisted area regions with their concentrations of available skilled labour. Telecommunications provides a good example of this process, with substantial assisted area employment growth in the (early) 1960s (Table 5.4; Meegan, 1982). Taking the decade as a whole, the Development Areas (Das) received some 75% of the overall net increase in jobs in telecommunications, shifting their share of the industry from 30% to 46%. However, within the major companies, clear spatial production hierarchies were associated with these developments, with the DAs being allocated mainly Strowger and Crossbar assembly work. The oldest technology embodied in Strowger exchanges "tended to be located where there

Table 5.4 : Regional distribution of employment ('000) in the telecommunications industry (MLH 363, 1968 Standard Industrial Classification), 1952, 1960, 1966, 1971 and 1973 (suppressed data shown by *)

Regions	1952		1960		1966		1971		1973	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
North	4.1	(7.3)	4.8	(7.7)	13.1	(13.5)	14.8	(15.3)	17.1	(16.9)
North West	10.4	(18.5)	12.2	(19.6)	17.5	(18.1)	18.5	(19.2)	18.0	(17.8)
Wales	1.4	(2.5)	1.2	(1.9)	3.6	(3.7)	2.7	(2.8)	3.5	(3.5)
Scotland	0.1	(0.2)	0.2	(0.3)	1.6	(1.7)	3.8	(3.9)	4.2	(4.1)
Northern Ireland	0	(0)	0.1	(0.2)	3.6	(3.7)	4.4	(4.6)	4.8	(4.7)
DEVELOPMENT AREAS	16.0	(28.5)	18.5	(29.6)	39.4	(40.7)	44.2	(45.8)	47.6	(46.9)
Yorkshire & Humberside	0.5	(0.9)	0.2	(0.3)	0.4	(0.4)	0.7	(0.7)	*	*
East Midlands	5.1	(9.1)	7.4	(11.9)	9.0	(9.3)	8.1	(8.4)	8.2	(8.1)
East Anglia	0.1	(0.2)	0.4	(0.6)	0.1	(0.1)	1.2	(1.2)	*	*
South East	23.8	(42.4)	25.7	(41.2)	32.6	(33.7)	22.6	(23.3)	24.5	(24.2)
South West	0	(0)	0.2	(0.3)	0.4	(0.4)	1.1	(1.1)	*	*
West Midlands	10.5	(18.7)	10.1	(16.2)	14.9	(15.4)	18.6	(19.3)	19.7	(19.4)
NON-DEVELOPMENT AREAS	40.0	(71.3)	44.0	(70.5)	57.4	(59.4)	52.3	(54.1)	53.8	(53.1)
UNITED KINGDOM	56.1	(100.0)	62.4	(100.0)	96.7	(100.0)	96.6	(100.0)	101.4	(100.0)

Source : Meegan (1982) from Fothergill, S and Gudgin, G (1978) 'Regional employment statistics on a comparable basis, 1952-1975', CES Occasional Paper 8, London.

were available supplies of workers with traditional electrical and mechanical engineering skills. For GEC this was the North and for Plessey it was Merseyside... Research into digital electronic equipment was concentrated in non-Assisted Areas". (Meegan, 1982, p 30).

However, when in the mid-1970s excess capacity became a problem, subsequent cuts came in precisely those lines of production upon which the Development Area plants were most dependent; Crossbar and Stowger equipment. A number of plants were closed in the re-organisation of telecommunication production, and by 1981 the DAs share of total employment had fallen back to 35%. Thus even in situations in which less favoured regions have gained through production decentralization, the type of mature product they have obtained does not generally provide an adequate basis for long-term stability or for the development of new advanced products. Further, as product lines have shifted from electro-mechanical to electronic, so the skilled craft labour of the assisted area regions becomes less relevant to production requirements; electronics is characterised by a polarized workforce with concentrations of scientists and technologists on the one hand and semi-skilled assembly labour on the other, but comparatively few skilled manual workers. Other locational factors consequently hold sway. In the UK, the production of both telecommunications and electronic computers seems to have decentralized strongly out of London, but to the surrounding high-amenity areas of the South East rather than to the more distant Assisted Areas (Table 5.5). Thus between 1968 and 1979, the Outer Metropolitan Area of the South East increased its share of computer production from 41% to 48% of the national total, while the Assisted Areas' share slumped from 25% to 17% (CURDS, 1982). The situation can of course change rapidly, and anyway differs from country to country. However, on the basis of the trends observable and on the factors underlying them, we do not envisage that Europe's less-favoured regions are likely to benefit to any great extent by decentralization from core regions, nor do they seem to possess the basis (with one or two exceptions) for developing their own indigenous NIT production industries. The self-perpetuating dominance of core regions in this respect will continue, fuelled by the concentrations of research and development activity within them.

Table 5.5 : Changes in the Location of Telecommunications and Electronic Computer Establishments by Region, 1968-1979 (in the UK)

	Telecommunications				Electronic Computers			
	1968		1979		1968		1979	
	No	%	No	%	No	%	No	%
GLC	20	28	27	26	6	18	5	9
OMA	10	14	21	20	13	41	26	48
Total (South East)	30	42	48	46	19	59	31	57
Rest of Non-Assisted Areas	13	18	22	21	5	16	14	26
Assisted Areas	28	40	34	33	8	25	9	17
TOTAL (United Kingdom)	71	100	104	100	32	100	54	100

Source : Census of Production 1968 Directory of Businesses
1979 Classified List of Businesses

5.3 The computer services industry

5.3.1 The characteristics of the market

While most of the concern for the locational attributes of NIT production has concentrated on hardware manufacturing, the software side has received remarkably little attention given its scale and impressive growth record. A recent study of the micro-computer market noted that software costs are now a significant proportion of the system value - about 45% with only 20% representing the cost of hardware and the remaining 35% being absorbed in sales, distribution and marketing costs. The market for computer services constitutes an important segment of the total IT market, accounting for approximately 15% of worldwide IT sales (see Table 5.1). In 1980, the world computer services market was worth $8.5 billion, with batch services and software services making up most of this total. However, the fastest growing sector of the market is for software products (ECSA, 1981). It has been estimated that the software products worldwide market will grow from $5.5 billion in 1982 to $27.5 billion in 1987, a 38% annual average growth rate (Financial Times, 1983).

In comparison with Europe's competitive position in the manufacturing of computers, the European computer services industry is in a far healthier state. Although the single largest company operating in Europe is again IBM (IBM Remote and Batch Computing Services), only two other US-owned companies feature in the European 'top-twenty' by total revenue (Table 5.6). French companies are particularly prevalent with ten of the top twenty places. As the market for software products continues its explosive growth, considerable opportunities are presented for small companies to achieve market breakthrough with a new product. One of the more extreme examples of such success is the 1-2-3 integrated software package from Lotus, which by October 1983 was topping the US microcomputer charts even though the company was only formed in 1982.

The computer services industry is already an important employer. A study carried out by Quantum Science Ltd (1981) for the European Computer Services Association estimated that France had the largest computer service industry, followed by the UK. They estimated on the basis of an analysis of the major firms that in 1981 there were 34,500 employed in France and

Table 5.6

TOP 20 COMPUTER SERVICES COMPANIES IN WESTERN EUROPE (1982)

Company	Country of majority sharehldg.	Owned by	Services*				Employees	Total revenue ($m)
			RCS	BATCH	SP	SS		
IBM RCS[1]	U.S.	Public corporation	X	X			n.a.	180.0
Scicon Group	U.K.	BP	X	X	X	X	3,500	175.4
SG2 Group	France	Societe Generale/Private	X	X	X	X	4,290	165.4
CISI	France	CEA (Government/BNP)	X	X		X	2,700	162.7
Cap/Gemini/Sogeti	France	Independent			X	X	4,000	155.7
Gelsco	U.S.	General Electric	X		X	X	1,200	150.0
Finsiel Group	Italy	IRI/Banca d'Italia				X	2,320	139.3
GSI	France	CGE	X	X	X	X	2,350	138.2
Datev	Germany	Tax Advisors Co-operative	X	X		X	1,830	101.2
Sema Metra Internatnl[†]	France	Paribas		X	X	X	1,400	88.6
CCMC	France	Public Accountants/Staff/ Societe Generale (F)	X	X			1,180	81.0
Control Data	U.S.	Public corporation	X	X	X	X	1,100	74.4
Thomson Informatique[‡]	France	Thomson-CSF			X	X	1,750	74.1
Datema	Sweden	Johnsson Group	X	X		X	1,100	73.8
Telesystemes	France	PTT	X	X		X	1,590	73.6
Sligos Group	France	Credit Lyonnais/Tymshare	X	X	X	X	1,690	68.3
CIG	Belgium	Societe Generale (B)	X	X	X	X	1,040	66.3
Kommunedata	Denmark	Local government	X	X		X	1,470	65.5
SESA	France	CGE/Cap Gemini Sogeti/ Staff			X	X	680	59.6
ICL Consultancy and Training	U.K.	ICL			X	X	1,110	59.3

1. IBM Remote and Batch Computing Services revenue only is included. IBM captive revenue is excluded. †. Some Metro International, Logics and Systima: computing services revenue only included. ‡ Thomson Informatique: includes TITN. Sysecs and Answare. *Key: RCS, Remote Computing Services: SP, Software Products: SS, Software Services.

Source: Financial Times feature on Computer Software, 10.10.83

34,000 in the UK, followed at some distance by West Germany (18,100) and Italy (17,700). The industry is important then not only in terms of making NIT applications possible in other industries, but as a generator of employment and wealth in its own right.

5.3.2. The regional distribution of computer services and software production

A number of characteristics of the market for computer services have locational implications. First and foremost, the market is highly competitive and has tended to become even more so as a result of recent high entry rates of new small firms. In Italy, for example, 75% of computer service firms in 1981 had entered the market since 1975 (Antonelli, 1982). Markets would appear to be most competitive in more favoured regions which have relatively high rates of new entry owing to the easier availability of finance and skilled personnel. The concentration of large firm headquarters and R & D units in more favoured regions also provides greater external economies for the growth of small firms. A second feature of the market for computer services which has locational impacts is its fragmentation into high and low growth segments; in relative terms, the higher growth segments (such as software products) are concentrated in core regions while the peripheral regions have only the low growth segments, such as data preparation and batch processing. Antonelli (1982) suggests that the Italian Mezzogiorno possesses only 'routinised' computer services because of the low level of requirements from the externally owned branch plant sector. In the UK too the lower demand levels in peripheral regions are partly responsible for the relative absence of more specialist computer services. Finally, some segments of the computer services market are highly localised owing to the need for continuous servicing and the relatively high costs involved in frequent visits to more distant customers. In West Germany, for example, one half of software sales are to clients within 50 kms of an establishment and only 20% to clients from more than 200 kilometres away (PROGNOS, 1982). The need for a relatively close (and ongoing) relationship between supplier and customer can limit the availability of some computer services in peripheral regions because of an unwillingness on behalf of the supplier to service distant (and hence expensive) customers. PROGNOS (1982) reports that for this reason there is inadequate provision of computer services in six less-industrialized districts in the south of Germany.

What then of the regional distribution of the computer services industry? In spite of the greater localisation of markets than is found for NIT manufacturing, computer services are still regionally concentrated. In France and the UK the concentration is in the dominant metropolitan region while in Italy and West Germany concentrations are found in the faster growing industrialized regions:

- in the UK 56% of all computer service offices are in the South East planning region, and only 43% in provincial regions. In contrast, only 45% of computer users are in the South East and 56% in the provinces. The extent of underprovision in Wales and Scotland can be seen from Table 5.7 to be more pronounced than in other provincial regions.

- in Italy, 68% of computer service firms were located in the more industrialized North with less than 10% in the Mezzogiorno in 1977.

- in France, 60% of software companies and 76% of data processing employees are concentrated in Greater Paris.

- although there are no comparable European-wide statistics on the regional distribution of computer services, some indication of variations between countries in the degree of core region concentration can be gained by examining the location of head offices of Members of the European Computing Services Association (ECSA). Table 5.8 thus shows the (Level II) region within each country (excluding Luxembourg and Greece) which has the highest number of ECSA members. In countries with strong primate cities, very high concentrations of ECSA members are found in a single dominant region (more than three-quarters in the case of the UK, France, Belgium and Ireland). Denmark has a more even distribution, although more than half of the national total of ECSA members are to be found in the Copenhagen region. For the remaining countries (Italy, the Netherlands and Germany), no region has more than half of the national total, with Germany providing the most extreme example of a lack of a single dominant region, Hamburg possessing just 11% of Germany's ECSA members.

Table 5.7 : Regional Distribution of UK Computer Service Offices and Users

Location	% offices	% users
Greater London	32.0	21.3
Rest South East	24.1	24.1
Total	56.0	45.4
West Midlands	8.0	8.3
North West	9.3	10.4
Wales	1.8	3.7
Northern Ireland	0.7	1.1
South West	5.8	5.3
Scotland	4.9	8.3
North and Yorkshire & Humberside	7.9	9.6
East Midlands and East Anglia	5.6	8.0
Total Provinces	44.0	54.6
TOTALS	100.0	100.0

Source : IDC Europa

Table 5.8 : Region within each country with the largest number of members of the European Computer Services Association, 1981

Nation	Region with the most ECSA members	No. of ECSA members in the region	Total No. of ECSA members in the country	Highest membership region as a percentage of national total
United Kingdom	South East	129	175	74%
Italy	Lombardia	84	176	48%
France	Ile de France	55	68	81%
Ireland	Dublin	23	23	100%
Belgium	Brabant	22	26	85%
Denmark	Kobenhagen	14	23	61%
Germany	Hamburg	11	108	11%
Netherlands	Noord Holland	9	30	30%

Source : ECSA, 1981

In the case of one of the more centralized distributions, the UK, a number of reasons have been advanced to explain the spatial concentration of computer service firms:

- the concentration of head offices of both multi- and single-site organisations in metropolitan regions. In the UK, 67% of single-site companies and 63% of the head offices of multi-site firms are in the South East.

- the relative size of regional markets; in the UK only the markets of the West Midlands and North West besides the South East are considered to be of sufficient size for the establishment of branch plants.

- the introduction of production hierarchies in large organisations which increases demand for higher order services in headquarter regions and reduces demand in regions with high levels of external ownership. This effect is further reinforced by the economies of centralised service provision available to multi-site organisations.

- the lower entry rates of computer service firms in provincial regions resulting from:

  (a) externalisation of demand by multi-site manufacturing organisations

  (b) the prevalence of low-technology branch plants which create little demand for higher order computing services and provide limited spin-off opportunities for new IT manufacturing and service firms.

- the lower degree of awareness and implementation of new technology by indigenous manufacturing firms also reduces demand for computer services in provincial regions.

Evidence of some recent <u>decentralisation</u> of computer service activities can be discerned from the examples of Italy and the United Kingdom:

- in Italy, computer service firms were more regionally concentrated than all employment in 1977, but less regionally concentrated in 1982.

New firm formation rates were well above the national average in the South during the late 1970s, although the absolute number of entrants involved was very small. However, the relative decline in the share of the Northern industrialized regions during this period mainly benefitted semi-peripheral areas suggesting that decentralisation was essentially short-distance.

- a similar situation appears to have appertained in the United Kingdom where Greater London's share of computer service entrants declined during the 1970s, whereas the Rest of the South East substantially increased its share (Table 5.9). Although the share of UK provincial regions increased markedly during the 1960s, this trend does not appear to have continued into the 1970s, perhaps suggesting that centripetal forces have been reasserting themselves.

As with the production of NIT hardware, we must then conclude that the existing concentration of computer services firms and employment in national and European core regions is likely to continue into the future. Although the local market-serving aspects of computer services ensure that all but the least industrialized regions will have some computer service provision, these are likely to continue to be relatively low-level data processing and machine/ software maintenance. The growth segments of the market, such as the development of new software products, in which wealth and new jobs are undoubtedly being created at a rapid rate, are likely to remain in the core regions of the community with their well-developed social, institutional and educational infrastructures and networks.

Table 5.9 : Development of Computer Services in the U.K.

Location	Dates of Company Formation							
	Pre-1965		1966-70		1971-75		1976-80	
	No	%	No	%	No	%	No	%
Greater London	50	54.9	74	36.5	123	38.6	123	33.5
Rest South East*	19	20.9	60	29.6	100	31.3	131	35.7
Provinces	22	24.2	69	33.9	96	30.1	113	30.8
TOTAL	91	100.0	203	100.0	319	100.0	367	100.0

* South East includes East Anglia

Source : Green (1981)

CHAPTER SIX

THE USE OF NEW INFORMATION TECHNOLOGY

6.1 Overview

6.1.1. Introduction

In the most general sense, all workers are potential users of NIT as all jobs involve the use of information. Some jobs are more intensive users of information than others however; indeed, the primary purpose of some jobs is the production, processing or distribution of information. These 'information occupations' have been growing both absolutely and relative to other types of occupation, as work by the OECD (1981) has indicated (Table 6.1). Such occupations now comprise about one-third of the total workforce in most advanced economies. Within this third, information processing occupations account for the largest share; although some jobs within this category are highly skilled and demanding of high levels of education, the bulk of the jobs fall in the clerical and related category where the information processing tasks are of a more routine nature. The OECD have estimated that by the mid 1970s an average of 22% of the economically active populations of the countries they studied (see Table 6.1) were engaged in these routine information handling activities. The potential displacing effect of New Information Technology upon this type of employment has given rise to much concern in the Community as a whole and in each member state.

In this chapter, however, the object of our interest is the up-take of NIT by different types of business enterprise and the impact NIT is having upon these enterprises in terms of, for example, access to information and profitability, rather than upon the labour market impacts. We are particularly concerned with the effects of NIT usage upon the spatial organization of different types of enterprise, and the implications which the growth of NIT usage may have for less-favoured regions. Will it, for example, encourage greater central control at the expense of peripheral areas, or will NIT be used in peripheral regions to facilitate indigenous development? A further possibility is that the speed at which the adoption of NIT takes place will be regionally differentiated, such that implicit centralisation takes place as the core region enterprises derive

Table 6.1 : Components of "Information Labour Force" : as a percentage of economically active

Country and time / Components	France		United Kingdom		Germany	
	1954	1975	1951	1971	1950	1978
INFORMATION	3.6	6.4	3.9	5.0	3.1	6.3
Scientific and technical	0.6	1.3	0.5	1.4		
Consultative services	1.8	3.0	1.1	1.5		
Information gatherers	0.3	0.5	1.0	0.9		
Market search and co-ordination specialists	0.9	1.6	1.3	1.2		
INFORMATION PROCESSORS	13.4	19.7	18.3	23.5	11.2	19.5
Administrative and managerial	6.3	6.7	4.5	6.6		
Process control and supervisory	1.5	3.2	3.2	3.7		
Clerical and related	5.6	9.8	10.6	13.2		
INFORMATION DISTRIBUTORS	1.9	3.9	2.0	3.2	1.1	2.8
Educators	1.6	3.7	1.7	2.9		
Communication workers	0.3	0.2	0.3	0.3		
INFORMATION INFRASTRUCTURE	1.4	2.1	2.5	3.9	2.9	4.6
Information machine workers	0.6	0.7	1.4	2.3		
Postal and tele-communication	0.8	1.4	1.1	1.6		
TOTAL INFORMATION	20.3	32.1	26.7	35.6	18.3	32.2

Source : Table 1.2 of OECD publication "Information Activities, Electronics and Telecommunications Technologies" ICCP Series, Number 6, Volume 1, Paris 1981.

the benefits of NIT first and improve their competitive position vis-a-vis the periphery. In this chapter, we explore the evidence relating to such issues for the major sectors of the economy.

6.1.2 The users of new information technology by industrial sector

The potential up-take and use of NIT varies considerably between industries. In some industries, the type of tasks amenable to the application of NIT constitute only a small proportion of their total activities, while in other industries informational activities are paramount. Table 6.2 shows for France, Germany and the UK the proportion of total employment within each industry sector which is comprised of the information occupations defined by the OECD study. In each country, the proportion is lowest in the primary industries (<8%) and is highest in the finance and insurance sector, in which between 80-90% of total jobs are deemed 'informational'.

Systematic evidence for the actual take-up of NIT within industries is exceedingly scarce. One notable exception is provided by the Eurodata Foundation's survey of the present and future demand for data modems connected to PTT networks for the purpose of data communication. Of the total Network Terminating Points (NTPs) in Western Europe in 1979, 30% were in the Banking and Finance Sector, 20% were in manufacturing enterprises, 10% were in businesses providing data processing (DP) services, 9% in Distribution and 8% in Government (Table 6.3). This aspect of NIT - that associated with data communication - is thus seen to pervade virtually all aspects of economic activity. Although certain service industries are strongly represented in terms of number of NTPs, the fact that the manufacturing sector accounts for one-fifth of the total should serve to dispel the misconception that NIT is exclusively a service-sector issue - information occupations and the technology which supports them cut across industrial sectors.

Variations between countries in the share of NTPs accounted for by the different sectors are enormous, as Table 6.3 shows. At one extreme, in Greece virtually all data communication is undertaken by the banks and airlines, which together account for 84% of total NTPs, in Italy banks account for 47% of the total while in Germany the proportion is less than

Table 6.2

PERCENTAGES OF ECONOMICALLY ACTIVE WITHIN EACH SPECIFIED INDUSTRY GROUPING, DESIGNATED "INFORMATIONAL"

Industry / Country and date	Primary industries	Manuf. industries	Con-struction	Transport commun-cation & other public utilities	Distri-butive trades	Finance, insur-ance & real estate	Personal, community, & other business services	Public admini-stration & de-fence	Information occupations as a percen-tage of all economically active	Coeffic-ient of variation
France (1975)	6.1	22.3	14.5	40.4	45.9	92.1	43.9	42.6	32.1	0.64
Germany (1976)	7.1	24.0	14.4	52.3	34.1	90.1	46.3	37.3	32.8	0.61
United Kingdom (1971)	7.1	27.5	16.6	43.6	46.7	82.8	35.8	43.2	35.6	0.57
Coefficient of variation	0.29	0.17	0.30	0.10	0.11	0.04	0.12	0.13		

Source : OECD Publication ICCP Series, Number 6, Volume 1, Paris, 1981

Table 6.3 : Number and Percentage of Network Terminating Points by Industry in 1979

	INDUSTRY SECTOR														
	Process Manuf.	Discrete Manuf.	Air Transport	Banking and Finance	Education and Res.	Surface Transport	Insurance	Health Care	Distribution Trades	Government	Util.	DP Services	Other Bus.	Private Homes	TOTALS
Belgium	10.19	5.68	2.03	24.46	4.23	1.78	2.27	.95	7.58	12.88	9.11	12.39	6.46	.00	100.00
Denmark	6.12	7.77	1.70	29.39	11.64	1.97	.80	1.29	9.03	5.49	2.12	15.46	7.22	.00	100.00
France	11.64	11.93	1.41	32.33	5.22	1.38	1.18	1.25	4.16	8.23	4.98	10.54	5.79	.00	100.00
German FR	5.53	12.96	1.58	18.93	3.08	2.00	2.30	.34	26.95	10.21	3.24	3.95	7.50	1.44	100.00
Greece	.29	1.74	10.41	73.99	3.10	.00	.32	.00	.31	2.86	1.27	3.65	2.07	.00	100.00
Ireland	10.34	3.60	3.16	12.29	11.78	5.87	1.13	1.66	2.20	22.95	3.15	13.63	7.28	.00	100.00
Italy	7.75	7.87	1.44	47.44	2.98	.62	.69	2.17	1.85	13.57	4.14	5.50	3.97	.00	100.00
Luxembourg	2.41	5.86	1.69	70.76	1.09	.05	.04	.35	4.32	9.09	.41	3.23	.71	.00	100.00
Netherlands	5.73	9.70	3.82	22.96	12.50	2.24	1.11	.94	7.83	4.24	3.41	20.80	3.93	.00	100.00
UK	12.51	13.38	1.01	25.84	8.41	1.70	1.60	.67	4.93	5.04	5.63	11.75	7.54	.00	100.00
Western Europe	9.08	10.89	1.61	29.59	5.95	1.74	1.49	.94	9.00	8.20	4.72	10.06	6.51	.23	100.00

Source : Eurodata Foundation Reports on 'Data Communications in Western Europe' 1980

20%. Conversely, the share of NTPs in the distributive sector is considerably higher in Germany (27%) than elsewhere, while in the Netherlands and Denmark the Education and Research and DP service sectors have much higher NTP shares than their equivalents in the Community as a whole. A different pattern again is revealed by the UK, with the manufacturing sector being relatively more important in the total structure, accounting for 26% of NTPs, slightly more than the Banking and Finance sector.

An alternative way of looking at the differential use of data communication equipment is to consider the NTP penetration rates within industries, standardised by employment. Table 6.4 consequently shows the number of NTPs per 1000 workers within each industry. A wide range of variation exists between penetration rates in different countries:

- summed over all industries, the UK and Luxembourg have the highest NTP penetration rates (5.2/1000 workers), with Ireland, Belgium, but particularly Greece, having the lowest.

- unsurprisingly, the DP service industry has by far the highest penetration rate, although the range is again substantial, one NTP for every two workers in the UK and Netherlands to one for every nine in Greece.

- the banking and finance sector has the second highest penetration rate in each country, being lowest in Greece and Ireland (<8 NTPs/1000 workers) and highest in Italy (109 NTPs/1000 workers). Within Northern Europe, Germany has a substantially lower data communication penetration in the banking sector than do its neighbours.

- NTP penetration rates in government are higher in Italy and Belgium than in other countries.

- NTP penetration in the distribution sector is substantially higher in Germany than in other countries, with France having one of the lowest levels.

  in manufacturing, the UK dominates the picture, with a penetration rate (4 NTPs/1000 workers) twice as high as the next country (the

Table 6.4 : Number of Network Terminating Points (NTPs) per thousand working population by industry sector, 1979

	Process Manuf.	Discrete Manuf.	Air Trans-port	Banking and Finance	Educ-ation	Surface Trans.	Insur-ance	Health	Distri-bution	Govern-ment	Util.	DP Services	Other Bus.	TOTAL
Belgium	1.8	1.4	18.3	27.3	1.1	1.0	6.4	0.7	1.7	5.3	6.1	350.0	1.0	1.5
Denmark	1.6	5.9	34.6	49.9	7.1	3.5	3.7	1.0	2.6	4.7	3.8	277.9	1.0	3.4
France	1.9	2.8	17.9	41.4	4.9	1.0	4.4	1.7	0.5	2.5	4.4	196.8	1.0	3.0
German FR	0.8	1.8	34.8	22.4	2.4	1.3	3.9	0.2	5.0	3.9	2.7	187.3	1.3	2.8
Greece	0.004	0.1	4.4	8.7	0.2	0	0.3	0	0.01	0.2	0.1	115.0	0.03	0.4
Ireland	0.6	0.6	4.3	7.4	2.0	2.2	1.0	0.3	0.2	4.7	0.8	262.0	0.6	1.3
Italy	1.2	1.8	34.5	108.5	1.5	0.5	4.0	2.3	0.6	6.0	4.4	131.6	0.4	3.2
Luxembourg	0.5	3.0	8.3	99.8	1.5	0	0	0.3	1.1	4.6	0.7	200.0	0.2	5.2
Netherlands	2.1	3.1	38.8	34.0	7.4	1.9	3.5	0.5	2.0	2.3	2.8	551.8	0.7	4.1
UK	4.2	4.7	14.0	63.8	4.7	2.4	7.0	0.6	2.1	3.5	7.1	599.6	1.7	5.2
TOTAL	1.9	2.8	20.44	46.9	3.6	0.1	4.8	0.8	2.1	3.6	4.6	307.3	1.1	3.6

Source : Eurodata Foundation Reports on 'Data Communication in Western Europe' 1980.

Netherlands), and more than five times as high as Germany and Ireland. In Greece, the survey identified no NTPs at all in the manufacturing sector.

In general terms, the importance of this one aspect of NIT - i.e. data communication connections - clearly highlights the differences between the use of NIT in different industries and in different countries. Although we can identify those sectors (such as banking/finance, manufacturing, computer services, etc) upon which NIT is likely to have the greatest impact - in terms of organisation, location and employment - two important gaps remain of particular relevance for the less-favoured regions:

- Firstly, we will need to distinguish between large and small enterprises within each sector, for available evidence suggests that the up-take of NIT is markedly lower in SMEs than in large firms (see Section 6.3 below). It can reasonably be hypothesised that this puts SMEs at a relative disadvantage, either by reducing their general efficiency, and/or more crucially by lowering their degree of awareness of and access to external sources of technological and other information. If this is so, then the problems of SMEs in relation to NIT become an important consideration within regional development strategies which are becoming increasingly oriented towards the mobilisation of indigenous potential.

- Secondly, although certain industrial sectors are not expected to become important users of NIT in relation to other sectors, they may be of great importance in terms of development options and strategies for the less-favoured regions of Europe. Agriculture provides the best example here. The levels of NIT penetration within agriculture are likely to be very low - indeed, the Eurodata Foundation study did not even identify agriculture as a separate sector of interest - but at the same time the agricultural sector remains dominant within the economies of Europe's least-favoured regions, notably in parts of Ireland, Italy and Greece. It consequently needs to be considered whether NIT can help contribute to rural agricultural development strategies, such as by enhancing the access to information of farmers and/or farming development officers. As well as examining the high NIT usage sectors therefore, we will also review NIT applications within agriculture, to which we now turn.

6.2 Agriculture and the use of new information technology

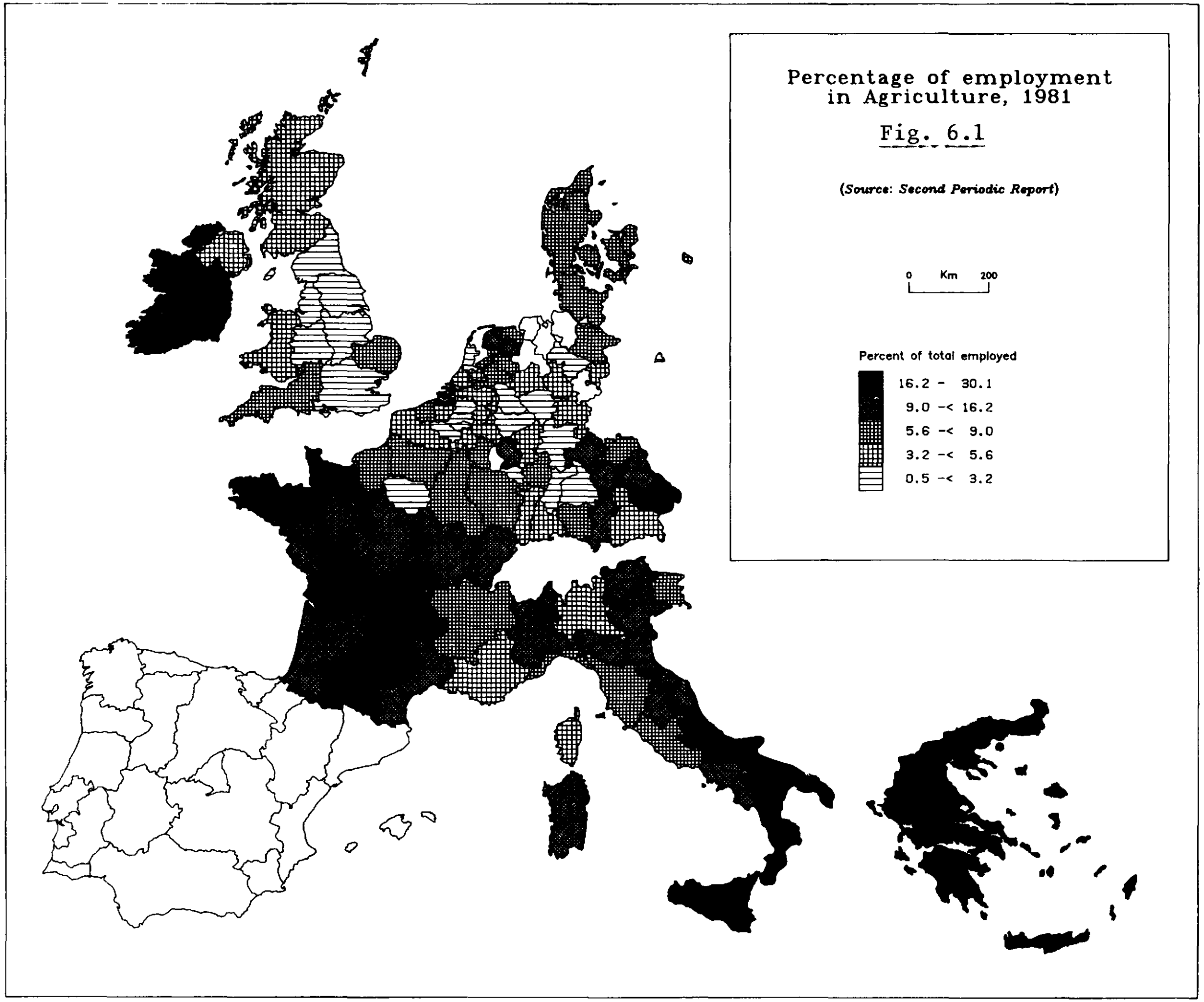
6.2.1 The importance of agriculture within Europe's less-favoured regions

Although agriculture is continuing to decline as a source of employment within each member state, it remains of considerable importance to certain countries. Greece, Ireland and Italy have major agricultural employment sectors (33%, 21% and 15% of their respective workforce). At the regional scale, Fig. 6.1 shows that relative concentrations of agricultural employment characterize the extreme western and southern peripheries of Europe. In addition to Ireland, the western regions of France nearly all have in excess of 16% of their employment in agriculture. In Italy, a clear divide exists between the North and South of the country, with only the latter displaying strong dependence on agriculture.

Such dependence would not in itself be a problem were it not also associated with underemployment, low levels of mechanisation and low income. Gross valued added per agricultural worker is lowest in Ireland, Southern Italy and South-West France and highest in the northern European 'core' from the Paris Basin through Benelux, the Netherlands and Northern Germany. Disparities are wide and are actually getting wider; between 1964/5 and 1976/7 the ratio between the regions with the highest per worker incomes and those with the lowest rose from 5:1 to 6:1. In the peripheral rural regions of Europe, the agricultural sectors are then a brake on development - still large in terms of employment but providing only low incomes and continuing to lag a long way behind the rest of Europe. It is consequently important to include the modernisation of agriculture within any regional development strategies for these areas. From the present study's perspective, the possible role for NIT within such modernisation needs to be evaluated.

6.2.2 Information transfer within agriculture

The promotion of an efficient agricultural sector within Member States and within the Community as a whole is dependent upon the rapid and regular dissemination of information. The scale of the problem is suggested by the fact that in agricultural science alone between 200,000 and 250,000 publications appear every year.



Percentage of employment in Agriculture, 1981

Fig. 6.1

(*Source*: *Second Periodic Report*)

"The nature of information generated at the research level poses problems to its management and efficient transfer to different categories of agriculturalist who advise and provide services for farmers" (Craig, 1979, p 3).

This complexity, and the need to transfer new information on a regular and continuous basis as a pre-requisite for its exploitation, necessitates the existence of information brokers, and all countries in Europe have consequently developed agricultural extension services (employing in total 31 thousand agricultural advisors in 1975; PACTEL, 1980). The agricultural adviser in the extension services is an essential link in a two way information channel between farms and those responsible for research, development, planning and policy-making for agriculture. A distinction between general and specialist advisers is universally recognised and extension services are normally organized accordingly on a two tier basis. In terms of information transfer, information technology has already had a major impact upon the higher levels of researchers and specialist advisers, to whom on-line agricultural data bases have proved valuable. Communication at lower levels between generalist advisers and farmers is also amenable to NIT, however, and considerable interest is being shown in applications of videotex technology.

6.2.3. Applications of Videotex in agriculture

A recent market research study undertaken by a consortium of consultants (Aregon International Ltd, IPC Agricultural Press and Misset)[1] on behalf of the CEC has demonstrated a very positive attitude to videotex among both farmers and extension workers across all countries of the Community. Although by no means a representative sample, 90% of respondents to a questionnaire following national seminars on agricultural videotex thought that a service would be of use, 73% would be prepared to pay for a service and 65% would like to have access to a service now or in the near future. Of the respondents, farmers felt that the most useful subjects for inclusion on an agricultural videotex system were:

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1. Videotex in Agriculture ('The Aregon Report') August 1981

- fertiliser prices
- local market prices
- local weather
- farm finances
- feedstuff prices
- general agricultural news
- national market prices
- diseases

From the farmers' viewpoint, it is then clear that the main characteristic of such a service is that it should provide information with a considerable local content.

The potential size of the market for agricultural videotex across Europe is difficult to determine at this stage, but even if only large farms (>50 hectares) are considered as possibles, some 500 thousand such units exist in the Community. Within the advisory and extension services, the penetration rates are of course likely to be considerably higher than for farmers.

A more accurate indication of the potential market for videotex in agriculture is being examined in a CEC financed pilot project in Ireland, in collaboration with the Irish Agricultural Development Council (ACOT) and the PTT. The trial is deliberately taking place in a context in which there is no national videotex system already in operation. This trial will be particularly interesting from the point of view of Europe's LFR; for the moment however, the only established working example of agricultural videotex in Europe is provided by the UK.

There are a number of organisations providing specifically agricultural information on Prestel, the UK's public videotex service. One example from the commercial sector involves the IPC Magazine 'Farmers Weekly', which has a data-base of 500 frames on Prestel conveying both static information (e.g. regulations) and information which is changed frequently and quickly (e.g. grain prices). The Agricultural Development Advisory Services (ADAS) of the Ministry of Agriculture, Fisheries and Food has 1200

pages on Prestel to supplement their extension services. Information on the system covers seven main subject areas:

- estate management
- business management and labour
- crops and grass
- special announcements (e.g. disease outbreaks)
- livestock
- marketing
- mechanisation

Information is prepared for input to Prestel by ADAS specialist advisers and is primarily aimed at the farming community itself. The up-take by farmers has been disappointing however, with only 350 Prestel sets on farms by 1982. The adopters differ in a number of respects from the average farm. They tend to be:

- large units
- involved in marketing their own products
- run by younger, more educated farmers
- in arable farming rather than livestock or dairy farming

The particular suitability of Prestel for the arable sector is explained firstly by their need to be constantly aware of produce spot price changes, and secondly because of the greater importance of weather changes to arable farmers than to livestock.

This emphasis on arable farming is reflected in a strong regional differentiation in the number of Prestel sets installed on farms, with a concentration in the eastern half of the country. In the west of the country, where farms tend to a greater extent to be engaged in livestock production as well as being on average smaller, the uptake of Prestel has been low. A further factor inhibiting the diffusion of Prestel in the less sparsely populated west of the country is the greater cost of gaining access to the service; although British Telecom claim to serve 60% of the population as a whole on a local call charging basis, only 20% of farmers are within the local call range of a Prestel centre. In the west, where Prestel centres are few and serving large regions (e.g. Cardiff for the

whole of Wales, and Bristol for the South West), the costs of using Prestel are a further deterrent limiting the service's uptake. In as far as the service offers advantages to farmers in the quality of information available to them and in the speed and ease of access, agricultural videotex in Britain appears then to be perpetuating the differential between the more prosperous large enterprise arable areas of the east and south and the smaller livestock enterprises of the west and north.

6.2.4. The regionally differentiated impact of new information technology within agriculture

On the basis of the admittedly limited information available, it seems likely that the rate of adoption of NIT in Europe will not be equal among all types of farming enterprise. The earliest adopters of videotex services are likely to be the largest arable farming enterprises, which are most immediately influenced by climatic and price variations and which also possess the necessary financial resources to invest in the hardware and the managerial expertise to make use of the information it provides. With respect to on-farm computing too, evidence from the UK suggests that only the largest farms will adopt (ADAS, 1981). At the other extreme, small livestock farmers operating on the margins of commercial agriculture are the group least likely to make use of NIT. Within this group, NIT on its own cannot bring about a more commercial approach to management - it could only be used to support such a transformation. In between these extremes there are specialist forms of agriculture (e.g. horticulture, viticulture) where the potential for NIT is also considerable in so far as these activities are already organised on a highly commercialised basis.

Given these contrasts in rates of diffusion between different user groups within agriculture, it is clear that farmers in Europe's most peripheral and least-advantaged areas will be slow in responding to the potential of NIT. The early adoption of NIT by large agricultural enterprises in the core regions of the Community would improve their competitiveness vis-a-vis the more backward agricultural regions of the periphery, thereby increasing regional contrasts in agricultural income.

Nevertheless, the established role of the agricultural extension services and their presence in all of the Community's less favoured regions provides a basis for advancing the adoption of NIT applications such as videotex.

Encouraging the adoption of NIT by the advisory services themselves would have the additional benefit of a demonstration effect to potential users in the farming community. There is also considerable scope for encouraging further technological and software development so as to combine videotex information services with computer processing power through 'gateways' or telesoftware. The economics of such a combination - essentially a videotex service with an 'intelligent terminal' - are likely to be attractive to smaller farming enterprises which currently fall below the economic thresholds for commercial videotex or for on-farm micro-computers as separate packages. Such a development would not only improve the penetration of the new technologies into smaller enterprises but would also have positive regional implications, given the existing relationship between mean holding size and peripherality.

Finally, given the problems of telecommunications infrastructure in a number of the most peripheral rural regions (particularly in Greece and Ireland), the possible advantages of broadcast teletext services, that can be received on modified television sets without the use of the telephone system, needs to be evaluated. Even in areas where network access is not a problem, evidence from the UK suggests that the use of agricultural information on such services is 20 times greater than for videotex. Strategies to encourage the development of broadcast telextext services could help overcome some of the technical, economic and attitudinal barriers to the up-take of videotex services, and help ensure that farming enterprises in less-favoured regions are able to share in the information provision benefits of NIT. It is our contention that in the absence of a concerted effort to stimulate the application of NIT as part of a general strategy towards improving the efficiency of European agriculture, current trends in its use are likely to disadvantage the peripheral regions of Europe.

6.3 Manufacturing and the use of new information technology

In terms of the geographical dimension to the impact of NIT upon the manufacturing sector, two quite different aspects need to be distinguished. Firstly, there is the possible role of NIT as an organisational control innovation within large companies. Our concern here is to determine to what extent, and in which direction, can NIT be used to change control

relations between the corporate centre and the various arms of the corporate periphery, and to further determine whether there are any likely regional outcomes of such changes. Secondly, there is the question of whether the adoption of NIT is regionally differentiated, particularly amongst small and medium sized enterprises (SMEs). NIT would seem to offer particular benefits, through its 'distance-shrinking' characteristics, to peripherally located enterprises; for example, in enabling them to obtain more effectively the information required for technical innovation. To what extent are such opportunities likely to be seized, and are there barriers to the up-take of NIT which could be overcome within a wider policy package to encourage indigenous development? In this section we review in turn these different aspects of NIT usage by manufacturing enterprises.

6.3.1 New information technology and corporate organisation

There is considerable debate about the possible influence of NIT upon corporate organisation, specifically concerning its centralisation/ decentralisation effects. This debate can frequently be couched in regional terms, given the tendency for corporate headquarters to be concentrated in core regions. The complexity of the relationship between technological change and organisational structure and control can be seen in the following extended passage from OECD (1981):

> "New information technolgies tend to integrate the activities of the production process with those of the organisational process. Previously separate control systems are merged to form an overall (process and management) control system. The implication of such structural application are far-reaching, and as yet, barely perceived, but a number of case study effects can be indicated:
>
> - Organisation units tend to be more integrated and to merge into large departments.
>
> - Programming functions and units tend to be centralised and go upwards in the hierarchy.
>
> - At lower levels of the organisation, more and more autonomy is given to work groups by decentralisation of certain control

decisions. On the other hand, there is a centralisation of control of production data.

- The role and significance of middle management is greatly reduced. Some of its functions are now performed by the information system and are controlled at a higher level; some other functions are given to lower organisational levels. Consequently some middle management positions disappear.

Certainly there is evidence that electronics technology has increased the degree to which tasks are structured, limiting discretion in most of the dimensions examined. ... Some of the impacts may take a long time to manifest themselves. For example, upward occupational mobility might be adversely affected. The traditional route from the shopfloor is via supervisory position which, as suggested, would be less in number and will increasingly require fewer managerial skills." (from: Information Activities, Electronic and Telecommunications Technology, OECD, Paris, 1981)

Such prognoses bode ill for the less-favoured regions of the Community which are already characterised by fairly routine forms of production and by truncated occupational hierarchies. An even more explicitly 'centralist' scenario is portrayed by Meegan (1982) in his consideration of the possibilities opened up by the adoption of satellite communication systems able to handle, through a single earth station, a wide range of communications (including data transmission, electronic mail, facsimile transfer, telephony, computer linkages and tele-video):

"As with any development in telecommunications, these satellite-based systems could allow either greater centralisation or decentralisation of corporate administrative functions. But, as with telephony, the balance seems to tip towards greater centralisation of control, giving an entirely new meaning to the term 'satellite plant'! Thus, for example, it is not difficult to envisage centrally-controlled computers beaming instructions directly to numerically-controlled machine tools in outlying factories. The use of video-conferencing facilities (where voice and visual information is transmitted simultaneously to different sites) will allow the presentation

centrally of, for example, blueprints (themselves produced perhaps by the use of computer-aided design [CAD]) and demonstration of particular operations. the requirement for on-site visits from Head Office would of course be reduced accordingly. As far as the outlying plants are concerned, workforce composition is likely to be altered, with a reduction in the range of skills required being particularly likely. Thus, the workforce at these plants would need to be able to work from centrally-prepared drawings, whilst no longer needing the skills to draft these drawings in the first place. Supervisory and maintenance jobs would increase in importance, as direct labour took on more of a machine-minding role. Certain management functions would also be threatened. Thus, for example, the accounting role could be reduced to the routine collection of data, to be transmitted, via electronic mail or direct computer linkage, for analysis at Head Office." (Meegan, 1982, p 44).

It is, however, important to realise that the technology itself in no sense 'causes' a change in organisational relationships; it makes possible different forms of organisational relationship, and can consequently be used by adopting companies to support either a strategy of centralisation or decentralisation. This variation in outcome depending on corporate strategy is evident in two case studies undertaken as part of this study and described in the UK National Report (CURDS, 1982). The two case studies are not directly comparable in so far as one deals with a large multi-product company as a whole (Unilever) and the other with one function (Accounts) in a single-product company (The Ford Motor Company). Nevertheless the following general points can be made:

- The present organisation and structure of companies affects the rate and pattern of NIT introduction. Unilever, a decentralised organisation, has used NIT to integrate the company, but has allowed considerable freedom for operating companies to use NIT as they wished.

- The development of communications networks and associated hardware provides the opportunity for companies to reorganise and restructure, it does not determine the pattern change.

- Companies do not consider communications factors except at the margin in making most location decisions, though differences in communication infra-structure are an important contributory factor in the location of higher-order managerial functions.

- Insofar as communications infrastructure and service considerations are important to Unilever, they are at a national, rather than a regional level. More specifically regulations on data transfer across national boundaries can effect the decisions as to which country to locate particular functions.

- The mechanisation of particular functions like accounts in Ford, at a variety of sites can be a first step towards centralisation of control and work itself once data links are provided between sites.

- Where such centralisation occurs it is influenced by the existing pattern of sites and non-communication factors, particularly labour costs.

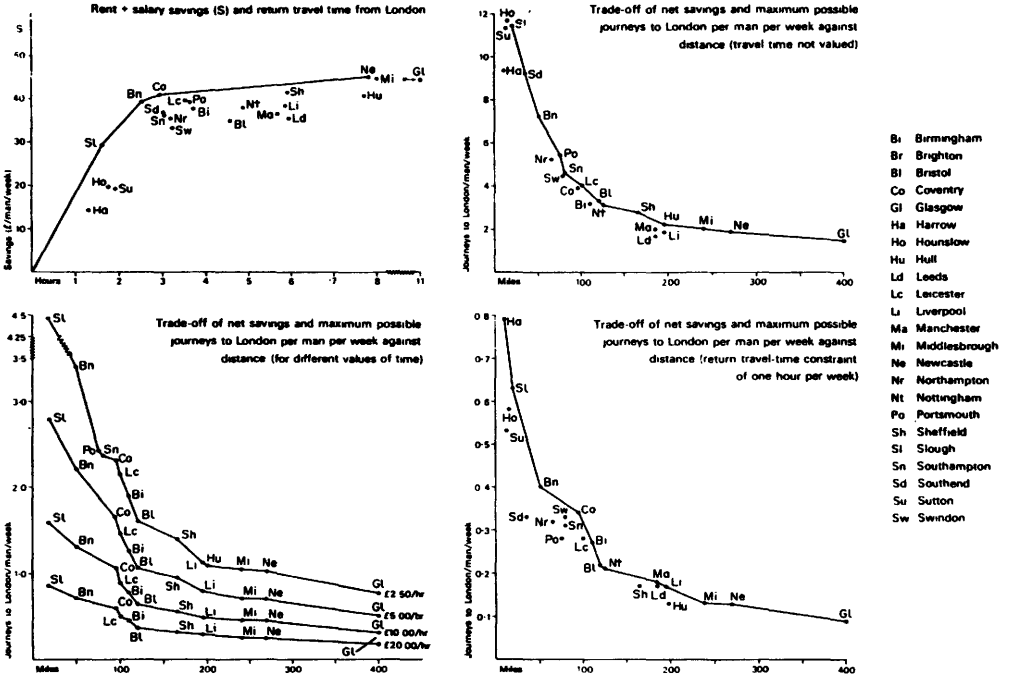
The above case studies highlight the need to consider the relative importance of communications vis-a-vis other factors in decisions about which functions to locate where in a large manufacturing company. Whether more widespread use of NIT will lead to a decentralisation of decision-making functions from headquarters in a capital city to a peripheral region depends not only on communications factors. For example a major survey of the 300 largest companies undertaken in connection with the Mercury feasbility study in the UK indicated that telecommunications costs were a very small percentage of total operating costs. Other factors relevant to locational decisions include:

- wages
- rents for office space
- travel costs for meetings that still need to be conducted face-to-face

The interrelationship between these factors is exemplified in Figure 6.2 (Goddard and Pye, 1977). This shows the trade-off between the extra business travel costs arising from relocation from London against the savings on rents and salaries. It suggests that:

Fig. 6.2

Communication costs and Relocation Potential from London



Source : Goddard and Pye, 1977

- savings do not increase beyond 100 miles

- business travel costs continue to increase with distance and thereby consume all other savings

- only those functions requiring little contact with the capital can be relocated. These tend to be the lowest grade clerical applications rather than key functions like R & D, marketing, etc.

The relationship described in Figure 6.2 explains the pattern of short distance, intra-regional dispersal that has been experienced from London and other major capitals. Such decentralisation further disadvantages the periphery because contact with suburban locations is more difficult than the metropolitan centres upon which most road, rail and air links focus.

Clearly the greater use of telecommunications could modify the costs and benefits in relocation decisions. However, the volume of business travel transferred would have to be substantial to fundamentally alter the influence of other factors. Fitting the range of substitution values obtained from surveys of business contacts into the equations that produce Figure 6.2 suggests that the impact of telecommunications on the decentralisation of headquarters functions is likely to be marginal.

This conclusion could be modified if relocation were to be associated with some administrative reorganisation which lead to the devolution of decision-making responsibility to lower levels in the company. More specifically:

- Greater autonomy at lower levels in the company would reduce the need for communications with headquarters.

- If relocation were to a major office centre some distance from the capital rather than a small suburban site then the likelihood of new business links being forged in the new location would be increased, thus reducing communication costs.

A move away from centralised data processing with remote job entry terminals to distributed processing based around major nodes could support

such a strategy when voice and information transmission systems are merged within the company. Again though it needs to be stressed that the technology is an enabling factor and that the impact of its use will be dependent on the wider organisational and locational strategies being pursued by individual corporations.

6.3.2 Regional aspects to the adoption of new information technology and access to information

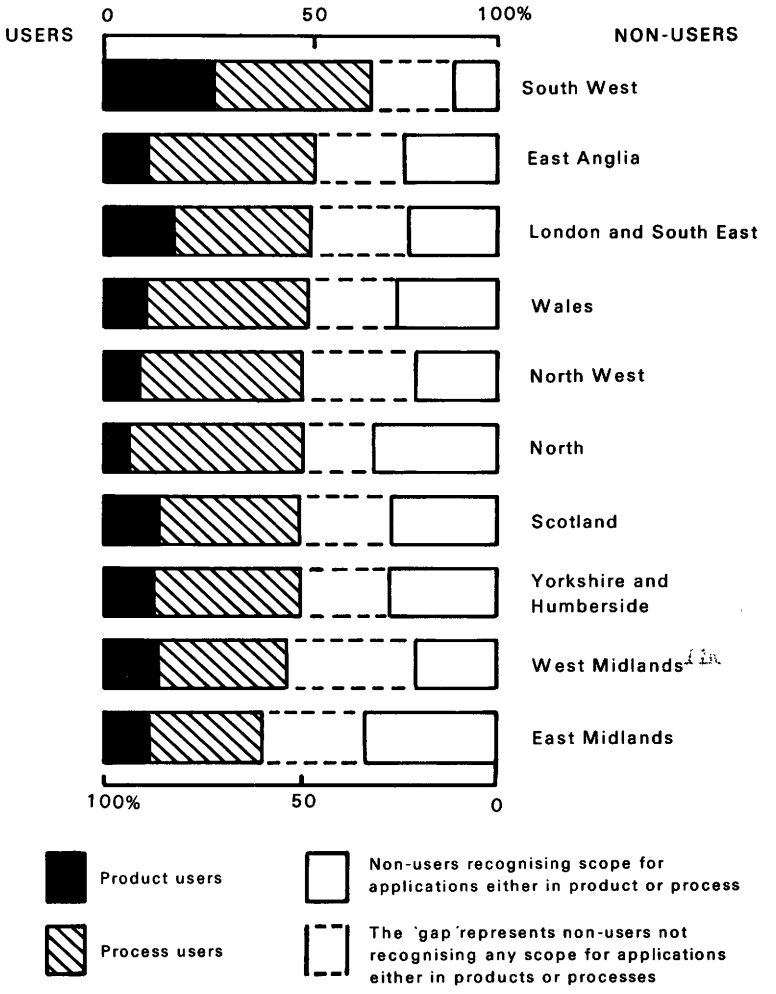
In terms of the extent to which the use of NIT is regionally differentiated, there is comparatively little evidence on the variation in rates of up-take of NIT between enterprises located in core and peripheral regions. A number of studies from the UK have however indicated systematic regional differentials in a number of aspects of technical change. Northcott and Rogers (1982), for example, found in a survey of a representative sample of GB manufacturing establishments that there were significant regional contrasts in the incorporation of micro-electronics into products; 33% of establishments in the South East of England (the most prosperous region) having having done so compared with only 12% in England's most depressed region, the North (Fig.6.3).

A survey undertaken by CURDS (Thwaites et al, 1981; Oakey et al, 1982) looked in more detail at rates of innovation (defined as the introduction to the factory of a new or improved product during the five year period ending in 1977) in three sub-sectors of the electronics and mechanical engineering industry (Scientific and Industrial Instruments, Metal Working Machine Tools and Radio and Electronics Components). The survey of establishments in these industries indicated:

- There is a strong association between location, size and ownership of establishments and innovation. For example, only 44% of the independent firms in the Northern Region in the three high technology sectors introduced a new or improved product compared with 77% in the South East Region (process innovation did not reveal the same degree of regional contrast).

- Research and development effort on the factory site is important for innovation. Thus 44% of those factories without an R & D facility

FIG.6.3 MICROELECTRONICS: USERS & NON-USERS BY REGION



Source: Northcott and Rogers, 1982

had failed to introduce a new product compared to only 11% of those with such a facility.

- Small firms are least likely to engage in R & D, but particularly those in the peripheral regions. Thus 35% of single site independent firms in the Development Areas had no R & D facility compared to only 10% in the South East.

These findings can be summed up in a model which predicts the probability of innovation in different types of establishment (Table 6.5; Alderman, et al, 1982). Having allowed for the effects of differences that might be attributable to the sector of the establishment, its employment size (which is highly correlated with R & D effort) and its corporate status (independent, branch of small corporation, branch of large corporation) the model reveals that there are still significant regional differences in the likelihood of innovation. For example:

- A small independent firm located in the South East has a probability of 0.21 of recording an innovation compared with a probability of 0.13 for a similar firm in the Development Areas.

- While the likelihood of innovation varies with the size of the establishment and the corporation, regional contrasts remain. Thus a large branch factory located in the South East and owned by a large corporation has a 0.91 probability of recording a scientific instruments innovation compared with a 0.86 probability for a similar branch in the Development Areas.

These results suggests that policies designed to foster innovation in peripheral regions would be most effectively devoted to promoting in-house R & D effort. It can be hypothesised that the unaccounted for regional influence in the model is attributable to problems of access to technical information facing particularly SMEs in the periphery; if so, these problems could possibly be removed by policies designed to deliver information about innovation to those companies.

The PSI study mentioned above (Northcott and Rogers, 1982) asked respondents to identify important sources of information about micro-electronics. Printed information ranks high on the list, but so do

Table 6.5

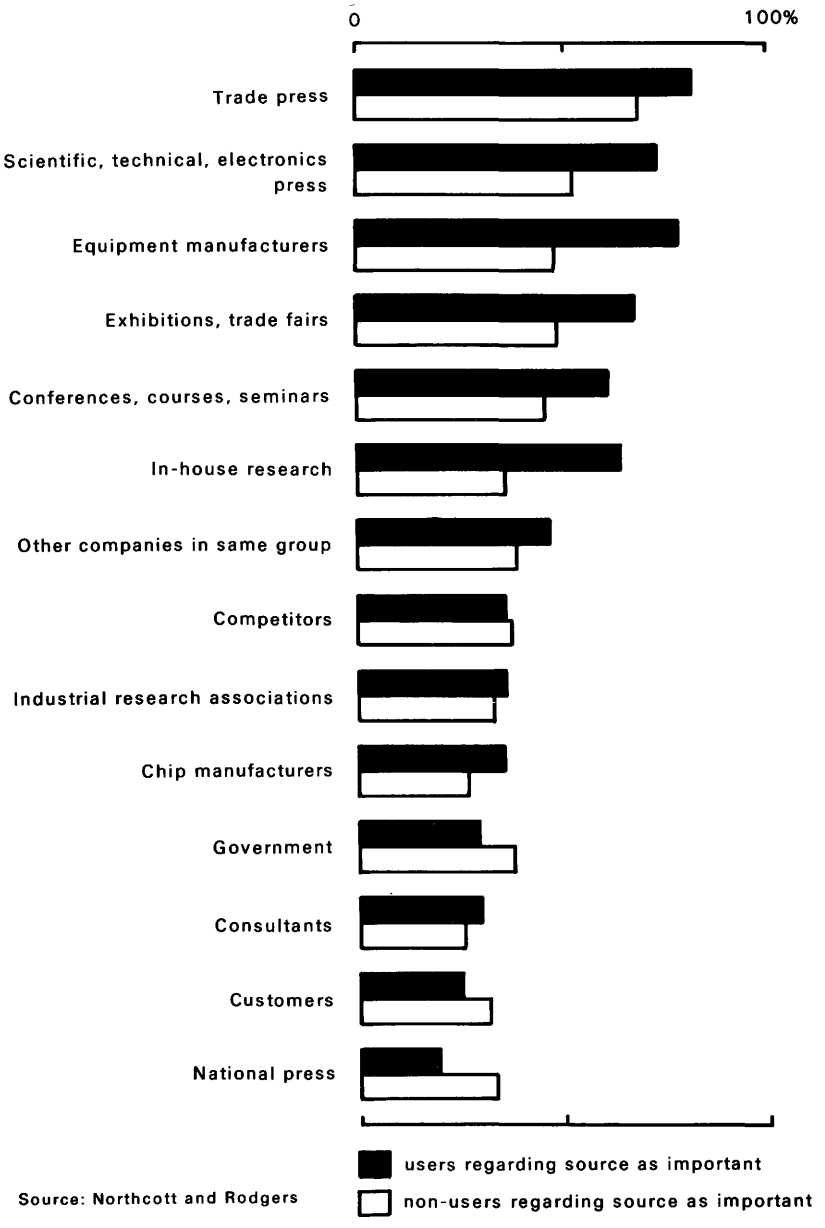
Probability of Innovation in Different Types of Establishment

Predicted Probabilities For Model (18) (to 2 d.p)	Metalworking Machine Tools				Scientific Instruments				Radio & Electronic Components			
	Location				Location				Location			
	South East	Other	Inter-mediate	Develop-ment	South East	Other	Inter-mediate	Develop-ment	South East	Other	Inter-mediate	Develop-ment
Single	0.15	0.11	0.09	0.09	0.21	0.16	0.13	0.13	0.10	0.08	0.06	0.06
Multi <100 ⩽10 plants	0.24	0.19	0.15	0.15	0.32	0.26	0.21	0.22	0.18	0.13	0.11	0.11
Multi >10 plants	0.37	0.30	0.25	0.25	0.47	0.39	0.34	0.34	0.28	0.22	-	0.19
EMPL												
Single	0.30	0.24	0.20	0.20	0.75	0.69	0.63	0.64	0.57	0.49	0.43	0.43
Multi ⩾100 ⩽10 plants	0.44	0.36	0.31	0.31	0.85	0.80	0.76	0.76	0.70	0.63	0.57	0.58
Multi >10 plants	0.59	0.51	0.45	0.46	0.91	0.88	0.85	0.86	0.81	0.76	0.72	0.72

Missing values denote empty data cells

Source: Alderman, Goddard, Thwaites and Nash

FIG.6.4 SOURCES OF INFORMATION ABOUT MICRO-ELECTRONICS



Source: Northcott and Rodgers

sources which can only be tapped by personal visits - for example to exhibitions, conferences and the like (Fig.6.4). The CURDS research on innovation (Thwaites, Oakey and Nash, 1981) revealed that as one moves from general awareness to specific applications, in-house R & D becomes increasingly necessary. This of course needs to be supplemented by external sources of technical knowledge, for example provided by industrial research associations or government laboratories (Table 6.6). Most private and public research laboratories in the UK are highly concentrated in the South East. Not surprisingly the surveys revealed that:

- SMEs located in the Development Areas had fewer contacts with research laboratories.

- Non-independent establishments located in the periphery made greater use of external sources of technical information. These were generally provided by other company locations.

- Branches located in the South East used more extra-company sources of technical information, particularly overseas.

One may conclude that SMEs in peripheral regions (of the UK at least) have not only fewer resources devoted to research but also fewer connections with the technical expertise relevant to product innovation.

To what extent will greater use of NIT in communications improve access to information for manufacturing activities based in the periphery, particularly in the Small and Medium-sized firms?

Part of the problem here, itself symptomatic of the wider problem, is that while the peripheral regions may have the greatest need to tap external information sources of information and may derive the greatest benefits from so doing, they are least likely to make use of NIT in helping them to obtain such information. Part of the explanation for this state of affairs is the lower levels of awareness of new services and new technologies and the benefits that can be obtained from them. For example, in the UK there are major regional variations in levels of awareness about the PTTs videotex information retrieval service, PRESTEL (Table 6.7). Lack of awareness, or more correctly, false awareness, of the real benefits of adopting particular technologies was identified as a

Table 6.6

Type of Organisational Contact by Ownership Status

	Other Group Plants	Centralised R & D	Government R & D	Higher Education	Other Firms	Industrial Research Associations	Customers	Technical Journals	Other
Total									
N = 424	58	38	32	47	38	99	20	40	52
% = 100	13.7	9.2	7.5	11.1	8.7	23.3	4.7	9.4	12.3
Single									
N = 158	-	-	16	23	21	39	11	26	22
% = 100			10.0	14.6	13.3	24.7	7.0	16.5	13.9
Group									
N = 266	58	38	16	24	17	60	9	14	30
% = 100	21.8	14.3	6.0	9.0	6.4	22.6	3.4	5.3	11.3

Source: Postal and Interview Survey of the Innovation Project Report; Thwaites, Oakey and Nash.

Table 6.7 : Regional levels of awareness of PRESTEL (the UK's Videotex service), in the first quarter of 1982

London	44%
East Anglia	41%
South East	39%
West Midlands	33%
South West	32%
Yorkshire	25%
East Midlands	23%
North West	22%
Scotland	19%
North	18%
Wales	14%
Northern Ireland	N/A

Source : Prestel

major characteristic of non-adopters of Computerised Numerically Controlled (CNC) Machine Tools (Thwaites et al, 1982). The survey compared the pre-conceived attitudes of non-adopters to CNC with the actual experiences of a matched sample of adopters. Substantial differences were apparent, with for example only 30% of non-adopters believing that CNC would decrease the average time of a job, compared with the 90% of adopters which found that it had done so (Table 6.8). In general the problems are seriously overestimated and the benefits underestimated. So there is a need not only to increase general levels of awareness of NIT but to increase knowledge of the specific benefits in particular applications.

This is particularly important with respect to regional indigenous development strategies, for the 'target' group of such strategies, SMEs in peripheral regions, have the lowest levels of both awareness and use of NIT. A survey of manufacturing firms in the Northern Region of England (James et al, 1979) sought to assess the awareness and utilisation by managers of a range of available office communication technologies; the lowest levels of both were found in independent firms as opposed to branches or subsidiaries, and in small firms as opposed to medium or large firms (Table 6.9). The negative association between firm size and the use of NIT is borne out by German evidence on electronic data processing; application densities increase substantially from small to large firms (Fig. 6.5; PROGNOS, 1982). Evidence on computer adoption from the UK suggests that the variations between group plants and independent plants (a distinction partly related to establishment size) are greater than are the variations between plants in assisted and non-assisted regions (Fig. 6.6; Thwaites et al, 1982).

To an extent, such variations in the use of NIT partly reflect the greater suitability of advanced telecommunications for large, multi-site enterprises. One specific example of this is indicated in a study of inter-regional business travel in the UK (James et al, 1979). Travellers returning from business meetings were surveyed and asked to rate the characteristics of the most important meeting(s) that occurred on the trip according to a number of descriptive scales. These ratings were used in a simple model which indicated the feasibility of transferring the meetings to advanced telecommunication systems on the basis of experimental research on the feasibility of such systems for handling different meeting tasks. It was found that the degree of 'substitutability' of meetings by

Table 6.8 : Comparison of the Effect of Introducing CNC upon Adopters with the Perceptions of Non-Adopters Regarding Possible Adoption

	Proportion of respondents stating the use of CNC had involved changes or would involve changes					
	Decrease		Remain Stable		Increase	
	Adopters	Non-Adopters	Adopters	Non-Adopters	Adopters	Non-Adopters
	%	%	%	%	%	%
Overtime	22.6	35.3	66.1	58.8	11.3	5.8
Jobtime	90.5	30.3	7.9	63.6	1.6	6.0
Setting up time	66.7	51.7	15.9	41.4	17.5	6.9
No of jigs/fixtures	74.6	41.0	20.6	41.3	4.8	5.0
Scrap	69.4	36.4	27.4	59.0	3.2	4.5
Stockholding	45.9	34.6	54.1	61.5	0	3.8
Space	38.1	28.0	47.6	66.0	14.3	4.0
Material handling	25.8	40.0	72.6	55.0	1.6	5.0
Inspection	66.7	34.6	28.6	61.5	4.8	3.8
Amount of work undertaken	4.8	N/A	33.3	N/A	61.9	N/A

Source : Thwaites et al 1982

Table 6.9

Availability and Utilisation of selected telecommunications equipment by managers in Northern Region manufacturing and service establishments (in descending order of mean scores)

Ownership

1 Branch
2 Subsidiary
3 Independent

Size

1 Over 500 employees
2 300-499 employees
3 100-299 employees
4 1- 99 employees

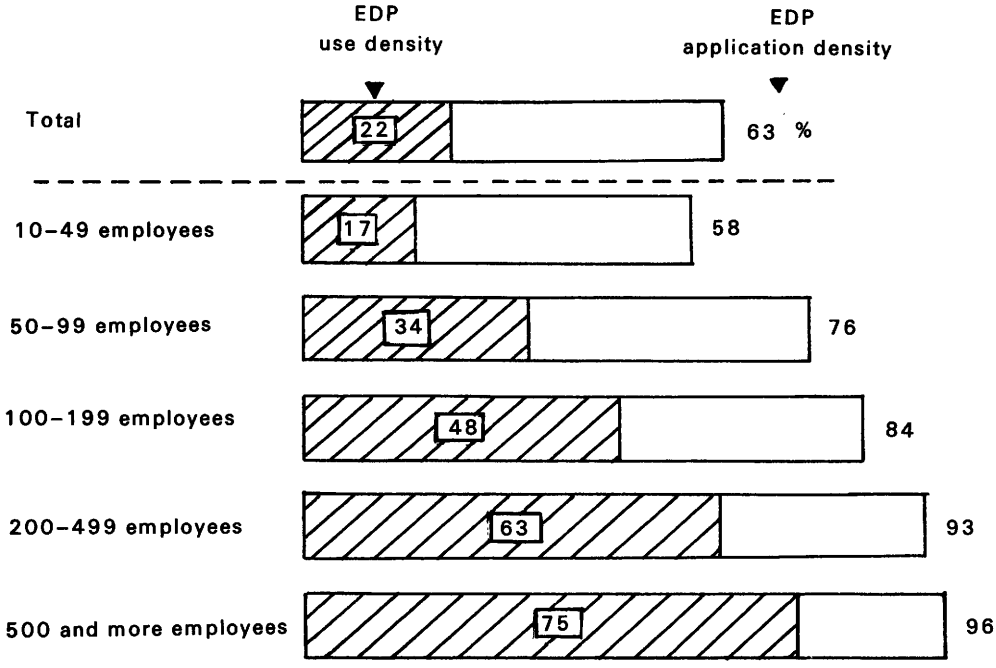
Technology

1 Mass production
2 Batch production
3 Jobbing

Note: All differences significant at 5% level

Source: James, Marshall and Waters (1979)

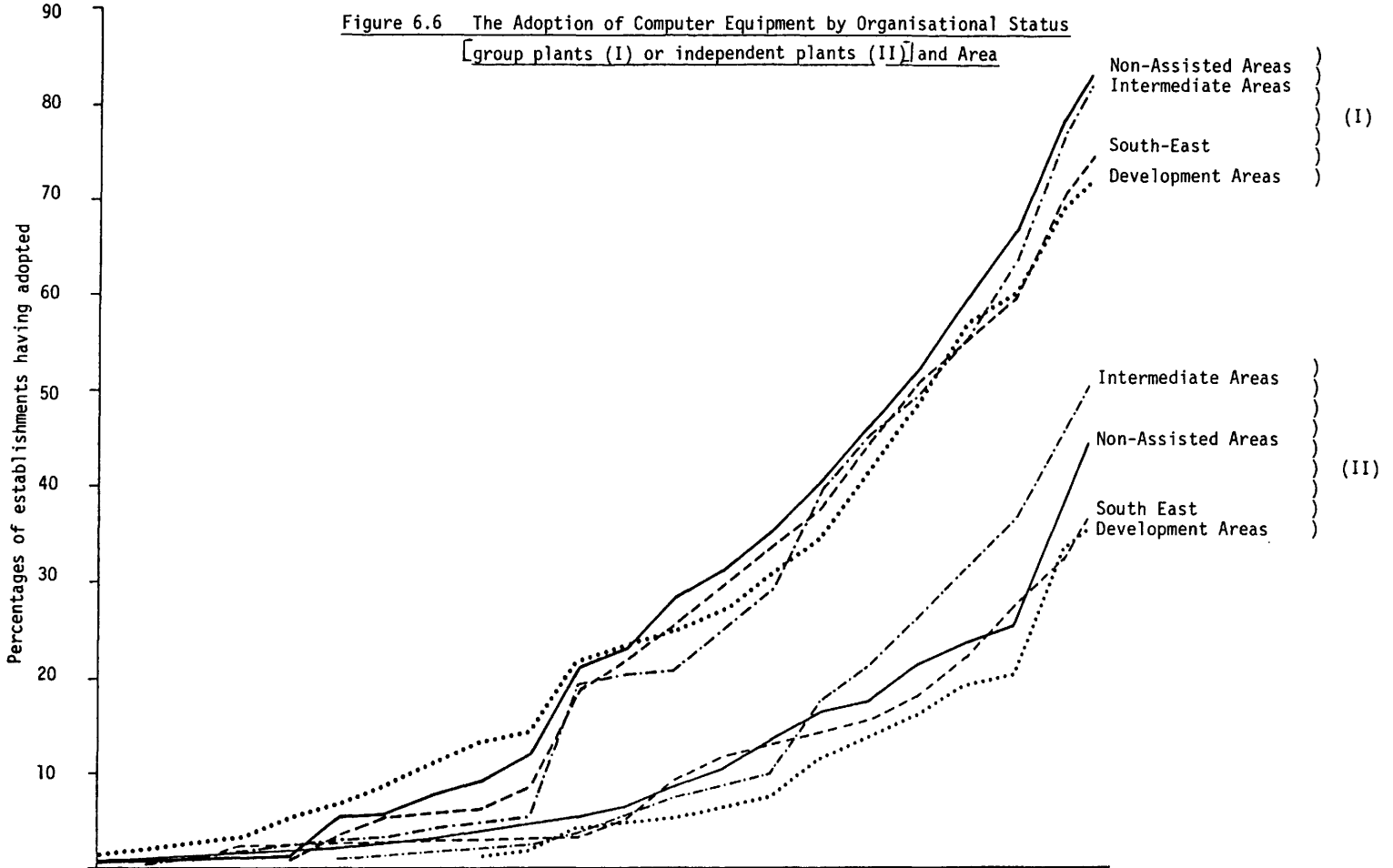
FIG.6.5 EDP USE DENSITY AND EDP APPLICATION DENSITY ACCORDING TO THE NUMBER OF PERSONS EMPLOYED PER ESTABLISHMENT



(Establishments with 10 and more employees)

Source: German national report

Figure 6.6 The Adoption of Computer Equipment by Organisational Status [group plants (I) or independent plants (II)] and Area



Source: Thwaites, Edwards and Gibbs, Report to the DOI (1982)

telecommunications was greatest for meetings within multi-plant corporations and was least for meetings involving small firms.

Nevertheless, for certain tasks NIT should offer particular benefits to small firms. The Bolton Report (1971) on small firms in the UK identified a number of main areas in which small businesses needed to improve their performance. These were:

- retrieval and use of information
- cost and other control information
- production scheduling and purchase control
- marketing
- finance
- management behaviour

As Bird (1978) has noted, "it is striking that the first two of these at least, as well as some aspects of financial management, seem likely candidates to benefit from recent developments in telecommunications and information technology". This potential is suggested by Table 6.10, which shows the types of activities which need to be undertaken in coping with a range of typical problems. When classified in this way, it can be seen that many of these problem-solving activities involve retrieving information from outside the enterprise and/or retrieving and processing information generated within the enterprise.

Although computer-based information retrieval affords new possibilities for the small firm, it is unlikely that individual small firms could afford the hardware involved or generate sufficient usage to make the service charges worthwhile. A review of data base charges, for example, has noted that "in our judgement these costs are prohibitively high to the great majority of small firms". (DI/Shell UK, 1982, p36). The same study considers that even groups of small firms in an area would not generate sufficient information requirements to warrant registration with specific data bases, a finding reinforced by the experience of Control Data Corporation's Business and Technology Centres in the USA. The report concludes that.. "What is wanted is an advisory and broking service, not instantaneous on-site access to the various sources" (DI/Shell UK, 1982, p37).

Table 6.10 : Activities carried out to cope with problems/satisfy needs

ACTIVITIES / PROBLEMS/NEEDS	Funds transfer	Information retrieval from external established data base	Information retrieval from external rapidly changing data base	Information retrieval from internal sources	Calculations and forecasting	Matching
Obtaining finance	✓	✓	✓	✓	✓	
Cash flow	✓			✓	✓	
Inventory/stock control	✓		✓	✓	✓	
Production control				✓		
Credit control	✓	✓		✓	✓	
Estimates, specifications, costs and forecasts		✓		✓	✓	
Tax returns	✓	✓		✓		
Complying with central government requests for information				✓		
Liaison			✓	✓		✓
Reference to information		✓	✓	✓		
Marketing		✓		✓		✓
Recruitment			✓	✓		✓

(Ticks indicate relevance of activity to particular problem or need)

(Taken from Bird (1978), p.32).

The crucial role of information brokers in mediating between the small firm and the array of computerised data bases is indicated by recent action research with international patent data bases and small firms in North East England (Stephenson and Riley, 1982). In situations in which the specialist adviser/broker is able to build a relationship of trust with the small firm, and react in an iterative way to a particular problem, very substantial benefits and cost-savings can accrue. The lesson of this experience is that the technology alone is not sufficient; small firms will simply have neither the time or inclination to use it unless it is marketed by proving its relevance in working situations and unless the technology is supplemented by specialist human intermediaries.[1]

The benefits of NIT in terms of external information retrieval are likely to be most apparent with a two-level service targetted at SMEs in a locality or sub-region. Firstly, an information broker with access, through NIT, to national and international sources of information, such as patent or technology data bases, marketing data bases, etc. Secondly, a set of information, much of it locally generated, available to SMEs through direct access to a 'local area network'. To provide just one example of an information set useful to small firms, industrial capacity registers are being set up by many local authorities to facilitate local purchasing and local sources of supply. Such information, easily available through a closed user group on a local area network, could provide a valuable service to small firms both in terms of identifying local suppliers and identifying possible market opportunities. In developing local area networks and the services based upon them, there is clear scope for pump-priming action by public authorities.

Such initiatives, to be fully effective, would need to be part of a more widely conceived regionally-oriented innovation policy, for as we have seen available evidence suggests that peripheral regions lag behind core regions in the propensity of their enterprises to innovate. Although a variety of factors are likely to be responsible for such differentials, including the availability of skilled labour and of finance for innovation, part of the

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1 See Hull and Hjern, 1982 and 1983, for discussions on the importance of intermediaries in small firms assistance policy more generally.

explanation would seem to lie in the poor quality 'information environments' in peripheral regions. If coupled with the appropriate institutional frameworks, NIT could help overcome at least part of this deficiency. Detailed policy suggestions within a proposed package of regionally-oriented measures to encourage innovation have been made to the CEC in our project final report and are beyond the scope of this research paper. Suffice it to say that the overall aim of such a policy should not be the equalisation of levels of technological achievement between the regions of Europe through the dilution of the resources of core regions, rather it should be through the releasing of latent potential in the lagging regions, thereby adding to the sum total of technological advance in the Community as a whole. Without policy intervention, we believe that disparities between regions in the quality of their information environments are likely to widen and the technology gap between prosperous and less-favoured regions become more rather than than less pronounced.

6.4 The service sector and the use of new information technology

As outlined at the beginning of this chapter, the conventional classification of economic activity into primary, manufacturing and service sectors is in many ways inadequate when it comes to considering the impact of NIT. Impacts on employment are likely to be greatest on the 'information occupations', regardless of which industrial sector they occur in. The service sector is the most heterogeneous sector of all in terms of its characteristics and in the impacts of NIT upon activities and employment. As noted in Table 6.2, the banking and finance sector has the highest percentage of information occupations and will be hugely affected by developments in NIT; some other service sector activities, however, particularly in the area of personal services, are likely to be unaffected by NIT. Perhaps the most useful internal sub-division of the service sector is to distinguish between producer or business services on the one hand (i.e. services to manufacturers, commerce and government) and consumer services (i.e. services to individuals) on the other. The distinction is not without ambiguities, with banking services for example being provided to both businesses and individuals.

6.4.1 Banking and Finance

As well as being a major employer in its own right, the banking industry is important to economic development through its key role in savings, investment, commercial and financial transactions. The nature of the business which banks transact has proved particularly amenable to the application of NIT, and banks have been in the vanguard of the adoption of NIT in all Community countries. As such, the sector provides an interesting case study.[1]

In spite of the very different organisational structure of banking in the member states (ranging from the small number of large private banks in Ireland and the UK, through the very much more heterogeneous mixture of private, savings and co-operative institutions in Germany, to the largely nationalised banking structure of France), they are all undergoing similar pressures to reduce costs, increase efficiency and at the same time to provide additional and more sophisticated services to clients. These pressures have emerged to a large degree from increasing competition for customers and from the direction business has taken in the past and is likely to take in the future. The growth in customers (partly as a result simply of rising incomes but also of the trend towards payment of wages by cheque or direct transfer) has largely been in small accounts which from the banks' point of view are notoriously expensive to service. In order to carry out these services it has been necessary to deal with increasing quantities of paperwork largely undertaken by appointing additional staff. In Ireland, for example, employment in banking increased by 19% between 1977 and 1981. This type of cost increase clearly acts as a spur to efficiency.

The present situation finds the banks to some degree caught in the dilemma of needing to reduce costs in which labour is the main factor on the one hand, and to expand services which are labour intensive on the other. The compromise to a large degree is seen in the rapid adoption of new

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1 The case study of the Irish, UK, German and French banking sectors was undertaken for CURDS by Neill Marshall and John Batchler of the University of Birmingham. It is presented in more detail than above in CURDS, 1982.

technology. The routine tasks of data and information transfer, storage and retrieval can be transferred largely from labour to machine, releasing resources for the expansion of personalised and sophisticated customer services which require additional staff but which can only be provided efficiently through the use of NIT.

Efforts to improve bank efficiency in Europe have been going on for some time with nations exhibiting different stages of development. The UK was amongst the first nations to automate routine banking tasks on mainframe computers in the 1960s. This was made possible through a combination of technology and organisational structures which led to a centralised computer solution which could absorb the high costs necessary for such a decision. The back office of the branch was linked in batch mode to the mainframe replacing manual systems of ledger and statement posting. A small number of computer centres were set up to which terminals in each branch office were connected. This type of operation, completed some years ago in the vast majority of UK banks, is only now diffusing throughout Ireland and is not expected to be completed until 1985. The lag is due in part to the small size of Irish banks in general which inhibits investment but also to the poor telecommunications system in Ireland which prevents direct connection of branches to central computer centres for data transfer purposes. In Ireland data are still physically transferred from more remote units to key centres where they are passed electronically via leased lines to computer centres.

The continental nations tended to follow the UK lead in automation but by the time this was undertaken technology was further advanced and it was possible to 'terminalise' the front office as opposed solely to the back office. Therefore, although centralised computers were set up in a few centres (e.g. Credit Lyonnais have three) these were fed from cash desks with on-line access thus truncating paper at source. This essential difference between the UK and the German and French situation is illustrated in Table 6.11 which shows the high ratio of front to back office terminals in Germany and France compared with the situation in the UK. However, it is anticipated that UK banks will rapidly adopt technology moving towards the European pattern of terminalisation whereas Ireland is not expected to make any substantial impact on front office technology before 1985.

Table 6.11: The Nature of office automation in Europe 1979

	Ratio of Back Office to Front Office Terminals	Front Office Terminals Nos.
U.K.	1:6.2	5,000
Germany	1:1.2	20,500
France	1:1	14,000
Sweden	1:0.1	10,400
W. Europe	1:1	

Note: Figures include banks and building societies

Source: PACTEL Automation in European Banking, 1979-1990, 1979

Table 6.12 ATMs in use and planned in Europe

	1979	1980	1985	1990
Austria	3	20	350	980
Belgium	80	120	470	1300
France	1230	1600	5000	11300
West Germany	50	100	2300	8200
Italy	200	280	1600	5100
Spain	700	930	2400	4300
Switzerland	300	360	980	2100
U.K.	2200	2600	4200	2300

Source : Bachtler, 1982

The routine tasks of cash deposit and withdrawal have been a major cost factor in bank operations and one which lends itself to automation. Automatic Telling Machines (ATMs) are one means of relieving such pressure on counter staff while at the same time improving access by customers to a limited set of banking facilities. There were 2256 ATMS in service in the UK in 1981 and Lloyds Bank estimate they would have required 3000 extra staff if these machines had not been installed. The machines tend to be installed in central business districts and major suburban locations, which leads to differentiated banking services available to clients dependent on location. Ireland at the end of 1981 had 48 ATMs in service, and more are planned, although problems of operation and machine costs are expected to inhibit widespread installation. This is not the case on the Continent, where ATMs are expected to diffuse widely in Germany and where there were already some 2600 installed in France by 1980, a number which it is anticipated will rise ten-fold by 1990. In the field of banking technology, the French have proved in the vanguard of adoption and are currently installing a second generation of ATMs - Guichet Automatique Banquaire (GAB) - which offer a wider range of services to customers. At the end of 1981, 60 GABs were in service with a potential usage far in excess of any other system in Europe (Table 6.12). A natural progression from attending a bank or one of its installations to obtain information is to obtain the same service at home or in the office. Experiments in Velize, France give the opportunity for 2000 households to obtain information on the services offered by Credit Lyonnais, in addition to balances and transactions on their accounts through their television sets, passwords ensuring personal security. In Germany, 35 banks are carrying out Videotex experiments which will probably determine the use to which this technique will be put in future years.

Even more advanced NIT applications and systems, heralding the arrival of the 'the cashless society', are now emerging in Electronic Point of Sales (EPOS). EPOS allows a customer to use a debit card to make purchases at a store and automatically have the sale charged to his/her bank account (Marti and Zeilinger, 1982). Of 21 EPOS systems existing or scheduled, as of 1982, 9 are French, 2 Dutch, 2 Belgium and 2 small operations are British. In France, where the experiments with these systems are more advanced, the banks (Banque Regionale de l'Ain, Credit Agricole, Societe Generale) participate in experiments in which terminals are installed in a variety of retail locations ranging from small shops to department stores

and to hypermarkets. Credit Agricole in their experiment with the Euromarc Hypermarket chain have already issued cards to 40,000 account holders and plan to install 30,000 POS terminals throughout France over the next five years.

The system operates on the basis of a memory or 'smart card' which incorporates a semi-conductor memory which enables the card to maintain a record of payments. Such is the interest in France in this technology that manufacturers of equipment, banks, PTTs and retail stores have come together to carry out pilot schemes (currently limited to Lyons, Caen and Paris) for a nationwide scheme. Even the pilot will mean the installation of some 1,500 terminals and the issue of 150,000 cards to bank account holders.

The regional impacts of the use of NIT in banking are difficult to discern. At the international level, the creation of collaborative efforts such as SWIFT or CEDEL are likely to create employment in the areas in which they are centred both nationally and internationally (i.e. the Computer Centres), which is offset by the employment displacement in the local areas of personnel previously engaged on these tasks. Similarly the banks seem likely to increase employment and revenue abroad and within their international divisions at home. The principal location of both collaborative and international efforts are likely to be close to centres in which international information or links are most easily established and maintained. It is highly unlikely these will be in peripheral locations.

Collaboration at the national level in clearing house operations is likely to be centralised with employment displacement at lower levels where these tasks are currently performed. In countries such as the UK this operation already exists and any major effects have already been absorbed. However in France this type of collaborative effort is just emerging and its full impact yet to be felt. In keeping with other mainframe computer-based services only a few locations can be selected in one country and these are generally near large business centres. Table 6.13 illustrates the case of the UK where 8 out of 13 Computer Centres are in two out of 11 UK regions.

The impacts of new technology on basic banking functions at the local branch level are, as we have seen, likely to be considerable. The continuing and indeed increasing need to provide personal services to customers, however, is likely to limit the extent to which banking

Table 6.13 : Organisation of the Major Banks*

Economic Planning Region	Head Offices	Regional Offices		Computer Centre	All Branches+		Population+
		No	%		No	%	%
Greater London & South East	6	19	(22.6)	4	4489	(30.0)	30.1
East Anglia		7	(8.3)		522	(3.5)	3.3
South West		10	(11.9)	1	1451	(9.7)	7.7
West Midlands		8	(9.5)		1031	(6.9)	9.2
East Midlands		4	(4.8)	1	871	(5.9)	6.7
North West	1	11	(13.1)	4	1630	(10.9)	11.7
Yorks & Humberside		7	(8.3)	1	1219	(8.1)	8.7
Northern Region		5	(6.0)		725	(4.8)	5.6
Wales		5	(6.0)		955	(6.4)	5.0
Scotland	2	7	(8.3)	2	1732	(11.6)	9.3
Northern Ireland		1	(1.2)		357	(2.3)	2.8
TOTAL	9	84	(100.0)	13	14982	(100.0)	100.0

+ Source: Davies and Davies (1981)

* The distribution of head, regional and computer offices is for the following banks; Barclays, Lloyds, National Westminster Bank, Midland, Williams & Glyns, Co-op, Bank of Scotland, The Royal Bank, Trustee Savings Bank.

activities can be centralised. Consequently it is to be expected that on a regional scale, there are unlikely to be major contractions of banking employment in peripheral areas relative to core areas. Indeed, in as far as peripheral areas have lower percentages of their population using banks, there may be greater scope for expanding services (and hence local employment) by capturing previously un-tapped markets. At the sub-regional scale, however, there might be relative concentration of employment in branches providing specialist services to customers, at the expense of down-graded local branches handling more routinised transactions through the application of ATMs and auto-banking. The specialist branches are likely to be located at the points of maximum accessibility within sub-regions (e.g. city centres), or in suburban centres involving a trade-off between accessibility and rent levels. The less-urbanised parts of sub-regions may experience lower levels of banking employment than currently enjoyed, with automated local services and more specialised services available only in sub-regional centres. Whether this type of scenario becomes realised will depend to an extent on the level of consumer acceptance of face-to-machine rather face-to-face relationships.

6.4.2. Business services

Forces for both centralisation and decentralisation can be discerned with respect to the organisation and location of business services. The exact nature of the impact of NIT will depend on the corporate organisation of the sectors concerned, particularly the balance between large, multi-region and small, local companies. Many business service activities have traditionally been the preserve of small and medium-sized enterprises serving local markets. However the 1960s and 70s have witnessed an increasing concentration of ownership within key business services like accountancy and management consultancy. For example, a survey of 10 business services sectors (accountants, finance companies, insurance brokers, solicitors, advertising agencies, computer bureaux, architects, consultant engineers and management consultants) in 3 provincial regions of the UK has revealed that 67% of establishments are branch offices and 71% had their headquarters in London. Such concentration has occurred through internal expansion and the establishment of branch offices in various locations and external expansion through the acquisition of previously independent local firms.

Developments in telecommunications have no doubt facilitated this process of ownership concentration and the geographical expansion of services of large companies into peripheral regions. While this branch expansion has produced additional employment and improved the quality of services available in peripheral regions it may also have been to some degree at the expense of indigenous service industries. Insofar as a more widespread use of NIT results in greater dispersal of business service firms from capital cities, the net effect on employment in peripheral regions may not be positive. In contrast to mobile manufacturing firms, service enterprises are likely to compete directly in local markets in peripheral regions, a fact that is often overlooked in policies designed to stimulate mobility in the service sector.

6.4.3. Consumer services and new information technology-based services

The primary emphasis in the present chapter has been upon the regionally differentiated impacts of the adoption of NIT. Although consumer services would not normally be considered as potentially mobile, developments in NIT are themselves changing the geographical possibilities for service provision, and a number of the indirect and/or long-term effects of NIT adoption may have profound impacts. Certainly in the case of retailing, employment is unlikely to be mobile between regions, as retail outlets serve local or regional markets. However, the retailing organisations, particularly the larger ones, are major users of NIT, for example in the form of automated stock control and point-of-sale terminals. While the adoption of such labour saving technology is likely to proceed most rapidly in high labour cost regions, most large operators recognise that scale economies arise if all stores are linked together as quickly as possible. As a result the direct long run regional differentiation in employment effects is unlikely to be significant. However the indirect employment effects may be more important. In established national retailing chains the use of NIT in centralised purchasing and distribution may reduce the importance of regional middle management functions. At the same time NIT may enable national chains to enter into regional markets previously protected by the barriers of distance. In both instances, established patterns of local purchasing by regional retail chains may also be disrupted. Insofar as NIT facilitates further concentration of ownership in the retail sector it may contribute to further import penetration both

regionally and nationally, with consequent negative impacts for regional and national producers of consumer goods.

Even more subtle indirect effects may arise through inter-regional variations in the rate of household adoption of NIT. Such household adoption may be necessary to realise the economies of scale required to justify investment in network infrastructure, cabling being a prime case in point. This investment will, in turn, provide the basis for more specialised producer services. At the same time household use of NIT may facilitate business applications through greater familiarity on the part of employees of the potential of the technology. Given that adoption of NIT by households is likely to be related to income and given the existence of higher per capita incomes in the core regions of Europe, such developments will contribute a further negative element to the disadvantage of the peripheral regions of the Community.

A further thesis concerning the impact of NIT on service provision generally also needs consideration in a regional context. This thesis has been developed by Gershuny (1982) in connection with the FAST Programme. He suggests that developments in NIT will accelerate the growth of the "self-service economy" whereby households substitute goods for services previously bought in established consumer markets (e.g. television sets substituting for entertainment services). This trend may displace jobs in conventional personal services but lead to additional jobs in the creation and management of the "software" necessary to deliver these services electronically.

Table 6.14, taken from FAST (1982), attempts to provide some crude estimates of the job creation potential of new services to individuals, classified under broad headings such as intelligence services, audio visual services, electronic games, etc. Martin (1978) has gone further in specifying 108 potential new services which could be made available on cable systems. While the commercial viability of many of these services is unproven, there can be little doubt that substantial (gross) job creation is likely in the provision of these new services in the medium-to long-term.

Unfortunately, the types of skills necessary to produce NIT-based services is highly specialised and available chiefly in the more prosperous regions

Table 6.14 : Range of Gross Job Creation Potential of Existing and Likely Applications, 1980-1995

Application	Job Creation Potential in Application and Maintenance (1000 jobs)
1. Automation	
. Plant automation	100 - 400
. Office automation	100 - 200
. Others (distribution, retail stores ....)	10 - 50
2. Transport	
. Car electronics	25 - 90
. Others	?
3. Communication (point to point)	
. Satellites - all purposes	10
. Video-communication inter-enterprises	0 - 17
. Video-communication grand public	0 - 50
. Other point to point communication	?
4. New services for companies & administrations	
. Computer-aided design	15 - 80
. Intelligence services	8 - 42
. Information for business management	100 - 200
. Business databanks	30 - 200
5. Education - training	
. Training aids inside companies	10 - 40
. Teaching aids for public education	9 - 15
. Packaged education at home	10 - 40
. Training (all formal types)	200 - 300
6. New services to individuals	
. Utility information & intelligence services to individuals	25 - 100
. Audio-visual : entertainment & topical information	200 - 300
. Electronic games, toys, sports	40 - 70
. Do-it-yourself informatics cultural & artistic	50 - 130
. Automation of repetitive household task	0 - 50
. Health protection & warning equipment	10 - 75
7. Others	
. Alarm & protection systems (goods)	50 - 100
. Building management systems	12 - 60
. Regulation of heating/air-conditioning	50 - 150
TOTAL	1050 - 2769
+ Production of electronic components	
minimum : 20% of above total	211 - 554
maximum : 50% of above total	527 - 1384
TOTAL (rounded)	1300 - 4100

Source : FAST

of the Community. Once the electronic services software is written it is perfectly mobile between regions so we may witness population-orientated conventional consumer services in the least-favoured regions being displaced by NIT-based services produced and delivered from more prosperous areas (the situation is analogous to the displacement of local theatres by TV programmes produced in capital city studios).

Such trends are not inevitable. NIT could equally facilitate the development of local electronic services tailored to meet local needs. But this depends on the existence of the necessary regional networks of interest groups coming together to exploit the potential of the new technology. Unfortunately in many of the peripheral regions of Europe such networks may have atrophied with the regions becoming highly dependent, local initiatives and entrepreneurship having been drained away by the increasing external control of local economies and an increased reliance on transfer payments. Considerable stimulation by public agencies may be necessary to create the conditions favourable for local communities to respond to the potential of NIT.

Much the same pattern of production in core regions servicing the demand in peripheral regions, seems likely for those Valued Added Network Services (VANS) which are already beginning to emerge in the wake of the newly 'liberalised' regime for telecommunications in the UK. The wide variety of possibilities for commercial VANS, transmitted via the British Telecom and Mercury networks, include automatic ticket reservation systems; customer databases; archiving; message systems; telesoftware storage and retrieval; user management packages for accounting statistics, etc; and general videotex systems. The expected growth rate of such services is rapid, and is accelerating with the greater penetration of electronic office systems and as Cable TV networks begin to be established. Although such services <u>can</u> be provided from any point on a network, tariff barriers (except on packet switched networks), the availability of software skills, the availability of finance for high-risk new ventures, and spatial market concentration all militate <u>against</u> enterprises in peripheral or less-favoured regions being able to capture a significant share of the rapidly expanding market. In as far as such new NIT-delivered services replace or subsume locally provided non-electronic services, then peripheral regions seem consigned to experiencing only the job displacing impact with the newly-created jobs being concentrated in core regions.

CHAPTER SEVEN

REGIONAL CASE STUDIES ON THE IMPACT OF NEW INFORMATION TECHNOLOGY

The review of available evidence and the European-wide synthesis based upon it, which has been presented in previous chapters, has established that the regional impacts of NIT are proving to be highly complex. The same technology appeared to be associated with a wide range of possible outcomes, centralising and decentralising, job creating and job displacing. Consequently there is no mechanistic 'formula' for predicting the impact of NIT upon a given region. The net regional impact will obviously be determined by the balance between negative and positive impacts of the new technology, but again there is no easy way of predicting what there will be; they can only be specified and understood within the context of particular regions. For example, we have demonstrated that NIT offers considerable potential to economic actors located in peripheral regions - how these actors respond to the potential can vary enormously between regions however. It was consequently necessary to explore this complexity of impact and response through in-depth regional case studies. These are summarised briefly in the present chapter, and more fully in our Phase II Report to the Commission (CURDS, 1983).

The studies were conducted in France (Languedoc-Roussillon); Greece (Crete and Salonika); the Irish Republic (North East and Mid West) and Northern Ireland (Armagh, Newry, Mourne); Italy (Calabria and Sicily) and the UK (Northern Region). The regions were selected to demonstrate the very considerable diversity to be found in Europe's less-favoured regions, from de-industrialisation to atrophied agrarian economies, from areas of stagnation to others with elements of growth and/or revival. All however are peripheral, both in their national and EEC contexts (Figure 7.1), and all have regional per capita GDPs below the EEC average (ranging from 96% of the average in Languedoc Roussillon to only 48% in Calabria; Table 7.1). A further feature of similarity, which emerged clearly from the case study reports, is that all need support if they are to share with the core regions in the benefits of New Information Technology.

Fig. 7.1

REGIONS/SUB REGIONS SELECTED FOR PHASE II STUDIES

(Base map : indicators of GDP at market prices per employed person, purchasing power parities; EEC 10 = 100, 1979)

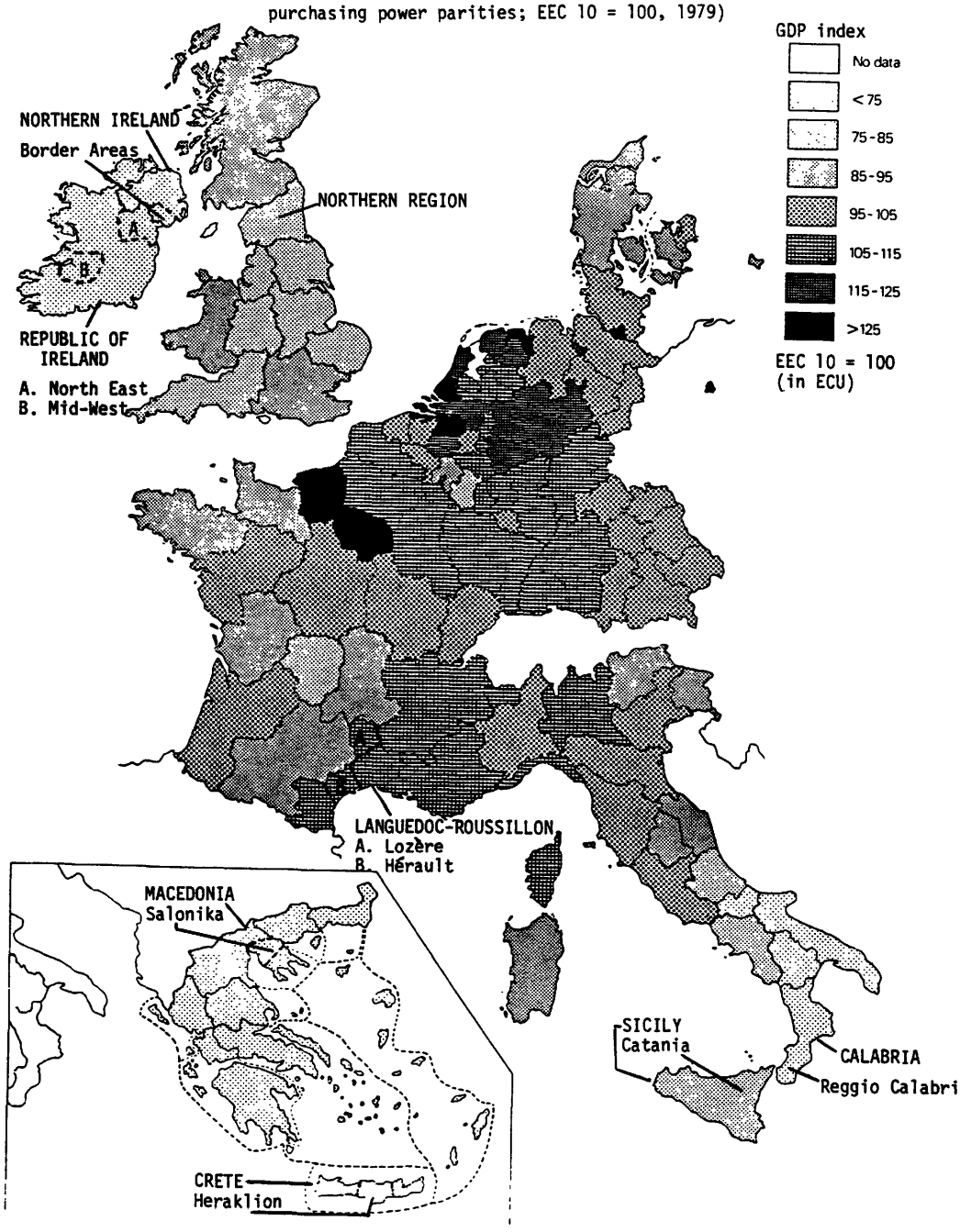

Table 7.1: Basic Statistics for Phase II Study Regions

	Languedoc-Roussillon (Fr)	Calabria (It)	Sicilia (It)	North (UK)	Northern Ireland (UK)	Republic of Ireland	Crete (Gr)	Macedonia (Gr)	EEC10
Total population (1980) 1,000s	1,838	2,083	5,012	3,082	1,547	3,401	502	1,696	-
GDP indicator (EEC10 at purchasing power parities = 100) (1979)	96	48	57	90	70	62	(Regional Stats N/A) (Gr = 58)		100
Registered unemployment rates (%) (1980)	8.4	11.0	13.5	9.9	11.8	8.3	N/A	N/A	
Percentage of workforce employed in: (1979) Agriculture	14.3	20.2	19.2	0.6	6.2	20.4	62.7	42.6	6.7+
Industry	28.5	24.0	25.5	48.7	37.6	32.7	15.9	28.4	40.1+
Services	57.0	55.8	55.4	49.8	54.6	46.4	21.4	29.0	52.8+
Standard of Living indicators: (1978) Cars/100 inhabitants	35.1	17.1	22.7	21.0	22.5	19.3	14.2	13.9	31.1+
Telephone Subscribers/100 inhab.	22.4	10.5	16.4	16.2	17.7	12.1	(16.3)	(21.6)	25.2+

Sources: EUROSTAT, except data on Greece; which is taken from Phase II project reports:

Greece - total population - 1981 data
" - workforce by sector - 1971 data (note:agriculture includes all Primary Sector)
" - cars - 1982 (vehicles)
" - telephones - 1981 data for number of exchange lines (approximates to number of subscribers)

+ EEC9 only
N/A = not available

7.1 The case study regions

France : Languedoc-Roussillon (sub-regions : Herault and Lozere)

The region contains strong internal contrasts, from the well-developed and growing urban axis of the coastal areas (including the sub-region of Herault, centred on Montpellier), to the upland rural hinterland characterised by a declining agricultural sector and - until recently - substantial de-population (exemplified by the Department of Lozere). The net regional population balance has changed since the mid-1970s as a result of immigration to the 'sun belt', but the regional economy remains relatively underdeveloped and unable to meet the employment needs of its growing population; as a result Languedoc-Roussillon has the highest level of unemployment in France. Growth points within the regional economy include inward investment in advanced manufacturing sectors (electronics and pharmaceuticals particularly), and parts of the service sector which are benefitting from the continuing development of tourism.

Greece : Crete (Heraklion) and Macedonia (Salonika)

Crete is the largest of the Greek Islands and is the most southerly part of the European Community. Agriculture and tourism are the dominant sectors of the economy. Heraklion is the major city of Crete, and is the fastest growing sub-region on the island. Agriculture still employs 40% of the workforce, in a traditional grape producing sector and a new export sector producing salad crops (much under glass). The island's tourist industry is concentrated in the Heraklion sub-region and inspite of infrastructure bottlenecks (e.g. sewerage and water), growth prospects remain strong. Salonika, in the northern Greek region of Macedonia, is very different in that its recent growth and future growth potential lies in the manufacturing sector, particularly in the footwear, clothing and textile industries.

Ireland (North-East and Mid-West) and Northern Ireland (The Border Area)

Both of the Irish Republic sub-regions investigated are experiencing high levels of population growth and are predominantly rural, with continuing strong dependence on agriculture. The Mid-West has benefitted particularly from the influx of overseas investment into the Republic, with foreign establishments accounting for more than half of the region's manufacturing employment. The UK region of Northern Ireland presents a very different picture, with continuing decline in its traditional manufacturing sectors and minimal inward investment. The sub-region selected for investigation is particularly deprived, with its circumstances made worse by being a border area in a politically unstable situation. The economy is heavily dependent upon public sector services, these having grown while all else has declined.

Italy : Calabria (Reggio Calabria) and Sicily (Catania)

Calabria is the least developed Italian region, still heavily dependent on decaying small-scale peasant agriculture. Even in the province centred on the main town of Reggio Calabria there is little industrial development, with the manufacturing sector being almost wholly made up of small firms in traditional sectors selling to local markets. In spite of the climate, tourism has not developed to any great extent (Calabria is mountainous, with few beaches, and communications are very poor). Sicily has a much stronger economy than Calabria and has undergone considerable modernisation over the last 15 years; agriculture, manufacturing and tourism are all considerably more developed. The province of Catania has a degree of dynamism and the town itself is a centre of commerce.

UK : Northern Region of England

The Region has two major conurbations, including that centred on Tyneside with a population of over 1 million, as well as substantial rural areas. The North experienced early industrialisation, building up a heavy industrial base which continues to suffer long-term decline. Industrial diversification, stimulated by regional policy, created a branch plant economy which has proved vulnerable to restructuring and recessionary

pressures. The small firms sector is under-represented in the region, constraining its potential for generating indigenous growth. The expansion of the service sector has in the past helped to compensate for job losses in other sectors, but unemployment levels remain higher than in any other UK region with the exception of Northern Ireland.

7.2 The telecommunications infrastructure

The telecommunications infrastructure is the starting point for considering the likely and potential impact of NIT, because so many developments are dependent upon the existence of modern and efficient telecommunications services. In most of the study areas, however, the stimulation of demand is a much more important issue than the supply of infrastructural capacity. All the areas do have specific infrastructural problems with bottlenecks, lags in the provision of advanced services, etc, but only Heraklion (Crete) has a really pressing problem of inadequate infrastructure.

All the PTTs covered by this study have invested and are continuing to invest in new telecommunications infrastructure, and the (peripheral) study areas are sharing in this investment; indeed, in some instances, there is an element of positive discrimination in favour of these regions. The Italian PTT, for example, intends to devote a substantial share of new investment to the Mezzogiorno so as to reduce waiting times and in Greece, PTT plans are incorporated in regional development policy within the National Plan exercise.

This is not to suggest that all regions in Europe have a similar quality of telecommunications infrastructure; as we have seen in Chapters 2 and 3, massive variations exist between member states, reflecting their relative prosperity and the priority afforded to improving telecommunications. Possibly the best endowed of the study areas in Languedoc-Roussillon, where a quarter of telephone exchanges are now electronic, waiting times for connection are insignificant, the packet-switched data network, Transpac, is available throughout the region, and Montpellier is to be one of the first four French cities to be cabled. The high level of enthusiasm and activity for advanced services and networks in France contrasts markedly with the position in Heraklion (Crete), grappling with the problems of overburdened telephone networks. Because exchange capacity is so limited,

waiting times for telephone connection can be very lengthy indeed; businesses have priority over residential subscribers, but might still wait up to 5 years.

Clearly, the scope for NIT applications is very different in these two extreme cases. In general terms, the situation in Greece and Italy is most constraining because of the lack of dedicated data networks - data communication has to rely on (costly) leased lines to avoid the inadequacies of the PSTN. In certain other peripheral regions considered, notably Northern Ireland and the Northern Region of the UK, the reports make clear that the telecommunications infrastructure is in no way constraining the development or application of information technology; the problem in these regions lies not on the supple side but in low levels of demand. Although the causes may differ, all of the study regions have telecommunications penetration levels below their respective national averages, reinforcing the assertion made in Chapter 3 that the distance-shrinking technologies, which would seem to offer the most benefit to peripheral regions, are in fact under-used in these regions.

7.3 The production of new information technology

Some of the study areas have obtained significant though small shares of decentralised hardware production. In the Montpellier area of Languedoc-Roussillon, for example, an electronics industry has been built up around an IBM-established factory producing computers and telephone equipment. The regional report points out that although the electronics industry here is not at the forefront of technological development, it has good prospects and is becoming a new regional specialisation, with local supply linkages and technical/training support from the educational institutions in Montpellier.

The Irish Republic has also been successful in attracting overseas industrial investment and has secured a share in NIT manufacture. The Mid-West sub-region has recorded rapid growth in employment in this sector, helped by supportive institutions; for example, the National Institution of Higher Education at Limerick. But the developments which have taken place are very much production units; there is little or no R & D capacity, few local linkages, and little evidence for growth in indigenous NIT

manufacture. An even more extreme example is presented by a major electronics factory located in Catania (Sicily), which has very few local linkages since there are no relevant producers in the areas.

A rather different situation is presented by the Northern Region of the UK. Here an established electrical engineering industry exists, but the region has managed to attract few of the new electronics industries. The region had substantial capability in manufacturing electro-mechanical telecommunications equipment, but these branch-plant production units are now becoming superceded as new electronic exchange equipment is brought into production in other parts of the country.

Even more so than for manufacturing, the computer services and software industries are under-represented in the case study regions. It is a feature of these peripheral regions that computer penetration is relatively low so that the computer service industry is fairly undeveloped - perhaps a few firms mainly concerned with sales and machine servicing rather than with the higher level activities of software production. However, each of the case study regions have educational and other public sector institutions which seem capable of making up for some of this deficiency. The developing role of Universities and other centres of higher education seems to emerge particularly strongly from the case studies, with Informatics Centres, Software Centres, Microprocessor Applications Institutes, etc., already established or in the process of being established in the peripheral regions considered.

7.4 The users of new information technology

Of all economic sectors, agriculture has been least affected by developments in NIT. In some of the case study areas, many farmers do not even have a telephone. In Reggio Calabria and Catania penetration levels in the farming community are inhibited by high installation costs which are borne by the subscriber, and the case studies in Ireland and Greece also noted very low levels of telephone connection. Much higher levels of farm telephone penetration are achieved in the more sophisticated and modern agricultural sectors of the UK (Northern Ireland and the Northern Region) and, to a lesser extent, France (Languedoc-Roussillon).

The case study reports considered the information needs of the agricultural sector, focussing particularly on videotex applications. In Languedoc-Roussillon proposals had previously been advanced (but not implemented) for an interactive videotex system supplying legal, technical, economic and social information direct to farmers. In Heraklion (Crete), some form of videotex service, with a strong emphasis on market data, was suggested as being of value to the large co-operatives and co-operative unions, while in the Irish Republic (West Region) a pilot agricultural videotex system is currently in progress. In the UK, the Agricultural Development and Advisory Service (ADAS) offers a substantial database on Prestel; this, however, achieves greatest take-up on the larger arable farms in the South rather than in the peripheral areas, and overall penetration is low. Limited agricultural information is also available directly to farmers on the much more popular (and cheaper) off-air teletext services in the UK.

NIT is coming into use in manufacturing industry in each of the study areas but often slowly, and appears to be proceeding at a slower pace than in the core regions. The large, frequently externally-controlled establishments are much more likely to use NIT (advanced telecommunications, computers, microprocessors in products and processes) than smaller, often indigenously-controlled concerns. Inward investment creating new branches of large corporations tends to be seen as an effective means for building up NIT use in these regions.

In the more industrially-advanced case study regions (Northern Region of the UK and Languedoc-Roussillon) computer use in manufacturing is widespread in support of administrative tasks, but is also becoming important in new applications such as Computer-Aided Design. Even in the large-plant economy of the Northern Region, however, only a handful of the region's largest firms use advanced telecommunication links and very few use them for research tasks like database searching. In the less industrialised regional economies, NIT use is at a much lower level but examples of applications can still be found; in Heraklion (Crete), for example, the Chamber of Commerce and Industry hopes to link in to a proposed EEC database system to provide information for exporters.

As expected, size of establishment emerges very strongly as a factor in the take up of NIT. A 1982 sample survey conducted in Italy's Mezzogiorno of

manufacturing plants with 20 or more employees revealed that as many as 60% had acquired computing facilities, while the proportion rose to 90% for establishments with 200 or more workers. Significantly, many of these firms had experienced difficulties in selecting hardware and software, in obtaining qualified manpower and in organisational adjustments to accommodate the installation of a computer. A general observation made in a number of the regional case studies was the existence of barriers to NIT adoption by small firms through what were perceived to be inadequate support structures (public or private).

Within the service sector, banking is one of the major users of NIT in all of the case study locations. Through their demands on the PTTs, the banks have in certain instances pushed forward investment in networks and services. In regions with very low overall levels of NIT use, the banks often stand out as the principal user. In Heraklion (Crete) for example, almost all bank branches in the city have installed computer terminals over the last 2-3 years, sending data to Athens and to other branches over leased lines. In the Irish Republic most branches have mini-computers, and send data in disc form to Dublin, a system that is shortly to be replaced by a real-time system using leased lines. As well as putting pressure on PTTs to up-grade infrastructure, the banks would seem to have an important 'demonstration effect' role within peripheral areas in being the earliest, and perhaps most visible to the public, of the major users of new information technology.

The tourist industry also appears to be a prime candidate for NIT, particularly interesting given the importance of tourism within many of the Community's least-favoured and peripheral regions. The major airlines appear to be the leaders in this sector; in Catania (Sicily), for example, the local Alitalia office can link into the airline's videotex system for bookings, flight availability, etc. Many tourist operators and large hotels rely heavily on telex, while even in Heraklion (Crete) microcomputing systems are beginning to be applied for accounting, payroll and booking operations in a few of the larger hotels. Similarly it is reported that some of the big tourist operators in Catania have computer and facsimile links to operators in Northern Italy and abroad.

The tourist industry, with its need for constantly up-dated information systems, would seem to be an obvious potential user of interactive videotex

developments. In the UK, a videotex service for operators and travel agents, with 'gateway' links into airline computers in the US and elsewhere, is very well established on Prestel. This is the most important of Prestel's Closed User Groups and is fully interactive. In Herault (Languedoc-Roussillon), a tourist databank (providing details of camp site availability, etc) as a videotex service was due to be established during 1983, while the case study report on Heraklion noted the enthusiasm for some form of videotex system linking hotels, tourist offices, and overseas operators and agencies.

Finally, with respect to the use of NIT, in France and the UK there is an emphasis on applications which serve private consumers. In France there are attempts to develop widespread household take-up of 'Minitel' videotex terminals and projects (e.g. in Herault) to establish community databases. In the UK, renewed efforts are being made to market Prestel for home use, linking it with the boom in home computing. Both countries have plans for substantial cable-TV networks, which are potentially important for the development of new NIT-based services (tele-shopping, tele-banking, etc).

7.5 Policy suggestions in the regional case study reports

All of the case studies included some examination of policies which might help the areas considered to share in the benefits of NIT. The suggestions made by the experts conducting each study are not the policy recommendations from the project; such recommendations, based on considerations of all the studies together and taking into account the existing policy environment, have been made to the Commission in our project final report and a number are outlined in the final chapter of the present report. The suggestions put forward in the individual case studies are nevertheless interesting in the indication they provide of the communality, or otherwise, in problems and policy needs in the widely-varying regional contexts examined.

All of the case studies agree on the need to envisage any regional policy for new information technology within a broader strategic framework. The report on Languedoc-Roussillon, for example, sees NIT as one component facilitating the growth and development of certain key sectors which could constitute 'poles' of economic development. Within these key sectors, defined on the basis of regional specialisms having good growth prospects

(biomedicine, electronics and food processing), the report argues that NIT has the potential to establish and strengthen links between industry in the region and external markets. Thus the regional NIT strategy is one component of a broader regional industrial development policy. Similar points are made in the Irish and UK reports, in which NIT is seen as having a role to play both within inward investment strategies and within strategies aiming to improve the performance of the indigenous sector, such as by encouraging innovation.

The case studies all make recommendations on the most appropriate institutional frameworks for developing and implementing regional NIT strategies. The widely varying suggestions made in this respect reflect the very different existing institutional arrangements in the various member states and regions within them, and should serve to remind us of the need for sufficiently flexible 'policy packages' to ensure their applicability in a range of regional contexts.

The report on Languedoc-Roussillon is probably least explicit in making suggestions concerning the machinery for implementation, perhaps not surprisingly given that France already has (national) NIT policies, with interventions and experiments already established or planned in the region. The report suggests that the most appropriate spatial unit for formulating an NIT strategy is the level of Languedoc-Roussillon as a whole, which would fit in with existing administrative structures, but that for some purposes it may be necessary to envisage larger units as being more appropriate (evidence of the 'distance-shrinking' nature of the technology!).

The Greek report proposes a mixture of new and existing institutional arrangements, involving the creation of a national NIT committee working within the Five Year Plan system, below which would be NIT committees for each nomos. The latter could include representation from the local authority (nomos) itself, the Government's Regional Development Service, the OTE (the PTT) at local level, Chambers of Commerce and Industry, industrial development agencies, NIT producers, educational institutions, and users of NIT, including organisations representing manufacturers, co-operatives and hoteliers. The report considers the nomos to be the most appropriate level at which to operate a strategy and establish a committee,

since the nomos constitute administrative entities and, moreover, there are government plans for decentralisation to elected nomos administrations.

The Irish report goes a step further in 'proposing' new regional development agencies as the most appropriate vehicle for carrying out a regional NIT strategy, a response to the existing highly fragmented organisational structure, with separate bodies responsible for mobile investment, small firms, infrastructure, and so on. The report recommends that a NIT strategy should be carried out by agencies which have wide regional development remits, are regionally controlled and relatively autonomous and which can provide a 'one-step' facility. Shannon Development, in the Mid West, comes closest to this kind of agency and could, the report suggests, provide a model for other regions.

The report's comments on Northern Ireland cover similar ground, in advocating that a NIT strategy should be an explicit component of the wider regional industrial strategy. The sub-region selected for examination (the Border Area) is, it is argued, too small to provide the spatial focus for a NIT strategy, which would have to be formulated at the level of the Province as a whole. It could, however, include policy on cross-border issues and co-operation (e.g. in telecommunications infrastructure).

The Italian case study report notes that there is a policy formulation 'gap' between the level of the Mezzogiorno as a whole, at which most agencies and policies operate, and the much smaller provinces (i.e. Reggio Calabria, Catania). It is argued that NIT strategies would be best developed and implemented at the intermediate regional level (i.e. Calabria, Sicily). This would necessitate the creation of regional-level agencies, a requirement already anticipated in Calabria by current proposals to establish a regional Agency for Economic Development.

The study of the Northern Region of the UK presented detailed proposals for a regional strategy concerned specifically with NIT. In the absence of a regional planning agency, it would be necessary to establish a specific organisation (a regional NIT committee) to devise and implement the strategy, drawing on organisational resources and expertise throughout the region. The committee could include representatives from British Telecom (the PTT), central and local government, large users, small firms agencies, trade unions, NIT producers, the education sector and the region's inward

investment promotional agency. It is felt that a regional-level strategy would be most appropriate but, because of lack of organisational entities at this level, county-level strategies may prove more easy to develop and implement. The NIT strategy does not have an overall regional economic plan to fit into; however, since NIT and its impacts are so all-embracing, a comprehensive NIT strategy incorporates many of the elements one would expect to find in a broader regional development plan.

The Northern Region report went on to specify the various elements of the strategy proposed. We summarise these below, not because they could be necessarily generalisable to other regions - indeed, a number of the suggestions would be inappropriate in different types of region, which may require very different 'policy packages' - but because they serve to illustrate the all embracing nature of a NIT strategy in a particular regional context, which in turn should make obvious the need for very careful consideration to be given to the institutional arrangements for policy formulation and implementation.

The elements of the proposed strategy for the Northern Region include:

(i) Telecommunications : monitoring investment and lobbying for further investment; encouragement and support to efforts involved in marketing telecommunications; lobbying for tariff reductions; establishment of liaison groups of users to articulate needs.

(ii) Industry : increase publicity and support for existing NIT initiatives and bring them into a coherent strategy; consider a regional dimension to Department of Industry innovation support schemes; establish 'shop front' agencies offering general NIT advice and bureau services; consider setting up computerised databases on regional goods and services; arrange awareness seminars, visits, etc., enhance regional promotion efforts by reference to telecommunications and their relevance to branch plants.

(iii) NIT in the Community : monitor education and training in NIT, seeking to make it more extensive and accessible; support use of NIT by voluntary organisations; monitor domestic use of NIT and applications for the disabled, with reference to identifying production opportunities.

(iv) Production of NIT : encourage incorporation of NIT in existing products; identify and promote the establishment of a hardware specialism; investigate and support new opportunities for software/Value Added Network Services production.

The report concludes that there is a need for a strategy backed by a regional committee to support and give coherence to existing initiatives, bid for and develop new initiatives, keep abreast of developments and provide an element of direction and leadership. A locally-focussed model for such an approach is already established in the UK at Milton Keynes and appears to be achieving a considerable degree of success.

In spite of the very different regional situations considered by the case studies, a number of policy suggestions can be identified which are made in most, if not all, of the reports. There is, for example, generally expressed interest in the establishment of computerised databases and, ideally, videotex systems for the dissemination of information needed by key economic sectors. Thus the Heraklion (Crete) case study report called for the establishment of on-line (videotex) systems serving the tourist industry, agricultural co-operatives and importers and exporters at the Chamber of Commerce and Industry. In regions with greater manufacturing activity, including Catania (Sicily), Ireland and the Northern Region of the UK, the need was expressed for information systems which could more effectively match required inputs with available outputs.

Other policy suggestions commonly recommended in the reports included:

- the desirability of encouraging technological innovation through the establishment of Innovation/Technology Centres

- the need to promote awareness of the benefits of NIT in regional enterprises, particularly amongst SMEs, in which barriers to adoption and use seem highest

- the importance of trying to encourage the growth of the computer services sector within regions (again relating to barriers to adoption, as well as to the sector's own potential job and wealth creating role)

- the need to involve the educational sector in ensuring that the training and manpower requirements of NIT can be met.

The perhaps surprising communality of many of the proposals is indicative of the fact that all of the peripheral regions considered are experiencing below-average activity with respect to developments in new information technology both in production and application aspects. These regions need positive policy intervention if they are not - by default - to miss out on the benefits of NIT; without such intervention they may instead in time experience only the disbenefits. We believe that this eventuality would conflict with the Community's desire to see balanced regional growth, and that a clear case can be made for developing an NIT element within the Community's regional policy. In the final chapter we identify some of the major issues of policy concern which have arisen from the study, placing them within the context of the different problems which the less-favoured regions are experiencing with respect to new information technology.

CHAPTER EIGHT

POLICY ISSUES ARISING FROM THE STUDY

8.1 The need for an explicit regional new information technology policy

We would contend that the Community's existing policy instruments are, for a variety of reasons, not adequate to deal with the situation we have described in previous chapters in which the less-favoured regions are 'missing out' on the benefits of NIT while being in danger of suffering direct and indirect disbenefits. On the one hand, existing Community policies towards encouraging NIT have, because of their principal objective of creating a strong European industry, not been able to take account of the regional dimension. Although it has been recognised that there are, and will continue to be, negative effects associated with new information technology, and that retraining programmes and programmes to encourage SMEs will consequently be necessary, almost inevitably these industrial information transfer and social policies have, because of their wider objectives, not been able to adequately take into account the problems caused by the uneven geographical impacts of NIT.

While existing technology and industry policy lacks a regional dimension, existing regional policy lacks an industrial or technological dimension. Thus although certain aspects of NIT can be considered eligible for assistance under existing funds such as the ERDF - telecommunications infrastructure providing perhaps the most important example - other aspects of NIT developments and applications are not eligible within the present policy parameters. We therefore conclude that there is a need to develop an explicit NIT element within the Community's Regional Policy; without such a policy development, we believe that on the basis of the evidence we have assembled, the benefits of new information technology will be concentrated predominantly in the core regions of the Community, thereby diminishing the prospects for continued economic integration and balanced regional growth.

The purpose of this concluding section is to highlight a number of the policy issues which have arisen from the analysis presented in the previous chapters. Our comments are directed primarily at a European scale of policy concern, but a number of them would be equally applicable within the

context of regional policies operated by individual member states. Our intention here is not to spell out detailed policy proposals but to identify major issues of policy concern in the light of the different problems which the less-favoured regions are experiencing with respect to New Information Technology.

8.2 The diversity of 'the problem'

The range of policy responses needs to be broad primarily because regional NIT deficiences and weaknesses take many forms. For example, in many of northern Europe's peripheral regions, the supply of telecommunications infrastructure and service provides a perfectly adequate base for NIT developments; in a number of the Mediterranean regions, however, in Southern Italy and particularly in Greece, there are major deficiencies with respect to the quantity and quality of telecommunications infrastructure. Within any 'policy package', infrastructure deficiencies and their amelioration need to be addressed, but this section of the package will be more appropriate in some regional contexts than in others.

As well as the type of problem with respect to NIT varying considerably between regions, the potential contribution of NIT within broader regional development strategies can only really be determined at the level of particular regions. This is because the strengths and weaknesses of regional economies, and the development potential of the productive enterprises within them, vary considerably even between regions which superficially appear to have the same type of economic structure. As an illustrative example of this proposition, take NIT applications within agriculture, such as interactive videotex systems providing information on markets, supply prices, weather, technical advances, and so on. Our Phase II Case Study contractors discussed such developments with representatives of the agricultural communities in the regions concerned. The point was made in Reggio Calabria (Calabria, Italy) that an agricultural sector almost entirely made up of subsistence peasant farmers, relying heavily on state income support, would have no possible need for a process innovation which provided them with better information about market changes when they were not, in fact, selling their goods to market in the first place. In

other words, the application of NIT could not be realistically envisaged as the sector has no real development potential which NIT could help exploit.

In contrast, much interest was expressed by agricultural representatives in Heraklion (Crete, Greece) in applications such as videotex systems; not only is the level of organisation of small scale producers into marketing co-operatives considerably greater than in Reggio Calabria, but the orientation of production towards national and international markets is much more evident. There is still of course a backward peasant sector as well, but in overall terms agriculture in Crete seems more dynamic and offers much greater development potential than it does in Reggio Calabria - as a result, there is a possible role for NIT to play in facilitating its further development. This example serves to show that particular policies will be appropriate in some regional contexts but not in others; we need therefore to envisage a 'package' of measures from which those relevant to each region can be selected on the basis of the types of problem they face and the types of potential which they offer. In the sub-sections which follow, we outline some of the major issues which would need to be addressed by a European regional NIT policy.

Even within a single region, however, we need to make clear from the outset that formulating an 'appropriate' regional NIT strategy is by no means straightforward, while the task of actually implementing a strategy may require a considerable degree of co-operation between a surprisingly large number of public and private agencies within any region. The Case Study report of the Northern Region of England, for example, faced with the absence of a regional planning agency recommended that a Regional NIT Committee would need to be established both to provide a forum for formulating a regional NIT strategy and as a way of establishing the necessary inter-organisational harmonisation which would make its subsequent implementation possible.

8.3 Regional policies towards the new information technology industries

Within this part of the package it would be necessary to distinguish between hardware and software activities and between policies concerning the attraction of mobile investment and those concerning the encouragement of indigenous NIT production. Regions with little or no existing

production of information technology, such as much of Greece and Southern Italy, are clearly going to find it difficult either to attract mobile investment projects or to develop their own indigenous NIT industries. Other regions which already have NIT production capacity, such as, of our case study locations, Languedoc-Roussillon or the Mid-West of Ireland, are likely to be best served by trying to encourage the indigenisation of the industry, for example by promoting local supply linkages.

The first policy issue to address is to ensure that there is a regional dimension to Community or national policies towards NIT industries. Community policy towards NIT is based on the fundamental objective of attempting to ensure that a European production industry survives in the face of American and Japanese competition; the location of production within Europe has not been perceived of as a relevant issue. Most member states also employ policies to foster the development of national high technology industries, with the regional implications rarely considered. As a result, high-technology projects can often attract effectively the same or even greater aid in grants from technology-specific or innovation-oriented schemes as they could from regional policy schemes; because of ceilings to total grant aid, in such cases there may be no regional differential at all, and hence no incentive for mobile projects to consider locating in the less-favoured regions. To an extent, ceilings on aid are determined by the CECs Competition Policy Directorate-General. It would seem important, in order to facilitate more balanced regional growth in the new technologies, to permit national governments to provide regional 'top-up' aids to sectoral or high technology schemes (i.e. by allowing the normal aid ceilings to be exceeded).

The same lack of a regional dimension is also evident within the Community's own industrial policies, such as those designed to promote innovation. Consideration could usefully be given to the means of ensuring that a regional dimension is incorporated into these policies. This would not necessarily impose constraints on other Directorates or dilute other Community initiatives; on the contrary, the size of the ERDF could provide considerable opportunities for implementing policies which are less well-endowed in resource terms by, for example, providing 'add-on' support to technology projects locating in or benefitting the less-favoured regions of the Community.

Even if projects are attracted to less-favoured regions, in the long-run it is only through strategies aiming to 'indigenise' NIT production that the full benefits would accrue to the regions, ultimately enabling them to develop their own NIT production industries and the ability to generate new products. This process can be initiated by actively encouraging the 'regionalisation' of material and service linkages to NIT industries. A variety of policy instruments could be used to promote this objective, ranging from the insistence upon regional supply 'quotas' which has been employed to good effect in France, to financial aid for NIT-related new firm formation and product diversification, through to promoting the greater diffusion of information on NIT contracts, supply requirements, etc to enterprises, particularly small and medium sized enterprises, in peripheral or less-favoured parts of the Community. These examples apart, product innovation based on NIT is perhaps too narrow a focus for a regional policy; its stimulation needs to form part of a broader regionally oriented innovation policy.

The aim of such a policy should not be equalisation of levels of technological achievement between the regions of Europe through the dilution of the resources of core regions, rather it should be to release latent potential in the lagging regions which would add to the sum total of technological advance in the community as a whole. For example, a better balance of R & D effort between centralised laboratories in core regions and R & D effort close to the production line could assist the lagging region and improve the overall effectiveness of the same amount of R & D input.

Such a policy could contain a number of elements:

(i) Contribution towards the cost of building R & D facilities adjacent to factories in less-favoured regions (e.g. high depreciation allowances).

(ii) Contribution towards the costs of relocation of parts of public R & D laboratories relevant to the industrial structure of particular regions.

(iii) Contribution towards the cost of employing R & D personnel in such facilities.

(iv) Contributions towards the costs of the introduction of science parks, adjacent to universities and other institutes of higher education, including contributions towards the costs of Universities working with local SMEs.

(v) Technical advice to SMEs provided by expert panels drawn from large firms and local universities, including advice on the use of computerised databases to monitor technical development.

(vi) Technology brokerage services linking together new product opportunities with SMEs.

(vii) Technical training programmes orientated at all levels but particularly senior management lacking a scientific background.

(viii) Regional NIT applications centres, with a brief to undertake R & D (with a focus on D) in hardware and software applications relevant to regional industry and commerce.

A final major policy issue which needs to be addressed with respect to the production of NIT is the need to develop policies which are targetted at, or at least do not discriminate against, NIT 'software' activities. We would argue that these software aspects of NIT production, ranging from software products per se through to computer services, are if anything more important than the hardware elements, because they also help to create the conditions of subsequent applications of NIT within the wider regional economy. Clearly then, NIT-related services should essentially be treated in the same way as manufacturing projects, and in no way discriminated against on the basis that they are 'service' industries. Within the ERDF, this would mean a change in the regulations to remove a mobility criteria for services (other than tourism) within the quota section and a change in the maximum firm size threshold within the non-quota section to bring NIT-related activities defined as falling within the service sector into line with manufacturing activities.

8.4 Regional policies towards telecommunications infrastructure

As demonstrated in earlier chapters, telecommunications infrastructure is far from adequate in a number of peripheral parts of the Community, including Ireland, Southern Italy and, particularly, Greece. We would contend that existing regionally-oriented support for telecommunications investment (in the form primarily of the Infrastructure Section of the ERDF) is of crucial importance in ensuring that peripheral and less-favoured regions do not fall further behind in the provision of the infrastructure upon which so many NIT developments are based. A case can further be made for considering whether infrastructure outside the present assisted areas, but affecting directly the level of their services, should be eligible for assistance in the regional funds. Examples of this type of problem were identified in the regional case studies, including the Milan telex node, the Athens international telephone exchange, and the Dublin data network links. There is perhaps little point in subsidising investment in peripheral regions if other crucial parts of the network are inadequate.

Another issue which may develop if member states follow the UK route to network liberalisation is the desirability or otherwise of infrastructure investment support for competitor networks. If the Mercury project in the UK is anything to go by, peripheral and rural regions are unlikely to be able to demonstrate the market potential to warrant investment in the new network infrastructure. If such competitor networks do become established, some mechanism (which could range from investment aid to a basic requirement in granting a license) will need to be found to ensure that peripheral regions do not suffer a deterioration in their telecommunication services (which could arise indirectly through the response of the PTT in attempting to meet the competition, for example, by concentrating their new investment in core regions).

A further question concerning telecommunications infrastructure which European regional policy could usefully address is the case for extending the eligibility for aid to network attachments - such as electronic switchboards, call connect systems, telex and facsimile machines, data modems, data and videotex terminals, etc. In a very real sense, these network attachments are as much part of a region's 'telecommunications

infrastructure' as those parts of the public networks which run into the factory or office. The difference of course is that the attachments are not normally publicly funded, in whole or in part, and would not therefore meet the conditions for eligibility. We would suggest nevertheless that eligibility rules and investment size minimum levels should be re-examined to determine whether a means can be found for encouraging the diffusion of the basic infrastructure for NIT applications within enterprises in peripheral regions.

A number of policy issues were raised in the consideration of regional telecommunications tariff variations in Europe. A particular anomaly in need of attention concerns the effects of national borders on tariff rates. Certain border regions face cost penalties as a result of international calls generally being charged at higher rates than national calls, regardless of the distances involved. We would urge that pressure is applied to European PTTs to encourage them to harmonise their tariff structures, particularly as they affect border regions.

The report has also noted the fact that peripheral regions within member states are to an extent disadvantaged with respect to their costs of telecommunications, since most variable costs are charged according to distance. We contend that pressure should be applied or inducements offered to national PTTs to take greater cognizance of the regional dimension not only within their investment plans but in their tariff structures as well. For example, a reasonable case can be made for passing on some of the benefits of ERDF infrastructure aid for telecommunications projects to the consumers of telecommunications services within the regions concerned, perhaps by lower installation costs of equipment or by differential tariff rates.

8.5 Regional policies towards the use of new information technology

Although not all less-favoured regions of the Community have deficiencies with respect to their telecommunications infrastructure, all make markedly less use of NIT than do their core region counterparts. The reasons for this are complex and varied; although in some instances the economic structures of less-favoured regions are simply less appropriate for the application of NIT, there seem in addition to be marked deficiencies with

respect to the awareness of NIT and the benefits it can bring coupled with a number of regionally differentiated barriers to adoption which are serving to inhibit the diffusion of NIT within the economies of less-favoured regions. A number of elements of a policy package designed to counter the awareness/adoption constraints prevailing in such regions can be envisaged:

Illustrative examples would include :

- NIT demonstration projects within Public Agencies
  in less-favoured regions, particularly those concerned with economic development issues (industrial, agricultural, SMEs, regional development, etc). Relevant applications of NIT would encompass inter-office communication systems, videotex projects, etc. The demonstration effect would not be directed at technical feasibility but at showing by demonstration the usefulness and ease of use of the new office and communication technologies.

- The establishment of regionally relevant data bases/information systems. Examples could include data bases on export information, industrial capacity registers, sources of supply, industry-specific technical information, etc.

- The establishment of NIT Information and Resource Centres. The purpose of these centres would be to: (a) demonstrate, particularly to SMEs but also to large firms and agencies, the range of applications of NIT (e.g. telecommunications developments, database searching, mini-computing systems, etc) and to provide impartial advice on appropriate hardware and software, sources of supply, etc; (b) a subsidiary function could be to provide 'bureau-type' NIT services to SMEs (e.g. telex, facsimile transfer, database searching, etc).

- Support for NIT feasibility studies: including studies on the feasibility of enhancing the telecommunication links of enterprises and groups of enterprises (e.g. non-terrestial

telecom links in remote areas, cabling, local area networks, the shared use of long-distance leased lines by SMEs) and the feasibility of establishing new services based on NIT (e.g. videotex services, computerised databases, value added network services, etc).

- The establishment of NIT Applications Research Institutes, the purpose of which would be to engage in research and development work within the field of NIT hardware and software applications of relevance to particular regional economic sectors or regional requirements. The maximum benefit would come from a network of such centres, each using pooled information and expertise to develop applications of NIT relevant to particular regional contexts.

- Support agencies/intermediaries offering (impartial) advice on NIT applications (for example by supporting consultancy costs) or offering particular services which benefit from the application of NIT (e.g. access to technical information from remote sources).

Our approach in these examples, and indeed in the study as a whole, has been to focus on the needs of regional productive enterprises rather than on new technology per se. Hence our emphasis here on intermediaries and 'information brokers' as well as on videotex experiments and the like. Technological solutions to managerial or institutional deficiencies seem unlikely to succeed, for they generally fail to adequately define the nature of the problem. We need firstly to determine what are the constraints upon or inadequacies of regional productive enterprises before posing the question of whether NIT can assist in overcoming these constraints or reducing the inadequacies. Applied in this way, NIT can indeed offer considerable possibilities for enhancing the development potential of the less-favoured regions of the Community. Following Schmookler (1972) we contend that the benefit of a given technology to a society is determined by the number of people who have access to it, or access to its benefits; the full benefits of new information technology to

European Society will not be realised if the peripheral or less-favoured regions continue to lag so markedly behind the rest of the Community in their use and application of the developing technologies. Without policy intervention, we must conclude that this gap is likely to widen rather than to narrow, and that the consequent concentration of the information and knowledge upon which future wealth will be generated will serve to widen inter-regional disparities in economic well-being.

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The study provides a statement of the existing situation with respect to new information technology (NIT) in the Community, considering in particular the present and likely future impact of NIT developments upon the less-favoured regions of the Community. It shows that considerable variations exist in the regional impact of NIT; the peripheral and less-favoured regions of the Community are seen to be lagging behind the central and more prosperous regions; involvement in the hardware and software aspects of NIT production is far less developed. In short, the peripheral regions are failing to share in the benefits of NIT. In the longer term they may reap only the disbenefits through a continued deterioration in competitiveness. In order to prevent the gap widening between prosperous and less prosperous regions, the study proposes that a regional NIT policy be established.

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