Teleworking

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1. Introduction

'Working at home can be very productive for people who have tasks to complete, such as writing reports'

James Martin, 1978.

The past few years have seen several experiments by large companies into the use of information technology for homeworking. This is a development in employment which may have a profound effect on the way that many of us work in the future. It has been called several names including remote working and networking, but the most popular being 'Telecommuting'.

The principle is that many of today's jobs could be done at home using a computer rather than travelling to work to do them. The technology enabling a person to sit at home and communicate with a remote computer through a terminal has been available for many years, but recent advances have made this process simpler, and more jobs can now be done using a computer than previously.

There have always been homeworkers of some form, often working in garment manufacture, or packaging. The increasing use of information technology in many forms of work has added many new possibilities to the jobs which can be done in the home.

Various futurologists have made great claims for the possibilities of homeworking via computer and some of these possibilities are only now starting to be realised.

A 1983 survey of the largest British companies (Korn/Ferry Int.,1983) found that 44% of the companies expected to be employing staff working from home with a telephone link to a computer by 1988.

Jack Niles, Director of the Information Technology Program at the University of Southern California's Center for Futures Research, predicts that there could be 15 million telecommuters in the USA alone by 1990. He also calculated that if one urban commuter in seven became a telecommuter then there would be no need for the USA to import oil. Several companies using homeworkers via computer link have noted a 30-40% productivity increase.

So why is telecommuting as yet such a small movement? A National Opinion Poll conducted in July 1979 found that only 35% of people would prefer to work at home, but this was before information technology really started to make an impact and the result of a similar poll today might give a very different result. Of those who have tried telecommuting, the overwhelming majority say that they enjoy their work.

In this report I hope to examine the technology which has made telecommuting possible, and how this has developed and will develop in the future. I will also look at the types of work which are suitable for homeworking and those which are not, how jobs use the technology, the possibilities for homework by the disabled, and what opportunities the future holds. In the third main section I will take a look at how the work is organised and managed, and any difficulties peculiar to homeworking. The fourth section deals with the effects of homeworking on the worker, the rates of pay, and effects on health, families and friends. The main body of the report is closed with two brief case studies of companies employing homeworkers.

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2. Technology

In this section I intend to outline the technology involved in homeworking and its development. It is due to the recent developments in the technology available and its decreasing cost that homeworking using this technology is becoming more prevalent. Significant developments have taken place in hardware, software, and telecommunications which all have an important role in homeworking. Looking into the future, there are great changes coming especially in the telecommunications field, where recent deregulation around the world has increased the pace of change.

A homeworker's set up will typically consist of a personal computer or terminal, connected to the telephone line by a modem.In the 1982 Low Pay Unit survey of seventy-eight technology-using homeworkers (Huws, 1984) found that a large proportion (41%) of those asked had some form of connection to the employer's or client's computer, and 36% used a modem to connect via the telephone network. However, it was also found that quite a large number (24%) had no computer equipment at home, and made journeys to the employer's office where they used the employer's main-frame.

With the developments in micro technology since the survey was carried out in 1982 this percentage has probably decreased, with it being cheaper to type programs into a home micro and then transfer them to the employer's computer either by sending a floppy disk, or by sending the programs over the phone. There have also been developments in software resulting in compilers which previously could only be run on a mainframe being able to run on a machine in the home, thus making debugging of code quicker,as frequent visits to the employer do not have to be made.

The survey also found that 97% of the homeworkers used the telephone to communicate with their employers. This means that even if the telephones were not being used for data transmission when the survey was carried out, then it would be possible for the homeworkers to use them for data transmission if they had the equipment available. With the prices of modems dropping significantly since the survey was carried out, it is likely that this option is used more now, and will become almost universal in the future.

Overall 92% of those surveyed used some form of equipment. 36% used a remote terminal attached to the telephone network. 11.5% also used a microfiche reader in conjunction with the terminal. As stated above 23% used no computer equipment. One person used a viewdata terminal. 17% used a microcomputer (this figure is certainly larger now), 8% used a wordprocessor, and one person was using a microwriter, which was a single-handed replacement for a QWERTY-type keyboard. 5% used a typewriter or other traditional office equipment, with 3% using 'other equipment'.

Since the survey was carried out there have been many developments which will have affected the types of technology used. There has been a tendency towards the use of micros, with the price of a suitable machine dropping to between £200-2000, from a previous range of £500-4000. The average cost of equipment bought by the homeworkers in the survey was £2157. If traditional office equipment is excluded then the average cost rose to £3171 which is a very substantial investment. In 1988, a suitable PC, printer, modem and software would cost around £1500, which has probably led to more homeworkers investing in the equipment.

It has been suggested that telecommuters are increasingly making use of other services such as fax, telex and courier services (Kinsman, 1987). This is likely to increase over the next few years with PC's being able to scan, transmit and receive fax, and E-Mail services such as British Telecom's Telecom Gold providing access to telex without the need for a dedicated telex line and terminal. In the long-term, it will be possible to eliminate the use of these services and use an integrated system for text and document transmission.

2.1 Home Computer Development

At the start of technology homeworking, home computers did not exist. They have only developed significantly since Steve Jobs and Stephen Wozniak built the first Apple computer in a garage in 1976. Since then the personal computer market has grown from nothing to the current position where it is worth around $30 billion world-wide, and rivals the world market for mainframes (figures taken from projections in January 23,1984 issue of Fortune magazine). Before 1976 the only method of communicating with a remote mainframe was by the use of a terminal. These terminals generally have to be connected to the employer's mainframe to be able to function. This connection is usually through the use of a modem and a telephone line, resulting in high telephone bills, as the connection is held even when the worker is not currently typing. Terminals are also generally expensive considering their facilities compared to those of a PC.

The personal computer was first seen in early 1976 when Jobs and Wozniak showed the Apple I at the Homebrew Computer Club. The two inventors worked for Atari and Hewlett-Packard respectively, and when their employers showed no interest in their development, they raised some capital by selling Jobs' Volkswagen and Wozniak's calculator and started producing the Apple I in their garage. In June of that year The Byte Shop, an early Silicon Valley computer shop, ordered fifty Apple I's. With the money raised from this and the introduction of Mike Markkula, ex-marketing manager at microprocessor manufacturer Intel, who found more capital, the company really started business, hiring personnel and establishing a manufacturing facility. The famous Apple logo was created around the same time.

In early 1977 the Apple II was shown at the San Francisco computer fair. The sales were phenomenal, and by the end of 1977 they had sold $2.5 million dollars worth of computers. A mass market for personal computers was instantly created. By 1983, Apple had sold over 750,000 Apple IIs worth around $600 million and had 4000 employees and in 1982 reached the Fortune 500 of top companies, an amazing achievement in just five years.

The Apple II consisted of a 6502 processor, a QWERTY keyboard, about 48K of random access memory and interfaces for monitors and disk drives. The software which was written for it, such as Visicalc, made the computer worth having and have since been copied and developed for other computers including main-frames.

Other US companies took notice of the success of the Apple machine and introduced their own micros. Commodore Business Machines, who had previously made calculators, introduced their PET series which was very popular in the scientific community as it had a good collection of interfaces making it easy to use to control experiments. The US electrical chain , Tandy, also produced their own range of micros, the TRS-80, which sold well to various markets and had the benefit of being backed by a known name. Both the Commodore and Tandy machines included a built in monitor and the storage medium for these machines was almost always floppy disk drives.

In the UK the market did not take off in the same way as it had done in the US due to people having less disposable income and the prices of the machines putting the machines out of the reach of the average persons pocket. Where people did own the machines they tended to belong either to businesses or be low budget cassette-storage-based systems in the home. Tandy, Commodore and Apple dominated the market both in the US and the UK, until the introduction of the Sinclair machines in 1980-82, when these machines took the majority of the home market, with the business market being unaffected.

In August of 1981, the long-awaited IBM PC was introduced to the US. This made the business world, which had previously tried to ignore the personal computers, sit up and take notice. If the name in computers considered the personal computer to be worth selling then the businesses of the world had better consider buying. It was clear from the start that IBM were to become a very significant player in the world-wide personal computer market. The machine that IBM produced was not particularly innovative, being based on the Intel 8088 processor, and was quite expensive. The bottom-end machine had 64K of RAM and was able to load programs and data from cassette-tape. A decent usable system would cost around $4500. The machine took off due to IBMs marketing clout and it soon became a standard. The machine was not launched in Europe until the beginning of 1982 and was in very short supply. Many so-called 'grey imports' came across from America where the machine was easier to get hold of and were sold at inflated prices.

During this time the UK was undergoing a computer boom, with Sinclair and Acorn machines sales rivalling those of the US machines. Sales were aided by the Government initiative to put a micro in every school and parents bought their children machines to help them keep up with their school work (or so the parents thought. In many cases they were used almost exclusively for playing games). By the end of 1982 the UK had the highest personal computer penetration rate in the world, with six per cent of homes having a personal computer. By 1985 this figure had increased to twenty-one per cent (SCPR,1985).

The success of the IBM PC sparked a number of 'clone' manufacturers who created machines which would run the same software as the IBM PC. After some legal wrangling, these machines were declared legal, providing they did not actually copy the read only memory of the IBM machine. One company, Compaq, which was a Texas Instruments spin-off, became the fastest growing US corporation ever in 1986 when it entered the Fortune 500 faster and higher than even Apple had managed. Of course, without the success of Apple and then IBM, Compaq would probably never have existed.

By 1984, many of the manufacturers making machines which were not IBM compatible had withdrawn from the market or gone bankrupt. These manufacturers included previously successful companies such as Osbourne, Texas Instruments and Timex. Apple were starting to get worried after their successors to the Apple II, the Apple III and Lisa had all flopped, but in January 1984 they successfully introduced a cut-down version of the Lisa called the Macintosh. This machine was very different to any PC before it, and had a 'user-friendly' system of a mouse and windows which made the machine usable after only a few minutes training. Around this time, IBM introduced a cut-down PC called the 'PC jr', but it offered very limited facilities for the price, did not sell well and was subsequently withdrawn.

The world-market continued to be dominated by IBM, with other non-IBM-compatibles being restricted to the low-price home market, with the exception of the Macintosh which sold on its own merits and developed a dedicated following of its own, especially in the growing desktop-publishing world.

In the USA the IBM PC and associated machines were also considered home machines, whereas in the UK they were until late 1986 considered almost entirely business machines. The change in 1986 occurred due to the introduction of Alan Sugar's Amstrad PC-compatible for arround £500. This price was around half that of PC-compatibles previously available in the UK. The machine followed in the footsteps of Amstrad's word processor which had also sold into the home market due to it costing less than some electric typewriters.

In April of 1987, IBM announced that they were stopping production of all of their current PC models with immediate effect. They announced a new range of machines called the Personal System 2 or PS/2. The main models of the range included a new type of architecture on the printed circuit board, called Micro Channel Architecture (MCA) which made the machine easy to expand but difficult to copy as IBM had patented the MCA and many of the things associated with it. The new machines would run old IBM PC software, but were really intended to take a new operating system, called OS/2, which IBM and Microsoft were developing. OS/2 would take advantages of the MCA and machines without the MCA would have to run a slower, reduced version of OS/2.

In May 1988, an announcement was made by IBM that licences to produce the MCA had be sold to several other manufacturers in return for a royalty on each machine produced (PCW 1988). This will help the spread of the new standard of OS/2 with people being more likely to buy if there is competition rather than from a monopolistic situation with only IBM being able to supply machines.

OS/2 has been criticised for various reasons, but is a vast improvement on the old MS-DOS system used on the old PCs, and with IBM allowing other manufacturers to produce 'clones' the future of OS/2 seems assured.

The market for PCs has developed to the point where top of the range PCs are now rivalling minicomputers for power. This has led to the development of 'workstations' . These are a cross between the PC and the minicomputer. They are powerful, capable of being used by several users at one (via attached terminals), and useful for high-powered personal computing such as computer-design. Machines which fall into this category are the workstations made by DEC, Sun and Apple, who make the Macintosh II which although made by a traditional micro manufacturer is powerful to be classed as a workstation.

It is in this direction that the future of the PC seems to lie, with the machine being able to run several applications at once. This will allow the user to work on a program whilst sending another one to the employer via a modem, rather than having to wait whilst the old one is sent.

So, the PC of the future is likely to be a personal workstation, with a modem to connect it to the employers machine, or perhaps a direct digital connection using ISDN (see later in this chapter). The machine will have a hard disc drive (or perhaps read/write laser disc), for storage and several megabytes of memory.

2.2 Software

The success of the personal computer has led to a multi-billion pound software industry catering for all kinds of users. The most popular kind of program is the word processor, as it is useful to everyone, and word processing programs are available for almost every personal computer ever produced. The word processor is followed by the database and spreadsheet (often with associated

graphing program). Games are available for most PCs, with many home machines being used almost exclusively for that purpose. Even the previously business-only IBM PC and compatibles are now having games produced for them as they start to penetrate the home market, and to provide light relief for the business user.

The next most popular type of program is probably the communications package. This is used to connect the computer to another, either by direct connection, usually via two RS-232 serial ports, or by indirect connection via two modems (see later section on modems).

The packages provide access to many of the modem's functions and allow text which has been prepared earlier using a word processor to be sent down the connection at once rather than having to establish the connection and then type the text in character by character. To prevent errors during transmission a series of protocols have been developed which transfer files in blocks and correct errors or request retransmission of the erroneous block. These protocols require both of the machines which are communicating to be using the same protocol, so most communications (or comms) packages have several protocols available, such as Kermit, X-Modem and Y-Modem. The packages also provide facilities such as auto log-on which will automatically dial the telephone number of the system required (if using a modem) and then enter the User ID and password for that service. Some (e.g. Crosstalk and Multicom) will accept macros, which are groups of instructions which are executed later using a single command. Using this facility it is possible to leave your PC running , then when system use is at a low point, say at three o'clock in the morning, it will dial the system, log on, download (that is transfer from the system down onto disk in the PC) any files or mail sent to you, and then log off. In some cases it is possible to program the package to send an acknowledgement to any messages left for you.

The prices of comms software depends on the facilities provided and the machine for which it was written. A simple program with few features such as Comet from Mektronic Consultants costs just £10 for the IBM PC version, whereas the Mass Breakout program from PC Communications, which has many sophisticated features such as four error correction protocols and secure printing, cost from £699 including a modem (Prices taken from TeleLink magazine Vol.2 No.3). There are also a number of packages, available for a variety of machines, in the Public Domain which are available for the price of a blank floppy disk and a small charge for transfer. Some of these 'free' programs are of excellent quality e.g. Uniterm for the Atari ST, and Procomm for the IBM PC and compatibles.

It is indicative of the importance that computer communications will have in the near future that the new Amstrad portable PC-compatible includes both a built-in modem and a comms package, Mirror II. This is another example of the increasing use of portable PCs by people in the field who can then plug their machine into the nearest telephone socket and transfer their data either to a mainframe or to their desktop PC back in the office.

2.3 Modems

A modem is a device which converts the data coming from the computer to a series of signals or tones suitable for sending down a telephone line (this process is called modulation), and decodes the signals from the telephone line back into data (de-modulation). Hence the name modem, MOdulator-DEModulator. Some of the earliest modems were Acoustic Couplers. These plugged into the serial port of the computer and had two rubber cups which fitted over the mouthpiece and earpiece of the telephone. The rubber cups contained a loudspeaker for the mouthpiece and a microphone in the earpiece. The signals to be sent were then converted from the digital form in

which they were received from the computer into tones, with one tone denoting a '1' bit and a different tone denoting a '0' bit. These acoustic couplers were prone to interference from external noise sources as the rubber cups did not block out all background noise. They did have the advantage that they could be attached to most 'phones including public callboxes and so could be used by travelling salesmen etc. who were required to send data back to base. As the machines were prone to noise they were not very reliable or fast (usually 300 bits/second) and their usage has declined, although they are still used for sending data from public callboxes and are the only type suitable for this use.

The other main type of modem is the direct connect type. This is wired directly into the telephone system, usually by plugging a lead into a jack socket in the wall which are now commonly available in the UK. The modem is again connected to the computer using the computer's serial port (RS-232 port). The method of transmission is similar to that for acoustic couplers in that tones are sent and received, but with a direct-connect modem there is no speaker or microphone and the tones are sent and received purely as electrical signals. This eliminates any problems of external noise. The above method of transmission is used for speeds up to 1200 bits/second. At higher speeds the modem has to be able to detect the difference in phase of the signal as well as the frequency of the signal. Using a direct connect modem with built-in transmission correction software it is possible to transmit at 9600 bits/second, and this speed is likely to increase with improvements in the telephone networks around the world (see section on telephone networks).

Some of the more recent modems are so-called 'intelligent modems' which can take commands from the computer to do such things as dial the number (older modems and acoustic couplers required the user to manually dial the number before connecting the modem), automatically answer incoming calls (allowing the user to use the system as a base and send data to it from a remote site), and automatically retry engaged numbers.

The increased speed of the more recent modems is due to improved chip technology ,with chips such as the AMD 7910, meaning that less components are needed so the price also falls. There are various standards for modem transmission speeds and frequencies some of which are little used in the USA, such as the V.23 standard of 75 bits/second in one direction and 1200 in the other. However with modem speeds increasing, especially in the USA where they have more reliable phone lines, the use of these slower non-American protocols is decreasing. V.23 was the standard which was used for accessing the Prestel videotex system but this service is now available at a much wider variety of speeds.

The advent of the IBM PC-compatible has led to many modem manufacturers developing modems on a slot-in card which dispenses with mess of cables which can accumulate when using a modem. Some manufacturers supply software with the modem so that the user can connect to a system without having to find a suitable software package.

2.4 Telephone Networks

The telephone was invented in 1876, just over a century ago. Since then it has had a profound influence on all industrial societies. There are around 600 million telephones in the world today and the uses of the telephone networks is ever expanding.

The most rapid period of growth and innovation has been during the last couple of decades, with the recent deregulation of the networks in the UK, America, Japan, Australia and Canada giving more impetus to the changes which were taking place.

Most important of all the recent developments has been the introduction of digital networks. These networks come in two main forms.

1. The voice network.

In these networks the voice is broken down into a digitised signal, usually at the local exchange and is then transmitted in digitised form down a line to the destinations local exchange where it is reassembled into an analogue signal and transmitted to the destination. An example of this system is British Telecom's System X exchanges. The advantages are less line noise and a more reliable service as if one route breaks down the conversation is simply swapped to a different route with the users being unaware of anything. These voice networks are used by modem users and are generally proving to be more reliable for data transmission than the old mechanical networks.

2. The computer networks.

These are essentially a development of the telegraph. Data is transmitted down a line using high and low voltages to indicate '1' and '0' bits rather than converting into tones.
The services are usually accessed by dialling to the local node on the network using the telephone voice circuit, a modem at the node then converts the data back into digital form, splits the message into short packets which are then labelled and transmitted to the destination node. Many of the popular on-line services such as Prestel and Telecom Gold are available through this system of 'packet switching'. The UK system is called PSS (Packet Switch Stream) and there is an international network connecting services in many countries' services worldwide. The service is available only to people paying a PSS subscription, but as the call to the local node is usually a local call it can pay for itself quickly if systems are accessed a lot. There is a charge made for the amount of data transmitted but this is usually less than the cost of a trunk call to the system to transmit the same amount of data.
A very important change which is currently in the planning and development stage is ISDN. ISDN stands for Integrated Systems Digital Network, and it will be able to handle all kinds of services which use digital information. These services include voice transmission, data, facsimile (fax) and moving pictures. The idea is similar to the packet switching above but instead of calling the local node by telephone, each home and work location will have its own node. The idea is to replace the telephone with a general-purpose digital network.

ISDN will not happen overnight, but when it does become widely available, probably around the year 2000, it will have a great effect on homeworking. Phones providing a picture, possibly moving, of the person to whom you are talking will become available at reasonable cost, unlike those tried in the past which have not been a success due mainly to quality not being up to standard. It will be possible to have a sketchphone capable of transmitting high quality drawing as they are drawn, and whilst the ideas being drawn are discussed. Developments like these will make it easy for people to come to terms with homeworking where they previously found it too isolated.

A few trial systems have been set up, notably in a Tokyo suburb and one set up based on a digital exchange in the City of London which has now been extended to Manchester, Birmingham and Nottingham. According to British Telecom there were around 200 centres available at the beginning of 1988.

3. Type of Work.

3.1 General Homeworking

Homework has existed in Britain for many years, but most has been unaffected by information technology. The types of work which have been done in the home are diverse, and if the jobs done from the home are also included there is even greater variety.

Employers use homeworkers for a variety of reasons.

a) To provide an extendable workforce.

By employing homeworkers on a casual basis an employer has a ready supply of workers if there is a sudden need for work to be done quickly or if the employer is in a business where demand fluctuates a lot. It is much easy to 'lay-off' homeworkers than it is regularly employed labour. This results in workers often being treated poorly as there is little representation for homeworkers and as they have little contact with one another it is difficult for them to air their grievances. To the employer, however, the use of homeworkers in times of need is very convenient.

b) To retain women workers who want to return to their homes to look after their children.

Many employers do not like employing women because they think that they will want to have a family and leave work to look after them. By employing the women as homeworkers after they have had children both the employer and the woman gains because the employer does not lose the training and investment put into the employee, and the woman has a means of income whilst remaining in the home and being able to care for her children.

c) To reduce overheads.

Many jobs do not really require a specific place of work and can be performed anywhere e.g. typing. The employer can avoid having to provide a work place and it's subsequent heating and maintenance costs by employing a person to do the work in their own home.

d) Employment of freelance workers.

Many employers make use of freelance workers, or outworkers for jobs which cannot be done 'in-house'.

Examples of this type are designers and journalists. In order to keep their costs to a minimum many freelance workers choose to work from home.

Finding out exactly what jobs are being done can be difficult due to the homeworker's reluctance to disclose details in fear of the employer's reaction or due to fear that the Inland Revenue will find out that they are working. However, several surveys of homeworkers have been carried out which give a good idea of the types of work traditionally using homeworkers.

The most recent comprehensive study of this nature of work in Britain was the Department of Employment-sponsored study carried out by Catherine Hakim in 1981 (Hakim, 1987). In the

survey it is estimated that there were around 658,250 home-based workers in Britain in 1981. This number is likely to have grown since then, with more companies experimenting with and moving into homework, either in it's traditional form or in the new form of telecommuting.

The survey shows that the largest proportion of the home-workers were employed in selling, with this accounting for around a third of home-based workers, and managers and administrators making up a large number of the others working from home. The number of those actually working in the home, rather than from home, was found to be around 230,000. Of these, 71% were found to be women, whilst men made up 71% of those working from home.

The largest number of those working in the home were found to be employed in processing, making and repairing (excluding metal and electrical work) with 18.5% doing this type of work. Almost as many, 17%, were employed in clerical and related work. Those working in education, health and welfare made up 14.5% as did those engaged in literary, artistic and sporting employment. Other large groups were professional managers, scientists and engineers, salesmen (actually working in the home this time), and those painting or assembling products. There were estimated to be around 28,000 childminders, a figure far lower than the TUC estimate of 130,000 during the late 70s (TUC, 1978).

The popular image of the homeworker is someone, usually a woman, manufacturing goods, for a single employer. However this accounts for only 10% of the homeworkers surveyed and with the recent decline in the clothing industry the number will have decreased. The indications from the survey are that white-collar and service work is increasingly being done in the home rather than in an office.

Some of the jobs which have been done as homework are:-

Typing.

Anyone with a typewriter (or equivalent) and a reasonable typing ability could set themselves up as a homeworker. Many place adverts in local shops and colleges offering to type C.V.s, letters, job applications and theses.

Manufacturing.

Many people work making simple products in their home. They make christmas crackers from kits or knit jumpers for sale on market stalls etc. Most of these jobs are low cost, involving little if any investment by the worker, but are also usually low pay, perhaps being paid only a few pence per hundred crackers. In 1981, some workers in manufacturing were found to be paid as little as 19 pence per hour, once their piecework rate had been altered to an hourly rate (Cragg, A. & Dawson, T. 1981).

The homeworker has generally been a woman at home with children, who does the work either while the children are asleep or when possible during the day. The type of work which is suitable for home employment is often also well suited to this kind of work organisation, doing the work when possible, a bit at a time.

Many of the jobs done in the home will remain unaffected by information technology, but some will change. Those working in the home as typists, managers and salesmen will be able to use the

new technology to aid communication with their employer, thus speeding the work, and they will be joined by many who are able to work in the home through the introduction of new technology.

3.2 New Technology Homework

With the increasing use of information technology it will be possible for many more people to work at home. Some work is already being done using the technology currently available, and as the idea becomes more accepted this method of working will undoubtedly become more popular.

There was a survey carried out in 1982 by Ursula Huws for the Low Pay Unit, of 78 homeworkers who were using some kind of new technology in their work (Huws, 1984). Although the sample was small his survey is the most recent in Britain, and gave some interesting results.

Of the 78 workers questioned by far the largest group (78%) were computer professionals working from home. This would seem to indicate that i) their work is particularly suited to homework, and ii) the computer industry has a more enlightened view of homeworking. As the essentials of their work can be provided at low cost, as most computer companies will already have the equipment whether it is being used in the office or the home, and the work does not involve a separate workplace, it would indeed seem that the work is suited to this type of employment. Computer companies are more aware of the technology available and the possibilities of homework, as they are in an industry that is central to the idea of telecommuting/homeworking.

The type of work done by the workers surveyed was :-

Programmers	50%
Analyst/Programmers	13%
Technical Authors/Translators	6%
Project Managers	5%
Consultants	4%
Consultant/Systems Analysts	3%
Consultant Programmers	3%
Public Relations/Audio Visual	3%
Company Director	1%

The remaining 12% were employed in various forms of clerical work. These included data entry clerk; computer operator/clerical; word processor operator; word processor and data processing operator; word processor/secretary; and microwriter. The microwriter was a single-handed machine which was used as a replacement for the usual QWERTY keyboard. The London-based Microwriting Communications Bureau used homeworker using these devices for home-based word processing in 1981-82, but the experiment stopped in 1982 due to problems 'finding the right work in the right quantity'.

3.3 Computer Work

The computer industry is one of the main exponents of homeworking and several UK companies have done experiments on this type of employment. The jobs which are moved out vary from company to company but generally have several things in common.

i) They do not require much apparatus other than a home terminal, with some jobs requiring less equipment than this.

ii) They are output oriented. That is, the amount of work done can be measured from the output. This is the only way that performance can be assessed for homeworkers as they are not generally restricted to specific hours of work.

The Experiments

Six UK computer companies have experimented with homeworking in various forms.

F International

A computer systems company, set up in the early sixties. It was based around the idea of homeworking, employing mostly women working in the home. This company is covered in more detail in the Case Studies section.

ICL Contract Programming Services (CPS) Unit

ICL began off-site work almost twenty years ago. The aim of introducing homework was to be able to retain the services of female programmers who had decided to start families. The programmers were originally employed on a freelance basis, but in the past ten years this has changed so that they are employed as staff, but with variable hours and a minimum earnings guarantee. They also now have holiday and sick pay. As well as programming the CPS has branched out into software support, technical writing and applications development. A secondary organisation, Product Maintenance Support (PMS), was set up in the late seventies to take over the support side. CPS currently employs around 180 homeworkers, with PMS accounting for a further 100. Initially the workers were hired out individually to users who managed the project themselves, but more recently CPS have been taking on complete projects and managing them themselves. CPS originally suffered from a lack of exposure, both within ICL and in the outside world. This was not helped by the way that the early homeworkers were used i.e. as extra staff when a project team needed support. In 1984-85 a restructuring took place, resulting in a more unified approach, and CPS were allowed to compete for projects alongside ICL's other programming departments.

CPS organises meeting between homeworkers to reduce the isolated feeling that can result from homework. It also produces a newsletter so that employees feel part of an organisation. The newsletter also contains hints for household chores, as well as technical updates and group news.

Many employees have an OPD (one-per-desk) micro which has a built in telephone enabling them to use the machine as a terminal. The OPD is used more as a management aid than for remote system connecting, but is used for transferring spread-sheets, documents etc. Some workers have more powerful PCs and all technical authors are supplied with an ICL word processor. Some also use Apple Macintosh micros which are particularly useful for this type of work.

Hewlett-Packard

Hewlett-Packard have not had a formal experiment, although some staff have company-owned micros at home and these are used on an ad hoc basis for company projects, and have access to an electronic mail facility. The company decided not to introduce more extensive homeworking in 1983 after studying the use of working at home, but the possibility of further homeworking is being kept under review. The workers making use of the homeworking facilities are generally programmers and their managers.

Rank Xerox

Rank Xerox introduced homeworking in 1982 in order to reduce the cost of facilities. Initially 55 workers were sent home. They were employed on a freelance basis, and each worker set up as a limited company. The workers were not all computer staff, with workers coming from market research, business planning, financial, and personnel departments. The Rank Xerox Networking experiment is covered in greater detail in the Case Studies section.

Digital Equipment Company Ltd

Like Hewlett-Packard there was no formal experiment but a number of office-based managers and engineers have taken a terminal home. Some workers, including the managing director, use the electronic mail facility, and others use the terminals for interactive communication with the USA outside of normal UK office hours.

IBM UK Ltd

Started a small-scale home terminal experiment involving about 30 workers in 1984. This is undergoing evaluation, with particular interest in the effect that homeworking has on the employee's family and the relationship between the employee and their manager. As many departments involve a great deal of 'team' working they are thought unlikely to be suitable for homeworking. Again the experiment is with programmers and managers.

It would appear that many computer-related jobs are suitable for homeworking. They do not require a lot of day-to-day contact with fellow employees and what contact is required can often be satisfied using an electronic mail messaging system.

As IBM noted, some programmers work much better in a team and would find it difficult to work at home without the constant interaction of the team. Also some computer projects are unsuitable for splitting neatly into sections suitable for individual programmers.

A possible way around this problem is the introduction of a number of 'neighbourhood office' in a location remote from the headquarters, where groups of programmers work together, though not in the centralised office. This can reduce the costs of having large programming centres in expensive areas such as London as groups of programmers can have their neighbourhood office in a cheaper area, closer to their homes, thus reducing their travelling costs and enabling them to buy homes in cheaper areas, away from the South East.

In the USA, data entry seems to be a growing use of homeworkers. This type of work is suitable as it does not have to be done at any specific time and the performance of the worker is easily judged from the output. Large insurance companies and companies with similar data-entry requirements are taking a keen interest both here and in the States.

The 1981 Low Pay Unit survey found that 95% of the workers questioned were female, and a similar number had children at home. All those surveyed had previously worked 'on site', with an average work experience of around ten years. This would seem to back up the assertion of ICL's CPS and F International that homework is especially suitable for skilled women with children at home, and, in fact, two-thirds of those questioned left work to work in the home when they became pregnant.

The average length of time that the homeworkers had been working at home was four and a quarter years, but more than a quarter had been doing the job for less than a year. The average working week was twenty-two and two-thirds hours, with 51% working for five days per week. A fifth said that they worked six or seven day per week when they had work. This means that they are able to spread the work more thinly than normal workers, perhaps only working for long periods at weekends when their spouse was around to look after the children.

3.4 The Disabled

One of the obvious advantages of being able to work at home is that there is no need to travel to work. This is particularly important to the disabled who may be unable to find work suitable to their skills due to he difficulty they have in travelling to and from work. There have been many schemes using the disabled working in the home for such things as basket weaving and knitting. The opportunity to work at home using the new technology opens a new path to them. This field has been explored by the Department of Trade and Industry who performed an experiment which introduced information technology and home-working to the disabled in their own homes.

The DTI Remote Work Units Project

The Remote Works Unit Project was set up in 1982 as part of 'Information Technology Year'. It was part of a larger scheme to introduce information technology to the disabled and to study how it can be used to help them.

The pilot project involved six disabled people working in the home. Each was supplied with a microcomputer to help in their particular job. The project was extended over the next two years to another 58 disabled people who were similarly equipped with the support of various information technology consultancies. A wide variety of jobs, employers and disabilities were used in the experiment. As well as jobs such as computer programming and word processing, the workers were employed for a wide variety of tasks including copy-typing, typesetting, tachograph analysis, financial management, book-keeping and accountancy, credit control, estimating and viewdata editing for Prestel.

The project was a great success and there was a second phase added which ran from 1984 to 1986 and comprised a further 40 units. These units were managed by IT World Ltd, an information technology consultancy, and help was also provided by the Manpower Services Commission in the form of training, special aids and general support. The scheme was taken over by the MSC in January 1987 and is operated on a nation-wide basis.

Of the 100 people originally taking part in the scheme, about 75 were still operating in 1987. A few had set up as self-employed, which in some cases had failed. IT World felt that if these people had been put into formal employment instead, then they would have remained in the scheme. Other workers had to withdraw due to ill health or being made redundant.

Some of the jobs, such as data entry, were low-skilled, which meant that the workers needed a high degree of management from the employer and this was found to be a difficulty as remote management requires a higher than average amount of empathy.

3.5 Opportunities

Although the vast majority of new technology homeworkers are currently in the computer industry, this is likely to change as the idea of homeworking becomes more acceptable to the general public and employers.

The opportunities for the expansion are many and I will outline a few below. Many jobs which are output oriented and do not require face-to-face contact can be considered for homeworking. The problems involved will vary from job to job, with a common one being that of work management.

A lot of jobs which rely on typing and text entry can be done from home, although the amount of secretarial work done in the home may not increase too much due to the amount of contact required for many secretarial tasks, and the increasing amount of typing and messaging possible on a PC by the manager/employer.

Journalist/Author

Many journalists and almost all authors currently work at home and rely on couriers and the postal service to deliver their work to the employer. Over the past decade may of the writers have started to use word processors, either on a PC or on a dedicated word processing machine. The copy can then be printed and sent to the publisher or a floppy disk holding a copy can be sent. It is also possible to send the writing to the publisher over the telephone network using an electronic mail system. The preparation of text is aided by the use of a word processor resulting in writing time being reduced, and PC-based word processors often include a spelling checker, and sometimes a thesaurus, which aid the writing process and reduce the time spent proof reading the work.

Recently several typesetting companies have introduced a service in which an author can send a disk or transmit the work over the phone to the typesetter, increasing the speed at which the work is typeset as the writing only needs to be typed once. Another recent development has been desktop publishing, in which a writer can typeset their own work on the PC and then produce a high quality printout on a desktop laser printer. The resulting printout can either then be photocopied if only a few copies of the document are required, or phototypeset if the work is to be published.

Even more recently, there have been developments in disk storage resulting in the production of compact discs (very similar to the audio variety) which hold large amounts of read-only data for use on PCs. Discs have been produced which hold a dictionary, spelling checker, thesaurus, quotations library and style manual all on one disc, and discs holding an encyclopedia have also been manufactured. These applications use only a small part of the capacity available which is equivalent to about 500 full length novels.

The developments have made the home authors work easier and with improving communications in the home it is likely that journalists, who currently have to work in an office to be able to get the news as soon as it arrives, will be able to move back to the home for their place of work.

Salesmen

Salesmen who currently have to report back to their office will be able to type their reports into a portable PC or their home PC and then transmit the information over the phone lines. They will be able to use spreadsheets and databases on their PCs, which again will reduce the number of calls made to the office.

The employer will not require an office for each salesman and will thus save on costs, and with the salesmen having to make fewer trips to the office they will be able to visit more customers and thus hopefully increase profits.

Stockbrokers/Financial Consultants

Before the Big Bang, stockbrokers were restricted to working in or near to the actual markets. Since deregulation, computer technology has taken a large part in financial dealings, with the world's stock exchanges being electronically linked. This means that the place of work for the dealer no longer needs to be close to the Stock Market because any place can be connected to the computer network and have all the information available at the same time as someone actually working near the Market.

It would be possible for a firm of stockbrokers to have their office in a location where property prices are much lower and still work with the same effectiveness. Taking this idea further fund managers can work from home overseeing the dealing, using a home terminal connected over the telephone network perhaps via the Packet Switch Stream.

With increasing use of digital technology in financial work it will soon be possible for many of the people who currently commute into the City every day to simply dial into their firms computer using their home terminal and carry out the work in their home.

The Financial Times of 12th May 1987, gives an example of a stockbroker who, tired of the punishing commuting into the City every day, left his job and started an international securities dealing operation in Edinburgh, where he could live only a few minutes walk from his office.

Students

Many universities in the USA have extensive computer networks on campus for use by the students and staff. Drexel University in the States specify ownership of a home computer as an entry requirement. This has led to a change in the way that students work, study and socialise.

Coursework can be handed out and submitted over the network. Notes can be made available and messages can be sent via electronic mail. Queries to the library about the availability of a book can be performed over the network.

The University of Bradford in the UK is also hoping to wire itself up so that each student and member of staff has access to a terminal or micro.

Students still at school may be able to have a similar network available, and with the introduction of ISDN (see Technology chapter) it will be easy for teachers, pupils and parents to access the network to submit work, read notes, report illness, and assess performance of pupils. Places where the community is widely distributed and education is difficult due to the large distances involved

will be able to introduce remote learning, with lessons, work and reference material all being available over a computer network.

Some other jobs which are suitable for homework are :-
designers;
accountants;
architects;
lawyers;
teachers;
psychologists;
and exam markers.

4. Work Organisation.

In this section I aim to outline how the work of information technology homeworkers is organised. One of the main problems associated with this mode of working is that of effective management. It is difficult to manage workers who you never see and rarely talk to, but if management is not satisfactory the work does not get completed correctly and neither the worker nor the employer are happy. The use of homework does have it's advantages for the managers and these must also be taken into account.

Many of the homeworkers operate as freelance consultants and programmers. All those homeworkers in the Rank Xerox experiment are employed as freelances. The use of freelance workers brings with it another difficulty, as the work force being managed is not a constant, but is always changing.

4.1 Choosing Homeworkers.

All large employers of new technology homeworkers have found that one of the most important parts of the management role is recruiting. If the wrong people are recruited for homeworking then it will never succeed, but with carefully selected staff productivity and efficiency will increase and both the employee and the employer will be satisfied.

To be suitable for homework a person must have certain qualities. The worker should have good communication skills, better than average, as they do not have the contact time in which to communicate with the manager, so the time that is available must be used effectively.

Managers of homeworkers need to have good telephone manner and be sensitive to the needs of the homeworker. The manager should be aware of the home circumstances of the worker, and this can often give a hint to whether the person is suitable for home work. Single parents, for instance, are generally thought unsuitable due to the pressures of looking after the children on their own.

Managers look for people with good 'on site' experience with both Rank Xerox and CPS requiring at least 4-5 years experience before considering an employee for homework. There has to be a great deal of trust between the employer and employee and more stringent requirements are imposed on the employee by the employer than would be the case for a normal worker.

The employee needs to be emotionally stable to be able to cope with the drastically altered lifestyle. For this reason recently divorced people are often less suitable than a single or married person. Overall this leads to married women being the most suitable for homeworking and this is reflected in the proportion of homeworkers who are married women. There have been problems recruiting in certain areas, particularly in the North, where middle-class wives do not generally go out to work as much.

In the 1982 Low Pay Unit survey of new technology homeworkers (Huws, 1984), 32% of homeworkers found their jobs through word of mouth. Many others had worked 'on site' for a company before moving back to the home to work.

Training of recruits was also found to be more difficult than for office-based employees due to the lack of day to day contact which often leads to informal learning. For this reason employers prefer to use people who are currently working for them rather than new recruits for homework.

One of the advantages of using homeworkers is that the workers are qualified, experienced and self-motivated, which is not always the case with office-based workers. This means that to a certain extent the employees manage themselves.

4.2 Work Patterns

In the various surveys of new technology homeworkers (Huws, 1984; Kinsman 1987), several patterns of work were found. No one pattern was appropriate for all workers, as circumstances and type of work varied.

In the 1982 LPU survey of homeworkers (Huws, 1984), 54% of the 78 workers questioned worked for only one employer, with 11.5% each having worked for two and three employers. The next largest category was 10% who had worked for nine or more employers. This represents a group of genuine freelance workers, who were selling their services to a number of employers. All Rank Xerox outworkers are freelance workers with a back up of being able to take up to 50% of their possible work from Rank Xerox. Some of the workers surveyed worked through an agency and dealt with several clients, but these workers generally tended to classify themselves as working for a single employer, the agency.

The small number of freelances seems to indicate that the majority of new technology homeworkers work for a single employer. Whether this will continue is debatable. More companies will start moving their own staff out to do homework, but freelance staff who currently travel to their client's workplace will also start to work at home more. The number of employees moving into the home will probably increase at a greater rate than the number of freelances moving back, thus continuing the trend, but it will be interesting to see how many companies follow the Rank Xerox example of making their employees into freelance workers and then sending them home to work.

Many people said that homeworking with a very young child at home was very difficult and some of those who had tried it said that they would not want to do it again. Those who had coped had generally found it difficult to work more than 16 hours a week, which is around two-thirds of the average amount of time spent working by new technology homeworkers (22 and two-thirds hours per week). Some homeworkers employed nannies to look after the children while the mother was working, others employed a child- minder for the first year or so only. Some workers have commented that homeworking is a good way of getting away from the children, but this is only the case if a child-minder can be employed.

Mothers with small children were generally found to work in the evenings when the children were asleep or during weekends when a spouse could look after the children. Once the children started school the pattern tended to change, much to the relief of some husbands who were feeling neglected in the position of 'computer widowers'. It is possible for the parents to do more 'on site' work while the children are at school. difficulties still arose during school holidays which in many cases resulted in the parent returning to evening work. Some workers also found it difficult to keep up the dual roles of being homeworker and housewife/person, wit work coming before doing the housework. This could lead to problems if the emotional and psychological base were not stable, and this reinforces the need for stability when selecting homeworkers.

Physical workspace was another problem. Ideally the homeworker should have a home office, but this involves the loss of valuable home space, and was therefore not always found to be possible.

Homeworkers use a variety of different methods for organising their work. In the Kinsman study (Kinsman, 1987), most found it best to draw up a work plan. Each task was defined and then split into sub-tasks, and deadlines were set by the worker for each task. The plan was continually reviewed as the work progressed. Quite a large number of the workers found that they were working unsociable hours towards the end of projects in order to get the work done in time for the deadline. Workers stressed the need to be organised, disciplined and good time managers.

4.3 Management

The problem of managing a remote workforce is the uppermost in many employers minds when considering homework. Homework has both advantages and disadvantages for mangement. As was stated earlier in this section, the main advantage is that the home-workers are self-disciplined, self-motivated, experienced and productive. Some managers found that compared to the homeworkers, on site staff were of lower quality and more difficult to deal with. They found that because the homeworkers were generally paid on an output basis, they wanted to work, whereas they thought that some on site workers thought it sufficient to simply attend work. Ninian Eadie, a director of ICL, has commented that because the number of homeworkers at any one time varies, the company has less control over the group as a whole, but that the group was found to require less control and be more flexible and freer than on site teams. This flexiblity allows the workers ore freedom to go about their work as they want to rather than having a rigid structure imposed on them.

As the work is contract-based, there are frequently deadlines to be met. This can lead to changes in the pace of the work, and it is up to the managers to ensure that their employees can cope with the pace, and try to relieve the pressure by ensuring that the work progresses smoothly. This involves the manager keeping in regular, frequent contact with all of their workers, either by visiting or, as is more usual, by telephone. By using electronic mail systems the amount of contact of this kind can be reduced, so that the work patterns and home life of the workers are not disturbed by phone calls.

By keeping detailed staff performance records including details of workers' methods managers will be able to assess how suitable a worker is to a particular task, and help new workers with effective methods to employ.

Morale is an important consideration for managers of homeworkers as they can become worried as deadlines approach. for this reason, managers need to have good counselling skills and should be able to give the homeworkers reassurance and help, perhaps from their own experience of homeworking. To be able to do this the manager must have a good knowledge of the home background of the worker, and any special difficulties that the worker may have, such as a handicapped child. The manager should not be too maternalistic towards the workers however, as they have to be pushed if the work is to be done on time.

Some managers of homeworkers have noticed that the due to the inherent communication problems involved in remote management, managers compensate for this by improving communications with workers, but managers of office workers often do not realise that there is a communication problem in their office, resulting in conventional office communications often being inferior to those in homeworking systems.

The managers have to be careful that they do not supervise their workers too closely as this can give workers the impression of having someone looking over their shoulder all the time. Some homeworkers say that one of the advantages of homeworking is that you are your own boss, with increased freedom and independence. In the 1982 LPU survey (Huws, 1984), 13% of workers said that this was a major influence on their decision to take up homework.Close supervision in offices has been associated with increased stress, and it is likely that the same result would occur in homeworking if supervision was to be introduced that was too restrictive.

One of the main places of resistance to the introduction of homeworking is in management. The reasons for this are not particularly obvious or clear, but seem to be based on fear of loss of power, control and even employment. One of the main reasons for the lack of success when homeworking was introduced into France was the resistance of supervisors and managers who felt that their positions were threatened by this form of work. The way to overcome this fear is to train and educate the managers of the workers as well as the homeworkers about the way that homeworking works and about the need for effective management if the use of homework is to succeed. Hopefully, managers will then see that there is still a very important role for them, perhaps with their importance even increasing. For example, F International has a high management ratio with around one manager to every five programmers.

5. Effects on Workers.

In this section of my study I aim to examine the effects that new technology homeworking can have on the worker. Matters which are considered here are job security, payment and expense, health, isolation,and effects on family and friends. The change from a normal pattern of working to the different one involved in homeworking can be a traumatic one, and can lead to many problems, including psychological and domestic trouble. Many of the problems can be overcome when recruiting homeworkers by ensuring that they are suitable for homework (see section 4.1 Choosing Homeworkers).

When asked whether they enjoyed homeworking, all employees of ICL's CPS and F International said that they did (Kinsman, 1987), and in the Low Pay Unit survey 76% gave an unqualified positive answer, with a further 15% saying that they sometimes enjoyed their work. This shows that homeworking is very popular with the majority of those who have tried it, what ever problems may be associated with it.

5.1 Conditions and Status of Employment

The conditions of homeworkers vary widely depending on their job and the attitude of the employer. The LPU survey from 1982 (Huws, 1984) provides some interesting information about the conditions of employment for new technology homework, and the survey done by Francis Kinsman (Kinsman, 1987) gives information about the employment of homeworkers working for F International and ICL's CPS division. The 1981 National Homeworking Survey (Cragg & Dawson and also Hakim, 1987), also provides some information about homeworking in general.

The LPU survey found that only 13% of the sample were employed on a freelance basis, with the others generally being employed by a single employer, and a few working for agencies. 55% said that they were self employed, even though many actually only worked for one employer. The payment of National Insurance which is usually a measure of employment status gave a slightly peculiar result with 6% of employees paying their own stamp and 7% of the self-employed had their stamp payed by the client. The proportion of self-employed homeworkers in the 1981 National Homeworking Survey was only 27% for all workers working in the home, with most working for a single employer, which is a significantly lower figure than was found for new technology homeworkers in the LPU study.

The National Homeworking survey came to the conclusion that often the workers were self-employed because their employers did not want to have to go to all the trouble of taking them on as full employees. For a worker to be eligible for the main benefits of employment protection legislation, they must be employees. As most were not employed, and of those who were many did not qualify for protection due to them not working sufficient hours per week, a large number of the homeworkers had no formal employment protection, which must be a cause for concern, especially if homeworking is to become more popular. The lack of security in job tenure is reflected in the LPU survey which found that 88.5% of the self-employed regularly found themselves without work, and even more worryingly, that 11.5% of employees often found themselves with no work to do. As the work is usually payed per hour or per project, this means that the homeworkers have no income from their work during these periods. 76% of workers found that they often had more work than they could cope with. When asked what they did when this occurred, answers included work it out through discussion, work overtime, employ subcontractors, and one unfortunate person who simply replied 'cry'! When questioned on what would happen if they failed to complete work on

time, 6% said that they would not dare, and 11.5% said that they would receive no more work from that employer.

Promotion prospects also showed a worrying trend, with 69% of those in the LPU survey saying that they had no hope of promotion, with self-employed people especially giving very little hope of any promotion. 49% of employees said that they thought promotion was still a possibility. The lack of promotion prospects generally does not seem to worry the workers very much as 76% said that they were definitely happy with their work. If homework is to increase in the future it is important that homeworkers do not miss out on promotion as this could lead to employees being reticent to try this method of work. With more employees going back into the home to work, the proportion of homeworkers with promotion prospects should increase naturally, but it is an important factor that all those involved in homework need to consider before embarking on this type of work. Union Membership

Homeworkers have traditionally had very little involvement with trade unions. In the 1981 National Homeworking Survey 14% of homeworkers were found to be union members. The LPU surveyof 1982 showed that although new technology homeworkers had a higher membership, 37% had been or were members, the proportion is below that found for a similar group of workers in normal employment (A 1981 Datalink magazine survey found 56% were union members). The lack of unionisation of homeworkers is not purely attributable to the number of homeworkers who are self-employed, and it more likely to be due to the difficulty which unions encounter in when trying to contact homeworkers to recruit them. Homeworkers have difficulty finding out about unions which are relevant to homework. The lack of unionisation is also due to the lack of interest in unions shown by many of the homeworkers who can see little advantage in being union members.

If homeworking becomes more popular for low-skill jobs such as data-entry then it is important that homeworkers are made aware of and are able to join trade unions, through publicity by the unions and with the help of the employer. If this is not done then it is likely that homeworkers will end up being exploited, and the new technology homeworkers will be equivalent to the sweatshop workers of the last century, having to do large amounts of work for low pay, with no job security. The trade union movement has traditionally been opposed to homework as it was seen to perpetuate poor conditions and low pay. In 1978 a new view emerged which sought to incorporate homeworkers into unions. The TUC view was put in the 1978 TUC Statement on Homeworking, which was subsequently updated in 1985.

5.2 Payment and Expenses

Homeworkers have normally been paid less than workers doing the same job out of the home. The most recent study (1981) of homeworkers generally (Hakim, 1987) found that 25% of homeworkers earned less than £1.50/hour compared to 8% of normal workers. Men tended to have higher rates of pay than women. In the LPU survey of new technology homeworkers in 1982 the average rate of pay was £4.62/hour which indicates, as would be expected, that homeworkers using new technology are better paid than other homeworkers. However, this figure hides a large variation in pay, with the lowest paid earning just 10p/hour (about £80/year) and the highest £13.78/hour (£21,500/year).

The survey goes on to break the figures down into groups, with the pay of the computer professionals being of particular interest here. The average hourly pay for this group was £4.63, very similar to the average for all the workers. Now we shall compare this rate with the average for

workers elsewhere. It is difficult to find out rates of pay in the computer industry but a few surveys were carried out around the time of the LPU survey. The New Earnings Survey gives us the average for computer programmers/systems analysts, but the group includes a large number of junior and trainee programmers which distort the average, by lowering it compared to the LPU survey group in which all the workers had several years experience. Even so the average pay was £5.69/hour, around 25% higher than was found for the homeworkers.

The Incomes Data survey of August 1982 gives more details allowing the exclusion of junior personnel. The average given for a comparable group is £6.54, which is 40% more than the homeworkers were earning.

As homeworkers often do not have a guarantee of work for the whole year, times without work bring their annual pay even further down in comparison to those in normal employment.

It was found that the few men in the LPU survey earned closer to the rate of those in normal work, £6.79/hour. The reasons for this are not really very clear but are likely to be connected with the men being in higher paid jobs through having worked in the computer industry. Childless women were on the same average hourly rate as women with children but they earned over £3,000 more per year than women with children as they are able to work for more hours.

It could be said that the correct group with which to compare the pay of homeworkers is the group of freelance programmers working on contacts. The average for this group is around £14-15 per hour, which makes the homeworkers pay look even worse.

As with the unionisation and rights of homeworkers, the pay aspect of their employment appears to be in need of a rethink if employees are to be encouraged to take on this form of working. The trend towards sending employees out after working on site should help the pay rates as few employees are likely to accept a pay cut. Those being made freelance workers, as is the case with Rank Xerox employees get around half of their pay from their previous employers and have to find the other half in the form of external contracts. Again, this should increase the rate of pay as the freelance contracts will usually pay at a higher rate than in-house work.

Most of those homeworkers who are self-employed have to purchase their own equipment. The average cost of this equipment was £2157, with the price of computer equipment being higher at £3171. This is a substantial investment by the worker and accounts for a large proportion of years pay. It is comparable to buying a second-hand car and the decision to buy must be carefully considered, although the extra income gained by owning ones own computer equipment will probably pay for the equipment within two years.

5.3 Health

With workers spending more of their time in their homes rather than travelling to work where they are likely to move around more, it is likely that homeworkers' health will suffer unless some other form of exercise is taken.

The LPU survey asked about the health effects of homework and 36% of workers said that they felt that their health had been affected by their work. However, only 23% said that the effect was an adverse one. Some of the 13% who said that their health had improved said that their work had helped keep them sane.

The health problems reported were stress (9%), exhaustion (8%), and headaches and eyestrain (6%). These problems are probably due mainly to the lack of control of work pace, resulting in the worker overworking as a deadline approaches. Problems such as eyestrain can be helped by education in correct lighting and ergonomics, and limiting the time that a worker spends at a VDU each day.

In the future workers will have to take more care over their health, and need to be properly educated in the correct way to work, including ergonomics and relaxation.

5.4 Isolation.

Perhaps the most obvious disadvantage of homework of any kind is the feeling of isolation that it can bring. Most homeworkers cite this as one of the most disagreeable things about their mode of work.

While there is no obvious solution to the problem of isolation, there are several ways in which the problem can be reduced. Effective management with just sufficient contact with the worker will help the worker to feel a part of the company. The use of the telephone and electronic mail will aid this. The employee can be kept informed of progress on other parts of the project that they are working on, and can be told of any social events which the company or workers are organising. If homeworkers are able to contact one another this can help both in their work and their well being as they can socialise together and a share each others problems. CPS have a newsletter which keeps employees informed about the goings-on at work and what is planned for the future. This all goes to help the worker feel that they 'belong' to the organisation and are not forgotten and left in a corner.

Another way of reducing the problem of isolation is to set up neighbourhood work centres, where homeworkers get together both to work and to socialise. This is effectively a satellite office and although not truly homeworking, is a step in that direction with work being less centralised. The idea does have it's problems, although the problems of having a neighbourhood office may be less than those associated with homeworking. The centres would be difficult to organise and will reduce the savings made on office space.

5.5 Effects on Families and Friends.

One homeworker, when asked to give the advantages and disadvantages of homework replied,'Being with the children all day.', as both an advantage and a disadvantage! This gives an idea of the conflicting effects of homeworking.

The typical homeworker is a married woman with two children. As well as the effects on the homeworker, working at home can effect the family, especially if the children are in the house when the mother is working.

Homeworkers have expressed concern about the effect that their work is having on their children. The children usually accept their parent working at home, and in some cases take an interest in the work. Sometimes the older children help by taking messages, doing the shopping while mother works, and some even help with word processing. Some children use the parent's equipment, when

the parent is not using it, for playing games or helping with their school work. There is a story of one highly computer literate child who had programmed a client's job at the age of eight.

The homeworker's spouse, usually the husband, is often involved in computing and can help in technical matters. Those who are not can help with support at times of stress. Most husbands are appreciative of the extra money coming in and help out by sharing the household tasks more. It is essential that both the husband and the wife are involved in the decision to take up homework, and it is found that strong, stable marriages lead to successful homeworking.

Friends of homeworkers are often surprised at their mode of work and many take an interest. This can lead to the friend being recruited, either to help out or as a 'full-time' homeworker in their own right. Friends who are not working themselves sometimes express amazement that the worker can combine the working and home life successfully, although it is obviously easier to combine the two lives when working at home than when working away from home.

6. Case Studies.

To illustrate the use of homeworkers, I have chosen to give an outline of the homeworking experiences of two of the UK's most forthright proponents of homeworking. The two companies involved are both involved in the computing industry, as are most current users of homework, but started using homeworkers at different times, for different reasons, and in different ways.

6.1 Rank Xerox Ltd

Rank Xerox call their method of homeworking 'Networking'. In 1981-82 they started an experiment which involved various employees leaving the direct employment of the company and starting their own businesses as freelance consultants. The people involved were from a wide spread of jobs, not only computer-skilled people. People with skills in marketing, market research, business planning, operational research, financial control, taxation advice, major capital programme control, management services, technical service engineering, systems analysis, programming, pensions, safety, security, training and personnel. The workers were almost exclusively specialists and managers, with no representation of secretarial or support staff. They were from a wide range of ages with the youngest being 28 and the oldest 62.

The idea of using homeworkers came about as the result of an investigation into office costs. It was found that an employee earning £10,000 per year actually cost £27,000 per year when office overheads in central London had been taken into account. How every £100 spent on the cost of Rank Xerox HQ was itemised.

Item	£
Facilities costs (Rent, rates, power, heat, telecomms etc.)	31
Basic Salaries	30
Cost of Employment (Pensions,NI etc.)	15
Data Processing Costs	12
Other costs (Travel etc.)	12
Total	100

Around a third of the costs were bound up in facilities, and Rank Xerox saw the introduction of homeworking as a possible way to reduce these costs. They hoped to reduce these costs as they were increasing rapidly and produced no benefit in themselves. There were other ways in which these costs could have been reduced, e.g. by moving offices to a cheaper location, but it was thought that the introduction of networking would produce greater savings.

Rank Xerox has always had a reputation for being entrepreneurial, and managers are allowed a great deal of self-regulation. Many of it's staff consider leaving to start their own business and in the past Rank Xerox had attempted to keep in contact with some of those who had done so through a traditional contract of employment. This had proved largely unsuccessful as the individuals wanted more independence and autonomy, and so it was decided that a different form of contract and relationship was needed.

Rank Xerox were obviously aware that the technology was available for employees to work at home, as indeed it had been for many years. The rapidly falling price of this technology also encouraged them to use networking.

They recognised a difference in jobs, some of which were labelled 'continuity' jobs and others which were 'output' jobs. Continuity jobs are those where being at the place of work is a necessary feature of the job. Jobs which come into this category are that of the receptionist or bank cashier. These jobs were unsuitable for networking as they relied on the place of work for their function. Output jobs are those in which achievement of a set of defined objectives is the aim of the work, and the place that the work is done is purely incidental. Jobs in this category are programming, data-entry, and planning. It is these jobs which Xerox recognised as suitable for networking.

The organisation of the Xerox 'Future Company Office' consists of two parts.
The Core Staff

Generally the 'continuity' workers. A reduced number of full-time salaried employees who work on the company premises. They maintain day to day management, and include 'networker managers' who are responsible for managing the greater number of networkers.
The Networkers

The 'output' workers, who rarely, if ever, go to work on the company premises. They are given their objectives by the managers in the core staff and work towards these objectives.

The link between the networkers and the core staff was originally two Xerox 820 microcomputers, connected over the telephone line, using an electronic mail system for passing messages and reports etc. LAter the link was developed so that the 820's could access a central Xerox 8000 series machine allowing more power to be accessed from the home.

The link between the networkers and the Rank Xerox organisation was maintained through a special contract and a self help group, Xanadu, set up by Xerox for workers starting their own businesses. The contract was designed to encourage people setting up their own businesses to perform specific, defined tasks for Rank Xerox as one of the clients of their business. The businesses must remain independent of Rank Xerox and to ensure this a networker's business is only allowed to spend up to 50% of it's potential work time doing work for Xerox. The rest of it's time should be spent working for other clients. Work given by Rank Xerox is well defined in terms of task and quality, and to a set price, thus fast work will result in fast profit, encouraging the worker to complete the task in the least time possible, but maintaining the quality required.

Those leaving Rank Xerox to become networkers are given training and advice on setting up their own business. The training given covers financial matters, skill enhancement and microcomputer skills. Those who want to join the networkers are carefully vetted to ensure that they are psychologically suitable and able to self-discipline themselves.

Once the networkers have officially left Rank Xerox, a sense of belonging is maintained by inviting them back (around one day per fortnight), and through the Xanadu (an acronym for Xerox Association of Networkers and Distributed Utilities) self-help association. Xanadu helps by giving business contact, enabling group purchasing and maintaining contact between members and Xerox. Most networkers have joined, but they are outnumbered by other small businesses which Xerox has encouraged to join.

The networking plan was originally to have 150 employees working in this mode, but by 1987

employ a further 150, many of whom are networkers themselves. The reasons for the slow progress are the unsuitability of some of the jobs to networking, and problems with management. The main management problem was that the core managers were trying to manage networkers without first experiencing networking themselves. The success of the experiment, however limited, is that Rank Xerox are a very aggressively entrepreneurial company, and they have allowed their homeworkers a good deal of autonomy and independence. The networkers enjoy this independence and are happy with their work. Many of the small business have grown and rely little on the work available from Rank Xerox. As the company's experience with this mode of employment grows they will be able to overcome more of the problems and the number of networkers will gradually grow to become a significant part of the Rank Xerox organisation.

6.2 F International

F International (FI) was set up in 1962 (when it was called Freelance Programmers Ltd) by Steve Shirley. It now employs over 1,000 people most of whom are homeworkers.

Stephanie Shirley resigned from her computing job in 1962 to set up as a freelance programmer with capital of £6. She sent many letters enquiring about work, but it was not until she changed her name to Steve on the letters that she got an interview. She finished her first job when she was eight and a half months pregnant, but in the first year her company had a turnover of £700. Her son was seriously mentally disabled, but Steve threw herself into her business and by 1964 had four other workers, all working from home.

The business expanded and by 1970 there were 100 employees, by 1978 there were 500 and by 1985 over 1,000. The expansion had not all been plain sailing however. In 1970 the recession caused a drop in trade and Steve's partner left taking valuable business and employees. Steve overcame the difficulties and by 1973 was back in profit. The workers were almost exclusively women, who had discovered that all that computer programming required was a head,a desk, some paper, and a pencil and so could be done at home.

A Danish subsidiary was formed in 1975, but growth there was slow due to the country's supportive child care system meaning that mothers were able to go out to work as normal. In 1986 the subsidiary was sold to the local management. Problems were also encountered when a Dutch subsidiary was set up. Employment legislation made the homeworking method of employment difficult, and the feminists and traditionalists argued over FI's method of employment. All of FI's attempts to succeed in America have failed for various reasons and FI seem to have given up hope of any success there.

F International have been surprisingly slow to take advantage of the new opportunities opened up by the advances in technology. Some use is now made of micros and the telephone network for data transmission but this only has only recently come into general use.

Recent problems with management structure seem to have been solved and the success of the company can be judged in that 25% of the 1986 Times Top 500 companies are clients of F International. One in four of it's employees hold shares in the company with Steve and Derek Shirley still holding 58% of the shares.

75% of FI's workers are 'panel members', that is self-employed homeworkers, operating on flexible hours, typically doing programming work. An additional 15% are working part-time or flexi-time

ona salaried basis. The full and part-time salaried staff are mostly found in the management, sales or technical side and three-quarters of these are also home-based.

F International's entry requirements are :-

1) 4 years experience plus qualifications.

2) Ability to do at least 20-25 hours work per week.

3) Ability to make two or more visits to clients premises

per week.

4) A telephone and some kind of 'office area'.

5) High professional standards and level of self-discipline.

Promotion prospects are available to workers and they can progress up the hierarchy into management and other fields.

Projects are broken into short periods requiring a minimum number of hours, but the workers are left to their own devices as to how the organise the work. F International estimates that productivity is increased by up to 30% by using this form of working.

Panel members are paid an hourly rate, depending on their grade, and are reimbursed for travel and other expenses. Panel members are not given a contract of service, but instead have specific contracts for each job. Members earning over the taxable limit are required to register for VAT.

There have been complaints by panel members that the rate of pay is significantly lower than those available elsewhere.

In June 1987 F International were awarded the third annual 'Team Excellence Award', which had previously only been won by the RAF's Red Arrows, underlining the spirit of participation that is present in F International. The award's sponsors are Rank Xerox (UK) Ltd.

7. Future Developments.

We have seen what has been done in the field of homeworking and in this section I will put forward some possibilities for the future. How homeworking develops depends on the attitude that employers take to the concept, and whether the general public can come to terms with the idea of not 'going to work'. I will look at the factors that will determine the success of homeworking, and see how homeworking may possibly change.

In the short term, over the next 5 years say, there will not be a mass exodus from the centres of work back to the homes. It will take time for the problems inherent in homeworking to be overcome. Minds need to be opened and new skills need to be learned. Improvements in management methods are necessary, building on the experience of homework employers such as ICL, Rank Xerox and F International. These companies are setting the example for others to follow by moving skilled jobs into the home and learning from their mistakes. They have realised the problems that are involved in homeworking and are working to solve them as they see homeworking as one of the new modes of work for the future, alongside job sharing and reduced working hours. Other companies will start to take notice of the homeworking schemes do far and some will start their own experiment. If they start soon they will have the advantage of a head start if and when homeworking becomes a more common mode of work. They will have the experience and management skills necessary in this new form of work, while those who lag behind will still be trying to develop theirs.

What will happen in the next few years, and it has started to happen in the States, is that low skilled jobs, such as data entry, will be moved into the home, as this way a large number of people can be employed with little overhead cost to the employer. It is vitally important that homework does not become stigmatised by becoming known as a low-skill method of working. This could happen if employers take advantage of the current lack of protection for homeworkers by continuing the low rates of pay and lack of job security, which has always been associated with homework in the past. If they do then skilled workers will be reticent to take up homeworking as it will involve a pay cut, or appear to be a step backwards. If the recent improvements in the working conditions of newer homeworkers, due to the ICL, F International and Rank Xerox schemes, continue then skilled workers will be attracted to homework and it will be seen as an acceptable thing to do. If sufficient companies employ homeworkers without exploiting them, then the homeworker will become happier and more common.

A great deal of research needs to be done into the problems of management, as this is currently one of the major difficulties when introducing homeworking. As more people experience homework there will be a better supply of managers with relevant experience and it is the short supply of these managers which is holding homework back. To be able to effectively manage home-workers it is almost essential for the manager to have worked in this mode himself. He will then know the kind of problems involved and have a good idea of how to go about solving them.

If the use of skilled homeworkers is achieved then the future for homework generally looks bright. For it to succeed the workers will have to be paid a comparable wage to those working in offices (the savings on office cost should be able to cover the price of the extra communication involved), and they should have the same job security.

A debatable point is whether the new homeworkers will tend to be self-employed or not. Employees like the security that they have in a steady job whereas employers prefer the flexibility

of freelance labour, which is a reversal of what occurred during the Industrial Revolution when industry bosses preferred to hire permanent staff which went against the wishes of the workers who did not want to be tied down and were in a seller's market situation.

There will probably not be a swift change to the majority of people working at home, but the pace will increase as more and more experiments are successful. It is difficult to say what proportion of jobs could be done from the home and the number which are really suitable will probably be significantly less. No doubt some employers will try to send workers home when they could do their work more effectively in the workplace, but they will soon learn which jobs are and are not suited to homeworking.

With the success of homework there would be a race to develop tools for use by homeworkers, with computer manufacturers competing to capture orders for home workstations from large corporations would may start sending large numbers of their staff home. This would lead to cheaper technology and new developments.

Some reasons for not homeworking will disappear in the future. At the moment it is necessary to go to a work place if the work involves a good deal of reference to books or access to specialised machinery. In the future the need to access books will be reduced with more books available in the home via a computer. Standard reference books which change little from month to month could be stored on some form of computer mass storage, perhaps video disc, compact disc or some other form under development such as 'digital paper'. All these media are capable of storing enormous amounts of data in a small, convenient form which can be used in the home. This will eliminate the need for lawyers to refer to huge volumes of legal precedents, for example. They will be able to call up any information on their home computer/information centre and have instant access to it. Data which changes more frequently will be accessible through a digital computer network such as ISDN so that jobs which currently require a person to be in one place to access the latest information will now be possible in the home.

As communication costs fall, due to increasing competition, there will be an increase in the number of homeworkers as the cost of communication is the main overhead involved in homeworking. This will also lead to a reduction of the isolated feeling that many homeworkers suffer from, as items such as videophones using a digital network become both practical and affordable.

It may be that, as Alvin Toffler suggests, many workers will work in their own 'electronic cottages' working on their 'electronic cottage industries'. What some of these industries will be, we do not yet know, but others will be similar to the small businesses of today. Jobs like financial dealing are obvious targets for decentralisation with costs of office space in the City soaring. The possible decentralisation of many of the jobs currently performed in large cities may see an exodus, with workers moving to remote places, such as the Highlands of Scotland, where the pace of life is more leisurely.

The homeworker of the future will be able tp sit in front of their workstation, which is connected to a world-wide digital network, and call someone on the other side of the world on their videophone, then request the text of book stored in New York, and have it delivered to their screen within seconds. This opens up the possibility of not just telecommuting, but of global telecommuting, with people being able to work for a company in one country whilst living in another. Barbados is already wiring itself up, in the hope that it will become one of the international information centres for the world in much the same way that the Cayman Islands became a world financial centre.

The future of homeworking rests in the hands of the managers of today. If they start to use homeworkers fairly then it is likely to spread to a much wider group of people than the mother with young children who currently dominate the home workforce.

If the UK does not take up homeworking then other countries will and may be able to provide labour at lower prices, resulting in the UK falling behind in a vital area.

8. Conclusion.

In this compiling this report I learned a great deal about homeworking and the application of information technology. I was surprised at the amount of material that is available on the subject, and although some of it was of little use in the project it proved interesting to read in it's own right.

In this report I have examined the technology which has made telecommuting a real possibility and looked at a few of the planned future technical developments which have applications in the field of homework. The development of the personal computer and it's acceptance into the home has resulted in an increase in momentum in the field of homework. much of the technology required to make the home workstation for the homeworker of the future is already here albeit in a somewhat restricted form. Within the next decade these developments will be applied to homework, as the developments of the seventies are used now. There have been rapid developments not only in the home computer field, but also in the field of data transmission, with modern modems bearing as little resemblance to those of the seventies as the modern workstations do to the Apple I. The networks over which data is transmitted have also developed, with most countries now installing digital telephone and data networks.

The types of work which are suitable for homework vary greatly but those currently being performed in the home are almost all output based. That is, the progress and productivity of the worker can be assessed from the results which are produced. Many of the large companies currently employing information technology homeworkers in Britain are involved in the computer industry in one form or another. They employ programmers, analysts and managers as homeworkers and both the workers and the employers are happy with the arrangements. There is also evidence that a number of low-skill workers are using IT in their homework for such jobs as data-entry.

The use of homework opens the door to employing the disabled in the home. The DTI experiment has been particularly successful in this field and it is to be hoped that more employers will consider the disabled for homework.

In the future the number of jobs done in the home will increase, the rate of the increase depending on both the employers and the workers. Many office based jobs are suitable for conversion to homework, though it must be stressed that many other jobs will never be able to be performed effectively from home. These jobs generally require the worker to be in a particular place to do their work.

It is the organisation of the work which will decide whether homeworking really takes off. If good management is available, with experience of homeworking, then homework will become more popular amongst skilled workers. If management is poor, then the work does not get done efficiently, the worker has pressure put on him/her, and as a result neither the worker nor the employer are happy with homeworking.

Looking at past studies of homeworkers, both those using new technology and those who were not, it was found that homeworkers are almost always payed less per hour than a worker doing an equivalent job elsewhere. This situation is being changed slightly with companies such as Rank Xerox who are setting staff up as self-employed freelance workers and guaranteeing them work for up to half of their work time. It is then up to the worker to find work for the remaining time. They can try to get work as a normal freelance worker which pays at a much higher rate than homework.

Homeworkers were found to be mostly self-employed, though a large number of these self-employed workers only actually did work for one employer. The workers were also found to have very little, if any, job security and many went for periods without work or income. A smaller number than would be expected belonged to a union, and homeworkers generally were found to have little union representation.

If the employment conditions and pay of homeworkers do not improve soon, there will not be the large growth in this area which many people hope for. With poor conditions and pay homework will only attract low skilled workers and the mothers which make up such an overwhelming proportion of those currently home-working.

The current position is that the majority of homeworkers, including those using the new technology, are mothers with young children. Some of the newer homeworkers are breaking away from this pattern, through experiments like the Rank Xerox one, with office workers moving back to work at home. Men working at home tend to be better paid than women. With more men taking up homeworking, hopefully there will be an increase in the level of pay for women doing similar jobs in the home.

For homeworking to develop properly it is necessary for forward-looking companies to try this mode of work, because if more people try homeworking there will be more experienced managers able to help improve conditions.

In the next few years, homeworking will grow slowly, still being dominated by mothers, but the pace of growth will gradually increase as there are more and more successes. Eventually the numbers of homeworkers will have increased to the point that most homeworkers are men and it is when this point is reached that we will know that homework has really taken off.

9. Future Work.

Given more time to go further into the subject of IT and homeworking I would attempt several things.

1) Cover the literature available in greater depth.

Follow up some of the more obscure references.

2) Attempt my own survey of homeworkers, similar to the one carried out for the Low Pay Unit. Contacts could be made through placing adverts in the Press and magazines likely to be read by the homeworkers. As the LPU survey was done in 1982, many things are likely to have changed in the six years since then.

3) Interview some of those involved in homeworking, such as managers, workers, employers etc. Contacts could be made through adverts as in 2 above or through companies known to be using information technology homeworkers.

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