E.R.

4.

PRIME MINISTER

In your conversation with John Ashworth, you asked him to "imagine we are French and construct a programme".

In this box, there are several short pieces from Dr. Ashworth reporting on developments in the areas you discussed. He suggests that you might like to glance at the attached booklet. It is precisely what you had in mind - the French approach to constructing a programme of innovation encouraged from the centre.

MP

mh.

22 October 1980

cc Speech folder HB

# 10 DOWNING STREET

*From the Private Secretary*

DR. ASHWORTH
CENTRAL POLICY REVIEW STAFF

The Prime Minister was grateful for the notes you submitted earlier this month, following up your conversation with her. I now return your copy of the NRDC report, and the booklet on the French approach to national innovation (with added value!).

We hope to be able to go ahead with the function for entrepreneurs and financiers early in the new year. I will be in touch with you again about this.

The Prime Minister's speech on 25 February is to the Parliamentary and Scientific Committee - this will be a much larger function than is implied by a Parliamentary Select Committee, see attached letter.

The Prime Minister is content to drop for the present the question of the use made by foreign companies of UK university laboratories.

I look forward to receiving the list of Wolfson Foundation supported units.

M. A. PATTISON

27 October 1980

255

Prime Minister 4.
Three notes from John Ashworth, following his talk with you. (You saw one of them for the small business meeting)

THE PRIME MINISTER'S INITIATIVES

1. I undertook to ensure that the note on the problems of private investors and availability of venture capital commissioned from ACARD would constitute a background brief for the Prime Minister when she met British bankers. This work is now underway and should be completed by early December.

2. I have been giving some thought to the idea of the Prime Minister hosting a function designed to bring entrepreneurs and financiers together. I think it a good idea and, subject to any thoughts you might have, would suggest some time in January. The Prime Minister's programme (as far as I am concerned) might therefore look:

| | | |
|---|---|---|
| early December | - | receipt of ACARD note |
| early January | - | meeting with entrepreneurs/bankers |
| 25 February | - | Speech to Parliamentary Select Committee. |

I think it important to have at the January function a number of those, like Mr Naylor of Job Creation Limited and Mr L Cary of Venture Capital Reports, who have themselves successfully created small businesses designed to make a profitable commercial venture out of bringing entrepreneurs and financiers together in novel ways. Indeed I think the more of these the better - especially as I imagine the Prime Minister would not normally expect to see such people in other fora.

3. I hope to let you have a complete list of possible Wolfson Foundation supported units next week. The latest, slightly bizarre, success has been the development by a group at Strathclyde University of a novel fermentation method for the production of soy sauce. The product is currently undergoing trial market testing and will go into volume production if this is satisfactory. The new process is so much cheaper than that currently employed that those concerned are confident that they will not only be able to satisfy growing UK demand but have high hopes of exporting to Japan!

4. I have made discrete enquiries about the chances of Dr Cesar Milstein (inventor of the mono-clonal antibody technique) being awarded a Nobel

Prize. He has been nominated, is felt to have a good chance and we will know tomorrow when I believe the announcements will be made in Stockholm. However, any action by the UK government to press Dr Milstein's case is likely to be counter-productive.

As you know, Milstein did not get it MMP

5. I have made further enquiries into the use made by foreign companies of UK university laboratories. The Prime Minister said she wanted to take this up with both Sir Keith Joseph and Sir Raymond Pennock. On reflection my advice would be to let the issue drop for the following reasons:

(a) Many UK companies are currently suffering from severe cash flow problems and are having to retrench wherever they can - this retrenchment frequently includes the more long term and speculative work they might commission from the Universities.

(b) The reputation of UK Universities as centres of excellent research is deservedly very high and present Government policy is encouraging them to capitalise on this reputation wherever and however possible.

(c) A combination of (a) and (b) above has meant that a number of Universities have found it easier to interest foreign, rather than UK, companies in their contract research and development facilities.

On balance this will mean that foreign money will maintain, in UK Universities, facilities which would otherwise be likely to disappear or which would have to be supported by public funds. These facilities will be available to UK firms when they are again in a position to make use of them. The situation may be irritating but it is understandable and I do not see how the Government could affect things without prejudicing other, more important, policy objectives.

EXISTING AVAILABILITY OF VENTURE CAPITAL

The investment climate for new small companies has changed quite markedly since I first started canvassing opinion on this topic in 1978 (in connection with the work published as the ACARD report on Industrial Innovation). In part this seems to have been due to the establishment of "small firms" or "new venture" divisions of banks (clearing as well as merchant) and no doubt in part also due to the tax changes announced in the last budget and the other initiatives taken by the Government. As an indication of this change Mr P Naylor of Job Creation Limited (itself an innovative new company) tells me that he has no trouble finding capital for his (often rather risky) projects in depressed areas and Mr L Cary of Venture Capital Reports Limited (another innovative new company) has been able to maintain a creditable 30% success rate in finding financial backing for entrepreneurs - and it seems likely that entrepreneurs only go to the likes of Venture Capital Reports Limited as a last resort!

2. However, although the investment climate might be changing it is still too early to tell whether actual performance, in terms of the successful establishment of sound businesses, has really changed. In the crucial area of new technology based firms (NTBFs), for example, it is too early to tell whether the new-found enterprise of the NRDC will be commercially profitable.

3. It seems, therefore, that the Prime Minister will be more likely to be able to point to some promising signs and hopeful beginnings in this area by February 1981 rather than solid achievements. It is likely that the Advisory Council for Applied Research and Development (ACARD) in its reply to the Prime Minister's request for advice on the problems of the private inventor will reiterate the opinion they expressed in their 1978 report on Industrial Innovation, viz that the most effective help that can be given would be to establish some form of loan guarantee scheme in conjunction with tax relief for equity investment in NTBFs by private individuals and modest alterations in the way losses can be written off for tax purposes.

4. There are signs, however, that real problems are developing at what is coming to be called the "post-development gap". This is a term for the shift in emphasis (managerial as well as financial) when an innovative product or process ceases to be an exciting piece of high-technology and becomes a mundane, but potentially very profitable, article of general commerce. The finance needed to bridge the "post-development gap" is often far greater than that needed to bridge the "pre-development gap" between research and development. It is usually far beyond the resources of the likes of the NRDC or small companies and, as the attached article from the Financial Times of 25 September points out, has presented UK companies with awkward problems in the past.

5. I hope that in briefing the Prime Minister the clear distinction is made between venture capital needed to start new firms, or new businesses within existing firms (the "pre-development gap") and that venture capital needed to maintain an adequate market share in a growing market which is consequently attracting foreign competition ("post-development gap").

F.T. 25/1/80



LOMBARD

# Exploiting our skills

BY DAVID FISHLOCK

EVERYONE knows that Britain once led the world in radio-astronomy because of its pioneering radio-telescope at Jodrell Bank. But that was back in the Fifties. Fewer know that as a direct result British industry led the world in the Sixties with its earth stations modelled on Jodrell Bank which picked up the whisperings of the first satellites.

Like so many other markets for novel products of high-technology the one for large earth stations has long been lost to the Americans and the Japanese. It wasn't a case of Britain failing to develop a scientific invention, but of Britain failing to mount a coherent industrial policy capable of sustaining from profits the unending input of cash and skills advanced technology demands.

## Indispensable

On a grander scale Rolls-Royce made precisely the same mistake in the Sixties. It gravely under-estimated the financial and other resources needed to translate a brilliant new three-shaft concept of aero-engine design into the RB-211. A decade later it can point to 700 engines in service—including some in the North Sea—and orders for another 500, with new developments in the pipeline which suggest a production of at least 250 RB-211 engines a year in the early 1980s. Top of its attractions for airlines, Rolls-Royce engineers say, is that they expect to maintain a 4.5 per cent advantage in fuel consumption over all rivals throughout the decade. This fuel economy is a direct result of harnessing high technology; of more advanced materials operated at higher temperatures.

But had Rolls-Royce been a more typical British industrial situation, it would have vanished in 1971. Only the fact that it was an indispensable source of engines for military aircraft, warships and submarines obliged the government to keep it alive as a state-owned organisation.

With publication today of the eighth report from ACARD, the Advisory Council for Applied Research and Development—the body which has replaced the office of the government's chief scientific adviser—it is becoming increasingly clear that the development gap from which Britain is so often said to be suffering is in a significantly different place from the one normally perceived.

The truly serious gap is not that due to the reluctance of British scientists, engineers, inventors to launch into manufacture with their ideas. The real gap is far more wasteful of resources. It is the hiatus left when companies launch themselves enthusiastically upon the neck of some new technology, only to come a cropper because they failed to realise how much it would cost. It is a post-development gap.

EMI is a classic example of a company which, armed not only with a brilliant invention but with an unusually realistic estimate of what it might cost to launch the new product, still under-estimated the eventual scale of effort required to compete with U.S. industry.

The latest ACARD study surveys "information technology," a vast tract of fast-advancing technology embracing telephones and telecommunications, video systems and word processors—and of course the ubiquitous computer which now lurks behind each one. It finds a marvellously innovative picture in Britain, with such projects as Prestel and System X, and a strong presence in "software," the craft of computer programming which determines whether and how the new technology works.

But ACARD also finds ample evidence of post-development gaps yawning wide in the 80s. It finds too many British companies competing in every promising sector; too many "sponsoring" ministries and departments, each with its own idiosyncratic requirements, each encouraging someone to tailor the innovation precisely to its want.

ACARD's urgent message is that if the Thatcher Government expects industry to win and hold a significant slice of the looming £10bn-a-year world market for information technology, a single department of government must orchestrate the national effort. This probably means that the BBC, police, armed forces, Post Office, hospitals, schools—even the taxmen—must all defer to the technological choices of the Department of Industry.

Actually £50bn was the figure quoted at the Paris conference.

The ACARD report does NOT say this — what it does say is that public purchasing should be used intelligently (a rather different point!)

N R D C

1. The latest annual report of the NRDC (attached) records the retirement of Mr W Makinson as Managing Director and the appointment of Dr J C Cain as his successor. A number of other changes are reported which are probably not unconnected with this change in management:

(a) a 40% rise in authorised new projects (from 113 in 1978/79 to 157 in 1979/80) and hence in expenditure

(b) the establishment of a new subsidiary (Finovia Limited) to provide finance for leasing activities

(c) the establishment of the Small Company Innovation Fund (SCIF) with £2 million capital to provide tailor made financial packages for small companies was foreshadowed in the report and announced on 23 September.

2. The report shows that the NRDC has responded to the criticisms of those, including the Advisory Council for Applied Research and Development (ACARD), who have been keen to see a more aggressive and entrepreneurial spirit.

3. The Financial Times leader on 25 September (copy attached) seems to me to be a fair comment and, interestingly, makes a point I made earlier about the need to provide the NRDC with competition in the form of increasing the "number of decision-making units withing the public sector".

# Financing new technology

F.T. 25.8.81

THERE is one category of public spending on industry which evokes a degree of sympathy, if not wholehearted approval, from Sir Keith Joseph, the Industry Secretary. The encouragement of research and development has emerged in discussions within the Government and at the National Economic Development Council as one of the few forms of Government industrial intervention which commands widespread support. Britain's main problem, however, seems not to be so much a lack of investment in research and development in relation to national income—R and D spending seems to be comparable to that in the U.S., Germany, France and Japan. Still less is Britain suffering from a shortage of scientific talent. The problem seems to be the inability of British companies and financial institutions to put finance, technology and production management together efficiently to generate marketable new products.

## *Joint ventures*

The National Research Development Corporation exists partly to help fill this gap in Britain's corporate and financial system, by investing public money in joint ventures on the "technological frontiers" where Britain's private sector financial institutions frequently fear to tread. The difficulties facing any Government initiative to stimulate technological achievement are illustrated in microcosm by the NRDC's annual report, published on Tuesday.

The NRDC's financial success, based mainly on licence income from a number of spectacularly successful projects, particularly in pharmaceuticals, has exposed it to a line of criticism unknown in other parts of the public sector. It is widely accused of spending too little money. In the past ten years it has appeared to many technologists to have adopted an unduly cautious stance and the management's chief embarrassment has been the corporation's inability to spend as much on new projects as it receives from its licence income. Its borrowing limit of £50m, set in 1967, has never been approached and in recent years it has repaid loans to the Department of Industry and ended up with a substantial cash surplus.

The Wilson Committee's criticism, that the NRDC does not do enough to support innovation among the smallest companies and entrepreneurs and that it should play a more active role in seeking out investment opportunities, is being partly answered this year by the establishment of a new fund to invest in small companies and start-ups. But this will make only a marginal contribution.

The general worry about the lack of suitable opportunities for a marriage between the NRDC's resources and the private sector's technological achievements remains.

The NRDC's experience suggests that too much cannot be expected from selective Government intervention in commercial research and development. If their activities are governed by the sort of reasonably stringent profitability criteria which the NRDC adopts, there is no reason to expect public servants to be any more enterprising and less risk-averse than private investors. The fact that the public sector treats its scientific employees just as meanly, in relation to other professionals, as the private sector, suggests that public bodies are unlikely to have any advantage in technological knowhow.

None of this means, however, that a Government concerned about the low productivity and technological backwardness of British industry is entirely helpless. The stark choice seems to be between pushing on a piece of string, by insisting that all assistance for R and D should be done on a strictly non-risk basis, or, on the other hand, signing blank cheques for highly risky and often unsuccessful ventures—a policy which, in effect, has been adopted in some of the Ministry of Defence's purchasing.

## *Incentives*

But between these extremes there are a number of more attractive possibilities. One which the Government is apparently considering is to provide more general assistance for research and development, perhaps in the form of fiscal incentives, while leaving the decisions on specific projects entirely to the private sector. Perhaps the most important general principle is to use a number of decision-making units within the public sector and not to concentrate too much energy and money on grandiose projects.

W 02097

MR RATTISON (dlr)
10 Downing Street

1. I do not expect that you often have the pleasure (?) of reading New Scientist and so I attach a couple of articles that you have probably missed. The first is an interesting example of the Social Science Research Council (SSRC) doing relevant research at last (!?); (the Centre for Socio-Legal Studies is one of the few "in-house" R & D units of the SSRC). The second seems to me much the more intellectually innovative and perhaps even more relevant - but I leave that to your more informed judgement!

PM has seen (and ignored!) MS 9/10

2. I believe the Prime Minister is having a meeting shortly with DoI ministers on the problems of venture capitalists, new companies, inventors and related topics. I thought it might be helpful, therefore, if I let you have a progress report on the follow-up work to my meeting with the Prime Minister on 11 September. I attach these as self-contained notes under the appropriate heading.

DR J M ASHWORTH

P.S. I'd like my marked copy of the NRDC report back sometime.

Cabinet Office

9 October 1980

*As the major party conferences get underway we ask:*

Photos from Keystone

# Why are politicians so charismatic . . .

The leader speaks, and the party members break into spontaneous applause. Or do they?

**Robert Eagle**
is a freelance writer

Now is the season of the party conference. The time of the year when politicians take over the winter-gardens stages, recently relinquished by comedians, jugglers and mimics, to rally their fans and top up their egos with applause and mutual congratulation. Applause at party conferences is just as important as policy-making: it boosts morale, promotes solidarity and invigorates the lads and lassies before they throw themselves into another year of the "Order, Order" ordeal. The most successful party conference will be the one where applause comes loudest, oftenest, and appears most spontaneous. And the stars will rise temporarily at least, of those politicians who manage to elicit the most vigorous ovations.

The applause accorded to politicians may not look like a very fruitful field for scientific investigation. Far too much opportunity for observer bias. But for the past year an Oxford sociologist, Max Atkinson, senior lecturer at the Centre for Socio-Legal Studies at Wolfson College, has been taping and transcribing from the hustings and party conferences sections of speeches which brought applause for the speaker. He concludes that applause for politicians is hardly ever spontaneous. It is deliberately elicited by rhetorical devices which tell the audience exactly when it is supposed to clap. An orator's success depends on his or her knack for timing these tricks so that the audience responds on cue.

So far Dr Atkinson has identified only a handful of these applause-generating ploys. "But they are remarkably widespread. I was astonished to find every speaker I studied using the same devices to fish for applause."

The device most frequently used at the end of a speech is the "repetition and sign off". The speaker signals his audience that he is coming to the end by declaiming a string of sentences which are stylistically very similar, and signs off with a rallying cry ending on a downward intonation. An example from David Steel during last year's election campaign:

*"The people of Liverpool Edge Hill showed it could be done.*
*The people of Leeds can show that it could be done on May 3rd.*
*And we're going to break through at this election and bring an end to 30 years of failure for Britain."*
(Applause)

And from James Callaghan:

*"As long as there's a family without a home,*
*as long as there is a patient waiting for a hospital bed,*
*as long as there's a man or woman without a job*
*or someone who suffers from discrimination because of their colour,*
*so long will our work as a Labour government not be done.*
*We go forward in that spirit and that resolve."*
(Applause)

"Used correctly the repetition can have the audience so primed up that it begins clapping before the sign off is complete," Atkinson reports. "If applause comes while the speaker is still speaking, it sounds much more spontaneous."

Even more desirable than applause at the end of a speech is applause in the middle. "If you get applause during your speech as well as at the end, you are much

more likely to draw the attention of press reporters and party managers," Atkinson comments. To achieve this, orators use the "contrast" technique. *Vide* James Callaghan again:

*"I can say to you, Mr Chairman, that in this election*
*I don't intend to* make *the most promises;*
*I intend to* keep *the most promises."* (Applause)

Another contrast from Edward Heath:

*"Neow, the Labour prime minister and his colleagues*
*are boasting in this election campaign*
*that they have brought inflation* deown
*from the disastrous level of 26 per cent.*
*But we are entitled to inquah:*
*Who put it up to 26 per cent?"* (Applause)

And a classic example from Ronald Reagan:

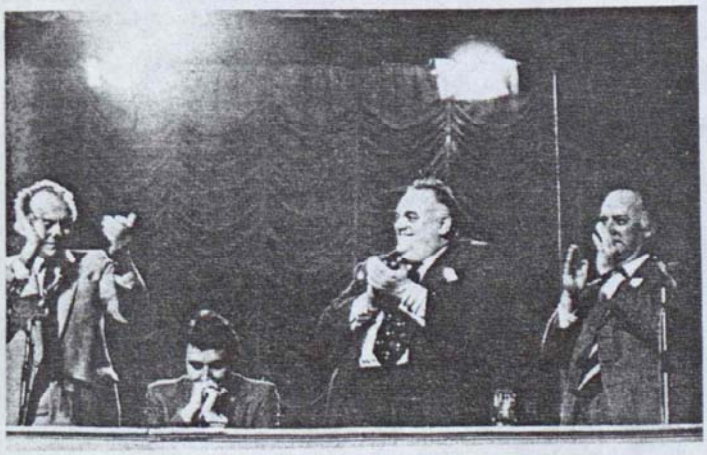
*"I don't want Jimmy Carter's job.....*
*That's not what I want.*
*I want to be President of the United States."*
(Uproarious applause)

Atkinson has found the contrast technique to be the commonest ploy for eliciting mid-speech applause. To achieve maximum effect the contrast should be crudely obvious. If it is not so obvious, the audience may take longer to catch on. It will still applaud, but less vigorously. If the audience does not seem to have recognised the contrast by applauding within half a second (after which the silence begins to become embarrassingly noticeable), an experienced speaker will follow through with a prompt such as:

*"That's the difference!"* (Callaghan)
or *"That is entirely unacceptable!"* (Heath)
which brings the audience back on cue.

Obviously speakers are likely to be cheered only by people who agree with their views, so at any meeting where various factions are present the ambitious politician should give his supporters as many opportunities as possible for applauding. Atkinson believes that Tony Benn's status in the Labour Party owes much to his skill at switching his faction on to applause more efficiently than other Labour orators. As an example he cites a passage from a speech Mr Benn delivered to the Labour Party special conference in May this year. In less than two minutes he elicited three ovations, and each ovation was cued in by a contrast:

*"We shall find two or three million demoralised long term unemployed*
*who have to be put back to work in factories*
*not that Hitler has* bombed
*but that Thatcher and Joseph have* closed." (Applause)
*"... I am waiting for us to say more often*
*that some things are right.....*
*and some things are* wrong." (Applause)
*"... that it is wrong to cut down on money for*
kidney machines



*and spend five billion on* a new Polaris submarine
(Applause)

Another technique favoured by Mr Benn, and occasionally by Mrs Thatcher, is to continue talking while the applause is going on. "You can say almost anything, repeat yourself or just waffle," Atkinson observes. "But if you keep talking you give the impression, *A:* that you were not really fishing for applause in the first place, and *B:* that you are so popular that you are being drowned by your audience's enthusiasm."

To support his case that applause, especially mid-speech applause, is a stylised ritual rather than spontaneous outburst, Atkinson points out that *it almost always lasts eight seconds,* give or take one second either way.

But it is a useful ritual, "If an audience is listening for cues to clap, it will also, presumably, be listening to the speaker's ideas."

Pauses are another way of keeping the audience hanging on your words. Even the most mellifluous speaker has to pause for breath now and then, but Atkinson finds that politicians tend to pause at the oddest places, in the middle of a phrase or train of thought. President Carter is particularly enamoured of the pause and uses it as often as possible:

*In recent years* (pause)
*expanding* (pause)
*Soviet power* (pause)
*has increasingly* (pause)
*penetrated* (pause)
*beyond* (pause)
*the North Atlantic area.*

"The pause increases anticipation and attentiveness. If you pause somewhere unusual, such as after an adjective or preposition, your audience will be intrigued to know what comes next," Atkinson suggests.

Although President Carter's style is perhaps not typical, the importance of the pause is recognised by professional speech writers. After giving a lecture recently in Boston, Atkinson was approached by a Democratic party speech writer who told him that it was their practice to write pauses into speakers' scripts. As a rule of thumb they allow bursts of no more than seven words before a pause. With an educated audience occasional bursts of up to nine words are permissible.

Atkinson's studies of political speechmaking have been made in his own time and are not part of an officially spon-

sored research project. He makes no claim to have laid bare all the secrets of oratorical success, and will be scrutinising the party conference speeches for other applause-eliciting devices and exceptions to the rule. "But this is the first time in a 15 year research career in sociology that I have come up with results which are so regular. And given the importance of public speaking in the making and breaking of political careers, I think these findings have more than academic interest."

His studies of applause have encouraged him to reflect on the negative aspects of that phenomenon, booing and jeering. He suggests that, paradoxically, boos and jeers may also serve the speaker's interests. And he disagrees with those who complain that the backchat and catcalls heard in the House of Commons reflect poorly on Britain's parliamentary system.

"In an assembly where only a few individuals get a chance to say their piece on any one day, jeering provides an escape for frustration. A convention which allows you to jeer also encourages you to follow the speaker till he gives you something to jeer at. From what I have seen in Europe and America it seems that quieter more polite assemblies are also more boring. Fewer people listen and more people sleep." □

# . . . but why can't they converse normally?

## If only they would learn the rules of conversation, they would be far more appealing

**Dr Geoffrey W. Beattie**
is lecturer in psychology at the University of Sheffield

Conversation involves difficult and subtle skills. We generally avoid interrupting the other speaker, and yet are able to respond efficiently and quickly when he or she stops: from records of different kinds of face-to-face conversation I found the average delay in responding was only 575 msec, and in more than one-third of all cases there was no delay at all. Clearly, this fluent yet unrehearsed dialogue depends upon subtle signals between the conversants. Inability to use these signals is characteristic of several kinds of mental disorder, including schizophrenia and neurosis. And I have found that politicians may also find them difficult.

Before the last general election I analysed how politicians behaved in television interviews: I was interested particularly in James Callaghan and Margaret Thatcher. Callaghan was generally seen as relaxed and affable, while Thatcher was generally viewed as condescending and domineering. Callaghan was seen as being the more effective interviewee.

Yet when I analysed video-recordings of Thatcher's interviews I found the general perception of her as dominant is something of an illusion. For example, in one *TV Eye* interview shown in April last year, James Callaghan interrupted his interviewer Llew Gardner more than Gardner interrupted him. This is in line with the general observation that dominant people interrupt more often than less dominant people. In the same week, Denis Tuohy interviewed Margaret Thatcher on the same programme—and he attempted to interrupt her much more often than she attempted to interrupt him. I have played a video-recording of the interruptions from this interview to various audiences and found a marked failure among viewers to identify accurately that it is Tuohy who does most of the interrupting.

One feature of Thatcher's interview style is that she tried to finish her point even when interrupted. She tenaciously clings on until the interrupter gives in.

In this example, from the *TV Eye* interview, the words in bold type were spoken simultaneously by Thatcher and Tuohy. Tuohy started speaking after the second "society":

M.T.: *. . . there are comparatively few people, they could be measured in thousands, who wish to destroy the kind of society which you and I value, destroy the free society.* **Please, please this is the most, please this is the most please this is** *the most important point you have raised, there are people in this country who are the great destroyers.*

D.T.: **You were talking about striking ambulance workers, you were talking about ancillary workers in hospitals.**

I have found from earlier studies that when two people did start to talk at the same time, one would typically give up within half a second; Thatcher and Tuohy persisted for as long as five seconds.

Margaret Thatcher often wins the battle for the floor when she is interrupted, and for this reason viewers see her as very domineering; they often fail to notice that it is not she, but her interviewer who interrupts in the first place. The reason interviewers interrupt her so often seems to be that she sends out ambiguous signals which interviewers misinterpret.

Over the past 15 years psychologists have investigated the signals that people use to indicate that they have finished speaking in conversation. In the mid-1960s Adam Kendon at the University of Oxford found that if the speaker looked at the listener when he stopped speaking, the listener was more likely to respond without any delay than if he did not. He suggested that this "work", was the crucial signal.

This research seems to have been based on the assumption that something analogous to traffic lights operates in conversation. When the lights turn green a driver should move off. Kendon suggested that when the speaker looks at the listener at certain points, the listener should then begin speaking. However, Kendon studied only one particular type of conversation, and subsequent research on other types showed that this nonverbal signal was not of central importance.

In the early 1970s, Starkey Duncan of the University of Chicago pioneered a different approach. He noted six

signals. Five of them are accompaniments of speech and are therefore carried in the auditory channel—things like drawl, intonation and so forth—and the sixth is the cessation of a hand gesture. Duncan argued that the more of these signals that were present at one time, the more likely the listener was to begin speaking without interruption. On the other hand, if the listener tried to speak when none of these signals was present, Duncan found that interruption was the inevitable result. In this framework, turn-taking seems to be viewed as analogous to a driver approaching an intersection where there are no traffic lights. He has to pay attention to a number of things—the speed of cars on the main road, their distance from his, their spacing, etc—and on the basis of all of these, he has to decide whether to move forward.

Duncan's research implies that conversation should not be much more difficult on the telephone than face-to-face; after all most of the signals, according to Duncan, are carried in the auditory channel. From the research of Adam Kendon we would make the opposite prediction. Recently Phil Barnard from the MRC Applied Psychology Unit in Cambridge and myself put this to the test; by studying real directory inquiry calls.

Directory inquiry calls may appear restricted but they are more interesting than one might imagine. For example, they need only 19 words to convey all the relevant information but we found some were as long as 492 words; and the average was 116. Some people seem to enjoy chatting to telephone operators. When we analysed the conversations we discovered that there were fewer interruptions on the telephone—in fact interruptions in face-to-face interaction are almost twice as frequent as on the telephone. We also found that listeners were just as quick at responding on the telephone when the speaker had finished. This research thus supports Duncan's conclusions that many signals involved in turn-taking must be carried in the auditory channel.

There are also signals in conversation to indicate that we have *not* finished speaking. Duncan had identified gesture as one such signal. Filled pauses—sounds like "ah", "er", "um"—seems to serve a similar purpose. They tell the listener that the speaker needs time to think in order to plan his speech. We discovered that filled pauses are used to compensate for lack of vision on the telephone—they are almost four times as frequent on the telephone as in face-to-face conversation, if one controls the number of periods of silence. Subscribers rely on them much more than do operators.

Psychologists have thus made some progress in identifying how speakers and listeners manage to take turns so efficiently in conversation. What then is Margaret Thatcher's problem? My research suggests that interviewers interrupt her in conversation because they misinterpret her nonverbal signals. Many of these interruptions occur at the ends of clauses in her speech in which there is drawl on the stressed syllable in the clause, and a falling intonation pattern on the clause. Duncan has identified all three of these as common signals that a speaker uses to signify that he has finished talking. When these three signals occur together in normal conversation, they often indicate that someone has finished, unless he uses other signals to indicate that he has not. Thatcher very rarely uses filled pauses which have such a function and which would be effective in this context; even the fluent Callaghan uses five times as many filled pauses as she does. Consider the following exchange between Margaret Thatcher and Denis Tuohy:

M.T.: *The police do a fantastic job*
D.T.: *Coming*
M.T.: *and we must support them in every way possible*
D.T.: *Coming towards the end of our time Mrs Thatcher.*

Tuohy starts to speak after Thatcher says "job", which seems appropriate because it is the end of a clause, there is downward intonation and there is drawl on the stressed middle syllable in "fantastic". Tuohy seems to think that Thatcher has finished and begins speaking, but she has not. A filled pause after "job" would probably have been effective in signalling that there was more speech to come.

This research has a number of practical applications. It is now widely believed that some types of mental illness are exacerbated by a lack of social competence, and the suggestion is that it may be possible to alleviate certain illnesses by a training in social skills. Turn-taking may be one skill in which it is necessary to provide instruction, and indeed Peter Trower, now at the Hollymoor Hospital in Birmingham, has been having some success at improving the social behaviour of patients, including certain aspects of turn-taking. In some ways the therapy could be improved because it is largely based on the earliest framework for investigating turn-taking. Patients are trained to display certain signals which indicate that they are ready to hand over the floor and there is heavy reliance on direction of looking as a crucial signal. Future training will have to pay more attention to the vocal aspects.

As for politicians, it is clearly important for them to become super-efficient at all the processes in conversation, especially as the televised interview has largely replaced the political address. Persuading these professional persuaders might be more difficult, however. □

EXISTING AVAILABILITY OF VENTURE CAPITAL

The investment climate for new small companies has changed quite markedly since I first started canvassing opinion on this topic in 1978 (in connection with the work published as the ACARD report on Industrial Innovation). In part this seems to have been due to the establishment of "small firms" or "new venture" divisions of banks (clearing as well as merchant) and no doubt in part also due to the tax changes announced in the last budget and the other initiatives taken by the Government. As an indication of this change Mr P Naylor of Job Creation Limited (itself an innovative new company) tells me that he has no trouble finding capital for his (often rather risky) projects in depressed areas and Mr L Cary of Venture Capital Reports Limited (another innovative new company) has been able to maintain a creditable 30% success rate in finding financial backing for entrepreneurs - and it seems likely that entrepreneurs only go to the likes of Venture Capital Reports Limited as a last resort!

2. However, although the investment climate might be changing it is still too early to tell whether actual performance, in terms of the successful establishment of sound businesses, has really changed. In the crucial area of new technology based firms (NTBFs), for example, it is too early to tell whether the new-found enterprise of the NRDC will be commercially profitable.

3. It seems, therefore, that the Prime Minister will be more likely to be able to point to some promising signs and hopeful beginnings in this area by February 1981 rather than solid achievements. It is likely that the Advisory Council for Applied Research and Development (ACARD) in its reply to the Prime Minister's request for advice on the problems of the private inventor will reiterate the opinion they expressed in their 1978 report on Industrial Innovation, viz that the most effective help that can be given would be to establish some form of loan guarantee scheme in conjunction with tax relief for equity investment in NTBFs by private individuals and modest alterations in the way losses can be written off for tax purposes.

4. There are signs, however, that real problems are developing at what is coming to be called the "post-development gap". This is a term for the shift in emphasis (managerial as well as financial) when an innovative product or process ceases to be an exciting piece of high-technology and becomes a mundane, but potentially very profitable, article of general commerce. The finance needed to bridge the "post-development gap" is often far greater than that needed to bridge the "pre-development gap" between research and development. It is usually far beyond the resources of the likes of the NRDC or small companies and, as the attached article from the Financial Times of 25 September points out, has presented UK companies with awkward problems in the past.

5. I hope that in briefing the Prime Minister the clear distinction is made between venture capital needed to start new firms, or new businesses within existing firms (the "pre-development gap") and that venture capital needed to maintain an adequate market share in a growing market which is consequently attracting foreign competition ("post-development gap").

F.T. 25/1/80



LOMBARD

# Exploiting our skills

BY DAVID FISHLOCK

EVERYONE knows that Britain once led the world in radio-astronomy because of its pioneering radio-telescope at Jodrell Bank. But that was back in the Fifties. Fewer know that as a direct result British industry led the world in the Sixties with its earth stations modelled on Jodrell Bank which picked up the whisperings of the first satellites.

Like so many other markets for novel products of high-technology the one for large earth stations has long been lost to the Americans and the Japanese. It wasn't a case of Britain failing to develop a scientific invention, but of Britain failing to mount a coherent industrial policy capable of sustaining from profits the unending input of cash and skills advanced technology demands.

## Indispensable

On a grander scale Rolls-Royce made precisely the same mistake in the Sixties. It gravely under-estimated the financial and other resources needed to translate a brilliant new three-shaft concept of aero-engine design into the RB-211. A decade later it can point to 700 engines in service—including some in the North Sea—and orders for another 500, with new developments in the pipeline which suggest a production of at least 250 RB-211 engines a year in the early 1980s. Top of its attractions for airlines, Rolls-Royce engineers say, is that they expect to maintain a 4.5 per cent advantage in fuel consumption over all rivals throughout the decade. This fuel economy is a direct result of harnessing high technology; of more advanced materials operated at higher temperatures.

But had Rolls-Royce been a more typical British industrial situation, it would have vanished in 1971. Only the fact that it was an indispensable source of engines for military aircraft, warships and submarines obliged the government to keep it alive as a state-owned organisation.

With publication today of the eighth report from ACARD, the Advisory Council for Applied Research and Development—the body which has replaced the office of the government's chief scientific adviser—it is becoming increasingly clear that the development gap from which Britain is so often said to be suffering is in a significantly different place from the one normally perceived.

The truly serious gap is not that due to the reluctance of British scientists, engineers, inventors to launch into manufacture with their ideas. The real gap is far more wasteful of resources. It is the hiatus left when companies launch themselves enthusiastically upon the neck of some new technology, only to come a cropper because they failed to realise how much it would cost. It is a post-development gap.

EMI is a classic example of a company which, armed not only with a brilliant invention but with an unusually realistic estimate of what it might cost to launch the new product, still under-estimated the eventual scale of effort required to compete with U.S. industry.

The latest ACARD study surveys "information technology," a vast tract of fast-advancing technology embracing telephones and telecommunications, video systems and word processors—and of course the ubiquitous computer which now lurks behind each one. It finds a marvellously innovative picture in Britain, with such projects as Prestel and System X, and a strong presence in "software," the craft of computer programming which determines whether and how the new technology works.

But ACARD also finds ample evidence of post-development gaps yawning wide in the 80s. It finds too many British companies competing in every promising sector; too many "sponsoring" ministries and departments, each with its own idiosyncratic requirements, each encouraging someone to tailor the innovation precisely to its want.

ACARD's urgent message is that if the Thatcher Government expects industry to win and hold a significant slice of the looming £100bn-a-year world market for information technology, a single department of government must orchestrate the national effort. This probably means that the BBC, police, armed forces, Post Office, hospitals, schools—even the taxmen—must all defer to the technological choices of the Department of Industry.

Actually £50bn was the figure quoted at the Rees conference.

The ACARD report does NOT say this — what it does say is that public purchasing should be used intelligently (a rather different point!)

Govt Machinery 4

You agreed that this should be published. PA now MS

See refs to France in eg pp 31-34

MS 15/8

ADVISORY COUNCIL FOR APPLIED RESEARCH AND DEVELOPMENT

# INFORMATION TECHNOLOGY

August 1980

ADVISORY COUNCIL FOR APPLIED RESEARCH AND DEVELOPMENT

INFORMATION TECHNOLOGY

Foreword

In its first report "The Applications of Semiconductor Technology", ACARD discussed some of the implications of the rapid developments taking place in micro-electronic technology and put forward proposals to stimulate the use of this technology in United Kingdom industry. Two subsequent reports[1] of the Council have examined specific fields of application. However, the report "Technological Change: Threats and Opportunities for the United Kingdom"[2] identified information technology as possibly the area of application with the greatest potential for creating employment and suggested that the United Kingdom had advantages - for example the international use of the English language - which should enable it to gain a significant share of the world market for information services and associated products.

In the knowledge that some of this country's major competitors had well developed plans for promoting information technology by concerted action from their governments and industrial interests, ACARD decided that a Working Group should examine the subject in order to identify the likely directions of development and the constraints to development and application in the United Kingdom.

The Working Group met six times between January and May 1980. Its terms of reference were -

"To consider whether the development and application of information technology in the United Kingdom should be stimulated;

To consider whether there are constraints to the development of the industries in the United Kingdom which supply and apply information technology equipment, software and systems, compared with our major competitors;

To make recommendations."

[1] Items 2 and 4 in the Bibliography (p 60)

[2] Item 3 in the Bibliography

The members of the Working Group were -

| | |
|---|---|
| *Sir Robert Clayton CBE F Eng (Chairman) | Technical Director, GEC Ltd |
| Mr C A P Foxell | Director of Purchasing, the Post Office |
| Mr D Leighton Davies | Deputy Managing Director, Racal Electronics Ltd |
| Mr C N Read | Director, Inter-Bank Research Organisation |
| Mrs V S Shirley OBE | Chairman, F International Ltd |
| Dr P E Trier CBE F Eng | Director, Philips Industries Ltd |
| *Mr G H Wright MBE | Regional Secretary for Wales, Transport and General Workers Union |

*ACARD member

The Working Group's report was endorsed by the Council at its meeting in June 1980. [It has been submitted to the Government and is now published in order to draw attention to the importance of this area of technology.] The report, like previous ACARD publications, is intended to provide a non-technical guide to the subject and the issues raised; it does not aim to be a comprehensive technical account of information technology.

The Council are grateful to the Working Group for their contribution to ACARD's work and wish to acknowledge also the support provided by the Computer Systems and Electronics Division of the Department of Industry, the Central Policy Review Staff and the ACARD Secretariat in the Cabinet Office.

CONTENTS

## SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

1. Information Technology - which combines the technologies of computing and telecommunications - will perhaps be the most important area of application of microelectronics. It will eventually affect virtually every household and occupation. It will change patterns of employment and, if the opportunities to supply new goods and services are taken, has the potential to create many jobs.

2. Information technology offers new ways of manipulating and presenting information which are used in, for example, electronic telephone exchanges (which can provide many new services), word processors, electronic mail and viewdata systems. This country's future trading performance will depend greatly on its ability to compete in world markets for products and services based on information technology and on the rapid and effective application of such products and services by industry and commerce generally.

3. Certain of our overseas competitors - notably France - have recognised the importance of this subject and have established national programmes to stimulate its development. Despite some notable achievements there is less awareness in the United Kingdom of its potential impact and we have fallen behind other countries in our appreciation and application of the new developments.

4. Responsibility for the various elements of official policy that bear upon information technology is at present split between a number of Government Departments, the Post Office and other public bodies. A single focus within Government is required in order to ensure that this subject is given adequate attention and that its development is not inhibited through conflicting policies. Such a focus would increase the efficiency of decision making and actions and would reduce the number of bodies with which private sector interests have to deal. Also required is an explicit and publicly stated recognition by Government of the importance of information technology and a programme to increase general awareness amongst both industry and the public. It is important that these measures be introduced rapidly; we will otherwise fall further behind in the development and application of this crucial technology.

5. Our principal recommendations (with relevant paragraph numbers in parentheses) are -

i. One Minister and Government Department should be responsible for co-ordination of government policies and actions on the promotion and development of information technology and its applications through awareness, education and training, sponsorship of industry, provision of risk capital, public purchasing, publicly funded R and D, national and international regulations and standards, legislation, communications and related programmes such as satellite technology. (9.5)

ii. Responsibility for regulation of communications and broadcasting should be exercised by a single Government Department (7.11)

iii. The Government should make it clear that effective exploitation of information technology is essential to the future industrial and commercial success of the United Kingdom. This commitment should be emphasised on all suitable occasions by Ministers and officials.

The Government should support its views with publicity for existing United Kingdom achievements in information technology and imaginative promotion of them.

Innovative applications of information technology by Government Departments, local authorities and public corporations should be encouraged and plans for them should be publicised. (5.9)

iv. The Post Office (or its successor for telecommunications) should have the mandate to provide a world-competitive United Kingdom communications network and should have sufficient finance for procurement and installation, whether from public or private sources. (7.5)

Other recommendations are -

v. Careers services at both school leaver and higher levels should review the guidance given to students about opportunities in information technology, in order to attract entrants from a wide range of disciplines. (6.5)

vi. The Government, its agencies concerned with training, and educational bodies at all levels, should examine the provision of education and training courses in subjects related to information technology and propose measures to stimulate an increase of training in firms. (6.5)

vii. The Government, through Trade Associations and the National Economic Development Council, should improve the links between supplier and user interests in information technology in order that United Kingdom firms may be better able to anticipate future requirements. (6.6)

viii. The Government should recognise the importance, to the information technology supply and application industries, of United Kingdom strength in international discussions on regulations and standards, and staff and financial support must be available for such activities to ensure that our delegations go to them well prepared technically, commercially and politically, and ready to argue strongly for our national interests. Trade Associations must similarly be prepared to play their part on behalf of their industries. (6.14)

ix. The Government should bring forward proposals for data protection legislation, taking into account the views of the Data Protection Committee, without delay. (6.18)

x. The Government should put in hand urgently a review of the legal reforms required to aid and expedite the use of information technology in the United Kingdom and should then legislate to bring about such reforms as fast as possible. (6.20)

xi. The Government should consider legislation to permit the creation of new organisational forms to aid joint information technology projects, taking into account precedents in France and Belgium. (6.23)

xii. The Post Office should be free to supply terminal equipment and information technology services for use with its network but should not have an exclusive right to do so. It should not be the approving authority for terminal equipment and services provided by others. (7.8)

xiii. The Government should employ public purchasing to pull through novel developments in information technology. (8.1)

xiv. The Government should consider the possible role of information technology in promoting national objectives, and give appropriate financial support to relevant projects. (8.2)

xv. The Science Research Council and the Department of Industry should keep their research priorities under review in the light of the needs of information technology. (8.7)

xvi. The Department of Industry, with the Ministry of Defence, the Science Research Council and the Post Office, should increase the present co-ordination of all publicly funded R and D applicable to information technology. It should also make greater effort to ensure both that research which it supports is likely to be applied and that transfer of results to industry takes place. (8.8)

1. INTRODUCTION

1.1 The application of microelectronics technology in the United Kingdom and elsewhere is taking place mainly in two major areas of industry. One is the general field of product manufacture - improving manufacturing processes and the resulting products through automation, instrumentation, control engineering and the replacement of electromechanical devices by electronics. The other area is becoming known as "information technology", which for brevity we shall usually refer to as IT. Information technology is already being applied in many fields of activity, as the following illustrations show.

1.2 Word processors. Reports such as this frequently go through many drafts before the final version is produced. Authors make manuscript amendments, re-write sections and re-order material. Typists then have to re-type either the whole or major parts of the text. This re-typing takes time and carries the risk that new errors will be produced. The use of text processing typewriters (commonly called "word processors"), with storage of text on disc or tape and with visual displays, can now reduce the routine work of both typists (since unaltered sections can be re-typed automatically) and authors (since less checking is required) and enables successive drafts to be produced more rapidly. Word processors offer similar advantages in the preparation of such documents as tenders, contracts, legal papers and specifications.

1.3 Telecommunications. Large organisations, particularly those operating internationally, now find that the most cost effective way of providing internal communications may be via the international telecommunications network, by providing visual display units (VDUs) with keyboards and printers throughout the organisation and computers for routing and storing messages, letters and data. Such systems speed communications and allow records of the

information transferred to be filed automatically for as long as necessary. Once installed for international links, the system may also provide the best way of communicating even within a single building. Where the communication links involve satellites and there is sufficient traffic, the organisation may install its own terminals for direct satellite communications.

1.4 Video discs. When replayed on suitable equipment (which will sell for about the price of a television set) these will provide about an hour's moving pictures and sound for entertainment and education. The discs are expected to sell for about twice the price of a present full-price long-playing gramophone record. The ability to seek and "freeze" an individual picture will extend the use of such discs for information retrieval and educational purposes.

1.5 Telephones. Information technology is also bringing many new services for telephone users with the possibility of, for example, a telephone number for a person rather than a particular instrument. More important than the individual new facilities will be the transformation of the telephone system into a more flexible, personally acceptable service. For example, the ability to"switch off" the telephone but subsequently to identify the originators of any calls received, which is already possible with modern switching systems, will mean that telephone calls need not intrude on other activities.

1.6 These are just a few examples from the increasing range of IT applications. Because of its breadth of application it is possible to define information technology either widely or narrowly. On the one hand, the term may be confined to the actual equipment used to collect, store, process, transmit and display information. On the other, it may encompass not only the equipment

(and the software that controls it) but its interactions with human activities and the management systems necessary if the capabilities of new developments are to be fully exploited. We follow the latter approach in this report, in line with the UNESCO definition of information technology as:

> "The scientific, technological and engineering disciplines and the management techniques used in information handling and processing; their applications; computers and their interaction with men and machines; and associated social, economic and cultural matters."

1.7 We therefore include in information technology important sectors of the electronic components industry (with an emphasis on microelectronics), much electronic equipment (notably computers and their associated terminals, displays, etc) and the whole communications industry, including the broadcasting authorities and the Post Office. We further include the users and suppliers of information - industrial, financial, commercial, administrative, professional and individual - because their activities will be affected by new forms of information handling.

1.8 Governments in a number of countries, including the United States, France and Japan, have identified information technology as possibly their most important industrial growth area. The same view has been expressed in the United Kingdom, for example in several Conservative Party publications and in the ACARD report "Technological Change: Threats and Opportunities for the United Kingdom", while British electronics firms and the Post Office also demonstrate an awareness of the future importance of IT.

1.9 Two principal factors underlie current interest in IT. The first is that accurate and adequate information is a major component of industrial and commercial operations and an increasing proportion of the labour force in any

industrialised country is employed in information handling. The world market for IT products - in banks, shops, business houses, factories, government offices and the home - is vast (approximately £50 billion annual sales) and expanding rapidly (10% per annum in real terms). The second factor is technical - both computing and telecommunications now use microelectronic devices which offer fast data-handling capability at modest cost. This convergence of computing and communications (called 'compunication' in the USA and 'telematique' in France) creates radically new opportunities for data handling and the provision of information.

1.10 As some developing countries have created highly competitive manufacturing capabilities in traditional sectors of industry (steel making, shipbuilding, etc), so industrial nations have seen that future export opportunities will lie in advanced technology. Skills and expertise in IT, based on the design and manufacture of silicon integrated circuits and the writing of computer software, will form the basis for a substantial proportion of such exports. The value of these skills is enhanced considerably, with corresponding gains in employment if they can be incorporated in equipment sold to final consumers. (As an example, British technology lies behind the displays used in many pocket calculators and digital watches. It would have been much better if the United Kingdom had gained the Japanese market position in calculators and watches, rather than in displays alone.) A competitive United Kingdom share in the world IT market could thus be a major factor in our future industrial success; but equally important is an adequate use of IT in this country to improve the efficiency of industry, commerce and public services.

1.11 Information technology is of more than economic and industrial significance; it also has social and political implications. New forms of communication, and easier access to information, raise questions about the relationship of government to the governed, the responsibilities of professions to their clients, and the

privacy of personal data.[1] IT also offers advanced industrial countries a further way in which to promote cultural exchange and to open up new markets in developing countries, many of whom, advised by international bodies such as UNESCO, have identified IT as essential to their economic and social advance and are seeking advice and equipment. Control of information has always been a key factor in the organisation of power structures; new technologies, however, raise old questions in a more acute form. The social and political implications of IT cannot therefore be ignored.

1.12. In the light of the potential for IT outlined above, it is clear that the speedy and effective development and application of IT is of great importance to the future of the United Kingdom. We therefore aim in succeeding chapters -

i. to survey briefly the present position, likely technical developments and potential applications in the next 10 years;

ii. to review activity in other countries;

iii. to consider the degree of awareness of IT in this country and attitudes to its application;

iv. to identify constraints to the rapid and successful application of IT in the United Kingdom;

v. to consider the importance of communications to IT;

vi.. to assess the role of government in the development and application of IT in this country.

[1] These issues are studied in detail in the 'Nora' report (item 6 in the Bibliography)

1.13. Throughout the report, we make recommendations for changes which we believe will help the deployment of IT in the national interest and the creation of a strong United Kingdom presence in world markets. Further technical information, and more detailed discussion of some of the issues raised by IT, may be found in the books and articles listed in the Bibliography.

1.14. We have concentrated on the importance of IT in industry, commerce and government, and on the impact of IT systems on individuals. The basic technologies used in IT will also have wide applications in the domestic consumer and entertainment sectors. Examples are video tape cassette recorders, video discs, audio discs using opto-electronics (which can be smaller and less liable to damage), satellite broadcasting, traffic and route information in cars, and local and remote electronic control of the domestic environment and appliances. These and many other applications of the same technologies that are used in IT will create consumer demands at home and opportunities overseas.

## 2. TECHNOLOGICAL DEVELOPMENTS

2.1 The principal technological foundation for modern information technology has been the development of microelectronics, which makes possible small, low cost, reliable equipment which can perform complex operations on digitally encoded data. Increasingly, all types of information are being converted to digital form because of the ease with which such data can be handled and transmitted.

2.2 Information handling comprises five stages: input, processing, storage, transmission and output. Some or all of these five stages are built into various systems, which are made up of equipment ("hardware") and, most importantly, logical programs ("software") which control the operation of both individual pieces of equipment and of the system as a whole. Developments in each of these areas are reviewed in the following sections.

### Input

2.3 Established input devices for information systems are the telephone microphone and the typewriter and calculator keyboards. Most information is now fed into computers through keyboards but automatic data input, for example by scanning magnetically encoded cards such as cash dispenser cards, is increasing. The telephone dial and keypad can also be used as input devices to an IT system. Microelectronics is making possible "intelligent" input devices, some of which will themselves incorporate information processing and storage. Numbers on cheques are already read automatically but use a special type font. Systems are under development which will enable normal typefaces to be read automatically. Special writing pads are already available which can translate letters and figures in a particular individual's handprinting automatically

into a computer input. The recognition of handwriting is a longer term problem. Voice recognition systems can already respond to a limited vocabulary from a wide range of speakers or a wider vocabulary from a limited number of speakers. Systems which will recognise a wide vocabulary from many speakers will eventually be developed. Systems are also being developed which will extract features from visual images such as photographs and television pictures, e.g. for control of robots, scientific investigations and medical diagnosis.

Processing

2.4 As integrated circuit technology advances, microelectronic devices used for information processing will in coming years have even more transistors per chip, and the cost per function will continue to fall. Annual world production of microcircuits in 1985 has been forecast to be up to the equivalent of 250,000 transistors for every person on earth. This is the equivalent of a present day minicomputer for everyone every year.

2.5 Local processing by a small computer or 'distributed' processing through a network of small computers is possible, and complex operations can be performed by terminals which previously merely acted as input or output devices. Large computers will still have a significant role, for maintaining and manipulating large banks of data (bank accounts, insurance policies, public administration records, scientific measurements, etc.) but will not be the fastest-growing sector of the computer market as they have been in the past. The greater power of small computers will enable text processing to be more readily available. Most information is

presented in the form of words; devices to allow easy manipulation of text (such as word processors) are now available. Their development may well be the most significant aspect of IT. Conversely, as electronic transmission filing and editing all become more widespread, the need for photocopying will decrease.

Storage

2.6 Information in the past has been stored in different forms; eg words, figures, graphs, charts, pictures. All such information can be translated into sequences of binary digits (bits) ie ones and zeros. There are now many ways of storing such digital data, each of which offers a particular combination of capacity, access speed and cost. Developments in electronic memories in the last decade have been particularly important since they have made the microcomputer feasible. The low cost and great data storage facilities of modern devices mean that it is economical to use more complex software than before. This allows the use of a "high level" programming language much more like ordinary English. Memories have grown in capacity and fallen in real cost by about 25 per cent per annum. A continuation of these trends is expected, with a single chip holding a million bits in a few years' time.

2.7 Other storage techniques have similar potential. Magnetic 'bubble' memories, in which tiny portions of material are magnetically polarised in different directions, to represent a one or a zero, allow even greater storage capacity in a small volume. Optical storage techniques are also developing rapidly. The first to be produced on a large scale will be the video disc (which can be read or played many times but, as yet, cannot be re-used to record other material).

Further developments are likely to lead to optical stores in which users can insert ('write') information; such stores will ultimately have erase and 're-write' facilities.

Transmission

2.8 Transmission over optical fibres (tiny flexible glass rods) is opening up the possibility of carrying very large quantities of information for a variety of uses. This technology can not only be used to relieve existing congested cross-city cable routes, it can also provide low cost trunk and local distribution networks for telephony, data transmission, and where required "wide band" services such as television and videophones.

2.9 The continuing reduction in the cost of small ground terminals for receiving signals from satellites has made direct communication between two points via a satellite economical, thus reducing dependence on cable and terrestrial radio systems. For example, a system is being installed for one of the largest American hotel chains, with a receiving aerial about a metre in diameter on each hotel roof, which will make its communications system independent of public communication facilities. The system will offer instant accessibility and is claimed to be cheaper than the use of public links.

2.10 The radio frequency spectrum available for broadcasting, communication, navigation, and other purposes is a limited resource. Digitised speech or video signals are very suitable for processing by microcircuits but by comparison with analogue signals, require a wider band of frequencies. However, micro

electronics technology also makes it possible to reduce the amount of information transmitted to reproduce a voice or picture. These techniques reduce demands on the frequency spectrum; this is important both for the introduction of digital radio transmission and for releasing radio frequencies for new services.

2.11 Microelectronics is making possible faster, smaller, more reliable, more versatile switching of transmission channels and is opening up many new services for users. In voice systems, the user can have many new facilities, for example to receive his calls on any telephone, to call often-used numbers without having to dial the complete number, and to obtain an engaged number as soon as it is free. Similarly, electronic switching will allow enhanced and new data services.

Outputs

2.12 Visual display of information using a cathode ray tube, as in a television set, is fast and versatile; it can use colour and show both text and graphical information. The real cost of such display units is falling. Further improvements in definition and reductions in power consumption may be expected. The major likely development is a flat screen display, based not on a cathode ray tube but on a thin sheet of light emitting material or a fine grid of light emitting devices. Another important output device is the printer; current technical advances offer the prospect of printers that are both faster and quieter. New output devices include voice synthesisers, which are already in evidence. They are likely to be important in personal voice communication systems, including the instruction of users in the use of new facilities.

Combinations of new developments

2.13 The following are examples of developments involving a combination of some of the advances reviewed in the previous sections -

a. telex to desks of individual users

b. cheaper, higher speed facsimile

c portable data terminals

d. communication without use of wire in offices, stores and factories, eg by infra-red radiation

e. 'information mains' analogous to electricity supply mains in offices and factories.

Software

2.14 The component parts of an IT system have to be brought together by systems engineering, and programs have to be developed to enable the parts to work, both individually and together, and the whole system to be operated. Systems engineering and program development can take considerable time and at present are labour intensive.

2.15 The output of systems engineering and programming is generally called 'software' and is essential for most systems and many subsystems. Software developments are making it increasingly possible for people unskilled in data processing to use and interact with systems. Future design and use may be envisaged as three concentric circles -

i. the innermost circle will be those specialists who devise software to program subsystems, for example microprocessors, so that these subsystems can be put together by others to produce information systems;

ii. the middle ring will be the engineers and others who take the subsystems with their programs (without being specialists in their development) and design systems which can be used by unskilled people;

iii. the outer ring will be the final users (with no knowledge of the skills required in the two inner areas) who will be able to use these systems to transmit, process, store or retrieve information.

## 3. APPLICATIONS

3.1 As a result of developments in information technology, there will be a marked increase in the quantity of rapidly accessible information and in the ability to manipulate it. Access to constantly updated information is already available in offices and homes through teletext and through Prestel and similar viewdata systems. As printing and distribution costs rise and communications and computing costs fall, such systems may come to replace some paper publications. Business viewdata systems, now starting to be installed, will enable information to be disseminated rapidly within a company. Further developments will provide individual users with the ability to interact with the systems for financial, shopping and other purposes. Immediate opinion gathering will be possible and could have major effects on the relations of the individual with commercial, financial and government institutions.

3.2 Financial services may be considerably affected by IT. The time taken for information transmission, at present accepted and sometimes used to advantage in some business operations, can be effectively eliminated. In particular, it will be possible to arrange instantaneous transfer of funds. This will have implications for credit services that depend on payments taking time to be completed. Stock and commodity markets will also find their activities assisted and changed by IT.

3.3 Most office work is directly concerned with information and is susceptible to change because of IT. Within the next ten years, it may be cheaper to capture information and to file, copy and transmit it electronically, than to perform the same functions on paper. Electronic equipment and systems are likely to be introduced because they will be competitive in costs with paper systems, as well as offering enhanced facilities. Electronic mail has already been initiated in West Germany. Office premises and factories may be constructed with information mains, just as they now have telephone lines, so that digital information may be transmitted freely. As with electric mains, a variety of devices could be connected.

3.4 Word processors are already available; intelligent copiers able to reproduce documents from digital signals will be available shortly. The ultimate development of an electronic 'work station', with the desktop including a large flat screen on which images may be viewed, moved and edited, can be foreseen, although development may take some years. However, sufficient new equipment will be introduced to bring about profound changes in office activities, with demands for some skills, eg copy typing and filing, reducing significantly while others, related to the new developments, will be in greater demand.

3.5 IT will affect organisational structures, since the ease with which information can be made available permits either centralisation or decentralisation of control, providing managements with extensive choices for developing the effectiveness of their organisations.

Suitably introduced, IT could also improve work relationships within a firm by enabling everyone to be informed of matters which affect them.

The rest of this chapter deals in more detail with applications in various sections of the economy.

Public Administration

3.6 Central government, through its computer operations, is one of the largest users of information technology in the country, many of its computer systems (eg that for social security records) being very large. Tasks such as payroll calculations, revenue collection, accounting and the planning of major activities (eg defence logistics or motorway maintenance) are already performed with computers. Some tasks would be impossible in their current form without computers; others, because of their size and relatively recent introduction (eg VAT transactions), have been planned with them in mind from the start. Computers have been of significant benefit to government administration. Some applications have resulted in useful staff savings - at least partly taken up by the provision of new or enhanced services - and efficiency has been improved. However, the dependence of administration upon computers can increase its vulnerability to disruption.

3.7 Local government also uses computers extensively. In addition to educational applications, and the technical calculations of architects, engineers and planners which count for a large proportion of local authority work, IT will find application in housing allocation (possibly in the future inter-authority and linked with employment information), housing maintenance, police work and fire services, environmental health and trading standards, as well as in improved management information systems and some strategic studies. Local authorities have in many instances to match people's needs with the services available. IT can assist this greatly. Rapid provision

of housing advice will be possible through the introduction of computerised record systems and the installation of terminals in, for example, public libraries. Social work will also be assisted; many people feel more at ease answering questions posed by a computer than by a professional worker (this is relevant to medical and legal services also).

3.8 There are potentially large applications of IT in the automated transfer of routine information between government offices, between central government and local authorities, and between different parts of national corporations such as the Post Office. This calls for compatibility between systems, and opens up many opportunities for joint working.

3.9 The administrative systems outlined above, and the basic operations of the office discussed earlier in this chapter, will provide the main areas for exploitation of IT. The result should be a more efficient administration, which should be able to manage its major operations more effectively and provide speedier responses to individuals' requests.

Defence

3.10 The armed forces are major users of IT, for communication, command and control and for administration. Naturally, many applications are classified but the potential commercial benefits of techniques, software, devices and equipment developed for defence are likely to be considerable. The pace of advance is such that developments should often be quickly declassified and spin-off from the defence sector would be improved by systematic examination of classifications in the light of advances in technology.

Manufacturing Industry

3.11 The ACARD report "Computer Aided Design and Manufacture" discussed the potential impact of a branch of IT on manufacturing industry and gave examples to illustrate the increases in productivity, the cost reductions, and the quality improvements that could come from the installation of CAD and CAM systems. As equipment costs fall, such systems will become economic for progressively smaller firms.

3.12 There is increasing use of data collection and display devices on the shop floor; these range from simple keypads to visual displays with associated input, processing, and storage capabilities. They assist in inventory control, monitoring the availability of components, scheduling of staff time etc. Systems using intelligent terminals linked to small computers and sometimes to larger machines are becoming widespread in manufacturing industry. The prospect is that such systems will eventually be linked with CAD and CAM systems, providing greater integration of different manufacturing activities.

3.13 Information technology will have an impact on research and development in industry. Experimental work and testing will be helped by automation and data processing; computer simulations may assist or replace experimental investigations; and competitiveness will be increased by the use of IT to transfer information within the organisation and to increase awareness of developments elsewhere through scanning the world's scientific and technical literature.

3.14 Great improvements in productivity have already been achieved in some manufacturing companies through the use of automated production methods and there is currently considerable interest in the wider application of such methods, in particular through the use of robotics. But many firms employ more staff in offices on administrative and sales tasks than on the shop floor. Equal attention will need to be paid to improving productivity in these areas through the use of IT if administration costs are not to dominate total production costs.

Service Industries

3.15 Service industries are an expanding part of the nation's economic activity and provide (in public and private sectors combined) some two-thirds of the employment in the United Kingdom. The service industries can be affected by information technology in two ways. On one hand, the adoption of new technology can reduce the number of people required, but on the other, as pointed out previously by ACARD, the adoption of new technology can lead to expansion both by natural growth and by the creation of new services (see Bibliography, item 3). The extent and skill with which IT is applied will play a major part in this balance.

The following sections consider different sectors of the service industries

3.16 Retailing

Retail stores are already users of "point of sale" equipment (generally electronic cash registers which can transmit sales information to stock control computers), automatic warehousing and conventional computers for management purposes. Bar codes which identify products have been developed and standardised internationally. These codes may be 'read' by low power lasers or magnetic detectors and the information automatically compared with price information held in the terminal's memory or transmitted from the store's central computer. The benefits of bar codes include faster check-out operation, improvement in stock control and more detailed bills for the customer. Retailing will be affected by new plastic card based payment methods now being studied by the banks and credit card companies, whilst "remote shopping" via home terminals is a future possibility. The provision of more complex terminals and systems in retail stores will be a large growth area for the supplying industry.

3.17 Insurance, banking and finance. Rapid communications and computers have already markedly influenced financial transactions. Terminals in branches are already linked with central computers; these terminals will have steadily more powerful data handling capabilities. More services, including self service, will be accessible through plastic cards with magnetic or microprocessor memories or through closer integration of the IT systems

of the financial institutions with those of corporate and private customers. International data links already provide financial and commercial information around the world. Further developments in rapid international data communications will have important implications for London and the world's other major financial centres.

3.18 Transport and communications Computers are already used extensively to schedule and monitor transport services and to maintain seat booking systems. The links between seat reservation systems and hotel and banking systems may be expected to grow. Better systems for traffic management can be foreseen, with more extensive linking of traffic controls. The extent to which improved telecommunication facilities (such as video-phones and conference systems) will reduce the demand for physical travel is unknown. As energy costs rise, a shift to the use of such services will take place, but psychological factors enter and some commentators have probably overstressed the extent to which meetings will be replaced by remote links.

3.19 Printing and publishing. Recent disputes in the newspaper industry have drawn attention to the changes that IT can bring to traditional printing activities. The editing and composing of a newspaper may now be done wholly electronically. In a related field, direct recording of news events on video tape, obviating the need for film, is widely used in many countries although not yet generally employed in the United Kingdom.

Printing and publishing companies will not in future be using IT only in their traditional activities, but will move into the new fields of electronic printing and publishing, becoming providers of information for Prestel and other viewdata services. The market for some publications, particularly reference books with short-lived information (eg stock market information, holiday booking guides, telephone directories, railway timetables) will be most affected by IT, while books and publications of a more permanent character will be less affected. We do not accept a forecast of the disappearance of the printed book by the end of the century.

3.20 Health services Administrative computers are already extensively used in the National Health Service. Small systems for keeping records in doctors' and dentists' practices are already in use and will become widespread. Systems providing improved monitoring in intensive care units are on the way. The wider accessibility of data banks will aid medical diagnosis and epidemiolocical investigations. Interactive terminals in surgeries will enable patients to prepare basic information for the doctor before an appointment. The consequential freeing of professional staff for more direct contact with patients will be a benefit of IT.

3.21 Legal Services The foundation of case law is precedent, and computerised data banks allowing rapid search for relevant cases will become part of the operation of the legal system. Several such systems have been launched but currently run at high cost. Such legal services share the problem common to many data banks that if charges attempt to cover the heavy initial

costs, there will be little demand for the service. A feasibility study of an economical system for solicitors' offices, where the terminal will also offer other office automation facilities (word processing etc), is in progress. This could also have significance for small professional practices outside the legal field. As we have previously noted, word processors offer a further advantage especially useful in legal work since a document, once typed correctly, can be amended without fear of introducing errors in the unaltered sections.

3.22 Education The introduction of teaching aids using IT is foreseeable. Some schools already have small computers for teaching purposes. These systems familiarise pupils with the concepts of computing. A recent Government programme will provide £9 million mainly for curriculum development and teacher training. But this programme will not provide funds for buying micro-computers. Instruction in many subjects could be provided with interactive learning systems, some of which already exist. The declining cost of IT equipment could lead to a wider equivalent of the language laboratory that is used in many schools and colleges and would enable teaching resources to be better used.

3.23 Throughout the service sector, there will be expanding opportunities, change in institutions and habits, and improved services to the consumer, provided that the new technology is fully exploited.

Personal

3.24 Information technology will give the individual at home a better, wider range of communications and immediate access to a far greater range of information. With developments in Prestel, it will be possible to store and use personal information. Electronic mail may replace some correspondence and telephoning, and electronic means may be used for the payment of bills if ways can be found for establishing personal identity and authority, to eliminate the possibility of fraud. IT will enable more people to work at home, with particular benefit for those who could not otherwise find employment.

3.25 The selection of houses, cars, holidays and even jobs will be assisted by IT. The computer's ability to classify and categorise information and to retrieve it through searching for particular categories means that closer matching of offers and needs can be achieved. Much work will go into the development of software that guides and prompts non-technical users through the system (as, for example, System X will do).

## 4. OVERSEAS ACTIVITIES

4.1 The governments of France, West Germany and Japan are providing considerable direct financial support for IT developments by assisting R and D, or financing large-scale demonstration projects. They justify this on the following grounds -

a. Economic: if their indigenous firms are competitive in a growing world market for IT products, there are national benefits from enhanced employment and incomes.

b. Technological: IT-related firms are important generators of technology which can be transfered to other industries.

c. Strategic: the growing dependence of national life on computers argues for each country having its own computer industry.

By contrast, Government support in the USA comes mainly from Federal contracts for defence and space programmes. A summary of the main features of official policy in the United Kingdom's principal competitors is below.

### France

4.2 The French government have given IT a very high position in national priorities. Public awareness of the importance of "telematique", the new word coined to describe IT, was stimulated by the publication in 1978 of a report (item 6 in the Bibliography) of a Presidential Commission established to study the impact of IT on French society. The report (usually termed the 'Nora' report after one of its authors) discussed the decentralising influence that IT could have on a centralised society and the government organisation required to co-ordinate the use of computers in government and the promotion of industrial IT activities. It stressed the need for France to maintain indigenous computer and telecommunications industries to avoid dominance by American interests. This reflects French concern at the power of IBM. The report also emphasised the importance of software and the key position of data banks

in future industrialised society, again recommending that France had to establish appropriate data banks to avoid dominance from abroad. The consequences of IT for employment and the future importance of service industries were also discussed.

4.3 Since the 1960s, successive French governments have involved themselves closely in industry with the aim of transforming France from an agricultural economy to one based on advanced technology. IT is seen as central to this aim and expenditure on its promotion is currently £270 million annually. This is in addition to the support given to the major French computer manufacturer (£141 million), the development of computer peripherals (£94 million) and the components industry (£70 million).

4.4 Several highly publicised projects have been initiated to stimulate awareness of IT, to provide the incentive (and the funds) for industrial developments and to create the image overseas of French forward-thinking and competence in telecommunications and computing. One project, beginning in 1981, will provide cheap video-terminals in place of telephone directories to 250,000 households in a region, with the eventual intention of eliminating telephone directories throughout France. It is argued that the computer system will be cheaper and that it will have other applications. A second project will link telephone subscribers in Biarritz by optical fibres, enabling video telephones and private TV services to be distributed. Further projects include the French equivalent of Prestel, due to be launched experimentally late this year; a nationwide data network; a telephone handset incorporating a microprocessor; a push-button alarm for the elderly and infirm that automatically sends a distress message via the telephone; a national telecommunications satellite; and an extensive programme of introducing micro-computers into schools in order to teach pupils skills essential for their future work.

West Germany

4.5 West Germany is the largest European market for IT products and services. It has more than twice as many computers as the United Kingdom with a population only 10 per cent greater. Domestic manufacturers have been assisted by successive

government programmes, the last providing about £400 million over four years, one-third of which was for industrial R and D, one-third for the development costs of approved software projects, and the remainder for computer education and for research by the West German equivalent of the National Computing Centre. An information technology programme is awaiting approval. This will concentrate on the links between information technology and society and the impact of IT on individuals.

Japan

4.6 The Japanese government is closely involved with industry in the development of IT, as it is in many other industrial sectors. This involvement stems from a deliberate decision taken some 20 years ago to move Japan away from the more traditional labour-intensive heavy industries into high technology. The government provides financial support for R and D, co-ordinates industrial development and exports, and operates a preferential policy for public procurement. The main government agency involved (apart from the Ministry of Trade and Industry) is the Nippon Telegraph and Telephone Corporation (NTT) which operates Japan's public telecommunications system. However, the government also encourages competition among the major Japanese electronic firms and this provides a major spur to new developments (and to high R and D expenditure by firms). Particular projects under way include the development of a pattern recognition and processing system for coping with Japanese script, a comprehensive medical information system, a viewdata system ("Captain"), and the linking of a community with optical fibres and special terminals.

USA

4.7 In the USA, government involvement in industrial development and the promotion of advanced technology is primarily accomplished through the massive development and purchasing programmes of Federal agencies, notably in connection with defence and the space programme. Expenditure on computers in 1975 for these two purposes alone was thirty times that of the United Kingdom government. Current American dominance of much of microelectronics technology is largely the result of past defence funding for R and D and demonstration projects. There is no explicit government policy for the development of IT but increasing awareness that the very large development costs of advanced data transmission

and processing systems are likely to be beyond the resources of most private enterprises. The American position in IT is one of dominance; the USA accounts for half the world markets for computers, their associated equipment and satellite communications.

4.8 In contrast to most countries, the public telecommunications system in the USA is privately owned, with the Bell system serving 82 per cent of subscribers. Inter-state telecommunication is, however, regulated by the Federal Communications Commission (FCC). In a significant change of policy, the FCC decided early in 1980 that with many new types of electronic equipment being connected to the telephone system, and the increasing use of digital signals for speech transmission, they could no longer reasonably distinguish between data transmission and speech communication. They therefore decided to cease regulating the processing of data by telecommunications companies, and its transmission by data processing companies, thus opening up new markets for both interests.

Others

4.9 Many countries provide government support for advanced technology, particularly through development contracts and subsidies for R and D. Features of IT in other countries include the Canadian equivalent of Prestel ('Telidon'), where the graphics system is capable of much finer detail although needing greater transmission capacity and memory in the terminal, and the Swedish concern for the social implications of IT, in particular in personal privacy and the dependence of society on computers.

4.10 Discussions of an EEC initiative on information technology, aimed at establishing a stronger European share in world markets, have taken place in recent months.[1] Our view, based on previous initiatives, is that such discussions are unlikely to produce significant results in the foreseeable future. We should be concerned if United Kingdom action were to be delayed in the expectation that our competitiveness in world markets might be improved quickly by an EEC plan.

1. See Bibliography, item 13

## 5. AWARENESS AND ATTITUDES IN THE UNITED KINGDOM

5.1 The concepts of information technology are not radically new; they have been known and used for at least the last fifteen years. We are in an era of evolution rather than revolution; we shall in the future be doing many of the same things (editing texts, preparing reports, seeking access to files etc) more expeditiously or in new ways and doing some new things (rapid preparation of graphs and charts, for example). But the scale and pace of this evolution is unprecedented and we cannot be complacent. If the United Kingdom is to be effective in this field, we shall need the right decisions by industry, regulatory agencies and major purchasers, and acceptance of changes in working practices.

5.2 The current rapid advances in information handling are made possible by developments in electronics, particularly microelectronics, but it is the effects of these developments on individuals and organisations that are particularly arousing the present interest in IT. IT will notably affect methods of operation in offices, libraries and other organisations which primarily handle information. The great potential opportunities for this country in the supply of IT equipment and systems must not be neglected, but the impact of the application of IT on our society and economy is probably more important.

5.3 The techniques that can bring about these changes are already known. Although the time lag between invention and commercial application is decreasing, innovations which will have large scale impact during the next ten years will almost all be based on existing knowledge. The hardware required for most IT requirements is either already available or could be designed with present technology. Less certain is the ability to write the software necessary to use that hardware fully, and to apply the systems to specific industrial, commercial and administrative uses. The benefit that the United Kingdom derives from IT in the coming decade will depend more on education, training, work attitudes, the investment climate and regulatory systems (ie our ability to make successful use of IT) than on advances in technical knowledge. For this reason, many of our conclusions relate to these factors rather than the development of technology.

5.4 Previous ACARD reports have drawn attention to lack of public awareness of the potential of new technologies and the slowness of the United Kingdom in adopting them. The same failings may be discerned with IT. The present attitude in the United Kingdom is not as good as that in France, for example, where the government have publicly supported IT and have publicised the developments, the possibilities, the advantages and the problems to the point where there is public awareness of IT and attitudes have been influenced. Corresponding attitudes in this country are less favourable and include some resistance to change at all levels. We do not believe that there should be anxiety over the intelligent extension of the use of IT, but a sustained campaign to get this over to the public is necessary, since the pace of application of IT will hinge upon willingness everywhere to face the challenges posed by new developments. Firms overseas will be adopting the new developments in IT in order to gain competitive advantage; the United Kingdom must not be behind.

5.5 It is understandable that there is concern on the part of organised labour about the possible threat of IT to employment at a time when alternative employment opportunities do not appear plentiful. However, ACARD has commented before that failure to remain competitive in world markets through the use of new technology is the greatest threat to employment in this country. We hold the view that failure to use IT is a greater threat to employment overall than its adoption; the new services that will be generated will themselves be labour-intensive. They - and present communication services - will require more people to install them; there will be more maintenance to do (even taking into account the enhanced reliability of semiconductor devices) and more staff will be needed to educate and train the whole range of makers, installers and users.

5.6 There will be changes in the requirements for different skills. The demand for jobs which are 'skilled but routine', whether typing or turning out repetitive parts on a lathe, will be most affected by IT. The more basic manual tasks will be little affected, and jobs that require thought will be aided rather than displaced by IT. In introducing proposals for new IT-related equipment and work procedures, full consultation between management and staff - as envisaged in the discussions between the CBI and TUC on new technology - is essential, and provision of adequate training and retraining for those displaced from existing jobs must be a significant part of the arrangements.

5.7 Management attitudes must be positive for the full exploitation of IT. Complacency and ignorance of new possibilities will lead to commercial failure. Managers must be well informed on information technology so that they appreciate its full potential and understand its implications for their business. There is also a need for a better understanding of motivations for and against change. The education of both management and trades unions is an important factor in the application of IT.

5.8 There is more chance of public acceptance of IT and the necessary investment of money and people if it is clear that this is a key point in the future growth of the economy. This requires Government to take a public position in order to create the right climate for the improvement of efficiency and the acceptance of new technology. A clear statement of the importance that Government attaches to this subject is required.

5.9 A statement alone will not be sufficient - welcome though it would be. The French government have been successful in creating - on the basis of projects that are not yet operational - the impression that France is leading the world in IT. A firm Government policy on the importance of IT coupled with adroit publicity for some projects that catch the imagination has produced a situation highly beneficial to French industrial interests. We look for similar top-level support for the projects that show what British IT can do. We look also for the projects that will bring the significance of IT home to the public, like the French electronic telephone directory service.

We recommend that the Government should make it clear that effective exploitation of IT is essential to the future industrial and commercial success of the United Kingdom. This commitment should be emphasised on all suitable occasions by Ministers and officials.

The Government should support its views with publicity for existing United Kingdom achievements in IT and imaginative promotion of them.

Innovative applications of IT by Government Departments, local authorities and public corporations should be encouraged and plans for them should be publicised.

## 6. OPPORTUNITIES AND CONSTRAINTS IN THE UNITED KINGDOM

### Availability of People

6.1 The development, production and application of IT are all constrained by a substantial, or even critical, shortage of people trained in the skills needed for IT. Suppliers and users are experiencing a shortage of people with the ability and training to design systems and write programs. The speed at which technology is advancing makes this problem particularly acute.

6.2 UK software is as good as any in the world and we have the advantage that English is the basic international computer language. It is unfortunate that exploitation of these advantages is constrained by a shortage estimated as between 25,000 and 40,000 trained people. The causes of the shortage include the rapid expansion of the applications, a popular misconception that the field is highly mathematical, inadequate provision for training at all levels and lack of in-career training courses.[1]

6.3 The ability to write programs successfully is logical rather than mathematical. (Recent projects at the National Computing Centre have shown that people of modest educational achievements - say no more than two O levels - can be taught to become competent programmers.) Schools must recognise that pupils with aptitudes other than mathematics could have a satisfactory career in this field, and there is need for guidance to both teachers and pupils on the routes which lead to such careers.

6.4 The movement of trained staff from firms prepared to spend money on training to those prepared only to offer higher wages is an argument often quoted against investment in training. This must not be allowed to undermine training programmes and the extension of the levy/grant system may be necessary to ensure an equitable sharing of the costs.

6.5 The ACARD report on technological change (item 3 in the Bibliography) drew attention to the shortage of skills in microelectronics and related subjects. Schools, polytechnics and universities, the Manpower Services Commission, Industrial Training Boards and the relevant Government Departments should consider urgently

1. See Bibliography, item 19

the ways in which the supply of trained manpower might be stepped up. It is regrettable that none of the £9 million allocated by the Government for microprocessor education will be used for the purchase of equipment for use in schools. IT will itself release resources by enabling many office jobs to be done with fewer staff; one way of smoothing the introduction of new technology could be to train people displaced from current jobs in skills relevant to the development of IT. Government support for such training schemes might be envisaged. However, the longer term shortages at higher levels will not be eased this way; they require immediate measures to indicate to A-level students and new graduates of all disciplines the opportunities available in IT - particularly in software preparation.

We recommend that careers services at both school leaver and higher levels should review the guidance given to students about opportunities in IT, in order to attract entrants from a wide range of disciplines.

We recommend also that Government, its agencies concerned with training, and educational bodies at all levels, should examine the provision of education and training courses in IT-related subjects and propose measures to stimulate an increase of training in firms.

Industrial Activity

6.6 Our study has made us aware of gaps in the range of products in IT available from UK industry. Much of the present equipment for IT, including probably 90 per cent of the peripheral equipment, is coming from overseas. There are opportunities for UK industry, for example in the banks, but apart from a few good examples (such as a new banking terminal), opportunities are being missed. With the present pace of development, a great deal of equipment is being purchased and this provides opportunities, some of which are particularly suited to small specialist firms. In some cases, industry appears to be slow in anticipating future demands. We also believe that UK customers show more antipathy to novel equipment, compared with organisations overseas. There is a need for closer contact between supply and user industries in IT.

We recommend that the Government, through Trade Associations and the National Economic Development Council, should improve the links between supplier and user interests in IT in order that UK firms may be better able to anticipate future requirements.

6.7 There have been major achievements in British IT upon which we should build. Major development programmes in fibre optics have been conducted by both public and private firms and the Post Office recently announced plans for 15 routes comprising 280 miles of optical fibre cables. Britain is unique in having an operational viewdata service - Prestel - accessible by local call from several major cities, and this world lead should be exploited vigorously. Similarly, teletext (ie Ceefax and Oracle) was first developed here and has now been adopted by several other countries. Finally, ICL is one of the few presently viable computer companies outside the USA and Japan.

6.8 However, our supplying industry is stronger in electronics than in the mechanical skills required for peripheral equipment. We are particularly concerned that the UK now appears to lack the capability to design the electromechanical components which are still required in information systems.

6.9 We also note that our R and D effort in this field is now less than that of many of our competitors. Thus our effort on opto-electronics is now only about 10 per cent of that in Japan. We have to be selective and deploy R and D effort where there are the best chances of successful exploitation. We indicate appropriate areas in Chapter 8.

6.10 We have noted that a constraint to development in this field is the lack of transferability and mobility of technical staff between universities, government and industry. This, we believe, results in government funded work not getting developed and applied in industry. Some government research establishments contain "centres of excellence" which it would be wrong to destroy but which are remote from development, manufacturing and marketing. The best solution would be the free movement of people with their ideas.

6.11 We are also concerned that there should be a balance between the production and design of hardware and software. Failure to recognise the importance of software, and of the know-how in applying the technology, could have grave consequences. This importance is recognised in the "Nora" report which urges

the development in France of strategies to enhance competence in software and IT applications for both domestic use and the export of expertise. There is considerable British competence in this area, despite shortages of people. With encouragement and assistance, this could become a major British asset.

Regulation and Standards

6.12 IT by definition involves communication from one location to another. It is essential, therefore, that the equipments making up the communication links are compatible so that information may pass freely. Bodies exist for making both national and international regulations and standards in the field. The present regulatory organisations for communications in the UK, (eg the Post Office and the Home Office) backed up by Trade Associations, are linked with their counterparts in other countries through organisations which have no legal jurisdiction but which enable compatible standards and systems to be developed. Such organisations work well (see Appendix 2 for details). The British Standards Institution is similarly linked with international standards bodies on other aspects of IT.

6.13 Regulations and Standards may promote or inhibit development. In a rapidly changing technology, care is needed to ensure that they do not inhibit progress. Their formulation requires careful, detailed but often tedious and time-consuming drafting and discussion. There is a risk of their importance being under-rated, so that the best people are not sent to standards negotiations. It can be unattractive work with apparently little of commercial value at the end of the day. However, the intelligent preparation, advocacy and, if necessary, defence of positions, in particular in international negotiations, is vital to the UK. Other countries seem more adept at exploiting such negotiations for their own advantage, either by obtaining agreement that their national standards will be adopted internationally, or by frustrating competitors' intentions to capitalise on a technological lead. Extensive negotiations over viewdata standards have so far prevented Prestel from gaining the immediate world acceptance that its technological lead would justify.

6.14 Commercial implications of international standards (not merely European, which are often irrelevant to world markets) can be considerable. But not all the work can be left to our negotiators supported by Trade Associations. It is also up to firms to establish de facto standards by taking up commercial opportunities. If they lose a position, they cannot rely on our representatives in international discussions to restore it.

We recommend that the Government should recognise the importance, to the IT supply and applications industries, of UK strength in international discussions on regulations and standards, and that staff and financial support must be available for such activities to ensure that our delegations go to them well prepared, technically, commercially and politically, and ready to argue strongly for our national interests. Trade Associations must similarly be prepared to play their part on behalf of their industries.

Legal Constraints on the use of IT from deficiencies in law

6.15 The successful use of IT in the UK is being impeded by the lack of reform to certain aspects of the law which relate to the use of information. Unless such reforms are carried out as a matter of urgency, many future developments will be either prevented or substantially hindered. These are discussed below.

Data Protection Legislation

6.16 Power from the use of information, which can now be provided by IT, is great and there is clearly potential for abuse. Justifiable fears of such abuse are a major contribution to resistance to new ways of collecting and handling data by both Government and the private sector. The legitimate interests of citizens and users of IT must therefore be defined and protected. Laws are needed to prescribe such matters as the information to be handled, the uses to which it may be put, its disclosure to the people covered by the data and to third parties, the assurances to be given on collection, the safeguards for ensuring accuracy, relevance,

timeliness and completeness, the measures for ensuring security and the circumstances in which users must seek the consent of subjects of the data or authorisation from an appropriate authority.

6.17 In the international sphere, the lack of data protection legislation will place the UK increasingly at a disadvantage with other countries who have already legislated; British commercial and industrial interests of many kinds will suffer as a result. Without domestic legislation, the UK will be unable to ratify the international convention on data protection already produced in draft by the OECD.

6.18 Data protection was examined by the Data Protection Committee under Sir Norman Lindop whose report (item 14 in the Bibliography) was submitted to the Government in December 1978. The Committee made many detailed recommendations, including the establishment of an independent Data Protection Authority. The Government has not, however, responded to these.

> We recommend that the Government should bring forward proposals for data protection legislation, taking into account the views of the Data Protection Committee, without delay.

Copyright Laws

6.19 The copyright laws need to be modified to cover information held in forms other than writing on paper. Developments in IT mean that information will in future be held in electronic, magnetic, or optical forms and so the lack of appropriate copyright law will constitute a hazard for the users of IT and could remove incentives to develop innovative concepts in IT itself. The risks to IT users of inadequate copyright protection will be enhanced by the ease with which copies of documents (whether paper or electronic) will be sent to distant locations.

Other Laws

6.20 The admissibility of information held other than on paper as legal evidence is said to be open to doubt. This and any similar uncertainties relating, for example, to the laws of libel and fraud could constitute a further inhibition to users of IT. If the UK is to have a leading position in the supply and use of IT, such inhibitions need to be removed.

> We recommend that the Government should put in hand urgently a review of the legal reforms required to aid and expedite the use of IT in the UK and should then legislate to bring about such reforms as fast as possible.

Present Organisational Problems

6.21 IT brings together computing and telecommunications. This makes possible the interchange of information not only between units of a single organisation, but also between independent organisations - eg between suppliers and their customers, banks and their corporate customers, airline companies, Government Departments, and between Government Departments and private sector organisations. This kind of interchange of information often precipitates a situation in which the costs fall to one party and the benefits to another. The motivation to create system linkages of this kind is hard to promote, unless it is done jointly by all the parties with a clear understanding of how the costs and benefits will be distributed among them.

6.22 This type of joint venture requires new legal forms of organisation which do not affect the separate identity and legal standing of the co-operating parties. Such a legal form has been created in France - known as a Groupement d'Intérêt Economique (GIE), and in Belgium there is a similar corporate entity in the form of a non-profit making co-operative society. Such entities have proved themselves excellent vehicles for joint action to meet a common set of goals, with minimum legal and fiscal difficulties. This has been so even where the joint action is by very disparate organisations with common communication needs, for example telecommunications authorities with banks, or airlines with railway companies.

6.23 We have no such legal structures in the UK and it is difficult to envisage how, for example, the Post Office might undertake a joint venture with other organisations. Already some international organisations utilising IT, such as the banks' SWIFT network, have been established with headquarters in Belgium or France where these legal forms exist, rather than in the UK.

We recommend that the Government should consider legislation to permit the creation of new organisational forms to aid joint IT projects, taking into account the precedents in France and Belgium.

## 7. THE ROLE OF COMMUNICATIONS

7.1 While some applications of IT will be contained within a single room, office, store or factory, the major applications of the future will be dependent on national and international communications networks. Some transmissions will be via communications owned by the user or provider of the IT system, but most will require the use of existing public communications networks, suitably improved. A first class, modern, economic communications system is therefore essential for effective application of IT.

7.2 IT users' requirements will not, in the main, be for facilities which are technically difficult to provide. They will rather be looking for low transmission costs, speed of installation, reliability, and competitive transmission and switching technology to provide them with modern services. They are much more concerned if, as at present, it can take 9 months to obtain a new connection to the public telephone network.

7.3 Most of the present traffic on the telephone network is voice communication. Even in an era of data transmission, information technology and electronic mail, we expect the majority of the traffic to remain voice telephony. This will only be changed when video telephones are introduced (and widely accepted by the public - which was not the case when an attempt was made by the Bell System to introduce them in Chicago), or television programmes are distributed to homes by the telecommunications network. Even then modern techniques can reduce the data transmission rate required. A network which provides digital voice transmission will also satisfy substantially all other IT requirements (except possibly videophone and television). There is therefore no need for a separate network for IT from that for speech, although some with whom we have had discussions look forward to the development of information ring mains in neighbourhoods. Users would connect to these and specify the amount of information carrying capacity required. There is, however, a case for national standards for data handling via the public network in order to permit data interchange between different organisations, in the same way that speech can now be freely transmitted between individuals.

7.4 We believe that a feature of the development of IT over the next few years will be the replacement of physical movement of some information by 'electronic mail' in which keyed-in information is transmitted over the telecommunications network, stored as necessary, and displayed on a screen at the recipient's address, with printed copies being produced when necessary. There will be scope for different classes of service at different tariffs, eg as soon as connection can be made; when the network is lightly loaded; or overnight. Even in an era of electronic mail, though, there will be cross-coupling between telecommunications and postal services (for those without telephones) and the separation of these services has not had any fundamental effect on our conclusions.

7.5 The provision of a telecommunications network and the transmission and switching of connections between subscribers can be a profitable business at the rates which subscribers will pay. Such a network is at the heart of applications of modern information technology. The relevant technology, however, is changing rapidly and major investment in research, development, procurement and installation is required if the network is to remain competitive in world terms. It is vital that the provider and operator of the network should have adequate funds for this programme, from either public or private sources.

> We recommend that the Post Office (or its successor for telecommunications) should have the mandate to provide a world-competitive United Kingdom communications network and should have sufficient finance for procurement and installation, whether from public or private sources.

7.6 At present the Post Office not only provides the network but has a major influence on the introduction of those aspects of information technology which rely on the network.

> It determines the tariffs charged, the service to be provided and the timing with which they are made available to users.
>
> It controls the equipment which may be connected to the network. It provides some terminal equipment and at one time exercised a virtual monopoly over equipment directly connected to its terminals, although this has now been considerably relaxed.

It provides services such as Prestel, although it no longer monopolises the provision of viewdata services.

It has substantially a monopoly in the provision of point-to-point communication.

7.7 In our discussions, we have encountered a range of views on the future of IT, but nearly everyone would like a 'transparent' communications system with terminals (similar to the outlets for gas, electricity and water) to which they could attach equipment of their choice, provided that it has been approved as not harmful to the network. The role of the Post Office should be to provide the network. Such matters as approval of terminal equipment and approval of independent networks should not be the responsibility of the Post Office.

7.8 Opinions have varied on the future provision of services and equipment. Views include -

a. that the Post Office (or its successor, British Telecommunications) should be only the provider and operator of a transparent communications network (ie a 'bulk data carrier') and should not provide Prestel or similar services, nor should it supply terminal equipment;

b. that the Post Office should supply and operate the network and have the right to supply simple terminal equipment (eg a telephone) which would confirm the satisfactory working of the network;

c. that the Post Office should supply and operate the network and have the right to supply simple terminal equipment but would also be free to supply IT services and other terminal equipment in competition with private interests.

On balance, we support view c.

We recommend that the Post Office should be free to supply terminal equipment and IT services for use with the network but should not have an exclusive right to do so. It should not be the approving authority for terminal equipment and IT services provided by others.[1]



1. A Government statement on 21 July 1980 proposed changes in the Post Office's telecommunications monopoly which follow these principles.

7.9 We recognise that a consequence of the liberalisation of the Post Office's monopoly on terminal equipment could be the loss of this market to foreign competition and an increase in imports of such equipment.
We believe, however, that the rapid application of IT in UK service industries such as banking and insurance (which will lose competitiveness if they do not apply IT effectively) is so important that such liberalisation is necessary. It should, however, be introduced in ways that will give alert British manufacturing industry the opportunity to supply these users' needs.

7.10 The Post Office, together with the Department of Industry and the Home Office, at present have regulatory and supervisory powers for communications. Sound and television broadcasting systems have an increasing role in IT. Examples are the teletext (Ceefax and Oracle) services provided by the BBC and IBA, the use of television receivers for Prestel and other viewdata systems, and the possible use of broadcasting systems for regulating energy demands. Mobile radio (for emergency services, taxis, and industrial use) and point-to-point radio will also be part of IT systems, over which data as well as speech will be transmitted. These broadcasting and radio services (which are at present regulated by the Home Office) are parts of the total communications capability essential for IT. We believe that the supervision of their technology should be brought together with that of other communications, and this task is not appropriate to the Home Office.

7.11 The four principal responsibilities which should be brought together are: approval of equipment for connection to the public communications network; regulation of "value added" services using the network (eg data processing services); regulation of private communications systems; and control of the use of radio frequencies. We believe that, because of their interplay, it would be simpler, more efficient and less restrictive to make these the responsibility of a single organisation. This could also result in some staff savings.

We recommend that responsibility for regulation of communication and broadcasting, including the matters listed above, should be exercised by a single Government Department.

## PUBLIC PURCHASING AND SUPPORT FOR R & D

8.1 Government is a major user of IT. It provides funds to support its development and controls the regulatory system in which broadcasting and telecommunications authorities operate. It also has a major influence on the general economic environment, which governs the willingness of firms to invest. As a user, Government can determine the direction and market for major items of computer-based equipment by policies of standardisation and by its willingness to introduce innovative features. Traditionally, Government seeks the lowest cost systems that meet its requirements. In IT (as in other areas of high technology), selection of the lowest cost systems may in the long run weaken United Kingdom industry by not providing the initial market for a new development which bears heavy initial costs. The USA particularly has supported many projects in advanced technology through enlightened and innovative purchasing. Public purchasing in this country needs similarly to provide some of the market pull required to encourage new developments. Cost minimisation is an important criterion for decision, but can stifle advance, whereas imaginative, innovative purchasing can provide great commercial benefits at relatively little extra cost.

We recommend that the Government should employ public purchasing to pull through novel developments in IT, (and offer examples of possible projects in Appendix 1).

8.2 Government funded applications of IT could also be used to achieve national objectives outside the industrial or IT areas. The following are examples:

a. IT could assist a national campaign for energy economy;

b. the creation of commercial and industrial employment in the regions could be promoted (a distance-independent tariff would help this);

c. technology could be developed to provide assistance to the physically handicapped;

d. a substantial British contribution to the needs of developing countries could be made by study of their environments where the pattern of available industrial and commercial skills is quite unlike our own. The use of IT to overcome deficiencies could speed up such countries' progress. Projects could have political value as well as substantial export value.

We recommend that the Government should consider the possible role of IT in promoting national objectives, and give appropriate financial support to relevant IT projects.

Public Sector Research and Development

8.3 Work on IT supported by government funds is being undertaken in government establishments and in industry and universities. The Ministry of Defence and the Post Office, as customers, are supporting research and development aimed at their own needs, while the Science Research Council and Department of Industry are supporting work in the universities and industry. In addition the Department of Industry is undertaking work in its industrial research establishments.

8.4 We do not advocate an increase in government funded R and D, particularly in government establishments or universities, because we believe that application of the results of R & D, in the form of marketable products which

are put to successful use, does not in general come about unless the R and D is done close to manufacture, marketing and applications. Government R and D establishments cannot be strongly motivated to achieve successful commercial exploitation of research.

8.5 While we do not see a case for expansion of Government-funded R and D, we believe that development of IT and its applications should be emphasised within the existing budgets of the Science Research Council and the Department of Industry and that all possible civil advantages should be taken of related programmes in the Ministry of Defence.

8.6 Areas of importance to IT which should be considered by the Science Research Council and the Department of Industry when deciding their supported programmes include:

a. development of special silicon integrated circuits (microcircuits) for applications in IT;

b. applications of special and standard silicon integrated circuits in IT;

c. opto-electronics;

d. system analysis and design, software systems and programs;

e. displays;

f. pattern recognition;

g. bandwidth compression techniques;

h. new memory technologies;

i. novel sensors and transducers;

j. organisation of large data bases;

k. printed copy generation.

We do not suggest that it is within the United Kingdom's resources to establish a viable world presence in all these areas. A selective approach will be required, based on the availability of first rate ideas and people, and on industry's views on ultimate commercial importance.

8.7 We would draw special attention to two areas. First, satellite communications and broadcasting could be particularly significant in future IT systems and it is important that this is kept in mind in considering priorities in this country's present substantial financial support for satellite science and technology. Second, the technology of opto-electronics (already in use in sensors, displays and transmission) will also be important for many aspects of IT. It may eventually be supplemented by what some term "microphotonics" - the use of quanta of light ("photons") without the intervention of electrons - for information processing, storage and transmission.

> We recommend that the Science Research Council and the Department of Industry should keep their research priorities under review in the light of the needs of IT.

8.8 There is a need for better co-ordination of the R and D on IT undertaken by the Ministry of Defence, Department of Industry, Science Research Council and the Post Office. At present the CSE Division of the Department of Industry and its Computer Systems and Electronics Requirements Board are endeavouring to improve co-ordination, trying to ensure that projects they support are likely to be applied and that they are applied when successfully completed. But there is room for improvement.

> We recommend that the Department of Industry, with the Ministry of Defence, the Science Research Council and the Post Office, should increase the present co-ordination of all publicly funded R and D applicable to IT. It should also make greater effort to ensure both that research which it supports is likely to be applied and that transfer of results to industry takes place.

## THE ROLE OF GOVERNMENT

9.1 We have referred in previous chapters to a number of roles for government in the development of IT and its applications, concerning -

a. awareness and attitudes,
b. education and training,
c. sponsorship and support of industry,
d. international regulations and standards,
e. the legal framework for applications of IT,
f. public purchasing
and g. publicly funded R and D.

9.2 Responsibility for these roles is at present split between the Home Office, the Department of Trade, the Department of Industry, the Department of Education and Science, HM Stationery Office and the Central Computer and Telecommunications Agency (but the co-ordinating role of the CCTA in public purchasing does not extend to local authorities, the National Health Service or nationalised industries). In addition, public risk capital for IT ventures is provided by the National Enterprise Board and the National Research Development Corporation.

9.3 This spread of responsibilities for the advancement of developments and applications of IT does not seem to us to provide a coherent framework for policy making for such a nationally important subject. Decisions on one aspect of IT (eg satellite broadcasting) may have repercussions in a very different area (eg standards for data transmission). Responsibility for taking a view of the whole field should rest with one part of Government. We do not suggest the transfer of detailed responsibilities, for example, for education from the Department of Education and Science, but we do believe that it is necessary that all the factors which will influence the development and application of IT in the national interest should be studied together, and that Departments' plans and actions are co-ordinated and monitored.

9.4 There is also the difficulty that costs and benefits from the introduction of IT systems can fall to different Government Departments. Separate financial targets and accounting systems do not easily allow the redistribution of costs and benefits. Projects where the

net national benefit would be substantial may not then come to fruition. There is need for a system of project cost and benefit distribution which can overcome departmentalism.

9.5 We believe that a focal point is necessary, in view of the number of organisations involved, to improve awareness in government, to promote a programme covering both projects and publicity, to improve internal communications and provide necessary couplings, to avoid delays because of the rate of technical change, and to create a positive public consciousness of IT. There is a need to make existing United Kingdom efforts more coherent. The French have managed to achieve coherence in IT and have aroused national consciousness and international interest with a programme which is probably not vastly greater than the sum of United Kingdom efforts. By contrast, British activities, including those of the Department of Industry which already has many of the responsibilities in the IT field, are fragmented and organised in traditional sectors which do not correspond to the new technological possibilities. The creation of a focal point would also assist the private sector, which at present has to deal with many parts of Government on IT matters.

> We recommend that one Minister and government Department should be responsible for co-ordination of government policies and actions on the promotion and development of IT and its applications through awareness, education and training, sponsorship of industry, provision of risk capital, public purchasing, publicly funded R and D, national and international regulations and standards, legislation, communications, and related programmes such as satellite technology.

## 10. CONCLUDING REMARKS

10.1 Our concluding note, in line with the central theme of this report, is that Government, industry, commerce, trade unions and the professions must take the new developments in information handling very seriously. They will affect working arrangements, management systems and personal life. They offer great commercial opportunities for this country if successfully exploited. It will be necessary to examine the changes in management organisation and techniques which are necessary to make best use of information technology. The Civil Service, local government, and industrial and commercial managements are frequently aware of the systems which are available but are sometimes slow in

adjusting their methods of working to make effective use of them. It is essential to start not from the way that tasks are tackled with present methods but to examine the true tasks to be performed and how they can best be undertaken with the aid of the new technology.

10.2 The successful exploitation of IT is crucial to high employment, a satisfactory balance of trade, competititive industry and an efficient commercial sector. But time is not on our side. If we are to maintain a presence against the present commercial strength of the USA and Japan and the clear intentions of France and West Germany, to name but our major competitors, the message of this report has to be taken up by all sectors in effective action now.

APPENDIX I

## DEMONSTRATION PROJECTS WHICH COULD PROVIDE IMPETUS FOR UNITED KINGDOM EFFORTS IN INFORMATION TECHNOLOGY

1. Creation of "centres of excellence" for communications in commercial centres such as the City of London.

2. Installation of an optical fibre cable communication network in an area such as part of a new town, with advanced terminal equipment for speech, text and other information.

3. Use of a United Kingdom satellite for communication and broadcasting.

4. Provision of cheap black and white Prestel-like video terminals for telephone directory information, for use with telephones.

5. Supplementing postal services by telex and facsimile transmission from post offices and other public places.

6. Establishment of a demonstration Government office with the latest, preferably British, electronic communications, word processing, copying, information processing and storage etc.

7. Creation of an effective information retrieval system for the Manpower Services Commission to assist job placement.

8. Provision of microcomputer systems for education, training and applications in schools and colleges.

9. Provision of Prestel receivers in schools and public libraries.

Note: These projects vary greatly in impact and cost. The Working Group would be prepared to provide assessments of impact and cost, if required.

# PRINCIPAL REGULATORY BODIES IN TELECOMMUNICATIONS & ALLIED FIELDS

## 1. THE INTERNATIONAL SCENE

The main body involved in the regulation of international telecommunications is the INTERNATIONAL TELECOMMUNICATIONS UNION (ITU) through its INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE (CCITT). Questions or recommendations raised by member Countries of CCITT at the Plenary Sessions are assigned to study groups and joint working parties (which are made up of experts from both participating PTTs and the private sector) who, in turn, report back to the Plenary Sessions with the results of their investigations.

The Plenary Sessions then decide on appropriate Standards based on the evidence presented. These Standards then become official CCITT Recommendations, the adoption of which is not mandatory but does provide positive benefits to the member Countries. Consequently, CCITT Standards are generally accepted throughout the world and are currently published and implemented covering the transmission of data in various forms over telex networks, telephone networks, and public data networks, including the modern 'packet switching' networks. Standards cover such factors as operating speeds, modulation techniques, interface connections and protocols, etc., etc.

The ITU also controls the allocation and use of radio frequencies throughout the world. The CONSULTATIVE COMMITTEE ON INTERNATIONAL RADIO (CCIR) is a sister organisation of CCITT and works in essentially the same way, i.e. via Plenary Sessions with their Study Groups and Joint Working Parties. The final Recommendations are then submitted to a WORLD ADMINISTRATIVE RADIO CONFERENCE which takes place periodically (the last one was in 1979, and the one before that in 1964). These conferences are attended by representatives of World Governments, e.g. the UK Government is represented by the Home Office, and the U.S. Government by the Federal Communications Commission (FCC). Agreements are reached at these conferences on the international allocation of radio frequencies, and the two main considerations are:

1. To keep the communications concerned with the safety of shipping and aviation clear and open.

and,

2. To avoid interference between one country's internal broadcasting services and those of its neighbours.

/...

Agreements reached at the World Administrative Radio Conference are then controlled and monitored by the INTERNATIONAL FREQUENCY REGISTRATION BOARD (IFRB) which is another ITU organisation. Complaints of interference whether to aviation or maritime communications or domestic broadcasting services are normally referred to the IFRB, the ITU and the country operating the radio station concerned.

Another regulatory mechanism in the international arena and of particular interest to the UK, is the EUROPEAN CONFERENCE OF POSTAL AND TELECOMMUNICATIONS ADMINISTRATIONS (CEPT), which has twenty six member administrations and which aims at 'the harmonising and practical improvement of their administrative and technical services'. Like CCITT, this organisation is essentially consultative and has no legal jurisdiction over its members.

Yet a further international organisation, though not strictly regulatory, is the INTERNATIONAL TELECOMMUNICATIONS SATELLITE ORGANISATION (INTELSAT) which has approximately 100 member nations. The technical and operational management functions of this organisation are supplied by COMSAT (the U.S. Communications Satellite Corporation) but under the overall direction of the Board of Governors which represent the member nations.

Other prominent organisations in the international area - although not strictly concerned with telecommunications per se - are the INTERNATIONAL ORGANISATION FOR STANDARDISATION (ISO) together with the INTERNATIONAL ELECTRO-TECHNICAL COMMISSION (IEC). The IEC, headquartered in Geneva, recommend Standards for electrically operated equipment for international use and, where possible, the BRITISH STANDARDS INSTITUTION (BSI), adopts the same or similar Standards as well as the same form of publication of those Standards. In the special area of radio interference, the IEC has set up an "INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE" (CSIPR), and many UK manufacturers are now designing equipment to meet the Standards defined by that Committee.

## 2. THE U.K. SCENE

In the field of telecommunications the main regulatory body is the BRITISH POST OFFICE (BPO) with powers vested in it by the Post Office Act - 1969 - which give it a virtual monopoly in the country. There are a number of exceptions to this monopoly, mainly concerned with systems which are installed entirely within a single building or site, or within and for the exclusive use of a single business. Furthermore, the BPO may license other organisations to run systems which it may, itself, from time to time not have either the resources or the desire to offer. In particular, the BPO has issued a general licence covering "Private Attachments to Post Office Telecommunications Installations" dated 1 July 1977. This licence

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has, in turn, resulted in a series of "Technical Guides" which detail various specifications which must be met by any equipment connected to BPO circuits. Such equipment must then be submitted to the BPO for evaluation and test before written permission is given. The requirements for connection to the PUBLIC SWITCHED NETWORK (PSN) are different from those, for example, for connection to BPO supplied private circuits, and separate listings are maintained for equipments for which BPO approval has been given for each type of connection.

Any communication system involving a radio link requires, in addition, the approval of the HOME OFFICE through a "Home Office Wireless Telegraphy Licence".

The BPO monopoly applies not only to the UK and the Isle of Man but also to International Systems in so far as they operate within the UK. A department of the BPO, known as the "External Telecommunications Executive" is involved in evaluating and licensing privately supplied equipment for connection to international circuits.

Although not strictly a regulatory body, the BRITISH STANDARDS INSTITUTION (BSI) publishes various Standards which are relevant to the general information processing industry, most importantly concerned with electrical safety and radio interference. Although these Standards are not mandatory within the UK, similar Standards frequently are in many other countries. However, compliance with the appropriate British Standard is considered by most responsible manufacturers to be of considerable importance and would be normal.

The BSI runs a testing and inspection service to assist manufacturers in ensuring that their equipment does meet the appropriate Standards. They also run an organisation called "Technical Help to Exporters" (THE), which assists manufacturers in respect of overseas technical requirements. The BSI also works closely with many other interested Bodies, e.g. the TELECOMMUNICATIONS INDUSTRY STANDARDS COMMITTEE which, in turn, consists of representatives of various Government Departments and scientific and industrial organisations, such that the resulting BSI Standards are, in fact, a joint recommendation of both Bodies.

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