DEPARTMENT OF TRADE AND INDUSTRY
1-19 VICTORIA STREET
LONDON SW1H 0ET
TELEPHONE DIRECT LINE 01-215 5422
SWITCHBOARD 01-215 7877

Secretary of State for Trade and Industry

4 March 1985

Rt Hon Michael Heseltine MP
Secretary of State for Defence
Ministry of Defence
Main Building
Whitehall
London SW1

Not pleased h.p.m. Treasury are keen that this should not be acted upon by MOD, since they believe D&E will help eindirectly the need for these skills in future. (Michael Fallon in Treas) MBT 11/3

Dear Michael,

SKILL SHORTAGES

I am writing about a problem which concerns us both: the serious, and increasing, shortage of skilled people in high technology industries in general, and in what may broadly be called the "information technology" industries in particular.

2 I think you know that, early last year, we in the DTI became sufficiently concerned at the growing evidence of skill shortages in the information technology field to set up a committee under John Butcher to look into the whole question and to make recommendations for action. The Committee published its first report last July, and concluded both that the market could absorb significantly more IT-skilled graduates than were currently available, and that additional graduate manpower would be required up to the end of the decade and probably beyond. I enclose a copy of this report in case you have not see it. A second report, on shortages below graduate level, was published in January, and a final report will appear shortly. Also, the Engineering Council issued a policy statement in February of last year calling for an increased output of engineers and technologists.

3 Some action has already been taken. The individual companies on John Butcher's committee have taken the initiative in proposing a new "partnership for change" with the higher education system. They have been instrumental in setting up an "Information Technology Sills Agency", under the aegis of the CBI Education Foundation, which will both act as a focal point for interpreting industry's needs to the academic world and co-ordinate positive help in the shape of donations of equipment, loan of visiting lecturers, offering increased undergraduate sponsorship and opportunities for undergraduate industrial experience, etc. On the Government side it has recently been agreed (though no announcement has yet been made) that my Department, together with DES, DEm and the Scottish and Welsh offices, should contribute to a

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package of support totalling some £42 million over the three years 1985/6 - 1987/8 to increase the number of undergraduate and post graduate places at higher education institutions. My own Department's contribution will be £2½ million in 1985/86 and £5 million in each of the two subsequent years. We also expect substantial help from industry.

4 Some of the major defence contractors in the high technology field have, I know, impressed on you personally the difficulties they are finding in recruiting the skilled manpower necessary to carry out their defence commitments, and I very much welcome your interest in this question. You will be very conscious of the need for the defence industries to have access to the right number and quality of technology trained graduates if they are to fulfill their commitments. Defence accounts, of course, for over half the Government funded R&D in the UK, and I am sure industry is right in its view that skill shortages are acting as a brake on progress in the defence field just as much as in the civil field.

5 I would like therefore to seek your support for the initiative we and other Departments, in conjunction with industry, are taking to tackle the problem. I believe that, in view of the substantial extent of Defence R&D spend, you may feel it right for that support to be in financial terms. Even if it is not of such a size to be commensurate with the benefit which flows back to defence industries as users of IT skills, I do think it will be an important signal, both of the co-operative effort across Government, and also to the defence industry.

6 I hope very much that you will be able to agree to this. It would be helpful if you could let me and Keith Joseph know your reaction fairly quickly, since we are anxious to make an early announcement of the Government package of support that has been agreed.

7 I am sending copies of this letter to the Prime Minister, to the Chancellor of the Exchequer and Chief Secretary, to the Secretaries of State for Education and Science, Scotland, Wales and Employment, the Minister without Portfolio, Sir Robert Armstrong and to Sir Robin Nicholson.

NORMAN TEBBIT

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IT Skills Shortages Committee

First Report

The Human Factor — The Supply Side Problem

Department of Trade and Industry

Information Technology Skills Shortages Committee: First Report

Summary and Conclusions

There is intensifying national concern about shortages of skilled IT manpower and the loss of UK market share in the rapidly growing IT sector.

The Government established a Committee under Mr John Butcher MP, Parliamentary Under Secretary of State at the Department of Trade and Industry, to explore the extent of any problems and to propose action to tackle them.

In this its first Report, the Committee assesses the demand for and supply of IT skilled manpower at graduate level; and proposes an outline plan of action to deal with any shortfall. A subsequent report in the autumn will consider skills in the technician area and progress on the points for action.

Despite the difficulties inherent in attempting precise quantification of the additional IT skilled graduate manpower required, the Committee considered that **the market could comfortably absorb more graduates** with the requisite skills now; and that given the rates of growth in the IT areas predicted by industry and commerce, additional graduate manpower with IT skills above and beyond the expansion already planned will be required for the rest of this decade and possibly beyond.

The Committee believes that the risks of inaction, measured in terms of deteriorating economic performance, transcend the current uncertainties about the precise size of the requirement; and that action is therefore needed to set in place the means of responding to industry's demands as these develop.

The Alvey Directorate estimate a shortfall of 1,500 graduates now and 5,000 by 1988. These figures are themselves open to debate but, whatever the precise figures, it is clear that there are shortages and action is therefore needed now to increase the number of first-degree places in the appropriate disciplines, the number of IT conversion places on offer to graduates, and to expand the role of upgrading and updating courses. Distance learning should play an increasing role in satisfying the requirements of students and industry for IT skills education and training. A campaign to bring back British and acquire experienced foreign expertise should be considered.

Because of the urgency of the situation and the distinctive features of the constraints involved including availability of

teaching staff, specialised equipment and accommodation, the Government is looking for **a new partnership with industry** to help secure the expansion in manpower supply which industry requires.

Representatives of industry have put forward an imaginative series of proposals which could constitute a plan of action to help overcome the constraints on the education system responding to industry's demands. These proposals will be developed into a detailed programme of targetted action.

Section 1 — Introduction

Information technology is the fastest growing industrial sector worldwide. The United Kingdom industry is growing at 8 per cent per annum compared with a world average rate of 15 per cent per annum. In some sectors such as semi-conductors and data communications the world growth rate is 20 per cent. Manpower constraints are said to be losing market share for the UK. A number of surveys have highlighted particular pockets of difficulty (eg. in the UK semi-conductor industry[1]) and a number of proposals have been submitted to Government by representatives of industry calling for an investigation and for action.

2 The Government itself has already acted to increase the supply of manpower with IT skills; and consideration is being given to a further 'switch' towards engineering and technology in the Higher Education sector. Furthermore, the main thrust of the Adult Training Strategy announced in the White Paper 'Training for Jobs' (Cmnd 9135) is directed towards securing an adequate supply of people with up-to-date skills to meet the demands of new technology. The Government has also recognised that if industry's perceptions of shortages of skilled IT manpower at graduate level are correct, further action beyond that already planned or under consideration would be required as a matter of urgency.

3 On 4 April representatives from industry, education and Government met under the Chairmanship of Mr Kenneth Baker MP, Minister for Information Technology, and decided that Mr John Butcher MP, Parliamentary Under Secretary of State at the Department of Trade and Industry, should chair a Committee to explore the scale of the problems and to recommend any necessary action to address them urgently.

4 The Members of the Committee were drawn from the sectors represented at the April meeting — a full list is at Annex I. On 13 June, the Committee agreed the terms of reference set out in Annex II. These are to try to establish the likely demand for and supply of IT manpower in the short, medium and longer term; and to recommend action to resolve any imbalances. **The Committee decided that despite difficulties of collecting and analysing hard information in what is a diffuse and rapidly developing industrial field, appropriate action should not be delayed where specific problems were identified.** The Committee's recommendations for action should dove-tail with the Government review of the 'switch' to engineering and the new technologies in the Higher Education sector.

5 The Committee recognised that additional information about the demand and supply of manpower with IT skills, particularly at higher technician and technician levels, would be difficult to acquire within the deadline agreed for publication of its first Report — the end of July 1984. This Report, therefore, reflects the Committee's overview of the supply of graduate/professional manpower with IT skills; and some initial proposals for action. A second Report, in the Autumn, will be issued on shortages in the technician areas and on progress with the points for action from this Report.

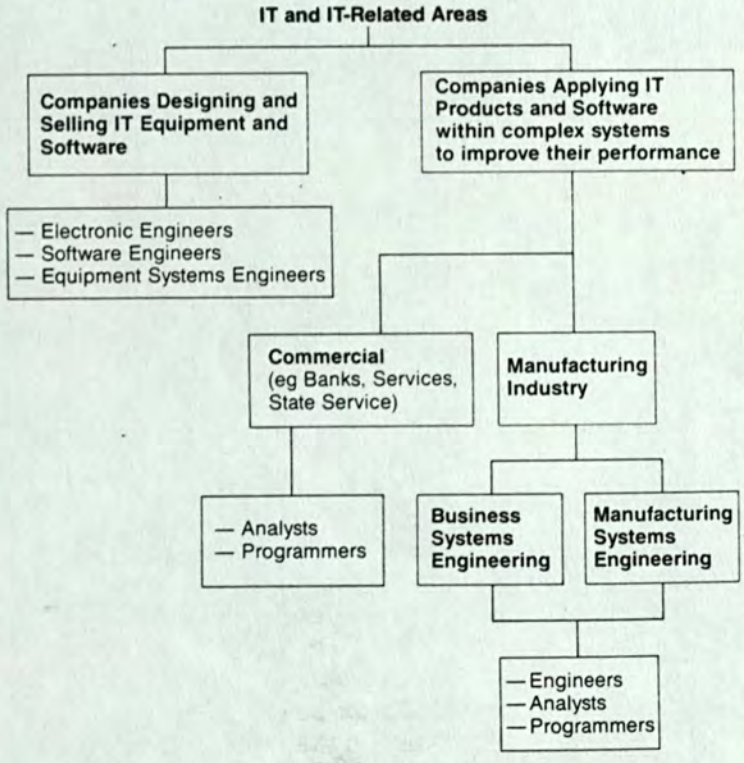
Section 2 — The Demand for IT Manpower at Graduate/Professional Level

6 To assess the demand for graduate manpower with IT skills it is necessary first to identify the **source** of the demand; the **baseline** of employment; and the **assumptions about growth** which are likely to condition demand. It is then possible to examine the **type of skills** likely to be required.

Sources of Demand

7 The pace of technological development in the field of Information Technology and its diverse applications makes precise definitions of what constitutes the 'IT industries' difficult. The first part of Annex III describes in general terms the main areas of current concern. Nevertheless, it is beyond doubt that IT is now all-pervasive; few sectors of industry and commerce are not affected by it. The demand for manpower with IT skills — which are described in the second part of Annex III — comes from a wide cross-section of industrial and commercial users and not only, or even perhaps mainly, from the 'IT suppliers' themselves. The Committee, therefore, focussed on the key skills in demand at graduate level irrespective of the particular area of economic activity where they would be put to use.

8 The relationship between IT suppliers, IT users and IT-based organisations, and the skills they require, is illustrated in the following diagram submitted by Professor Parnaby:



The requirement for IT manpower with differing educational backgrounds will be strongly influenced by the different rates of growth of the sectors described above.

Size of the IT Graduate Base

9 There is no agreed set of definitions enabling a precise assessment of the size of the IT graduate base to be made. There is a variety of information which sheds light on parts of it. A report[2] based on statistics compiled by the Engineering Industry Training Board, which excludes areas of relevant employment outside the Board's scope, puts employment in **electronics** in 1983 at 331,000. Within that total, the number of scientists and technologists stood at over 30,000 while managerial staff, most of whom are likely to be graduates, numbered about 21,000. The EITB definition suggests therefore that at least 50,000 graduates are employed in the electronics industry itself. The Computing Services Industry Training Council (COSIT), which covers the **computing services sector**, in evidence to a House of Lords sub-Committee recently[3] estimated that some 35,000 staff, the majority graduates, were directly employed in this sector; and that a similar number provided computing services within or as contractors to user companies. Thus a conservative estimate would suggest that somewhere in the region of 100,000 graduates — not necessarily all specialists — are employed in these two areas, electronics and computing services.

Growth in Demand

10 Information technology and associated industries have enjoyed rapid growth in recent years. As a consequence there has been a rapid increase in the numbers of graduates employed across the range of IT manufacturers, IT service industries, and users.* This is expected to continue over the rest of the decade as more organisations in manufacturing industry and the service sector employ the products of the IT industries, and as the IT sector becomes the lead sector in the economy at large. Evidence presented to the Committee by its industrialist members suggests that their companies, along with many others in the IT industries, are planning on the basis of anticipated growth in output of around 20 per cent per annum over the rest of the decade. One major company (Plessey) estimate that graduate recruitment planned by eight major organisations in the IT area will be over 4,000 in 1984, and that this will grow by 10 per cent per annum. Another company, Hewlett Packard, expects its new graduate recruitment to grow from 1,250 in 1984 to over 3,000 by 1988. A similar picture is painted by other major employers of IT-skilled manpower.

General Trends Affecting Demand

New technology

11 The EITB figures reveal an increase in graduate level manpower in the electronics industry between 1978 and 1983 while the number of technicians declined. Technological change is introducing new tasks which only graduates can perform; and in some areas is making it possible for one graduate to perform tasks previously carried out by several technicians. This trend is likely to strengthen, adding further to demand for graduates.

COSIT[4] estimate that the **Computing Services sector in the UK has sustained a revenue growth of 20 per cent per annum since the mid-1970s, and that the work-force has expanded by 7-8 per cent per annum over the same period. EITB figures[5] report a rise in output from the **electronics industry** of 35 per cent between 1978 and 1983, with an increase in the number of scientists and technologists of over 40 per cent from 21,000 to 30,000. A recent study by the Policy Study Institute[6] estimates that the number of **engineers with micro-electronics expertise** rose 75 per cent from 26,000 in 1981 to 46,200 in 1983.*

Demand for Experienced Graduates

12 In addition to the demand for new graduates, several reports have suggested an even greater demand for experienced IT manpower[7]. In the case of the semi-conductor industry, the greatest need was for graduates with 2-7 years' experience[8]. These reports reflect the low recruitment in the past decade and illustrate the problems of effective manpower planning and the part that industry ought to play in giving clear signals to bright young people who have a choice of attractive career options. Firms are increasing new graduate intake to compensate for the lack of experienced staff, and an element of substitution is clearly possible. By itself, however, the supply of new graduates cannot provide a complete solution to this problem. One suggestion approved by the Committee was that there should be a determined effort to lure back experienced British IT manpower currently working abroad; and to acquire non-British skilled IT manpower, for example through imaginative Joint Ventures between larger companies and individual IT entrepreneurs and product developers involving stock option schemes.

Specific Skills Likely to be in Demand

13 Graduates with a background in electronic engineering and computer science are in heavy demand now and employers believe this will continue to be the case in the future. The skills learned within these disciplines are regarded as 'core' skills to which employers can add specific training for particular IT tasks. Physicists and mathematicians are also recruited, in some cases possibly where graduates with the preferred skills are not available; in other cases they are equipped to provide skills much in demand, eg software engineering.

Demand for New Graduates

14 The 'First Destination Statistics' show the proportions of new graduates in different disciplines finding employment within six months of graduation. As such they provide an indication of the strength of demand for graduates with different educational backgrounds. 1982 was the last year for which complete figures are available. The figures[9] show that 90 per cent of university graduates in electrical/electronic engineering, and 86 per cent of polytechnic graduates in this subject, found employment within 6 months. The equivalent percentages for maths and computer science were 83 per cent and 84 per cent. (There were no precisely comparable figures for physics.) It should of course be noted that some graduates found employment in industries not requiring IT skills — see paragraph 17 below. A further quick survey of graduate requirements among 9 major companies was carried out by Mr T G P Rogers, a member of the Committee. The results are set out in full in Annex IV, but clearly the disciplines expected to be most in demand in the period from 1984-1989 were electronic engineering and computer science. The view of employers consulted was that graduates in these disciplines were also likely to be in greatest demand in 1989.

Growing Need for Multi-disciplinary IT Skills

15 Technological convergence requires a convergence of skills. Within electronic engineering and computer science, therefore, demand is growing for graduates with more flexible skills. As technology advances, attention is shifting increasingly away from concentration on either hardware or software towards a combination of skills in both — software and systems engineering. Another important area is manufacturing

systems engineering, which will typically need to embrace electronic engineering, computing, production/process engineering and business applications. As advanced manufacturing technology develops and is adopted more widely, so will demand grow for graduates with a combination of these and other skills. Other specific requirements brought to the notice of the Committee include telecommunication engineers, integrated circuit designers, microwave (including radio frequency) engineers and artificial intelligence engineers. The rapid development of technology in these areas, encouraged by programmes such as ALVEY and ESPRIT, will add to the demand for graduates with the appropriate advanced technology backgrounds along with the rapidly changing disciplines of the mechanical or production engineer.

16 These considerations point to the need for a high proportion of first degree courses to be broadly based and to have a considerable degree of flexibility in their composition and structure. Graduates in physics and mathematics are still likely to be essential for contributions at the frontiers and in software engineering in particular. The UGC and NAB assisted by the advice of such representative organisations as the Engineering Council will have an important part to play in promoting courses which respond to industry's clearly-signalled requirements.

Section 3 — The Supply of Graduate IT Manpower

17 The main sources of supply of graduate level IT manpower are **new graduates** with a suitable educational background; **post-graduates** undertaking conversion courses; **upgrading** of existing manpower, including those from non-IT backgrounds; and **updating** of those with broadly relevant skills.

i New Graduate Output and Deployment

There is no single IT subject as such but it can be assumed that the most directly relevant subjects are electrical/electronic engineering, maths/computer science, and physics. Some graduates with IT skills will be drawn from other subjects, and many graduates in these 3 subjects could not undertake IT work without further training.

The total output of the three 'relevant' subjects in 1982 (the latest year for which full figures are available) was as follows:

New First and Higher Degree Output : 1982

	UK	Overseas
1 Electrical & Electronic Engineering		
Univ/First Degree	1909	526
Poly CNAA*/First Degree	591	175
Other CNAA/First Degree	216	64
Univ/Higher Degree	307	382

**CNAA is the validating body for first degrees taken in the non-university higher education sector (eg polytechnics, institutes of higher education).*

2 Maths/Computer Science		
Univ/First Degree	3290	497
Poly CNAA/First Degree	589	115
Other CNAA/First Degree	194	38
Univ/Higher Degree	528	285
3 Physics (including Maths with Physics)		
Univ/First Degree	2314	143
Poly CNAA/First Degree	92	10
Other CNAA/First Degree	17	2
Univ/Higher Degree	538	199

Source: First Destinations Statistics
CNAA Annual Report 1982

Almost all overseas students return home after graduation or further study. Higher degree graduates are not properly a net addition to output of first degree graduates because the great majority, except perhaps for computer scientists, are likely to have taken a first degree in the same subject as their postgraduate qualification. As a broad approximation, therefore, new graduate output can be taken as the sum of university and CNAA first degrees. (It should be noted that output in these subjects has increased substantially since 1982, particularly that from polytechnics.)

Detailed first destinations information suggests that the great majority

of university and polytechnic electrical engineering, maths, computer science, and physics graduates enter employment in the UK labour market (such information is not available for other (non-polytechnic) CNAA graduates). At present very few UK graduates/post-graduates start work abroad. The main potential losses were through subsequent training in non-related skills (but including teaching in schools) and work in non-IT employment. Some are also attracted abroad after gaining useful experience in the UK. Training outside the subject meant a loss of perhaps 5 per cent in electrical engineering and 10 per cent each in the other subjects. Very roughly then the numbers of university and polytechnic graduates entering employment were:

Electrical and electronic engineering : 2400
Maths/Computer Science : 3500
Physics : 2200

By type of UK employment the allocation was roughly as follows (percentages):

	1			2	3
	Direct Science or Engineering Employment*	Of which: a Eng R&D	b Scientific R&D	Computing, Systems Anal.	Other
Electrical & Electronic Engineering	89	75	7	3	8
Maths/CS	11	4	6	56	34
Physics	60	23	32	13	26

**including scientific/engineering support work.*

By sector of employment, again roughly, the deployment was as follows (percentages):

	Engineering and allied	Public Uts, transport, comms	Other Industry	Commerce	Other*
Electrical & Electronic Engineering	67	10	6	3	15
Maths/CS	27	5	8	41	20
Physics	39	6	15	11	28

**including higher education*

Growth in supply of new graduates

These figures suggest that of the total output of about 8,100 new university/polytechnic graduates entering employment in 1982, some **6,000** entered employment in science and engineering, or computing and systems analysis. To this should be added graduates of other (non-polytechnic) CNAA first degree courses — perhaps another 300-400 graduates entering relevant employment.

The most recent DES projections showing university/CNAA graduate output up to 1989/90 are set out in Annex V. These projections take account of current trends in student enrolment, demographic trends, and policy decisions likely to make an impact on the figures (eg the recent NAB planning exercise). These figures show output in electrical/electronic engineering rising from 2.9 thousand in 1981/2 to 3.6 thousand in 1989/90 (a rise of about 24 per cent); in mathematics from 2.5 thousand to 3.6 thousand (about 44 per cent); computer science from 1.8 to 2.9 thousand (about 61 per cent); and physics from 2.4 to 2.9 thousand (21 per cent). Total output in these subjects in 1989/1990 is expected to be 13,000. (It should be noted that on the basis of present policies most of the increase will take place in the CNAA sector.) Allowing for wastage and diversion, a plausible assumption might be that between **8,000 and 10,000** graduates in these disciplines will enter the IT Industries in 1989/90 on current plans.

ii **Graduate Conversion**

Under the DES' IT in HE initiative (which commenced in 1983/84) post-graduate conversion courses will produce around 1,000 IT practitioners up to 1985/86, after which the programme will become part of the normal HE baseline. Some 200 students per year undergo graduate level conversion courses in electronic engineering under the MSC's TOPS programme. In addition, a number of companies operate IT conversion programmes for graduates in non-IT disciplines. It should be noted that not **all** of the above will be a net addition to IT manpower as some students will be undertaking conversion courses closely related to their first degree subject.

iii **Upgrading**

The MSC's Training Opportunities Programme (TOPS) provides a significant resource for upgrading training in IT skills. Some 12,500 trainees annually undertake training in new technology, computer skills or other technician areas. Of those about 6,000 trainees take courses between technician and post-graduate levels — critical for economic growth. A discrete part of the TOPS programme concentrates on developing and pump-priming post experience courses in the newest technology, especially IT. Throughput on such courses is currently about 400 trainees (Annex VI provides details of the relevant courses).

iv **Updating**

It is difficult to estimate the number of employees with relevant backgrounds undertaking in-house updating in IT skills. The main responsibility lies with employers for securing the full potential from this source of IT manpower. We are aware of some companies carrying out major schemes. Under the DTI's Microelectronics Applications Project (MAP) training scheme some 30,000 places are available annually, most at graduate level, of short duration, and aimed at practising engineers requiring additional skills.

Further Information about Demand and Supply

18 The Committee hopes to provide additional information about demand for and the supply of manpower with IT skills in its second Report. Further work is however required to inform longer-term policy

decisions in this area. The Committee therefore endorses the proposal to commission the Institute of Manpower Studies to conduct a detailed survey which will address future trends and constraints, focussing where possible on a five-year horizon and providing a better data base on IT skills than is available at present.

Section 4 — Graduate IT Skills: The Balance Between Demand and Supply

19 There is no agreed data base defining skill shortages. But the steady accumulation of survey material and employer evidence points firmly in one direction as the following examples illustrate:

i A survey conducted by the **National Electronics Council**[10] covering 18 of its members employing qualified IT/electronics staff around the end of 1983 found that vacancies for graduates had risen by 25 per cent between 1983 and 1984, with not all of the 1983 vacancies being filled. Electronics vacancies were up by at least 11 per cent, computing science by at least 28 per cent. The shortage of high quality recruits, particularly those with experience, was a feature of the responses. Software was a commonly-reported problem area.

ii In their evidence to the House of Lords sub-Committee[11] **COSIT** commented that there were significant shortages of experienced staff in the areas of programming, systems and technical management.

iii **Plessey** have commented that they would have recruited an additional 700 engineering graduates in the past three years had they been able to. They anticipate a gap of 12.5 per cent between demand and supply for a number of years to come.

iv **Hewlett Packard** reports a shortage now of systems designers and expects serious skill shortages in the latter part of the decade.

v A **National Computing Centre** survey[12] estimated that the total number of computer professionals in commerce and industry falls 8 per cent short of existing demand and will be 25 per cent short in two years.

vi **The Policy Studies Institute** survey[13] suggested that some 21,000 extra engineers with micro-electronics expertise were wanted.

Further Evidence

20 Additional evidence suggesting skill shortages is to be found in the information available about **pay levels**, the **employment prospects** for new IT graduates and **sponsorship**. Although comprehensive data about **pay** tends to lag behind events, numerous individual reports to the Committee suggest a very rapid upward movement in pay levels, particularly for those with IT skills in key areas and especially for experienced staff.

21 The **employability** of new graduates with IT skills provides indirect evidence of shortages, particularly for electronic engineers and computer science graduates. Some evidence to the Committee about vacancies for new technical graduates comparing this year to last year indicates an increase of 181 per cent in all such vacancies with an

increase of 112 per cent for computer science graduates and 115 per cent for physics graduates.

22 The increase in the number of students being **sponsored** by firms also points in the same direction. Companies are seeking to secure a sure supply of scarce graduates with IT skills.

23 The Committee has reviewed this information. Incomplete though it is, the message it conveys is clearly **that the market could absorb significantly more graduates with IT skills than are currently available to it.** The longer the delay in meeting the demand, the greater the damage to the economy. The Alvey Directorate assess the shortfall of new graduates in 1984 as about 1,500. Given current expectations by employers about growth in the IT and related industries, **the Committee believes that graduate manpower with IT skills additional to that already projected will be required during the rest of the decade, and possibly beyond.** The Alvey Directorate believe that some 5,000 additional graduates will be required by 1987/88 with the bulk of the requirement being split between electronics and computing science, with physics, mathematics and other engineering making up the remainder.

24 Whatever the precise figures, it is clear that the shortages of skilled manpower are damaging to individual firms and to the nation. Without the necessary supply of skilled manpower, companies cannot be expected to keep up with overseas competitors across the whole range of information technology from the microchip to the satellite. They will not be able to apply rapidly-changing state of the art production methods nor maintain the momentum of their Research and Development at the frontiers of knowledge. With the expenditure of substantial amounts of both public and private funds on programmes such as Alvey it would clearly be wasteful if the technological gains resulting from such investment could not be properly exploited because skilled manpower was lacking.

25 All members of the Committee agreed on the existence of shortages of IT skilled manpower, although estimates of the size of the shortfall vary. The Committee believes that inaction in the face of a balance of payments deficit of over £2 billion in IT products, and in the face of continuing shortages of skilled IT manpower, is unacceptable.

Section 5 — Measures to Increase the Supply of Graduates with IT Skills within the Existing Framework

Meeting Immediate Needs

26 Given the Alvey Directorate estimate of a 1,500 shortfall now rising to 5,000 by 1988, the Committee reviewed the mechanisms currently available, and the constraints; and suggested some additional proposals for action.

27 The supply of graduate manpower with IT skills can be increased through action in the areas of **first degree provision, post-graduate conversion, in-company training,** and **upgrading and updating.** The use of distance-learning techniques can play an important role in enabling supply to be increased in a cost-effective manner. Action in these areas will yield results over different timespans. Increased provision of first degree courses introduced in the 1985/86 academic year will not yield extra graduate manpower until 1988, whereas conversion would produce results in a year or two and retraining perhaps even sooner. A combination of measures is therefore necessary to meet industry's immediate and continuing requirements.

28 In the light of current estimates of demand, and of representations from individuals and organisations, including the Engineering Council[14], DES Ministers are currently considering with their colleagues the scope for creating additional **first degree** places in universities and polytechnics in technological disciplines currently in high demand, particularly electronic engineering and computing science. This tends to be described in terms of a "switch" from other subject areas, but complex questions of staffing and other resources arise which are not further discussed here. The Committee believes that its examination of the problem of IT skills shortages endorses the case for increased output of graduates in IT subjects and has indicated those areas in which the extra provision is required. But the Committee recognises that extra first degree places alone will not solve some of the difficulties identified.

29 The value of existing **conversion courses** for graduates is widely recognised. They can take the form of highly specialised courses for those from cognate disciplines, such as the physical sciences and other forms of engineering, or more general courses for those with less relevant degrees, which nevertheless enable people to apply IT effectively. In the short term, the conversion of those with less relevant degrees helps to meet unsatisfied demand, but in the longer term emphasis should turn to highly specialised courses for those with relevant backgrounds. Because the lead time is short, one-year conversion courses have a continuing and significant part to play in a robust strategy. Although the number of students emerging from conversion courses under the DES' IT in HE initiative is so far small, preliminary indications are that such students are readily employable. The case for extending the initiative seems strong and is under consideration by Ministers as a complement to extra first degree provision. Some companies are running or planning to introduce

conversion courses for technological and non-technological graduates in IT skills, and others recognise that more could be done in this area. The NAB have proposed extending the existing conversion courses available under the IT in HE initiative. This could be accomplished speedily. The relevance of the NAB proposals to industry's requirements is being considered as a matter of urgency.

30 Action is already under way in the areas of **upgrading** and **updating** through such schemes as TOPS and MAP. These might be extended, or better utilised. **In-house** training, including schemes in conjunction with educational institutions for both sponsored and unsponsored students, is often used to enable new graduate recruits to become fully effective.

31 The use of **distance or open learning** techniques will play an increasingly important role in the provision of IT skills. At graduate level a number of different initiatives are already in hand, but two worthy of particular mention are a Science and Engineering Research Council (SERC)/Open University scheme to provide two Masters Courses, one in manufacturing and the other in the industrial application of computers; and a tutored distance learning initiative is being discussed by a number of major industrial users of IT skilled manpower with the Alvey Directorate and the MSC to develop and offer a series of course modules in modern electronics and IT skills. Such courses should be attractive to companies who would find difficulty in releasing scarce staff for extensive periods of external study and could offer a speedy, partial solution to the problems under consideration. The Committee supports such innovation, particularly where it involves the use of IT to increase the cost-effectiveness of learning. The Tutored Video Instruction technique also holds out considerable promise in the area of updating.

32 The measures described above are making some early impact on the supply of IT skilled manpower. But there are a number of **constraints** inhibiting efforts to expand numbers and improve quality through conventional measures.

33 The first constraint is **financial.** Electronic engineers and computer scientists are expensive to train, and the resource costs of providing additional first degree and conversion places in higher education will be substantial, as will the opportunity costs of getting things wrong. In their further consideration of the scope for such expansion, therefore, Ministers are likely to take particular account of the extent to which costs might be shared by support from those sectors of the economy with the greatest manpower demand.

34 The second serious constraint is the availability of **teaching staff**. With the highest salaries currently commanded by experienced staff in industry, the recruitment of teaching staff is already a problem, as is evidenced by the relative difficulties experienced by universities in recruiting staff to fill IT posts under the DES' 'New Blood' initiative. Furthermore, the increase in the use of distance learning will, initially at least, be resource-intensive in terms of teacher time. Ministers therefore hope that industry will assist by the loan of (or financial support for) highly qualified staff to help in teaching at the forefront of technology.

35 The third major constraint is the availability of **accommodation and equipment**, both of which are in short supply.

36 An important aspect of any proposed expansion in the number of graduates with IT skills is the availability of a sufficient number of high quality young people with relevant A-levels (and BTEC equivalents). There has been a considerable growth in mathematics and science A-levels in recent years, but this pool of young people has attractive alternative outlets in other areas such as medicine and accountancy. Although the position has improved, the supply of good maths and physics teachers is still not entirely adequate. The Government is emphasising the importance of a broad curriculum to 16 which includes maths and science and is generally encouraging relevant studies. A number of other bodies, including the Engineering Council, are making major efforts to promote a positive attitude towards industry in schools. Their efforts are fully supported by the Committee. One particularly important initiative is the Women in Science and Engineering (WISE) year, jointly sponsored by the Council and the Equal Opportunities Commission. Women still only account for about 5 per cent of admissions and applications to electrical and electronic degree courses, a massive waste of potential in this area. Industry too has a vital part to play in encouraging young people to pursue courses in areas of key skill shortage by means of sponsorship and the provision of readily-accessible signals about industry's requirements through the pay and career structures offered to graduates, and through consistent recruitment policies. Industry can play a major role by developing links with schools either directly or through the network of Science and Technology Regional Organisations (SATROS) supported by the Department of Trade and Industry and some Local Education Authorities.

Section 6 — A New Partnership Between Industry and the Education System

37 Representatives of industry have presented an imaginative set of proposals aimed at overcoming some of the constraints noted in the previous Section of this Report and at encouraging a "partnership for change" to enable the education system to respond more effectively to industry's changing requirements.

38 Industry is ready to undertake the following initiatives:

i Higher Education

- Supply key executives as Visiting Professors and help with the supply of lecturers.

- provide consultancy and employment opportunities for academics to enhance dialogue at local level and increase the earnings of key individuals.

- provide equipment on loan or as gifts and give access to very expensive leading edge equipment which universities and polytechnics could not possess.

- commission universities and polytechnics to supply contract education, eg conversion courses, development courses, updating programmes etc.

- make key people available to help coordinate activities to tackle shortages.

- enter into training partnerships with academic bodies.

- establish "IT Training Companies" with equity participation by companies, academic institutions and Government. In this context the Committee welcomed the proposals put forward by DES to enable polytechnics to trade on their own account.

- increase sponsorship of students on relevant undergraduate and post-graduate courses.

- provide greater opportunities for students to obtain industrial experience within academic programmes.

- encourage greater interchange of views between industry and education.

ii Schools

- offer staff to teach part-time and to relate school work to industry.

- help train teachers by visits, secondments, exchanges and courses.

- provide equipment on loan or as gifts.

- Participate actively in programmes designed to promote vocational studies.

- Help schools to appreciate the vocational needs of children and how to respond to them.

Points for Action

39 Preliminary discussions between Government and industry have identified the following areas of agreement:

i The UGC and NAB will identify their teaching needs so that industry can gauge what assistance can be provided.

ii Institutions will be invited to identify their needs for equipment.

iii "Good practice" in giving students relevant industrial experience will be publicised.

iv A more formal system for regular teacher visits and secondments to industry will be examined.

40 Action along these lines, taken together with the other proposals submitted by industry, creates **a new partnership between industry and higher education** which should enable changing national skill requirements to be met in a more relevant, flexible and cost-effective way. The Government will vigorously pursue all these ideas including novel concepts such as the IT training companies. The Committee's Second report will review progress made in these areas.

APPENDIX I

List of Sources

1. 'Key Skills and the UK Semi-Conductor Industry' — Institute of Manpower Studies (IMS), October 1983
2. 'Manpower in the Electronics Industry' — Engineering Industry Training Board (EITB), May 1984
3. The Computing Services Industry Training Council (COSIT) — submission to House of Lords Select Committee on Science and Technology — sub-Committee 2, New Technologies (not yet published)
4. COSIT, op. cit.
5. EITB, op. cit.
6. 'Microelectronics in British Industry: the Pattern of Change' — Policy Studies Institute (PSI), March 1984
7. 'Special Manpower Needs' — Employment Market Research Unit (EMRU), Department of Employment (not yet published)
8. IMS, op. cit.
9. 'Graduates and Jobs' — Department of Education & Science, and Department of Employment: HMSO, June 1984
10. National Electronics Council (NEC) Survey, 1984 (published May 1984)
11. COSIT, op. cit.
12. National Computing Centre Membership Survey, February 1984
13. PSI, op. cit.
14. 'Policy Statement on Resources for Engineering Education' — the Engineering Council, February 1984

ANNEX I

Information Technology Skill Shortages Committee

John Butcher MP	Parliamentary Under Secretary of State for Industry
Hon Peter Brooke MP	Parliamentary Under Secretary of State for Education and Science
David Baldwin	Managing Director: Hewlett Packard UK
Christopher Ball	Chairman of the Board: National Advisory Body for Local Authority Higher Education
Dr J H Burnett	Principal — Vice Chancellor: University of Edinburgh
Mr G R Hall	Director: Brighton Polytechnic (representing The Engineering Council)
Geoffrey Holroyde	Director: Coventry (Lanchester) Polytechnic
Mr C Marr	Head of Electronics Section: National Economic Development Office
Mr B Oakley	Director: Alvey Programme, Department of Trade and Industry
Dr E S Page	Vice-Chancellor: University of Reading
Professor J Parnaby	Group Director — Manufacturing Technology: Joseph Lucas Limited
Mr T G Rogers	Director — Personnel and Europe: The Plessey Company plc
Mr D Stanton	Employment Market Research Unit, Department of Employment
Sir Peter Swinnerton-Dyer	Chairman: University Grants Committee
Sir Robert Telford	Chairman: The Marconi Company Limited
Mr J Wiltshire	Head of Occupational Policy Branch: Manpower Services Commission

Terms of Reference

ANNEX II

(i) To establish with more precision what employer demand for IT manpower at professional (graduate) and technician level is likely to be over the next 10-15 year period, with reference to the short, medium and long term;

(ii) To establish how far the education and training system is likely to meet these needs over these timescales on present financial plans;

(iii) To determine what steps should be taken by industry and others (a) to meet any shortfall, by additional support for the education system and by increased provision for training and (b) to improve signals from the employment market in matters such as manpower demand and vacancies, pay, career progression or sponsorship of students, recruitment etc.

Definitions

ANNEX III

The term IT and hence the scope of the Committee's activities may be said to cover:

- electronic systems and consumer electronics
- telecommunications and radio frequency engineering
- computing, software and hardware
- computing services
- knowledge based systems
- artificial intelligence
- communications between electronic data processors
- design and production of manufacturing systems, as distinct from their application.

The broad skills needed for IT and related sectors of industry and commerce may be disaggregated as follows:

- computer science, especially software
- electronic engineering
- software engineering
- mathematics
- physics and materials science
- systems engineering
- AMT
- other engineering, especially mechanical, design and production

ANNEX IV

Graduate Requirements by Discipline

1 It was agreed at the Committee meeting on 28 June that a quick survey of graduate requirements by discipline in major IT companies would be undertaken by Mr Rogers (Plessey).

2 This was done by asking 9 major companies two questions:

1) What is the distribution of your 1984 graduate intake by discipline?

2) What is your view of the intake you expect to require in 1989, and how would you wish this to divide by discipline assuming there are no supply constraints to prevent this?

3 The figures supplied are set out in Appendices A and B. The broad conclusions are:

	Question 1 1984		Question 2 1989		%
	No	%	No	%	Increase
Electronic Eng	1365	34	2335	37	71
Physics	439	11	655	11	49
Maths	226	6	375	6	66
Computer Sci	852	21	1415	23	66
Other Sci/Eng	629	16	692	11	10
Other	536	13	759	12	42
Total	4047	100	6231	100	54

4 It is apparent, therefore, that the major increases in demand will be for electronic engineers and computer scientists with a similar percentage increase for mathematicians (though the numbers for these are much smaller).

5 It should be noted that IBM and ICL have a different pattern of needs to serve the commercial data processing field with proportionately much larger marketing and sales teams to sustain.

6 In comments made by the participating companies there were notable reservations about the quality and content of Computer Science and IT courses pointing to the need for closer contact between education and industry.

Table 1: Graduate Requirements of Major Companies in the Electronics Industry 1984

	Mechanical Engineering	Electronic Engineering	Electrical Engineering	Physics	Maths	Computer Science	Other Science/ Engineering	Others	Total
Plessey	9	227	16	54	10	141	31	40	528
GEC	126	419	209	222	114	250	42	34	1416
S T C	15	140	15	35	20	87	25	50	387
Ferranti	30	180	5	60	30	155	—	10	470
British Telecom	10	140	25	40	20	60	5	—	300
Racal	12	150	8	10	8	45	20	7	260
IBM	—	60	—	—	—	—	—	240	300
ICL	5	29	—	12	19	85	15	135	300
Hewlett Packard	—	20	2	6	5	29	4	20	86
Total	207	1365	280	439	226	852	142	536	4047

Table 2: Projected Graduate Requirement 1989

	Mechanical Engineering	Electronic Engineering	Electrical Engineering	Physics	Maths	Computer Science	Other Science/ Engineering	Others	Total
Plessey	10	370	16	85	30	225	25	40	801
GEC	100	610	220	300	150	350	50	70	1850
S T C	20	300	20	50	40	185	40	45	700
Ferranti	35	360	5	120	70	320	—	10	920
British Telecom	12	210	30	40	25	75	8	—	400
Racal	15	300	12	25	20	80	30	18	500
IBM	—	80	—	—	—	—	—	280	360
ICL	8	40	—	15	20	90	20	207	400
Hewlett Packard	2	65	6	20	20	90	8	89	300
Total	202	2335	309	655	375	1415	181	759	6231

ANNEX V

Projected Home Graduate Output in Science and Technology

1 The tables following show projected home science and engineering graduate output disaggregated between individual disciplines. Tables 1 and 2 show the information for university and CNAA graduates separately, and Table 3 shows aggregate figures. (The home graduate proportion of total CNAA graduate output is estimated.)

2 The data, prepared by DES Statistics Branch on the basis of material obtained from the University Statistical Record and the CNAA, constitute new projections based on known policy decisions affecting intakes to the university and public sectors of higher education.

3 The figures exclude those currently undergoing post-graduate conversion courses through the DES IT in HE initiative: this will lead to an additional qualified output of some 750 computer scientists and 250 electronics engineers by 1985/86.

Table 1: University Home Graduates

G B First Degree Output (thousands)

	ACTUALS				PROJECTIONS							
	78/79	79/80	80/1	81/2	82/3	83/4	84/5	85/6	86/7	87/8	88/9	89/90
SCIENCE: Total	14.8	15.1	15.7	16.4	17.3	17.4	17.3	17.1	17.7	17.7	17.3	17.3
of which												
Agricultural Science			1.3	1.3	1.4	1.3	1.2	1.2	1.3	1.3	1.2	1.2
Biological Science			4.4	4.5	4.4	4.1	4.2	4.0	4.1	4.1	4.0	4.0
Mathematics (excluding computer science)			2.2	2.2	2.5	2.6	2.8	2.8	2.9	2.9	2.8	2.8
Computer Science			1.0	1.2	1.6	1.7	1.5	1.7*	1.7*	1.7*	1.6	1.6
Physics			2.0	2.2	2.4	2.5	2.6	2.5	2.6	2.6	2.5	2.5
Other Sciences			4.8	5.0	5.0	5.2	5.0	4.9	5.1	5.1	5.2	5.2
SOCIAL SCIENCE: Total	15.8	16.3	16.7	17.2	17.6	16.8	16.2	15.7	16.3	16.3	15.8	15.8
of which												
Hard			9.9	10.2	10.4	9.9	9.6	9.3	9.6	9.6	9.3	9.3
Soft			6.8	7.0	7.2	6.9	6.6	6.4	6.7	6.7	6.5	6.5
ENGINEERING: Total	6.8	7.1	7.5	7.9	8.1	8.3	7.9	8.1	8.7	8.6	8.4	8.4
of which												
Aeronautical			0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Chemical			0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8
Civil			1.3	1.3	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Electrical & Electronic			1.7	1.9	2.0	2.1	1.9	2.1*	2.2*	2.2*	2.0	2.0
Mechanical			1.3	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5
Production			0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Mining			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Metallurgy			0.3	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Other general & combined engineering			0.8	0.9	1.0	1.1	1.0	1.1	1.2	1.2	1.1	1.1
Surveying			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other technology			0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Combinations with other subjects			0.4	0.5	0.5	0.5	0.4	0.4	0.5	0.5	0.5	0.5
ALL OTHER SUBJECTS: Total	21.4	22.0	22.3	23.0	23.3	23.7	22.8	22.1	23.0	22.5	21.9	21.9
of which												
Education	1.1	1.2	1.2	1.3	0.9	1.0	0.9	0.9	1.0	1.0	1.0	1.0
Medicine	5.1	5.2	5.1	5.2	5.2	5.4	5.3	4.9	5.0	4.6	4.4	4.4
Architecture & other professional subjects	0.9	1.0	1.0	0.9	1.0	1.0	1.9	1.0	1.0	1.0	1.0	1.0
Arts:	14.4	14.6	14.9	15.6	16.1	16.3	15.8	15.3	15.9	15.8	15.4	15.4
of which												
Languages	8.1	8.4	8.6	9.0	9.4	9.2	8.8	8.6	8.9	8.9	8.7	8.7
Music & Drama	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.4	1.5	1.5	1.4	1.4
Other Arts	5.0	5.0	5.0	5.2	5.3	5.7	5.5	5.3	5.4	5.4	5.3	5.3
TOTAL	58.9	60.4	62.2	64.5	66.3	66.2	64.3	62.9	65.7	65.1	63.4	63.4

Including graduates from the IT Initiative. Totals may not sum due to rounding.

Table 2: CNAA Home Graduates

G B First Degree Output (thousands)

	ACTUALS					PROJECTIONS							
	78/79	79/80	80/1	81/2		82/3	83/4	84/5	85/6	86/7	87/8	88/9	89/90
SCIENCE: Total	2.3	2.0	3.6	3.1		4.0	5.4	5.9	6.5	7.1	7.1	7.1	7.2
of which													
Biological Science			0.8	0.7		0.9	1.2	1.3	1.4	1.5	1.4	1.5	1.5
Mathematics (excluding computer science)			0.3	0.3		0.4	0.5	0.6	0.6	0.7	0.7	0.7	0.8
Computer Science			0.6	0.6		0.7	1.0	1.1	1.4*	1.5*	1.5*	1.3	1.3
Physics			0.2	0.2		0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4
Other Sciences			1.7	1.4		1.8	2.4	2.6	2.8	3.0	3.1	3.1	3.1
SOCIAL SCIENCE: Total	6.6	5.1	7.8	6.9		7.7	9.6	9.8	9.8	9.7	9.2	8.8	8.7
of which													
Hard			5.4	5.3		6.0	7.5	7.6	7.6	7.6	7.1	6.9	6.8
Soft			2.4	1.6		1.7	2.1	2.2	2.2	2.1	2.1	1.9	1.9
ENGINEERING: Total	3.2	2.9	4.1	3.7		3.8	3.9	4.7	5.5	5.6	6.2	6.2	6.2
of which													
Aeronautical			0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0*[1]	0.0
Chemical			0.1	0.1		0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Civil			0.7	0.7		0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9
Electrical & Electronic			1.2	1.0		1.0	1.0	1.2	1.4	1.5*	1.6*	1.6*	1.6
Mechanical			0.8	0.8		0.7	0.7	0.9	1.1	1.1	1.2	1.2	1.2
Production			0.3	0.2		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Mining (including metallurgy)			—	—		—	—	0.1	0.1	0.1	0.1	0.1	0.1
Other general & combined engineering			0.6	0.5		0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8
Surveying			0.1	0.1		0.3	0.5	0.5	0.6	0.6	0.7	0.7	0.7
Other technology			0.2	0.3		0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5
ALL OTHER SUBJECTS: Total	9.0	10.7	14.7	12.1		13.0	15.1	16.7	16.3	15.9	15.1	14.5	14.2
of which													
Education	2.9	2.7	4.1	3.3		3.1	3.9	3.8	3.6	3.7	3.5	3.4	3.3
Medicine	0.5	0.5	0.6	0.6		0.6	0.7	0.8	0.8	0.7	0.7	0.7	0.7
Architecture & other professional subjects	0.9	1.4	1.9	1.6		1.8	2.1	2.3	2.2	2.3	2.1	2.1	2.0
Arts:	4.7	6.2	8.1	6.7		7.5	8.4	9.9	9.6	9.1	8.8	8.3	8.3
of which													
Languages	0.6	0.6	1.1	0.8		1.0	1.0	1.3	1.3	1.3	1.3	1.2	1.2
Music & Drama	3.8	5.5	4.6	4.4		4.7	5.1	5.9	5.9	5.6	5.4	5.1	5.1
Other Arts	0.3	0.1	2.4	1.5		1.8	2.3	2.7	2.4	2.2	2.1	2.0	2.0
TOTAL	21.2	20.7	30.3	25.8		28.5	34.0	37.1	38.1	38.3	37.6	36.6	36.4

[illegible]luding graduates from the IT Initiative.

[1] Figures for Aeronautical engineering output are very low in the public sector. Actual output for 1980/81 — 0.024.

Table 3: University/CNAA Home Graduates

G B First Degree Graduate Output

(thousands)

	ACTUALS					PROJECTIONS							
	78/79	79/80	80/1	81/2		82/3	83/4	84/5	85/6	86/7	87/8	88/9	89/90
SCIENCE: Total	17.1	17.1	19.3	19.5		21.3	22.8	23.2	23.6	24.8	24.8	24.4	24.5
of which													
Agricultural Science			1.3	1.3		1.4	1.3	1.2	1.2	1.3	1.3	1.2	1.2
Biological Science			5.2	5.2		5.3	5.3	5.5	5.4	5.6	5.5	5.5	5.5
Mathematics (excluding computer science)			2.5	2.5		2.9	3.1	3.4	3.4	3.6	3.6	3.5	3.6
Computer Science			1.6	1.8		2.3	2.7	2.6	3.1*	3.2*	3.2*	2.9	2.9
Physics			2.2	2.4		2.6	2.8	2.9	2.8	3.0	3.0	2.9	2.9
Other Sciences			6.5	6.4		6.8	7.6	7.6	7.7	8.1	8.2	8.3	8.3
SOCIAL SCIENCE: Total	22.4	21.4	24.5	24.1		25.3	26.4	26.0	25.5	26.0	25.5	24.6	24.5
of which													
Hard			15.3	15.5		16.4	17.4	17.2	16.9	17.2	16.7	16.2	16.1
Soft			9.2	8.6		8.9	9.0	8.8	8.6	8.8	8.8	8.4	8.4
ENGINEERING: Total	10.0	10.0	11.6	11.6		11.9	12.2	12.6	13.6	14.3	14.8	14.6	14.6
of which													
Aeronautical*[1]			0.2	0.2		0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Chemical			0.8	0.8		0.8	0.8	0.8	0.9	1.0	1.0	1.0	1.0
Civil			2.0	2.0		1.9	1.8	1.8	1.9	1.9	2.0	2.0	2.0
Electrical & Electronic			2.9	2.9		3.0	3.1	3.1	3.5*	3.7*	3.8*	3.6*	3.6
Mechanical			2.1	2.2		2.1	2.1	2.3	2.5	2.6	2.7	2.7	2.7
Production			0.4	0.4		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Mining & Metallurgy			0.5	0.5		0.4	0.5	0.6	0.5	0.5	0.5	0.5	0.5
Other general & combined engineering			1.4	1.4		1.5	1.6	1.6	1.8	1.9	2.0	1.9	1.9
Surveying			0.2	0.2		0.4	0.6	0.6	0.7	0.7	0.8	0.8	0.8
Other technology			0.5	0.6		0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9
Combinations with other subjects			0.4	0.5		0.5	0.5	0.4	0.4	0.5	0.5	0.5	0.5
ALL OTHER SUBJECTS: Total	30.4	32.7	37.0	35.1		36.3	38.8	39.5	38.4	38.9	37.6	36.4	36.1
of which													
Education	4.0	3.9	5.3	4.6		4.0	4.9	4.7	4.5	4.7	4.5	4.4	4.3
Medicine	5.6	10.2	5.7	5.8		5.8	6.1	6.1	5.7	5.7	5.3	5.1	5.1
Architecture & other professional subjects	1.8	2.4	2.9	2.5		2.8	3.1	3.2	3.2	3.3	3.1	3.1	3.0
Total arts:	19.1	15.2	23.0	22.3		23.5	24.7	25.7	24.9	25.0	24.6	23.7	18.6
of which													
Languages	8.7	9.0	9.7	9.8		10.4	10.2	10.1	9.9	10.2	10.2	9.9	9.9
Music & Drama	5.1	6.8	6.0	5.8		6.1	6.6	7.4	7.3	7.1	6.9	6.5	6.5
Other Arts	5.3	5.1	7.4	6.7		7.1	8.0	8.3	7.7	7.8	7.5	7.35	7.3
TOTAL	79.9	81.2	92.5	90.3		94.8	100.2	101.4	101.0	104.0	102.7	100.0	99.8

*Including graduates from the IT Initiative. Totals may not sum due to rounding.

ANNEX VI

Manpower Services Commission TOPS Sponsored High Level Courses 1984/85

Subject	Level	No of courses	No of trainees
Flexible Manufacturing Systems	MSc	4	51
	HND	1	18
Computer Aided Engineering	MSc	1	10
	HND	4	78
Computer Aided Design	MSc	3	35
Robotics	MSc	2	25
	HND	1	20
Telecommunications	MSc	3	45
	HND	2	32
Opto-electronics	MSc	1	10
	HND	2	40
Industrial Data Processing	HND	1	24
Software Engineering	MSc	1	15

Trainees on these courses which last about 46 weeks full-time, receive TOPS allowances.