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Computers in Ireland

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PREFACE

This study was undertaken primarily for the purpose of gathering factual information about the present stage of development of computing in Ireland and of assessing the likely future developments. It aimed also at identifying measures needed to ensure that developments are encouraged along lines likely to be of most benefit to the country. It was felt that such a study was timely, since computing is the fastest growing industry in both Britain and the US and is quite evidently now growing rapidly here too. No previous investigation having been carried out, it was decided that this one should be a broad survey of the whole field. Studies in depth of particular problem areas might then be undertaken later. A number of such problem areas are identified, and are discussed in the report: we are very conscious of having merely scratched the surface.

The whole report is in two parts. In Part I, we set out an analysis and interpretation of the statistical data that were collected by means of questionnaire surveys, together with calculations of future growth projections based on these data, and on developments in other countries. Detailed tabulations of the replies to the questionnaires are provided in the appendices A and B. In Part II we go on to report on development trends at a sector level and present our findings on questions of development policy for the 1970's.

Since our survey was carried out, the Computer Utilisation Group of the OECD Committee for Science Policy (on which Ireland is represented by computer specialists from Civil Service Departments) have developed a computer questionnaire for use by member countries. The purpose of the questionnaire is to enable countries to gather information on computing in a standard form and thus facilitate international comparisons. We were in touch with the OECD regarding the development of their questionnaire which covers much the same areas as those used in our survey.

The Department of Finance are currently undertaking a survey of computer installations using the OECD questionnaire. The results of this survey will up-date the statistics set out in this report. It is to be hoped that an annual survey of this kind will now be carried out to enable trends in computer developments to be identified and to allow any necessary measures to be taken in good time.

ACKNOWLEDGEMENTS

While responsibility for the content of this report is entirely mine, I wish to acknowledge the substantial help in its preparation received from many individuals and in particular from Mr. Michael G. Tutty of the Department of Finance who was seconded to work full-time on the survey over the period from September, 1968 to March, 1970. Without his dedication to this task, this report could hardly have been completed. His patient collation of the data and drafting and redrafting of the material has made my task a much more enjoyable one than it might well have been.

I wish to thank particularly also Mr. Tony Moynihan of the Irish Management Institute and Mr. Frank Land of the London School of Economics, who both contributed their expert advice on many questions and devoted a great deal of time to this project. The "we" of the report refers to the above-named three individuals as well as to myself.

I am indebted to Mr. Seamus Gaffney, Department of Finance, and to his staff in the ADP Unit, with all of whom I have kept in close touch, particularly in connection with the public sector.

In the course of this survey many individuals actively engaged in computing were consulted, from whom much of the material included in the report has been gleaned. Invariably the assistance received was courteous and constructive. I am grateful to the many firms and individuals who conscientiously filled up lengthy questionnaires.

Computers in Ireland

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INTRODUCTION AND SUMMARY

> "In the nineteenth century the first industrial revolution replaced manual labour by machines. We are now living in the second industrial revolution, and every year we are replacing the labour of human brains by a new kind of machine—computers." [1, p. 24]

This comment from Servan-Schreiber is typical of many which now appear almost daily in publications and speeches, prophesying a major change in our economic and social environment due to the computer. These prophecies provoke widely different reactions. On the one extreme are the pessimists who foresee mass redundancy of humans or a progression towards a computer-dominated 1984 and who are thereby driven to a neo-luddite attempt to block the spread of computers. On the other extreme are the optimists who conjure up visions of a utopian state in which man will no longer have to toil in order to live but can relax, commune with nature and turn his mind to higher things, leaving the computer to look after the supply of his material needs.

Neither of these extremes is likely to prove realistic. One thing is certain, however—computers will have a considerable impact on all spheres of activity.

*The author is Professor of Statistics at Trinity College Dublin. His enquiry was commissioned by the Institute which has accepted the paper for publication. The author is responsible for the contents of the paper, including the views expressed therein.

They will not replace the human brain but rather assist in extending human brain-power in tackling new problems and seeing problems in a new light.

The most interesting and beneficial uses of the computer are now only at the stage of being recognised. Most organisations in this country, and indeed in most countries, are still at the first level of computer usage—where it is used as a "super-clerk" to replace routine manual or mechanised clerical operations. The development of more sophisticated applications can only proceed slowly, being built up step by step in the light of experience gained in the lower level applications.

Nevertheless it is desirable that we should plan ahead to ensure that we are not taken unawares by developments or left behind by them.

In this Study, we have gathered information about the present stage of development of computing in this country and the likely future developments. We have looked also at measures which may be needed to ensure that computers will be used in the future to the optimum extent and in the most efficient and co-ordinated manner.

In Part I of the report, we analyse the current "state of the art" in regard to the use of computers and the personnel engaged on computing. Information in this area was gathered by means of questionnaires issued to existing users of computers and to a sample of the personnel engaged in computing. The replies to these questionnaires are summarised in Chapter 2. Detailed analyses are given in Appendices A and B.

The future growth of computing is then considered. The existing users and a sample of other organisations were asked about their future plans. In the light of these plans and of studies carried out in other countries, some estimates of future growth are set out in Chapter 3.

Before embarking on this analysis, we consider briefly in Chapter 1 the current stage of development of computing in Ireland, setting it in a world perspective. Very great developments in the technology have taken place since computers were first introduced into business organisations in 1950. The trend has been steadily towards making the computer increasingly user orientated. In the early days, the problems lay in getting the computer to work at all.

This user orientation represents a fundamental change in the computing scene, with important repercussions. Originally computer applications were controlled and carried through by an engineer with some knowledge of the business and a screwdriver in one hand. To-day the important applications involve re-organisation of the structure of a company, and they must be directed and controlled by the Company's own decision-makers who possess an adequate knowledge of computer capabilities.

The other important repercussion is that the applications to-day tend to be such that their implementation often requires very substantial investment in terms of man-hours of systems analysis and programming.

In the light of these developments, we look first, selectively, in Part II of the report at a number of broad sectors in the economy. In some of these sectors we

have found the beginnings of a development towards sector level co-operation in hardware and software and in the promotion of an awareness of computer potentialities. In others, we see a clear need for such co-operation.

In Chapter 5 in the light of the results in Part I and of our discussions with industry experts and users, we present our findings on certain institutional needs, in particular the need for some form of central computing council to co-ordinate activities at the national level.

We have appended a short glossary of the main technical terms used in this report (Appendix F). For a comprehensive dictionary of computer jargon the reader is referred to [2].

The general conclusions of this report may be briefly summarised as follows:

1. There is great potential for computer developments, particularly in a number of broad sector groupings, with the possibility of substantial benefits accruing to the economy. If the full potential is to be achieved in many individual sectors, some measure of co-operation will be necessary. There are a number of obvious steps that could be taken in this regard.
2. The basic need is for top level computer education in the sector groupings.
3. Steps should be taken to promote and co-ordinate computer developments: a national strategy should be evolved.
4. There is a need for much wider dissemination of information about computing, both of a specialist kind to users and also of a general kind to the public through adult education and in school curricula.

PART I

AN ANALYSIS OF THE CURRENT SITUATION AND PROJECTIONS OF FUTURE GROWTH

1. THE GROWTH OF COMPUTING

Definition of a Computer

A computer is a device capable of automatically accepting and storing data, applying a sequence of processes to the data and supplying the results of these processes; it operates under a program of instructions which can be accepted and stored like data and can be altered within the computer. The three essential characteristics of a computer are:

(1) automatic working,

(2) its ability to store instructions, and

(3) its ability to make decisions in the light of the data or of intermediate results and alter accordingly the course of the work.

Early developments

The development of computers was foreseen by Charles Babbage in the early nineteenth century but, because of limitations in the mechanical technology of his time, he was unable to complete the construction of the machine himself.

It was not until 1946 that Babbage's ideas bore fruit when the University of Pennsylvania in the US completed the first electronic computer—the ENIAC (Electronic Numerical Integrator and Calculator). This was followed in 1949 by the development of the EDSAC (Electronic Delay Storage Automatic Calculator) in Cambridge University in Britain.

A remarkably early commercial interest in computing was taken by the London firm of caterers, J. Lyons & Co. Ltd. This company was to some extent financially involved in the EDSAC project and by 1949 was actually building its own machine, LEO I, which two years later was successfully programmed to do a simple commercial job and by 1954 was in full operation, carrying out a large payroll job, a teashops order processing job based on data supplied by

150 teashops and a tea stocks analysis job providing management information [3]. LEO I was the first computer to be designed and built for commercial work, as distinct from mere mathematical calculations. The following is an extract from a memorandum to the board of J. Lyons, written twenty-three years ago, which led to the decision to build LEO I:

> "Here for the first time, there is a possibility of a machine which will be able to cope, at almost incredible speed, with any variation of clerical procedure, provided the conditions which govern the variations can be pre-determined. What effect such a machine could have on the semi-repetitive work of the office needs only the slightest effort of imagination . . . We feel, therefore, that the Company might well wish to take a lead in the development of the machine and indeed that, unless organisations such as ours, namely the potential users, are prepared to do so, the time at which they become commercially available may be unnecessarily postponed for many years" [3, p. 26].

In the early days, the problems lay in getting the computer to work at all and the limitations on its use were primarily technical ones. Since then there have been extraordinary developments in technology. Computers are now in their third and heading towards their fourth "generation", each new range of models bringing substantial advances in speed, smallness of size and reliability. The computer has developed into a highly sophisticated management tool and the limitations on its use now reside in the ability of management to take advantage of its capabilities.

Uses of Computers

Notwithstanding the Lyons' work, the orientation of computers was initially strongly towards scientific and mathematical applications. Their potential for dealing with long and complex calculations was easily recognised. Growth of commercial work was slower, principally because applications requiring much handling of data were hindered by the slow speeds of input and output devices compared with internal processing speeds. Here, the early applications of computers were largely in mechanising routine clerical and accounting procedures. The computer was used as a super-clerk with the ability to carry out routine tasks more efficiently and economically than the manual systems or punched-card systems previously used.

In its capacity as a super-clerk, the computer has certainly paid its way and continues to do so. It brings savings in costs—though these are often fairly marginal—together with accuracy and timeliness of the output, increased flexibility and the capacity to absorb, without disruption, increasing volumes of business or peak loads.

It is now well recognised that this is only the first and least significant level of computer usage [4]. Computers can be used in business organisations for more

sophisticated types of applications. They can help managers and administrators to extend their ability to co-ordinate and control their sphere of activity by such means as integrating different jobs and providing better and more timely information for decision-making. They can help in the management process itself, not just in the activities under the supervision of management.

As the technology has improved and as a fuller appreciation of the capabilities of computers has come about, the boundaries of the potential computer applications have been ever-widening. The vast bulk of computing is now in the non-numerical areas. They can deal with any structured problem from simple payroll to crime prevention, traffic control or playing a good game of chess.

Growth of Computer Installations

The rate of growth of computer installations has been high, particularly in the last ten years. There is no sign of any slackening off in the rate of growth. Table 1.1 gives some recent statistics.

TABLE 1.1: *Number of computers installed at 1st January*

Year	*USA*	*UK + EEC*	*Japan*
1960	3,612	479	37
1965	22,495	5,018	1,164
1966	29,142	7,634	1,624
1967	39,516	9,543	2,302
1968	52,000	13,270	3,500
1969*	68,500	19,750	5,100
1970†	85,000	29,000	7,500

*Estimated. †Forecast.

Source: "International Management", November 1969, McGraw-Hill.

The recent annual growth rates have been about 30 per cent in the US and 40–50 per cent in Europe and Japan.

Development in Ireland

For the purposes of this study, we have concentrated on computers of a size likely to have a significant impact on an organisation. We have therefore omitted desk-type and other small computers and have looked only at computers of a capital value of £30,000 or more.

At the end of 1969, we had 59 computers installed in this country in 53 organisations with a total capital value of about £8 m. The first computer wa

installed by Comhlucht Siuicre Eireann in 1958. Growth was slow up to 1964, by which time only 8 organisations had installed computers. The rate of growth since then can be seen from Table 1.2. which sets out information in respect of the 50 organisations about which we have the necessary data:

TABLE 1.2: *Growth in number of computer installations in the Republic*

Year	*Installations*	*Installations replaced*	*Net cumulative Installations*
1964	6	1	13
1965	3	—	16
1966	3	1	18
1967	18	1	35
1968	13	3	45
1969	10	5	50

A big rise in the number of installations occurred in 1964 with an increase from 8 to 13 in the total number of organisations with computers installed. The next two years brought a slow rate of growth. In the last three years, the rate of increase has been high. A significant factor now is the replacement of existing computers by more modern or bigger models.

In addition to the organisations with computers installed, some 250 others are using bureau facilities, either using the commercial bureaux or using spare time on other computers. Here too, the rate of increase in the number of bureau users has grown substantially in the last three years. Table 1.3, which sets out the date of commencement in the case of 52 organisations for which information is available, shows that 75 per cent of them commenced using a computer in the last three years.

TABLE 1.3: *Year when bureau services were first used*

Year	*Number commencing each year*	*Cumulative total*
pre-1965	5	5
1965	5	10
1966	3	13
1967	11	24
1968	13	37
1969	15	52

The total annual expenditure on computing by all of these organisations is in

the region of £4.5 m. Total employment on computer work is of the order of 2,250.

Computing is therefore already a substantial activity in this country.

2. THE CURRENT SITUATION

The information in this chapter is derived in the main from two questionnaire surveys—one in June 1969 of organisations with a computer installed, the other in December 1969 of organisations using computer bureau facilities. It must be borne in mind therefore, that the figures given relate to mid-1969, and they will generally have risen rapidly since then, as indicated in Chapter 4 below. The surveys are analysed in detail in Appendices A and B. The relevant parts of these appendices are indicated after each section heading below.

2.1 *Numbers and Expenditure* (A.1, B.1)

In mid-1969, including the computer bureaux, 49 organisations in the Republic had a total of 54 computers installed. Forty of the computers were in 38 commercial organisations,[1] 8 in 7 universities/research institutes and 6 in 5 computer bureaux. In addition, it is estimated that there were 250 organisations using a computer on a bureau basis. Between the date of our survey and the end of 1969 4 additional organisations installed a computer and one organisation added a second computer to its installation, making a total of 59 computers installed in 53 organisations.

The organisations using computers are widely distributed throughout the various economic sectors, as shown in Table 2.1. Many of the largest organisations in the country are using computers. Of the 50 largest Irish industrial companies included[2] in the *Irish Times* list at 31st December, 1969, 18 had a computer installed (including 2 with small computers), one had a computer on order and 8 were using a computer bureau—see Table 2.2. Among the top 10 organisations, 8 had computers installed (including one with a small computer), one had a computer on order and one was using a computer bureau.

Computer usage is not restricted to the larger organisations. Many small organisations are using computers, particularly by availing of computer bureau services.

The total number of personnel employed on computer work is estimated at

[1]The term "commercial organisation" is used to include central and local government authorities and public and private bodies engaged on commercial-type activities, as opposed to organisations engaged on educational or research activities. The commercial organisations with a computer installed will be referred to as "commercial in-house users" to distinguish them from the bureau users.

[2]Of the 37 commercial organisations with computers installed in the Republic, only 29 were eligible for inclusion in the Irish Times list—being registered Irish companies having their ordinary shares quoted on the Dublin Stock Exchange.

TABLE 2.1: *Breakdown by sector of organisations using computers—position at December, 1969*[3]

Sector	*In-house installations*	*Sample of 96 Bureau users*
Agriculture, forestry and fishing	—	—
Transportable goods industries:		
Mining and quarrying, turf production, bog development	2	1
Manufacturing:		
Food	5	8
Drink and Tobacco	4	1
Textiles, clothing and footwear	3	1
Paper, printing and publishing	3	4
Chemicals and chemical products	1	10
Clay products, glass cement, etc.	2	1
Metal and engineering (incl. vehicles)	3	8
Other manufacturing	1	3
Building, construction and Services:		
Building and construction	—	1
Utilities (gas, water, electricity)	1	1
Transport and communications	2	3
Banking, insurance and finance	2	7
Commerce:		
Wholesale distribution	4	13
Retail distribution	2	3
Other	—	5
Public administration and defence	6	16
Universities, research institutes, other educational establishments	7	1
Data processing services	5	—
Other services	—	9
Total	53	96

TABLE 2.2: *Organisations included in the Irish Times "50 largest Irish industrial companies" at 31 December, 1969*

	Top 10 organisations	*Top 50 organisations*
Computers installed	8	18
Computers on order	1	1
Using computer bureau	1	8
Not using computing facilities	—	23

[3]Four new installations since our mid-1969 survey have been included.

2,250,[4] as set out in Table 2.3. As can be seen from this table, 55 per cent of these personnel are employed by commercial in-house users and a further 34 per cent are employed by bureau users.

The categories[5] of staff employed vary greatly between the different types of organisations, as shown in Table 2.4. For all users, data preparation and control staff form 64 per cent of total employment. This varies from 32 per cent in the case of the universities/research institutes to 82 per cent in the case of the bureau users. Systems and programming staff plus the EDP Manager account for 25 per cent of all employment, varying from 18 per cent for the bureau users to 47 per cent for the universities/research institutes.

The estimated total annual direct expenditure on computing (excluding overheads such as accommodation, light, heat, etc.) by all commercial in-house users, universities/research institutes and bureau users is running at the rate of £4·5 m.[6] The total direct expenditure for the different categories of user is shown in Table 2.5.

TABLE 2.3: *Number of people employed on computer work at the end of* 1969

Category	*Commercial in-house*	*Universities/ Research institutes*	*Bureau users*	*Commercial bureaux*	Total
EDP manager	41	4	20	—	65
Operations manager/supervisor	40	4	—	—	44
Systems analysts	77	2	53	18	150
Programmer/ analysts	58	8	40	—	106
Programmers	162	15	26	34	237
Operators	147	9	—	28	184
Data control staff	159	5	119	—	283
Data preparation staff	547	15	507	94	1,163
Other	—	—	—	22	22
Total	1,231	62	765	196	2,254

A breakdown of the annual expenditure under different heads is summarised in Table 2.6. Among the commercial in-house users, hardware and peripheral equipment accounts for just over 50 per cent of expenditure, personnel for 40 per cent. The smaller the installation, the smaller the percentage spent on

[4]This estimate is based on the figures supplied by respondents, grossed up to take account of the non-respondents. The figures from which the staff of the commercial bureaux are estimated are set out in Appendix B.

[5]Job descriptions of computer personnel are given in Appendix C.

[6]This estimate has been derived by grossing up the figures supplied by respondents as set out in Appendix A.

TABLE 2.4: *Percentage of total computer staff employed in each category of staff*

Category	*Commercial in-house*	*Univerities/ Research institutes*	*Bureau users*	*Commercial bureaux*	All
EDP manager, systems and programming staff	28	47	18	27	25
Operations manager/supervisor and operators	15	21	—	14	10
Data control and data preparation staff	57	32	82	48	64
Other	—	—	—	11	1

TABLE 2.5: *Direct annual expenditure*

Category		*Number of Organisations*	*Total Expenditure* (£'000)	*Average Expenditure* (£'000)
Commercial in-house users	Large	3	1,328	443
	Medium	20	1,348	67
	Small	18	576	32
	All	41	3,252	79
Universities/Research Institutes		7	244	35
Bureau Users		250	975	4
		Total	£4,471	

hardware—39 per cent in the small installations compared with 43 per cent in the medium and 63 per cent in large installations. Staff costs form a very small proportion of expenditure by the universities/research institutes—26 per cent. This reflects the large number of part-time users such as students and teaching staff in respect of which no salaries would be included under computer personnel.

Among the bureau users, the principal item of expenditure is the sum paid to the computer bureaux for the use of their facilities. Only the large users have any significant expenditure on personnel—32 per cent of their total expenditure is on staff costs.

TABLE 2.6: *Breakdown of direct annual expenditure*

Category	*Percentage Expenditure on*	*Computer Personnel*	*Computer Hardware and Peripherals*	*Computer Bureau Services*	*Other*
Commercial In-house Users	Large	32	63	—	5
	Medium	46	43	—	11
	Small	51	39	—	10
	All	40	51	—	9
Universities/Research Institutes		26	63	—	10
Bureau Users	Large	32	8	55	5
	Medium	4	5	88	3
	Small	—	—	99	—
	All	25	7	64	4

The percentage of staff expenditure for each category of staff is set out in Table 2.7. The percentage of staff expenditure going on systems and programming staff is much greater than the corresponding figures for staff employed given in Table 2.4, reflecting the higher salaries of this category of staff.

TABLE 2.7: *Percentage of the annual expenditure on computer staff devoted to each category of staff*

Commercial	*Commercial in-house*	*Universities/ Research Institutes*	*Bureau Users*
EDP manager, systems and programming staff	43	58	41
Operations manager/supervisor and operators	18	25	—
Data control and data preparation staff	39	18	59

2.2 *Utilisation of Capacity* (A.2.)

At present the computers are being used mainly for up to 40 hours per week—the equivalent of one shift five days per week—or for 41–80 hours per week. Forty-three per cent of the commercial users fall into each of these categories.

There will be a trend towards greater utilisation in the future. Those using the computer for not more than 40 hours per week will fall to 20 per cent.

Twenty-nine per cent will be using their computer for 80–120 hours per week—treble the present percentage in this category—and 11 per cent will be using it for more than 120 hours per week—almost double the present percentage.

This trend reflects the usual pattern of building up usage as more applications are developed. As would be expected, the organisations about to install a computer will be using it initially for about 40 hours per week.

The projections of future usage in Ireland show a higher utilisation than was expected by British organisations at the time of the Ministry of Labour survey [5, Appendix 13].

Among the universities/research institutes, usage varies greatly from less than 40 hours per week to continuous operation six or seven days a week. Little change is expected in the future.

Nearly half of the commercial in-house users allow time on their computer to be used by other organisations. This is significantly higher than in Britain—the Ministry of Labour survey found only 10 per cent giving time in this way [5, p. 35]. There is a direct relationship between the size of the installation and its use by outsiders—100 per cent in the large, 47 per cent in the medium and 33 per cent in the small category allow time for outside use.

Routine data processing is the main outside use made, with program development also significant. The total number of hours used per month by outsiders is 786, but 43 per cent of this is accounted for by one medium sized installation. The average number of hours used per month is 56, but this falls to 34 when the one major organisation is excluded. In only two cases, one large and one medium, does the usage exceed 100 hours per month.

Time is made available generally both during and outside the normal shifts. It is used mainly by non-associated organisations. In most cases, a charge is made for the time used.

Half of the organisations would be willing to make time—or further time—available to other organisations. There is a significant difference here between those already giving time and the others—69 per cent of the former have further time available; only 37 per cent of the latter would be willing to make time available. The total number of hours which they would be willing to make available is 1,603 per month, an average of 94 hours per installation and more than twice the number of hours already made available. The small installations lead the field here with an average of 121 hours per month but when one installation with over 450 hours available is excluded, this average falls to 51. Most of the time which can be made available is outside the normal shifts.

Five of the university/research institutes allow time on their computer to be used by other organisations. A total of 64 hours are used, 50 of them being on one installation. This is made available mainly during the normal shifts and a charge is made.

Four would be willing to make further time available. In the case of the three which supplied estimates, this further time totals 150 hours per month.

Taking together the number of hours at present made available to outside

organisations and the number which organisations would be willing to make available, it seems that an average of 62 hours per installation is available for use by other organisations, of which less than one-third—20 hours—is at present being used.

The significance of this time being available is diminished by a number of reasons:

(1) Most of the additional time available is outside the normal shifts i.e. at night or at weekends; there are some jobs which would not be suitable for processing at these times e.g. payroll where a quick turnaround would be required and staff might have to be available to deal with errors.

(2) In most cases, all that would be made available is the computer installation itself. The users would have to do their own systems, programming, data preparation and operating. This might be suitable for an organisation using time as a supplement to in-house operations but other users would miss the benefits of the advice and assistance provided by the commercial bureaux—this is important now that the cost of the actual computer is less than 50 per cent of the total cost of computer applications.

Nevertheless, there are many jobs for which spare capacity on an existing installation would be appropriate. Availing of this time would be of benefit to the economy in ensuring that optimum use is made of our investment in expensive capital equipment.

Few of the commercial organisations (12 per cent) make use of time on a computer other than their own—except under a standby arrangement. Three of the universities/research institutes do so. The main reason for using another computer is to make use of facilities not available on their own installation—e.g. larger core storage or disc facilities.

2.3 *Hardware* (A.3, A.4.)

As well as the increase in recent years in the number of computer installations, the average capital value has been increasing also. The average capital value is now £149,000, compared with £113,000 in 1967 and £92,000 in 1964.

Most of the computers installed by the commercial users are rented rather than purchased—71 per cent as against 29 per cent. None of them has been leased from an intermediary. In the case of the universities/research institutes the position is rather different—only one of the eight computers has been rented, the rest being purchased.

In 43 per cent of the present commercial installations, there are no tape or disc drives available. These are mainly small installations—none of the large installations and only 24 per cent of the medium installations fall into this category, compared with 73 per cent of the small installations. Eleven per cent of the installations have both disc and tape facilities, 20 per cent have discs only and 26 per cent have tapes only.

The trend towards tape and disc facilities can be seen by comparing, where appropriate, the present installations with those that they replaced and by comparing the present installations with proposed upgradings or replacements. The trend is particularly clear in the case of planned changes—among the 15 organisations which propose to change their installations, 11 have not at present got any disc or tape facilities but all of them will have one or both of these facilities in the future.

Four of the seven university/research institute installations have no dics or tape facilities, one has disc facilities and the other two have both discs and tapes. Two of the organisations which have no disc or tape facilities propose to acquire both.

Most of the commercial users have card input. Twenty per cent have paper tape input either as well as or instead of punched cards. One organisation also uses terminal input. The position is generally the same in the universities/research institutes. One of them is using terminal input.

Output in both categories is provided mainly by line printers and punched cards. Paper tape and character printers are also used. Graphic display output is used by one commercial user and one university/research institute.

Data preparation is carried out mainly by using automatic key punches and verifiers for punched cards. Paper tape is produced by special punch and verify machines, by typewriters with by-product paper tape or by accounting machines. One commercial organisation uses mark sense readers.

In the case of the bureau users, punched cards are the main type of input used, though a substantial number are using paper tape—40 per cent of those that do their own data preparation. In almost 40 per cent of the bureau users, the computer input is produced as a by-product of another operation—e.g. as a by-product from accounting machines.

A change in configuration—either upgrading or replacement—has either been made or is proposed by over 70 per cent of both the commercial in-house users and the universities/research institutes. The introduction of new application and anticipated growth of the organisations concerned are the principal reasons given. Technological advances/obsolescence are also important reasons.

Stand-by arrangements, whereby access to another computer will be available in the case of breakdown, are normal practice among the commercial users. Only 15 per cent have not made any such arrangements. The universities/research institutes have not generally made stand-by arrangements—only two of the seven have done so. Presumably their applications are less time-critical than those of the commercial users.

In most cases—about 80 per cent—the stand-by arrangements are informal. Generally they are made with the computer manufacturer or with another non-associated organisation. In most cases, the arrangements are reciprocal. Half of the organisations have had to make use of the stand-by facilities at some time.

Prior to the introduction of computers, almost all the commercial in-house

users were using some form of mechanical or electronic data processing equipment. Most of them—80 per cent—were using punched card equipment; many of them—29 per cent—were using accounting machines; some were using both.

This is in line with British experience—76 per cent of those involved in the Ministry of Labour survey had been using punched card equipment prior to the introduction of the computer and 70 per cent had been using accounting machines [5, p. 15].

Five of the seven universities/research institutes were using this type of equipment.

Only 44 per cent of the bureau users were previously using other data processing equipment for the work now computerised. They were mainly using accounting machines.

More than half of the commercial in-house users are still using mechanical or electronic equipment as well as the computer. It seems that the computer has replaced punch card equipment quite extensively. Only one organisation has ceased entirely to use their accounting machines. A further transfer of work to the computer is expected by almost all of these organisations within the next two years.

The organisations now installing a computer are following the same pattern as their predecessors—they are all using some other equipment and expect to transfer all the relevant work to the computer within the next two years.

Six of the universities/research institutes are now using other data processing equipment, mainly accounting machines. Some of the work involved will be transferred to the computer within two years.

Fifty-eight per cent of the bureau users are using other data processing equipment, again mainly accounting machines. In over 30 per cent of these cases, all of the work will be transferred to the computer within two years. Some will be transferred in a further 25 per cent of cases.

2.4 *Data Transmission* (A.5.)

At the time of survey, five organisations were using data transmission facilities. Three of them use on-line transmission, two use off-line transmission. Three of these organisations are universities/research institutes. The other two are commercial in-house users.

A further nine organisations expected to use data transmission facilities in the future—seven commercial in-house users and two universities/research institutes. Six will be using on-line facilities, three using off-line facilities. The bureau users were not questioned about data transmission.

2.5 *Applications and Software* (A.6).

At present, computers are being used principally in the marketing (including sales, distribution) and finance (including costing, management accounting)

areas. Marketing is the more important for the commercial in-house users—36 per cent of usage against 20 per cent in the finance area. Finance is the more important for the bureau users—49 per cent against 26 per cent for the marketing area.

The most important area for the universities/research institutions is the scientific/research area, accounting for 62 per cent of their usage. This area accounts for less than 1 per cent of the commercial in-house users applications and for 5 per cent in the case of the bureau users.

Program development and maintenance absorbs a substantial amount of computer time—13 per cent in the case of all the in-house users.

Future projections do not reveal any marked change in the percentage of computer time devoted to the different areas. A greater proportion will be allocated to the production (including purchasing, stock control) area at the expense of the marketing and finance areas. The commercial in-house users expect to more than double the time devoted to scientific/research applications.

Few of the commercial in-house users or the bureau users have made use of application packages—29 per cent and 18 per cent respectively. Among the in-house group, size of installation does not seem to affect the use of packages. Among the bureau users, 50 per cent of the large users have availed of packages while few of the others have done so.

The reasons for the small usage may be:

(i) that the available packages cover mainly technical areas rather than e.g. the basic commercial applications normally required by these organisations;

(ii) that the packages would have to be modified to suit Irish conditions e.g. tax in DCF calculations; and

(iii) that some packages require core storage larger than is available to the individual organisation.

The packages which have been used are mainly scientific-type packages for such matters as linear programming, network analysis, structural engineering and vehicle scheduling. A number of commercial-type packages have also been used for debtors and creditors ledgers and stores accounting and control.

The universities/research institutes have made greater use of application packages—six out of the seven have used some packages. The packages are all scientific-type ones e.g. for statistical, mathematical and modelling applications.

All of the packages used have been supplied by the computer manufacturers or the computer bureaux.

The computer manufacturers and software companies are regarded as the most suitable people for developing packages, the commercial in-house users favouring the manufacturers and the bureau users favouring the software companies. A number of organisations suggested that packages should be developed by industry groups.

Forty-five per cent of the commercial in-house users and 26 per cent of the bureau users think that it would be possible to develop further application packages which would be useful to them. All of the universities/research institutes thought so.

The type of packages which they consider could be developed include payroll, share registration, stock recording/order analysis, truck scheduling and routing, critical path analysis, computerised type-setting and economic modelling. Many of these are in fact already available: it is not clear whether the respondents were unaware of this, or whether the existing packages were unsuitable. (Since the time of our survey the use of packages appears to have increased substantially.)

The universities/research institutes considered that they themselves could develop appropriate packages for statistical and mathematical routines, for research based applications and for special compilers.

The majority of organisations have applications which they would wish to computerise but which are held back for some reason—71 per cent of the commercial in-house users, 51 per cent of the bureau users and all the universities/research institutes.

The main factor holding back developments among the commercial in-house users are lack of capacity or unsuitability of the existing computer configuration and lack of trained computer personnel. Among the bureau users, the main restricting factors are unsuitability of the work for processing on an outside computer and the geographical remoteness of the bureau. The universities/research institutes are held back mainly by lack of funds. A lack of capacity or unsuitability of the existing configuration (which of course is directly related to the lack of funds) and a lack of applications software are also stated to be important factors by the universities/research institutes.

2.6 *Programming Languages* (A.7)

At present assembler language and languages at the level of RPG, NICOL, TABSIM, etc., are the programming languages most used by the commercial in-house users.

Future projections show a shift towards higher level languages. COBOL will be much used by almost half of the organisations compared with 20 per cent at present. The move to higher level languages—conserving staff resources at the expense of machine resources—would be expected in view of the increasing staff costs relative to machine costs.

FORTRAN is not much used by these organisations nor do they expect to use it much in the future. It is, on the other hand, the principal language used among the universities/research institutes and is expected to remain so in the future, reflecting their orientation towards scientific/research applications.

Few of the bureau users were able to say what programming languages are used for their applications—36 per cent were able, most of them being the

larger users. COBOL is the principal language used, with FORTRAN also in frequent use. Future projections do not reveal any proposed changes.

2.7 *Staffing* (A.8, B.2—B.8)

Over half of the commercial in-house users have experienced difficulty in recruiting computer staff. The principal difficulties are stated to be the lack of experienced personnel, high salaries sought and high mobility of computer staff. In order to examine further the extent to which they had made efforts to recruit staff, they were asked to indicate where they had advertised vacancies. A large proportion of those experiencing difficulties had advertised in Ireland and a number had also advertised outside Ireland. Two organisations had advertised in North America. One of these latter organisations commented that, though they had recruited some people from North America, they considered that there was no potential in this market. Three of the universities/research institutes have experienced recruitment difficulties.

Very few of the bureau users have experienced recruitment difficulties. It should be borne in mind however that almost half of the bureau users have no specialist computer staff employed and most of the others employ a very small number of computer staff.

The source of recruitment of each category of computer personnel is indicated later.

There is a heavy reliance on computer manufacturers for training courses for all levels of staff, but particularly for programmers and operators. The IMI play a significant role in providing training at the higher levels. A wide variety of courses provided by consultants are used to a small extent.

The organisations do not propose to make any radical changes in the training courses used. The courses which they propose to use will be provided principally by the computer manufacturers and the IMI.

Most of the commercial in-house and the bureau users consider that the range of courses now available in Britain and Ireland is adequate in terms of relevance, quality and cost. Five of the universities/research institutes do not consider the range of courses to be adequate.

The organisations which were not happy with the present range of courses were asked to indicate the type and duration of courses which were needed. However, most of what they suggested appears to be already available.

As would be expected, there has been displacement (as distinct from redundancy) of staff in most of the organisations due to the use of a computer—80 per cent of the commercial in-house users but less than half of the bureau users.

The displacement is not large. It averages 25 per installation in the commercial in-house cases and 5 per installation in the case of the bureau users. There is a direct relationship between the size of the installation and the number of staff displaced—averaging 140 in the large installations, 25 in the medium and

10 in the small installations. Similarly among the bureau users, the average was 7 for the large, 3 for the medium and 2 for the small users.

On the other hand it is clear that there has been no redundancy caused by the introduction of the computer—the displaced staff were either absorbed in other areas of the organisation (42 per cent), transferred to computer work (35 per cent), absorbed through normal staff losses by marriage, retirement, etc. (23 per cent) or retired early (1 per cent).

These findings are quite in line with British experience. A recent report by the British TUC found that fears of redundancy were unfounded. The study carried out by the Manpower Research Unit in the Ministry of Labour in 1965 found that in only 13 out of 331 organisations had staff been discharged and even in these the numbers discharged were very small [5, p. 18]. The reasons adduced to explain this were (i) the length of time it takes to install a computer system (which facilitates absorbing excess staff by discontinuing recruitment), (ii) the predominance of women employees with no firm attachment to an office career (who inflate the normal rate of staff losses), (iii) the fact that in many cases the computer system took over from punched card systems and much of the impact of mechanisation had been absorbed previously and (iv) the general expansion of business [5, p. 7]. These reasons are also valid in the Irish context, particularly (iii)—78 per cent of the organisations which have installed a computer were previously using punched card equipment.

The principal effect which the computer has had on employment has probably been in controlling the rate of increase in clerical staff. The Ministry of Labour report estimated that the net effect of computers had been to reduce the total number of jobs which would otherwise have been available by about three-quarters of one per cent [5, p. 7].

The main staff categories[7] in computer work are the EDP Manager, operations manager/supervisor, systems analyst, programmer/analyst, programmer. We give below, as revealed by our questionnaires, brief descriptions of the qualifications and experience of the typical staff member in each category.

EDP Manager: He will generally have had at least five years experience in computer work and will be fairly new to the job, having been in it only two or three years. Before being appointed EDP Manager, he is likely to have had experience as a systems analyst, but it is possible that he has had no previous computer experience at all. Typically his age is around 35, although the age range is quite wide, and he is drawing a salary of around £3,000. He is likely to have a degree and possibly some other professional qualification such as in accountancy. Usually before entering computer work he will have worked in some other business area, generally in the same firm. The amount of formal computer training received is rather small. More than likely he has not attended any EDP or systems management courses, and even if he has, nothing over two to four weeks in duration.

[7]See Appendix C.

Operations Manager/supervisor: He may have been appointed without previous computer experience, or he may have had a few years' previous experience as an operator, or possibly a programmer. Usually he would previously have worked in some other area of the same firm, as a clerk or as a supervisor of a punched card installation. His age is around 35, although the age range is wide, and his salary would be around £2,000. Usually he would have the Leaving Certificate, but not a degree. He will almost certainly have received formal training lasting several weeks in operations management or in operations, and probably also in programming.

Systems Analyst: He is likely to have had a few years' experience of computer work, but to be fairly new to the job of systems analyst. His age is around 30, and his salary around £2,500. His previous computer experience is most probably in programming, and he may well have commenced his business career as a clerk. His job mobility is not remarkable: he is likely to be still in the same organisation where he began his business career and then transferred to computer work, but he may now be working for another organisation. He may possibly have a degree, but if he does have any academic qualification beyond Leaving Certificate, it is more likely to be a professional qualification in accountancy or engineering. He will almost certainly have received formal training in programming and systems analysis.

Programmer/Analyst: This category of staff perform some of the functions of both programmer and systems analyst. He is likely to have been transferred to this position direct from clerical work within his own organisation; and to have now at least two years' experience of the job. His age is around 25 and his salary around £1,750. Most likely he has no academic qualification beyond Leaving Certificate, but he might possibly have a degree or an accountancy or other additional qualification. He is most likely to be working in the same organisation where he began, but he may have moved once. He will have received formal training in programming.

Programmer: This the largest category of those being described. He is quite likely to have had only one or two years' experience of any kind of computer work and of programming in particular. His age is likely to be between 20 and 29 and his salary between £750 and £2,000, with a median salary of around £1,250. He may well have been appointed as a programmer without previous working experience, or he may previously have worked as a clerk usually in the same organisation. He is more than likely not to have any academic qualification beyond Leaving Certificate, but he may possibly have a degree or other further qualification. He is very likely to have received formal training in programming. Contrary to general opinion, his job mobility is not all that great. He is very likely to be in the organisation where he began, or he may perhaps have moved once.

2.8 *How the Computing Function is Organised* (A.9)

The initiative in deciding to use a computer is generally taken by top management. This was indicated by 75 per cent of the commercial in-house users, 54 per cent of the bureau users and three of the seven universities/research institutes. Personnel in the accounting area are the next most important initiators—this was the case in 15 per cent of the commercial in-house users and 23 per cent of the bureau users. Management services departments have not played a significant role.

If the replies to this question can be taken at their face value, they point to a considerable amount of top management involvement in computer developments. This is a very healthy situation as it is generally agreed that top management involvement is essential for the success of a computer project [4].

The person in charge of the data processing generally reports to a second line executive—this was so in 62 per cent of the commercial in-house users and 56 per cent of the bureau users. The second line executive is generally in the finance or accounts area.

More data processing managers report to the Chief Executive among the bureau users than among the commercial in-house installations—39 per cent compared with 22 per cent. In the seven universities/research institutes, two report to the Chief Executive and a further two to a second line executive.

In more than 65 per cent of the commercial in-house installations, the data-processing manager gives full-time attention to data processing. A higher proportion of these are found in the small than in the medium or large categories. The picture is very different among the bureau users where only 13 per cent have full-time data processing managers, the highest proportion being in the large category. Only one of the universities/research institutes has a full-time data processing manager.

Where the data processing manager devotes only part of his time to data processing, his other functions are usually in the finance and accounts area or in general administration. In the universities/research institutes, his duties vary greatly and include lecturing, research work and the provision of advice to research staff.

The principal reason why the bureau users decided to use an outside computer rather than acquire a computer of their own was that their total volume of work was inadequate to use a computer fully. This was indicated by 77 per cent of the respondents. Lack of trained computer personnel and a wish to develop computer expertise with a view to acquiring a computer of their own were each significant reasons in the case of 21 per cent of the respondents.

2.9 *Advice and support in starting up* (A.10)

Most organisations received outside advice when considering the feasibility of installing or using a computer but quite a substantial proportion say that they did not—22 per cent of the commercial in-house users, 41 per cent of the

bureau users and 2 of the 7 university/research institutes. A high proportion of these were in the medium and small categories.

Among the commercial in-house users which did seek outside advice, staffing was the area on which advice was most sought, closely followed by advice on hardware. Among the bureau users, advice on computer applications and on computer program packages were the main areas. Advice on staffing was low on their list, as would be expected. Among the universities/research institutes, advice on hardware and software were most sought.

The computer manufacturers were the most frequently used source of advice for the commercial in-house users, particularly as far as hardware and software are concerned. Outside consultants were frequently approached on staffing questions but were little used in other areas. There was much contact also on all areas with organisations in the same line of business. Computer service bureaux were the main source of advice used by the bureau users with the computer manufacturers and outside consultants also being important sources. The universities/research institutes relied on the computer manufacturers and other organisations in their own line of business.

Having selected a computer or computer bureau and the applications to be tackled, most organisations receive further support from outside their organisation e.g. on systems and programming. The type of support can be expected to differ considerably between the in-house users and the bureau users. That sought by the in-house users is likely to be short-term while they are building up their own expertise. The bureau users are likely to need continuous support on a long-term basis. The support received is therefore examined separately for each type of user.

Almost all of the in-house users received support from outside—92 per cent of the commercial users and 5 of the 7 universities/research institutes. Partial support rather than total support was generally sought. Systems analysis and programming and training were the main areas on which support was sought. The computer manufacturers were the principal source of support—the Ministry of Labour survey found a similar position in Britain [5, p. 35]. Outside consultants were a significant source of support only for systems analysis.

A small number of organisations—15 per cent of the commercial and 2 of the 7 university/research institutes—contracted work out. The main job contracted out was the punching, compilation and testing of data and programs prior to the installation of the computer.

The majority of the organisations were satisfied with the support they received. Twenty-two per cent were not satisfied, mainly due to inadequacies in the staff giving the support.

When asked the extent to which they considered that an organisation installing a computer for the first time should rely on outside support, most organisations felt that some support should be sought under all heads. Twenty per cent of the commercial organisations felt that no support should be sought

on programming. Partial rather than total support was favoured in all areas.

The manufacturers are regarded as the best source of support, particularly in training and programming. Outside consultants are seen as a useful source of support on systems analysis.

The only significant difference between the support the organisations now think should be sought and what they themselves actually sought is that more consider outside support on training to be necessary.

All of the bureau users depend on the bureau for some support. Computer operation is provided for all—in two cases only partial support on operation is provided, the user's own staff having access to the computer from time to time. The proportion of organisations relying on the bureau for other services is set out in Table 2.8.

TABLE 2.8: *Percentage of bureau users relying on support from the bureau*

	Partial Support	*Total Support*	*Total or Partial*
Data Preparation	10	54	64
Programming	11	77	88
Systems Analysis/Design	50	30	80
Staff Training	2	18	20

The bureaux look after programming, systems analysis and data preparation for most of the users. This is particularly so in the case of programming and systems analysis where they provide facilities for 88 per cent and 80 per cent of the organisations respectively. On systems analysis the support is generally partial rather than total. Data preparation facilities are provided for 64 per cent of the organisations.

A higher proportion of the large users do their own data preparation, systems analysis and programming than is the case in the medium and small categories of user.

Most organisations were satisfied with the support received from the bureaux. Twenty per cent expressed some dissatisfaction, mainly regarding lack of dependability on turn-around time and inadequacies in systems and programming work.

Most organisations think that any organisation using a computer for the first time should rely on outside services. The number indicating this is similar to the number that do rely on outside services at present.

2.10 *Benefits Expected and Received from the Computer* (A.11)

Better information for management decisions is the benefit most frequently expected from computer applications in all areas. Reduction/control of staff costs is the next most frequently expected benefit, and greater flexibility came

third. Over all applications, these results were expected in approximately 85 per cent, 50 per cent and 40 per cent respectively of the cases.

The universities/research institutes differ somewhat but not markedly in their expectations. Flexibility was their main expected benefit with information for management and reduction/control of staff costs coming next.

On the face of it, these replies indicate an increasing degree of sophistication in the approach to computing. The initial use of computers in business and administration was for carrying out existing clerical and accounting work more cheaply and efficiently. The general view nowadays is that the real benefits come from higher level applications or from a more sophisticated use of the lower level applications e.g. deriving better information for management as a by-product of these applications [4]. It is interesting to note that in Britain, the Ministry of Labour survey in 1965 found that better service for management was given as a reason for using a computer by only 33 per cent of the organisations [5, Appendix 6]. This survey has recently been up-dated but the results were not yet available at the time of going to press.

Turning to the benefits actually received from the computer applications among the commercial in-house users we find that significant benefits were got in 44 per cent of the areas where benefits were expected and marginal benefits in 28 per cent of these areas. The figures for the bureau users and university/research institutes are very similar, significant benefits in 46 per cent and marginal benefits in 26 per cent being got in both cases.

A substantial proportion have not yet assessed the benefits from their applications—16 per cent for the commercial and bureau users and 2 of the 7 universities/research institutes.

A greater proportion of applications have yielded significant benefits on information for management decisions and on flexibility than on any other areas. This applies to all categories of users. On staff costs, the benefits have been marginal.

Very few applications resulted in detrimental effects where benefits were expected. A number of organisations indicated effects in areas where no change was expected. These effects were mainly beneficial.

2.11 *Co-ordination of Computer Activities* (A.12, A.13)

Nearly half the commercial in-house and bureau users feel that the information currently available to them on all aspects of data processing is inadequate. Four of the seven universities/research institutes also thought so. Software, systems and programming methods, applications and packages are the main areas in which they consider information inadequate.

Computer manufacturers, user associations, professional societies and technical journals are regarded as sources that could provide the information.

About half the commercial in-house users and the universities/research institutes and 70 per cent of the bureau users thought that one central body is

required to co-ordinate all computer activities such as dissemination of information, the development of training courses, the development of application packages, etc. The Irish Computer Society, the Computer Users Association or the Irish Management Institute are regarded as the most appropriate bodies to fill this role—the first two organisations being preferred by the commercial in-house users and the third by the bureau users.

2.12 *Decimalisation* (A.14)

All of the commercial in-house users and most of the bureau users will be affected in the data processing area by decimalisation. The in-house users expect to be affected substantially but the bureau users will only be affected marginally. Three of the universities/research institutes will be affected marginally.

Most of the commercial in-house users have appointed a decimalisation officer to look after all aspects of the changeover. In some, broad policies for the changeover and implementation plans had already been formulated at the time of the questionnaire. The majority indicated that the manufacturers would be providing software for use in the changeover. Only two organisations stated that they had not taken any steps towards meeting the changeover.

In the case of most of the bureau users, the bureaux are looking after the matter for them or have made provision in the original programs to cater for it. A few indicated that they had not taken any steps to cope with the changeover.

3. PROJECTIONS OF FUTURE GROWTH

3.1 *General considerations*

Computing is the fastest growing industry both in Britain and in the US. In Britain, according to a study undertaken by the Hoskyns Group, user expenditure on computing has been growing at an annual rate of 25 per cent [6, p. 10].

Forecasting the future development of computing is hazardous in view of its early stage of development particularly in Ireland, and the rate at which changes are taking place in computing technology and techniques.

The Hoskyns study projected an average annual growth rate in Britain of 18 per cent for the industry as a whole in the decade 1970–1980, bringing expenditure to £2,100 m. or 4 per cent of GNP. A faster growth is projected foi the earlier years, flattening out in the later years [6, p. 10.].

As we are at an earlier stage of development than Britain, our growth rates are likely to be higher over the next five years.

In looking at the future breakdown of expenditure on computing, a number of key developments must be considered particularly on hardware and software.

As far as hardware is concerned, current developments are leading in two

different directions—on the one hand towards large computers giving considerable economies of scale and on the other hand towards small cheap computers to cater for the needs of the smaller organisations. The first leads towards the development of large bureaux providing services for many different users. Developments in data transmission and the availability of terminals reinforce this trend. The second development leads towards small in-house computers, each organisation looking after its own needs.

Both of these trends will undoubtedly continue. The trend in Ireland at the moment seems to be more towards the installation of small computers but the balance could easily swing the other way before too long. The Hoskyns Report sees these small computers as merely a deviation which will not have a lasting impact on the overall market [6, p. 8]. In the long run, they may reinforce the trend towards large bureaux in filling the role of both stand-alone computers and on-line terminals.

On the software side, the continuing shortage of computer staff, both here and abroad, relegates hardware considerations to a secondary place relative to the problem of conserving scarce personnel resources. This is now the key problem area, particularly for the small user. It leads towards the provision of software services by specialist organisations—either through the computer bureaux or through separate software houses.

Taking these factors into account, the Hoskyns Report makes the following projection of the breakdown of user expenditure in Britain in 1975 and 1980 [6, p. 11]:

Breakdown of end-user expenditure 1970–1980

Item	*Percentage Expenditure*		
	1970	1975	1980
Hardware	29·5	26·0	22·0
Terminals	·5	1·3	1·5
Data transmission	·5	1·3	1·5
Software (in-house)	30·0	27·9	17·5
Software (external)	1·0	4·0	6·0
Operations	22·9	21·7	21·0
Consumables*	9·0	7·3	7·0
Consultancy	·6	·5	·5
Service Bureaux	6·0	10·0	23·0
Total	100·0	100·0	100·0

*Consumables covers expenditure on stationery, discs, tapes and similar items.

The most notable features of this projection are the significant increases in the share of expenditure on the use of service bureaux, external software, data transmission and terminals and the significant decline in the share of expenditure on in-house software and, to a lesser extent, hardware.

3.2 *Projections for Ireland*

In the course of our surveys, we sent a questionnaire to all corporate members of the Irish Management Institute (about 600 organisations) asking them whether they were using computer facilities and, if not, whether they expected to do so within two years or within five years.

As set out in Appendix D, a total of 238 replies were received, a response rate of about 40 per cent. The response was strongly biased in favour of organisations using computing facilities—45 per cent of the respondents were already using computing facilities. Among the other 131 organisations, 19 (15 per cent) expected to commence using computing facilities within 2 years and a further 30 (23 per cent) within 5 years. Twenty-six organisations (20 per cent) thought that they might use such facilities. The other 56 organisations (43 per cent) did not expect to do so.

Any realistic forecast of future growth in Ireland must be based on informal personal judgements. This we try to do below in the light of our discussions with the personnel involved in computing in the principal economic sectors, the stage of developments already reached and the projections of foreign studies such as the Hoskyns Report. We make projections of the number of computer installations to be expected in 1972 and 1975, their total capital value, the number and categories of staff which will be required to service these computers and total user expenditure. These projections have to be regarded as tentative, but they do indicate the general order of magnitude of the likely developments.

Number of installations

In analysing the current computing situation in Chapter 2 above, we divided the computer installations into three different categories based on the size of the installation. We maintain this breakdown in considering future developments. The different categories and the number of installations in each category are set out in Table 3.1.

TABLE 3.1: *The number of computer installations at the beginning of* 1970 *and projections for* 1972 *and* 1975

Category	*Capital Value* (£'000)	*Number of installations at the beginning of*				
		1970	1972		1975	
			min.	*max.*	*min.*	*max.*
Large	500	4	7	8	9	10
Medium	60–499	25	33	42	50	93
Small	60	24	47	54	92	133
All		53	87	104	151	236

Different considerations apply in projecting developments in each of these sectors so we examine each separately.

In the large category, the principal limitation is the small number of organisations which are of sufficient size or of such a nature as to warrant such an installation. The development of large computer bureaux or utilities will add somewhat to this market. Projections for this category can best be made on the basis of identifying particular organisations which are likely to require a large installation and considering how soon they are likely to acquire it. As set out in Table 3.1., we expect three or four such installations by 1972 and a further two by 1975.

In the medium category, we cannot be as specific but expect an annual growth rate within a range from about 15 per cent to 30 per cent. This is the equivalent of about 4–8 installations per annum over the next two years and 6–17 over the subsequent three years.

There seems to be a strong demand at present for small computers in the £20–50,000 range. This has been encouraged by the greater variety of machines now available in this range. As discussed above it is not possible at this stage to determine what the future balance will be between the use of small computers and the use of bureau facilities. For the next two years at least, the number of small installations is likely to grow rapidly—we estimate a growth rate of from 40 per cent—50 per cent. This rate of growth is unlikely to be maintained in the subsequent years. We estimate that from 1972 to 1975 the annual growth will be in the region of 25 per cent—35 per cent. This gives an additional 12–15 installations each year up to 1972 and 16–26 installations each year from 1972 to 1975.

On the basis of these projections, we would expect from 87 to 104 computer installations in the country at the beginning of 1972, an increase of 17–25 per annum. This number should increase to between 151 and 236 installations in 1975, an annual increase of 21–44 installations from 1972 to 1975.

Capital value

As set out in Table 3.2 these projections would envisage a 65–95 per cent increase in the total capital value of computer installations by 1972 and a 140–230 per cent increase by 1975.

TABLE 3.2: *Capital value of computer installations at the beginning of* 1970 *and projections for* 1972 *and* 1975[8]

	1970	1972		1975	
		min.	*max.*	*min.*	*max.*
Capital Value (£ m.)	7·6	12·5	14·7	18·1	25·4

[8] These projections are based on the average capital value of the present installations in each category.

Bureau Users

Among the bureau users, the growth rate has been very high in recent years (see Table 1.3). Despite the trend towards small in-house installations, we expect that the number of bureau users will increase at an annual rate of from 30 per cent to 40 per cent over the next two years, slackening to an annual rate of 20 per cent to 30 per cent over the subsequent three years. As set out in Table 3.3, this would mean an annual increase of from 86–120 users in the next two years and from 102–195 between 1972 and 1975.

TABLE 3.3: *Number of bureau users at the beginning of* 1970 *and projections for* 1972 *and* 1975

	1970	1972		1975	
		min.	*max.*	*min.*	*max.*
No. of Bureau users	250	422	490	729	1076

Numbers of Staff

From these projections of the growth in computer installations and in the number of bureau users, we can forecast the number of computer staff which will be required to cater for this volume of computing. We concentrate on four categories of personnel—systems analysts, programmer/analysts, programmers and operators.

We base our forecasts on the staffing complement which the existing commercial in-house users expect to have in two years time, as set out in Appendix E. The expected staffing complement rather than the current one is used because we feel that it gives a more realistic picture of the real staffing requirements of a computer installation. The existing installations would seem to be somewhat understaffed, partly due to the shortage of available staff. Though our projection of installations includes computer bureaux and universities/research institutes, both of which have a staffing structure different from the commercial in-house users, we have not attempted to separate our projected figures into these different categories and consequently we do not attempt to separate the staffing requirements. Since the computer bureaux tend to have a larger staff than the commercial in-house users and the universities/research institutes tend to have a smaller staff, they should balance each other out to some extent. Use of the commercial in-house users staffing complement as an average for all categories should not affect the order of magnitude of our projections.

The detailed calculations are set out in Appendix E and the overall results are summarised in Table 3.4.

TABLE 3.4: *Number of computer staff at the beginning of* 1970 *and projections of additional staff required by* 1972 *and* 1975

Category	*Staff as at* 1970	*Additional Staff Required by* 1972		1975	
		min.	*max.*	*min.*	*max.*
Systems analysts	150	195	255	470	780
Programmer/Analysts	106	220	275	470	720
Programmers	237	395	505	825	1,350
Operators	184	145	210	365	665

These projections show the magnitude of the staffing problem which is likely to arise if the expected level of computing is to be achieved. A further 100–130 systems analysts will be required in each of the next two years, an annual increase of about 65 per cent to 85 per cent over the present population of systems analysts. One hundred and ten to 135 programmer/analysts will be needed, an annual increase of 100 per cent to 130 per cent. The number of programmers required will be 195–250, an annual increase of 80 per cent to 110 per cent. For operators, the annual increase required is 40 per cent to 55 per cent, representing 75–105 people each year.

User expenditure

The existing computer users expect to increase substantially their expenditure in computing over the next two years (see Appendix A.1). The expected increase is 64 per cent for the bureau users, 51 per cent for the universities/research institutes and 27 per cent for the commercial in-house users. The most substantial increases are expected in expenditure on hardware and peripherals—76 per cent for the bureau users, 51 per cent for the universities/research institutes and 31 per cent for the commercial in-house users. Expected increases in expenditure on personnel for these three groups are 61 per cent, 33 per cent and 19 per cent respectively.

Taking these figures together with the figures projected above for the growth in the numbers of installations, we estimate that the current annual direct user expenditure on computing of £4·5 m. will have doubled by 1972, indicating a current annual growth rate of some 40 per cent.

PART II

DEVELOPMENT TRENDS AND INSTITUTIONAL NEEDS

4. COMPUTING AT SECTOR LEVEL

To supplement the surveys described in Part I, one approach we decided to adopt in our investigation of the development of computing nationally was to isolate for study a number of broad sector groupings. Within the resource constraints of our study, we had necessarily to be quite selective in the choice of sectors for study. We therefore selected only a few which appeared to have common problems and special potential for further growth. Seven of these are examined in the subsequent sections of this report, covering central government, local government, agriculture, health, construction, scientific and technical information services and the universities/research institutes/technological and other colleges and schools. These are sectors on which, for one reason or another, special comment seemed useful.

Many important sectors are not discussed at all and it should be pointed out that the fact that a sector is not discussed does not imply that computers are not being extensively used or have no potential use in that sector. We do not, for example, mention banking and insurance or transport and communications, in all of which important computer developments are taking place.

From discussions with individual users within the sectors we examined, it seems clear that special action to develop computing further could profitably be taken. The particular action required will differ from sector to sector. However, there appear to be four basic common desirable aims. These are:

(i) promoting and planning the overall developments of computing in the sector;

(ii) securing co-operation in the development of common computing applications;

(iii) securing co-operation in the sharing of computing facilities;

(iv) identifying and providing for the training requirements specific to the sector.

To achieve these aims, some form of organisation needs to be set up within

each of the individual sectors. This sectoral organisation should be concerned with ensuring that specific information about developments in the sector here and abroad is communicated to the interested people, that any matters hindering the development of computing in the sector receive adequate attention and that any common problems are tackled on a co-operative rather than on an individual basis. These are not matters that can be left to the individual organisations to arrange, or to the computer manufacturers or consultants. As computer applications develop from general routine applications to more sophisticated applications, they are becoming both more expensive to develop and more specific to the individual sector and can be expected to have fundamental long-term effects on the sector. Decisions on the type and objectives of the applications must be taken by the experts in the particular sector. In many cases these decisions are best taken at a sector level rather than by the individual units within the sector. This facilitates optimum co-operation in developing the desired applications.

The sectors will also have training needs which are specific to the individual sector—e.g. the particular applications found in the health area may require special training for the personnel over and above the basic training common to all sectors.

The corollary to this is that top management should become familiar with computing developments and needs within their own individual sector. The requirements are best identified by people involved at the sector level.

We are satisfied that our general conclusions about the need for co-operation and the type of co-operation required at a sector level are correct. But we do not regard the particular suggestions we make on individual sectors as definitive at this stage since we have not been able to examine the sectors in sufficient depth within the scope of this survey. We aim rather to point out possible lines on which developments might be pursued. Our discussion of these sectors brings out that the type of co-operation required is basically the same in all sectors.

4.1 *Central Government*

The Devlin Report made the following comment on the scope and the need for using computers in the public sector:

> "As large operating entities, Departments produce quantities of internal information essential to their management, about organisation, personnel and finance; in the course of their work, Departments collect masses of information about the needs and requirements of their clients. In an unmechanised age, this information was stored on files and retrieved through registry systems. The introduction of automatic and electronic data processing, at first as an aid to manual accounting, now offers possibilities of a sophisticated information system" [7, para. 12.10.1].

The last sentence of this paragraph isolates the two different levels at which computers can be used, both of which have much significance for the civil service.

At the lower "super-clerk" level, the scope for computerisation is evident from the number of large-scale routine administrative tasks performed by the civil service—social welfare payments in the Department of Social Welfare, tax collection in the Revenue Commissioners, etc.

At the higher level, the use of computers can help administrators to extend their ability to co-ordinate and control their sphere of activity by such means as integrating different jobs and providing better and more timely information for decision-making. As well as enabling the existing tasks to be performed more efficiently, computers can also provide the means of tackling tasks which could not otherwise be performed—e.g. programme budgeting (P.P.B.S.), now being brought in on an experimental basis, could not really be operated fully without using computers. The benefits from the higher level uses of computers are likely to be much more significant than from the lower level uses.

At present a substantial volume of computing is going on in the civil service. Four computers have been installed—two in the Revenue Commissioners with a capital value of about £700,000 and two smaller ones in the Department of Lands and Defence. The Aviation Communication Service of the Department of Transport and Power have a special computer for message switching. The Department of Posts and Telegraphs plan to install a computer in the near future. A number of other Departments use spare time on the existing installations, mainly through a bureau service organised by the ADP Unit of the Department of Finance using the night shift on one of the Revenue Commissioners' computers. These Departments include Education, Central Statistics Office, Meteorological Office, Health, Paymaster General's Office, Agriculture and Fisheries and Social Welfare. The Finance ADP Unit are now acquiring a large computer of their own to cater on a bureau basis for the needs of most or all of these other Departments.

The Devlin Group did not examine the computer requirements of the Civil Service in any great depth but recommended that a comprehensive examination of the present and future requirements of the service as a whole should be undertaken [7, para. 12.10.4]. The Minister for Finance commissioned the writer in June 1968 to carry out a survey with the following terms of reference:

> "To review the development of automatic data processing and computers in the Civil Service and to recommend such measures as are desirable and practicable towards ensuring that automation in this field (including the field of scientific-type applications) is utilised to the optimum extent and in the most efficient and co-ordinated manner".

A report was presented to the Minister in December, 1969.

There appear to be four main areas to which attention must be given if the full benefits of computing are to be gained in the Civil Service—(1) the spread of a fuller understanding of the role and uses of computers and greater involvement in computing on the part of the top administrators, (2) the planning of computer applications at a departmental and at a central level, (3) the overall co-ordination and direction of computing throughout the civil service and (4) recruitment and grading policies for computer personnel.

As discussed elsewhere in this report, the higher level applications are more far-reaching in their impact on administration. There are a number of examples of higher-level applications which are either in operation or planned. For example, the Revenue Commissioners are engaged on a reorganisation and reshaping of their activities with a view to achieving one comprehensive computer system for their whole operations. But computing is still generally on the first level.

If a qualitative change in the role of the computer is to be effected, overall forward planning of computer applications will be required. Individual applications should not be viewed in isolation. They should be looked at in relation to their possible integration with other areas, the possible use of data for new purposes in the same area or elsewhere and the manner in which they contribute to the overall objectives of the organisation. Planning would also be required to use the limited resources, particularly manpower resources, most effectively, priorities being established between the different applications on the basis of the potential benefits of each application. This would need to be done both at a departmental level and for the Civil Service as a whole.

At departmental level, each department could assess the overall potential for computers throughout the department, taking into account both routine data processing and higher level applications. The aim of such a study would be to provide a comprehensive picture of the likely ultimate impact of the computer and thus to provide a framework within which the individual applications can be tackled.

This type of forward planning has been adopted in departments which already have computers of their own and in some other departments. It should be extended to all the departments.

At a central level, the task would be to integrate the plans drawn up at a departmental level into one composite overall plan, to build into this plan measures to take account of inter-departmental needs and to make recommendations on priorities between different departments and between different applications.

At present, overall co-ordination of computing in the civil service is the task of the ADP Unit of the Department of Finance. The main objectives of the unit are to extend and promote the efficient use of computers in the civil service and to help in developing and installing computer applications for departments. As already mentioned, it has also been concerned with organising a bureau service for departments using spare capacity on one of the Revenue

Commissioners' computers. They are now formalising and extending this bureau service by acquiring a computer of their own.

While in principle this Unit provides the necessary co-ordinating mechanism, in practice it appears to be organised on too small a scale to fulfil its functions adequately. Some of these functions it can only deal with on a part-time basis at present, others only on an *ad hoc* basis. These include the determination of appropriate recruitment, grading and salary structures, training and development of computer staff, the development of common computing standards and procedures throughout the Civil Service and the provision of expert support and technical advice for all departments.

All of these tasks should be carried out by a central body which might be called the Central Information Systems and Data Processing Service. This Central Service would be responsible for the following main functions:

(i) recruitment, training and development policies for all computer personnel;

(ii) systems support i.e. helping Departments in carrying our computer feasibility studies, providing systems and programming services and setting standards of documentation and project control;

(iii) technical support i.e. advising on the choice of computing and ancillary equipment and keeping in touch with computing developments;

(iv) drawing up plans for the development of computing and advising on overall policy;

(v) providing a comprehensive computer bureau service for all Departments that require it.

Several advantages resulting from carrying out these functions on a centralised basis are apparent. Centralisation enables the personnel involved to specialise in particular fields and to keep in touch with developments which affect them. It allows a greater depth of expertise to be developed and avoids duplication of effort. Some degree of centralisation of systems and programming staff is desirable to allow flexibility in allocating staff to different projects so that expertise and experience gained in one department can be made available to others. A constant exchange of information and ideas between experienced staff is facilitated. New recruits can more easily be assigned to tasks within their capacity and high level staff can more easily concentrate on more difficult problems. Centralisation also facilitates the development and implementation of common standards.

It is quite clear that the potential benefits to be derived in the Civil Service from a full use of computers are such that greater resources should be devoted to computing. The Central Service outlined above should be headed by a high level Director with considerable computing experience. He would have

to play a leading role in promoting computing throughout the Civil Service and in organising and building up the Central Service into a fully comprehensive body.

An essential component of any centralised system should be an Inter-Departmental Committee which would provide the main communication link between the Central Service and the higher administration in the departments. Since each department will be affected by the decisions taken within the Central Service and by the standard of service provided, they should have some means through which they can exercise some influence and control over it. The Committee should be concerned with such matters as advising on general computer policy and the broad objectives which the Central Service should seek to attain, establishing priorities between departments in the allocation of resources by the Central Service and reviewing the service provided by the Central Service.

It is important to make a clear distinction between the centralisation of the services described above and the provision of centralised computer operations. While centralisation of the former functions is of immediate importance, centralised computer operations is a more long-term problem. The provision of computer hardware facilities could be approached in a number of different ways ranging from complete decentralisation on the one hand, with each department looking after its own computer requirements independently, to complete centralisation on the other hand, with one central computer providing services to all departments.

Neither complete centralisation nor complete decentralisation is envisaged but the optimum mix of both. The structure may be complex and will evolve only as a result of experience and it will never be static. Once there is sufficient planning strength in the Central Service, the proper deployment of equipment to meet the requirements of the whole Civil Service can be kept constantly under study and review. The ultimate picture which we would envisage would show perhaps three large computers catering for the general administrative requirements of the Civil Service, linked through data transmission facilities, some specialised computers for dedicated systems—e.g. the message-switching computer now used by the Department of Transport and Power's Aviation Communication Service—and a computer with on-line conversational facilities to be used for scientific and experimental type work.

The organisational arrangements proposed above are in line with developments in the Civil Services of other countries.

One country which seems to have this type of organisation is the Netherlands. A Unit within the Ministry of the Interior is responsible for computing developments throughout the Civil Service. It is staffed by over 70 systems analysts, programmers and other specialists. Its responsibilities include examining and developing applications in departments, ensuring compatibility between different systems and making recommendations to an Inter-Ministerial ADP Committee. This Committee is a policy-making body which reports to the

Minister of the Interior. The Unit also supervises the Inter-Ministerial Computer Centre which provides bureau services for a number of Ministries.

Denmark appears to have central co-ordination of computing without centralisation of hardware. The Administrative Council of the Danish Government acts as an advisory council to the Government on administrative matters. Its membership includes representatives of the main functional areas of central government. The Council's secretariat has a section concerned with ADP co-ordination. Its functions include the review and evaluation of new projects, initiation of new projects and the provision of assistance to Ministries in developing their computing applications.

Full centralisation of all computing services—both personnel and hardware —can be found in Northern Ireland.

In common with other sectors, the Civil Service suffers from a lack of experienced computer personnel. The common difficulties of recruiting and retaining suitable computer staff are aggravated in the case of the Civil Service by the fact that computer personnel are integrated into the general service salary and grading structure, thus limiting the degree to which the special and changing requirements of these scarce personnel can be met. Close contact between the computer personnel and the general service staff and full mobility both between general service work and computer work and *vice versa* is highly desirable. The grading and salary structure for computer personnel would however need to be directly related to those outside the Civil Service and kept sufficiently flexible to adjust to changes in the supply and demand situation.

The spread of awareness of the potential of computers, the involvement of top level administration in planning computer applications, the setting up of an adequate organisational structure to direct and co-ordinate developments and the allocation of adequate resources, particularly manpower resources, to the development of computing should help to ensure that the optimum use of computers will be made in the Civil Service.

4.2 *Local Government*

At present two local authorities have a computer installed—Dublin Corporation and Dublin County Council—and Wexford County Council have acquired a small computer. A number of the other local authorities are using computer bureau services. Five are using tabulator equipment and a large number are using accounting machines.

There is thus already a considerable degree of automation and mechanisation of the work of the local authorities. From the replies to our questionnaires, it seems that there is a significant trend towards greater automation. A number of the authorities indicated that they planned to commence using computer facilities—either in-house or service bureau—within the next two years.

The types of work for which computers are being used at present are mainly clerical procedures which were previously carried out on tabulators, accounting

machines or manually. These include payroll, rates applotment, rates demands and reminders, house-purchase loan repayments, housing rents and general accounting procedures.

Up to now, each of the local authorities has gone its own way. There has been little if any co-operation between them or co-ordination of their efforts.

The scope for using computers for the work of the local authorities is quite considerable. This can be confirmed by looking at the developments which have taken place in Britain and in other countries in the areas where their functions are similar to those of the Irish local authorities.

If the full benefits of computers are to be obtained, it is clearly desirable that the local authorities should co-operate and co-ordinate their efforts.

Co-operation is needed primarily on developing common applications. Most of the activities carried on by local authorities are common to them all. As well as the accounting functions which are already being computerised, there are many administrative tasks which may be computerised—e.g. electoral rolls, vehicle registration, driver licensing and housing activities. The problems met in these areas are common to all the authorities. If each authority were to attempt to develop its own systems and programs for these applications, there would be a great amount of duplication of effort and a waste of scarce personnel resources. Progress would necessarily be very slow. By combining and developing joint systems and programs to cater for the needs of all authorities, the development costs would be smaller, progress quicker and the benefits could be disseminated more widely to the smaller authorities which would not be able to bear the cost of going it alone.

Greater consideration could also be given to the higher level uses of computers —the provision of better information for management and the integration and co-ordination of different applications.

In addition to its uses in the administrative and financial areas of the local authorities, computers can contribute much in the technical areas of their work, particularly in engineering and architecture. A number of packages have been developed for use in these areas and there is potential for further developments[8]. If these packages are to be widely used it is necessary for some central unit to keep up-to-date on what is available so as to be in a position to direct the local authority enquiries to the appropriate sources. Advice must also be available on how to apply these packages, particularly in the early stage of utilisation. The development of further packages could also best be done on a centralised basis. In Northern Ireland, this type of specialised service is provided for local authorities by the Computer Services Branch of the Ministry of Finance.

As far as computer hardware is concerned, centralisation would bring considerable economies. If each of the local authorities were to acquire a separate computer to cater for its own needs, few would be able to justify anything but a very small computer. But small computers are much less economic than big ones in terms of the amount of work that can be done for

a given level of expenditure. Small computers would also limit the range of facilities available to the local authorities and so limit the range of applications which they could develop. The development of any higher level applications would be severely restricted.

In addition, decentralisation of hardware would limit the flow of information from the local authorities to the Department of Local Government and other bodies. The Department is concerned with overall co-ordination of the activities of the local authorities and with providing specialist and advisory services to them. If adequate information is to be available to the Department to carry out its co-ordinating function properly, they must have ready access to much information and be able to process it readily to suit their requirements.

In Britain, early developments among the local authorities have been on a decentralised basis. Some measure of co-operation has been achieved—local authorities in adjoining areas have in a number of cases acquired joint computing facilities. The drawbacks of unco-ordinated developments have been recognised and a Local Authorities Management Services and Computer Committee (LAMSAC) [9] has been established to co-ordinate the development of all management services, including the use of computers, among the local authorities.

Computer services for local authorities in Denmark are organised in six regional centres. These centres were originally set up to provide tabulator services but have since evolved to provide a full range of computer services. The need for co-ordination between these centres is well recognised and arrangements have been made for co-operation in such matters as joint systems design.

In Sweden, a central computer centre has been developed by the Swedish Town Federation. The authorities in the two biggest cities—Stockholm and Gothenburg—have their own computer installations and do not make use of the centre.

The Department of Local Government have already taken the initiative in examining what type of measures are needed in this country. They set up a team in 1969 with the following terms of reference:

> "To examine the scope for the use of computers in local government, to recommend in general terms how that use should be developed; and to indicate the practical steps to be taken to that end."

The report of this survey group has now been published [10].

It is clear that the optimum use of computers in our local authorities will not be achieved without some measure of co-operation. We consider that a special body should be set up to co-ordinate and control computing developments in this area. Such a body should be organised jointly by the Department of Local Government, the local authorities and organisations closely concerned

with various aspects of the work of the local authorities—e.g. an Foras Forbartha. It should be concerned with providing systems analysis and programming services for computerising the administrative and accounting functions of the local authorities, with developing the use of computing in the technical areas and with providing suitable hardware facilities.

4.3 *Agriculture*

The agricultural sector is of major importance in this country. Almost 40 per cent of total male employment is in farming and a further 25 per cent of employment in the transportable goods industries is in activities ancillary to farming. Agriculture accounts directly for about one-fifth of the total national income and indirectly for over 20 per cent of the value of industrial output [11, p. 37].

One of the aims of Government agricultural policy is to increase efficiency in the production, processing and marketing of farm products [11, p. 37]. To achieve this aim, the most efficient use of the resources available to the agricultural sector will be required, including the use of up-to-date management techniques and tools both at farm level and in processing the outputs from the farm. Computers can assist in this direction.

One area in which there is considerable scope for using computers is in the agricultural co-operatives. In 1968, there were 346 co-operatives with an aggregate turnover of more than £185 m. The dairy co-operatives accounted for 54 per cent of this turnover, the livestock marts accounted for 25 per cent. Five of the co-operatives had a turnover of more than £5 m. while a further thirteen had a turnover exceeding £2 m. [12]. Though firm figures are not yet available for later years, the total annual turnover of the co-operatives is now in excess of £200 m. The trend among the smaller co-operatives in the future is likely to be towards rationalisation through amalgamation into larger units [11, 12].

This group therefore contains a number of large-scale businesses and has consequently to tackle the complex management and administrative problems associated with any large-scale organisation.

A number are already using computers. About ten of them are spending an aggregate of some £50,000 on using computer bureau facilities. The main applications which have been computerised are routine clerical accounting work such as milk cheque or other payments and stores accounting. Some scientific-type applictions have been implemented such as linear programming for feed mix and for route scheduling in transportation problems.

Up to now, the individual co-operatives have tended to go their own separate ways as far as computerisation is concerned. The decision to use a computer and the development of the appropriate systems and programs have generally been on an individual basis rather than on a planned basis to meet the needs of all the co-operatives.

The Irish Agricultural Wholesale Society (IAWS) have taken some steps towards acting as a co-ordinating body in this area. They act mainly as suppliers to the retail co-operatives but also aim to assist them in various other ways. As part of their machinery-supply operations, they have provided consultancy services on such matters as the type of machinery required. This has gradually been extended to cover advice on other problems, including vehicle routing and feed mix problems. Recently, they have developed a package program for computerising milk cheque payments. This package is at present used by a number of creameries and is available to all. Their involvement in this area has developed in response to requests for assistance from the co-operatives.

The services provided by the IAWS are valuable but, if they are to be provided on an adequate scale to meet the needs of the co-operatives, a more formal approach will be necessary.

Currently, discussions are taking place between the IAWS, the Irish Agricultural Organisation Society (IAOS) and the co-operatives about rationalising the situation. There are a number of reasons why a combined effort would be very valuable.

The structure and activities of the various co-operatives are rather similar and the problems which they face are consequently common problems. For example milk payments are made by all the dairy co-operatives. The other types of co-operatives make similar payments. Artificial insemination (A.I.) records are common to all A.I. stations. Transportation problems are common to them all. It would be possible to develop common packages to deal with these problems on a global rather than on an individual basis, as has been done by the IAWS in the case of milk payments.

The co-operatives which have been using computer bureau facilities are quite satisfied with the service that has been given on their routine applications. They recognise, however, that this is only the first level of computer usage and they expect to progress to more sophisticated applications in the future. For these applications a deep knowledge and understanding of the particular management problems of the co-operatives will be more important than technical computer expertise. What they will require is a body of high level expertise specialising in the needs of the co-operatives and able to help them to develop the management information and other systems they will require. This expertise should be built up within the co-operatives. Since their requirements will be quite similar, it could be developed on a co-operative basis.

An example of what might be done here is given by developments in Denmark. The Danish co-operative societies have set up their own centre for data processing and operations research—the Danish Agricultural EDP Centre. The Centre is owned and controlled by the two Danish associations of co-operatives, one for the dairy industry and one for the bacon industry.

The Centre has three computers in operation with a staff of about 200 people on systems, programming, operations and research and development. The type

of work which they are doing is very similar to that being done or envisaged here—milk and pig payments, wage payments, stores accounting, feed mix, route planning, investment appraisal, etc. The Centre is fully self-financing from current revenue, which at present amounts to about £700,000.

The co-operative movement is only one part of the agricultural sector. There are many other areas in which computers can be beneficially applied.

For the farmer himself, computers can be of benefit. An article on the use of computers in agriculture in Britain indicated that considerable progress is being made in providing computing services for the individual farmer [13]. One commercial organisation provides a dairy forecast scheme based on herd structure, stocking rate per acre and feeding stuffs. Monthly and yearly forecasts are provided. They are a valuable planning and control tool for the dairy farmer. This organisation is also developing a total farm planning scheme. Other organisations are involved in providing analyses of performance in egg production. The Ministry of Agriculture, Fisheries and Food provides computer based advisory services on farm management, dairy management and poultry.

In order to profit fully from our natural advantages in agricultural production, we must use the most modern management methods at farm level. Running a farm is a management problem at least as complex as that found in any other type of enterprise. Computers could be of much help to the individual farmer in analysing input-output results, in considering alternative courses of action and in maximising the return from his own holding. The individual farmer will be closely in touch with the co-operatives and through them with any computing centre which may be developed. Much information about the farmers would already be stored in the centre. It would be a logical step for the centre to expand its activities into this area.

In agricultural research, the Agricultural Research Institute is using a computer quite extensively for such matters as the analysis of data from surveys and experiments, simulation and information retrieval.

Some of the agricultural marketing boards are using computers as part of their normal operations. In the Department of Agriculture and Fisheries, some applications have been developed and more are planned to deal with their administrative tasks.

The main areas where special co-operative and co-ordinating arrangements are required are the co-operatives and the individual farmers. The problem facing the agricultural sector is the development of expertise in agricultural computing. The establishment of a co-operative organisation on the Danish lines set out earlier would appear to be a practical and efficient way of tackling the problem, though initially any organisation developed here must operate on a much smaller scale. It would be concerned with the development of systems and programs suitable for the computing requirements of the co-operatives and the farmers and with ensuring that adequate hardware facilities are made available.

4.4 *Health*

The hospital system is a large and complex organisation. Looked at as an industrial enterprise, it is one of the largest in the country. In the course of its operations it creates, processes, stores and retrieves vast amounts of data. It has many inter-communicating departments, has accounting and business functions, compiles statistics, carries on research and teaches. In recent years its work has greatly increased in complexity. Like many other organisations that need to adapt to modern conditions, the operations of hospital systems have lately been subjected to much scrutiny both here and abroad [14, 15, 16, 17]. The potential benefits of applying automatic data processing methods are recognised to be very great.

In Ireland there is as yet only one computer used substantially in the health sector. This is an ICL 1901A controlled by the Dublin Health Authority and sited in St. Kevin's Hospital, Dublin. It replaces tabulating equipment that was used for routine administrative jobs such as salaries and wages and general accounting. In addition to these jobs, it will also be used for various medical statistical analyses, both for the Medico-Social Research Board and for the Dublin Health Authority, such as national mental health surveys, school health statistics and dental surveys. St. Kevin's Hospital will make use of the computer. Initially they will be producing an index of patients (they have about 1,200 at any one time). They would hope to develop this into a computerised medical records system both for use by the medical staff and for deriving statistics (e.g. length of stay). But these further developments are not yet even at the planning stage.

The Irish Heart Foundation makes use of the Trinity College computer for data processing in connection with its "Mediscan" service.

An interesting computer application which is being developed by the Department of Health is for the payment of chemists for prescriptions dispensed under the new health schemes which will replace the dispensary system. Prescription forms will be sent at the end of the month to the Department of Health who will repay the cost of the drugs.

A similar system operates in Northern Ireland [18, Ch. 10]. As well as performing the routine function of repaying the cost of drugs to the chemist, the use of the computer enables the information to be analysed to show, *inter alia,* factors influencing drug prescribing, the use of newly marketed preparations and drug usage in different geographical areas. With the help of this information it is possible for example to analyse patterns of drug usage in attempting to reduce overall costs.

A scheme with the ultimate aim of preparing national hospital in-patient statistics based on returns made by hospitals was initiated recently by the Medico-Social Research Board.

A small number of hospitals have been involved in a pilot study since mid-1969. Returns are made in a standardised form about each patient discharged

from one of these hospitals. The scheme, which is based in its entirety on one already in operation in Scotland [19], has been implemented here with the aid of the ADP Unit of the Department of Finance. When fully operating, this scheme will provide statistical information on about 300,000 admissions per year.

The information being collected falls into three categories:

(1) data relating to the patient—name, address, age, sex, etc.

(2) administrative data—source of admission, date placed on waiting list, date of admission and discharge, etc.

(3) clinical data—diagnosis, operations, etc.

From this information, statistics will be derived analysing by diagnosis, sex and age the waiting time before admission, the duration of stay and manner of discharge. A regional breakdown of these statistics will also be prepared. *Ad hoc* statistics will also be prepared as required. Another use of the information will be for producing a diagnostic index listing the patients treated in order of diagnosis. This will facilitate access to appropriate clinical notes needed for research and other purposes.

There are a number of areas in which these statistics are useful. They enable the trends of disease among hospitalised patients and their social and demographic characteristics to be observed. This is of assistance in the planning and administration of the hospital services. They provide useful epidemiological data. They provide information for management decisions in relation to the utilisation of hospital resources and the management of groups of patients.

The logical follow-up to the collection of statistics is to personalise the data by preparing a computer record for each individual rather than each discharge and linking the different records for each individual. Thus there would be just one record which would give details of each stay in hospital by any one person.

The usefulness of standardised medical records is well recognised in this country. The Fitzgerald Report [14, pp. 84–5] made the following recommendations:

(i) Each hospital must have a central records office adequately staffed and working to the best of its ability pending the development of a national system.

(ii) The hospital record system throughout the country should be standardised.

(iii) It should be on the unitary system i.e. all the data relating to a particular patient should be contained in a single file under one continuing number.

(iv) The basic documents should be designed in a form suitable for data processing.

(v) Emphasis must be laid on the confidential nature of medical records and they must be so labelled. It is essential that staff dealing with such documents are informed—and constantly reminded—of this fact.

The report suggested the creation of a full-scale computer service which would retain all the data relating to hospital patients at a single national centre. This would make available previous hospital records of every patient irrespective of the hospitals involved. The standardisation of records and access to a computer would make available a great wealth of medical material for statistical use, e.g. in research, community health, hospital planning, drug usage and ambulance services. The report recommended that an advisory board should be established to facilitate the setting up of an efficient and standardised system in every hospital.

This is an ambitious and far-sighted scheme, for which much experimentation and re-organisation of hospital procedures would first be required. As yet no steps have been taken or firm plans developed with a view to implementing it.

The picture abroad in the medical computing field at the present time is one of active experimentation on all fronts with many pilot projects being developed.

Sweden is probably the country that is furthest advanced in medical computing. One pilot project is being developed at Danderyd, a 1,500 bed central hospital in Stockholm county. The system provides for the storage of 12 million patients' records, and immediate on-request display, in visual display terminals, of vital statistics and any available critical medical, x-ray and medical history information. The plan is to continue to develop the system until by 1972 it becomes operational as a fully integrated system for all the hospitals (about 45) in the country.

The overall aim of this scheme is to make it possible for the county to follow continuously the morbidity of the total population in the region and control the actual utilisation of the available resources in the various forms of health care, providing a rational basis for the long term planning of medical care. For these purposes the system will record all activities related to each patient at the hospital, and other medical institutions as well as in the doctor's office [20, 21].

Another independent project of a similar kind, but adopting a somewhat different approach, is under way at the 2,000 bed Karolinska hospital in Stockholm [22]. The aim is to develop software for a complete hospital information system suitable for a wide range of large and medium sized hospitals.

A Hospital Administrative Centre has been set up with computer-connected graphic display units and printing terminals. All information about each patient is kept on the computer medical record data bank. The computer is used for allocating resources to individual patients from the booking of the patient's initial visit to the doctor, arranging times for entry to the hospital, for tests, examinations, operations, etc.

A major element in both these projects is the standardisation and the computerisation of the individual records which as well as helping the treatment of current patients, is of significance for research and administrative purposes.

In a number of hospitals in Britain, pilot projects are also being developed [see e.g. 18, 23]. The US Department of Health, Education and Welfare has sponsored research to investigate the possibility of setting up regional or national medical record centres.

In Israel since 1964, a team of doctors and nurses from the Hebrew University of Jerusalem have collaborated with a private data processing agency, public health physicians and hospital authorities in an attempt to achieve a central medical data bank. It now contains detailed information on all children born in the city of Jerusalem during the last five years—on their birth, the health of their mothers and some data on fathers and siblings as well. Plans are now under way to extend the system to all residents of Jerusalem—some 300,000 people and then to create a model that will be applicable both to the entire state of Israel and to any other population group [24].

As well as in hospital administration and medical records, there are a number of other areas in which the use of computers is being developed in the medical field. Many of these are discussed in the McLachlan and Shegog book [18]. They include the handling of clinical data, electro-cardiogram interpretation, radiotherapy treatment planning and the analysis of laboratory tests.

It is quite clear that the health sector provides ample potential for computerisation. Effective action could be of considerable assistance in controlling the cost of the health services by ensuring the optimum allocation and usage of the scarce medical resources available. It would enable doctors to concentrate on patient care, rather than spending time on clerical chores.

Some of the potential computer applications require co-operation at a central level—e.g. linked personalised medical records. Others could be developed independently e.g. hospital information systems—but could more efficiently and effectively be developed on a central basis. The problems to be tackled in all areas are common and one system could be developed to suit all rather than have individual hospitals going their own way and duplicating the systems analysis and design being done by others. For a small country, the cost factor here would seem to be overridingly in favour of the common approach.

The first step which is needed is probably to seek and disseminate detailed information about the potential for using computers in the health sector. This would involve making first-hand acquaintance with what is going on abroad, passing on this information to the various parts of the sector and making a general assessment of the economies of applying in Ireland such applications as have been developed abroad. The drawback of the present situation is that there is no person or body specifically charged with this responsibility. Information is therefore obtained and disseminated in a haphazard way.

It would seem quite appropriate, for example, for the Medico-Social Research Board to take on the responsibility of co-ordinating and directing progress in this field. The Board was set up by the Minister for Health (a) to organise and administer research into specific health problems and into the provision and operation of the health services and (b) to advise the Minister on health problems and the compilation and use of health and vital statistics.

There appears to be at present inadequate knowledge within the medical profession about the potentialities of computers. In the long term no doubt this will be remedied through provision for the education of medical students in medical computing, just as they become familiar with the use of the stethoscope or microscope. In the short term, however, crash courses for top level administrators are clearly indicated. Medical computing is becoming a speciality in its own right. This was recognised some time ago by the major computer manufacturers who, realising the potential, have all set up special medical divisions or international medical centres to carry out development work in medical systems. As in other sectors of computing, the applications are now becoming so bound up with the subject area and so sophisticated that those who are ultimately running the medical computing services must be medically trained, rather than computer specialists with some knowledge of the medical field.

No effective developments can take place without the full co-operation of all people concerned in the administration and operation of the health services. Any central body that is set up must consult with these people and receive their support for all developments. To provide a channel through which their voices and opinions might be effectively conveyed to this body, an advisory group might be formed representative of the medical professional bodies, the Department of Health, the Regional Health Boards, the hospital administrators, etc.

It is not realistic to assume that it is possible to do nothing until general hospital information systems are developed abroad, and then apply them here. Before that can happen much experimentation, in the form of pilot projects, will have to be carried out in order that the medical profession can gain the vital experience in computer methods, in the light of which the necessary adjustments and reorganisation of hospital procedures can be made. Without this no significant implementations will be possible.

4.5 *The Construction Industry*

Building and construction work accounts for over 50 per cent of annual capital expenditure in this country. Its large employment content can be seen from the number of different sectors which make up the industry—architects, quantity surveyors, civil and structural engineers, builders' providers and building contractors.

Despite its size and importance in the economy, very little use of computers has as yet been made in this industry. The Institute for Industrial Research and

Standards has been concerned with the development of a number of individual computer applications, and a few individual organisations—e.g. quantity surveyors and civil and structural engineers—are using computer facilities, but on a small and restricted scale.

The lack of computerisation may be attributed to the complex structure of the industry—all of the sectors mentioned above must be co-ordinated and integrated in any construction project—the small size of the individual organisation involved and the different requirements of the individual sectors.

In view of the nature of the construction industry and the developments which have taken place abroad, it seems that considerable benefits could be obtained by using computers in this industry. In all of the component sectors of the industry, some computer applications have already been introduced and much research and study is going on with a view to extending these applications. One essential point which has emerged is that effective use of computers can only be made if the problem is tackled on a co-ordinated basis at industry and at sector level.

A working party of the Irish Computer Society has had a preliminary look at the computer requirements of each sector with a view to developing an overall concerted plan of action for the whole industry. This is a valuable initiative but the working party is a part-time one and has no funds at its disposal for carrying out the volume of research and development which will be required if further steps are to be taken towards implementation.

In Britain until recently, the pattern was also one of slow and piecemeal development. A co-ordinated approach is now being sought. In 1966, the Ministry of Building and Public Works set up a Committee on the Application of Computers in the Construction Industry with the following terms of reference:

> "To keep under review the present and potential applications of computers in the construction industry, taking account of experiences and trends in other industries; to identify areas in which there is a need for co-ordination of effort; to examine the need for action to secure the wide application of existing knowledge and the promotion of further advances; and to make recommendations".

The Committee found that much progress had been made in applying computers to the industry but that it was almost wholly confined to individual and separate processes—e.g., structural design, bills of quantities and suppliers' stock control. Each application was developed in a particular sector with little regard for the needs of other sectors [25, p. 7].

In individual sectors—e.g., the building contractors—the Committee found that the bulk of computer work was done by a few of the larger organisations but that even these encountered sizeable areas which they could not tackle because of dependence on other sectors or because of the development costs involved [27, p. 1].

They therefore identified two levels at which co-operation and co-ordination are required—on an industry level to ensure that applications are designed in such a way as to suit the requirements of all sectors rather than just one individual sector and at a sectoral level to avoid duplication of effort, to extend the benefits of existing work to the smaller organisations and to tackle the major projects which are beyond the capacity of any one organisation.

One major problem which they identified at the industry level was that of the lack of standardisation in the vocabularies and codes used in the different sectors. The flow of information from one sector to another is such that considerable benefits would be achieved if computer-based data in one sector could be passed on to the other sectors and be in a form suitable for their requirements. The existing proliferation of specialised vocabularies was seen as a major obstacle to this information-flow—whether computer-based or not. Time and money had to be spent on translating information produced, e.g. at the design stage into form suitable for use by the building contractor.

The Committee set up a study team to look into this question, including the determination of criteria for a coding system which would enable computer-processed information to be used more effectively both within individual firms and offices and in communications between them. The study team produced a detailed report [26]—summarised in [25]—setting out the framework for a co-ordinated information system and recommending that work should commence on drawing up such a system.

As the implications of data co-ordination are wider than the question of applying computers to the construction industry, further work in this field has been passed to a working party of the Ministry's National Consultative Council. This working party is engaged on some detailed studies.

One recommendation which the Computer Committee have made is that a National Construction Industry Computing Centre should be set up. This Centre would advise organisations on how best to take advantage of computer applications and where to find suitable programs. It would also provide information, education and other services. The development of such a Centre is being approached by setting up units in the individual sectors, under the overall co-ordination of the Computer Committee, with the aim of uniting them at a later stage into one body.

At the sector level, steps have been taken in a number of areas.

In the building contracting area, a sub-committee was established with the following terms of reference:

> "To identify the factors and problems which influence the profitable use of computers by contractors; to propose action leading to the solution of these problems; and to advise on the means of implementing these solutions" [27, p. 4].

The principal findings of this sub-committee, as set out in its first report [27], were:

(i) that there is a need for education for management in the use of computers;

(ii) that a reappraisal of the organisation of construction projects is required to take account of new computer techniques; and

(iii) that computer-based methods are desirable for controlling information flows so as to achieve more effective management of material costs and a feedback of data from the building site—for this purpose standardisation is needed through a preferred vocabulary and an industrially acceptable library of operations descriptions.

It recommended the establishment of an organisation for Software Evaluation Exchange and Development for Contractors (SEEDCON) with a small permanent staff plus people on short-term secondments from the industry. The immediate tasks SEEDCON might undertake were seen as the evaluation of existing programs to see what could be made generally available, thus avoiding duplication of effort; the promotion of proven standard programs among organisations which have not yet used a computer; the provision of an advisory service—a focal point to which the individual contractor can take his problem and receive practical advice; and the establishment of short and long-term training and educational schemes to ensure that the best use is made of existing knowledge.

In the civil engineering area, an organisation is being set up—the GENESYS Centre. This Centre will have exclusive rights to a computer program-handling system GENESYS, a master program making use of existing programs for structural design and which can accommodate new programs as they become available. Using it, designers will be able to specify the important features of structures and control the design procedures. GENESYS will then call on the required computer programs, carry out the necessary calculations and will present the designer with the results. The Centre will market GENESYS on a commercial basis and provide advisory services, information, practical demonstrations, educational courses and lectures [28].

Working Groups have also produced reports on computer-aided architectural design [29] and on the preparation of bills of quantities with the aid of a computer [30].

The developments in Britain show that developing computer applications n the construction industry is a complex matter and that progress is likely to be extremely slow if left to the unco-ordinated efforts of individual organisations.

The position is the same as far as the Irish construction industry is concerned. If the full benefits of computers are to be reaped, it seems clear that a co-ordinated approach on the lines being followed in Britain will be necessary. The organisations within each sector must come together to see how computers can help them and to develop the necessary systems. Overall co-ordination

of these sectoral developments must be achieved so that inter-sectoral needs can be taken into account.

If anything effective is to be achieved, it seems clear that some central body should take on the responsibility of co-ordinating and directing progress.

It would seem quite appropriate, for example, for an Foras Forbartha—The National Institute for Physical Planning and Construction Research—to undertake the necessary co-ordinating role. Among the functions of an Foras are the provision of research, training and information services for the building and construction industries. They have both the funds and expertise necessary to initiate effective action in this area. They are already looking into the needs of the industry and the manner in which these needs might best be tackled.

Without close collaboration with, and co-operation from the individual parts of the industry, an Foras would not be able to make much progress. They should bring into this project all the interested people, including the Institute for Industrial Research and Standards and people in the industry who have already had some experience of computing. Together they could work out the approach to be adopted to the overall problems and the order of priority for tackling particular problems. In view of the progress which has already been made in Britain in this area, close liaison with British research and developments would also appear desirable.

4.6 *Scientific and Technical Information Services*

"Knowledge is the master resource of our time" [31, p. 3]. Scientific and technical information (STI) is that form of knowledge of particular value to the economic growth of the country. It is international and its world volume is growing exponentially. Currently, some two million documents and articles are published annually in 26,000 journals and 30,000 books [32, p. 2].

The utilisation of STI requires the development and maintenance of efficient services co-ordinated and tailored to the diverse needs of users. A developing country is entirely dependent on its STI services for the efficient transformation of new knowledge into the production of goods and services. The quality of a country's STI services determines its performance in the face of international competition. STI services therefore constitute a key sector of the economy.

STI is used in industry, the professions, health, social, environmental and other public services, universities and research institutes. These users need information as a basis for decision-making or as a basis for further research. They are all vitally concerned with having efficient and economic means of access to existing knowledge. If the relevant information is not available to them, it can lead to misapplication of resources through inadequate decisions or through duplicating research already completed.

The conventional methods of storing and disseminating information—the publication of information in printed form and the library services—are no

longer adequate to cope with modern requirements. These services are being augmented by new techniques and new storage media—e.g. microphotography, facsimile transmission and computers.

Computers, with their ability to store and retrieve large volumes of data quickly and efficiently, now occupy a significant place in information servicing and their role will undoubtedly increase in the future.

The Canadian report on STI, already quoted, envisages that eventually computers will form the backbone of information services, aiding users through remote time-shared consoles [31, p. 9].

The Dainton report on the British National Libraries [33] envisages that in the future the larger libraries, laboratories and industrial firms will be directly linked through individual computer terminals to a computerised national library catalogue. It suggests that computer storage will be able to retain full texts and transmit them by facsimile transmission in response to queries.

A number of information services are already being provided through computer-based systems. For example, the Medical Literature Analysis and Retrieval System (MEDLARS) developed by the US National Library of Medicine contains a computer record of more than ½ m. entries. The US Library of Congress has developed computerised cataloging and library systems—the MARC system. The American Chemical Society has a computer-based system for chemical abstracts.

The growing volume of available information, the greater application of science and technology in all sectors of the economy and the inter-disciplinary approach in scientific research—including the social sciences—all point to the principle that a prime requirement for an efficient and comprehensive information service is the co-ordination and integration of the various services. The separate development of a large number of specialised information services limits the availability of the information for any particular use or user. The Canadian study found that a major drawback is that there is no single place where all information sources are listed and that there is no assurance that any agency can supply a complete listing of people or documents relevant to an endeavour [31, p. 22].

In the US, there are over 500 different information services and efforts are being made to co-ordinate them. A Committee on Scientific and Technical Information (COSATI) has been established to develop a co-ordinated information system among the executive agencies. It is encouraging the development of communications systems with the ultimate aim of linking all federal systems and providing rapid access to information. It is seeking consensus from industrial, academic and government areas for a national plan for making all US information systems compatible.

In Britain, the Office for Scientific and Technical Information (OSTI) in the Department of Education and Science is concerned with encouraging the development of information systems and the training of information specialists.

It is concerned also with promoting the co-ordination of British efforts in international co-operation on compatibility of systems.

Two important reports prepared in Britain may be mentioned. A sub-Committee on Scientific and Technological Information prepared a report [34] for the Parliamentary and Scientific Committee evaluating government information services and liaison with other countries. This report stressed the urgency of comprehensive library and information services and recommended that the Government should assume responsibility for planning and co-ordinating such services. The Dainton report on the organisation of the national libraries [33] recommended unified control of all the libraries to help achieve the standardisation and co-operation which would be needed in the future.

The study carried out in Canada [31] recommended the establishment of a Scientific and Technical Information Agency to develop a comprehensive national information policy and to plan its implementation. It also recommended that a National Referral Centre be operated by the Agency to provide a central point of contact through which seekers of information might be directed to the appropriate sources.

On the international front, the OECD Scientific and Technical Information Group is endeavouring to establish compatible international exchange systems. UNESCO and the International Council of Scientific Unions (ICSU) are co-operating on a project (UNISIST) for the communication of scientific information which will be computer-based.

Here in Ireland, the OECD 1963 report on "Science and Economic Development" [35] listed 33 organisations and a number of advisory services concerned with disseminating information in Ireland. The main ones are the large libraries and government and research institutes.

In many of these, efforts are being made to cope with modern information requirements, including the introduction of computer-based techniques.

Trinity College is computerising its library operations and will also provide a service based on the MARC library tape system—this is an alerting system for books published in Britain and the US operated by the British National Bibliography and the Library of Congress.

It is used in the accession procedures for new books and for producing catalogue cards. It also provides the means for accumulating a machine readable catalogue which will be the basis for more sophisticated future systems. The MARC tapes incorporate the Standard Book Numbering System which was developed by the writer [39, 36] and has been accepted as an ISO international standard. This will be used for title identification in all the basic library operations.

The Institute for Industrial Research and Standards provides a computerised information service in relation to Chemical Abstracts. They act as agents for the Chemical Society Information Unit at Nottingham University.

The Agricultural Institute are developing a number of services, including

the preparation of a computerised indexing system for reprints and references.

The OECD study found that there was little co-ordination between the many information services. It recommended that:

> "the main technological change required in the field of technical information is a central library co-ordinating body for the purpose of organising a joint library service. There is also an increasing need for a national documentation or technical information centre. Some libraries are modernising but in general this is being done in isolation from other library developments".

The situation has not changed much in this regard since.

The Third Programme [11, p. 154] contains the following paragraph on the subject:

> "The NSC[1] is also considering the development of a national system for scientific information. The existing volume of information and its rapid rate of growth have tended to swamp the traditional ways of dissemination. New techniques based on mechanisation and the use of large computers for storage and retrieval provide the potential means for dealing with this problem. A computerised scientific information service is, however, still at the experimental stage. For a small country such as Ireland, which must have ready access to the world pool of scientific and technological knowledge, it is likely that needs can best be met by keeping in touch with developments elsewhere and by arranging for some form of overseas link-up as soon as a suitable opportunity arises".

The Irish Association of Documentation and Information Services (IADIS) was formed in 1966 from a reorganised Irish Association of Documentation. Its membership includes information scientists. The main bodies concerned with information services are members of the IADIS and it provides a forum in which the personnel of these bodies can discuss their proposed developments and achieve some measure of co-ordination.

In association with the NSC, the IADIS held a discussion meeting on "Scientific and Technical Information: the Future" early in 1969. Interested bodies represented included the OECD and the United Nations Economic Commission for Europe. A wide-ranging discussion took place on future developments in Ireland.

It is recognised that the prime requirement in Ireland is for a national policy on information services. This should aim at developing an integrated information system designed to meet the needs of all users and employing modern techniques, including computer methods.

[1]NSC—National Science Council.

Such an information network should provide access to all information generated here or abroad. It should link in with world information systems, or with any integrated world information network that may be developed. It should also provide a central data base with information on our own national resources and other internally generated information.

The setting up of a comprehensive automated STI network would naturally comprehend computers along with other new techniques, media and methods of modern library science.

It is not within the scope of this study to comment on the total development of STI services (any more than it would be to comment on the development, e.g., of medical services), but simply to point out that computers constitute one of the major new equipment developments in this field. National computer policy must take account of STI needs, and on the other hand STI must be fully informed on national computer policy.

For this reason it is suggested that, pending the formation of any national co-ordinating information services authority, there is an urgent need to take now the simpler first step of setting up a small national body charged specifically with the co-ordination and development of computer applications in the STI field. Its members would be drawn from the main organisations concerned with the provision of information services. This body could eventually become one division of the larger national information authority.

4.7 *The Education and Research Sector*

The virtually unlimited potential matched by high computer costs make the educational sector at the present time of exceptional importance from the point of view of computer development. In a small country like Ireland, there seems little case for the separate consideration and support for computing in the various institutions that comprise this sector: the universities, research institutes, technological and other colleges and secondary and primary schools. From the computing point of view, they form a whole and should be subject to a unified funding procedure.

There are a number of reasonswhy co-ordination in computer developments extending over the whole sectorhas recently become imperative. High hardware costs have been mentioed. Piecemeal, unco-ordinated development would also lead to costly dupication of programming effort in developing essentially the same program at different locations. A proliferation of separate small computers in the institutions begs the question how computing might best serve the needs of education and establishes artificial boundaries stifling healthy growth. On the other hand, larger centres serving a variety of needs, including research and administration as well as education lead to higher utilisation at lower cost and take care of seasonal loads (e.g. teaching needs are low during summer).

Currently the four main universities each have separate computer installations with an aggregate capital value of about £800,000. Two of the research institutes—the Institute for Industrial Research and Standards and the Dublin Institute of Advanced Studies have small computer installations. The Agricultural Research Institute has a terminal linked in to a large commercial computer installation in London. Other Institutes—e.g. the Economic and Social Research Institute and an Foras Forbartha—use computer time on the university and other outside installations. The College of Technology in Bolton Street have a small computer installation.

The universities' plans for the future envisage an expansion of their facilities within two years to a capital value of about £1 m. and further expansion within five years. The existing installations in the research institutes are no longer adequate for their requirements and they will need either to expand their installations or to use time on an outside computer. The technological colleges, teacher training colleges and schools will undoubtedly require computing facilities before long.

These developments all add up to a substantial investment in computing by these institutions.

In the computing field, we are faced with an explosively advancing technology. The social and economic gains to be made through the use of computers are limited mainly by the availability of people educated in computing. To-day at any level, education without computing experience is inadequate. Intellectually and industrially, the country will lag to the extent that the educational sector does not keep abreast of this technology.

Elsewhere in this report we comment on the problems of computer education [sections 5.1, 5.2]. In this section we are concerned only with the type of organisational arrangements that would be necessary to meet the educational computer requirements for the whole sector. If a planned computer development is to take place, the first essential is to make an assessment of the computer objectives for the whole sector. A design for a total integrated hardware system could then be thought out in the light of these objectives.

Some day one large central utility may serve the needs of all educational institutions, and the problems of choosing hardware configurations will be simpler. At the present time there are a number of options available, and these make the decision problem complex. An institution can buy service from a commercial computer bureau, preparing its own data and using post or courier services; it can be connected by remote terminal to a large central installation; or it can operate its own small independent computer system. The last is becoming the most costly and least satisfactory from the educational point of view. Nationally, it means a greater number of operating, programming and systems staff. Quickly obsoleted technical skills of operating small systems of little educational value tend to be taught, rather than general principles of more permanent value. The small systems are inflexible and do not expose the users to the most advanced technology.

At the present time, however, there can be no question of all computer facilities being centralised. In the light of the existing state of the technology, an optimum mix of local, terminal, satellite and central facilities is required.

The use of computers should no longer be regarded as an esoteric activity. It is more like using the telephone. Learning to program a computer is a much easier skill and requires much less time than learning a foreign language. In designing a hardware system for the educational sector primary attention should be given to the important developments which will undoubtedly take place in secondary and technical education: when computing catches on here, as it is now beginning to do in other countries, the resources required for it may be much larger than that required in higher education and research.

The provision of computing power will therefore become a necessity over the whole educational sector. It is not a capital expenditure like a new building, but rather a continuing expense, like the cost of electricity.

The problems of providing computing power in the educational sector have been looked at in other countries. In the US, the President's Science Advisory Committee reported on computers in higher education in 1967 [40]. They estimated the cost of providing adequate computing at around four per cent of the overall educational cost per student per year. They stated that since the major economic and socially productive uses are dependent on educational computing it was in the national interest to have adequate computing for educational use in all institutions of higher education by 1971–72. The report was not primarily concerned with secondary education, but they found that training in the nature and use of computers was rapidly but randomly invading secondary education. They recommended that the office of Education and the National Science Foundation jointly establish a group to investigate the use of computers in secondary, junior high and elementary schools. Co-operation between schools and universities, particularly providing service to schools from university centres, should be encouraged. They recommended that the Federal Government collect meaningful data concerning computers and the jobs, personnel, and educational facilities associated with them, and provide annual forecasts.

In Britain a committee (The Flowers Committee) was set up in 1964 by the Secretary of State for Education and Science "to assess the probable computer needs during the next five years of users in universities and civil research establishments receiving support from Government funds". The Committee reported in 1965 [41] and, following on one of its recommendations, a permanent Computer Board was established with the continuing task of assessing the need for computers in universities and research councils, providing such computers within an approved policy and budget and satisfying itself that they are effectively commissioned, adequately used and efficiently managed. An annual report was to be published. The first of these appeared in 1969 [42].

The Board consists of a chairman and seven members drawn from the

universities, the research councils and private industry. To assist the Board, assessors attend the Board meetings as necessary from the appropriate Government departments and research councils.

Unfortunately, and shortsightedly, the Board was appointed specifically to deal with the provision of digital computers for research purposes. In their first annual report, the Board comments that the exclusion of teaching uses from the terms of reference was "largely accidental", and go on to state that "there is a growing awareness that the requirement for computing facilities for teaching purposes is likely to increase rapidly, and that it cannot continue to be regarded as a relatively small component of total demand which can be absorbed in the Board's program without specific recognition" [42]. The other evident shortcoming of this board is that it is not concerned with schools and technical colleges.

The Board believes that increasing interdependence of universities in computing matters will be essential. Within its limited frame of reference, it is well placed as a central and impartial body to take a co-ordinating role.

The original Flowers Report [41] recommended that hardware facilities be provided through the creation of regional hierarchies. By this they envisaged one large computer located in each region to which each local university and research institute would have access. Most of them would also be provided with more modest computers of their own to cater for their normal requirements. They recommended three regional centres initially with a further three to be considered further. They also recommended that the regional centres should be staffed in such a way that expert knowledge could be made available rapidly and efficiently.

The type of use made of computers by educational institutions is rather different from that of commercial organisations. In the universities, computers are used for teaching, for research and for administration. Many different faculties use computers in the course of their instruction, particularly the engineering, science and medical faculties. Computer science is taught as a subject in its own right. On the administrative side, computers are used for such purposes as student registration and records, payroll and accounting and library catalogues and records. The research institutes use computers mainly in connection with their research projects. The replies to our questionnaire showed that 84 per cent of the computer time used by the universities and research institutes was for education and scientific/research work. Among the commercial users, less than one per cent of their computer time was in these areas.

Since their applications are different, their systems software requirements are also different—this point is discussed at length in paragraphs 81–83 of the first report of the British Computer Board [42]. At present the universities employ a number of highly skilled systems programmers to develop specialised systems software suitable for their type of applications. Co-operation in this area would be extremely valuable. It would avoid duplication of effort and

speed up the development of adequate software to meet their specific requirements.

In areas where similar applications are being developed or considered, co-operation would also be beneficial—e.g. on administrative applications such as student records or on library applications. Incompatibility of hardware in separate installations limits the exchange of programs and the development of joint programs.

The Flowers Committee found considerable duplication of effort among the universities and research institutions. In many cases they discovered similar programs being developed at several places simultaneously to solve much the same problem. They recommended that the research councils should take a definite lead in drawing together the country-wide efforts on the development of major programs of a standard nature. They considered that much could also be done by maintaining up-to-date libraries of standard programs.

In Ireland each of the universities has planned its basic requirements for the next five years or so—additional expenditure will be on expanding rather than replacing existing facilities. There can be no question of any of these facilities being scrapped right away in favour of a co-operative venture. Co-operation must be planned to coincide with the end of the "life span" of the existing installations.

In the meantime some co-operative links may be feasible. For example, the Trinity College and UCD installations are rather complementary, Trinity having direct access terminal display units and UCD having remote access batch processing facilities. It may be possible and beneficial for inter-links between these systems. Some co-operation could also take place on common applications and on systems software development.

If co-operation is to be achieved, somebody must be given the task of initiating and supervising the necessary action towards this end.

A full-time working party could be set up to study the design of a hardware system for the educational sector. The appropriate body to oversee this work would be the National Science Council. The working party could report back to a divisional council of the NSC, given, say, a remit for one year's work. Afterwards, a co-ordinating committee could be set up, representing all interests, and working within the framework provided by the divisional council.

The HEA has already taken some action in relation to the universities. A Committee was appointed in 1968 by the Minister for Education to report on the computer requirements of the higher education institutions. Representatives from the institutions concerned were on the Committee. As a result of recommendations made by that Committee, a standing Committee is now being appointed by the HEA to keep these computer requirements under review, to examine individual proposals and to consider schemes for linking and other forms of co-operation.

The HEA does not cover all the institutions with which we are concerned.

The research institutions do not all come within its scope, nor do the schools and technical colleges. Nevertheless this is a valuable initiative. Membership of the standing committee is drawn in the main from academics concerned with the teaching of computer studies in the universities, and it is clearly desirable that a forum be so provided for the discussion of common problems and the formulation of common policy: the co-ordination of computer facilities in higher education is a necessity which cannot be postponed. The way in which we see this committee performing a most useful function in this respect is in receiving and working to guidelines provided by the Minister for Education advised by the divisional council of the NSC mentioned above. The standing committee of the HEA would be represented on, and form an essential nucleus of, the co-ordinating committee of the divisional council.

5. A PROPOSAL FOR A CENTRAL COMPUTING COUNCIL

In Chapter 4, we pointed out the need for some form of organisation to be set up within each of the individual sectors. There still remains the problem of co-ordinating the overall development of computing in the economy. This could be the function of a Central Computing Council.

Basically, the objective of this Council would be to develop a national strategy. The principal areas for which it would be responsible are:

—planning and forecasting
—training and education
—promoting developments in individual sectors
—information dissemination
—research
—liaison with international bodies
—standards and standard documentation
—maintaining an index of application programs
—privacy/security/ethics.

In the area of planning and forecasting, the Council would be responsible for maintaining up-to-date statistics on computing e.g. up-dating our survey—gathering information on likely developments in the individual sectors and making projections of future growth. On the basis of these projections, they would identify the resources needed to sustain the expected level of growth—e.g. staffing and data transmission requirements.

On training, the Council would be responsible for ensuring that adequate facilities are available for the training of both management and computer specialists. Their aim would be to see that a spectrum of courses would be available catering for all categories of personnel and ranging from basic to advanced levels of training. They would identify gaps in the available facilities and seek to have suitable courses developed to plug the gaps. As well as ensuring that the necessary courses are available, they would also be concerned with

ensuring that the number of people being trained is adequate to cater for the staffing requirements implicit in the future growth projections. If the demand for trained personnel is likely to exceed the supply, the Council would be responsible for developing and implementing special measures to deal with the situation.

Computer education should also be part of the Council's responsibilities. This is quite distinct from the training functions, in that it should seek to provide for people not directly involved in computing a general appreciation and awareness of what computing is all about, how the computer works, the uses and limitations of computers and the social and economic implications of computers. Such education should be made available both in the schools and in adult education establishments. The Council would be responsible for seeing that proper facilities are provided in this area.

At the level of developments in individual sectors, the Council would act as an initiating and stimulating body. The Council would not be concerned with particular applications but would see that the proper organisational and institutional arrangements were being made to facilitate and co-ordinate developments in that sector. They would act as an advisory body to which sectors could come for guidance.

The Council would also act as a source and a disseminator of information. It might maintain a library of computer literature and act as a source to which people can look for information or from which enquiries can be directed to the most appropriate source. It might publish information about computing in this country—e.g. current statistics and projections, developments in individual sectors etc.—and about developments abroad which would be of particular significance to this country.

In the area of research, the Council would be concerned with the overall level of effort being put into research on computing topics. They would keep in touch with the work being done in particular sectors and seek to stimulate further effort where necessary. It would also be responsible for sponsoring research on general computing problems of specific interest to this country.

A number of international bodies are now concerning themselves with computing and are promoting international co-operation in discussing common problems and in collecting and disseminating information about developments in the individual countries. For example, the OECD have a committee on computer utilisation in member countries, which is concerned with developing a standard questionnaire for gathering information in different countries on a comparable basis, the development of data banks—including the problems of privacy raised by such data banks—and the development of management information systems. The Council would take on the role of liaison with these bodies and would be the body through which information about computing in Ireland would be channelled to them and through which information about their work and findings would be disseminated here.

Standards and standard documentation are an essential part of any well-

organised computing department in an organisation. Once we progress towards the stage where information will be transferred from one organisation to another in computerised form, the need for co-operation and standardisation on a general level arises. The Council would act as a stimulator and co-ordinator of developments in this area.

The maintaining of an index of application programs available might also be undertaken by the Council. This is a function at present performed in Britain by the National Computing Centre. Their index contains details of programs available from a wide variety of sources—manufacturers, users, software houses and bureaux. The index makes it possible for organisations to avail of programs developed elsewhere to handle procedures similar to their own and thus helps to avoid duplication of effort.

The development of large data banks, holding personal information about individuals and enabling this information to be readily retrieved, raises the problem of the threat to individual privacy in a more acute form than in the pre-computer era. We have not yet reached the stage where this is a matter of immediate concern but it should nevertheless be anticipated and kept under review. The security of computerised information in regard both to industrial espionage and possible destruction of the data might also be kept under review. Much of the security will depend on the integrity of the computer specialists. The possibility of organising computer personnel on a professional or other basis might be considered.

At present, the only central body which concerns itself with the general development of computing in the country is the Irish Computer Society. This is a private association with a membership of about 175 people, principally computer specialists and people from educational establishments. It operates through a part-time Council and has no full-time staff. Its main activity is the organisation of lectures and seminars on topics of interest to its members. It also organises working groups on particular aspects of computing—at present it has three such working groups concerned with decimalisation, data transmission and standards. Recently it has taken steps to set up a co-ordinating body to look after the training of computer specialists.

The Society plays a very useful role in catering for the interests of computer personnel and in providing a forum in which their problems can be made known and discussed. The type of organisation envisaged as a Central Computing Council is however quite different from such a Society. We consider that the Society should be represented on the Council and its members will undoubtedly be depended on to provide much of the technical and specialist input which the Council will need. The links between the Council and the Society should be very close but the Society should continue, and would insist on continuing, in its role as an independent association of computer specialists. This indeed is how matters have developed in Britain and various other countries—the British Computer Society has close links with the National Computing Centre but still maintains its own separate existence and functions.

The National Computing Centre in Britain was established in 1966 as a public company limited by guarantee, following discussions between the computer users, computer manufacturers and the Government. Its objective is to promote an increased and more effective use of computers in Britain. The overall governing body is a Council of twelve, six of whom, including the Chairman and a full-time executive Director, are appointed by the Ministry of Technology, two elected by members representing computer manufacturers, three elected by members representing computer users and one elected by members representing professional bodies, etc. Membership of the NCC is open to any person, association or body engaged in the manufacture, sale or use of computers or concerned in education or research with computers or otherwise interested in computing. Organisations outside Britain may become associate members. The NCC is financed from Government grant, members subscriptions and the sale of products and services. It employs about 200 people. Its main areas of activity are:

(i) *information:* it maintains an index of existing computer programs and publishes a number of books and documents on computing, including a monthly newsletter;

(ii) *advice and stimulation:* it provides up-to-date advice and independent opinions about computing, data processing and computers;

(iii) *education:* it has developed and organised training courses for management and for computer specialists;

(iv) *applications and software:* in collaboration with appropriate groups, it undertakes studies of applications in various fields; it is also concerned with developing software for specific purposes, e.g. compilers and operating systems, and with developing techniques and methods, e.g. for systems design.

The area in which it has made its greatest impact is in training—a basic training package which it devised for systems analysts is being used by over 70 colleges and training establishments in Britain and is being marketed on a world-wide basis.

Such an elaborate body as the NCC may not be required in Ireland. The NCC could, however, be a very useful source of information and help for our proposed Central Computing Council and the Council could seek to have ready access to the expertise and knowledge which the NCC possesses. A formal link between the two bodies might be established.

The Central Computing Council might best be modelled on the lines of the National Science Council with a governing Council and a small full-time secretariat provided by the Department of Finance.

The Council should be representative of the main sectors of the economy, computer specialists and educational interests. The representatives from the

main sectors of the economy should be people at a policy-making level who would be capable of stimulating and directing effective action in their own sector. In sectors where a central body exists to co-ordinate computing developments—as suggested for a number of sectors in Sections 4.1 to 4.7—the head of this body might be the appropriate representative. These people should have or acquire a good knowledge of computing, particularly of computing developments here and abroad in their own sector. Where necessary, special training facilities might be laid on for this purpose. Computer specialists could be represented through the Irish Computer Society. The Chairman of the Society might be made an *ex-officio* member of the Council. One or two representatives of educational establishments should also be on the Council.

In addition to the overall Council, it might be necessary to operate through a number of sub-Committees for particular areas e.g. for training and education and for standards. The Council should be given power to appoint such sub-Committees as it might consider necessary and to bring in any necessary expertise from outside the Council to assist on the sub-Committees.

The size of the Secretariat will depend on decisions taken by the Council about the precise functions and activities they should undertake. The head of the Secretariat should be a high-level appointment of a person with a wide background in management or administration and in computing. In the initial stages, a further two full-time staff might be required. We would envisage these as general administrative staff rather than highly qualified specialist staff. One area in which a specialist might be required at this stage is for education and training.

In Sections 5.1 to 5.5 we elaborate on some of the problems with which we envisage the Council would be concerned.

5.1 *Computer Education and Training for Management and Computer Specialists*

Since the general use of computers has only developed in recent years, we have not yet reached the point where there are agreed training requirements and training standards for computer personnel and for management involved in computing. The needs of these personnel are changing with the advances in technology and in our understanding of the potential of the computer. Many different and unco-ordinated approaches to the development of training facilities have therefore evolved.

In Israel, a five-year plan for a national ADP training programme has recently been proposed by the Israel Institute of Productivity at the request of the Advisor on ADP to the Ministry of Finance. The programme is designed to provide specialised training for systems analysts and designers in the fields of administration, engineering and information technology. With stress on its economic necessity, it would be worked out as a joint project with the UN Technical Assistance Agency. It would be geared to the specific job requirements—heads of ADP units, heads of planning units, systems analysts, execu-

tives using ADP systems, programmers, and instructors in ADP. For its preparation, background information would be gathered under the following heads:

—Estimated number of computers in Israel, distinguished by size and by economic sector and expansion of usage by 1973.

—Trends of ADP development in Israel: hardware, new applications, co-ordination and integration of systems by institutions and enterprises, increase in service bureaux usage, prospective use by small enterprises.

—Manpower forecasts.

—Job specifications.

In January 1968, the UK Co-ordinating Committee for Examinations in Computer Studies was established in Britain. The major reason for its establishment was a recognition of the urgent need to develop a nationally recognised structure of courses and qualifications for computer personnel. It was felt that there was much advantage to be gained from immediate co-operation in ensuring that unnecessary duplication of effort was avoided and that adequate provision was made for the training of all categories of computer personnel. The Committee includes members of various educational institutions, the NCC, the British Computer Society and observers from the Government Departments concerned with education.

The approach adopted by the Committee is the establishment and promotion of courses of study leading to appropriate qualifications, other than at degree or final professional level, awarded on the results of national examinations. The examinations are conducted by the member bodies under the overall control and supervision of the Committee. The courses are provided mainly at technical and other colleges of further education. Before approving a course, the Committee ensure that the teaching staff are properly qualified and that the facilities for practical work are adequate. The Committee have approved a number of courses and examinations leading to qualifications in systems analysis, in programming and for computer operators. The ultimate aim is to link the various courses available through a system of examinations leading to nationally recognised qualifications.

Nationally approved courses and examinations are very useful in any area where a large number of people are being trained for a common type of work. They enable prospective trainees to know that certain mimimum standards are being met in whatever course they intend to follow. They enable prospective employers to know that certain minimum standards have been met in the courses attended by potential employees and in any examinations taken by them.

As far as computer personnel are concerned, we should now be at a stage where agreed standards can be laid down for the basic training of systems

analysts, programmers and operators. In view of the mobility of personnel between this country and Britain, co-operation with the UK Co-ordinating Committee would be desirable to ensure that any standard courses and examinations developed here would be acceptable in Britain and *vice versa.*

The advanced training required by these personnel depends to a large extent on the type of work on which and the area in which they are employed, and is less susceptible to standardisation. Nevertheless, there is a need for some body to concern itself with seeing that an adequate range and depth of courses is being developed and made available.

While the greatest apparent shortage of trained personnel is at the level of the computer specialists, particularly the systems analysts, much more attention should be given to computer training of management. The depth of training generally undertaken by management seems quite inadequate in light of the potential development of computing. This is discussed further below.

We have already suggested that the Central Computing Council should have overall responsibilities in the area of computer training. For an area as large as training, the Council should set up a sub-Committee representative of the interests concerned—the Irish Computer Society, the IMI, the Department of Education and other educational establishments.

Training for Management

Elsewhere in this Report the need is stressed for management involvement in computing if the full benefits of computers are to be obtained.

It is not enough to employ and train computer specialists and hand over to them the task of introducing the optimum amount and type of computing required by the organisation. This may work if the only interest is in the lower level computing applications. But for the higher level applications, management must become involved in determining what it wants from the computer system and in judging the feasibility of the projects.

At present, courses for top management are provided by the IMI, the IPA and the computer manufacturers. A wide variety of courses are also available in Britain from numerous management training bodies. A considerable proportion of the top management of Irish organisations have attended one or more of these courses.

The typical structure of top management courses is a two to four day course aimed at giving a general appreciation of computers, how they work and the type of projects for which they can be used. They bring together managers from widely different areas and so are pitched at a very general level.

It is difficult to see how a short general course of this type can give top management an adequate appreciation of the full ramifications of computing and the ability to see clearly how they can be applied in their own particular area. It would be quite adequate if only the low-level applications are being implemented as their effects are unlikely to percolate up the managerial hierarchy as far as the Board or the Chief Executive and they require no major changes

in the organisation. But to appreciate fully the potential of higher level applications, top managers must invest more time in familiarising themselves with computing.

There is no need for top management to become computer specialists. They must, however, gain sufficient appreciation of the capabilities of the computer to enable them to set the broad objectives of the high level computer systems and to decide on alternative proposals devised by the computer specialists to meet these objectives.

There are two key people in a typical organisation for whom special training should be provided. They are the Chief Executive and the Information Director (or whatever member of the Board looks after information systems within the organisation).

We consider that they should take an intensive course in computing on a part-time basis over a number of months. Some parts of such a course would be common to all types of organisations, other parts would have to be tailor-made for the individual organisations or the individual sectors.

The type of course we envisage would cover:

—the mechanics of using a computer, including some practical experience;

—the cost of using a computer;

—organisational implications of computing—role of management and computer specialists, training required, recruitment of staff, impact on first level supervision and clerical workers;

—feasibility studies—including role of manufacturers, consultants and bureaux;

—project definition and control—including budgeting and scheduling;

—systems design.

Most of these topics would be common to all organisations, though some particular sectors might need separate discussion of their special areas, particularly in systems design.

From this basic outline, the participants should move on to consider applications in the form of case studies. These should be followed by visits to organisations which are leaders in applying computing techniques in their sector, either here or abroad, where they can meet and talk with people at their own level who are dealing with problems similar to their own. These visits would have to be arranged mainly on an individual basis.

Such a training course may appear rather long and expensive to a busy Chief Executive or Director. However it must be seen in relation to average annual expenditure on computing of over £400,000 by organisations with large computer installations and £67,000 and £32,000 in the case of organisa-

tions with medium and small installations. Even more important is the potential impact computing could make on the organisation in the future, bringing a qualitative change in management. To be able to control developments, the Chief Executive and Directors must be able to understand fully what is going on in the computing world.

Line management must also be involved in computing. Their role is to collaborate with the computer specialists in assessing management information requirements and the economic and social implications of a computer system. They should assess and plan for any reorganisation that computer systems may demand and take responsibility for all aspects of implementing the system, other than technical aspects connected with the computer itself. Once the system is implemented, they are responsible for its on-going operation and for non-technical aspects of any modification which might be required in the light of experience.

Line management should undertake much the same type of training as the top management, though more specifically related to their own particular area of management.

Computer Specialists

The main categories of computer personnel with which we are concerned are EDP managers, operations managers, systems analysts, programmers and operators. Sample job descriptions for these categories are set out in Appendix C.

The training of EDP managers and operations managers has two principal aspects—training in management and training in technical computer skills. These requirements are at present being catered for by the IMI and the computer manufacturers.

From the replies to our questionnaires, there appears to be a heavy reliance on the computer manufacturers for training in those areas, with the IMI facilities also being much used. A number of people have also availed of the many courses available in Britain.

For systems analysts, the main bodies providing training facilities are the computer manufacturers, the IMI, the IPA and Trinity College. Various courses are available in Britain also. Due to the shortage of systems analysts in relation to the demand for them in the UK, the NCC have sought to develop a structure of courses to cater for their needs. A basic course has been developed by the NCC and is being marketed widely by a private company. It is being used by over 70 colleges and training establishments in the UK. The course given in Trinity College is based on this package. The NCC are proceeding with the development of preliminary and advanced systems analysis courses to complement the basic course.

For programmers, the computer manufacturers are the predominant source of training. One private school in Dublin provides computer programming courses.

A major part of the training of systems analysts and programmers consists of in-house on-the-job experience.

The range of formal courses available between this country and Britain appears to be adequate to meet the actual demand for training facilities. Yet sufficient numbers of people are not being trained to meet the growing requirement of Irish organisations. This applies particularly in the case of systems analysts. There is an acute shortage of trained and experienced systems analysts. The rapid expansion in the number of computer installations in recent years, all of them seeking to recruit some experienced systems analysts, has put a strain on the supply/demand situation. It has resulted in increasing salary scales for systems analysts and a loss of experienced people from existing organisations. The growth in the number of organisations using computers and seeking computer personnel is likely to continue in the immediate future, adding to the demand for experienced personnel.

If the present and prospective shortage is to be remedied, some planned approach to the development of experienced personnel over and above the projected needs of existing users will be necessary. Since on-the-job experience is so important in the training of systems analysts, any plan must be developed with the co-operation and participation of the user organisations.

Two possible approaches are the design of training courses which would include practical problems supplied by existing organisations or the provision of on-the-job training facilities in some of the larger installations for new recruits over and above their own internal requirements.

In either case, the trainees would be involved in actual applications designed to develop the necessary skills and to give them suitable experience. At the end of the training period, they would be available to take up positions in new or existing installations.

As well as providing a pool of trained personnel in anticipation of future requirements, such a plan would also provide a method of entry to the computer field for people working in organisations which are not using and do not intend to use computer facilities. The principal mode of entry up to now has been by transfer to computer work within an organisation in which the person was already employed. Recruitment of people from outside the organisation has generally occurred only where experienced people were being sought. This lack of a recognised entry system has undoubtedly narrowed the market from which people with the necessary aptitude for and interest in computer work can be recruited.

We have suggested above that a sub-Committee of the Central Computing Council should concern itself with training. This Committee would be the appropriate body to organise special schemes of this type. It would be concerned with setting standards for acceptance for training, developing and supervising training schemes and working out the necessary financial arrangements.

5.2 *Computer Education in Schools and for Adults*

Why should computers be introduced into schools? Looked at from the widest point of view, computers are one of the most significant inventions of our time. Their use is intellectually exciting. Not to provide the opportunity for our children to become acquainted with them would be an educational deprivation.

There seems to be a common misconception that the study of computers in schools is necessarily a specialised topic which is the preserve of mathematics teachers and suitable only for the more able mathematics scholars. Certainly, there is a developing science of computers with its own jargon and technicalities. In discussing the introduction of computer education in schools, we do not have in mind primarily computer science as a subject in its own right, but rather the introduction of relevant computer topics into the general liberal education of all pupils. These topics can be handled by teachers of any background.

Apart from its use in bringing to life and stimulating interest in certain areas of mathematics, computing aids natural science, economics, statistics, geography, business and social studies, even literature and music. It ought not to result in one more subject being added to the curriculum, but rather permeate all existing subjects.

Because of the wide-ranging impact which computers are likely to have on society, it is desirable that all children should acquire some knowledge of the nature and uses of computers, their limitations and their economic and social implications. The present generation of children will be using computers as a natural and readily available tool in many day-to-day activities in the future: the earlier they are introduced to this new power and significant factor in the world around us, the easier it will be for them to understand and come to terms with it.

For adults, likewise, the fact of the existence of this new body of knowledge is in itself sufficient reason for the provision of educational opportunities to enable them to comprehend the nature of the computer, its capabilities and limitations and its philosophical implications. To many people the computer is a machine about which they have heard much but about which they know and understand very little.

Schools

Very active experimentation in the introduction of computers in schools is taking place abroad. It has been found that pupils respond with interest and keeness to experience with computers. The Centre for Educational Research and Innovation (CERI) of the OECD prepared a short review, in November 1968, of developments in Europe and the US. It dealt with the introduction of computers in secondary education, the objectives, the methods and the intellectual and equipment resources [43, also reprinted in 49]. Since then, much

has happened, and a full programme of research and development has now been launched by CERI. At that time, they found that the introduction of computer education into secondary schools had been on a haphazard and random basis. In the main the impetus had come from individuals, many of whom were interested in only one facet—for example, the use of computers in the teaching of mathematics. One result of this was that in too many schools computer education was restricted to mathematics lessons or even to mathematically-gifted pupils. Many of the most valuable rewards of computer education were lost.

Nevertheless, the CERI review showed that by 1968 schools in several countries, including Germany, the US and the UK, had begun to give instruction in the nature and use of computers and computing. The topics covered in these schools include the following:

—social implications of computer technology

—nature of computers

—use of the computer for problem solving

—use of computer games and simulation

—use of the computer in data-processing.

The computer is also used to develop an understanding of mathematical concepts.

The degree to which many of these topics can be covered depends on the access to computer facilities. This varies very much and may include visits to local computing centres, testing and running of programs on local computers, periodic visits by portable computers, provision of computers discarded by others or small computers specially designed for educational purposes or the provision of remote terminals linked to a large computer.

In view of the rapid prospective increase in the use of computers throughout the UK, an Inter-departmental Working Group was set up in 1965 to consider what implications this might have for the educational system. Represented on the group were the Department of Education and Science, the Scottish Education Department, the Ministry of Education for Northern Ireland, the Ministry of Technology, the Ministry of Labour, the Science Research Council and the University Grants Committee. The group published a report, "Computer Education," in 1967 [44].

This group concerned itself more with the contribution which the educational system could make to the development of computer specialists than with the wider aspects of computer education—though it did distinguish between the general role of education within the school system and the training in specific narrow skills required by computer specialists. They considered that the schools should provide the groundwork by giving an introduction to computer concepts and principles at various levels within the general educational

framework, thus enlarging the educational base from which computer staff can be recruited.

Recently a significant document in the form of an interim report has been prepared by a Committee (the Bellis Committee) for the Scottish Education Department [45]. The Committee was set up in 1967 with a remit to consider the implications of computers for the schools and to make recommendations. Its members included school teachers who had taken part in experimental work in computer education, people working with computers in universities and particularly associated with school developments, representatives from further education, commerce and industry, and members of the Inspectorate.

The Bellis Committee takes the view that it is of vital importance to the nation and to the pupils themselves that there should be created in the schools a broad base of knowledge about and interest in the computer at appropriate levels, not just expertise in specific techniques of programming. Instruction should not be limited to those pupils who are mathematically or scientifically inclined. The report includes details of a recommended introductory one-year course of appreciation of the power and applications of the computer. The time requirement would be two periods per week. The teaching should be undertaken by teachers of various subjects. Pre-service and in-service training courses for teachers should be provided.

To provide for instruction for teachers and access to computing facilities for schools, the Bellis Committee recommend the establishment in Scotland of three educational computer centres on a regional basis. Siting of the centres in Colleges of Education is suggested as appropriate, since research into the development of school courses would then be encouraged, and students attending the College of Education would also be able to make use of the centre. The Committee considers that a postal or messenger service to the centre with data preparation equipment available in the schools would be quite adequate. On-line data links, while attractive, might be too costly and are regarded as a longer-term possibility.

While the Bellis report provides the basis of an official policy for Scotland, no such coherent national policy appears as yet to have emerged for the rest of the UK. Nevertheless, a great deal of pioneering effort and experimentation has taken place.

The British Computer Society have a working party on computer education in schools [46, pp. 35–43]. It is divided into a number of sub-committees concerned with such areas as curricula for computer courses, dissemination of information on books suitable for use in schools, the introduction of computing into non-mathematical areas, the availability of hardware facilities and the availability of training and other facilities for teachers.

One of these sub-committees has recently recommended that a small full-time central organisation should be established to arrange and co-ordinate a continuing programme of experiments and to collect and disseminate information on all aspects of computer education in schools.

A Computer Education Group has also been formed, affiliated to the British Computer Society [46, pp. 59–60]. This Group is an informal organisation of teachers and other interested people. By the end of 1969, it had over 1,000 members. The objects of the Group are to disseminate information about developments in this area and to help one another in solving problems in setting up courses, getting access to computer facilities and specialist lecturers, etc. They publish a regular bulletin—"Computer Education".

A now famous pioneering project in bringing computing into the school curriculum took place at the Royal Liberty School in Essex, where an Elliott 903 computer has been installed since early 1966. As well as providing facilities for its own pupils, the Royal Liberty School Computer Department now also provides facilities for 24 other schools in the area, as well as organising adult education and teacher training courses to satisfy local needs. A full account of how this project was initiated and how it has developed is given by W. R. Broderick, the master whose brainchild it was, in a book, "The Computer in School" [47]. Broderick has recently estimated that the cost of providing educational computing facilities at his centre works out at £3 5s. 0d. per student per year. Currently, they process 45,000 programs for some 18,000 students per year.

A substantial number of other schools in the UK are now using computer facilities in local universities, technological colleges, local authorities or commercial organisations.

The British National Computing Centre, in collaboration with the Department of Education and Science, the local education authorities, computer manufacturers and individual schools, have developed a computing course designed to introduce pupils of sixth form standard in both arts and sciences to business uses of computers. Initially, it is being tested in the Bristol area but it is planned to extend it to other areas. It is designed for an hour and a half session per week for two terms. The first term consists of an introduction covering the following broad areas:

—why computers?

—what is a computer and how does it work?

—flow charting and programming

—the impact of computers in business and society

—backing storage and input/output devices

—introduction to computer languages.

After this general introduction, pupils who are particularly interested in the business use of computers will take an "Advanced Data Processing" course while others will go on to a detailed study of the "Sociological Impact of Computers" [48, pp. 45–46].

The computer manufacturers are also marketing their own school courses

which provide teaching material, training for the teachers who will be giving the course in the school and data preparation and computer facilities [50, see also 48, pp. 33–34, 49, pp. 63–65, 71–72].

Canada is one country where an official policy towards introducing computers into secondary schools appears to have been adopted. In 1968, the Ontario Department of Education approved the objective "that every student have a basic understanding of computers in order to appreciate the limitations of computers as well as their potential for problem-solving in a wide variety of areas." Currently, 100 high-schools in Ontario give two year courses for students aged 16 and 17. Some of the larger schools have computers of their own, but most use a delivery service to a computer centre owned by the Board of Education.

It is clear that, in Britain and in other countries, computing is widely accepted as both beneficial and a desirable subject for introduction into schools. Much progress has already been made and vigorous efforts are being made to extend the availability of courses and facilities.

In Ireland, computer education has not yet been introduced in any secondary or vocational schools.[2] At the time of the latest revision of the leaving certificate curriculum, computer education was suggested as one of a number of possible additions to the curriculum but it was not accepted. The first level at which a student can get an introduction to computing is in third level education—either in the universities or in the technological colleges—and then only if he follows a limited range of disciplines.

In Britain, the initial impetus came from pioneering efforts of a few enthusiasts. The experience gained from their experiments led to an expansion to other schools as more people got interested. It would be a pity if this slow process were now to be repeated here, rather than the adoption of an official policy.

The initial step needed in Ireland would seem to be the training of a number of teachers who could introduce computing in some schools as a non-examinable subject. The teacher training could be obtained either by availing of one of the packages developed abroad or by developing a special course here, perhaps in the technological colleges. In the first instance, a course of about ten days duration would be sufficient.

The present availability of computer facilities should not be an obstacle to getting started. To run programs for the pupils, access to a computer could be arranged either at off-peak hours in a local computer installation or by regional technological colleges providing facilities for schools in the region. Later on, more formal arrangements would be required, as has been recommended by the Bellis Committee for Scotland [45]. We have already discussed the provision of hardware facilities for the educational sector in Section 4.7.

The proposed education and training sub-committee of the Central Computing Council, in close collaboration with the Department of Education,

[2]In Northern Ireland, Portora School has recently installed a terminal and uses a computer manufacturer's school course.

might be the most appropriate body to provide the initial stimulus by seeking out a number of schools that would be willing to co-operate and making arrangements for the necessary teacher training.

Adults

In arranging courses for adults, the aim should be to cater for the general public who are neither employed in a computing area nor embarking on a career in computing.

The type of courses required would be similar in content to those developed for schools. They should concentrate however on conveying an understanding of the economic and social implications of computing and how the computer works. Some practical experience of using a computer should also be given where access to computing facilities is possible. Arrangements on the lines of those suggested for schools might be sought—the use of off-peak time on a local installation or the provision of facilities through technological colleges.

At present, the Extra-Mural Studies Department of UCD include among their courses for adults two courses in computing. One is an introductory course covering the basic principles and mathematics of computer programming and various computing applications in the fields of scientific research and industry. The second course is an advanced one covering much the same ground as the introductory course but at a higher level and in greater depth.

As far as we are aware, no other educational establishments provide computing courses for adults.

In Britain, courses are available from the Extra-Mural Studies Departments of various universities and from bodies such as The City Literary Institute in London.

There is a definite need for adult education in this area and courses should be made more generally available. In addition to the universities, establishments which could appropriately provide courses are the commercial and technical colleges and the Dublin Institute of Adult Education.

The overall development of such courses could be a further responsibility of the proposed education and training sub-committee of the Central Computing Council.

5.3 *Development of the Computer Industry*

A feature of the current computer scene is the growth of a large number of organisations providing computing services or engaged in manufacturing computer hardware components such as core stores, discs, line printers, terminals for on-line or off-line use, satellite and desk-top computers, etc.

There is considerable scope for developing various parts of the computer industry in this country—both to cater for the home market and for export. The Hoskyns survey [6] estimates for the UK market over the period 1970–75

average annual growth rates of 46 per cent for terminals, 54 per cent for software services and 30 per cent for service bureaux.

This Section looks at the development of (i) computer bureaux, (ii) computer consultancy, software and other services and (iii) the manufacture of computer hardware.

Computer Bureaux

Computer bureaux are basically involved in providing time on a computer for use by other organisations. In addition, they normally provide a range of supporting services, sometimes the complete range of computer services required by an organisation—e.g. consultancy work to advise on potential applications, programming services and data preparation services.

There are many computer bureaux operating in Britain. The Ministry of Technology undertakes a quarterly survey of these bureaux [51]. About 100 are included and these are reckoned to cover almost all those in operation. The total value of their billings to clients in the year 1968 was almost £23 m. Data for the first half of the year show that the billings were increasing by over 20 per cent in 1969. Four organisations together accounted for about 50 per cent of the total billings. Nine had a turnover of over £½ m.

A breakdown of the billing to clients is given in Table 5.1. The sale of computer time was their largest activity, accounting for 34 per cent of their revenue. Custom built programs to cater for the specific needs of individual clients represented 25 per cent of their revenue. The provision of programming/consultancy services and of package programs was also important, each generating 10 per cent of their revenue. At the end of June, 1969, these bureaux employed 7,500 people, of whom over 2,500 were programmer/analysts or consultants.

In Ireland, there are seven organisations providing bureau services. Two of these are subsidiaries of computer manufacturers and one is a part of a large commercial organisation which provides bureau services as an adjunct to its own internal data processing activities. We endeavoured to carry out a survey of their activities on the lines of the Ministry of Technology survey. A questionnaire similar to that used in Britain was sent to six of the bureaux—one was omitted as it had only just commenced operations. The response to this questionnaire was not adequate to produce any firm figures. Only three of them replied, including one which declined to disclose the breakdown of its billings to clients.

The breakdown supplied by the two respondents, as set out in Table 5.1, shows a pattern quite similar to that found in Britain—computer time sales generating 35 per cent of revenue and custom built programs 23 per cent. The only area where a considerable difference is found is in data preparation, which generated 28 per cent of revenue in Ireland compared with 6 per cent in Britain.

The total revenue of the bureaux in 1969 would seem to be in the region of

TABLE 5.1: *Billings to clients by computer bureaux. Percentage of total billings represented by each type of service*

Type of service	*Percentage of total billings*	
	Britain	*Ireland*
Custom built programs	24	23
Package programs	10	7
Programming/Consultancy	10	7
Computer time sales	34	35
Data preparation	6	28
Other/Unclassified	16	—

Source: British figures: Ministry of Technology (Industrial Statistics Branch) Survey for the quarter April-June 1969.

Irish figures: Data supplied in response to a questionnaire sent to the computer bureaux.

£630,000. This figure is based on the actual figures supplied by two organisations and estimated figures for the others drawn up with the advice of people directly involved in the business. A cross-check using the data on expenditure supplied by the bureau users confirms that this figure is of the correct order of magnitude.

The total number of clients served by these organisations in 1969 was in the region of 220.[3] Average revenue per client is therefore about £3,200.

Estimates of the number of staff employed in the bureaux at the end of 1969 are set out in Table 5.2. These estimates are based on the actual figures supplied by the three respondents, grossed up to take account of the three non-respondents. The three respondents account for approximately 50 per cent of the total revenue of the bureaux so their staff complement is probably also about half of the total.

TABLE 5.2: *Staff employed by Irish computer bureaux at 31 December 1969*

Category	*Number*	*Average*
Client contacts	8	1·3
Systems Analysts	18	3·0
Programmers	34	5·7
Computer Operators	28	4·7
Data Preparation	94	15·7
Administrative	10	1·7
Other	4	0·7
Total	196	32·7

[3]The total number of bureau users is about 250. Some 30 of these are using services provided by organisations other than the bureaux, e.g. time may be made available to them on a computer in an associated organisation.

They employed a total of 196 people, of whom 18 were systems analysts and 34 were programmers. Average employment per organisation was 33—including 3 systems analysts and 6 programmers.

In so far as their primary function is the provision of computer hardware facilities for other organisations, the future growth in bureau operations will depend on the way the balance develops between separate in-house computers and the shared use of facilities. Both of these approaches to computing will grow as the overall use of computing grows. The development of more complete ranges of computers, particularly at the small end of the market, enables each user to acquire appropriate in-house facilities no matter what the size of his operations. On the other hand, economies of scale and the development of large computers encourage the trend towards sharing facilities either in bureaux or computer utilities. Which of these two approaches will grow fastest is still unclear, but it may be noted that the Hoskyns survey [6] estimates an annual rate of growth of 29 per cent for the service area as opposed to 12 per cent for hardware over the next decade.

The scope for exporting computer time services is rather limited as there would be no particular advantages gained by a foreign organisation in sending its work here to be processed. The major cost involved is the cost of the computer itself and we have no relative advantage in this area. Where the scope for exporting such services does arise is in conjunction with providing other services such as data preparation or programming services. These are discussed in the next part of this Section.

There are no particular measures which need to be taken to develop computer bureau services. It is a competitive area—both between the bureaux themselves and *vis-à-vis* the computer manufacturers—and will undoubtedly be developed in line with market demand.

Computer Consultancy, Programming and other services

Computer consultants provide a variety of services including:

—feasibility studies and selection of computer applications

—evaluation of computer equipment

—systems analysis and design

—programming

—installation, staff selection and training.

Some organisations specialise in providing programming services—these are generally referred to as "software houses". Others specialise in providing data preparation facilities.

A recent publication [52] lists several hundred computer consultants and software houses in Britain, together with many organisations specialising in providing data preparation facilities.

In Ireland, a number of foreign computer consultants have opened branch offices. Many others are available to provide services from their overseas offices. There are only one or two Irish organisations solely engaged in consultancy services, though the computer bureaux also provide consultancy services.

A small number of Irish organisations specialise in providing data preparation services. One of the bureaux has also a large data preparation business. The fastest growing of these areas in Britain and the US is the software business. The software houses specialise in providing programming services—developing either specific programs for individual organisations or standard programs which can be sold to a number of different organisations for their common applications e.g. payroll, share registration. A considerable number of software houses have been established in Britain and the US, ranging in size up to large companies with a few thousand employees and an annual turnover of millions of pounds.

The software industry is one area of the computer services field that could be successfully and beneficially developed in Ireland. It is a highly labour-intensive industry—brain-power is the basic input, with capital investment required mainly in developing and training the necessary personnel. Salaries in this country are still relatively low, particularly in relation to the US. This should give us an important initial advantage. We also have a high level of education and, in many areas, a shortage of suitable employment opportunities for highly-educated people. Development of the software industry would provide high-level and challenging jobs here for many people who would otherwise have to go abroad to find jobs suitable to their capacities.

The development of an export market would be vital to the success of a software industry here due to the small size of the home market.

Israel is an example of a small country which has taken active steps to develop an export-oriented software industry [53]. ILTAM—the Corporation for Planning and Research Ltd.—is a government corporation whose main function is to promote Israel's software industry abroad. A number of areas have been identified as having particular export potential:

—basic software systems

—conversion of systems from one computer to another

—application packages in selected high-technology areas, including hardware/software systems

—software maintenance on behalf of customers

—technical assistance and operations in developing countries.

Already we are engaged in a small way in exporting software services—a significant proportion of the software work of one of the computer bureaux is for overseas organisations.

One of the main difficulties about breaking into the export market without

first developing an indigenous market is that of developing the initial expertise and convincing prospective clients that the necessary expertise is available. Two possible ways of getting over these problems are the encouragement of foreign software houses or new entrepreneurs to set up in Ireland and the development of links with overseas software houses, our software houses working initially on sub-contracts from them while building up both expertise and a reputation—this latter approach has been recommended for Israel [53]. In either case, a pre-requisite would be the attraction of highly trained and experienced people to this country who could then develop and train Irish people to the same level.

If we are going to enter the software business on a large scale, the time to start would be now while the market is still at a relatively early stage of development. Specific action to encourage developments will be needed.

One measure might be the provision of tax relief on profits from exports. The Finance Act, 1968, extended the export sales relief from income tax and corporations profit tax to profits arising from work carried out in the State on the rendering to non-residents of design and planning services in connection with chemical, civil, electrical or mechanical engineering works executed outside the State. There is a good case for extending this relief to computing services provided to overseas people.

What other incentives would be required and could be made available should be considered by the Industrial Development Authority in conjunction with the Central Computing Council.

While the software industry appears to have most potential for development, any incentives made available might also be extended to other areas where there is scope for the export of services. Two of these are computer consultancy and data preparation services. The one Irish organisation specialising in computer consultancy services already generates about 70 per cent of its revenue from abroad. The computer bureau, which has a large data preparation pool, does much data preparation work for foreign organisations, particularly in the US, the work being flown in. This is similar to data preparation services being provided in Malta for British firms [54], the competitive advantage resting in the availability and relative cheapness of labour.

Computer hardware

In such a fast-growing area as computing, it is natural that a large number of organisations should grow up producing components for the computers or equipment to be used in connection with the computer—e.g. terminal devices for the remote entry of data to the computer.

Ireland has already become involved in this industry. For example core memories—on which the data held in a computer are stored—are manufactured here. Further developments planned include the manufacture of terminal devices, of special purpose digital computers for use in scientific research and, possibly, the manufacture of small business computers.

The Industrial Development Authority are already successfully engaged in encouraging the establishment of these industries in Ireland and there will undoubtedly be many more such industries developed in the future.

5.4 *Data Transmission*

There are many ways in which data can be transferred from one location to another—by air or surface transport, verbally over the telephone, etc. Another way, and one which is now growing in significance, is data transmission. This involves the use of the telecommunications network to transfer data in a non-verbal form.

Data transmission is not an integral part of computing—it can be and is used for purposes unconnected with computing. But one of its main uses is for sending data to and from a computer installation. The need for and the demand for data transmission facilities are therefore directly bound up with future developments in the computing area.

One of the main advantages of data transmission is the time which can be saved—it is the equivalent of using the telephone rather than the postal service. Slower and cheaper methods of transferring data may be quite adequate for most operations but the ability to transfer data speedily can be of importance in particular cases, as discussed below.

Economies of scale have led to the development of large computer centres. These centres involve the transfer of data from remote locations (i.e. locations not in the immediate proximity of the centre) either physically or by means of data transmission facilities. Technological advances have reduced the time taken for the processing part of the computer operation and attention has therefore been focussed on the delay in getting data to and from the computer. Where there are advantages in getting a quick turn-around from computer jobs, the benefits may outweigh the additional costs involved in data transmission.

For transmission, the data are prepared in a form suitable for direct input to the computer—punched cards, punched paper tape, etc.—or keyed in directly via a typewriter keyboard. They are then passed along the telegraph or telephone lines. At the computer centre, they may be entered directly into the computer system—known as "on-line" transmission—or be reproduced in the form of punched cards, etc., for entry into the computer system at a later time—"off-line" transmission. For passing through the telegraph or telephone system, the data have to be changed or modulated into a standard form. At the receiving end, they have to be demodulated back into the original form. A modulator/demodulator—a modem—is used for this purpose at each end.

There are a number of computer bureau services in existence operating largely through data transmission links to their customers—bureaux operating in this manner are commonly referred to as computer utilities. The customers have a terminal—a device through which data may be transmitted—linked to

the computer centre or a small computer capable of processing some jobs but capable also of transferring data to the computer centre when greater facilities are required. Since these centres have a very large computer capacity, the time taken to process any job is very short and the results are sent back quickly, normally within a matter of minutes. This type of service has been used mainly for scientific-type jobs with small volumes of data requiring a large volume of computations. However its use for commercial-type applications—with large volumes of data requiring relatively small volumes of computations—is expanding.

In addition to the computer bureaux, a number of organisations organise their internal computing services on this type of basis.

Many computer applications require that the users have immediate and direct access to data stored in the computer and the ability to add to or delete from these data immediately. This is the case, for example, with air-line seat reservation systems. These time-dependent systems can only operate on the basis of on-line data transmission with the data being processed and the results produced almost immediately—this is called real-time processing.

The usual method of recording the data for input to the computer is by means of general purpose keyboard devices or special equipment such as tele-register equipment for banks or uni-sets for airline reservation systems. Some of these terminals are furnished with screens for the direct display in graphical or digital form of the data stored in the computer.

Perhaps the best-known examples of real-time computing systems are the air-line seat reservation systems. Aer Lingus operates such a system. Their offices in Ireland and some of their British offices are directly linked to the computer installation in Dublin and up-to-date information about the availability of seats on flights can be got within seconds using the terminals in these offices. Notice of a booking or a cancellation can be recorded directly in the computer-held records. Similar systems for reserving hotel rooms and theatre tickets are also available. Irish hotels are participating in some of the room reservation systems.

Another example of a real-time system is the storing of information on share prices and other financial information about companies. Stockbrokers can have immediate access to up-to-date information through terminal links.

Altogether in Ireland at present, there are about eight organisations using data transmission facilities, two of them using off-line transmission only. Aer Lingus are using data transmission for airline seat reservations. The Bank of Ireland has a terminal linked to the Trinity College computer. Comhlucht Siuicre Eireann is using off-line transmission for gathering data from decentralised locations. Hughes Brothers are in the process of installing an advanced system in which their branches will be linked via terminals to a central computer. The Agricultural Research Institute and also AnCo are using terminals linked to a computer utility in London.

Among the organisations with a computer installed at present, a further

seven commercial users and two universities/research institutes expect to use data transmission facilities in the future, three of them using off-line facilities only.

The number of enquiries about the availability of data transmission facilities received by the Department of Posts and Telegraphs increased substantially in 1969 to 15, compared with three or four enquiries in each of the two preceding years. Many of these enquiries were from organisations not yet using computers.

The GPO in Britain offer a wide range of data transmission services on both public and private telephone and telegraph networks. The services are divided into a number of categories, differing mainly in the speed of transmission permitted. The GPO's policy is to provide all users with what they need while ensuring at the same time that no user pays more for his service than is really necessary. The cost of transmission is related mainly to the speed of transmission and the reliability and accuracy sought. By providing services at different speeds each is, in a sense, tailor-made to match the performances of the equipment which will use it.

The first service operates at 50 bits per second[4] (bps) over the public Telex network or at 50 or 100 bps over private lines. A teleprinter is used, with a paper tape reader and punch as optional extras. Other services using public lines permit transmission at speeds up to 1,200 bps. On private lines speeds of up to 4,800 bps can be obtained. For users requiring transmission speeds faster than this, wideband circuits can be made available. These offer speeds of 40,000 to 200,000 bps. They enable magnetic tape units to communicate with each other at full speed and are also used to connect computers directly to each other. Wideband circuits are available only on private lines and cost up to ten times as much as the other private line services. These services are summarised in Table 5.4 [For further information see 59].

In Ireland at present, data transmission can be effected on telegraph lines up to 50 bps and on public telephone lines up to 1,200 bps. On private telephone lines, transmission at speeds of up to 2,400 bps is possible. Aer Lingus are using transmission speeds of 2,400 bps. The other Irish users are using slower speeds of transmission. Facilities using public telephone lines can be readily made available by the Department of Posts and Telegraphs. Private lines can generally be made available, but there might be some difficulties in particular areas, particularly those outside the main population centres.

It would be difficult at present to project the future demand for data transmission facilities in this country. Data transmission is a new area and one in which few people have had much experience. Most organisations would find it difficult at this stage to evaluate fully their potential for using data transmission facilities in the future, particularly in view of the number of unknown factors about future data transmission and computer technology.

[4]Roughly equivalent to the number of basic signals transmitted per second.

Data transmission technology is bound to change and develop substantially as more attention is paid to it. The type and cost of the facilities now available may bear little relation to those which will be developed in the next five years. These developments could alter the technical and economic feasibility of applying data transmission in many areas. Even now people are beginning to query whether the telephone network, designed for verbal communication, is the most economic way of transmitting data. A recent report [55, 56] from a group of experts in the UK suggests that, when voice channels are being used for data transmission, the effective utilisation is only about two per cent of the capacity. The report recommends the development of a network designed specifically for data transmission requirements.

The British Post Office commissioned a team of management consultants to look at the present and future demand for data transmission facilities in Britain [57, 58]. They found a current rate of growth of over 100 per cent per annum—230 per cent in the year to March 1969. While this growth rate must slacken off, they expect that the number of terminals in use in 10 to 15 years time will be more than 100 times as great as the present number. Their forecasts for numbers of terminals are set out in Table 5.3.

TABLE 5.3

Projection of numbers of terminals in the UK	
1973	51,000
1978	234,000
1984	434,000

From our studies of various sectors in this country and our general information about developments abroad, we can identify a number of areas in which data transmission facilities are of potential benefit. Whether and how soon the potential is turned into actual demand will depend on many factors, including the speed with which computing activities develop in each sector and the type and adequacy of the facilities which can be provided. Examples of such sectors are health, where central medical records could require on-line links for the hospitals, the education/research sector where the type of co-operation we have recommended could involve satellite computers linked to a central installation, the co-operatives in agriculture where a central computing centre might be too remote from some of them to make physical transport of data feasible and banking where transmission facilities are already being used in Britain and could eventually be introduced here also.

To attempt to quantify these possibilities is just not feasible within the scope of our present survey. All that can be said is that the demand for facilities is undoubtedly going to increase at a fast rate over the next ten years. An annual increase of over 100 per cent in the immediate future, as is being experienced in Britain, is not likely to be an over-estimate.

TABLE 5.4.: *British G.P.O. Data Transmission Services*

Category	*Maximum Speed of Transmission*	*Description*
Datel 100	50 bps on public telegraph lines. 50 or 100 bps on private telegraph lines	A standard GPO teleprinter must be used on the public network, with 5 channel paper tape reader and punch as optional extras. Any GPO approved equipment may be used on the private lines.
Datel 200	200 bps on public or private telephone lines	A GPO modem must be used on public lines; any GPO approved modem on private lines. Paper tape or card readers and punches and teleprinters can be used at each terminal.
Datel 300	200 bps on public or private telephone lines	This service permits transmission in one direction only. GPO provide all the terminal equipment at the outstation and the modem at the central point. The outstation equipment can be a punched card reader, a paper tape reader or a keyboard unit.
Datel 600	600 or 1,200 bps on public or private telephone lines	The GPO provide modems. Terminal equipment is not provided but must be GPO approved. Used for transmitting punched cards, paper tape and magnetic tape and to enable a computer to communicate directly with distant line printers or visual display units.
Datel 2,000	2,000 bps on private telephone lines only	The GPO do not provide modems but they must be GPO approved, used for transmitting data from magnetic tape and for connecting satellite computers directly to their parent computer.
Datel 2,400	2,400 bps on private telephone lines only	The GPO provide modems. Used for same purposes as Datel 2,000.
Wideband Circuits	40,000 to 200,000 bps on private telephone lines only	The GPO do not provide modems but they must be GPO approved. This service enables magnetic tape units to communicate with each other at full speed and can be used to connect computers directly with each other.

The Department of Posts and Telegraphs, who must provide the facilities to cater for the demand, will no doubt be keeping a close watch on developments abroad in this field, particularly technological developments, in order to anticipate the timing of developments in Ireland. Close liaison should also be kept with the individual sectors in Ireland in which data transmission might be used so as to get as much advance notice as possible of proposed developments.

The proposed Central Computing Council should be able to assist the Department in this area. They will have much information about likely developments in the individual sectors and will be able to give competent advice on the level of demand and the type of facilities which will be required. The link between the Department and the Council might be formalised by the setting up of a joint committee to act as advisors to the Department in this area.

5.5 *Computers and Privacy*

Modern computer developments have greatly facilitated the collection, storage and use of information.

Government Departments, local authorities and other public bodies store in conventional form vast amounts of data about individuals from such sources as tax returns, social welfare records, educational records, census returns and medical records. Traditionally each of these areas is dealt with by a separate department maintaining independent records. Greater efficiency would be achieved by having one composite data bank for all departments, in which comprehensive information about each person would be kept. By reducing duplication in the gathering and processing of information, by more rapid retrieval of information, by sharing the use of equipment and files, economies would be effected. The data would be an invaluable aid in economic planning, and could be more easily used by social scientists in the study of society. A central data bank has not really been feasible up to now, but the possibilities opened up by the computer make it a realistic goal and one towards which tentative steps have already been taken in the United States. With the computer, different records can more easily be combined, accessed rapidly from a central point and processed in a variety of ways not hitherto feasible.

Similarly, the storage and retrieval capabilities of the computer make such activities as the credit-rating business more economic.

The control of this information raises many problems. The problems are not new—they all existed in the pre-computer age—but they present themselves on a completely different scale once computers are used. By changing radically the economics of the situation, the computer has transformed the problem into one of new dimensions. More and more information will be stored and disseminated and the information which is stored is likely to be brought together and be made available more easily.

The principal problems arising are the dangers of incorrect information, the misuse of the information and the invasion of privacy.

An incorrect entry in the files of a Government Department or the records of a credit-rating association may result in preventing a person from getting, e.g. social welfare benefits or hire-purchase facilities. Adequate provision must be made for discovering the existence of this incorrect information and for having it rectified when it is found.

Misuse of the information may arise from disclosing it to unauthorised persons or through unauthorised access to the information. In the public sector, such disclosure would be facilitated by centralisation of records unless special precautions are taken. Only one source need be approached for comprehensive information rather than a number of different sources as under the present system. The extraction of the information need not even require the connivance of anybody within the Government service—it may be achieved, for example, by wiretapping the lines to the computer system or by mechanically interfering with it.

The computerisation of information will also make a further inroad on the individual's right of privacy. Information will be stored on a greater scale and will be disseminated to a wider range of recipients than hitherto. The information will be much more comprehensive and far-reaching, particularly in the public sector. To quote Professor A. R. Miller on this subject in relation to the proposed National Data Centre in the US:—

> "In the past our privacy has depended on decentralisation, the snooper's inability to get quick access to large amounts of information . . . the inefficiency involved in information handling, and the relatively low level of information that has been sought by government in the past because of the expense involved . . . Once you centralise, the payoff for breaking into the information system increases, which means that the cost per unit of dirt goes down . . . I think that the increased efficiencies brought about by the proposed (integrated information system) represent another step (in the direction of destroying our traditional bastions of freedom)". [60].

The computer provides the possibility of keeping a complete dossier on each person from birth to death with all documented details of his life.

Thus, while computers can bring great benefits in the storage and retrieval of information, these benefits must be weighed against the invasion of privacy. There will always be a conflict between the individual right of privacy and the society's right of discovery. A comprehensive study of the problem of privacy and freedom and the bearing of computer technology on it is given in [67].

There are of course a number of technical and operational measures which can be taken to prevent error and misuse of the information, such as read or write only protection devices, passwords, access restrictions, etc. These measures ensure that the task of penetrating the system is made more difficult and time consuming with increased risk of detection. None can ensure 100 per cent protection [61].

The available safeguards are expensive and in all cases the cost of additional safeguards must be weighed against the likely additional benefits. They cannot cover the whole ground and it seems that the problem of the invasion of privacy must be dealt with through legislative action.

In most Western European countries, the right of individual privacy is protected under general constitutional or legal provisions dealing with personal rights and freedoms. In the case of particular categories of information e.g. tax and census returns, specific protection is generally given to ensure that information about individuals is not published or used for purposes other than those for which it was collected. But additional safeguards may be necessary in the computer age. A considerable amount of debate on this subject has been generated in recent years, particularly in the United States. One survey [62] of the relevant US literature on this topic lists 69 books and articles in its bibliography, ranging from the highly technical [63] to the popular [64].

In Britain, a sub-Committee of the Legal Research Committee of the Society of Conservative Lawyers was set up in 1967 to consider the effect of computers on personal liberty and the legal safeguards necessary. Their report, "Computers and Freedom" [65], was published in December 1968. This report made a number of recommendations for supplementing the existing legal safeguards. Many of the recommendations were included in a bill—the Data Surveillance Bill—which was introduced into the House of Commons in May, 1969 by Mr. Kenneth Baker, Conservative MP. The main provisions of the bill were as follows:

(a) All data banks with information about individuals (including Government records except police and security files) to be registered with the Registrar of Restrictive Practices.

(b) Any person about whom information is kept to have access to it and be able to challenge it both for accuracy and relevance—a print-out to be supplied on the initial creation of the record and at any other time on the payment of a fee.

(c) The print-out to state what information is kept, the use made of it, who has access to it and who has used it since the last print-out.

(d) The passing on of information to unauthorised people to be legally restricted.

A separate Bill with an identical text was introduced at the same time in the House of Lords.

Neither of these Bills received a second reading because no time was found to take them.

A further step was taken in January, 1970 on a more general level when a private members bill—the Privacy Bill—was introduced aimed at establishing a general right of individual privacy and providing for remedies in the case of

any substantial or unreasonable infringement of a right of privacy. During the second reading of this Bill in the House of Commons, the British Home Secretary indicated that a committee would be established "to consider whether legislation is needed to give further protection to the individual citizen and to commercial and industrial interests against intrusion into privacy by private persons, organisations or companies" [66]. The Bill has been put aside for the moment at least in light of this announcement.

In the United States, much discussion of this subject was provoked by a proposal to set up a National Data Centre—a centralised data bank to serve 20 agencies of the US Government including the Internal Revenue Service, the Department of Health, Education and Welfare and the Bureau of the Census. All of these agencies now maintain separate record-keeping systems. The discussion has gone on since 1965 and has centred on the potential invasion of privacy and the threat to civil liberties, individuality and personal dignity such a data bank would represent. As yet, the proposal has not been approved by Congress and it is likely to be altered substantially before it is approved.

California has enacted legislation which (a) recognises an individual's right of privacy and (b) recognises computerised data in state files as "public records". This legislation would seem to guarantee the right of an individual to read his own file [62, p. 88].

Sweden is another country in which attention is being given to these problems. Two Commissions have been set up. One is considering the question of access to public documents, etc., in the light of the increasing computerisation of records. The second is considering the future structure of credit information systems and the manner in which protection may be given to the individual.

On the international front, the OECD have a Committee on Computer Utilisation, a sub-committee of which is concerned with public data banks and the protection of privacy. The Irish Government is participating in the work of this sub-committee.

The OECD proposed to hold a conference on the question of the social consequences of computer utilisation, with particular reference to the protection of privacy. At present they are gathering information from member countries on the legal position about individual rights to privacy in each country and any special measures in force or planned relating to privacy of computerised information systems.

Discussion of these problems in Ireland has hardly begun. They do not appear to be of immediate concern to us. The establishment of a National Data Centre incorporating all the records of the separate Government Departments and local authorities is not yet a live proposition. Data banks in the private sector are still at an early stage of development. Recognising the problem at this stage gives us the advantage of being able to plan well in advance, to foresee the dangers involved and to take appropriate steps to minimise them. Adequate measures can be taken from the start to build the necessary safeguards into such systems as are eventually developed.

Without such measures being taken, fears of misuses of data banks could impede their growth and obscure the considerable advantages they have for public or private services and for the development of socially useful information-sharing.

The ultimate solution must be a compromise between the individual's rights on the one hand and efficiency and the public's rights on the other. The relative weight to be given to each side is a value judgement. The minimum safeguard for the individual must be a right to check and correct the information which is held about him—with the possible exception of police and security files—and to be sure that there are adequate precautions to prevent misuse of the information.

The proposed Central Computing Council should concern itself with these questions and ensure that the problems are fully discussed and that all necessary measures are taken.

6. CONCLUSIONS AND RECOMMENDATIONS

1. Computing is an explosively developing technology. The current capital value of equipment installed in the Republic of Ireland is £7·6 m. and is growing at the rate of 35 per cent per annum. (§3·2).

2. Current annual direct user expenditure is £4·5 m. and is growing at the rate of 40 per cent per annum. (§2.1, 3.2).

3. At the end of 1969 there were 59 computers installed in 53 organisations. The number of users of computer bureaux was around 250. It is estimated that by 1975 the number of installations will have increased to around 200 and the bureau users to 1,000. (§3.2).

4. The number of people directly employed in computing is about 2,250, comprising by main category of work: 65 EDP managers, 45 operations managers/supervisors, 150 systems analysts, 340 programmers, 180 operators, 1,470 data preparation and control clerks. By 1975 around 650 system analysts, 1,700 programmers and 500 operators may be required. (§3.2).

5. By and large, firms have been satisfied with their computer installations or with the work done for them by the bureaux and have received the benefits they expected. The main benefits have tended to be in the form of better information for management. (§2.10).

6. Staff reductions brought about through the installation of computers have not been noticeable, and redundancy has been negligible. This is in line with experience abroad. (§2.7).

7. Special action is called for to develop computing within the various sectors of the economy. For this purpose some form of organisation should be set up within a number of individual sectors. (Chapter 4).

8. Certain possible lines of development within a number of individual sectors have been discussed in this report, but more detailed studies of the requirements of the individual sectors should be carried out. (§4.1–4.7).

9. A Central Computing Council should be created to develop a national strategy. It might be modelled on the National Science Council, with representation on it of all the main sectors. In the following paragraphs some of the problems with which it might be concerned are set out. (Chapter 5).

10. As computing becomes more sophisticated, its effects reach further up the management hierarchy. Planning decisions relating to the development of information systems cannot be left to the computer technologists, but an adequate knowledge of the potentialities is seen as yet to exist among few of the country's top decision makers. A basic function of the proposed Central Computing Council would be to improve this situation through promotion of top level computer education in the sector groupings. (§5.1).

11. There is currently a shortage of trained computer specialists and this will become increasingly acute as computing expands. A planned approach to training is required. (§5.1).

12. It does not appear that computing is yet being taught in any schools in the Republic, although it was introduced into some schools abroad as long ago as ten years and it is now being widely taught in the schools. On educational grounds, a strong case can be made for its inclusion in the curriculum. There is also a need for the provision of education for adults in this new field of knowledge. (§5.2).

13. There is much scope for the development of an export orientated computer industry in this country, in the fields of consultancy, software and peripheral equipment manufacture. Such an industry could provide high-level and challenging employment opportunities. (§5.3).

14. The demand for data-transmission facilities is likely to increase rapidly over the next few years. The Department of Posts and Telegraphs could keep in touch with the planning in the individual sectors directly and also through the agency of the Central Computing Council, and in this way ensure that supply is adequately geared to demand. (§5·4).

15. The computerised collection, storage and handling of information is invaluable in such areas as welfare services and social and economic planning but the use of the computer raises new problems of safeguarding the individual's rights against invasion of privacy and misuse of personal information. (§5.5).

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APPENDIX A

SURVEY OF IN-HOUSE AND BUREAU COMPUTER USERS

Introduction

Two questionnaires were circulated to gather information on the present use of computers.

The first questionnaire was sent in June, 1969 to 49 organisations known to have a computer installed or due to be installed at an early date. The organisations providing computer bureau services were excluded from this part of the survey. Replies were received from 47 of these organisations—96 per cent of all the organisations—as shown below:

In-house computer users at June 1969

	Number of organisations	*Questionnaire sent*	*Replied*	*Percentage covered*
Commercial organisations[1]:				
with a computer installed	37	36	35	95
with a computer on order	6	6	5	83
	43	42	40	93
Universities/research institutes	7	7	7	100
Total	50	49	47	96

For the purpose of analysing the replies from the commercial organisations, they have been broken down into three categories based on the approximate capital value of their computer installation. The breakdown is as follows:

Category	*Capital Value (£'000)*	*Number of replies*		
		Computers installed	*Computers on order*	*All*
Large(L)	>500	3	—	3
Medium(M)	60–499	17	4	21
Small(S)	<60	15	1	16
Total		35	5	40

[1]The term "commercial organisation" is used to include central and local government authorities and public and private bodies engaged on commercial-type activities, as opposed to educational or research activities. The commercial organisations with a computer installed will be referred to as "commercial in-house users" to distinguish them from the bureau users.

In many cases, the questions were relevant only to the organisations with a computer actually installed. The organisations with a computer on order are omitted from the analysis of those questions.

The second questionnaire was sent in December, 1969 to 96 organisations using computer bureau facilities. These include both organisations using the facilities offered by the commercial bureaux and those using spare capacity on a computer in another organisation. Replies were received from 56 of these organisations, a 58 per cent response rate.

There are no firm figures available for the number of organisations using bureau facilities. From the information available to us, it seems that the number is in the region of 250. The respondents to the questionnaire therefore represent about 25 per cent of all bureau users.

For the purpose of analysing the replies from the bureau users, they have been broken down into three categories based on their total annual expenditure on computing. The breakdown is as follows:

Category	*Annual Expenditure (£)*	*Number of organisations*
Large(L)	>4,000	18
Medium(M)	1,000–4,000	24
Small(S)	<1,000	14
	Total	56

The two questionnaires were very similar. Some of the questions were the same, some were slightly modified and some were omitted in the bureau questionnaire. A few questions were inserted specifically for the bureau users. The replies from both questionnaires are analysed in this appendix.

Explanations of symbols, etc.

Figures in brackets refer to notes which can be found at the end of the question.

. . in the figures column means less than half of the least significant figure included.

∞ means a percentage increase that cannot be estimated because the base is small.

Due to the rounding of numbers, the sum of a breakdown of figures may not add exactly to the total.

A.1. *Expenditure on computing.*

A.1.1. What is your annual expenditure under each of the following headings and what do you expect your expenditure to be two years hence?

Number of respondents[2]

Category	*Commercial in-house*	*Universities/ Research Institutes*	*Bureau users*
L	3		21
M	17		28
S	15		21
Total	35	7	70

Present expenditure (£'000)

Expenditure on:	*Commercial in-house*				*Universities/ Research Institutes*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Computer Personnel	422	524	244	1,190	64	65	3	—	68
Computer hardware and peripherals[3]	837	496	190	1,524	154	17	3	..	20
Supplies of punched cards, magnetic tapes, stationery, etc.	69	115	43	227	13	9	2	..	11
Use of a service bureau	—	—	1	1	1	113	52	11	176
Other	—	11	3	15	12	..	—	—	..
Total	1,328	1,147	481	2,957	244	205	59	11	275

Expected % increase over the next two years[4]

Expenditure on:	*Commercial in-house users*				*Universities/ Research Institutes*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Computer personnel	21	21	16	19	33	56	148	∞	61
Computer hardware and peripherals[3]	27	36	35	31	51	21	385	100	76
Supplies of punched cards, magnetic tapes, stationery, etc.	44	30	25	33	90	41	51	190	43
Use of a service bureau	—	—	14	14	208	46	87	141	65
Other	—	56	3	42	67	—	∞	—	∞
Total	26	30	24	27	51	47	110	150	64

[2]Information on expenditure was sought partly in the short questionnaire circulated to users and non-users—See Appendix D. A number of bureau users gave information about their expenditure in reply to that questionnaire but did not reply to the main questionnaire. The total number of bureau users for which information on expenditure is available is 70. Full replies were received from 27 commercial in-house users and 5 universities/research institutes. In the case of the others, information on personnel and hardware only was received. The figures for the other categories of expenditure in these latter cases have been estimated on the basis of the average expenditure by other organisations.

[3]In the case of computer hardware or peripheral equipment which has been purchased, an annual expenditure of 25 per cent of the capital cost has been assumed.

[4]A projection of expenditure was given by 26 of the commercial in-house users, 5 of the universities/ research institutes and 63 of the bureau users. The percentage increase in expenditure expected by these organisations has been used to estimate the total increase in expenditure by all the organisations.

A.2. *Utilisation of capacity*

A.2.1. For how many days per week and shifts per day (i) is the computer used at present and (ii) will it be used in the future?

(A shift is taken as equal to 8 hours.)

Number of hours per week	*Commercial in-house*								*Universities/Research*	
	Present				*Future*				*Present*	*Future*
	L	*M*	*S*	*All*	*L*	*M*	*S*	*All*		
≤40	—	7	8	15	—	2	5	7	3	2
41–80	1	7	7	15	—	6	8	14	3	2
81–120	—	3	—	3	1	7	2	10	—	2
>120	2	—	—	2	2	2	—	4	1	1
Total	3	17	15	35	3	17	15	35	7	7

Irish commercial in-house projections compared with British projections

No. of hours per week	*Percentage in each category*		
	Ireland		*Britain*[5]
	Present	*Future*	*Future*
≤40	42·5	20	33·6
41–80	42·5	40	50·9
81–120	9	29	10·8
>120	6	11	4·7

A.2.2. Is any time on your present computer used (other than under a standby arrangement) by other organisations?

If Yes:

(a) How many hours of computer time per month is by other organisations?

(b) By whom is it used?

(c) At what time is it used?

(d) Is any charge made for the time used?

[5]These figures are taken from Appendix 13 of the British Ministry of Labour survey—"Computers in Offices" [5]. They relate to the ultimate number of hours the organisations expected to use and are therefore comparable with the future projections for Irish installations.

Commercial in-house users and universities/research institutes

Time used	*Commercial in-house*				*Universities/Research*
	L	*M*	*S*	*All*	
Yes	3	8	5	16	5
No	—	9	10	19	2

(a) Hours used:

Total hours per month

Type of use	*Commercial in-house*				*Universities/ Research*	*All*
	L	*M*	*S*	*All*		
Organisations giving details[6]	2	8	4	14	5	19
Program development	72	63	14	149	21	170
Routine data processing	89	417	103	609	35	644
One-off jobs	7	21	—	28	8	36
Total	168	501	117	786	64	850
Average	84	62·6	29·3	56·1	12·8	44·7

(b) By whom used:

	Commercial in-house	*Universities/Research*
associated organisations	4	3
non-associated organisations	14	4

(c) At what time:

	Commercial in-house	*Universities/ Research*
During normal shift(s)	10	5
Outside the normal shift(s)	14	1

(d) Charge made:

	Commercial in-house	*Universities/Research*
Yes	14	5
No	2	1

[6]Two commercial organisations—1 large and 1 small—did not give details.

A.2.3. Do you have any spare capacity on your computer which you would be willing to make available to other organisations? (If you already make some time available, this question should be taken as relating to additional time which might be made available).

If Yes, please indicate the number of hours per month which you would make available (i) during the normal shift(s) and (ii) outside the normal shift(s).

Commercial in-house users and universities/research institutes

Further time available	*Organisations already giving time*					*Organisations not already giving time*				
	Commercial in-house				*Uni/ Research Institutes*	*Commercial in-house*				*Uni/ Research Institutes*
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*	
Yes	2	6	3	11	3	—	4	3	7	1
No	1	2	2	5	2	—	5	7	12	1

(a) No. of hours available among those already giving time:

Total hours per month

	Commercial in-house				*Universities/ Research Institutes*	*All*
	L	*M*	*S*	*All*		
Organisations giving details[7]	1	6	3	10	2	12
During normal shift(s)	—	85	—	85	50	135
Outside normal shift(s)	20	432	527	979	80	1,059
Total	20	517	527	1,064	130	1,194
Average	20	86	176	106	65	100

(b) No. of hours available among those not already giving time:

Total hours per month

	Commercial in-house				*Universities/ Research Institutes*	*All*
	L	*M*	*S*	*All*		
Organisations giving details	—	4	3	7	1	8
During normal shift(s)	—	44	10	54	4	58
Outside normal shift(s)	—	295	190	485	16	501
Total	—	339	200	539	20	559
Average	—	85	67	77	20	70

No. of hours available from all organisations—(a) + (b)

[7]One large and 1 university/research institute did not give details.

Total hours per month

	Commercial in-house				*Universities/ Research Institutes*	*All*
	L	*M*	*S*	*All*		
During normal shift(s)	—	129	10	139	54	193
Outside normal shift(s)	20	727	717	1,464	96	1,560
Total	20	856	727	1,603	150	1,753
Average	20	86	121	94	50	88

Addendum to Questions A.2.2. *and* A.2.3.

If the number of hours at present made available to outside organisations and the number which organisations would be willing to make available are totalled, the following picture emerges:

No. of hours per month

	Commercial in-house				*Universities/ Research Institutes*	*All*
	L	*M*	*S*	*All*		
Present	168	501	117	786	64	850
Further time	20	856	727	1,603	150	1,753
Total	188	1,357	844	2,389	214	2,603
Average per installation	63	79	56	68	31	62

A.2.4. Do you use time on a computer other than your own (except under a standby arrangement)?

If Yes:

(a) what uses do you make of it?
(b) by whom is the computer owned?
(c) at what time is it used?
(d) for what reasons do you choose to use a computer other than your own?

Commercial in-house users and universities/research institutes

	Commercial in-house				*University/ Research Institutes*
	L	*M*	*S*	*All*	
Yes	—	1	3	4	3
No	3	16	12	31	4

(a) What uses?

	Commercial in-house	*Universities/Research*
program development	1	2
one-off jobs	2	3
routine data processing	1	—

(b) By whom is the computer owned?

	Commercial in-house	*Universities/ Research*
associated organisation	2	—
non-associated organisation:		
computer service bureau	—	1
other	2	2

(c) At what time is it used?

	Commercial in-house	*Universities/ Research*
During the normal shift(s)	3	2
Outside the normal shift(s)	2	1

(d) For what reasons do you choose to use a computer other than your own?

	Commercial in-house	*Universities/ Research*
To avail of larger core storage	2	3
To avail of disc facilities	1	—
Pressure of work on own computer	1	—

A.3. *Computer Hardware and Peripherals*

A.3.1. Date of installation and capital value of computers.

Details are available for 50 of the 54 computer installations. Those for which information is not available are one commercial in-house installation and two computer bureau installations.

Year	Computer installations		Installations replaced		Net cumulative installations	
	Number	Capital Value[8] (£'000)	Number	Capital Value (£'000)	Number	Capital Value (£'000)
1958	1	60	—	—	1	60
1960	2	170	—	—	3	230
1962	3	130	—	—	6	360
1963	2	165	—	—	8	525
1964	6	776	1	100	13	1,201
1965	3	263	—	—	16	1,464
1966	3	273	1	50	18	1,687
1967	18	2,353	2	100	34	3,940
1968	13	2,767	3	395	44	6,312
1969	11	1,676	5	484	50	7,504

A.3.2. Is the computer purchased, rented from a manufacturer or leased from an intermediary?

The following table shows the replies from the 35 commercial in-house users and 7 universities/research institutes with a total of 46 computers installed.

	Commercial in-house			Universities/ Research Institutes	All
	L	M	S		
Purchased	2	6	3	7	18
Rented	3	12	12	1	28
Leased	—	—	—	—	—

A.3.3. Facilities available in the present and previous computer installations and any proposed changes.

The following details refer to the 35 commercial in-house users and 7 universities/research institutes.

[8]This column includes both the value of new and replacement installations and the value of additions to existing installations e.g. through the addition of extra core storage.

(a) Facilities available on the present installations:

	Commercial in-house				*Universities/ research Institutes*
	L	*M*	*S*	*All*	
Card or paper tape only	—	4	11	15	4
Tape drives	1	7	1	9	—
Disc drives	—	4	3	7	1
Tape and disc drives	2	2	—	4	2

(b) In 8 cases, the computer installation has been upgraded or replaced. The following table compares the facilities available on the previous and present installations:

	Previous	*Present*
Card or paper tape only	4	1
Tape drives	2	1
Disc drives	1	4
Tape and disc drives	1	2

(c) In 20 cases, the upgrading or replacement of the installation is planned. The following table compares the facilities available on the present and proposed installations in 18 of these cases:

	Present	*Proposed*
Card or paper tape only	13	—
Tape drives	2	4
Disc drives	1	7
Tape and disc drives	2	7

A.3.4. Type of input, output and data preparation used

Commercial in-house users and universities/research institutes

	Commercial in-house				*Universities/ Research Institute*
	L	*M*	*S*	*All*	
Input					
Punched cards	3	12	17	32	6
Paper tape	1	5	1	7	3
Terminal	1	—	—	1	1
Analogue	—	—	—	—	1
Output					
Line printer	3	17	15	35	3
Character printer	—	1	1	2	1
Punched cards	1	8	13	22	4
Paper tape	1	2	—	3	3
Graphic display	1	—	—	1	2
Digital display	1	—	—	—	—
Analogue	—	—	—	—	1
Data Preparation					
Punched cards:					
Automatic key punches/verifiers	2	13	14	29	6
Paper tape:					
Punch and verify	1	3	1	5	1
Typewriter/paper tape punch	—	2	—	2	2
Accounting machines	—	3	—	3	1
Mark sense readers	—	1	—	1	—

Bureau Users

Number of Organisations[9]*: 25*

Type of Input	*Number of orgs*
Punched cards	18
Paper tape	10
No answer	1

[9]The only organisations answering were those looking after their own data preparation either wholly or partly. Some used both punched cards and paper tape.

Input produced separately or as part of another operation (e.g. as a by-product from accounting machines)?

Separately	17
Part of another operation	9
No answer	2

A.3.5. Where a change in the computer installation—either up-grading or replacement—has previously been made or is proposed, what were/are the reasons for the change?

Change made or proposed	*Commercial in-house*				*Universities/ Research Institutes*
	L	*M*	*S*	*All*	
Yes	3	12	11	26	5
No	—	5	4	9	2

Reason(s) for the change:	*Commercial in-house*	*Universities/ Research Institutes*
Introduction of new applications	22	4
Anticipated growth of the Organisation	17	5
Unanticipated growth of the Organisation	1	1
Technological advances/obsolescence	9	4
Unsuitability of the configuration proposed for the original applications	4	1
Other:—		
To obtain increased processing facility by transfer to a disc system	1	—
Better facilities for research	—	1
To make old computer available for teaching purposes	—	1

A.3.6. Have you any standby arrangements by which time on another computer can be made available to you?

If Yes:
(a) Is it based on a formal agreement?
(b) With whom is it made?
(c) Have you made use of the standby facilities at any time?
(d) Is the standby arrangement a reciprocal one?

Commercial in-house users and universities/research institutes

Standby arrangements	*Commercial in-house*	*Universities/Research Institutes*
Yes	34	2
No	6	5

(a) Formal agreement?

	Commercial in-house	*Universities/ Research Institutes*
Formal	6	1
Informal	28	1

(b) With whom made

Arrangements made with		*Commercial in-house*	*Universities/ Research Institutes*
Associated organisation		3	—
Non-associated organisation	computer manufacturer	14	—
	computer service bureau (other than computer manufacturer)	2	1
	Other	15	1

(c) Use of standby facilities

Use made of Facilities	*Commercial in-house*	*Universities/ Research Institutes*
Yes	15	1
No	15	1
Not yet installed	4	—

(d) Reciprocal arrangement?

Reciprocal	*Commercial in-house*	*Universities/ Research Institutes*
Yes	28	1
No	4	1
No answer	2	—

A.4 *Use of other mechanical/electronic data processing equipment*

A.4.1. Was any mechanical/electronic data processing equipment (e.g. tabulators, visible record equipment) previously used for the work now processed by computer?

If Yes, please indicate the type of equipment used.

	Commercial in-house	*Universities/ Research Institutes*	*Bureau users*
Yes	33	5	24
No	2	2	31
No answer	—	—	1

Type of equipment	*Commercial in-house*	*Universities/Research Institutes*	*Bureau users*
Punched card equipment	28	2	9
Accounting machines	10	3	15
Desk computer/calculators	—	3	1
No answer	1	—	—

A.4.2. Do you at present use any mechanical/electronic data processing equipment (e.g. tabulators, visible record equipment)?

If Yes, please indicate the type of equipment used, the work involved and whether it is integrated with the computer system.

Do you expect to transfer any of this work to the computer within the next two years?

	Commercial in-house	*Universities/Research Institutes*	*Bureau users*	*New installations*
Yes	18	6	32	5
No	17	1	23	—
No answer	—	—	1	—

Type of equipment	*Commercial in-house*	*Universities/Research Institutes*	*Bureau users*	*New installations*
Punched card equipment	9	2	6	3
Accounting machines	9	5	26	2
Desk computer/ calculators	—	2	1	—

Type of work	*Commercial in-house*	*Universities/Research Institutes*	*Bureau users*	*New installations*
Accounting	13	4	24	2
Miscellaneous	4	3	4	3
Card processing before input and after computer processing	1	1	—	3
No answer	—	—	5	—

Integrated with the computer system:

Only in three cases was it indicated that this work was integrated with the computer system—two of them involved card processing before input and after computer processing.

Expect to transfer to the computer:	*Commercial in-house*	*Universities/Research Institutes*	*Bureau users*	*New installations*
All	9	1	10	5
Some	8	3	8	—
None	1	2	14	—

A.5 *Data Transmission*

A.5.1. Are you using data transmission facilities at present and do you expect to use such facilities in the future?

	Commercial in-house		*Universities/Research Institutes*		*All*	
	Present	*Future*	*Present*	*Future*	*Present*	*Future*
On line/off line	1	4	2	5	3	9
Off line only	1	5	1	—	2	5
Total	2	9	3	5	5	14

A.5.2. A number of questions were asked about the volume of data moving inwards and outwards between sources not in the immediate proximity of the computer, the number of sources from or to which the data move and the manner in which they are moved.

Commercial in-house users and universities/research institutes:

Most of the organisations have some movement of data between decentralised sources. In only 16 is the volume significant—12 commercial in-house users and 4 universities/research institutes. These include all of the organisations at present using data transmission facilities and 10 of the organisations expecting to use such facilities in the future.

The replies from these organisations are analysed below. The form in which data are transferred is broken down into four categories:

(1) Air-surface transport of documents

(2) Air-surface transport of punched cards, paper tape, etc.

(3) Off-line telephone or telegraph link

(4) Direct on-line link with the computer

The volume of data, for purposes of comparison, is expressed as the number of alpha-numeric characters transferred per week.

		Documents		*Punched cards etc.*		*Off-line*		*On-line*	
Direction	*Time*	*Number of orgs.*	*Average volume ('000)*	*Number of orgs.*	*Average volume ('000)*	*Number of orgs.*	*Average volume ('000)*	*Number of orgs.*	*Average volume ('000)*
Inwards	Now	13	1,240	10	658	3	1,033	3	1,480
	2 years hence	14	1,659	9	1,104	2	2,130	4	6,415
Outwards	Now	13	1,700	6	882	2	1,450	3	677
	2 years hence	13	2,426	6	550	2	1,850	4	3,178

A.6. *Applications and use of software packages*

A.6.1. Please indicate the approximate number of hours of computer time or the approximate percentage of your overall expenditure on computing:

(i) which you use at present and

(ii) which you will use two years hence for applications in the following areas.

Where any application overlaps two or more of these areas, please enter it under the principal area concerned.

Application Areas	Average % of time/expenditure in each area						
	Commercial in-house			Universities/Research		Bureau users	
	Present	Future	New[10]	Present	Future	Present	Future
Production (incl. purchasing, stock control)	16	20	—	..	2	16	24
Marketing (incl. sales, distribution)	36	31	9	—	—	26	23
Finance (incl. costing, management accounting)	20	19	80	..	1	49	39
Personnel (incl. payroll, staff records)	14	15	4	2	2	4	7
Education (incl. training)	0·1	0·2	—	21	17	—	—
Scientific/research	0·5	1	—	62	65	5	6
Program development and maintenance	13	13	7	13	13	..	1
Others	0·6	0·3	—	1	1	..	..
Number of organisations	35		5	7		47	

A.6.2. Have you used any application packages?

If Yes, please give details.

Packages used:	Commercial in-house				Universities/Research Institutes	Bureau users			
	L	M	S	All		L	M	S	All
Yes	1	4	5	10	6	6	3	1	10
No	2	13	10	25	1	12	21	13	46

Application	Number of Organisations		
	Commercial in-houses	Universities/ Research	Bureau users
Information retrieval	3	—	—
Linear programming	3	1	—
Project control	2	—	—
Stock control	3	—	1
Seat reservation	1	—	—
Structural engineering	1	—	1
Discounted cash flow	1	—	—
Vehicle Scheduling	1	—	—
Mathematical/statistical analysis	1	8	3
Dividends	1	—	—
Time-sharing operating system	—	1	—
Ledger accounting	—	—	5

[10]This column sets out the projections given by the organisations about to install a computer.

A.6.3. Do you think that it would be possible to develop further application packages which would be useful to your organisation?

If Yes, who do you think should develop them and what areas should they cover?

Potential for packages	*Commercial in-house*				*Universities/Research Institutes*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	—	9	8	17	7	4	4	1	9
No	3	6	10	19	—	8	8	9	25
No answer	—	2	2	4	—	6	12	4	22

Commercial in-house users:

Packages should be developed for the following applications by:

Computer Manufacturers

Testing program modules
Adapting UK packages for Irish conditions e.g. taxation in DCF
Process control
Stock-recording/order analysis
Payroll
Statistical analysis
File interrogation
Share registration
Truck scheduling and routing

Software companies

Specialist areas such as sales forecasting, van scheduling, CPA etc.

Industry groups

General areas such as invoicing, sales accounting, stock recording, payroll, rate applotment.

Universities/Research Institutes:

Packages should be developed for the following applications by:

Computer Manufacturers

Simulation
Special I/O device support
Non-linear programming
Statistical/mathematical.

Software Companies

Payroll/personnel
New systems software

Universities/research institutes

Advanced research-based applications
Statistical/mathematical

Bureau users:

Packages should be developed for the following applications by:

Computer Manufacturers

Stock control
Critical Path Analysis

Software Companies

Sales Accounting
Statistics
Stock forecasting
Payroll
Economic models
Computerised type-setting

A.6.4. Are any applications which you would wish to computerise held back by any of the reasons listed below?

Held Back	*Commercial in-house*				*Universities/Research Institutes*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	3	11	11	25	7	8	8	3	19
No	—	6	4	10	—	10	16	11	37

Commercial in-house and universities/research institutes

Reasons	*Number of organisations*	
	Commercial in-house	*Universities/ Research*
Lack of capacity on/unsuitability of the configuration	13	5
Lack of application software	2	5
Lack of systems software	3	3
Lack of trained computer personnel	11	4
Lack of suitable external advice	2	2
Lack of funds	—	6
Staff, union or management resistance or inadequacy	5	—
Other: Lack of communication between DP and line management	1	—
Rate of turn-around on program development	1	—

Bureau users

Reasons	*Number of organisations*
Unsuitable for processing on an outside computer	6
Geographical remoteness of the bureau	6
Unavailability of suitable program packages	4
Lack of necessary expertise among your own staff	4
Lack of necessary expertise among the bureau staff	3
Lack of suitable external advice	—
Lack of funds	4
Staff, union or management resistance or inadequacy	—

A.7. *Programming Languages*

A.7.1. What programming languages are/will be used for your computer applications?

Commercial in-house users

Number of organisations: 35

Language	*Present Applications*			*Future Applications*		
	much use	*average use*	*small use*	*much use*	*average use*	*small use*
Machine Language	1	—	—	—	—	1
Assembler Language	15	4	6	8	6	7
RPG/NICOL/TABSIM etc.	14	1	—	8	3	2
COBOL	8	—	3	17	5	2
FORTRAN	2	4	—	2	4	2
ALGOL	—	—	1	—	—	1
PL/1	—	1	—	2	—	—

5 planned installations: much use of Assembler 2
much use of RPG/NICOL/TABSIM etc. 3

Universities/Research Institutes

Number of organisations: 7

Language	*Present applications*			*Future applications*		
	much use	*average use*	*small use*	*much use*	*average use*	*small use*
Machine Language	—	—	4	—	—	2
Assembler Language	1	1	3	—	3	2
RPG/NICOL/TABSIM etc.	—	—	1	—	—	3
COBOL	—	1	1	1	—	3
FORTRAN	6	—	—	7	—	—
ALGOL	—	1	1	—	3	1
PL/1	1	—	—	2	—	—

Bureau users

Thirty-six organisations were unable to answer this question—6 large, 17 medium and 13 small.

Number of organisations: 20

Language	*Present Applications*			*Future Applications*		
	much use	*average use*	*small use*	*much use*	*average use*	*small use*
Machine Language	—	—	1	—	—	1
Assembler Language	2	—	—	—	1	—
RPG/NICOL/TABSIM etc.	2	1	2	1	3	1
COBOL	10	1	2	11	3	—
FORTRAN	4	2	1	4	2	1
ALGOL	—	—	—	—	—	1
PL/1	—	1	—	1	1	—

A.8. *Displacement of Staff*

A.8.1. Did the use of a computer result in a displacement of clerical and/or other personnel engaged on the work now processed by computer?

If Yes, in what way have they been redeployed?

Displacement of Staff:	*Commercial in-house*				*Universities/Research Institutes*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	3	16	9	28	—	10	8	3	21
No	—	1	6	7	7	7	8	7	22
No answer	—	—	—	—	—	1	8	4	13

Redeployment of staff:

Commercial in-house users

	Average per installation				*Numbers*
	L	*M*	*S*	*All*	
Organisations giving details	1	11	8	20	
Transferred to computer work	40	8	4	8	164
Transferred to other non-computer work	100	7	4	11	210
Early retirement	—	—	—	1	3
Normal staff losses by marriage, retirement, etc.	—	9	1	6	117
Discharged	—	—	—	—	—
Total	140	25	9	25	494

Bureau users

	Average per installation				*Numbers*
	L	*M*	*S*	*All*	
Organisations giving details	8	6	1	15	
Transferred to computer work	1·4	0·3	—	0·9	13
Transferred to other non-computer work	0·9	0·8	—	0·8	12
Early retirement	—	—	—	—	—
Normal staff losses by marriage, retirement, etc.	3·5	0·8	—	2·2	33
Discharged	1·4	—	—	0·7	11
Other: absorbed by expansion	—	—	2	0·1	2
obviated seasonal employment	—	1	—	0·4	6
Total	7·1	3	2	5·1	77

A.9. *Initiation of the use of a computer and location of computing within the organisation*

A.9.1. Who initiated the idea of using a computer for the work of your organisation?

Commercial in-house users

Initiated by:	*L*	*M*	*S*	*All*
Top Management	2	17	12	31
Management Services/O & M/Work Study Department	—	1	—	1
Functional Department (see breakdown below)	1	2	4	7
Computer Manufacturers	—	—	(2)*	(2)*
Outside Consultants	—	—	—	—
Other (see breakdown below)	—	(2)*	—	(2)*
No answer	—	1	—	1
Total	3	21	16	40

Universities/research institutes

Top Management	3
Management Services/O & M/Work Study Department	—
Functional Department (see breakdown below)	4
Computer Manufacturers	—
Outside Consultants	—

Bureau users

Initiated by:	*L*	*M*	*S*	*All*
Top Management	10	11	9	30
Management Services/O & M/Work Study Department	1	—	—	1
Functional Department (see breakdown below)	6	9	3	18
Bureau Proprietors	—	1	—	1
Outside Consultants	1	2	—	3
Other (see breakdown below)	—	1	2	3
Total	18	24	14	56

*In these four cases where an external initiator was indicated another internal initiator was also indicated.

Breakdown of "Functional Department" and "Other"

	Commercial in-house	*Universities/ Research*	*Bureau users*
Functional Department:			
Accounting	6	—	13
Research and planning	—	—	3
Sales	1	—	1
Personnel	1	—	—
Statistics	—	1	—
Engineering	—	1	—
Not specified	—	2	1
Total	8	4	18
Other:			
Associated organisation	—	—	2
Auditors	2	—	—
Accounting machine supplier	—	—	1
Total	2	—	3

A.9.2. For what reasons did you decide to use an outside computer rather than acquire a computer of your own? Please tick the appropriate box(es).

Bureau users only

	L	*M*	*S*	*All*
Lower overall cost	9	9	5	23
Lack of trained computer personnel	6	5	1	12
Wish to develop computer expertise with a view to acquiring a computer of your own in the future	6	3	3	12
Total volume of work inadequate to utilise a computer fully	12	19	12	43
To avail of computer application packages from the bureau	2	1	1	4
Other:				
spare capacity on group computer	1	—	—	1
lack of office space	1	—	—	1

A.9.3. (a) To whom does the person in charge of data processing report within your organisation?

(b) Is he responsible for any functions other than data processing?

If Yes, please indicate what these functions are.

(*a*) Reports to:

	Commercial in-house				*Universities/Research*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Chief executive	—	5	4	9	2	4	11	6	21
Second line executive	2	12	11	25	2	11	12	7	30
Third line executive	1	3	1	5	1	1	—	—	1
Other	—	1	—	1	2	2	1	1	4

Further Breakdown

Area of line executives:	*Commercial in-house*	*Universities/ Research*	*Bureau users*
Second line executive:			
Accounts/finance	12	—	18
Secretary/administration	4	1	6
Planning	1	—	—
Other	4	1	4
Not specified	4	—	2
Total	25	2	30
Third line executive:			
Accounts/finance	2		1
General services/administration	2		—
Management services	1		—
Total	5	1	1

(*b*) Other functions:

	Commercial in-house				*Universities/Research*	*Bureau*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	2	8	3	13	6	14	21	12	47
No	1	13	12	27	1	3	3	1	7
No answer	—	—	—	—	—	1	—	1	2

Type of other functions	*Commercial in-house*	*Universities/ Research*	*Bureau users*
Accounts/finance	4	—	27
Administration	2	—	11
Management Services/O&M/ Work Study	3	—	2
Research and planning	—	1	2
Systems activities	2	—	—
Lecturing	—	2	—
Other	2	2	3
Not specified	—	1	2
Total	13	6	47

A.10. *Advice and support from outside the Organisation*

A.10.1. In considering the feasibility of installing or using a computer, did you receive advice from outside your organisation?

If Yes, from what source(s) was the advice received?

Outside advice received	*Commercial in-house*				*Universities/Research*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	3	15	13	31	5	13	12	8	33
No	—	6	3	9	2	5	12	6	23

Source of advice:

Commercial in-house

Numbers of organisations: 31

Advice from:	*Advice on*			
	Hardware	*Applications*	*Software*	*Staffing*
Computer manufacturers	29	18	28	18
Outside consultants	7	9	4	26
Other organisations in the same line of business	13	10	8	11
Other organisations not in the same line of business	5	4	2	4
Other:				
Associate company	3	3	1	1

Universities/Research Institutes

Number of organisations: 5

Advice from	*Advice on*			
	Hardware	*Applications*	*Software*	*Staffing*
Computer manufacturers	5	2	4	1
Outside consultants	—	—	—	1
Other organisations in the same line of business	4	2	4	2
Other organisations not in the same line of business	1	—	—	—

Bureau users

Number of organisations: 33

Advice from	*Advice on:*			
	Choice between a bureau and an in-house computer	*Applications*	*Computer Programs and program packages*	*Staffing*
Computer manufacturers	7	8	8	3
Computer service bureau (other than computer manufacturers)	2	10	12	4
Outside consultants	7	6	2	5
Other organisations in the same line of business	1	4	2	2
Other organisations not in same line of business	2	1	—	2
Other	1	2	—	—

A.10.2. Having selected a computer and the applications to be tackled, did you receive support from outside your organisation?

If Yes, please indicate the source of the support and whether it was total support (T), i.e. a function taken over completely by an outside organisation, or partial support (P).

(Commercial in-house and universities/research institutes only.)

1

Support received	*Commercial in-house*				*Universities/Research*
	L	*M*	*S*	*All*	
Yes	2	20	15	37	6
No	1	1	1	3	2

Commercial in-house users

Number of organisations: 37

Support from	*Support on*							
	Training		*Systems analysis/ design*		*Programming*		*Other—please specify*	
	T	*P*	*T*	*P*	*T*	*P*	*T*	*P*
Computer manufacturer	8	25	1	27	1	34	—	3
Outside consultants	—	4	—	10	—	5	—	1
Other organisations in the same line of business	—	1	—	4	—	2	—	—
Other organisations not in the same line of business	—	2	—	—	—	—	—	—
Other: *IMI—1, IPA—1, NCC—1.	—	3*	—	—	—	—	—	—

Universities/Research Institutes

Number of organisations: 5

Support from	*Support on*					
	Training		*Systems analysis/ design*		*Programming*	
	T	*P*	*T*	*P*	*T*	*P*
Computer manufacturers	—	4	—	2	—	1
Outside consultants	—	—	—	1	—	—
Other organisations in the same line of business	—	1	—	—	—	2
Other organisations not in the same line of business	—	—	—	—	—	—

A.10.3. Did some or all of the support consist of work contracted out?

If Yes, please indicate briefly the type of work involved and the reason for contracting it out.

(Commercial in-house users and universities/research institutes only.)

Work contracted out	*Commercial in-house*				*Universities/Research*
	L	*M*	*S*	*All*	
Yes	—	2	4	6	2
No	2	18	11	31	3

Type of work contracted out	*Reason*	*Commercial in-house*	*Universities/ Research*
Punching, compilation and testing of data and programs	Awaiting installation	3	—
Systems design and programming	Shortage of staff and deadline pressures	2	—
Live operation	Awaiting installation	1	—
Program development and printing of data	Not Specified	—	2

A.10.4. Were you satisfied with the support received?

If No, please indicate why you were not satisfied.

(Commercial in-house users and universities/research institutes only.)

Satisfied with support	*Commercial in-house*	*Universities/Research*
Yes	28	3
No	8	1
No answer	1	1
Total	37	5

Reason for dissatisfaction	*Commercial in-house*	*Universities/Research*
Inexperienced staff supplied	2	—
Changes in staff during the project	2	—
Inadequate work done on systems and programming	2	—
Inadequate training given	2	—
Jobs did not operate as planned	—	1

A.10.5. To what extent do you think that an organisation installing a computer for the first time should rely on outside support? From what source do you think that this support should be sought?

(Commercial in-house users and universities/research institutes only.)

Commercial in-house users

Number of organisations: 40

Support desirable on	*Total Support*	*Partial Support*	*No support at all*	*Other*[11]
Training	17	21	2	—
Systems analysis/design	2	32	5	1
Programming	3	28	8	1
Other:				
Organisation	—	1	—	—
Operation	—	1	—	—
Installation	—	1	—	—

Source of support	*Training*	*Systems analysis/ design*	*Programming*	*Other*
Computer Manufacturer	38	22	29	3
Outside Consultant	5	17	5	—
Other organisations in the same line of business	3	9	3	1
Other organisations not in the same line of business	2	1	—	1
IMI	3	2	1	—
Other	2	2	1	—

Universities/Research institutes

Number of organisations: 5

Support desirable on	*Total Support*	*Partial Support*	*No support at all*	*Depends on organisation*
Training	—	4	—	1
Systems analysis/design	—	4	—	1
Programming	—	4	—	1

[11]Will depend on size and type of organisation—the larger and more original the application, the more internal resources will be required.

Source of support	*Training*	*Systems analysis/ design*	*Programming*
Computer manufacturer	4	3	4
Outside consultant	1	2	1
Other organisations in the same line of business	2	2	2
Other organisations not in the same line of business	—	—	—

A.10.6. To what extent are the following services being provided for you by (1) the bureau or other organisation whose computer you use, (2) by a separate organisation and (3) from within your own organisation?

(Bureau users only.)

Bureau users

Number of organisations: 56

T=totally, P=partially

Service	*Provided by*					
	Bureau or organisation providing computer facilities		*Other organisation*		*Within your organisation*	
	T	*P*	*T*	*P*	*T*	*P*
Computer operation	54	2	—	—	—	2
Data preparation	30	6	1	—	19	6
Programming	43	6	—	1	7	5
Systems analysis/design	28	17	—	1	11	16
Staff training	11	10	3	1	31	11

Breakdown of organisations providing services totally internally

Service	*L*	*M*	*S*	*All*
Data preparation	9	7	3	19
Programming	4	2	1	7
Systems analysis/design	5	4	2	11
Staff training	8	14	9	31

A.10.7. Where any of these services are provided for your organisation by a bureau or other organisation, are you satisfied with the service given?

If No, please indicate briefly why you are not satisfied.

(Bureau users only.)

Bureau users

Number of organisations: 56

Satisfied with outside services:	*L*	*M*	*S*	*All*
Yes	13	19	10	42
No	4	5	2	11
No answer	1	—	2	3

Number of organisations: 11

Reasons for dissatisfaction	
Turn-around time not dependable	4
Inadequate work done on systems and programming	4
Inaccurate data preparation	2
Slow set-up time	1

A.10.8. To what extent do you think an organisation using a computer for the first time should rely on outside services? From what source do you think that the services should be sought?

(Bureau users only.)

Bureau users

Number of organisations: 56

Service	*Should be provided from outside*			
	Totally	*Partly*	*Not at all*	*No answer/ depends on organisation*
Data preparation	16	21	11	8
Programming	29	17	3	7
Systems analysis/design	15	30	4	7
Training	20	28	1	7

Source of service from outside	*Data Preparation*	*Programming*	*Systems analysis/ design*	*Training*
Computer manufacturers	13	20	15	28
Computer service bureau (other than computer manufacturer)	26	26	21	14
Outside consultants	1	4	13	5
Other organisations in the same line of business	6	6	9	7
Other organisations not in the same line of business	2	1	1	1
Other: Professional body, e.g. IMI	—	1	1	1

General comment:

A number of organisations indicated that they considered that the answer to these questions depends on the particular circumstances of each individual organisation.

A.11. *Benefits expected and received*

A.11.1. What benefits did you *expect* to get from your computer applications? The boxes A to F relate to:

A. Reduction/control of staff costs
B. Reduction/control of costs other than staff costs
C. Increase in revenue
D. Better information for management decisions
E. Greater flexibility
F. Other—please specify.

Column G shows the number of organisations with applications in each area.

Commercial in-house users
Number of organisations: 35

Application Areas	*A Staff Costs*	*B Other Costs*	*C Revenue*	*D Information for Management*	*E Flexibility*	*F Other*	*G Number of Organisations*
Production (including purchasing, stock control.)	11	16	4	26	12	3	26
Marketing (including sales, distribution)	13	7	10	25	17	3	30
Finance (including costing, management accounting)	17	10	10	31	18	2	32
Personnel (including payroll, staff records)	17	6	—	17	10	1	26
Education	—	—	—	—	—	—	—
Scientific/Research	2	2	1	6	1	—	8
Total	60	41	25	105	58	9	122

Universities/Research Institutes

Number of organisations: 6

Application Areas	*A Staff Costs*	*B Other Costs*	*C Revenue*	*D Information for Management*	*E Flexibility*	*F Other*	*G Number of Organisations*
Production (including purchasing, stock control)	—	—	—	1	1	—	1
Marketing (including sales, distribution)	—	—	—	—	—	—	—
Finance (including costing, management accounting)	—	—	—	1	—	—	1
Personnel (including payroll, staff records)	1	—	—	2	2	—	2
Education	1	1	1	2	5	1	6
Scientific/Research	1	1	—	1	6	3	6
Other	1	—	—	1	1	1	1
Total	4	2	1	8	15	5	17

Bureau users

Number of organisations: 56

Application Areas	*A Staff Costs*	*B Other Costs*	*C Revenue*	*D Information for Management*	*E Flexibility*	*F Other*	*G Number of Organisations*
Production (including purchasing, stock control)	8	5	1	8	4	3	14
Marketing (including sales, distribution)	6	2	2	23	8	1	26
Finance (including costing, management accounting)	22	5	5	25	12	3	36
Personnel (including payroll, staff records)	5	3	—	5	2	—	8
Education	—	—	—	2	1	—	2
Scientific/Research	3	—	—	6	4	1	7
Total	44	15	8	69	31	8	93

A.11.2. How have the computer applications affected your organisation under each of the following headings?

A. Staff costs
B. Costs other than staff
C. Revenue
D. Information for management decisions
E. Flexibility
F. Other—please specify

The following tables should be read in conjunction with those in the previous question. For each heading under which benefits were expected from a com-

puter application, these tables analyse the actual effect which the application has produced. For example, taking the heading staff costs for the commercial in-house users, the previous question shows that benefits under this heading were expected from 60 applications; the first table below shows in column A that of these 60 applications, 35 per cent have produced significant benefits, 37 per cent marginal benefits, etc.

Commercial in-house users

Percentage in each rank

Effect / *Rank of Effect*	*A* Staff Costs	*B* Other Costs	*C* Revenue	*D* Information for Management	*E* Flexibility	*F* Other	*G* All
Significant Benefit	35	34	40	50	46	78	44
Marginal Benefit	37	32	24	28	21	11	28
No change	10	5	16	3	9	11	7
Marginal Detriment	—	2	—	—	—	—	<1
Significant Detriment	—	2	—	—	—	—	<1
Not Assessed	13	17	16	14	21	—	15
Not yet implemented	5	7	4	4	3	—	4

Universities/Research Institutes

Percentage in each rank

Effect / *Rank of Effect*	*A* Staff Costs	*B* Other Costs	*C* Revenue	*D* Information for Management	*E* Flexibility	*F* Other	*G* All
Significant benefit	—	—	—	25	67	80	46
Marginal benefit	50	—	—	50	20	—	26
No change	25	—	—	—	—	—	3
Marginal detriment	—	—	—	—	—	—	—
Significant detriment	—	—	—	—	—	—	—
Not yet assessed	25	100	100	25	13	20	26

Bureau users

Percentage in each rank

Effect / *Rank of Effect*	*A* Staff Costs	*B* Other Costs	*C* Revenue	*D* Information for Management	*E* Flexibility	*F* Other	*G* All
Significant benefit	20	13	38	62	71	25	46
Marginal benefit	34	52	25	19	13	37·5	26
No change	23	20	25	5	—	—	10
Marginal detriment	—	7	—	1	—	—	1
Significant detriment	—	—	—	1	—	37·5	1
Not assessed	23	7	12	12	16	—	16

A.12. *Information on computing*

A.12.1. Do you feel that adequate information is currently available on all aspects of data processing?

If No, on what aspects do you find the information inadequate and from what source would you like to see this information being provided?

Information adequate	*Commercial in-house*				*Universities/Research*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	1	10	10	21	4	9	10	8	27
No	2	7	5	14	3	7	8	4	19
No answer	—	—	—	—	—	2	6	2	10

Source of further information

1. Computer Manufacturers
2. Technical Journals
3. Professional Societies
4. User Associations
5. Semi-state body
6. Independent consultants
7. Bureau
8. No source given

For the 36 organisations that found the information inadequate, the following areas and sources were indicated:

Areas	*Source*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
EDP Management		—	1	6	7	—	—	—	—
Hardware		6	2	—	—	—	—	—	1
Software		6	3	2	2	—	1	—	1
Systems/programming methods		2	3	4	5	—	1	1	2
Application areas		4	2	3	5	1	1	—	1
Application packages		4	4	3	6	1	—	—	1
Training courses		1	1	5	2	1	1	—	—

Other replies: (1) need for information on all fronts from impartial consultants

(2) need for up-to-date bibliography of experience in each field from university or semi-state body.

A.13. *Co-ordination of computing developments*

A.13.1. Do you think that activities such as the dissemination of information, the development of training courses and application packages, etc., could best be co-ordinated in one single body in Ireland?

If Yes, what existing body might fulfil this role or what type of body should be created?

Co-ordinating body desirable	*Commercial in-house*	*Universities/ Research Institute*	*Bureau Users*	*All*
Yes	18	3	30	51
No	21	4	12	37
No answer	1	—	14	15

		Commercial in-house	*Universities/ Research Institute*	*Bureau users*
Existing Organisation	Irish Computer Society	4	—	4
	Computer Users Association	5	1	7
	Irish Management Institute	3	—	14
	Institute of Public Administration	—	—	—
	Institute for Industrial Research and Standards	—	—	1
	National Science Council	—	—	—
	Government Department	—	—	—
	Other—Institution of Engineers	1	—	—
New Organisation	Private company	—	—	2
	Private association of computer users	—	—	6
	Semi-state body	2	3	1
	Other: Amalgam of Irish Computer Society, Computer Users Association and Irish Management Institute	3	—	1

A.14. *Decimalisation*

A.14.1. To what extent will you be affected in the data processing area by decimalisation?

If you will be affected substantially or marginally, in what specific area will you be affected and what measures have you already taken?

Will be affected	*Commercial in-house*	*Universities/ Research Institute*	*Bureau Users*	*All*
Substantially	30	—	11	41
Marginally	10	3	26	39
Not at all	—	4	11	15
No answer	—	—	8	8

Areas in which affected	*Commercial in-house*		*Universities/ Research Institutes*
	substantially	*marginally*	*marginally*
File conversion	27	12	2
Program amendments	28	12	2
Documentation	15	19	3
Equipment conversion	3	12	—
Staff training	16	11	1
Parallel running	11	20	1

Note: This part of the question was omitted from the bureau users' questionnaire.

Measures taken:

Commercial in-house

Most of them had already appointed a decimalisation officer to look after all aspects of the changeover. In some, broad policies for the changeover and implementation plans had already been formulated.

The majority indicated that the manufacturers would be providing software for use in the changeover. Only two organisations stated that they had not yet taken any steps towards meeting the changeover.

Universities/Research Institutes

Only one of these organisations gave information. They have made plans for the changeover.

Bureau Users

A few indicated that they had not yet taken any steps to cope with the changeover. In most cases, the bureaux are looking after this matter or have made provision in the original programs to cater for it.

APPENDIX B

SURVEY OF COMPUTER PERSONNEL

Introductory

The survey of computer personnel was conducted partly through the general questionnaires sent to the organisations using computing facilities—the non-personnel questions from these questionnaires are analysed in Appendix A—and partly through special questionnaires sent to the individual personnel within these organisations.

As far as the personnel questions in the general questionnaire are concerned, the number of organisations to which the questionnaire was sent and the response rate were the same as is set out in the Introduction to Appendix A.

The special personnel questionnaire was sent to a number of the commercial in-house computer users with a request that copies be distributed to and completed by the individual computer personnel employed by them. The number of organisations chosen was designed to secure a coverage of 50 per cent of the organisations in each category of installation (large, medium and small) and 50 per cent of the computer personnel in each of the personnel categories of EDP Manager, Operations Manager/Supervisor, Systems Analyst, Programmer/Analyst and Programmer. The actual response received compared with the total number of personnel in each category is set out at the commencement of the analysis of the replies from each category.

This Appendix is laid out as follows. The replies to the personnel questions in the general questionnaire are analysed first in Sections B.1 to B.3. This is followed by a separate analysis of the replies from each category of computer personnel in Sections B.4 to B.8 in the following order—EDP Manager, Operations Manager/Supervisor, Systems Analyst, Programmer/Analyst and Programmer.

B.1. *Personnel numbers and breakdown of numbers and expenditure*

B.1.1. Please indicate the number of staff in your organisation at present engaged on computer work and the number you would expect to employ in two years and in five years in each of the categories set out below. (The categories listed are intended to indicate functional areas. Any one person may be

involved in more than one category. If this is so in your organisation, please enter him in his principal category.)

Commercial in-house users

Number of organisations: 35

Category	Present Total	Average per installation				Percentage increase	
		Overall	L	M	S	2 years	5 years
EDP manager	35	1·0	1·0	1·0	1·0	—	—
Operations manager/ supervisor	34	1·0	1·0	1·3	0·6	32	36
Systems analyst	69	2·0	8·7	1·9	0·7	39	61
Programmer/analyst	51	1·5	7·7	1·1	0·7	50	67
Programmer	144	4·1	18·7	3·4	2·1	22	30
Operator	130	3·7	13·3	3·1	2·5	9	15
Data control staff	139	4·0	9·7	4·6	2·1	5	18
Data preparation staff	491	14·0	64·0	11·9	6·5	8	5
Total	1,093	31·2	124·0	28·3	16·0	15	19

Universities/Research Institutes

Number of organisations: 7

Category	Present		Percentage increase	
	Total	Average per organisation	2 years	5 years
EDP manager	4	0·6	33	33
Operations manager/supervisor	4	0·6	50	200
Systems analyst	2	0·3	100	100
Programmer/analyst	8	1·1	125	225
Programmer	15	2·1	80	280
Operator	9	1·3	114	229
Data control staff	5	0·7	125	225
Data preparation staff	15	2·1	92	162
Total	62	8·9	100	200

Bureau users

The 56 organisations replying are classified as follows:

	L	*M*	*S*	*All*
No computer staff employed	3	13	9	25
Computer staff employed but no figures given	4	2	4	10
Figures supplied	11	9	1	21

Category	*Present Total*[1]	*Average per installation*[2]				*Percentage Increase*	
		Overall	*L*	*M*	*S*	*2 years*	*5 years*
EDP Manager	3	0·1	0·2	—	—	150	300
Systems Analyst	8	0·2	0·5	0·1	—	43	129
Programmer/Analyst	6	0·2	0·4	0·1	—	100	150
Programmer	4	0·1	0·3	—	—	375	500
Data Control Staff	18	0·5	0·6	0·5	—	33	47
Data Preparation Staff	77	2·0	4·1	1·0	1·1	18	75
Total	116	3·1	6·1	1·6	1·1	47	103

B.1.2. Have you designated any specific person in your organisation to liaise with the bureau on operational problems?

(Bureau users only)

	L	*M*	*S*	*All*
Yes	14	18	8	40
No	3	1	2	6
No answer	1	5	4	10

[1]The figures given for the present total staff employed are those given by the 21 organisations which employ computer staff and which gave figures.

[2]The average staff employed per installation has been calculated on the basis of the actual number of staff employed by the organisations which gave figures (i.e. those in the "present total" column) grossed up to take into account the organisations which employ staff but did not provide figures and divided by the total number of organisations. The calculation is therefore: Present total $\times$ 31/21 $\times$ 1/56.

B.1.3. What is your present annual expenditure on computer staff—direct wages and salaries only—under the following headings?

The total figures for expenditure on personnel may be found in Section A.1 of Appendix A. What is analysed here is the percentage of expenditure devoted to the main categories of personnel.

Number of commercial in-house users:	31
Number of universities/research institutes:	5
Number of bureau users:	21

Category of Staff	*Percentage of annual expenditure*		
	Commercial in-house users	*Universities/ Research Institute*	*Bureau users*
EDP manager, systems and programming Staff	43	58	41
Operations manager/supervisor and operators	18	25	—
Data control and data preparation staff	39	18	59

B.2. *Recruitment of staff*

B.2.1. Have you at any time recruited computer staff on fixed-term contracts? *If Yes,* please indicate the category of staff concerned and the period of the contract and why you adopted the fixed-term contract approach.

Only two organisations indicated that they had recruited computer staff on fixed-term contracts. One commercial in-house user recruited a Senior Systems Analyst for a 2/3 year period. The reason was that specific expertise was required while internal staff were acquiring the necessary experience. One bureau user recruited a Supervisor for a 4 month period for what is described as a one-off job.

B.2.2. Have you experienced any difficulty in recruiting specialist computer staff? Please comment on any difficulties you have encountered in recruiting or retaining suitable staff. In what countries have you advertised vacancies on your computer staff?

Recruitment difficulties	*Commercial in-house*				*Universities/Research*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	3	9	7	19	3	3	1	—	4
No	—	8	7	15	3	11	6	3	20
No Answer	—	—	1	1	1	1	4	2	7
No Staff	—	—	—	—	7	3	13	9	25

Comments on difficulties:

Commercial in-house

The main comments related to the following points:

(i) the small number of people available with technical competence and business experience;

(ii) the high salaries sought by computer personnel;

(iii) high mobility in search of experience and high rewards.

Universities/research institutes

Only one organisation commented, pointing to the small size of the pool of suitably qualified systems analysts and the difficulty in finding people with both a high level of technical competence and experience and suitable personality.

Bureau users

Only two organisations had comments, one referring to the limited experience and intellectual capacity of the prospective computer staff, the other referring to internal organisational constraints.

Vacancies for staff advertised:

Commercial in-house

Category	*Organisations experiencing difficulties: 19*			*No difficulties experienced: 15*		
	Ireland	*Britain*	*USA/ Canada*	*Ireland*	*Britain*	*USA/ Canada*
EDP manager	5	2	—	1	1	—
Operations manager/ supervisor	1	—	—	1	—	—
Systems analyst	10	5	2	5	3	—
Programmer/analyst	7	3	2	3	1	—
Programmer	11	7	1	8	4	—
Operator	9	—	—	3	—	—

Universities/research institutes

Category	*Organisations experiencing difficulties: 3*			*No difficulties experienced: 3*		
	Ireland	*Britain*	*USA/ Canada*	*Ireland*	*Britain*	*USA/ Canada*
EDP manager	1	1	—	1	1	—
Operations manager/ supervisor	—	—	—	1	1	—
Systems analyst	1	1	—	1	1	—
Programmer/analyst	1	1	—	1	1	—
Programmer	1	1	—	1	1	—
Operator	2	—	—	2	—	—

Bureau users

Category	*Organisations experiencing difficulties: 4*			*No difficulties experienced: 20*		
	Ireland	*Britain*	*USA/ Canada*	*Ireland*	*Britain*	*USA/ Canada*
EDP Manager	—	—	—	—	—	—
Systems Analyst	3	1	—	1	—	—
Programmer/Analyst	—	—	—	—	—	—
Programmer	3	1	—	1	—	—

B.3. *Training*

B.3.1. What training courses have you used for staff? Please indicate only the name of the body organising the courses.

Organising Body	*Commercial in-house*	*Universities/ Research*	*Bureau users*
EDP Managers			
Computer manufacturers	24	2	2
IMI	14	—	2
Training consultants outside Ireland	10	—	—
Parent or affiliate organisation	3	—	—
IPA	2	—	—
Civil Service Training Centre	—	—	1

Organising Body	*Commercial in-house*	*Universities/ Research*	*Bureau users*
Systems Analysts			
Computer manufacturers	13	—	6
Training consultants outside Ireland	8	—	2
IMI	5	—	—
Universities	4	—	1
Parent or affiliate organisation	2	—	—
National Computing Centre	2	—	—
IPA	1	—	—
Programmers			
Computer manufacturers	26	1	3
Universities	2	2	2
Training consultants outside Ireland	2	—	—
Programmer/Analysts			
Computer manufacturers	14	1	2
Universities	2	2	1
IMI	2	—	—
Parent or affiliate organisation	1	—	—
Training consultants outside Ireland	1	—	—
Operations Manager/Supervisor			
Computer manufacturers	17	1	
IMI	8	—	
Training consultants outside Ireland	4	—	
Universities	—	2	
Parent or affiliate organisation	1	—	
IPA	1	—	
Operators			
Computer manufacturers	18	1	
Universities	—	1	
Data Control Staff			
Computer manufacturers	3	1	2
IMI	2	—	1
Universities/technical colleges	—	1	2
Computer bureau	—	—	1
Training consultants outside Ireland	—	—	1
Data Preparation Staff			
Computer manufacturers	11	1	7
Training consultants outside Ireland	4	—	—
Training consultants in Ireland	2	—	—
Universities	—	2	—
Computer Bureau	—	—	1
Bureau liaison man			
Computer manufacturers			4
IMI			3
IPA			1
Training consultants outside Ireland			1

B.3.2. Do you propose to use any different training courses in the immediate future? *If Yes,* please indicate the category of staff involved and the body organising the courses you propose to use.

Different courses to be used	*Commercial in-house*				*Universities/Research*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	1	4	4	9	2	4	—	—	4
No	2	12	11	25	5	7	6	—	13
No answer	—	1	—	1	—	4	5	5	14
No staff	—	—	—	—	—	3	13	9	25

New courses to be used:

Category of Staff	*Organising Body*	*Number of Organisations*
Commercial in-house		
Board	Computer manufacturers	1
EDP manager	Computer manufacturers	1
	University	1
	Undecided	1
Operations manager	IMI	2
Systems analysts	IMI	3
Senior staff	Computer manufacturers	2
	IMI	2
	Internal	1
Universities/Research Institutes		
Operations manager	Computer manufacturers	1
	IMI	1
Programmer/analysts	Computer manufacturers	1
Programmers	Computer manufacturers	2
Operators	Computer manufacturers	2
Data control staff	Computer manufacturers	1
Bureau Users		
EDP manager	Computer manufacturers	1
Systems and programming staff	IMI	1
Programmers	Computer manufacturers	1

B.3.3. Do you consider that the range of courses now available in Britain and Ireland is adequate in terms of relevance, quality and cost?

If No, please indicate the type of courses which you consider to be necessary and the bodies which should organise them.

Range Adequate	*Commercial in-house*				*Universities/Research*	*Bureau users*			
	L	*M*	*S*	*All*		*L*	*M*	*S*	*All*
Yes	1	11	11	23	2	9	4	1	14
No	2	6	3	11	5	2	2	—	4
No answer	—	—	1	1	—	7	18	13	38

Courses needed:

The bodies are indicated by number as follows:

(1) Computer manufacturers
(2) Consultants
(3) Irish Management Institute
(4) Institute of Public Administration
(5) Universities
(6) Technological colleges
(7) Vocational schools
(8) Private schools
(9) Computer bureau
(10) Central training body
(11) Internal

Commercial in-house

Category	*Objectives*	*Duration*	*Organising Body*
Top Management	Appreciation	1–4 days	1, 3, 11
	Appreciation with project work	2 weeks	4
	Application of computers to management (e.g. MIS)	2–3 days	1, 3
Line Management in the User Area	Appreciation	2–3 days	3, 11
	Appreciation with project work	2 weeks	4
	Use of computers in different user areas	2–4 days	1, 3

Category	*Objectives*	*Duration*	*Organising Body*
EDP Manager	Business Administration	4–5 weeks	3
	New developments in techniques, applications, equipment and software appropriate to this country	as required	1, 3, 4
	Training and development of computer personnel, use of systems and programming statistics, management appreciation	2–3 weeks	—
	Systems and programming appreciation	—	3
Operations Manager/ Supervisor	Control of computer installation	2 weeks	3
	Practical aspects of hardware manipulations and operational systems	—	1
	Skills and methods of improving cost effectiveness in operating and data preparation areas	1 week	3
	New developments in EDP	as required	4
Systems Analysts	Basic course leading to a formal qualification	2 years	5, 6
	Business administration	2–4 weeks	3
	Techniques	2–3 weeks	1, 3
	File design for simple and complex data structures	—	5
	New developments in EDP	—	4
Programmer/Analysts	Occasional courses as required by innovations	—	1
Programmers	Systems course	2 years	5
	Standards	—	6, 7
	Basic disciplines of programming	2–4 weeks	1
Operators	Basic training	1–2 months	11
	Competence in handling equipment	—	1
	Appreciation of disciplines necessary in the operating area	1 week	1
Data Control Staff	Basic training	1–2 months	11
	Appreciation of all data flows in the organisation and control of data flows	—	11
Data preparation Staff	Basic training	1–2 months	11
	On site training	—	2, 11

Universities/Research Institutes

Category	*Objective*	*Duration*	*Organising Body*
Top Management	Appreciation	short	2, 5
Line Management in the user area	Appreciation	short	2, 5, 6
EDP Manager	Systems Management	6 weeks	2, 5, 6
Operations Manager/ Supervisor	Systems Management	4 weeks	1, 5, 6
Systems Analysts	Application development	10 weeks	1, 5
	and systems design	5 years	5
Programmer/Analysts	Application development,	10 weeks	1, 5
	systems design, programming	3 years	6
Programmers	Programming	8 weeks	1, 5, 6
		3 years	6
Operators	Equipment operation	3 weeks	1, 6
		1 year	
Data Control Staff	Systems appreciation	1 week	1, 7
		1 year	7
Data Preparation Staff	Equipment operation	1 week	1, 7
		1 year	7

Bureau users

Category of Staff	*Objective*	*Duration*	*Organising Body*
Top Management	Appreciation	2–3 days	3
	Information on applications in different sectors	—	3, 9
	Computer principles, management opportunities	1 week	10
Line Management in the user area	Computer principles, data flow control and planning, staffing and organisation	1 week	10
EDP Manager	General management techniques	2 weeks	3, 5, 6
	Systems and operations control	—	10
Liaison man—for liaison with the bureau on operational problems	—	—	1, 6, 7,

Category of Staff	*Objective*	*Duration*	*Organising Body*
Systems Analysts	Management problems, requirements and services; basic OR and other techniques	—	10
	Systems, O & M, Programming	—	5, 6, 10
Programmer/Analysts	Systems, O & M, Programming	—	10
Programmers	Programming, appreciation and background, logic and flowcharting	—	10
Data Control Staff	Outline systems analysis and programming	4 weeks	1
	Control and organisation of data and data flows; data checking	—	10
Data Preparation Staff	Appreciation of subsequent operations	—	7, 9
	Punching techniques	—	10

The subsequent sections of this Appendix analyse separately the replies received from each category of computer personnel in response to the special personnel questionnaire.

B.4. *EDP Manager*

Questionnaire Response

	L	*M*	*S*	*All*
Number employed by commercial in-house users at December 1969	3	20	19	42
Number of respondents	1	9	7	17
Respondents as a percentage of total number	33	45	37	40

B.4.1. *Length of experience on computer work*

Number of years' experience					
On computer work			*As EDP Manager*		
<5	5–10	>10	<3	3–5	>5
6	10	1	12	4	1

B.4.2. *Age*

Age			
20–29	*30–39*	*40–49*	*50+*
5	7	4	1

B.4.3. *Salary*

Salary				
£1,501–2,000	*£2,001–2,500*	*£2,501–3,000*	*£3,000–3,500*	*£3,501–4,000*
1	2	4	7	3

Salary/Experience

Salary	*Number of years*	*On computer work*			*As EDP Manager*		
		<5	*5–10*	*>10*	*<3*	*3–5*	*>5*
£1,501–2,000		1	—	—	1	—	—
£2,001–2,500		1	1	—	—	2	—
£2,501–3,000		1	3	—	3	1	—
£3,001–3,500		3	4	—	6	—	1
£3,501–4,000		—	2	1	2	1	—

Salary/Age

Salary	*Age*			
	20–29	*30–39*	*40–49*	*50+*
£1,501–2,000	—	1	—	—
£2,001–2,500	1	1	—	—
£2,501–3,000	2	—	2	—
£3,001–3,500	2	3	1	1
£3,501–4,000	—	2	1	—

B.4.4. *General Education*—acquired before and after commencing computer work.

Qualification	*Numbers*	
	Before	*After*
Leaving Certificate	16	—
Primary Degree in:		
Arts	3	1
Commerce	4	—
Engineering	2	—
Post-graduate Degree in:		
Business Administration	—	1
Other:		
Accountancy	4	1
H.Dip. in Education	1	—
Engineering	1	—
Secretarial	1	—
Diploma in Systems Analysis	—	1
D.P.A. (Trinity)	1	—
No post-secondary qualification	1	—

B.4.5. *Working experience before commencing computer work*

Type of work	*Numbers*
Accountancy	3
O & M/Work Study	3
Clerical	3
Mechanised accounting systems	3
Engineering	2
Management trainee	1
Teaching	1
None	1

B.4.6. *Entry to computer work and type of computer experience*

Transferred to computer work from within an organisation in which already working:

	Numbers
Yes	13
No	3
No answer	1

Appointed EDP Manager from within an organisation in which already working:

	L	*M*	*S*	*All*
Yes	1	5	5	12
No	—	3	2	5

Type of work on entering computer work:

	Numbers
Programmer	2
Programmer/Analyst	4
Systems Analyst	4
Systems Engineer	1
Operations Manager	1
EDP Manager	5

Computer areas in which they worked before appointment as EDP Manager:

	Numbers
Programmer	3
Programmer/Analyst	5
Systems Analyst	9
Project Leader	1
Systems Engineer	1
Consultant/Adviser	2
Operations Manager	1
None	1

B.4.7. *Job mobility*

Number of organisations in which they have been employed on computer work compared with number of years experience on computer work:

Years' Experience	<5	5–10	>10	*All*
Number of organisations				
1	5	5	—	10
2	1	3	—	4
3	—	—	1	1
4	—	2	—	2
Total	6	10	1	17

B.4.8. *Computer training received*

	Numbers
Appreciation	2
EDP/Systems Management (2–4 weeks)	7
Operations Management (<1 week)	3
Systems Analysis (1–6 weeks)	8
Programming (2–13 weeks)	12
Other	4

B.5. *Operations Manager/Supervisor*

	Questionnaire response			
	L	*M*	*S*	*All*
Number employed by commercial in-house users at December 1969	4	25	11	40
Number of respondents	4	7	4	15
Respondents as a percentage of total	100	28	37	38

B.5.1. *Length of experience on computer work*

Number of years' experience					
on computer work			*as operations manager/supervisor*		
<3	3–5	>5	<3	3–5	>5
6	4	5	10	2	3

B.5.2. *Age*

Age		
20–29	30–39	40–49
6	4	5

B.5.3. *Salary*

Salary			
£1,001–1,500	£1,501–2,000	£2,001–2,500	£2,501–3,000
4	4	6	1

Salary/Experience

Salary	Experience on computer work			as operations manager/supervisor		
	<3	3–5	>5	<3	3–5	>5
£1,001–1,500	3	1	—	4	—	—
£1,501–2,000	1	1	2	3	1	—
£2,001–2,500	2	1	3	2	1	3
£2,501–3,000	—	1	—	1	—	—

Salary/Age

Salary	Age 20–29	30–39	40–49
£1,001–1,500	3	—	1
£1,501–2,000	3	1	—
£2,001–2,500	—	2	4
£2,501–3,000	—	1	—

B.5.4. *General Education*—acquired before and after commencing computer work.

Qualification	Numbers Before	After
Leaving Certificate	12	—
Primary Degree: Commerce	1	—
Other: DPA	1	—
No post-secondary qualification	1	—

Note: One person did not answer this question.

B.5.5. *Experience before commencing computer work*

Type of work	Numbers
Management/supervision of mechanised accounting systems	6
Clerical	4
Sales	1
Accounting	1
Operator of tabulating equipment	1
Technician	2

B.5.6. *Entry to computer work and type of computer experience*

Transferred to computer work within the organisation in which already working:

	Numbers
Yes	13
No	2

Appointed operations manager/supervisor in an organisation in which already working:

	Numbers
Yes	14
No	1

Type of work on entering computer work:

	Numbers
Operations Manager/Supervisor	8
Operator	5
Programmer	1
User representative	1

Computer areas in which they worked before becoming operation manager/supervisor:

	Numbers
No other area	8
Operator	5
Programmer	1
User representative	1

B.5.7. *Job Mobility*

Number of organisations in which they have been employed on computer work compared with length of experience on computer work:

Years' experience / *Number of organisations*	*<3*	*3–5*	*>5*	*All*
1	6	4	4	14
2	—	—	1	1

B.5.8. *Computer training received*

	Numbers
Operations supervision/management (up to 3 weeks)	6
Operations (up to 4 weeks)	6
Programming (up to 9 weeks)	8
Other	3

B.6. *Systems Analysts*

Questionnaire response

	L	*M*	*S*	*All*
Number employed by commercial in-house users at December 1969.	26	38	14	78
Number of respondents	11	11	7	29
Respondents as a percentage of total	42	29	50	37

B.6.1. *Length of experience on computer work*

Number of years' experience					
on computer work			*as systems analyst*		
<5	*5–10*	*>10*	*<3*	*3–5*	*>5*
12	13	4	21	6	2

B.6.2. *Age*

Age				
20–24	*25–29*	*30–34*	*35–39*	*40+*
2	8	11	5	3

B.6.3. *Salary*

Salary				
£1,001–1,500	*£1,501–2,000*	*£2,001–2,500*	*£2,501–3,000*	*£3,001–3,500*
1	6	15	5	2

Salary/Experience

	Number of years	*on computer work*			*as systems analyst*		
Salary		*<5*	*5–10*	*>10*	*<3*	*3–5*	*>5*
£1,001–1,500		1	—	—	1	—	—
£1,501–2,000		5	1	—	6	—	—
£2,001–2,500		5	9	1	12	3	—
£2,501–3,000		1	2	2	2	3	—
£3,001–3,500		—	1	1	—	—	2

Salary/Age

	Age	*20–24*	*25–29*	*30–34*	*35–40*	*40+*
Salary						
£1,001–1,500		1	—	—	—	—
£1,501–2,000		—	2	2	2	—
£2,001–2,500		1	6	4	2	2
£2,501–3,000		—	—	4	—	1
£3,001–3,500		—	—	1	1	—

B.6.4. *General Education*—acquired before and after commencing computer work.

	Numbers	
Qualification	*Before*	*After*
Leaving Certificate (or equivalent)	29	—
Primary degree in:		
Engineering	3	—
Commerce	1	—
Economics	—	1
Other		
Accountancy	5	1
Engineering	3	—
Diploma in Systems Analysis	—	3
Other	2	2
No post-secondary qualification	11	—

B.6.5. *Experience before commencing computer work*

Type of work	*Numbers*
Clerk	16
Accountancy/Auditing	4
Engineer	2
OR/Work Study	1
Management of punched card installation	1
Sales	1
Other	4

B.6.6. *Entry to computer work and type of computer experience*

Transferred to computer work within an organisation in which already employed:

	Numbers
Yes	27
No	2

Appointed systems analyst within an organisation in which already employed:

	L	*M*	*S*	*All*
Yes	9	7	5	21
No	2	4	2	8

Type of work on entering computer work:

	Numbers
Programmer	19
Programmer/Analyst	5
Systems Analyst	4
Technical Adviser	1

Computer areas in which they worked before appointment as system analysts:

	Numbers
None	3
Programmer	19
Programmer/Analyst	7
Systems Engineer	2
Data Processing Manager	1
Technical Adviser	1

B.6.7. *Job mobility*

Number of organisations in which they have been employed on computer work compared with number of years' experience on computer work:

Years' experience	*<5*	*5–10*	*>10*	*All*
Number of organisations				
1	10	10	—	20
2	2	2	2	6
3	—	1	1	2
4	—	—	1	1
Total	12	13	4	29

B.6.8. *Computer training received*

	Numbers
Systems analysis (1–4 weeks)	21
Programming (1–14 weeks)	24
Appreciation/Fundamentals (up to 5 weeks)	13
Other	7

B.7. *Programmer/Analyst*

	Questionnaire response			
	L	*M*	*S*	*All*
Number employed by commercial in-house users at December, 1969	23	22	13	58
Number of respondents	3	6	—	9
Respondents as a percentage of total	13	27	—	15

B.7.1. *Length of experience on computer work*

Number of years' experience					
on computer work			*as programmer/analyst*		
<2	*2–3*	*>3*	*<2*	*2–3*	*>3*
1	3	5	2	2	5

B.7.2. *Age*

Age			
20–24	*25–29*	*30–34*	*34–39*
4	2	2	1

B.7.3. *Salary*

Salary		
£1,001–1,500	*£1,501–2,000*	*£2,501–3,000*
2	6	1

Salary/Experience

Number of years	*on computer work*			*as programmer/analyst*		
Salary	*2*	*2–3*	*3*	*2*	*2–3*	*3*
£1,001–1,500	1	—	1	1	—	1
£1,501–2,000	—	3	3	1	2	3
£2,501–3,000	—	—	1	—	—	1

Salary/Age

Salary	*Age*	*20–24*	*25–29*	*30–34*	*35–39*
£1,001–1,500		2	—	—	—
£1,501–2,000		2	2	1	1
£2,501–3,000		—	—	1	—

B.7.4. *General Education*—acquired before and after commencing computer work.

Qualification	*Numbers*	
	Before	*After*
No formal qualification	1	—
Leaving Certificate	8	—
Primary degree:		
Commerce	1	—
Engineering	—	1
Other:		
Accountancy	—	1
No post-secondary qualification	4	—

B.7.5. *Experience before commencing computer work*

Type of work	*Numbers*
Clerical	8
None	1

B.7.6. *Entry to computer work and type of computer experience*

Transferred to computer work within an organisation in which already employed:

	Numbers
Yes	8
No	1

Appointed programmer/analyst within an organisation in which already employed:

	Numbers
Yes	7
No	2

Type of work on entering computer work:

	Numbers
Programmer	2
Programmer/Analyst	7

Computer areas in which they worked before appointment as programmer/analyst:

	Numbers
None	7
Programmer	2

B.7.7. *Job mobility*

Number of organisations in which they have been employed on computer work compared with number of years' experience on computer work:

Years' experience / *Number of organisations*	*<2*	*2–3*	*>3*	*All*
1	—	3	4	7
2	1	—	1	2
Total	1	3	5	9

B.7.8. *Computer training received*

	Numbers
Systems Analysis	1
Programming	9
Other	4

B.8. *Programmers*

Questionnaire Response

	L	*M*	*S*	*All*
Number employed by commercial in-house users at December, 1969	56	68	48	172
Number of respondents	32	20	15	67
Respondents as a percentage of total	57	29	31	39

B.8.1. *Length of experience on computer work*

Number of years' experience					
on computer work			*as programmer*		
<2	*2–3*	*>3*	*<2*	*2–3*	*>3*
19	28	20	28	22	17

B.8.2. *Age*

Age			
20	*20–24*	*25–29*	*30–34*
2	38	22	5

B.8.3. *Salary*

Salary					
£501–750	*£751–1,000*	*£1,001–1,500*	*£1,501–2,000*	*£2,001–2,500*	*£2,501–3,000*
3	14	35	13	1	1

Salary/Age

Salary \ *Age*	*20–24*	*25–29*	*30–34*
£501–750	3	—	—
£751–1,000	14	—	—
£1,001–1,500	18	15	2
£1,501–2,000	5	6	2
£2,001–2,500	—	—	—
£2,501–3,000	—	1	—
Total	40	22	5

Salary/Experience

	on computer work			*on programming*		
Years' experience \ *Salary*	*<2*	*2–3*	*<3*	*<2*	*2–3*	*<3*
£501–750	1	2	—	2	1	—
£751–1,000	5	9	—	11	3	—
£1,001–1,500	11	16	8	13	15	7
£1,501–2,000	2	1	10	2	3	8
£2,001–2,500	—	—	1	—	—	1
£2,501–3,000	—	—	1	—	—	1
Total	19	28	20	28	22	17

B.8.4. *General Education*—acquired before and after commencing computer work.

Qualification	*Before*	*After*
Leaving Certificate	66	—
Primary degree:		
Commerce	4	2
Science	4	1
Economics	1	1
Arts	1	—
Post-Graduate (Economics, Business Finance, Management Accounting)	—	1
Other:		
Diploma in Public Administration	1	2
Statistics	1	—
Part of university course	3	1
Languages	1	—
Diploma in Systems Analysis	—	7
H.Diploma in Education	1	—
Business Management	—	1
No post-secondary qualification	38	—

B.8.5. *Experience before commencing work*

Type of work	*Numbers*
None	18
Clerical	38
Other	11

B.8.6. *Entry to computer work and type of computer experience*

Transferred to computer work within an organisation in which already employed:

	Numbers
Yes	40
No	9
Not then employed	18

Type of work on entering computer work:

	Numbers
Operator	13
Programmer	54

Computer areas in which they worked before appointment as programmer:

	Numbers
None	54
Operator	13

B.8.7. *Job mobility*

Number of organisations in which they have been employed on computer work compared with number of years' experience on computer work:

Years' experience / *Number of organisations*	*<2*	*2–3*	*>3*	*All*
1	17	24	11	52
2	2	4	8	14
3	—	—	1	1
Total	19	28	20	67

B.8.8. *Computer training received*

	Numbers
Programming	58
Other	7
None	8

APPENDIX C

JOB DESCRIPTIONS OF COMPUTER PERSONNEL[1]

Data Processing Manager

In collaboration with the chief executive and line management, the Data Processing Manager is responsible for developing and controlling data processing plans to meet the present and long-term needs of the organisation. He helps management to determine its information and other needs and advises on the feasibility of using computers to help meet these needs. He controls and co-ordinates the systems, programming and operating functions with the organisation.

Systems and Programming Manager

He is responsible to the Data Processing Manager for all systems and programming functions.

Systems Analysts

Senior Systems Analysts—They are concerned together with the Data Processing Manager in assisting management in determining the data processing and information requirements of the organisation and with directing the design of computer based systems to satisfy these requirements. They require the ability to understand complex and often ill-defined problems and to conceive imaginative and practical solutions to these problems. They also require the ability to communicate effectively with others.

Systems Analysts—They are responsible for the detailed design of part or the whole of a computer application. They examine the proposed application and define in detail the input and output requirements, the file contents and the relationships between them. In conjunction with the users, they design the forms for input data and output results. The qualities required are similar to those of a Senior Systems Analyst but at a lower level.

Junior Systems Analysts—They are responsible for the detailed design of small and relatively straightforward systems forming part of a computer application.

[1]This Appendix draws heavily on the British Ministry of Technology publication, *Staff Titles and Job Descriptions in Commercial Data Processing*, HMSO 1967.

Programmers

Senior Programmers—They advise on the feasibility and practicality of the programming for a particular application, produce overall plans for the programming work involved, define the files and programs needed, establish standard techniques and procedures for programming and for the associated documentation and arrange for the linking of programs. They require high conceptual and analytical ability to appraise the schemes devised by the systems analysts and to design the overall programming plan to implement them.

Programmers—They work from the plans drawn up by the Senior Programmers, provide detailed plans for the programming job, undertake the more complex programs and provide detailed specifications to Junior Programmers for the less complex programs.

Junior Programmers—They work from the detailed specifications provided by the Programmers and code them in the appropriate manner.

Systems Programmers—They are experts in the use of the operational and other software supplied by the computer manufacturer and help to ensure that optimum use is made of the equipment. They are roughly equal in status to the Senior Programmers.

Operations Manager

He is responsible to the Data Processing Manager for the planning, organisation and day to day control of the use of the equipment in the computer installation.

Operators

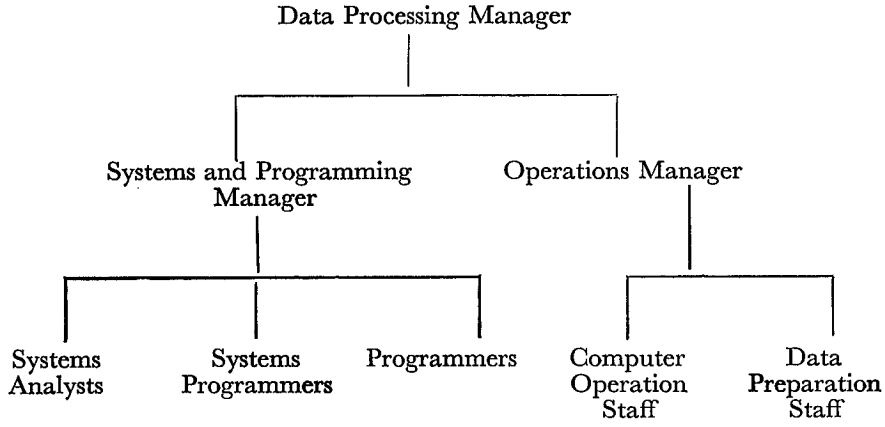
Chief Operator/Shift Leaders—On a multi-shift installation, in addition to a Chief Operator, there will usually be Shift Leaders who will deputise for him. They are responsible for the day to day scheduling and supervision of the operation of the computer and its peripheral units. They supervise the operating staff, assign duties, establish and enforce standard procedures for machine operation, ensure that the standard engineering routine maintenance is carried out and, in the case of a breakdown, ensure that the emergency action and/or the standby arrangements are swiftly implemented.

Operators—They are responsible for the actual operation of the computer. They set up and operate the equipment in accordance with the appropriate instructions, record machine utilisation in operating log books and make initial diagnoses of any malfunctioning of the equipment or the software.

Junior Operators—They set up the peripheral units and load and unload

them with data and program files as required under the direct supervision of the operator.

A sample organisation chart for a Data Processing Department would be:



APPENDIX D

SURVEY OF FUTURE INTENTIONS OF ORGANISATIONS NOT USING COMPUTER FACILITIES

A questionnaire was sent in February 1969 to all corporate members of the Irish Management Institute—a total of about 600 organisations—enquiring whether they were using computer facilities and, if not, whether they intended to do so within two years or within five years.

The total number of replies received was 238, a response rate of about 40 per cent.

The breakdown of the replies was as follows:

		Numbers
Using computer facilities at present		107
in-house facilities	33	
commercial bureau facilities	55	
bureau facilities in, e.g., an associated organisation	19	
Total	107	
Expect to use computer facilities within 2 years		19
in-house facilities	7	
bureau facilities (commercial or otherwise)	12	
Total	19	
Expect to use computer facilities within 5 years		30
in-house facilities	6	
bureau facilities (commercial or otherwise)	24	
Total	30	
May use computer facilities within 5 years		26
Do not expect to use computer facilities within five years		56
Total		238

APPENDIX E

CALCULATIONS OF FUTURE STAFFING REQUIREMENTS

From the projections of future computer installations (Table 3.1) and future bureau users (Table 3.3), we can derive estimates of the number of computer personnel that will be required to cater for this volume of computing.

The average present and projected staffing complement of the existing commercial in-house installations is:

Category	*Present*			*Two years hence*			*Five years hence*		
	L	*M*	*S*	*L*	*M*	*S*	*L*	*M*	*S*
Systems Analysts	8·7	1·9	0·7	11·9	2·5	1·1	13·7	2·8	1·3
Programmer/Analysts	7·7	1·1	0·7	11·6	1·5	0·9	13·0	1·7	1·0
Programmers	18·7	3·4	2·3	22·3	4·0	2·8	23·9	4·2	2·9
Operators	13·3	3·1	2·5	14·6	3·4	2·6	15·4	3·6	2·8

Demands for additional staff will arise from two sources—the existing users and new users. The demand from the existing users is projected on the basis of their own forecasts, as set out above. The demand from new users is projected on the basis of the expected staffing complement of the existing commercial in-house users two years hence—the rationale behind this is set out in the body of the report.

The number of each category of staff which will be required for the projected number of computer installations is therefore:

Category	*Existing installations*		*New installations*				*All installations*			
			1972		*1975*		*1972*		*1975*	
	1972	*1975*	*min.*	*max.*	*min.*	*max.*	*min.*	*max.*	*min.*	*max.*
Systems Analysts	37	58	81	123	197	360	118	160	253	418
Programmer/Analysts	30	43	68	99	157	270	98	129	200	313
Programmers	46	60	163	241	402	752	209	285	462	812
Operators	15	28	131	196	335	637	146	211	363	665

As well as the computer installations, the bureau users also imply some specialist computer staff and their requirements must also be included in the projections. The average present and projected staffing complement of the existing bureau users are as follows:

Category	*Present*	*Two years hence*	*Five years hence*
Systems Analysts	0·2	0·3	0·5
Programmer/Analysts	0·2	0·4	0·5
Programmers	0·1	0·5	0·6

Using the same basis as in the case of the computer installations, the total staffing requirements in the bureau users will be:

Category	*Existing users*		*New users*				*All users*			
	1972	*1975*	*1972*		*1975*		*1972*		*1975*	
			min.	*max.*	*min.*	*max.*	*min.*	*max.*	*min.*	*max.*
Systems Analysts	25	75	52	72	144	248	77	97	219	363
Programmer/Analysts	50	75	69	96	192	330	119	146	267	405
Programmers	100	125	86	120	240	413	186	220	365	538

Joining together the projections for the computer installations and the bureau users, we reach an overall projection of additional staff required, as set out in Table 3.4 in the main Report.

APPENDIX F

GLOSSARY OF COMPUTER TERMS

Application Package: A set of general programs designed to perform some commonly occurring type of business operation such as payroll or stock control.

Computer: A device capable of automatically accepting and storing data, applying a sequence of processes to the data and supplying the results of these processes; it operates under a program of instructions which can be accepted and stored like data and which can modify itself within the computer.

Computer Bureau: A firm that provides a computer service for customers.

Data Processing: The handling of business or other data by any means ranging from manual to computer operations, usually involving the up-dating of files.

Data Preparation: The transcription of the original data into a form suitable for processing by computer—such as punched cards, paper tape, magnetic tape—carried out by an operator using some kind of keyboard machine.

Data Transmission: The use of the telecommunications network to transmit data to or from a computer system.

Hardware: The physical units making up a computer system.

I/O—Input/Output: Input is the process of transferring data or programs into the computer store from some external medium. Output is the process of transferring information from the computer store to an output device.

Magnetic Disc: A storage device consisting of a number of flat circular plates like gramophone records coated on both surfaces with magnetic material. It is a common form of backing store used in computer systems. Data are read off/recorded on the discs by means of read/write arms as the discs rotate at high speed.

Magnetic Tape: A reel of plastic tape coated with magnetic material on which data may be recorded as a series of magnetised spots. It is the most common

form of backing store used in computer systems and is also used as an input/output medium. Data are read off/recorded on the tape as it moves under a read/write head.

Off-Line: A device is off-line if it is not under the control of the central processor—data are not transferred directly into or out of the computer system. For example, data may be prepared on magnetic tape off-line and the tape processed at a later date *on-line* by the computer.

On-Line: A device is on-line if it is directly under the control of the central processor—data are transferred directly into or out of the computer system.

Paper Tape: A reel of paper on which data are stored in the form of punched holes which can be sensed by a paper tape reader. It is one of the most common forms of input media for computers.

Peripheral Equipment: The input, output and storage devices attached to a computer and operated under computer control.

Program: A set of instructions composed for solving a given problem by computer.

Programming Language: The particular system of coded instructions used to control the computer's operations. Three levels of programming language are distinguished: (1) the machine language, or coded pattern of digits in the form recognisable to the central processor; (2) assembler language, or more symbolic form of instructions which have first to be translated into machine language by means of another program; (3) high-level language in which the instructions take the form of much more complex statements which are closer to the English language (in the case of commercial applications) or to the language of mathematics (in the case of scientific applications) and so make some sort of sense to the user. The program written in a high-level language must again first be converted into machine language by means of another program called a compiler.

Punched Card: A rectangular piece of cardboard containing data represented in the form of punched holes which can be sensed by a variety of machines. It is one of the most common forms of input media for computers.

Software: A term used in contrast to hardware to refer to a collection or package of programs. The term *applications software* is applied to suites of programs, or packages, designed to perform broad types of business or other tasks such as inventory management, payroll, project control, etc. *Systems software* means programs orientated towards the computer system that help in

various ways in its operations, such as in converting other programs written in a particular language into machine code, or in controlling the handling and location of stored data.

Software Company: A firm engaged in writing general programs for sale or lease to organisations using computers.

Stand Alone: Not on-line to any other computer system.

Terminal: An input/output device stationed remotely and connected via telephone, or telegraph line to a central computer system.

Upgrade: Replace a number of modular units by similar units of increased capacity or speed.

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