UNIVERSITY OF DUBLIN

TRINITY COLLEGE

COMPUTER LABORATORY

ANNUAL REPORT 1980/81

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SECTION 1 INTRODUCTION

This was the first full year in which the Laboratory operated exclusively with DEC processors. Apart from a major fault which affected the academic machine during Hilary Term, the central equipment was satisfactory. The extremely poor service, caused by overloading, which academic users experienced in Michaelmas Term was corrected when the processor was upgraded in March and a satisfactory level of service was maintained in the academic sector for the remainder of the year. Additional memory, to correct similar difficulties on the Library and administrative machine was ordered in September.

The Laboratory, which has no engineering staff, experienced increasing difficulty in coping with its greatly expanded communications network which now has almost 100 data lines linking equipment from over 15 different manufacturers. This has caused delays in the commissioning of new terminal lines and the isolation and correction of network faults and has made the establishment of a technical section with the Laboratory a matter of urgency.

The Computer Users' Committee was active throughout the year and made a number of valuable suggestions. In particular, the Committee designed an allocation system for the rationing of computer resources which it is hoped can be implemented on the academic DECsystem-2060 during the coming year.

SECTION 2 MACHINE UTILIZATION AND PERFORMANCE

The very heavy demand for academic computing severly overloaded the main DECsystem-2040 from the beginning of the academic year resulting in a very poor service to users. This already bad situation was made worse by a major breakdown which took place during January and February resulting in a loss of almost 600 hours of machine time, as Table 12 shows. The repair of this breakdown was effected by DEC delivering and installing the upgrade from a model 2040 to 2060 processor, ordered in July, some months ahead of the delivery schedule originally quoted and this, as well as curing the fault, provided a much needed increase in processing power which helped considerably in dealing with the backlog of work which had accumulated. At one stage, DEC temporarily installed a DECsystem-2020 to provide a skeleton academic computing service but fortunately the fault on the main machine was resolved a few days after this happened. A third disc drive was installed in November on the Library and administrative DECsystem-2020 and considerably eased the problems of file storage which were affecting many users. The poor response time of this system continued to deteriorate throughout the year as the workload on the machine increased. As Table 11 shows, however, the 2020 remained a very reliable system with a total down time of only 136 hours during the year.

Extensive use was again made of the link to the UCD Computer Centre. This provided access to their IBM system for research users requiring IBM software but mainly for a number of classes which are still taught IBM programming languages. The link also provided valuable access to plotting facilities on the UCD DECsystem-2060.

In the following tables, computer usage is expressed in terms of actual cost and amounts, in total, to £421730 which is that portion of the Laboratory's expenditure attributable to the provision of computer service. The basis of this costing is explained in Appendix C.

Analysis of Computer Use

Cost of Monthly Use per User Category (IR£)

Month	User Category					
	Library (Note 3)	Academic (Note 2)	Admin.	Outside	System Support	Total
10/81	4019	15735	5445	333	2301	27833
11/81	3704	16442	4980	259	1561	26946
12/81	7199	16463	3233	685	1295	28875
1/81	8763	22124	4157	315	1959	37318
2/81	4651	13073	3907	86	2327	24044
3/81	3109	38161	4294	307	2562	48433
4/81	2840	26392	3665	317	1956	35170
5/81	2432	31317	3759	116	2697	40321
6/81	1860	21045	2745	301	1986	27937
7/81	2217	20922	3099	99	1300	27637
8/81	3711	21909	2804	287	1270	29981
9/81	2573	28555	3272	328	1704	36432
Computer Science Machine (Note 1)	-	30803	-	-	-	30803
Overall	47078	302941	45360	3433	22918	421730

Note 1: The operational cost to the Computer Laboratory of the VAX 11/780 and B1700 research and teaching systems are only available on a full-year basis.

Note 2: In addition to this usage, processing was performed at UCD, at no cost to TCD. This is shown in Table 13.

Note 3: Library use includes major reprocessing work arising from conversion from IBM to DEC systems and which will not recur annually.

Table 1

Analysis of Computer Use

percent of Total Monthly Use per User Category

Month	User Category				
	Library (Note 3)	Academic (Note 2)	Admin.	Outside	System Support
10/80	14.4	56.5	19.6	1.2	8.3
11/80	13.7	61.0	18.5	1.0	5.8
12/80	24.9	57.0	11.2	2.4	4.5
1/81	23.5	59.4	11.1	0.8	5.2
2/81	19.3	54.4	16.2	0.4	9.7
3/81	6.4	78.8	8.9	0.6	5.3
4/81	8.1	75.0	10.4	0.9	5.6
5/81	6.0	77.7	9.3	0.3	6.7
6/81	6.7	75.3	9.8	1.1	7.1
7/81	8.0	75.7	11.2	0.4	4.7
8/81	12.4	73.0	9.4	1.0	4.2
9/81	7.1	78.3	9.0	0.9	4.7
Computer Science Machine (Note 1)	-	100.0	-	-	-
Overall	11.2	71.8	10.8	0.8	5.4

Note 1: The operational cost to the Computer Laboratory of the VAX 11/780 and B1700 research and teaching systems are only available on a full year basis.

Note 2: In addiion to this usage, processing was performed at UCD, at no cost to TCD. This is shown in Table 13.

Note 3: Library use includes major reprocessing work arising fr conversion from IBM to DEC systems and which will not re annually.

Table 2

Total Annual Cost per System per User Category (IR£)

Machine	User Category					Total
	Library	Academic	Admin.	Outside	Systems Support	
DEC2020	39800	434	44801	1061	853	86949
DEC2040	5565	83681	167	1400	8983	99796
DEC2060	1713	188023	392	972	13082	204182
VAX 11/780	-	26632	-	-	-	26632
B1700	-	4171	-	-	-	4171
Total	47078	302941	45360	3433	22918	421730

Table 3

Percent of Total Annual Cost per System per User Category

Machine	User Category					Total
	Library	Academic	Admin.	Outside	Systems Support	
DEC2020	9.4	0.1	10.6	0.3	0.2	20.6
DEC2040	1.4	19.8	0.1	0.3	2.1	23.7
DEC2060	0.4	44.6	0.1	0.2	3.1	48.4
VAX11/780	-	6.3	-	-	-	6.3
B1700	-	1.0	-	-	-	1.0
Total	11.2	71.8	10.8	0.8	5.4	100.0

Table 4

Analysis of Academic Computer Use
by Machine by Department - Cost IR£

Department	Cost of Computer Use					
	DEC 2020	DEC 2040	DEC 2060	VAX 11/780	B1700	Total
Computer Science	434	18346	31508	26632	4171	81091
Chemistry	-	14821	63023	-	-	77844
Engineering	-	19414	36595	-	-	56009
Statistics	-	7392	18237	-	-	25629
Psychology	-	5517	5684	-	-	11201
[illegible]re Mathematics	-	2544	7365	-	-	9909
Physics	-	4748	4074	-	-	8822
Zoology	-	1998	3080	-	-	5078
Economics	-	2544	2454	-	-	4998
Community Health	-	2251	2109	-	-	4360
Genetics	-	513	2899	-	-	3412
Business Studies	-	460	1741	-	-	2201
Applied Mathematics	-	882	1152	-	-	2034
Geography	-	877	1016	-	-	1893
Biochemistry	-	206	1265	-	-	1471
Pharmacy	-	311	1021	-	-	1332
Sociology	-	170	974	-	-	1144
[illegible]ucation	-	131	810	-	-	941
Language and Communication Studies	-	88	783	-	-	871
Physiology	-	14	758	-	-	772
Dentistry	-	0	444	-	-	444
Botany	-	43	289	-	-	332
Political Science	-	123	161	-	-	284
Environmental Sciences	-	126	37	-	-	163
French	-	13	128	-	-	141
Others (12)	-	149	416	-	-	565
Total	434	83681	188023	26632	4171	302941

Table 5

Analysis of Academic Computer Use
by Machine by Department - percent

Department	Percent of Total Computer Cost					
	DEC 2020	DEC 2040	DEC 2060	VAX 11/780	B1700	Total
Computer Science	0.1	4.3	7.5	6.3	1.0	19.2
Chemistry	-	3.6	14.9	-	-	18.5
Engineering	-	4.6	8.7	-	-	13.3
Statistics	-	1.8	4.3	-	-	6.1
Psychology	-	1.4	1.3	-	-	2.7
Pure Mathematics	-	0.6	1.7	-	-	2.3
Physics	-	1.1	1.0	-	-	2.1
Zoology	-	0.5	0.7	-	-	1.2
Economics	-	0.6	0.6	-	-	1.2
Community Health	-	0.5	0.5	-	-	1.0
Genetics	-	0.1	0.7	-	-	0.8
Business Studies	-	0.1	0.4	-	-	0.5
Applied Mathematics	-	0.2	0.3	-	-	0.5
Geography	-	0.2	0.2	-	-	0.4
Biochemistry	-	0.0	0.3	-	-	0.3
Pharmacy	-	0.1	0.2	-	-	0.3
Sociology	-	0.0	0.3	-	-	0.3
Education	-	0.0	0.2	-	-	0.2
Language and Communication Studies	-	0.0	0.2	-	-	0.2
Physiology	-	0.0	0.2	-	-	0.2
Dentistry	-	0.0	0.1	-	-	0.1
Botany	-	0.0	0.1	-	-	0.1
Others (15)	-	0.1	0.2	-	-	0.3
Total	0.1	19.8	44.6	6.3	1.0	71.8

Table 6

Analysis of Library Use

Cost - IR£

Application	Cost
Cataloguing	36773
Accessions	6864
Circulation Control	2549
Reader Services	656
SDI	236
Total	47078

Table 7

Analysis of Library Use

Percent

Application	Percent of Total Use
Cataloguing	8.7
Accessions	1.6
Circulation Control	0.6
Reader Services	0.2
SDI	0.1
Total	11.2

Table 8

Analysis of Administrative Use

Cost - IR£

User	Cost	
Finance Office:		
- Salaries and Wages	11666	
- General Accounting	10610	
		22276
Academic Administration:		
- Student and Graduate Records	16968	
- Admissions	2410	
- Faculty Offices	212	
- Miscellaneous	187	
		19777
Accommodation Office		1263
Buildings Office		1031
Staff Office		410
General Services Office		355
Information Office		248
Total		45360

Table 9

Analysis of Administrative Use

percent

User	Percent of Total Use	
Finance Office:		
- Salaries and Wages	2.8	
- General Accounting	2.5	
		5.3
Academic Administration:		
- Student and Graduate Records	4.0	
- Admissions	0.6	
- Faculty Offices	0.1	
- Miscellaneous	0	
		4.7
Accommodation Office		0.3
Buildings Office		0.2
Staff Office		0.1
General Services Office		0.1
Information Office		0.1
Total		10.8

Table 10

DECsystem-2020 Availability

Month	System Down-time - Hours					Availability	
	Engineering		Environ-mental causes	Soft-ware	Total	Hours	%
	Scheduled	Unscheduled					
10/80	8.25	4.93	0	0	13.18	730.82	98.23
11/80	8.70	1.02	2.93	0.18	12.83	707.17	98.22
12/80	2.48	13.57	4.33	1.40	21.78	722.22	97.07
1/81	2.38	1.98	0	4.55	8.91	735.09	98.80
2/81	2.02	0.77	0	0	2.79	669.21	99.58
3/81	2.22	0.98	0	0.15	3.35	740.65	99.55
4/81	2.45	12.87	10.75	0	26.07	693.93	96.38
5/81	0	2.67	0.27	0	2.94	741.06	99.60
6/81	1.92	0.10	0	6.22	8.24	711.76	98.86
7/81	12.83	0.03	0	5.25	18.11	725.89	97.57
8/81	4.55	0.10	13.32	0	17.97	726.03	97.58
9/81	0	0.03	0	0	0.03	719.97	100.00
Overall	47.80	39.05	31.60	17.75	136.20	8623.80	98.45

Table 11

Month	System Down-time - Hours					Availability	
	Engineering		Environ-mental causes	Soft-ware	Total	Hours	%
	Scheduled	Unscheduled					
10/80	3.00	2.72	0.10	0.60	6.42	737.58	99.14
11/80	0	13.43	1.08	0.12	14.63	705.37	97.97
12/80	10.58	4.58	0	4.47	19.63	724.37	97.36
1/81	17.55	96.95	2.30	1.43	118.23	625.77	84.11
2/81	260.80	221.02	0	0	481.82	190.18	28.30
3/81	24.20	119.25	0	0	143.45	600.55	80.72
4/81	3.02	15.60	9.40	0.17	28.19	691.81	96.08
5/81	6.87	1.18	0.25	0.17	8.47	735.53	98.86
6/81	36.00	69.20	0	0.05	105.25	614.75	85.38
7/81	0.03	4.32	0.12	0.97	5.44	738.56	99.27
8/81	3.13	54.72	13.35	0.40	71.60	672.40	90.38
9/81	35.38	31.73	0.45	0	67.56	652.44	90.62
Overall	400.56	634.70	27.05	8.38	1070.69	7689.31	87.78

Note: DECsystem-2040 from 10/80 to 2/81
DECsystem-2060 from 3/81 to 9/81

Table 12

Month	Cost of Use at UCD Rates - £ (Note 1)		
	IBM 4331	DECsystem-2060 (Note 2)	Total
10/80	141.68	359.65	501.33
11/80	646.89	508.20	115.09
12/80	356.30	286.27	642.57
1/81	368.33	298.95	667.28
2/81	267.92	386.08	654.00
3/81	872.92	194.59	1067.51
4/81	1790.07	143.20	1933.27
5/81	3079.62	370.25	3449.87
6/81	310.46	1263.13	1573.59
7/81	329.91	474.56	804.47
8/81	133.96	5447.08	5581.04
9/81	17.35	2255.32	2274.67
Total	8315.41	11987.28	20302.69

Note 1: This usage has been priced at UCD's billing rate to outside users and does not represent actual cost.

Note 2: Access to the UCD DEC machine was for plotting purposes only.

Table 13

SECTION 3 APPLICATIONS

3.1 Academic

While the basic growth pattern of academic computing continued as before the additional processing power of the model 2060 has made possible an improved service to those user departments, such as Chemistry, whose programs have a heavy computational content. Among the many research projects which used the computer were the analysis of an extensive dental health survey undertaken by the Dental School as part of an international collaborative programme, the establishment of a data base by the German Department to permit cross referencing of sixteenth century German root forms, the development, by the Department of Psychiatry, of an interactive computer program to investigate the responses of brain damaged alcholics, and the development of a packet-switched computer network by the Department of Computer Science in collaboration with UCD, the NBST, and European researchers. The latter is of particular interest to the Laboratory as a potential extension of its present service.

3.2 The Library

The final stage of the transfer of the main cataloguing system to the DEC machine was completed when a full edition of the complete computer based catalogue was produced in Hilary Term. Being the first edition produced on the DEC, this involved much additional computing work associated with the conversion and entailed reprocessing all the annual catalogue files since 1969 when computer cataloguing began. It was the biggest single task ever undertaken by the Laboratory and was completed well ahead of the original planned schedule by utilizing spare capacity on the main DECsystem-2040 throughout the Christmas vacation. Work continued

throughout the year on the other main Library development project, a real-time circulation control system using a dedicated PDP 11/34 computer, and it is hoped that this will go into limited operation during the next academic year. Modification of the main cataloguing system to permit simultaneous access by multiple terminal users was commenced together with a programme to convert the software, originally written in COBOL-68 language, to COBOL-74.

3.3 Administration

The existing administrative applications operated satisfactorily throughout the year. A number of new development projects of a pilot nature were undertaken successfully in the area of text processing using the existing DEC system facilities. These included the preparation of the new telephone directory and the production of the Gazette. A review of locally available word processing systems was carried out in Michaelmas Term and a machine selected for installation in an administrative office as a pilot project. Unfortunately, however, subsequent financial cutbacks prevented installation taking place. A close watch was also maintained on the rapidly developing commercial use of micro computers which are likely to play an important role in future administrative developments in College. Work continued on a new version of the Student Record system which is scheduled for completion during the coming year. This will permit simultaneous access by multiple terminal users and remove some existing restrictions on record size. A time-tabling program was also acquired and used experimentally for accommodation planning purposes.

SECTION 4 CENTRAL SERVICE DEVELOPMENT

4.1 Equipment

The main academic DECsystem-20 was upgraded from a model 2040 to a model 2060 at the beginning of March and its memory capacity was doubled from 256 to 512K words. This increased the processing power by a factor of more than three times and overcame the severe problems arising from poor response time. In September, orders were placed for an additional 8 communication ports and terminals and for a Calcomp Model 81 plotter which will fill a major gap in the Laboratory's service.

A third disc storage drive was added to the DECsystem-2020 to overcome problems arising from the large file requirements of many administrative and library applications and additional memory was also ordered to improve the response time of this machine.

Due to delays in the provision of new circuits, only a small number of new data lines were installed during the year. A telephone answering machine was also provided on a special extension (1752) to provide information about the current status of the computers for the benefit of terminal users who are unable to gain access.

4.2 Software

Relatively few changes took place to the central systems software during the year. A new version of the operating system, TOPS-20 Version 4, which had earlier been installed on the academic machine, was installed on the DECsystem-2020 in September. Implementation work commenced on programs for a new resource allocation system, designed by the Computer Users' Committee, to ration computer resources to users and it is hoped that this can go into operation during the coming year.

Among the application packages which were installed were BMDP, a set of statistical programs acquired by the Department of Statistics, CELLSIM, a program to simulate all populations and new versions of existing packages including SPSS, IMSL, CLUSTAN, Minitab, MULTAN, SNOBOL and the Management Game.

SECTION 5 OTHER ACTIVITIES

5.1 Teaching and Publications

Almost 200 people attended the 20 introductory courses for users which the Academic User Services Group ran during the year. The introductory leaflets produced by the Group were also in considerable demand and are now used by many lecturers as standard material for both undergraduate and postgraduate classes. The Computer Laboratory Newsletter was published as usual and work continued on the compilation of a catalogue of all known computer hardware in College which it is hoped will prove a useful reference document for anyone contemplating the purchase of equipment and which should be available early in the coming year.

5.2 Sale of Services

Income from the sale of computer services rose from £10,115 last year to £16,958. This increase reflects the sale of computer software packages developed in College to outside users rather than an increase in the sale of computer time and since the number of transactions involved was small, it does not constitute a reliable indication of growth.

SECTION 6 FUTURE DEVELOPMENTS

Following the upgrading of the main academic central processor, shortage of communication ports for access to the system and lack of adequate file storage have become a serious problem for users. In the short-term, therefore, the installation of more ports and terminals assumes a high priority. Eight are currently on order and will bring the total to 40 but it is estimated that to take full advantage of the processing power of the present machine at least 50 will be required.

The Computer Management Committee initiated a study to determine the computing requirements of College once the present DEC machines are superseded in the late 1980s so that development during the intervening period can be directed appropriately. Preliminary indications suggest that decentralisation of equipment will continue with the Computer Laboratory providing a supporting infra structure consisting of a high speed data network with specialised equipment and support staff.

Existing operational problems arising from the diversity of equipment now in use and the evolution of an extensive data communications network make the establishment of an engineering section within the Laboratory an urgent requirement for installation and maintenance purposes. This, however, is not only essential to ensure the on-going reliability of the present service but is also a pre-requisite for the longer term developments presently envisaged.

APPENDIX A

EQUIPMENT

1. The specifications of the equipment installed on September 30th, 1981 are as follows:

Digital DECsystem-2060:

1 x 2060 CPU with 512K words of memory and
32 asynchronous communications ports
3 x RP06 200 Mbyte disc drives
2 x TU45 120Kb, 9-track, 800/1600 b.p.i.
tape drives
1 x CD20-A 300 card/minute card reader
1 x DN20 synchronous communications port
1 x LA36 Console

On order:

- additional 8 asynchronous communications ports
- Calcomp Model 81 Plotter

Digital DECsystem-2020:

1 x 2020 CPU with 256K words of memory
32 asynchronous communications ports and
1 synchronous communication port
3 x RP06 200 Mbyte disc drives
2 x TU45 120 Kb 9-track, 800/1600 b.p.i.
magnetic tape drives
1 x LA36 Console

On order:

- additional 128K words of memory

Digital PDP 11/34:

For real-time Library Circulation Control system:

- CPU with 128K memory
- 8 asynchronous lines
- 2 x RL01 Disc drives
- 1 x RL02 Disc drive
- 1 x LA36 Console

Digital VAX 11/780:

1 x VAX 11/780 system in the department of Computer Science comprising the following:

- Central Processor with 1.75 Mbyte of memory
- 32 asynchronous lines
- 1 x LA120 Console
- 3 x RK07 Disc drives

On order:

- 1 x TS11 Magnetic tape drive

Burroughs B1700:

1 x B1700 System in the Department of Computer Science comprising:

- B1714 CPU and SPO including 64K memory
- A9480-12 Dual Disc unit
- A9115 Card Reader
- A9359.2 Line Printer

Communications

Approximately 100 terminals, most of which belong to user departments, have access to the equipment. These compete for the limited number of entry ports on the appropriate computer via a Gandalf PACX III

switching unit. The public terminals which may be booked in advance and located in the Terminal Room of the Laboratory have dedicated ports, however, to guarantee access. A high-speed data-line connects the DECsystem-2060 with the IBM 4331 machine in UCD.

APPENDIX B

STAFF

The Laboratory staff is organised as shown in Figure B.1. The functions of the main groups are as follows:

ACADEMIC USER SERVICES GROUP

This Group, comprised of programming staff, provides assistance to computer users by means of:

- an advisory service
- courses for users
- publications such as the Users' Guide and Computer Laboratory Newsletter.

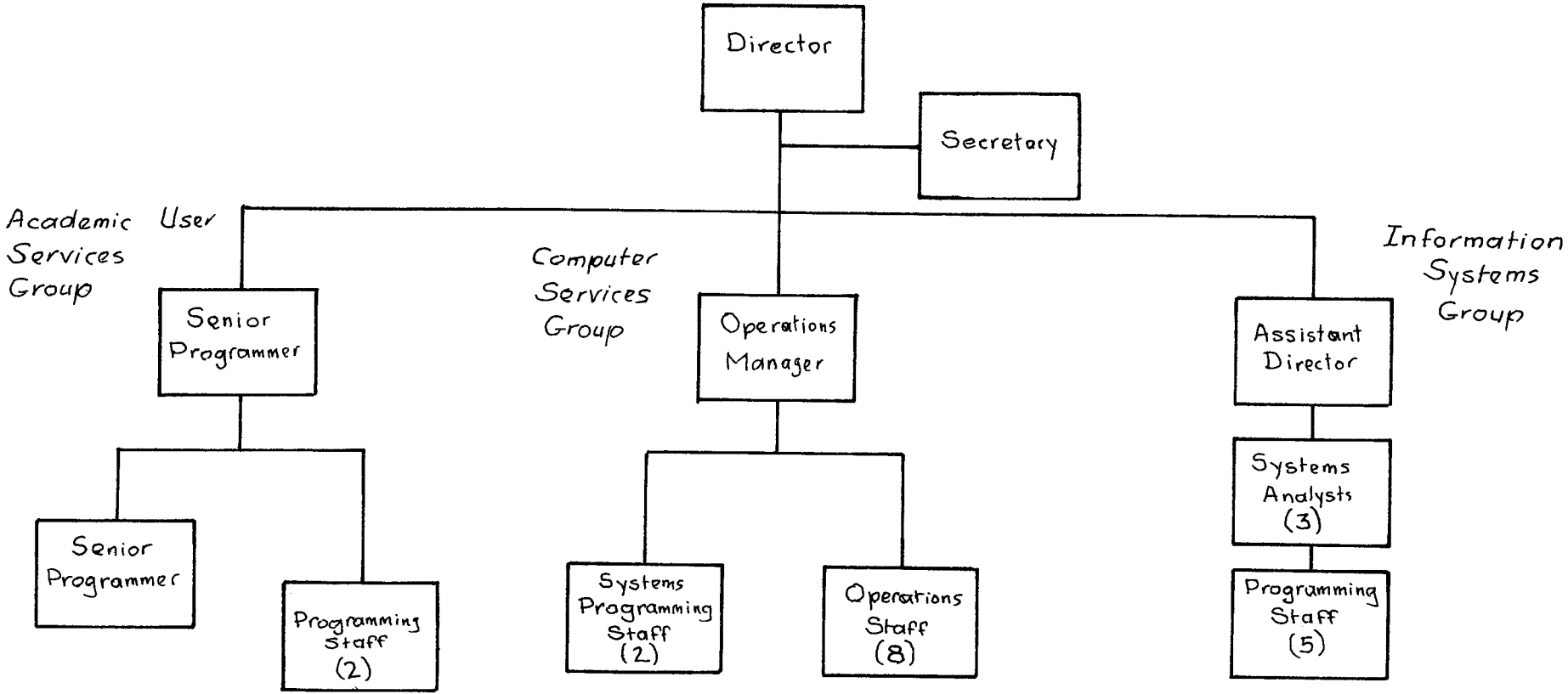
COMPUTER SERVICES GROUP

This Group is responsible for the running of the central computer equipment. It is staffed by operations personnel who look after the running of the machines and perform the associated ancillary functions, systems programmers who generate and maintain the central systems software, and janitors who are responsible for security.

INFORMATION SYSTEMS GROUP

This Group is responsible for the regular operation of existing administrative and Library computer applications and for the development of new ones.

Development of new projects is performed by Systems Analysts who design the applications and Programmers who write and test the computer programs needed for their implementation.



COMPUTER LABORATORY ORGANISATION

Figure B.1

APPENDIX C

COSTS

The services provided by the Laboratory may be divided into two groups:

1. Computer Service consisting of computer time together with the appropriate materials and supporting facilities. This is available to all college departments and to outside users.

2. Application Development Service

   This is a full systems analysis and programming service provided for library and administrative applications design. The Laboratory staff who perform this work normally use the "Computing Service" for test purposes on behalf of the user departments.

The total cost of running the Laboratory is shown in Table C.1 under the main expenditure headings used in the College accounts. The cost of providing each of the two services was determined by analysing all the categories of expenditure shown in Table C.1 to estimate the fraction of each used to provide each service. For example, in the case of salaries the cost of Systems Analysts is charged to Application Development, Operators to Computer Service, while the cost of others such as the Director is distributed over both in proportion to the estimated effort spent on each by the individuals concerned.

In the case of Computer Service, the expenditure was further apportioned between the DECsystem-2020, the DECsystem-2040, the DECsystem-2060 and the two machines operated by the Computer Science Department. In the case of the three central machines the records of time used were then costed for use in this report.

Table C.2 shows use of the two services by user category.

COMPUTER LABORATORY

ACCOUNTS

Year Ended 30 September 1981

Expenditure:

	Actual	Budget
	£	£
Cost of Staff:		
- Salaries	263,952	271,000
- Wages	14,110	12,700
Total Pay Cost	278,062	283,700
Rentals of Equipment	14,822	3,500
Purchase of Ancillary Equipment	144,718	141,150
Maintenance	76,079	80,800
Consumable Supplies	19,897	21,100
Cost of External Services	168	1,500
Insurance Charges	1,919	2,200
Miscellaneous Expenses	1,639	4,800
Total Non-Pay Cost	259,242	255,050
Recurrent Cost for Year	537,304	538,750

Income:

Income from Sale of Computer Services - £16,958

Table C.1

Analysis of Service Costs

User Category	Computer Service (Note 1)	Application Development Service (Note 2)	Total
Academic	320350	0	320350
Library	49783	46548	96331
Administrative	47967	69026	116993
Outside	3630	0	3630
Total	421730	115574	537304

Note 1: "Systems Support" use is included as an overhead in these costs.

Note 2: This breakdown is approximate and based on the total development cost distributed in proportion to the number of development staff assigned.

Table C.2

APPENDIX D

GLOSSARY

COBOL : COmmon Business Oriented Language
A computer programming language for administrative applications. In College, COBOL-68, a version of the language specified in 1968 was used but a newer level, COBOL-74 is now available.

IMSL : International Mathematical Subroutine Library. A set of mathematical computer programs.

Memory : Storage within a CPU used to store programs and data currently in use. In general, the speed of a computer system increases as the memory in its CPU is expanded. Memory is "working" storage unlike magnetic discs or tapes which are used for the longer term storage of data files.

P.A.C.X. : Private automatic computer exchange.
A device, similar to an automatic telephone exchange, which enables many terminals to compete for access to a limited number of entry ports on one or more computers.

Plotting : The production of computer output on paper in the form of graphs, drawings or maps, etc. The Laboratory has no plotting equipment at present and uses facilities in UCD.

Port : An entry channel through which one terminal at a time can communicate with the computer. Ports may be "synchronous" or "asynchronous", depending on the communications technique used. The former are normally used for high speed communication only.

Processor : The central component of a computer system. Six College processors are referred to in this report, DEC-2020, DEC-2040, DEC-2060, VAX 11/780, Burroughs B1714 and a PDP 11/34.

SDI Service : The current awareness service based on individual interest profiles operated by the Library.

SPSS : Statistical Package for the Social Sciences. A set of statistical programs widely used for survey analysis, etc.

System : This word is used in two ways, according to context:

1. An application system is a set of computer programs and their associated manual procedures to perform a specific task, e.g., the Payroll System or the Library Catalogue Production System.
2. A computer system is a complete computer consisting of the CPU and the peripheral machines connected to it for input, output, and data file storage purposes. This report refers to five TCD computer systems, the DEC-2020, DEC-2060, VAX 11/780, Burroughs B1700 and the PDP 11/34.

System Support : This term is used in the Report to describe use of the equipment by Computer Laboratory staff for central software development and maintenance, commissioning new application packages, instructing users, accounting for computer usage, copying files, for security purposes etc.

TOPS-20 : The main control program on the DECsystem-20.