UNIVERSITY OF DUBLIN

TRINITY COLLEGE

COMPUTER LABORATORY

ANNUAL REPORT 1972

C O N T E N T S

Section 1 Introduction

The Computer Laboratory is essentially a central service department. It does not teach, except in so far as is necessary to instruct its users in the use of its facilities, nor does it undertake research in the academic sense. It does, however, provide a computing facility, which like the Library, is at present freely available to all College departments for academic purposes and offers an advisory service to its academic users. Furthermore, it undertakes extensive development work both to enhance its own service and to design and implement computer procedures for the Library and Administration, whose needs in this area, unlike those of most academic users, cannot reasonably be filled by the users themselves. This report will outline the use of the services during the year and describe the main development activities of the Laboratory.

COMPUTER ACTIVITY

Total System Elapsed Hours

Month	Machine Use				Maintenance	Total Activities
	RAX	O.S.	Other	Total		
10/71	106.05	344.52	5.32	455.88	11.27	467.15
11/71	133.22	412.20	15.08	560.50	6.28	566.78
12/71	78.73	393.83	17.53	490.10	2.25	492.35
1/72	106.67	486.86	35.08	628.61	5.50	634.11
2/72	123.00	428.85	8.88	560.73	4.42	565.15
3/72	83.57	401.88	47.03	532.48	1.42	533.90
4/72	88.48	372.02	19.33	479.83	4.92	484.75
5/72	105.10	452.90	32.32	590.31	46.83	637.15
6/72	94.65	455.55	11.02	561.21	1.25	562.46
7/72	91.97	503.03	26.98	621.98	3.08	625.06
8/72	73.20	479.63	13.55	566.38	2.30	568.68
9/72	67.20	426.75	20.27	514.21	7.87	522.08
Totals:	1151.83	5158.00	252.40	6562.23	97.38	6659.61

RAX : Remote Access Computing System

OS : Operating System/360 - the main batch processing mode

Other : "Stand-alone" use of system without a standard control program

Maintenance : Scheduled preventive maintenance and unscheduled repair time. This does not include engineering time associated with moving the system.

Figure 1

Analysis of Computer Use

Percent of Total Monthly Use per User Category

Month	User Category				
	Library	Academic	Admin	Outside	Systems Support
10/71	11.06	49.19	23.30	9.61	6.84
11/71	9.87	22.09	47.07	5.96	15.01
12/71	30.28	30.95	18.23	8.29	12.25
1/72	35.19	35.73	13.05	10.43	5.60
2/72	18.90	42.71	14.64	9.87	13.88
3/72	15.25	50.14	14.78	9.39	10.44
4/72	16.72	54.52	11.12	11.92	5.72
5/72	13.69	59.15	12.65	10.85	3.66
6/72	23.03	40.33	22.98	8.26	5.40
7/72	17.20	41.01	23.74	7.58	10.47
8/72	18.99	46.53	20.64	5.21	8.63
9/72	21.32	37.26	27.85	6.03	7.54
Overall	18.49	40.48	23.31	9.56	8.16

"Systems Support" is time required for central software maintenance, central systems software development, and "housekeeping" activities.

Figure 2

Analysis of Academic Use
by Department

Department	Percent of Total Academic Use
Computer Science	57.12
Physics	10.00
Graduate School of Eng. Studies	7.89
Statistics	6.27
Pure Mathematics	5.09
Education	3.91
Chemistry	2.50
Engineering	2.04
Zoology	2.04
Botany	0.87
Biochemistry	0.55
Applied Mathematics	0.51
Economics	0.49
Business Studies	0.32
Pharmacology	0.21
Psychology	0.08
Geography	0.07
Genetics	0.03
Psychiatry	0.01.
	100.00

Figure 3

Section 2 Machine Utilization

2.1 Computer Activity

The measurement of computer activity is traditionally expressed in terms of machine "time". In the case of a system as complex as the Trinity one, where several tasks can be present simultaneously in the machine, taking turns at using various components, it becomes less easy to provide a meaningful measure of usage. The total central processor time (CPU time) used by a task is readily available but it takes no account of the use of peripheral units whereas the total "elapsed time" a task was present in the system is not a valid measure since the facilities are not exclusively available to the task for all of the period. A true measure of use of such a system can only be expressed in "accounting units" derived from the measured use of many separate items and the development of such a monitoring system has not yet been undertaken here. For this reason overall computer activity is expressed in terms of total "power-on" time and break-downs of this usage expressed in percentage form and based measured elapsed and CPU time.

Overall use of the machine is shown in Figure 1 which shows an average occupancy of greater than 18 hours a day over a full 366 day year. Figure 2 shows an analysis of machine usage by month for the five major use categories while Figure 3 further analyses "Academic Use" among user departments.

2.2 Ancillary Equipment

Apart from a card sorter, the main ancillary equipment consists of four keypunches and a verifier. Two of the punches are on open access in the User Preparation Room and are freely accessible to users for 24 hours a day from Monday to Friday and up to 13.00 on Saturdays. They are very heavily utilised and one must normally queue for service except late at night or occasionally out of term.

The other two punches are used by the Laboratory data preparation staff and a summary of the work of this group is shown in Figure 4.

Data Preparation

	Cards Punched
Library	40,493
Academic	13,825
Admin	176,181
Outside	45,576
	276,075

Figure 4

Section 3 Application Development

3.1 Library

The early part of the year was mainly occupied with the upgrading of several of the existing programs both to incorporate external changes and to improve performance and with the consolidation of the newly developed system for the production of the printed book catalogue and its supplements. The most significant development, however, was the modified extension of this, later in the year, to produce the catalogue in microfilm form. This development will, should it prove acceptable to readers, make possible the more frequent production of a greater number of copies of the catalogue and significantly reduce the computer time involved.

3.2 Academic

Programs to use the facilities for academic purposes are, in general, prepared by the academic users themselves and run on the equipment by Laboratory staff. For this reason, the nature of much academic work is not known to the Laboratory in much the same way as the work of readers is unknown to the Library staff. However, some idea can be inferred from the advice sought, the "package" programs used, and sample checks on the printout produced and based on this, the following examples of academic applications are outlined.

In the Department of Computer Science, research usage includes the development of computer software for computer teaching in schools, the development of a simulation model of the Irish educational system for planning purposes, traffic simulation, and several projects in the computer systems field such as the measurement of system performance, high level control language design, operating system development and the study of computer file handling techniques, including compression of text.

Dr. Blackith, in the Department of Zoology, uses the computer to study the distribution of organisms as part of his research in the field of ecology and also to predict the future size and structure of animal and insect populations.

Other academic usage includes the automatic scoring of examinations, by Dr. R. Brown, a study of foreign investment in Ireland by the Department of Business Studies, a study of agents of change and the business environment, by the Administrative Research Bureau, and the analysis of instructional procedures in second and third level institutions, by the School of Education.

For teaching purposes the biggest user is the Department of Computer Science which uses the system for teaching computing itself both to students of computer science and, on a service basis, to students in many other fields. The computer is also used in the teaching of other subjects. Examples of this are its use in the teaching of statistics by the Department of Statistics and the teaching of business decision making using a simulation model, by the Department of Business Studies.

3.3 Administration

Most work in this area concerned the extension of existing systems. The Student Record computer system was modified to automatically produce special self-adhesive cover labels for student files, to produce pre-printed registration cards to speed up the registration process and make possible ad hoc searches of the computer file with relatively little programming for the answering of queries. This facility was also provided for the admissions file and a common application form was developed in co-operation with the other Irish Universities.

The principal new systems implemented were the debtors and creditors ledger systems in the financial area and the student fee accounting system which went into operation for students registering in 1972.

Section 4 Central Service Development

4.1 Equipment

The central processing unit was enhanced by the addition of an extra 64K of main storage bringing it to its present level of 256K bytes. The main value of this was to increase the work throughput of the system by permitting more extensive multi-programming.

The two rented terminals in the Laboratory and Department of Statistics were replaced and augmented by six machines of a newer and less expensive type, some of which, it is hoped, can be located outside the Laboratory itself. Installation of these machines and their control unit, was originally planned for March/April 1972, but late delivery combined with the delayed move to the new building delayed this until the end of September.

4.2 Software

As a result of the additional storage mentioned in 4.1, it became possible to make two desirable and major changes to the control program software in the Laboratory.

The first of these was the selection of a replacement for the Remote Access Computing System (RAX) used to provide terminal service since 1968. This was the only such system small enough to operate on the machine as originally installed and while very effective at the time, was unable to take advantage of the new features, such as the extra storage, which were subsequently added. Its facilities were also largely incompatible with those of Operating System/360, the software that controls the bulk of batch processing work. In 1971, a new IBM program product, the Interactive Terminal Facility (ITF) became available which partly met the Laboratory's needs and an extensive set of modifications to tailor it to local requirements was undertaken.

This was a major project which was severely hampered by the resignation of the Systems Programmer in February 1972, and by the distruption caused by the delayed move to the new building in Pearse Street. However, it was completed satisfactorily.

The second systems software development was the introduction of a new and more efficient work scheduling component, the Huston Automatic Spooling Priority, (HASP), into our Operating System. This was made possible by the additional storage installed during the year and has significantly improved the work throughput of the system.

4.3 Accommodation

In September 1972, the Laboratory moved from its Terrapin building in the Fellows' GArden to new premises at 200/201 Pearse Street. The new accommodation which is a combination of new construction and renovated space, relieved the space problem which had been a major difficulty in the previous building, and provided a far more suitable standard of accommodation for both equipment and staff. The move, however, presented major problems since the original target date of August 4th was not met due to building difficulties and the delayed transfer, and associated disruption of service, finally coincided with peak activity in a number of administrative processing areas, with the final implementation of the RAX/ITF conversion, and the also delayed installation of new terminal equipment.

Section 5 Other Activities

5.1 Courses

Two introductory courses for users were held in October 1971 and January 1972 and were attended by a total of 44 staff, research students, and representatives of outside users.

Lectures on non-numeric PL/I programming were given to M.Sc students in Information Science by A.M. Tucker and on Data Processing by the Director to M.Sc students in Computer Applications, Information Science, Production Engineering and Applied Electronics, to MBA students, and to undergraduate BAI computer science students. The Director also lectured on the Trinity Computer-based Library Catalogue System at the SHARE European Association's conference in Gothenburg.

5.2 Sale of Computer Services

The Laboratory sells time on the College computer system to users in outside organisations, both on a batch basis, and through terminals but does not offer a programming or application development service due to shortage of personnel. A specialist consulting service in the field of civil engineering computation is, however, offered by the Computer Systems Research group in the Engineering School which, while not part of the Computer Laboratory, is supervised financially by the Computer Management Committee.

The Laboratory's net income of £10,864 for 1971/72 was slightly higher than the previous year's £9,875. It is still, however, much lower than the 1969/70 figure

of £15,635 and is unlikely to grow as more and more outside users acquire machines of their own, obsolescence makes the College system less competitive, and internal demands continue to grow.

5.3 External Contacts

In addition to its commercial activities the Laboratory and its staff have regular contact with a number of other organisations. Mr. Doherty and Mr. Kirwin maintained continuing contact with other Irish Universities on the subject of Admissions processing systems. Mr. Doherty also joined the H.E.A. Statistical Services Sub-committee.

The Director was co-opted to the Executive Board of the SHARE European Association (SEAS), an association of 180 organisations, largely academic, using large computers. Through this board and the association's University Committee, regular meetings were held with the directors of similar European computer centres to discuss common problems. The board visited College during the year and SEAS will hold its 1975 annual conference, with an expected 400 participants, here.

Section 6 Future Developments

6.1 Short Term

The growth in computer use is continuing. Figure 5 shows the rise in total "power-on" time and gives some indication of this use although it cannot reflect the increase in system performance and hence in the amount of useful work performed per hour. Furthermore, it indicates usage only and does not reflect those demands which the Laboratory has not been able to meet.

It is hoped that the 1972/73 work-load can be handled without major "load-shedding" due to the recent software developments and the upgrading of the Central Processor planned for January 1973. While these developments should avert immediate crisis, they leave the Laboratory with a very unbalanced system, i.e., a powerful processor but insufficient peripherals to avail of its full performance, and an operating staff insufficient in size and structure to use it efficiently. For example, it would need a minimum of two computer operators, one of supervisory calibre, to effectively run such an installation where it is at present possible to assign only one relatively junior girl. Furthermore, shortage of systems programming capacity prevents the development of optimal operating systems software and, in addition, the need to provide increasing "hands-on" service, essential for computer science teaching, using such a large system represents a further significant inefficiency.

At this stage, crisis seems therefore inevitable in 1973/74 unless the throughput of the system can be improved, by the attachment of additional direct access storage to correct the imbalance, by strengthening the operating and systems programming staff, and the provision of a satellite facility to fulfil "hands-on" needs.

The storage, which was originally requested in 1970, is now vital, not only to increase throughput, but also to permit the continuation of our existing library cataloguing application which is rapidly approaching file storage saturation point.

It is anticipated that the staff and equipment changes will involve an increase of the order of £21,000 p.a. in the Laboratory's 1973/74 budget but the Computer Management Committee's sub-committee on future requests is actively considering the above proposals at present and will present a more detailed report, shortly.

Growth in Computer Use

Year (Oct-Sept)	Total "Power-on" Time	Growth %
68/69		
69/70	5073	18
70/71	5946	17
71/73	6659	12

Note: This indicates total hours of computer time. It does not accurately reflect the work throughput per hour due to improvements in performance made in 70/71 and again in 71/72.

Figure 5

6.2 Long Term Growth

Estimates of growth over a five year period were made in 1968 and again, over a ten year span in 1970, and while financial considerations forced a slippage in the time schedule, the underlying growth in demand is substantially the same. These plans formed the basis of the College's submission to the H.E.A. Advisory Group on Computer Planning and Statistical Services of which Dr. J.G. Byrne is a member.

The greatly improved performance of systems now available suggests that expansion of central processor power after 1973/74 should not be made by enhancement of the existing machine. At this stage, it seems likely that a new processor should be rented in 1974/75 to initially supplement the present machine and then be expanded over a year or two to eventually assume the full workload.

A new factor which will influence computer expenditure to an increasing extent in future is manufacturers decision to charge customers for "software" which was supplied free of charge up to recently. The full effect of this will not be felt until a new machine is installed but by that time software rental costs are likely to represent about 8% of the Laboratory's total expenditure.

In summary, therefore, continuing growth can be expected for several years to come, exceeding the ultimate capacity of our present central processor by 1974/75. This will imply a sharp rise in annual equipment and software costs to the order of £190,000, compared to approximately £88,000 in 1971/72, and it is hoped that the Board will approve of a special case being made to the Higher Education Authority for this finance.

APPENDIX

EQUIPMENT

The specifications of the equipment currently installed are as follows:

1 x IBM 2044 Model H Central Processing Unit with 262,144 bytes (256K) of core storage and with

- One Multiplexor Channel
- One high speed multiplexor channel
- Single disk storage drive in CPU
- Store and Fetch protection
- Floating point arithmetic
- Console printer keyborad
- Interval timer
- Commercial Feature (full 360 instruction set

x IBM 2841 Model 1 Storage Control with

- File Scan
  and
  Record Overflow

2 x IBM 2415 Model 4, Magnetic Tape Unit and Control (2 drives) with 9-track compatibility, i.e., 800 b.p.i. tape at 15000 b.p.s. or 1600 b.p.i. tape or 30000 b.p.s.

1 x IBM 2821 Model 2 Control Unit (for 1403 printer)

1 x IBM 1403 Model 2 Printer with Universal Character Set feature and Interchangeable Chain Cartridge adapter
Print Positions: 132
Maximum Rated Speed: 600 lines/minute
Available chains: QN2
TN Modified for Library

1 x IBM 2501 Model B2 Card Reader with Card Image Feature

1 x IBM 1442 Model N2 Card Punch with Card Image Feature
Speed: 91 to 256 cards/minute depending on number of columns punched.

8 x IBM 2260 Display Stations Model 1 with alphameric keyboards

1 x IBM 1053 Model 4 Printer with pin-feed platen and accelerated carriage return

4 x IBM 2311 Model 1 Direct Access Storage Units

1 x IBM 2702 Transmission Control Unit

1 x IBM 1050 Terminal in a remote User Location

6 x IBM 2741 Terminals in the Laboratory and User Locations

APPENDIX 2

STAFF

The Laboratory has a staff of 26 organised as shown in Figure 6. The functions of the main groups are as follows:

DEVELOPMENT STAFF

This section is responsible for the development of new applications, as follows:-

Systems Analysts study the requirements of new systems in the library and administrative fields and design computer based procedures to implement them.

Programmers write and test the computer programs called for by the Systems Analysts' designs. They also act as advisors to academic users who do their own programming.

Systems Programmer. The Systems Programmer is responsible for the generation and maintenance of internal control programs needed to run the computer.

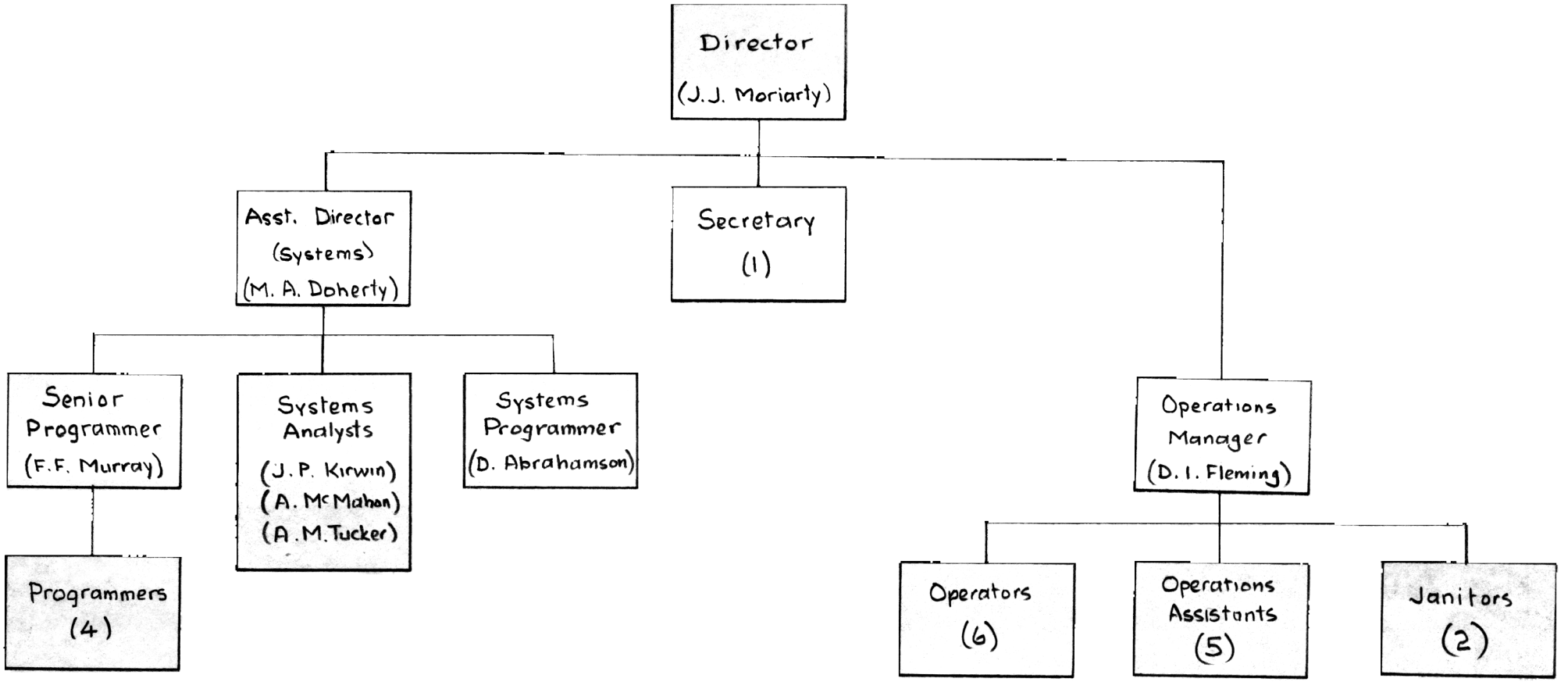
OPERATIONS STAFF

This section is responsible for the day-to-day operation of the computer. It operates on a 24 hour shift basis and duties are as follows:-

Operators are responsible for the operation of the computer itself.

Operations Assistants are responsible for the punching and verification of cards, the reception and dispatch of data, and generally assisting operating staff.

Janitors work on permanent night shift and are responsible for general security.



C O M P U T E R L A B O R A T O R Y

O R G A N I S A T I O N

Figure 6

APPENDIX 3

ACCOUNTS

COMPUTER LABORATORY
Year to 30 September, 1972

Cost of Salaried Staff	43,478
Cost of Wages	2,789
Rentals of Equipment	9,446
Purchase of Ancillary Equipment for Computer	31,669
Maintenance of Equipment	7,005
Consumable Materials	5,116
External Services Purchased	167
Miscellaneous Expenses of Computer Laboratory	1,143
Insurance	538
Cost of Computer Systems Research Staff	3,998
Charges for Computer Time - Systems Research	-
Miscellaneous Expenses of Computer Systems Research	952
	106,301
Less: Income from Computer Systems Research	4,220
NET RECURRENT COST FOR YEAR	102,081
Amortisation of cost of Computer	40,000
	142,081
Income from sale of Computer Services	10,864