# Computing in the University of Edinburgh

Report from the Computing Service Planning Group

30th June 1988

# PURPOSE OF DOCUMENT

The purpose of this document is to report to the Convener's sub-Committee of the Computing Policy Committee, the information and views on computing in the University of Edinburgh, gathered by the EUCS Planning Group since the summer of 1987.

The Planning Group's broad view of possible developments, and the major issues arising out of this exercise ***(see Sections 13 & 14)***, are identified for the committee to consider prior to the commencement of the next stage of the planning exercise. After the committee has responded on these issues, detailed scenarios of possible future directions will be produced for further discussion. After agreement has been reached, a strategy statement will be produced which will be submitted to the Computer Board.


## ACKNOWLEDGEMENTS

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Most of all, we would like to thank all those staff and post-graduates who took time to submit contributions, particularly the departmental representatives who were given the task of organising meetings and providing us with detailed information on their systems. We will make every effort to reduce the size of this task for the 1997 replacement exercise! Thank you also for the copious supply of coffee which kept us going during the round of departmental meetings.



**Peter Stephens**
**John Livingstone**

**EUCS Planning Group**
**June 1988**

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# 1. INTRODUCTION

On behalf of the Computing Policy Committee, the Planning Group of the Computing Service carried out an information gathering exercise on various aspects of computing in the University of Edinburgh during 1987 and 1988. This was to allow major issues which were likely to affect the future direction of computing to be identified, prior to the compilation of a ten year computing strategy statement which has been requested by the Computer Board as a prerequisite to its distribution of funds (approx £2.5m) for the enhancement of centrally managed computing facilities in 1990.

Information and views were sought from departments in a number ways. They included

1. A request to all Heads of Departments to provide a statement of their own departmental computing strategy.

2. Meetings between Computing Service staff and departmental representatives.

3. A survey of departmental expenditure on computing over the past five years and expected expenditure over the coming two years.***(see Appendix 9)***

4. A survey of all computing equipment installed in departments. ***(see Appendix 1)***

5. A survey of all members of staff and post-graduate students on various aspects of computing. ***(see Appendix 7)***

Whilst considering the future computing strategy of the University, it is necessary to know what computing is being used for at the moment, have some idea of likely developments which will impact upon the overall requirement for computing, what improvements are sought and what the current strengths and weaknesses are. During an exercise such as that undertaken, as might be expected, much of the input was critical and attempts have been made to relate only general complaints rather than individual opinions. It should be stated that the view overall was of a healthy, dynamic computing environment and, following visits to other Universities, it is clear that computing users in Edinburgh are generally, considerably better off than most of their U.K. counterparts. Also, after discussions with hundreds of members of staff, we were left at the end of the day with the distinct impression that computing is about people, not technology!

The following is only a brief overview. It is impossible to cover every activity or to identify every individual desire or complaint and it tries to concentrates on areas which are felt to be important to the long term direction of computing in this University.

## 2. GENERAL OVERVIEW

The University of Edinburgh recently celebrated the 25th. anniversary of the founding of the Computing Laboratory by Professor Michaelson. Unlike many other Universities, it was decided in Edinburgh to keep the academic and service sides of computing separate and, in 1966, the Edinburgh Regional Computing Centre (ERCC) was set up as a result of the Flowers Report which recommended three regional centres for University computing, in London, Manchester and Edinburgh. Its successor, the Edinburgh University Computing Service (EUCS) was formed in 1987 from the merger of ERCC and the Centre for Applications Software and Technology (CAST) an organisation which itself had been formed from an off-shoot of ERCC, the Program Library Unit (PLU). Since its beginnings in 1963, computing has penetrated throughout the University to the point where today, over 90% of departments make some use of it as a tool for:

- **Teaching**
- **Research**
- **Administration.**

Initially, departments came to the Centre to access computing facilities but Edinburgh's remit which was to concentrate on interactive services, with the convenience of access that that implied, set the tone for the development of services generally. It was accepted as a fundamental principle that the use of computers should be as easy and convenient as possible, and that users should not have to become "computer experts". Whether this was successfully achieved or not, will be covered later in this paper.

It was also recognised that not all problems could necessarily be solved on a single service and this, and the University's scattered nature, led to the early development of expertise in computer networking, the acceptance of the proposition that all computers should be capable of being connected to a common network, and of the importance of standard protocols. Today, Edinburgh has possibly the largest wide area network in the UK academic community ***(see Appendix 3).***

During the 1970s this philosophy encouraged departments to develop their own computing facilities to provide services which could not be provided centrally, a feature which was not common in the majority of UK universities until much later. These initial developments in distributed computing were led by the Department of Computer Science and were based on multi-user mini computers. The continual improvement in the price/performance ratio of these systems, plus the introduction of microcomputers in the late seventies, led to the position today where computing facilities on every desk, all able to communicate with each other, is being seen as desirable by the majority of staff within the University. The distribution of computing systems in Edinburgh, whilst not as wide as many staff would desire, is probably greater than in any other comparable institution at least in Europe. There are now in excess of **25** departmental multi-user systems and **1700** micro computers ***( see Appendix 1)*** in addition to centrally managed facilities which are accessible from over **2000** network connections in Edinburgh ***(see Appendix 3).***

The use of computing by departments has led to areas of special expertise including, for example, Parallel Computing which the Department of Physics saw as a useful tool for their development of computing in physics research and which is now of wider interest within the university and externally. Similarly, our Molecular Biologists have developed expertise in biocomputing which has led to the establishment of a Biocomputing Research Unit, Geography are renowned for their work in Geographic Information Systems, Edinburgh Computer Aided Architectural Design (EdCAAD) are leaders in their field and there are many other areas where the use of computing in research work has led to a special expertise in applied computing.

In the early 1980s those departments who research into the various aspects of computing itself were grouped into the School of Information Technology. This was formed to promote academic co-operation in this field and is a federation of departments which crosses faculty boundaries. It includes amongst others, the Departments of Computer Science, Electrical Engineering and

Artificial Intelligence all of whom are recognised world-wide as leaders in their fields. In addition to carrying out research into computing, they have used computers as tools for their research and their use has normally been in advance of the rest of the university. This, plus their early insight into future devlopments in computing, has allowed the University generally to benefit from their expertise. Also forming part of the School of I.T. are the Artificial Intelligence Applications Institute and the Centre for Speech Technology Research both of whom are actively researching into areas of computing which will be of wider interest in coming years to University computing and to that in external organisations.

Supporting the use of computing in departmental teaching and research are three service organisations, the:

- **Computing Service**
- **Management Information Services**
- **University Library**

On behalf of the University, the Computing Service (EUCS) manages and supports central facilities which include the Edinburgh Multi-Access Service (EMAS), jointly developed with the Department of Computer Science, which has been the major central service for over fifteen years, and the wide area communications network. In addition, EUCS also provides technical advice and support to departments not only on central facilities and the communications network, but also on their procurement and use of computing systems in general. The Computing Service also manages facilities on behalf of departments for example, the School of Information Technology's multi-user Gould system and the parallel processing systems in conjuction with Physics. Since its inception EUCS has complemented its service activities with devlopment work and offered access to its facilities to external organisations. The expertise and revenues gained from these activities have been beneficial to the computing service offered to the university in that Edinburgh has had access to experience and new technology ahead of other universities and the additional income has enhanced the level of facilities and support available.

The Management Information Services Unit, created in 1986, developed from the Data Processing Unit which was formed in the early 1970s by the University Secretary's Office to serve the central administration, primarily the Finance and Secretary offices. MIS continue to serve the administrative community in Old College and more recently, the Faculty Offices. Since the review of ERCC, they have also taken over responsibility for the support of in excess of 50 other units within the University whose activities are mainly administrative.

The University Library has always been an important service to the teaching and research community. Library computing was initially conceived as an internal project with the aim of automating circulation, acquisition and serial control together with the transfer of the catalogue to an electronic format. The latter has been a prodigious project expected to last for another four years. Access to information stored on the central Library system has been made available to the widely distributed departmental libraries by the installation of a dedicated network and, by integrating wherever possible their facilities with the University's wide area network, their longer term aim is to provide easy electronic access to all staff in departments.



# 3. FACULTY COMPUTING

## 3.1 Introduction

There are 8 faculties in Edinburgh and they are described in no particular order of importance.

- **Social Sciences**
- **Science**
- **Medicine**
- **Law**
- **Divinity**
- **Arts**
- **Veterinary Medicine**
- **Music**

The penetration of computing throughout the faculties varies considerably, the main concentration being within the Faculty of Science as is to be expected. The Faculty of Social Sciences is probably the next most intensive user with Medicine being an area where the application of computing has been concentrated for many years in a few specialised pockets but recently applied more generally. Law, Arts, Divinity and Music are now increasingly seeing possible benefits to be gained from the introduction of new technology but are hampered by various factors such as lack of funds and support resource.

## 3.2 Faculty of Social Sciences

The computing community within the Faculty of Social Sciences is diverse. Some concentrate on the IBM PC (or compatible) environment with microlabs well established in the William Robertson Building but there is also a growing community of Apple Macintosh users and this is reflected in the new Social Studies micro facility which is based mainly on this equipment. The "specialists" have adopted VMS and UNIX and there are several varieties of other equipment spread throughout.

EdCAAD (Edinburgh Computer Aided Architectural Design) and the Department of Geography both have very different specialised needs and have adopted UNIX and VMS respectively as their main operating system base. UNIX has suited the architectural environment where much software development has been necessary whilst the choice by Geography of VMS, which has a world wide base, was heavily influenced by the fact that they participate in many collaborative projects with external organisations in their work on geographic information systems.

The "business community" within the Faculty of Social Sciences i.e. Business Studies, Accounting and Business Methods and Economics, base much of their work on IBM PCs as these are the standard in industry and commerce. Economics also make use of their own DEC MicroVAX with VMS, again because of its wider applicability.

Economic and Social History, Sociology, Social Policy and Social Work, Social Anthropology, the Centre for Educational Sociology (CES) and the Research Centre for the Social Sciences (RCSS) base much of their work on microcomputers without any one standard prevailing in terms of hardware or software. These and other departments including Psychology, also make use of central services for large statistical analysis using packages such as SPSSX, SIR and SAS.

### 3.2.1 Observations

This is a Faculty of sophisticated computer users, relatively well provided for in computing terms although there is a widespread feeling that they are "second-class" citizens when it comes to the distribution of funds. Recurrent expenditure, particularly to meet maintenance and communications charges, is however a serious problem area for many departments.

Although their computing was originally perceived to be dominated by microcomputers, there is

still a substantial use ***(see Appendix 2)*** made of central systems by a few departments and this will continue to be the case for the foreseeable future. They have a need to share data, to access databases outside of Edinburgh and to preserve valuable data for very long periods of time. For these reasons, although much of their daily computing needs, particularly for teaching will be satisfied by desk-top systems, they will remain heavily dependent on effective networking to central and external services.

It was strongly emphasised throughout this Faculty that they wanted to use computers as a tool and were not interested in computing for computing's sake which was one of the reasons why they were now concentrating their teaching and much of their research on micros. The user interface on the network and any central mainframe services will have to be improved in future if they are to be of any interest to Social Scientists.

### 3.3 Faculty of Science

The Science Faculty have been heavy computer users for many years and this Faculty is still the largest user of central EMAS services ***(See Appendix 2)*** with the Departments of Chemistry, Mathematics, Meteorology, Geophysics, Genetics, Zoology and Statistics basing the majority of their computing on centrally managed systems although they all have a growing base of microcomputers and workstations.

Several other departments including Civil Engineering, Physics, Genetics and Zoology make use of the central VAX VMS service. There are however departmental facilities within this faculty which are probably equivalent or greater in power than the University's centrally managed provision.

The departments who carry out research into aspects of computing such as Computer Science, Electrical Engineering and Artificial Intelligence are primarily UNIX based and, after having set the trends for departmental multi-user mini computing in the early 1980s, are now repeating the process by installing Ethernet local area networks with local fileservers for workstations spread throughout these departments. The other members of the School of Engineering, Civil, Mechanical, and Chemical have until recently concentrated their teaching and research on EMAS but are now moving more towards a UNIX workstation/LAN environment with access to central facilities.

Another major development within the Faculty of Science has been the parallel computing facilities described earlier with the Department of Physics at the forefront. Physics have a long-term involvement in the development of computing in physics research and these specialised systems are now proving to be of more general interest to other departments including Mathematics, Meteorology and Molecular Biology.

The Department of Molecular Biology has played a leading role (on an international level) in the use of computing in sequence analysis and this, together with further anticipated developments, has led to the establishment of the Biocomputing Research Unit within the department. They and several other departments, including some in Medicine and Veterinary Medicine, make considerable use of the specialised Wisconsin DNA sequencing package on the central VAX service.

Microcomputers of varying types are in use throughout the Faculty. Their use varies considerably with some departments such Chemical Engineering and Chemistry using them for real-time data capture whilst others such as Forestry and Natural Resources, who have a departmental microlab based on Apple Macintoshs, and Geology, who have adopted the RM Nimbus, are using them for teaching purposes.

Within Agriculture, the computing facilities have to satisfy the requirements of both the University School and the Department of Agriculture and Fisheries' College of Agriculture. Their policy tends to be influenced by DAFS policy which is now consistent with the current University position.



A feature throughout the Faculty of Science is collaborative projects which dictate the type of equipment installed. The Department of Astronomy for instance is almost entirely dependent on the Starlink network for its research and must adopt practices consistent with it. They also make use of the Royal Observatory's VAX VMS system in addition to departmental microcomputers.

#### 3.3.1 Observations

There is a wealth of computing talent and expertise in many general and specialised areas within the Faculty of Science which continues to set the pace for the use of computing in the University and for many academic and research institutions in the U.K. and elswhere. The overall impression is of a well funded faculty pressing on in a wise and energetic manner. Computing is accepted and used in all areas and the contrast in the overall levels of experience and the amount and sophistication of facilties installed, compared with other faculties, is marked. However, the scientists would say that this is to be expected and they would argue that they are not well funded. Recurrent costs are also a problem for departments such as Computer Science and Electrical Engineering as the more equipment you have, the greater the maintenance overhead.

Out of necessity, there has been substantial bespoke software development in the Science Faculty but there are areas where differing solutions have been adopted for similar requirements and much "re-inventing of the wheel" has gone on. However, there are now signs of greater communication and co-ordination between departments, as evidenced by the School of Information Technology, the joint JCMB microlab, and the greater interaction between the biological science departments. The growth of interconnected LANs around King's Buildings is bringing with it more standardisation, mainly based on UNIX, and this greater degree of integration, initially achieved at departmental level, is now spreading to faculty level.

Very high speed networking will be essential to this faculty for the next ten years and it was the view of more than one department that the main function of the Computing Service for the next decade should be as a communications service which provides the framework for the interconnection of increasingly sophisticated departmental systems.

Even in this faculty, most users want computers for tools with as little involvement as possible in "computing for computing's sake". There are however, many applications which will never be satisfied by "off-the-shelf" solutions, and a high level of computing expertise will have to be retained and enhanced.

### 3.4 Faculty of Medicine

The Faculty of Medicine is spread over a large number of sites around Edinburgh. These include:

**Medical School, Teviot Place**
**High School Yards**
**The Royal Infirmary**
**The Western General Hospital**
**The Northern General Hospital**
**The City Hospital**
**The Princess Margaret Rose Hospital**
**The Astley Ainslie Hospital**
**Longmore Hospital**
**Bangour Hospital**
**The Royal Edinburgh Hospital**

These are the main concentrations but there are a number of other units located elsewhere. Developments in computing have been widespread but have appeared to be haphazard, possibly exaggerated by the fragmented nature of the Faculty.

Apart from the problems created by a wide geographic distribution, computing in the Faculty of

Medicine is further complicated by the multiple roles covered by many units and individual members of staff who carry out University, Health Board and Medical Research Council functions.

The distribution of microcomputers around the University ***(see Appendix 1)*** shows the dominance of this form of computing in this Faculty with over 400 installed. The majority are BBC micros or IBM PC/Clones but there are also a large number (76) of "others" which tend to be older Cromemcos and Apple 2s which will need to be replaced in the near future.

Although dominated by microcomputers there are areas of special significance in computing terms, in particular the Departments of Biochemistry, Medicine, Respiratory Medicine and Medical Physics and Engineering, all of whom are involved in applying larger systems, mainly DEC VAX and PDP11s, to their research in specialised areas which involve real-time data sampling and image analysis. Often the same equipment is utilised in a clinical environment.

Another major computer user is the Medical Statistics Unit which makes substantial use of central services whilst providing a statistical analysis service to the Faculty as whole.

### 3.4.1 Observations

The main problem when looking at the computing requirements of the Medical Faculty was identifying where responsibility lay for the provision of facilities, advice and support. The absence of a clear division of responsibilities is hindering developments as uncertainty can result in indecision and consequently, no action. At the moment, there are very few links at a policy or practical level between University and Health Board computing. This hampers much of the work of University staff who are dependent on Health Board information for their research work. Also much duplication of effort is required to transfer information from one area to the other and much effort could be saved from the better integration of facilities.

There are signs of a growing awareness of the benefits that computing might offer Medical Research even if it is only used as a word processor, and many ideas abound on how time, effort and money could be saved by the introduction of new technology. However, many of these ideas relate to non-University requirements for which external funding must be obtained.

One major deficiency that the University must resolve if it is to ease some of the problems in the Faculty of Medicine, is that of the lack of investment at the more remote sites i.e. those not located in the George Square area. University staff at the Western General, the City and the Princess Margaret Rose Hospitals feel that when any University planning is being carried out, they must be included in the provision of facilities. This is particularly true for communications where, although it costs more to connect these sites into the network, the benefits to be gained from better integration with the centre are also much greater.

The lack of a clear Health Board strategy has been a major problem in every area. Sporadic developments have been taking place over the years and only now are policies being defined in certain areas, such as PICK based systems and X25 networking. It is unlikely that University policy will ever be totally acceptable in a clinical environment and it is clear that the standards must come from the Health Board. As there is a stated need for patient data to be used for research, then it is important that the University is able to support solutions which are, wherever possible, compatible with Health Board systems and allow the easy transfer of data between the two environments in a secure manner. A high level regular liaison between the University and the Health Boards on computing matters will be essential if there is to be a co-ordinated approach to overcoming the current problems caused by fragmentation.

Also, if better progress is to be made on computing matters within the Faculty of Medicine then, in addition to more staff being dedicated centrally to medical user support, more departmental professional computing staff will be required. On the whole we saw a Faculty which is being badly affected by insufficient investment in computing and communications compared with its size and commitments, although it is clear that much of the investment is the responsibility of the Health Board.



## 3.5 Faculty of Law

The Faculty of Law has made good progress in computing over the past few years despite being hindered by the lack of funds.

A workstation with a networking capability has been provided for each of the secretaries within the seven Departments and Centres comprising the Faculty. Four BBC Micro computers are used as terminals for student access to the LEXIS database and a Faculty Computing Room was established two years ago for use by members of the academic staff. Their policy now is based on IBM PCs and they are distributing these to staff as fast as funds will allow.

They are also looking at the possibility of a collaborative venture with other Scottish universities on the creation of legal databases.

### 3.5.1 Observations

This Faculty has made good progress during its relatively short period of involvement in computing and has made careful use of funds allocated for that purpose. They have managed to stay abreast of the rest of the pack in Law computing but are in danger of losing ground if further substantial investment is not made in facilities and support in the immediate future.

The support offered to them by the Computing Service during their initial steps into computing which involved Sirius micros and Offload, led to some disolusionment. They have found it difficult to gain any real benefits from central mainframe services, mainly because of the complexity of these systems and the lack of adequate support at an applications level. To make any real progress they must now seriously consider dedicating staff full-time to computing support, as only by having staff on-site who are knowledgeable in legal and computing terms, will they be able to carry through to completion the projects they have in hand.

## 3.6 Faculty of Divinity

At present from a third to half the members of staff in the Faculty of Divinity make use of computers including PCs and central mainframe services. The heaviest usage is in multi-lingual word processing especially for the writing of articles, books and theses but work is also carried out in text searching and analysis. The use of computers is now crucial for research work in certain areas of Divinity. Their demands are complex due to the multi-lingual nature of the work often involving ancient texts, many users needing Greek and Hebrew.

In common with the other smaller faculties, Divinity's main problem has been a lack of adequate funding to meet their growing computing requirements. They are also affected by their remote geographic location from the centre of the University which makes communications charges higher and public facilities less accessible.

### 3.6.1 Observations

This faculty has its computing well managed and co-ordinated by its Faculty Computing Committee and makes good use of very modest funds; it would doubtless use more funds wisely too. Their computing requirements are complex in many ways and sophisticated solutions and support will be required.

Their remote location and the cost involved in distributing network connections around their old building has been a barrier to progress but these have to a large extent now been overcome. Any major future developments in communications must however, take into consideration the needs of remote sites such as New College.

In view of their primary requirement for multi-lingual text processing, their future policy will be based on local solutions, but good access to the outside world will still be essential as

most of their sources of research material are in various corners of the world.

Also, to make the sort of progress they now desire, they will require dedicated support resource backed up by Computing Service expertise, and they will require investment in a laboratory of systems for teaching purposes if they are to make any inroads into undergraduate teaching.

### 3.7 Faculty of Arts

Computing technology has now developed to the stage where it can be a useful tool for most departments within the Faculty of Arts but there are complex requirements such as multi-lingual text processing in languages such as Chinese and Japanese, which will require much more mature technology than is available at a reasonable price today.

Over the past few years nearly all departments have introduced some form of computing into their work, initially in many cases as a word processor shared between the departmental secretary and academic staff. In some instances, a single micro has been shared by more than one department, for example a Sirius between Philosophy and Russian.

Although most of the Faculty's current computing is based on a variety of micro solutions, some limited use has been made of central mainframe services. Also, the Department of Linguistics, with demands for compute power similar to science based disciplines, has been heavily involved in advanced computing since the early 1970s and has close links with departments in the School of Information Technology.

#### 3.7.1 Observations

The Faculty of Arts is ripe for gaining benefits from the introduction of new technology. They are however, badly constrained by current political thinking on the distribution of funds. The level of their Class Grants is totally inadequate to meet the needs of maintaining computing and communications equipment and alternative mechanisms will have to be found if a wider distribution is to be achieved. It is possible that the introduction of new technology could save them time, effort and money.

Although a large proportion of the work in this Faculty involves word processing this is in itself a complex operation given the multi-lingual nature of the departments. There are also important areas such as textual analysis which produce complex computing applications. The view therefore, that the computing needs of this faculty are simplistic and do not need as much investment in technology and support as other areas, is unfounded. If anything, because of their lack of technical expertise, the support requirement is as great as many science departments.

The applicability of computing to teaching and research in the Humanities is becoming more and more apparent, as shown by the number of national and international special interest groups which are emerging. These groups are allowing researchers to share their knowledge on computing and to make the best use of the limited funds available. Within Edinburgh, the lack of communication on a regular basis between departments was obvious during our round of departmental meetings. A Faculty Computing Committee might provide a useful forum to focus attention on various important issues and for managing scarce resources.

### 3.8 Faculty of Veterinary Medicine

The Departments within the Faculty of Veterinary Medicine have recently been subject to some reorganisation. The Department of Preclinical Veterinary Sciences was formed in April 1986 by the amalgamation of the Departments of Veterinary Anatomy, Pharmacology and Physiology and the unit of Veterinary Biochemistry. Veterinary Clinical Studies was formed from the amalgamation of the Departments of Veterinary Medicine, Veterinary Surgery and Animal Health. The other major department is Veterinary Pathology and there is also the Centre for



Tropical Veterinary Medicine.

Within Preclinical Veterinary Sciences, computing has been used in the case of Veterinary Physiology since the early 1970s and in the new department, a variety of computers are in use for example for real-time data capture in research work and for word processing.

Veterinary Clinical Studies have made use of central services for over 10 years, initially for Fortran programming and later for database systems when an IDMS based clinical/ epidemiological facility was developed. This has recently been superseded by a system based on Oracle on the central service VAX. They also make use of central systems for statistical analysis.

Veterinary Pathology are involved in DNA sequencing with the Molecular Biologists and they make use of a limited number of in-house micro computers for word processing.

CTVM make use of a variety of micro computers for word processing and real-time data capture and make use of central mainframes for data handling and filestorage.

#### 3.8.1 Observations

Computing within the Faculty of Veterinary Medicine is well established in certain areas but generally fragmented and it was difficult to develop a coherent overall picture. This could result from the lack of any overall co-ordination at a Faculty level and, based at two major sites, the Royal Dick Veterinary School at Summerhall and the Veterinary Field Station on the Bush Estate, their fragmentation might also be the result of geographic dispersion.

This faculty somehow seemed to be detached from the rest of the university computing environment, being more concerned with the practical application of current technology to current problems, without too much involvement in future developments, and leaving the "leading edge" work to others.

It is likely that computing will become an increasingly important tool for their research work over the next ten years and we feel that it would be in their interests to allocate more resource to computing development and support, and to manage their computing on a faculty wide basis.

### 3.9 Faculty of Music

A recent development in the Music Faculty has been the implementation of an Electronic Music studio. This involves some sophisticated real-time computing techniques and sound synthesis generates an enormous amount of data. Apart from this facility, their other major use of computing is in the Faculty Office for administrative purposes although they see an expansion into areas such as undergraduate teaching in the near future.

#### 3.9.1 Observations

Despite the lack of facilities within this faculty, the use being made is complex and interesting and their computing needs cannot be dismissed as minor. It will in due course consume large amounts of power and disc storage, and could require very high speed networking if central parallel processing facilities become involved. In future, they would like to see a local high performance processor located within the Faculty. It is expected that the use of computing will grow and in addition to further development of the Electronics Studio, staff will require access to systems for the production of teaching materials.

They hope to develop software for the production of musical notation and to encourage the use of computers amongst staff and students for conventional document production.

A high speed network connection into Alison House is required to support future developments.

# 4. COMPUTING AND TEACHING

## 4.1 Introduction

Computers are used widely throughout the university for the preparation of teaching material such as slides and lecture notes. In some departments, particularly in Science, computing is a necessary tool in the teaching of their disciplines and there are departments throughout the University where creative projects have been undertaken which have provided valuable experience and material.

There were however varying views on the benefits of computers to teaching except for the production by lecturers and students of papers and other materials. In the Faculty of Medicine for example, many departments stated that their teaching was dependent on students relating directly to patients and the human contact factor was critical. They could not see how this aspect could ever be replaced by computers.

## 4.2 Student Word Processing

A continuing growth in student use of word processing for essays and the like, is generally envisaged. The idea of students being able to submit word processed essays was desirable, the time saved in deciphering hand writing being considerable. It was also pointed out that if students were expected to submit word processed papers, then it would be necessary to ensure that they were provided with appropriate access to facilities and support. A common system solution for all undergraduates was considered desirable and there was some support for the suggestion that Fresher's week should be used to provide courses on basic keyboard skills, possibly provided by the Computing Service.

Basic keyboard skills for all new students and the concept of a wired campus with students submitting essays electronically had its attractions but many felt it was not desirable to eliminate the personal contact between student and lecturer possible with the current system.

The trend is toward teaching students basic word processing on micros which have a more "user-friendly" interface which cuts down the amount of tuition time involved in getting them started. This is an important factor in all areas of computers in teaching as the more time staff and students spend learning to use computers, the less time they have to spend on their own subject.

## 4.3 Undergraduate Computer Training

The Faculty of Divinity and certain other departments, felt that the Computing Service should play a bigger role in teaching students to use word processing or other standard packages. The ruling that undergraduates should be taught computing by their own departments was in their view an anachronism, dating back to 1963 when only Computer Science students needed such teaching, which should be reviewed.

## 4.4 Computer Aided Learning (CAL)

The work involved in developing CAL systems was a disincentive to many. Departments were ready to take advantage of any well proven teaching programmes that became available but at the moment there is a general lack of suitable material in this field. The lack of a central focus for computers in teaching support was another inhibiting factor and the need was highlighted for a greater cohesion between the Computing Service, the Teaching Learning and Assessment Centre and, in Arts, the Lanuage Learning Centre.

However, CAL was of interest in most areas, particularly in the language departments and it is expected that this will have a major impact on teaching practices over the next 10 years if sufficient facilities and support are made available.

### 4.5 Teaching Facilities

In general the trend appeared to be an increase in the use of computers in teaching with a declining use of central mainframe services coupled with an increase in local facilities, in particular laboratories of microcomputers or workstations. This is evidenced by, for example, the microlaboratories established in the Appleton Tower, Social Sciences, JCMB and Forestry and Natural Resources; the move by Computer Science to workstations, and the consideration being given within the Arts Faculty to a microlab for language learning purposes. The main benefits seen from this approach were improved access and reliability, the short learning curve involved in new students getting to grips with these systems and the user friendly facilities offered which were easier to tailor to suit particular needs. However, in some instances as stated by Computer Science, there were economic arguments in favour of using multi-user systems for teaching purposes and it is likely that there will continue to be a need, albeit a declining one, for access to central resources for this purpose.

In various departments concerns were expressed that the computing facilities available for teaching purposes in Edinburgh were inferior to those available elsewhere within the U.K., and particularly to those in universities in the United States. Examples were given of the disolusionment felt by new foreign students when they arrived in Edinburgh and compared the facilities offered with those they had seen in our brochures or they had experienced elsewhere. If this is a true position, then the attraction of this university to income generating students could diminish and further investigation is needed into this aspect.

It is possible that not enough emphasis has been placed on the use of computers for teaching purposes against that of research and whilst Edinburgh has a lead in the use of computers in the latter field, it could well be lagging behind in teaching facilities.

*A more detailed description of the use of computers in teaching, is given in* ***Appendix 4)***



## 5. COMPUTING AND RESEARCH

### 5.1 Introduction

The use of computing as a tool to aid research work is intensive throughout the University. At its most basic level it is used to word process research project reports and for project administration. At the other end of the spectrum it is an integral part of the most sophisticated research. The diversity of research activities and their different requirements has resulted in a diversity of solutions.

### 5.2 Facilities

#### 5.2.1 Central Facilities

Central services are still heavily used but the trend in recent years has been for their use to become more specialised, returning to the original role of large central machines with their main emphasis being on the support of large number crunching, statistical analysis, database management and the long term storage of valuable data which often needs to be widely accessed. They are also to a large extent acting as network "switches" for services such as electronic mail, the requirement for which is the fastest growing in computing in the University **(approx 30% per annum)**, and for the transfer of files of data and information.

For many departments, the continued use of the EMAS operating system as the major central service was seen as a hindrance as it was not compatible with their departmental systems. Perhaps more importantly, the applications software available on central and distributed systems was not compatible. This led many of them to concentrate more and more of their research computing on to local systems. However, there were others who felt that EMAS had much still to offer and were concerned about the possibility of it being replaced with a standard, but inferior, operating system. The prospect of a move away from a large multi-access system to a greater distribution of power was attractive to most but of great concern to those who currently carry out the bulk of their computing on central services. Their concern was mainly based on funding issues and the lack of staff to manage departmental facilities.

Although heavy EMAS users such as the Department of Physics are moving more of their research work on to specialised machines, it was clear that they and others saw a continuing need for some years to come for powerful centralised facilities which offer departments more than they can readily manage or afford themselves. These centralised facilities will be expected to adopt a more specialised role than the general multi-access, " all things to all men" facility currently offered by EMAS.

#### 5.2.2 Departmental Facilities

Departmental multi-user facilities continue to be a major computing force in the University's research work but their growth rate appears to have declined in recent years, particularly since the introduction of very high-powered desk top work stations such as the SUN. In common with centrally managed multi-user systems, these departmental systems are having to adopt a more specialised role, much the same as EMAS, but at a departmental level. In some cases, their main function now is to act as a departmental filestore connected to local workstations via a high speed local area network.

What was sought by most departments was the ability to transfer files from their local filestore to a central facility for longer term storage. Many also wanted the Computing Service to take over the management of their file storage and felt that central and local filestores should be compatible. This will require a far better network provision and higher level of integration of facilities, centrally and departmentally, than exists at the moment.

A large proportion of the 1700 plus microcomputers are used for research purposes, not only for word processing and other administrative tasks but also for real-time data capture,

statistical analysis, database management, the production of graphical material, image analysis etc. The research work of the university is as critically dependent on these systems as it is on central and more powerful departmental facilities. These systems offer convenience of access and use, particularly to the non-science departments and, as their power increases, it is becoming possible to carry out more and more tasks on them without having to resort to communicating with distant systems and incurring the costs involved. These are the main reasons why within Medicine, microcomputers predominate. Not only do they save money in communications charges from their widely dispersed accommodation, but micros also allow them to locate the system as near as possible to their research project which often involves a patient. This ability to have the system beside the project is becoming important to more than the medics as computers are increasingly integrated with other equipment.

It is inevitable that computing will increasingly be used as a tool for research purposes and that the increased power on desk-top systems will continue the current trend of more tasks being handled locally with central facilities being used more and more for specialised tasks.

### 5.3 Novel Architectures

Being a University, there will always be research problems which cannot be satisfied by standard hardware or packaged software and **very** large scale computations will be involved. The continuation of the developments in novel architectures will therefore be essential if this University's leading role in many areas of research is not to suffer. Today's novel architectures can often turn out to be tomorrow's "standard" solution, as witnessed by EMAS which in its day, was a major advance in the provision of computing facilities for researchers and gave those in Edinburgh a lead over their counterparts in other universities.

### 5.4 Information

All research depends on access to information and the more up-to date the information is, the better the results. Throughout every faculty, there was an expressed wish to have electronic access from researchers desks to information databases around the world. This is technically feasible at present but is restricted for financial reasons. Access to the major sources of information is channelled through the University Library which many researchers felt was restrictive. In their view, their international competitors have better access and this is assisting them to cut their project timescales considerably. Edinburgh is as a result losing its competitive edge in many areas for example in Business Studies and throughout the Medical Faculty. A mechanism for funding the provision of wider access to information sources is required.

### 5.5 Data Libaries

The Edinburgh Data Library is of increasing interest within departments including many outwith the Social Sciences who have been its traditional users. Information gathered during research is often of interest (and saleable) to others and the Data Library provides a suitable platform for making it more generally available. It is also seen as a suitable repository for information which needs long term storage, in some cases expected to be in excess of 100 years. As electronic data input methods improve, the amount of data which will require storage will increase enormously over the next ten years and the management and security of that data will be of paramount importance. This was seen as a major future requirement of the central service organisation.

### 5.6 DNA Sequencing

DNA sequence analysis is now an essential part of the research work of several departments not only in the Faculty of Science but also in Veterinary Medicine and Medicine. This work is currently based on the central VAX VMS service using the Wisconsin package and its large associated database. The demands of this package on both disc space and CPU are clearly exponential and if unconstrained will soon consume all spare VAX time throughout the University. The future provision of adequate facilities for this group of users requires urgent



consideration. It is possible that a dedicated resource, possibly based on novel architectures, might be required.

*(A more detailed description of the use of computers in research is given in **Appendix 5**)*

# 6. GENERAL OBSERVATIONS

## 6.1 Introduction

Every department had its own "wish list" of requirements and views on particular areas which affected them personally, much of which were of immediate rather than long term strategic concern ***(see Appendix 6)***. They also saw developments in a very localised manner and the following is an attempt to condense the various views into those aspects which were of general interest and of importance overall. All departments saw a continued substantial expansion in demand that would be constrained only by funding limitations.

## 6.2 Non Computer Users

It is our belief that the majority of staff within the University now make some use of computers in their daily work. Of those who said they did not use computers, one of the main reasons given for not doing so, was they did not have enough time to learn about them or to investigate possible uses.

## 6.3 Training

In various areas, but particularly in the Medical Faculty, staff found it difficult to spare time to attend training courses. During the departmental meetings, it was suggested that EUCS should review the way in which it presented training courses. It was not possible for many people to take several days off to attend courses and more short seminars spread over a number of weeks, possibly holding some outwith normal hours, were suggested as possible ways of overcoming this problem. On-site training with more emphasis on hands-on experience rather than lectures, was another frequent request in relation to training, particularly from non-scientific staff. The need to have equipment and software used on training courses which is consistent with what is installed in departments was emphasised in a number of areas.

It should be pointed out that moves have already been made to change the emphasis on the courses provided and equipment in the training area has been upgraded.

## 6.4 Documentation

A lot of departments felt EUCS documentation could be greatly improved. There were some signs of recent improvement but many felt that the documentation provided was "too technical" for the non-science user. The presentation also left a lot to be desired and discouraged prospective users. It was suggested by users in departments that a lot of the User Support staff workload could be eased if the answers to more simple questions could be easily found in documents.

## 6.5 Provision of Facilities

Another common message to emerge was the perceived lack of facilities. This was particularly true in areas such as the Arts Faculty where funding for computing was a major problem. Although this University is better equipped than most other U.K. universities in terms of installed equipment, there are areas where there is a desire amongst staff to make use of the new technology but they are unable to get their hands on it to get started.

## 6.6 Identifying Solutions

Many of those who said they did not use computers felt it was because the right system wasn't available for their work, and what was available wasn't easy enough to use. In discussions, most staff, including many in the scientific disciplines, merely wanted a tool which did not require them to spend large amounts of time becoming computer experts. Whilst there have been major advances in recent years in the usability of systems, in a University environment there are many applications where an "off-the-shelf" solution just isn't available. To develop such systems requires effort which often isn't available and is unlikely to be in the current financial

situation. In some cases, staff felt EUCS could give more help to them in identifying what was and wasn't possible from computers and it was suggested that perhaps the right systems were available but they just hadn't heard about them.

### 6.7 Home Computing

Many staff now work at home with computers, a practice which is likely to increase, and they want to bring data in the following day and mount it on a Departmental System. It is important therefore that equipment recommended for use within the University and the facilities provided, take into account the need for staff to have the opportunity to purchase compatible personal systems at a price that can be reasonably afforded.

### 6.8 Microcomputing

Microcomputing is now seen as the solution to many staff's computing requirements and the numbers installed are close to 2000. It is clear that many users share systems and many have access to more than one system. The growth in micro computing over the past five years has been considerable and in terms of numbers of users it is likely that this form of computing now dominates in this University.

From the results of the survey of departmental equipment, some consistency would now appear to be emerging on the hardware front. The IBM PC standard and Apple Macintosh tend to dominate current purchases. There are still a lot of BBC micros around and the problem of conversion of these to alternatives could arise in the not too distant future. Although these were originally purchased as terminals many are being used for other purposes and the conversion costs could be considerable. This will however be a problem which thousands of others will have to face and it is likely that tools to aid any conversion will be available. The Apricot/Sirius community is considerable but we believe that many of these have converted to an MS-DOS environment and most applications being run on them will be easily transferred to alternatives.

There is however a fairly widespread lack of confidence in EUCS's ability to provide micro support and this needs to be tackled. The lack of consistency might be explained by the continual technology developments over the past ten years. The high staff turnover in the area of micro support might have also added to this and to the support problems. The main complaints tended to focus on events which took place some time ago and it is possible that the new arrangements are proving to be more satisfactory but only time will tell.

Perhaps the greatest problems arising out of the explosion of microcomputing over the past few years have been those relating to management and support. The wide distribution of a wide variety of what are still complex pieces of equipment, often to a new type of user who expects a tool which can be switched on and be able to immediately perform the task it was purchased for, has placed new demands on the resources available for computing support within the University. These demands are likely to continue to increase over the next 10 years as the technology matures and its use becomes even more widely applicable. A more effective hardware and software policy will be required if support staff are not to be overwhelmed.

### 6.9 Word Processing

In terms of numbers of users, word processing is the main application throughout the University and will continue to dominate. A wide variety of solutions have been adopted with many departments having several different word processing systems in use which creates problems when staff wish to transfer information for further processing. Major complaints were voiced in a lot of departments about the word processing policy adopted in the past. The lack of consistency, the change from Offload to Wordcraft, the support arrangement changes, staff turnover and a perceived lack of proper recognition of the requirements of word processors were common concerns. This application area, and office systems in general, require a more effective policy on choice of systems and on the management and support of them.



### 6.10 Electronic Mail

Electronic Mail is a facility which, given a wider distribution of network connections, will also continue to be one of the major applications of computing in Edinburgh. During departmental meetings, it was clear that there is a need, greater than is being catered for at the moment, to have access to this facility. Most Faculties see the use of Electronic Mail, on a local, national and international basis as being highly beneficial to their work. The use of Mail would enhance the joint drafting of papers on an intra and inter-university, particularly on an international basis, and could reduce considerably timescales for joint research projects. Also collaboration between departments within this university and elsewhere for certain courses and research projects will mean students accessing facilities from a distance and effective communications between departments will be crucial.

### 6.11 Network Costs

The cost of network connections was a concern in many areas and the real money charges incurred are an inhibiting factor. The apparent bureaucracy in connection arrangements was another major concern raised in this area and many felt we should be aiming for a situation similar to the telephone network where nearly every office had a connection installed which was paid for centrally. The issue of how network connections are funded and installed is an old issue which obviously still causes concern in many areas and needs further consideration.

### 6.12 Database Management

The large number of users who said they carried out database management was surprising considering the supposed lack of such facilities on central systems over the years. However, it is clear from the responses to the equipment survey that a large number of microcomputers are being used for this type of application and, judging by the number who said they used EMAS for DBMS, it would also appear that much bespoke software has been utilised in the absence of packaged software.

Data collection, management and analysis and the ability to share the data and results are areas which will grow over the next ten years. Large amounts of secure data storage with appropriate user friendly packages to manipulate it will be required and centralised databases for reference, given suitable access mechanisms, could be widely beneficial.

### 6.13 Text Retrieval and Analysis

Many departments saw a need to analyse qualitative data and were hoping that suitable software would become available for such a purpose. Free format natural language text databases which permit sophisticated manipulation and analysis, will be essential for a number of departments.

From departmental discussions, it is clear that there is a substantial demand for this type of facility within Edinburgh and not only, as might be expected, from the Arts Faculty. The lack of an appropriate package on central systems was felt to be a serious deficiency

### 6.14 EMAS

#### 6.14.1 Bespoke Software

The bespoke software section of the staff survey and comments made during departmental discussions, suggest there could be a substantial exercise involved in any transfer from EMAS to an alternative. It emerged from this survey and from observations elsewhere that over the past 15 years, many users have developed their own software, much of it in IMP, and a few have used EMAS specific features. It is also clear that there is some software in use for which the source code is not available, or the author is unknown. Further investigation will be required in the immediate future into the actual scale of the problem. It is also likely that an IMP compiler will be required on any replacement systems.

### 6.14.2 Future of EMAS

The responses to the questions asked in the survey of staff are in-line with the recommendation of the ERCC Review Committee and are also consistent with the responses received during most Departmental meetings. Although many users were complimentary about the role EMAS had played in this University, most were resigned to the possibility of it being replaced. The main concern seemed to be that whatever it was replaced with, the main facilities currently offered should continue to be available. Most were prepared to accept possible degredation in a few areas but expected this to be compensated for in others by the adoption of a more universally available option which would open up new opportunities.

Concern was expressed in several areas about the prospect of EMAS being replaced by a more distributed solution without there being any adjustments to the current funding arrangements for computing. Many departments currently used central services not through choice, but because they were "free".

## 6.15 VMS

Most users of the ERCVAX service at departmental meetings expressed their satisfaction with the overall quality of service and felt it should be enhanced in the future. There was a general view that it suffered from being continually under-resourced particularly in terms of disc space and support staff. From discussions, it is apparent that part of the perceived support deficiency arises from the lack of exprience amongst EUCS User Support staff in VMS and the packages available on it. It was also pointed out that the current systems team of 2 was inadequate and that support to distributed VMS systems should be enhanced.

## 6.16 UNIX

The number of UNIX users who responded to the individual survey was surprisingly small when one considers that in this University there are over 200 MIPs of UNIX and less than 20 MIPS each of EMAS and VMS!

Overall, UNIX users liked UNIX and wanted more of it. Perhaps reflecting the type of user, the majority wanted more in the shape of departmental systems, but the installation of a central UNIX service, even one based on a basically non-UNIX system, was attractive.

The subject of UNIX arose throughout our discussions at departmental meetings. The fact that it offered manufacturer independence was a major incentive and whilst portability of software between systems was not quite as simple as was made out by some, it was probably easier across a range of hardware options than was possible with any other operating system. This is recognised in the recent decision by Government to make UNIX a mandatory requirement in all government computer procurements.

The main grey area that emerged on the UNIX front was at the applications software level. It was not clear how many of the packages currently run on EMAS and the ERCVAX could be mounted on UNIX, nor how good the performance would be. Even if we scrapped central systems altogether and moved towards only distributed solutions, there would be a need to provide packages such as Oracle, SPSSX, SIR etc.

## 6.17 Desk-Top Computing

The type of local work group with their workstations, local file store and high speed networking which has developed amongst the UNIX community, reflects the kind of environment that is now showing signs of emerging amongst micro-users within this University and elsewhere. For many this set-up is more attractive than direct connections to departmental or central multi-user systems which do not offer users the same level of user friendly interface nor the same level of control over their own destinies, as as they get from desk-top processing. At the same time it allows data and information to be shared on a wider basis in much the same way as



centralised facilities. This trend towards placing more of the power on the user's desk is not a local phenomenon. Although there are management and other problems associated with such arrangements they are finding acceptability throughout the University community, in industry and with nearly every major manufacturer.

## 6.18 Specialised Central Services

Powerful computer facilities based on novel architectures will be required for the solution of particular problems in computational physics but they are also of interest to several other departments within Science and other faculties. Much of the work on these new parallel architecture systems is into new areas of research which were not previously large scale users of central facilities. However at the moment, outside of a narrow community, the majority of people in the University just don't know what a parallel or vector processor or transputer can do for them. Even amongst the science disciplines, the benefits of these machines are often unclear. If we want to widen the base of the parallel processing community , then we will have to explain it in much simpler terms. It is possible that it will be several years before the benefits seen at the moment by the physicists and others, will become apparent to the masses and possibly this technology will remain a specialised tool for use by highly scientific users and will never be more widely applicable. It might on the other hand become the standard architecture of tomorrows general purpose computers.

## 6.19 Integrated Processing

The idea of integrated processing where the machine on the desk talks the same language as the machine in the centre or elsewhere, without the user having to be aware of it, was attractive to most people spoken to and seems to be confirmed by the staff survey. The current situation of several user interfaces when using micros, minis and mainframes causes problems for a lot of people. The need to log on and log off to send messages and files and to learn another "language" to do so, is a disincentive to many people.

## 6.20 Specialised Input/Output Devices

Although many Departments wanted centrally provided high quality specialised input/output devices, most would prefer to have them as near to their desk as possible. There will always be some facilities which can only be funded centrally but for present day items such as laser printers, most would prefer to have them installed within their Department if not within their own office.

## 6.21 Graphical Imaging

Increasingly sophisticated imaging techniques will become a necessity in many areas and the ability to transmit these images between researchers might impact upon networking requirements.

## 6.22 Software Investment

In a variety of ways, several departments stated that given the trend in the ratio of software to hardware costs, it was important for the central facilities and the individual user that investment in software was preserved as far as possible and that the choice of new machines should be based less on hardware peformance than on the software commitment to support and development of the operating system and compatibility with a range of machines. A smooth transition to any new environment was demanded by all current users of central services.

## 6.23 Software Procurement

The central provision of packages which were too expensive to consider on an individual basis was another stated requirement but many felt that the user interface across the network to centrally provided packages must be improved. It was also felt that the same packages should be supported across a range of systems. A central library of software for microcomputers that

could be taken out on loan was suggested . It was also believed that site licences should be negotiated by the Computing Service for software wherever possible.

### 6.24 Expert Systems

The use of AI based tools, especially expert system shells, was increasing and it was suggested that it could no longer be claimed that these were of interest only to the Department of A.I. and should be centrally supported. Considerable interest was shown in the creation of expert systems and it is expected that these will eventually be of central importance for teaching and research.

### 6.25 New Storage Technology

Video disc technology is already being introduced in several departments and it is possible that this new technology could make an impact on teaching practices in a number of areas. Access to these facilities in student halls of residence and in libraries would be desirable.

### 6.26 Data Input

A major barrier to the use of computing in research in many departments was data input. Devices such as document or optical character reading facilities which would assist with this, were universally required.



# 7. SUPPORT

### 7.1 Introduction

Support for computing is provided in various ways within the University. In addition to the Computing Service, M.I.S. provides support to over 50 administrative and related units and the University Library supports distributed Libraries. Both of them use EUCS for communications support and in the Library's case for other technical support.

### 7.2 EUCS Support

EUCS has traditionally provided user support to all departments but, as computing facilities moved to departments, so too did the need to have on-site departmental computing officers to the extent where there are now 49 of them ***(see Appendix 8)***.

During 1987 the Computing Service made major changes to its user support arrangements. These involved teams of support staff being allocated to the support of groups of departments within the University in broadly related areas. On the whole these new arrangements were very well received by departments although it was recognised that further improvements could be made particularly in the number of staff involved in user support.

There was also a common view that the installation of equipment within the Computing Service which was more closely related to departmental facilities, would greatly improve matters. The use of EMAS was felt to have resulted in not only systems staff being familiar with a system which was of diminishing importance to many departments, but that the rest of the Service was also EMAS orientated. This has resulted in the experience of departmental staff being in advance of central staff, which discourages mutual co-operation.

Those Science departments who had a number of their own computing officers saw little benefit from the EUCS User Support teams as they had little experience in relevant areas. The main support sought by these departments was for procurement of hardware and software. Also, what was repeatedly requested, in various forms, was help with the labour intensive parts of running a departmental machine:- backup, negotiating and obtaining maintenance, software licensing and general trouble shooting.

### 7.3 Support in Departments

Many departments had, often without knowing, developed their computing to the stage where full-time professional computing support was required within the department, but they were faced with the choice of either giving up an academic post or doing without and relying on the Computing Service. In most cases, they chose the latter option. Faculties such as Arts, Law and Divinity have suffered badly as a result of the lack of dedicated computing support resource.

It was suggested that time spent by EUCS staff in departments would be beneficial as they could be trained in more advanced techniques and relate this back to other parts of the service. Electrical Engineering felt that the part-time secondment of a member of EUCS to their department had been very successful.

Placing computing support staff within departments was generally desirable but many felt they should be managed by the department and should be qualified in a similar discipline. Others were concerned about the possibility of departmental computing staff being isolated from more general developments around the University and felt it would be better to "borrow" EUCS staff for a period of time to satisfy the needs of a particular project. Looking at the experiences of those departments who already have their own staff, it would really depend on the indivduals involved and on their departmental outlook. In most cases, departmental computing staff fulfill a function different from that of the central support staff and the two complement each other. Departmental staff know their own users and subject area in more detail and their priorities are defined by their Head of Department which avoids any conflict of interest. It was felt that

Central support staff have a wider knowledge and access to expertise which might not be visible at a departmental level, and the new user support arrangements provide them with the opportunity to get to know specific application areas in more detail than the previous arrangements.

### 7.4 Clerical Staff Support

Most of the complaints related to past user support arrangements and the main criticism tended to relate to the lack of consistency in advice which had left many departments with a variety of incompatible hardware and software.

Possibly the most critical users of EUCS support were clerical staff who had often borne the brunt of changes in policy on word processing packages, support agencies and staff in recent years. Their expectations of support were different from most academic staff in that they worked under different pressures and expected an "immediate fix" to problems as much of their work was time critical. Also, unlike many academics, they were on the whole less inclined to delve into a system to get it to work and wanted something which could be switched on in much the same way as their typewriter. However, in a lot of departments, there was high praise for secretarial staff who had mastered the basics not only of word processing but also spreadsheets and databases and other office tools.

Problems relating to departmental office staff support were related in many ways to the problems described for departmental administration in ***Section 9.*** There has been a multitude of organisations and staff involved in office systems support over the years and a clear long term office system support policy is needed.

### 7.5 User Support Staffing Levels

There was a general feeling that the area of user support was still under-resourced particularly in Medicine, and that staff should in future be qualified in a discipline of the area they were expected to provide support in. It was felt in more than one area that EUCS should provide more assistance at the applications level rather than just giving basic hardware and software advice. Throughout every faculty, it was emphasised that they wanted a computer as a tool and were not interested in computing for computing's sake.

### 7.6 Training and Documentation

As stated earlier, certain departments were critical of EUCS training courses and it was suggested that courses should be modularised as staff often could not spare time to attend courses lasting several continuous days. It was also suggested that more thought should be given to presentation and more emphasis should be placed on "hands-on" tution rather than lectures. There was also some criticism of EUCS documentation which didn't cater for the differing types of users and it was suggested that users should be consulted more about the contents of documents.

It was generally felt that primary functions of the Computing Service over the next ten years should be the provision of effective training for computer users throughout the University, and the production of documentation which enhanced that provided by manufacturers, and which was geared to suit the needs of the varying levels of users. This would require a greater degree of investment than in the past.

There was also some confusion over who was responsible for training in certain areas particularly in Office systems. EUCS, MIS and the Personnel Office had all at some time or other played a part in this activity. A clear definition of responsibility is required.



## 8. COMMUNICATIONS

### 8.1 Introduction

The layout of the Edinburgh communications and the number of X25 PAD connections per Faculty are given in ***Appendix 3.***

The communications network in Edinburgh (EDNET) is more extensive than in any other U.K. University. Although relatively well provided for, there was a common belief that access was still inadequate and that a programme of wiring every office should be undertaken.

### 8.2 LANs

The bulk of the connections are to X25 PAD ports with an increasing number of Ethernet local area networks being installed in more advanced departments. These are mainly used for connecting departmental multi-user systems and high-powered workstations. There was widespread scepticism amongst these departments about the Joint Network Team policy on LAN Open System networking standards.

Local area networks for microcomputers have made little impact within the University mainly because of the cost involved, in some cases in the region of £1000 per connection including software, which compares unfavourably with the cost of the latest IBM PC clones. There are a number of proprietary LANs in use, for example where there are concentrations of Apple Macintoshs using the Apple network. The main deficiency seen is the lack of a micro LAN which can support connections between the wide variety of equipment installed within single departments and also allow every micro access to the Wide Area Network. It was felt that the Computing Service should identify a solution in this area.

### 8.3 High Speed Spine

Funds have been provided by the Computer Board for the Computing Service to implement a high speed spine network initially to serve the King's Building's campus. Various plans are under consideration for the extension of this network to serve the Central area, and planning is also underway to upgrade it to a very high speed network in the 1990s, both developments being dependent on adequate funding being available ***(see Appendix 3).*** These moves were welcomed by most departments although reservations were expressed about the main effort once again being concentrated on King's Buildings. It was hoped that more remote sites would not be excluded from the high speed facilities.

### 8.4 Network Support

Several departments were critical of the network support offered in the past by the Computing Service, suggesting that it had failed to stay in step with the requirements of advanced departments. This was felt to have hindered developments and led to some moving forward more rapidly than the Computing Service and developing their own expertise. It was their view that the Computing Service should be "ahead of the pack" and be leading networking developments on a local as well as wide area basis.

### 8.5 Connection Provision

The provision on EDNET varies considerably depending to a large extent on where the department is located geographically and on their funding position. In general, the closer departments are to the centre of the University, i.e. where circuits are cheaper, the better the provision.

The growing number of collaborative projects, mergers and joint courses between departments in this university and externally, makes it increasingly important that widespread access to

high speed communications facilities is available to all departments. Electronic Mail was a requirement in every faculty. Some departments had not yet reached the critical number of network connections to make the use of Electronic Mail viable on a local basis and were unlikely to if the problem of connection costs was not overcome. Also, the growing number of joint courses will require a network which will offer access to remote facilities which is as close as possible to what is offered on directly connected terminals.

### 8.6 Connection Costs

The most frequent problem raised in relation to communications was the costs involved in installing and maintaining a connection. Real money charges were a barrier to a greater distribution of connections particularly for the non-science departments whose Class Grants were insufficient to meet the recurrent charges involved. From those who were geographically distant from George Square and King's Buildings, there was a view that the University should allow for this and contribute towards ensuring that their provision was at a level similar to that of departments who were fortunate enough to be located centrally.

There was a widespread opinion that a different funding mechanism should be found which would allow connections to the data network to be made as widely available as connections to the telephone network. The situation where telephones are paid for centrally and appear to be "free" to departments whilst data connections had to be paid for direct by each user, seemed unjust to a large part of the University. There was also some discontent in most faculties over the time and effort it took to get new installations planned and installed and again they were unhappy about the costs involved.

Whatever the solution is to the funding problem, there is a desire throughout for network connections to be widely available ideally with a socket at every desk.

### 8.7 Sub-Networks

The University Library has it own sub-network established to support direct connections to its GEAC system for distributed libraries. Various problems have been encountered with integrating the Libraries system into the standard Wide Area network and these are covered in ***Section 10.*** M.I.S. have also developed a network of terminals directly connected to their IBM mainframe which is connected as a Host to EDNET. They are now considering distributing direct connections to Faculty offices to overcome deficiencies in the current arrangements which involve Faculty micros connecting to EDNET using a 3270 emulator. The concerns over M.I.S. communications are described more fully in ***Section 9.***

The main concern relating to the establishment of substantial networks running in parallel with EDNET is the additional costs involved to the University. If this situation continues, there could be an EDNET, a Library network and a M.I.S. network connection into every department! This contradicts Edinburgh's original networking philosophy which was described earlier.

### 8.8 Medical Networking

Within the Faculty of Medicine, there was a special problem in relation to communications created by the wide geographic split of departments and the dual role and location of many of their staff. Much of the data required to carry out their research work is located on Health Board systems and many of their working contacts which could benefit from facilities such as Electronic Mail, are purely Health Board. The level of security required for such data is also greater than that normally expected for university research purposes. Lothian Health Board are only now implementing an X25 based wide area network to a limited number of centres. No plans have been made for any connection between the University network and the Health Boards and they are, for security reasons, unlikely to encourage such a link.

Medicine could benefit considerably from improved network connections, even within a University context, in view of their dispersed nature but any real benefit will only be gained if there is also improved access to Health Board facilities. Further discussions need to take place



between the University and the Health Board on how to overcome this problem and also to decide on where responsibility lies for the provision and funding of connections.

### 8.9 Future Role

It was clear that there will continue to be a substantial growth in demand for networking over the next 10 years and that greater speeds and accessibility will be required. The view from a number of informed sources was that the provision of an advanced, high speed, reliable communications network should be the main service offered by the Computing Service over the next decade.

# 9. ADMINISTRATIVE COMPUTING

## 9.1 Introduction

The main focal point for administrative computing in the University is the Management Information Services Unit which has concentrated in the past on servicing units within the Secretary and Finance Offices, all of which have been located in, or close to, Old College. In recent years, responsibility for computing within Faculty Offices has also passed to them and communications links have been established through EDNET, although consideration is being given to direct connections.

What was observed in nearly every department was a desperate need for a reduction in the amount of of skilled time involved in resolving differences in budgets, grants, class lists etc. and in reducing the amount of paper work and duplication of effort . Departments want to get at information available in Old College electronically and to be able to manipulate and update it without having to rekey, restructure and check every record. The Faculty Officers shared these concerns and were also highly critical of the current policy which restricted access to information on the MIS machine which meant that most of their needs could not be satisfied. Much of the information which they required was transferred to them manually and had then to be re-entered into their local microcomputer.

During discussions with departments and Faculty Officers it was apparent that there is a total lack of any overall policy for administrative systems within the university and that this is partly a result of their being a lack of any policy on administrative procedures and a multiplicity of organisations and individuals having been involved in support in this area. In some cases departments have sought advice from the Computing Service, in others from M.I.S. Possibly more frequently, systems have been developed by an enthusiastic academic purely to provide a "quick fix" for an immediate requirement for which there was no centrally recommended solution. Even within Old College, some units have not sought advice from MIS or have not accepted the advice given and have adopted their own preferred solution.

Many continue with manual methods only, and in a large proportion of cases the only administrative use is for word processing. A variety of spreadsheets and databases are filtering in to some areas but again there is no overall consistency either in systems chosen or practices adopted. Some commonality has developed in certain areas such as word processing where there have been centrally recommended options but even here there are several systems in use. A plea was made by more than one department for a properly supported, fully integrated, office systems environment.

## 9.2 Access to Information

The bulk of MIS computing is done on an IBM 4381 running the VM/CMS Operating System. Some of the data on the machine is highly confidential and IBM operating systems were not, at the time of installation at least, noted for their exceptional security when on an open network. Consequently terminal provision is by direct connection of 3270 terminals from secure or trusted offices. This limited access eased any security problems but it had the unfortunate side effect of encouraging the use of software particularly tailored to these devices. It is hard to escape the conclusion that inadequate investment has been made in remote access as compared to direct Old College access.

There is no obvious consensus on how or where administrative data should be stored. MIS feel it should kept on the DPU machine and this is probably best for highly confidential data. However less confidential data like class lists, could be distributed or kept centrally. MIS's wish to centralise everything does not seem very sensible - the Medical Faculty with its large variety of clinical classes needs much more elaborate records than (say) Arts; however distribution requires a revolution in both communications, which is coming, and thinking.

If the wider view of administrative computing is accepted, as it would be in a commercial organization, MIS becomes the key to substantial efficiency improvements throughout the University; it does however require different priorities from MIS. In particular records will mostly be distributed, all access should be via EDNET not an MIS network and as many as possible of the many micros and workstations should be able to complement the MIS provision by mounting suitable software.

### 9.3 Remit of M.I.S.

The objectives of MIS are defined by the University's Academic plan as "to provide and support computer and related systems for the handling of information required by the University's administration in its efforts to achieve the Academic Plan". MIS interprets this to require the provision of:-

a) A central Computer to manage the key records of the University

b) A Network(sic) to link users in administration with the computer, each other and other networks including EDNET.

c) Microcomputers and terminals to access and complement the mainframe service

Provision of a central computer and private network in an increasingly distributed computing scene clearly presume that administration is an activity confined to a small number of people in the Old College area. Yet almost any academic considers himself involved in, if not bogged down by, administration. It is clear also that this unstated assumption is also the reason why departmental administrative computing is almost totally divorced from MIS computing and largely unco-ordinated.

If the narrow view of administrative computing is accepted the objectives of MIS in the 1990s appear modest but sensible. This view would however, leave departments out in the cold without guidance or access to data, a logical consequence of the feeling that all serious administration was performed in the central area.

### 9.4 Policy

We understand that a strategy for management information systems is currently being developed but what gave cause for some concern was the apparent lack of any clear policy statement on the MIS unit's area of responsibility or a plan of the overall administrative function and the various inter-relationships which impact upon the exchange of data and information for administrative purposes. A policy for financial systems is being developed without any apparent attempt being made to relate this development to others that are going on, for example in the Personnel Office.

It is unlikely that a sensible administrative computing strategy will ever be possible unless there is a recognition at every level that administration is a university wide activity. An overall strategy must be defined and changes implemented which will allow an overall management information system to be introduced and enforced. This should not be taken to mean a monolithic system based in Old College which is accessible to a chosen few.

As it has to be accepted that administration is a university wide function and all the relevant parts of it must be integrated, then it must also be recognised that administration is only one small part of the university's overall activities and must therefore be integrated more fully with the overall computing environment to enable the easy exchange of data and information. It should be possible to achieve this and to still provide the level of security required for confidential information.

It must also be said that departments will have to be more receptive to the introduction of systems which are perhaps consistent with a central policy but might not be consistent with the preferred choice of academics in the department. At the same time any central recommendations



must be attractive to departments if confidence is to be gained in any overall strategy.

### 9.5 Implementation

If the University was a commercial organisation it would impose a uniform, but almost certainly highly distributed, office system over all faculties and departments. The substantial cost would be recovered by staff savings and better quality of management information. Given the high degree of numeracy in the University and the substantial ingenuity already shown, many of the benefits of a large investment program could be achieved by pragmatic, but carefully co-ordinated, measures leading slowly to more convergence, better use of existing equipment, and less untidiness.

# 10. LIBRARY COMPUTING

## 10.1 Introduction

Library computing was initially conceived as an internal automation project with little wider relevance. The aims were the automation of circulation, acquisition and serial control, together with the transfer of the catalogue from a manual to an electronic format. The latter is a prodigious project taking seven years and requiring the aid of staff supplied by the Manpower Services Agency.

A specialized supplier of library equipment, GEAC, was chosen for the first contract and their offering, a GEAC 8000, was installed. By the later half of the 1980s the machine was overloaded and a new machine was required. A difficult choice presented itself; the claims of compatibility pointed to a further GEAC machine whilst the wider aspects of the Library's role in information technology suggested a machine with secure and powerful communications. In fact a further GEAC, the 9000, has been installed and the transfer of work has begun.

The long term aims of the LIbrary for its involvement in information technology are excellent; however the drastic nature of the transformation from a parochial internal service to an open service dealing with thousands of staff and students does not yet seem to be fully realised.

## 10.2 GEAC Machines

GEAC Computers are a specialized manufacturer of hardware and software for library and banking operations. They are the foremost library supplier in the UK and of substantial importance in the USA and Europe. Their equipment is used in several UK Universities although the majority have adopted standard solutions. GEAC's specialized nature, and particularly the use of their own operating system, has cut GEAC off from other University developments and in particular from the "Coloured Books" range of communication software. The GEAC 8000 has in general given a satisfactory and user friendly service via its directly connected terminals but it came without any X25 communications software which was still under development. The communication throughput, once the X25 software was ready, has been disappointing and user access to the catalogue was not possible. To remedy this shortfall the Cambridge CATS software was obtained and mounted on EMAS, which has excellent communications but no other special attributes that might make it suitable for library work. The resulting service has been widely used from all areas of the University.

As the GEAC 8000 became overloaded, the Library negotiated for a more powerful 9000 machine. However GEAC were now in financial difficulties; as library computing evolved from a specialised corner to a form of information processing, GEAC had to write more and more software to support their customers. Competition from special packages running on general purpose systems, which had a much better software and communication infrastructure was eroding GEAC's market. However GEAC's problems were resolved, temporarily at least, and the University purchased a 9000 at a heavily discounted price, but once again the communication software was promised rather than demonstrable. The contract specifies functionality and performance for communications which, if met, would be adequate. Nevertheless GEAC's record in this area is not good and the Library has accepted a risk that most commercial firms would have avoided.

## 10.3 Distributed Libraries

The University Library has more than a dozen satellite libraries around the campus. The GEAC serves these as well as the Main LIbrary; the normal means of access is via a GEAC terminal directly connected over a dedicated British Telecom line. Some libraries also have an EDNET X25 terminal for electronic mail, access to the CATs software on EMAS and other central services. The Library thus maintains its own network parallel to, though much less extensive than EDNET.

Special mention is required of the Erskine Medical Library whose specialised facilities are relevant to Lothian Health Board and its staff, MRC funded staff and University research staff. The problems of providing service to these dispersed and disparate departments is discussed further under Medical Faculty.

### 10.4 Collaboration

Apart from the continuing collaboration with GEAC to improve and validate the 9000 software, the library is involved in several other co-operative projects. It is a member of CURL (Consortium of University Research Libraries) which is mounting a database in Manchester using the CATs software. It is also involved in projects for inter-library loans and the linking of the British Library and the National Library of Scotland via the JANET Network. A particularly promising project from the users point of view is SALBIN which aims to provide access via JANET to all the Scottish Academic Library catalogues.

It should be noted that all these projects demand reliable communications and if there was a greater co-ordination of systems installed within U.K. university libraries, then many of the deficiencies which projects such as SALBIN were set up to overcome, would not have arisen in the first place.

### 10.5 General Observations

The Library is involved in providing information to staff and students from its own resources and from libraries world wide. It also provides information to researchers far beyond the confines of the campus. The first requirement for a library system is a base of first class communications backed by a supplier with a proven record in managing transitions as protocols and standards evolve. Library requirements are important, clearly so too are good communications and, with the purchase of the GEAC 9000, this point seems to have been overlooked.

EUL and EUCS staff fervently hope that the GEAC's communications will prove satisfactory and evolve smoothly towards OSI. Even the best scenario leaves the linking of the GEAC to the proposed high speed spine a very grey area, whilst the worst outcome would be a disaster that could not be remedied for the sums the University would be entitled to withhold from the machines purchase price.

We believe that a small group should be set up under the CPC to produce a contingency plan in case GEAC's communications are not satisfactory. This group should also evaluate the available library software that runs on the principal systems which EUCS maintains viz:- Unix and VMS. This knowledge would be available in case any off-loading of function proved necessary to lower the demands on the communication software.

The aim of the library should first be to evolve from its private network to X25 working over EDNET for all operations except retro-cataloguing. This would provide a more standard base point for future evolution. In the long term the aim should be to run specialist software on a standard system. If the system chosen was one in common use around the University real savings in staff and maintenance would be possible.



## 11. COMPUTING SERVICE REVIEW

### 11.1 Introduction

The Edinburgh University Computing Service (EUCS) provides services to all departments within the University and to related organisations. These services take the form of central multi-access systems such as the EMAS, VAX VMS and UNIX services. In addition, EUCS supports the wide area data communications network and provides technical and user support in various aspects of the use of its central facilities and for distributed computing. It also acts as a procurement agency for computing equipment and software.

Most of the main issues and concerns relating to the EUCS services which were raised by users have been covered in the earlier sections of this paper. Also, in 1985/86 a major review was undertaken of the ERCC which identified organisational improvements and most of the Review Committee's proposals have been, or are in the process of being, implemented. The impression gained from discussions is that the changes have generally proved successful in the eyes of computing users although there are areas where further progress is expected. Of the list of recommendations made by that committee, we would make the following observations following our meetings with departments. Comments relating to the Committee's conclusions on Management and Funding are included in ***Section 12***.

### 11.2 Organisation

The Review Committee suggested a change to the organisation to emphasise a more service orientated outlook. These changes have now taken place with the merger of ERCC and CAST and the distribution of more staff resource into the area of user support. As is explained in ***Section 7***, these changes have been generally welcomed, but further improvements are still required particularly in the number of people dedicated to user support. Also, further improvement is required in support at an applications level. Many departments feel that the Computing Service should be providing support to users in applying the technology to do a job of work. At the moment there is a perception that all that is provided is advice on what hardware and software is needed and the user is then left to get on with doing the rest himself. Whilst this might be acceptable in those departments who have either their own dedicated computing support staff or an enthusiastic academic, it is not in the majority of departments, who have none of these. The question of how to provide departments with applications level support has still to be resolved.

### 11.3 Network Services

The Committee endorsed the Computing Service's adoption of international standards for data networking. On the whole this was accepted but those departments who had their own local area networks were scathing about the policies being enforced by the Joint Network Team and the Computing Service in relation to Ethernet Open Systems protocols.

Also, the Committee said the network should be seen as a means of transmission of information in electronic form rather than as a link between terminals and central computers. To some extent this is happening as shown by the increasing use of electronic MAIL and for file transfer both of which often include document interchange. The proposed spine network also meets the aims stated in their report.

Where there is still some way to go is in the improvement of the user interface of networking. Most users don't want to know about the details. They want to use it as simply as they use the telephone network and they want instructions on how to use it to be equally simplistic. For a large number of users the steps involved in using services such as MAIL and File Transfer are a deterrent. These are not solely network problems as they relate to the user interface on central and distributed systems but users are not concerned where the problem lies. They want a "tool" and couldn't care less whose problem it is. The documentation on the use of network facilities could be greatly improved to make life easier for the non-scientific user and steps have already been taken on this front, but the only answer will be a common user interface across the

network which removes the current need to know several different systems just to send a Mail message from the micro on your desk.

### 11.4 Central and Distributed Systems

#### 11.4.1 Central Interactive Service

The Committee believed that there would be a continuing role for a central interactive service until 1990 and beyond. Our observations show that many EMAS users are likely to move to workstations or specialised systems over the next few years and that the need for a central interactive service will decline. However, this will be a gradual decline so it will take some time after 1990 before the need for interactive services is eliminated altogether. In its place will be specialised central resources (eg. for long term file storage, very large scale number crunching, shared databases etc.), with fast network access to distributed workstations.

#### 11.4.2 EMAS

Our discussions showed that many EMAS users agree with the Committee's statement that EMAS was, and in many respects continues to be, the best available operating system for providing a general interactive computing service. However, as stated elsewhere, most were resigned to the possibility of it being replaced. The main concerns relating to its possible replacement by a more distributed arrangement related to funding arrangements and support for departmental facilities. All EMAS users also asked that any transition should be made as smooth and free of pain as possible!

#### 11.4.3 Other Operating System

The committee recommended that another operating system be identified to run in tandem with EMAS until 1990. This has not occurred although there has been an increase in the level of central UNIX and VMS facilities. From our departmental discussions, we see no need to introduce a further operating system. The main systems base in the University, apart from microcomputers, involve UNIX and VMS and, by concentrating on these options, some of the difficulties described throughout this paper relating to fragmentation and lack of integration, might be overcome.

#### 11.4.4 Future Development of EMAS

It was stated by the Review Committee that there should be no further development of EMAS beyond 1990 and that thereafter another operating system should assume the main service role, although EMAS might continue for a period in a much reduced role after that date. We see this happening as a gradual transition. As EMAS declines then users will move to other facilities either centrally based or within departments. However, in view of the size of task involved in transferring 20 years of data from EMAS and ensuring that user demands for a smooth transition are achieved, then it is likely that it will take some years after 1990 before it is possible to dispense completely with this system. This will mean maintaining an EMAS provision in some form or other in addition to any new facilities installed in 1990. How this is funded, either from within the 1990 replacement money or from other sources, will have to be considered.

#### 11.4.5 Filestore

We do not feel that the Committee's statement that the Computing Service should provide a long-term storage system which was functionally distinct from the central computers is relevant to a post-EMAS situation. The first part is accurate and is the expressed wish of most departments but as for the second part, the aim should be to arrive at a more integrated environment. To achieve this, it will be necessary to have central systems which are consistent with those in departments. Given that this consistency is arrived at, the need to have a filestore which is funtionally separate from other facilities is questionable. What will be needed is a university wide, integrated, hierarchical file storage system which allows users to store data on their desk, in their department or, when they want very secure long term storage, to be able to



ship it quickly and easily to a centrally managed system.

#### 11.4.6 Distributed Computing Support

The Committee stated that the Computing Service should become more of a supporter of distributed computing rather than a provider of central services. This movement continues to take place, perhaps not as quickly as some users would desire it but the increase in user support staff is an example. Some departments still felt that more could be done particularly in assisting with managing their departmental systems and in carrying out operational duties on them. It was felt that the situation would only improve after the systems installed in the computing service were consistent with departmental systems and EUCS staff experience became more relevant.

#### 11.4.7 VMS and UNIX Support

As recommended, support for these systems has been substantially improved over the past two years. VMS is still felt to be under-resourced at a system level and that more effort should be put into supporting departmental VMS systems possibly with system management being handled centrally.

#### 11.4.8 Applications Software

The Committee's views in this area have not been satisfied in many respects. Applications support arrangements are unclear in the eyes of many users and need to be clarified.

### 11.5 User Support

The Committee saw user support as the weakest area of ERCC support. Our discussions with departments confirm that major improvements have been made and the single point of entry, albeit in a slightly different from from what was originally envisaged, has been offered to discrete communities of users. The new user support arrangements also allow EUCS staff to develop expertise on the problems of particular groups of users as requested by the Committee.

The increased activity by User Support staff means that they are more aware of expertise on computing within departments which also satisfies another issue raised by the Committee.

### 11.6 Administrative Services

EUCS has, as requested, continued to negotiate maintenance contracts at preferential rates on behalf on the University. Not all departments make use of them though because even at preferential rates they are too expensive for some Class Grants. Better coverage could be provided from the existing micro contract if central funding could be provided. In fact nearly every micro in the University could be covered for little more than is being paid at the moment for select departments if this could be achieved, and consideration should be given to implementing such an arrangement.

The EUCS Administrative Group continues to provide the factoring and other valuable services described by the committee and some of their activities have been more closely integrated with user support as requested.

# 12. MANAGEMENT AND FUNDING

## 12.1 Management

### 12.1.1 Central Services

One of the conclusions of the ERCC Review Committee was that MIS and Library computing should continue to be separately managed from the Computing Service. We believe that this should be looked at again. From our observations, separate management of the computing of these three central service organisations is leading to a fragmentation which is undesirable at a time when computing, communications and the services provided should be moving towards greater integration.

Whilst in theory the Computing Policy Committee (CPC) defines computing policy for the University as a whole, in reality three separate committees govern the three services. Whilst there is representation from each organisation on each of these committees, differing outlooks at service and committee level without any clear central decision making on overall policy, are not conducive to the development of an integrated information technology environment. In our opinion EUCS and the computing aspects of the Library and MIS should be placed under a common management structure.

### 12.1.2 Technical

Before it is purchased, all computing equipment bought from UGC funds is expected to be approved by the Computing Equipment Panel (CEP) which is a sub-committee of the CPC. This does not always happen. Also, a large percentage of the equipment is purchased from other sources and, although departments are advised to seek approval from the CPC before buying **any** computing equipment, in a large number of cases this advice is ignored. This has to some extent led to the wide variety of equipment and software installed throughout the University. If a more integrated environment is to be developed, which we believe is the expressed desire of most departments, then a more effective mechanism is required which is also responsible for monitoring software purchases.

## 12.2 Funding

Funding problems arose everywhere. Even the Science departments who are perceived to be wealthy by other Faculties, said they did not have enough money to meet their needs. Recurrent expenditure appeared to be a bigger problem than capital although even with the recent adjustments in how the UGC equipment grant is distributed, capital equipment funds are insufficient to meet the growing demands for new technology in areas such as Arts, Law and Divinity. Real money charges for items such as maintenance, consumables and communications are a real headache for every department. The debate on top-slicing versus the current situation followed us throughout the University and, if power is to be distributed closer to the user's desk, which seems to be the trend world-wide, then major adjustments to the funding arrangements within the University will be required.

# 13. THE FUTURE

## 13.1 Introduction

Before any detailed scenarios can be presented, it will be necessary for the major strategic issues, identified in ***Section 14***, to be resolved, as any future direction will be heavily influenced by these factors. However, the following is the Planning Group's broad view of possible developments.

## 13.2 Funding

When looking at developments over the next 10 years we need to decide how to get to where we want to be from our existing well established computing base. There is 20 years of investment in software, data, staff and user experience in the present system and it cannot be discarded overnight, or at least not with the resources available to us. The £2.5m which we will get from the Computer Board will only be sufficient to put in place a basic infrastructure which the University will then be able to build on with funds obtained from other sources.

University departments are currently spending in excess of £2m per annum on computing equipment and, whilst this sum of money might sound large, it is in fact insufficient to meet all of the existing demands for facilities. As the technology matures and offers more useful tools to a wider population, these demands will increase at a time when university funding is further constrained. It is increasingly important therefore that existing investment is protected as far as possible and future policy allows best use to be made of scarce funds whilst still offering users access to up to date technology.

The funding situation is unlikely to improve much over the next ten years unless alternative sources of funds are found. Unlike 10 to 20 years ago, Universities are now the "poor men" of computing and suppliers are more interested in lucrative external markets. If leading edge technology is to continue to be made widely available throughout the University, then entrepreneurial activities must be encouraged. These activities will bring with them problems in implementing any strategy as the temptation will be for departments to take whatever they can get regardless of whether or not it is consistent with policy. As happens at the moment with non-UGC funded systems, it will be very difficult to enforce any standards. However, the alternative will be to try to spread inferior facilities across as wide a cross section as possible with only well funded departments having access to modern facilities. This is in some respects the current situation and there was a distinct feeling of a "north and south divide" about the university, with the divide occurring half way along Mayfield Road!

## 13.3 Integrated Distributed Environment

Regardless of the funding situation, we believe that the trend towards a distributed computing environment, which has been gathering momentum over the last 20 years, will continue, and that the main emphasis in any strategy for the next 10 years, should be on the provision and support of distributed computing. A major objective should be the fuller integration of systems throughout the University to enable better use to be made of facilities.

In the new environment, we envisage local work groups with facilities tailored to meet their specific needs, with the emphasis being power on the user's desk. These local groups will however need to interact with wider area work groups, on a departmental, faculty or university wide basis and it is important therefore, that a strategy is adopted which will allow full integration of all facilities at all levels. Users will also require increasing access to facilities outwith this university and it is important that full network access is provided from every system.

The key to integration will be an effective communications network and the adoption of standards throughout. It will also be essential to adopt standards at operating system and application package levels if a fully integrated distributed environment is to be successfully implemented.

## 13.4 Central Facilities

We still see a role for central facilities but with a different emphasis to those in the past. The current multi-access interactive services have been developing over a period of years into specialised servers for specific purposes such as, for example, long term data storage, database engines, information servers and very large scale number crunchers. We believe that this process will continue further.

We see it as important that the operating systems and applications software packages utilised on central facilities are consistent with those adopted in departments and that they are accessible via very high speed network connections.

Much debate has gone on about the future of EMAS. We believe that EMAS has served this university very well in the past but the days of the large scale, multi-access, interactive computing service which it supported, are numbered. It is our view that EMAS should not be replaced by a commercial alternative, offering similar facilities which would in all probability be inferior. We believe the EMAS service should be allowed to decline whilst a transition is made to a new distributed environment.

To facilitate the transfer to a new environment, users should be clearly informed now that EMAS as a general purpose interactive service is on its way out. They should be encouraged and assisted to look at alternative solutions for new applications and for the transfer of existing ones either to departmental systems or to enhanced versions of the existing central VMS and UNIX services. These should not become alternative interactive services, but should be dedicated to more specific functions, to serve more specific requirements, and to complement departmental facilities. It will be several years before all the functions currently handled by EMAS can be satisfied elsewhere and some provision will have to be maintained beyond 1990 but the sooner users are encouraged to use other systems, and support staff re-orientated, the sooner it will be possible to concentrate resources on a more integrated environment.

Any moves to a more distributed environment will of course be dependent on funds and support effort also being distributed, in line with the distribution of computing power.

## 13.5 Communications

As stated earlier, the key to an integrated distributed environment will be an effective communications network. The network must have adequate capacity and be easily accessible from any point in the university if it is to serve its function properly. This will require a greater investment in its funding and support than has been the case in the past. The provision of a university wide data communications network service should be the primary role of any central service organisation over the next 10 years.

## 13.6 Operating System Policy

At the moment the main operating systems in use in Edinburgh are, EMAS, VMS, and UNIX for multi-user and workstation systems and MS/PC DOS for micro computers. The removal of EMAS will rationalise this situation and we see no need to replace it with an alternative. VMS and UNIX multi-user and single user versions, plus personal computers, would appear to offer most of the facilities required within a university environment and a wide base already exists within departments. By concentrating any central facilities on VMS and UNIX, an integrated environment will be more easily achievable and central support resource will be more relevant to departmental requirements, bringing possible staff savings and other benefits.

It is likely that IBM will continue to set the standards in personal computing for the foreseable future although there will be less of a distinction between workstations and microcomputers. This will bring with it a clash between UNIX and personal computer operating systems but we do not see this as a major drawback to an integrated environment. IBM are committed to supporting UNIX across their entire range of systems and it is likley that routes between their standard PC and UNIX systems will be available. Digital Equipment Corporation (DEC) have to live with IBM



in the outside world and have already provided software tools for integrating IBM PCs with their VMS systems. They are also committed to UNIX support across their range. Other major microcomputer manufacturers such as Apple, who have a growing base within the university, are also taking steps to integrate their products with these mainstream environments at networking and applications levels. Alternatively, IBM and DEC are now starting to offer on their products, the user friendly interface which Apple introduced with theirs. Also, as UNIX gains wider acceptance in the outside world, standard applications packages are being converted to run on top of it. We believe therefore, that by concentrating on VMS, UNIX and IBM PC standards, a more integrated environment is possible and will provide a smooth transition path from the current situation.

However, this is a university and it is unlikely that all requirements will ever be met within a fixed range of systems. Allowance will therefore have to be made for new technologies which will emerge. It would be sensible though to ensure that whenever possible, any novel solutions which are installed have the capability of being integrated with the main environment at least at a communications level but preferably also at operating system and applications levels.

## 13.8 Applications Software Policy

Currently, there is little evidence of an effective support policy at an applications level within the University with differing packages being employed for similar purposes across the range of systems. This makes their use, support and integration very difficult and in future a more effective, co-ordinated policy will be essential. Most of the major applications packages are now being offered, or are being developed to run, across a range of systems and it will be neccessary to adopt effective policies in key areas such as statistical analysis, database management, text processing etc. which will facilitate the exchange of data and information between systems.

## 13.9 Conclusion

It is our view that the trends are towards a more integrated environment with UNIX, VMS and IBM dominating on a world-wide basis. These are already the main environments within this university and we feel that this is a sound base to work from. Open Systems standards are being developed and introduced but it will be some years before they offer a unified environment throughout. Our aim however should be to move in this direction in the expectation that by the end of the ten year timescale, a common user interface across most of the systems installed within the university might be achievable. Some rationalisation of supported systems and greater adherence to standards would therefore take us in the right direction.

# 14. MAJOR STRATEGIC ISSUES

## 14.1 Introduction

Before detailed scenarios can be developed for possible future directions, several major strategic issues, which have arisen from our investigations, need to be resolved. The following is a list of these issues and we request the Convener's Sub-Committee of the Computing Policy Committee to consider them and to advise the Planning Group of their views.

## 14.2 Diversity of Equipment *(Section 3 etc.)*

For a number of reasons there is a wide diversity of equipment installed throughout departments, with differing solutions being adopted for similar requirements, often within the same department. More effective support could be provided, and better use made of scarce funds, if more control was exercised over equipment and software purchases. This need not mean a dictatorial, one option for all policy, but it does mean a better controlled system than exists at the moment. If a more integrated environment is to be possible, then effective monitoring of departmental procurement is essential and consideration needs to be given on how to achieve this.

## 14.3 Support *(Section 7)*

The issue of user support is seen as very important by all faculties. It is clear that additional computing support is needed in many departments at a level which cannot be provided on a central basis. As facilities are moved closer to the user, then it will also be necessary to move funds and support closer. In most cases, departments prefer to manage their own support staff to avoid conflicts of interest. Whether this is the most cost effective way of providing support is open to debate.

We do not see any changing role of EUCS providing much scope in the immediate future for staff reductions or redeployments particularly against the background of the University Academic Plan which suggest EUCS staff cuts. There is already a lack of support in a number of areas and any resource freed up by the rationalisation of systems and applications software, will only compensate for existing central deficiencies.

Consideration needs to be given to how more support can be targeted at the "end-user", whilst still maintaining an adequate level of technical expertise, at a time when the university is being forced to shed staff.

One negative aspect of moving away from a parochial environment to more standard solutions, which will also impact upon the level of support provided, is that staff will become more "saleable" and might be attracted to more lucrative offers from outside. The loss of complexity in some of their work might also encourage them to look elsewhere. This could exacerbate the support position and the possible effects of a higher turnover of skilled staff needs to be considered.

## 14.4 Funding *(Section 6,12 etc.)*

If as we believe, the trend over the next 10 years will be to move power to the users desk, then major adjustments are required to the present arrangements for funding computing within the university. Whether this problem can be resolved or not is critical to any future strategy. If the funding arrangements cannot be adjusted, then the technical solutions adopted will have to reflect any limitations imposed by lack of money in key areas. This is not a problem associated only with non-science departments. The major users in the Faculty of Science have as much difficulty as anyone in meeting recurrent costs.

The committee is asked to consider whether or not the current mechanisms for funding computing can be modified sufficiently to support a further major distribution of facilities.

### 14.5 Teaching *(Section 4)*

It is possible that the use of computers for teaching purposes, and the facilities made available in Edinburgh, are inferior to other universities. This could have a detrimental affect on our ability to attract students. Consideration needs to be given to whether or not better support and facilities need to be focused into this area.

### 14.6 Medicine *(Section 6.3)*

The Faculty of Medicine has major problems arising out of the dual responsibilities of many of its staff and departments. The working relationship, and policy co-ordination, between the University and Health Board on computing matters, are in need of urgent improvement. The Committee is asked to consider how best to achieve this and the better integration of facilities.

### 14.7 Communications *(Section 8)*

The committee is asked to consider the suggestion that the provision of network services should become the major element of the Computing Service over the next 10 years.

The provision of three separate networks, EUCS, MIS and the Library, is both unecessary and very wasteful of resources. The committee is asked to consider their integration.

The issue of funding of access to the network requires a review of the current policy of each department having to fund connections themselves. It is suggested that the Committee examine alternative options (eg. central funding, as is the case with telephones), with the aim of getting network access for at least every department, if not every room in the University. Considerable capital savings might be made by tackling the wiring of the University as one project, particularly if allied with the proposed telephones wiring, as against the current "piece-meal" system.

### 14.8 Central Service Management *(Sections 9-12)*

By central services we mean those provided by EUCS, the University Library and Management Information Services. We believe that these three organisations, who provide university wide services, need to be better integrated at technical and managerial levels for computing matters. As described in our document, three networks have developed, and there are concerns about this trend towards isolation increasing unless steps are taken to ensure the full integration of the Library and MIS facilities with those in the rest of the University.

We feel that the current fragmented management of the computing activities of these three organisations does nothing to encourage integration and a management structure is required which has effective control over their computing developments. We do not believe that this can be achieved by a committee which meets once a term, let alone the three committees which are involved at the moment. We strongly suggest that the option of placing EUCS, MIS and Library Computing under one management structure, be seriously considered. A common approach will be essential amongst all of the University's information providers if efficient use is to be made of limited resources.

### 14.9 Administrative Computing *(Section 9)*

Consideration needs to be given on how to achieve a university wide administrative system which permits access to the information necessary for the normal functioning of departments and faculty offices. A university wide M.I.S. strategy could have major implications for any future overall strategy, particularly on networking, and needs clarified before a strategy statement can be defined.



### 14.10 Library Computing *(Section 10)*

Library requirements will have a major impact upon any future communications strategy. The signs are that GEAC will continue to be isolated from University networking practices, or at least be several years behind other manufacturers. The Library's commitment to this equipment must be reviewed before a strategy statement can be defined.

### 14.11 Central versus Distributed Computing

Assuming that funding and support problems can be overcome, the Committee is asked to consider the general tenet of this report with respect to not replacing the current multi-access EMAS system with a similar commercial product, but instead adopting a distributed computing policy. Central services should become more specialised and should be based on both VMS and UNIX systems. The existing EMAS system should be allowed to continue beyond 1990 to provide time for a graceful changeover.

*APPENDIX 1*

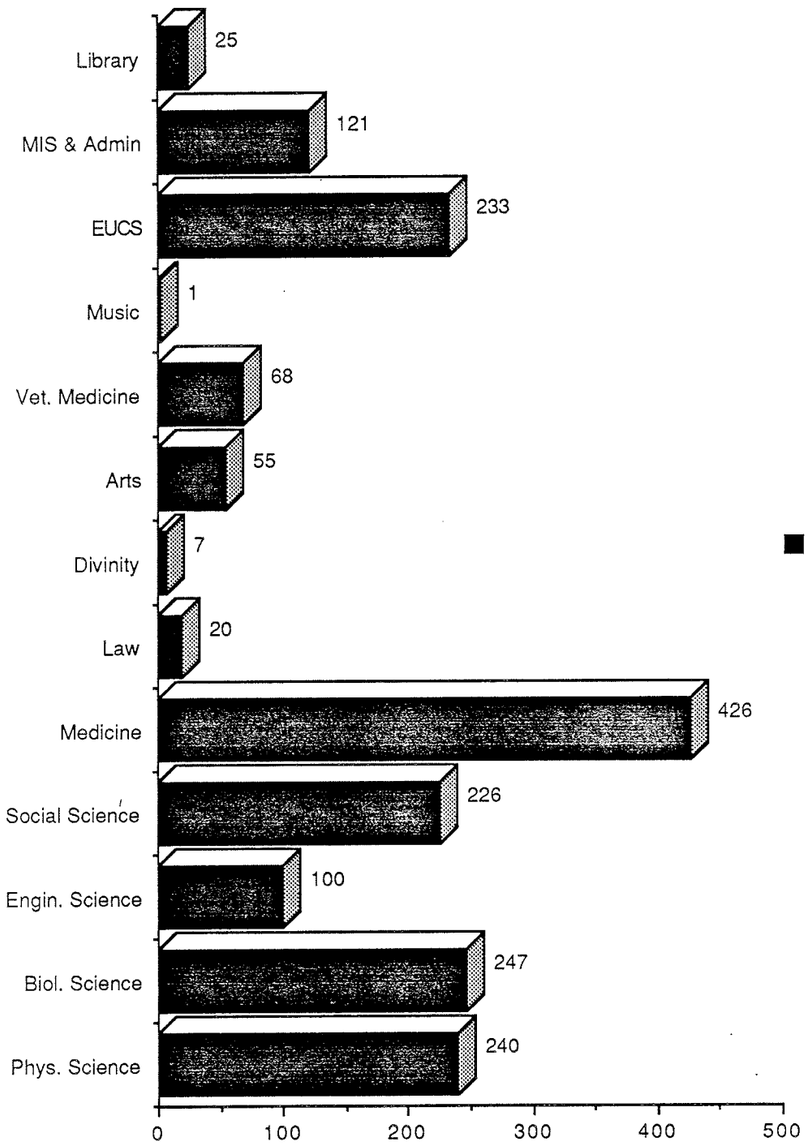
# DISTRIBUTED SYSTEMS

# INSTALLED MICROCOMPUTERS IN JANUARY 1988

| | IBM PC/PS2 | DCS Clone | Other Clone | BBC Micro | Sirius/ Apricot | Apple MAC | Atari | Other | Total |
|---|---|---|---|---|---|---|---|---|---|
| Phys.Science | 26 | 9 | 19 | 85 | 14 | 39 | 2 | 46 | 240 |
| Biol.Science | 22 | 64 | 7 | 82 | 26 | 23 | 3 | 20 | 247 |
| Engin.Science | 6 | 3 | 5 | 28 | 3 | 2 | 1 | 52 | 100 |
| Soc.Science | 77 | 36 | 16 | 16 | 26 | 28 | 11 | 16 | 226 |
| Medcine | 58 | 59 | 38 | 132 | 38 | 25 | 3 | 73 | 426 |
| Law | 6 | 4 | 0 | 5 | 4 | 0 | 0 | 1 | 20 |
| Divinity | 1 | 2 | 0 | 1 | 2 | 0 | 0 | 1 | 7 |
| Arts | 5 | 5 | 6 | 7 | 23 | 6 | 1 | 2 | 55 |
| Vet.Medicine | 14 | 7 | 11 | 18 | 2 | 0 | 0 | 16 | 68 |
| Music | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| EUCS | 48 | 8 | 0 | 64 | 56 | 40 | 8 | 17 | 233 |
| MIS & Admin | 79 | 0 | 7 | 0 | 32 | 2 | 0 | 1 | 121 |
| Library | 4 | 9 | 0 | 3 | 0 | 1 | 0 | 8 | 25 |
| Total | 338 | 206 | 109 | 441 | 226 | 166 | 30 | 253 | 1769 |

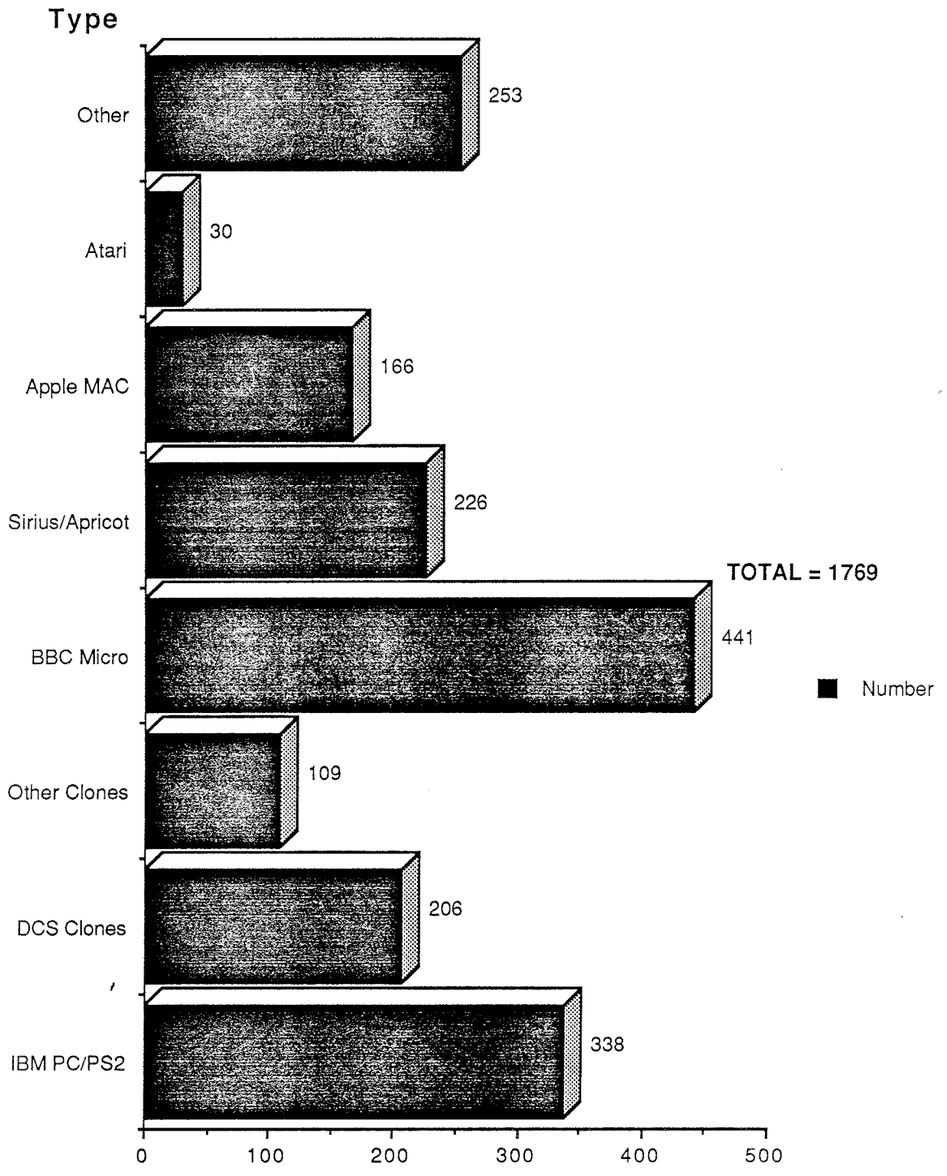
* Note EUCS figures include Public Areas and AT Microlab
Physical Science includes AIAI, Arts includes CSTR

# LOCATION OF MICROS INSTALLED IN JANUARY 1988

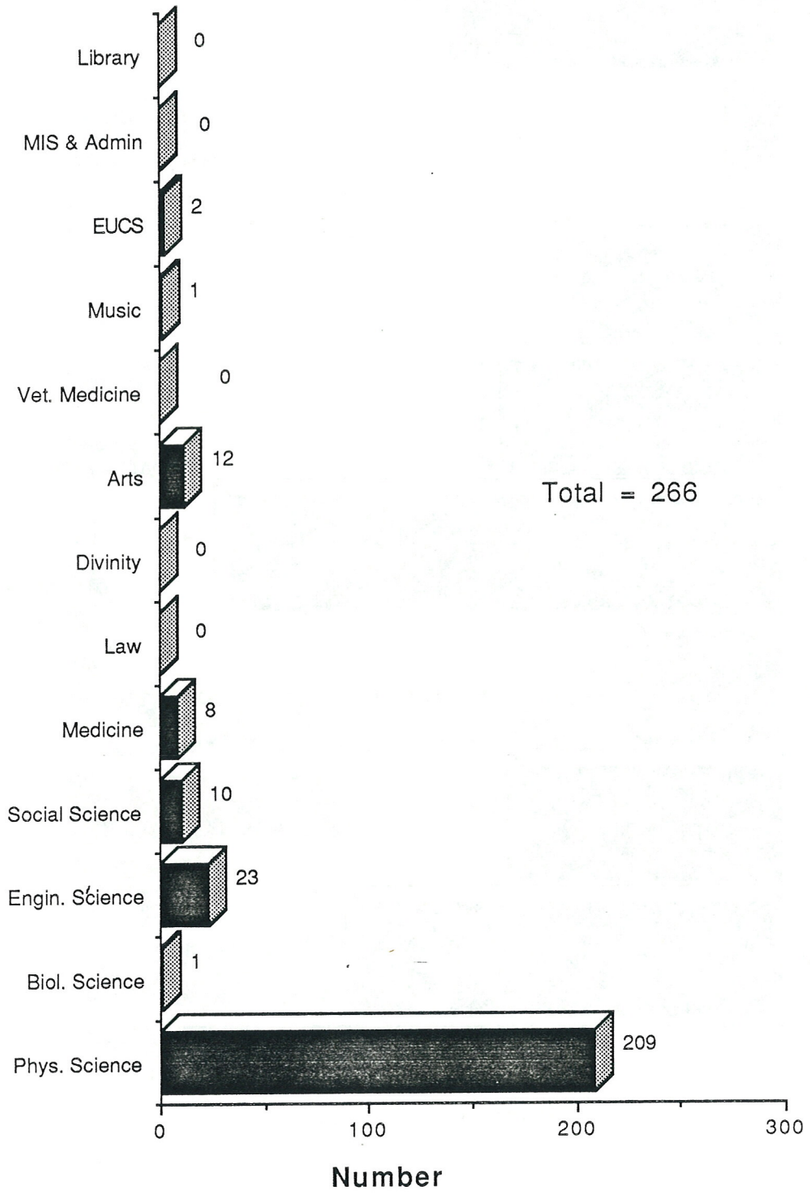





# TYPES OF MICROS INSTALLED IN JANUARY 1988



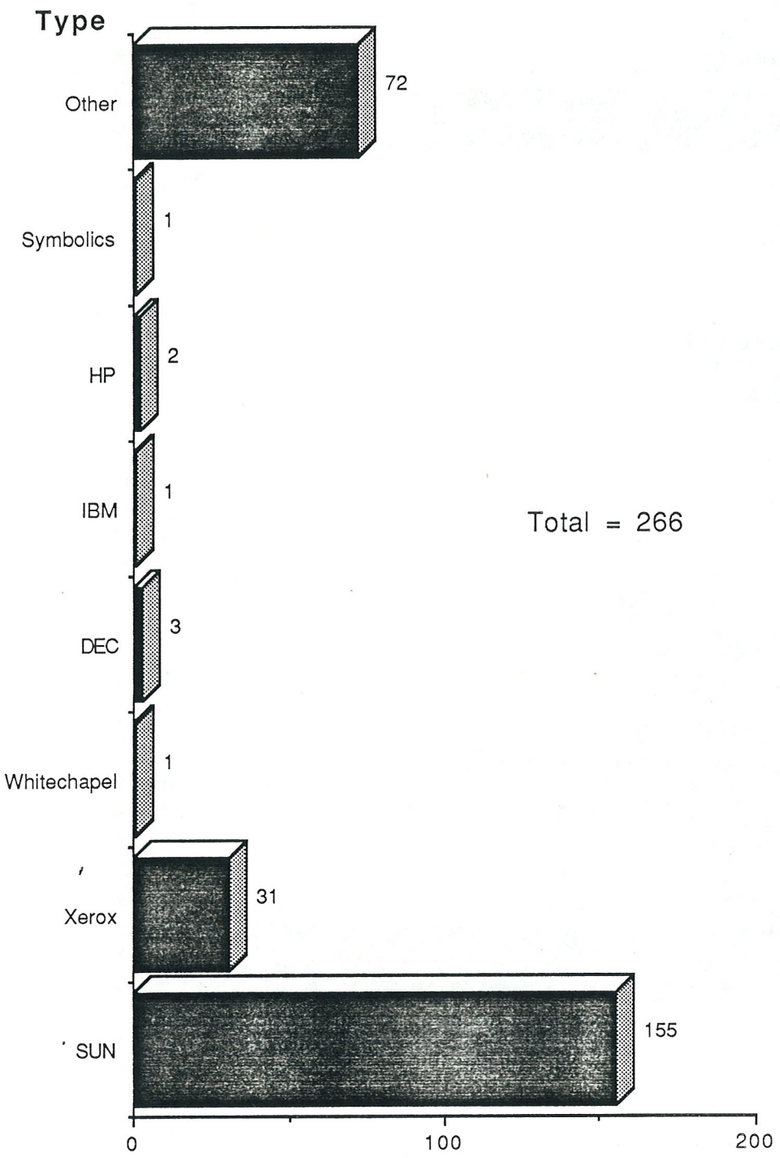
# LOCATION OF WORKSTATIONS INSTALLED IN JANUARY 1988




Total = 266

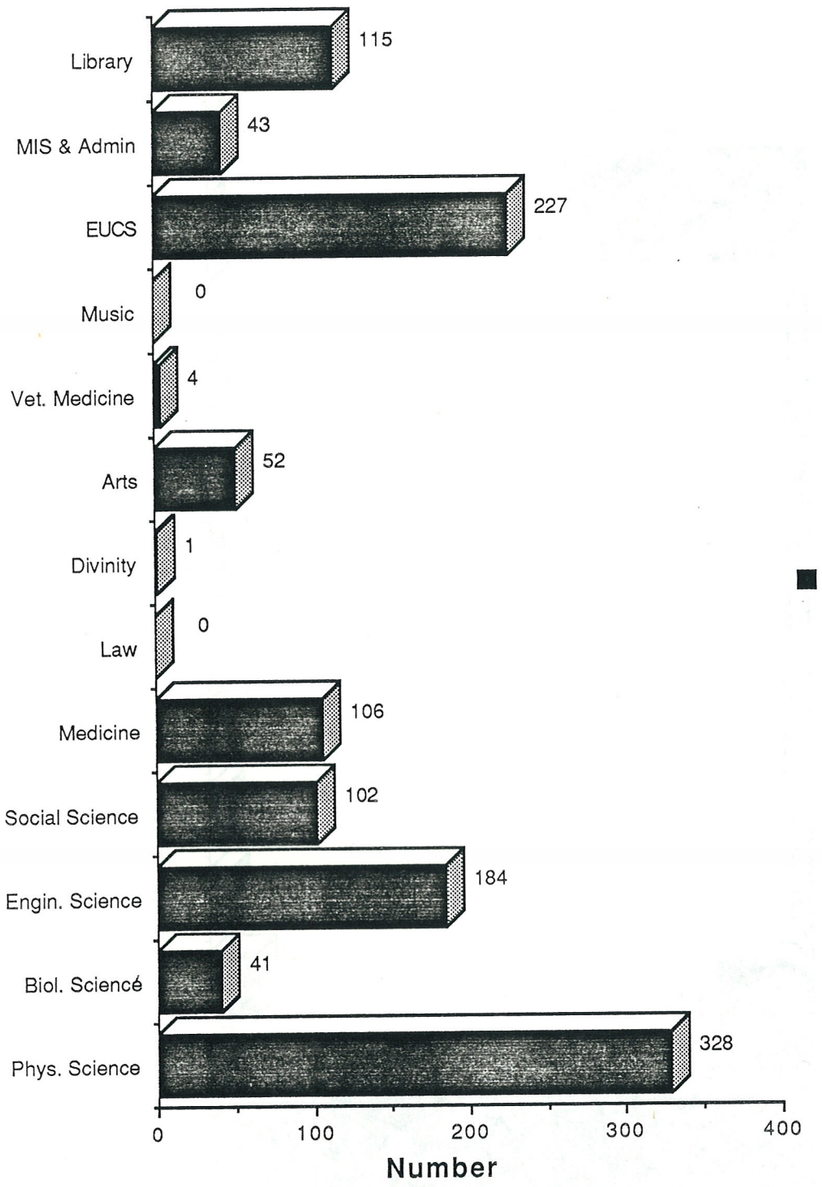


# TYPES OF WORKSTATIONS INSTALLED IN JANUARY 1988



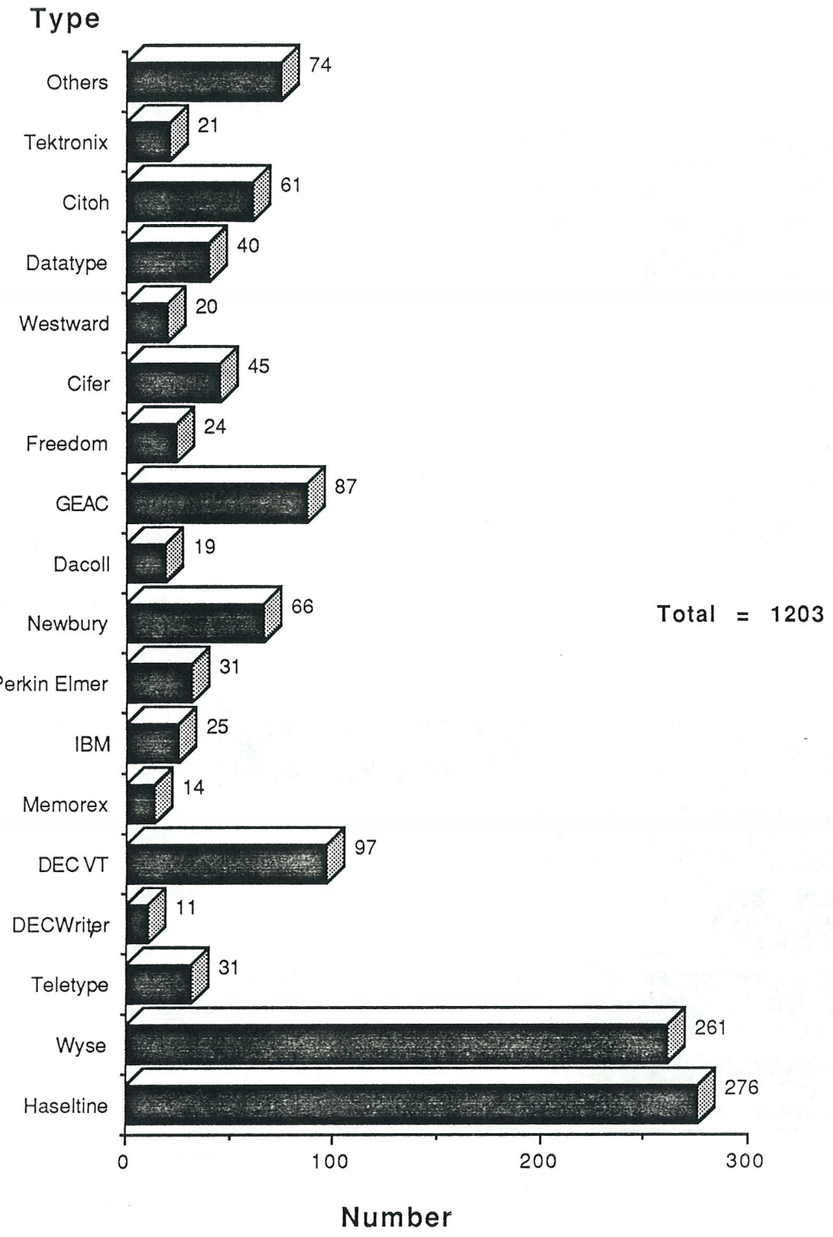

Total = 266

# LOCATION OF TERMINALS INSTALLED IN JANUARY 1988

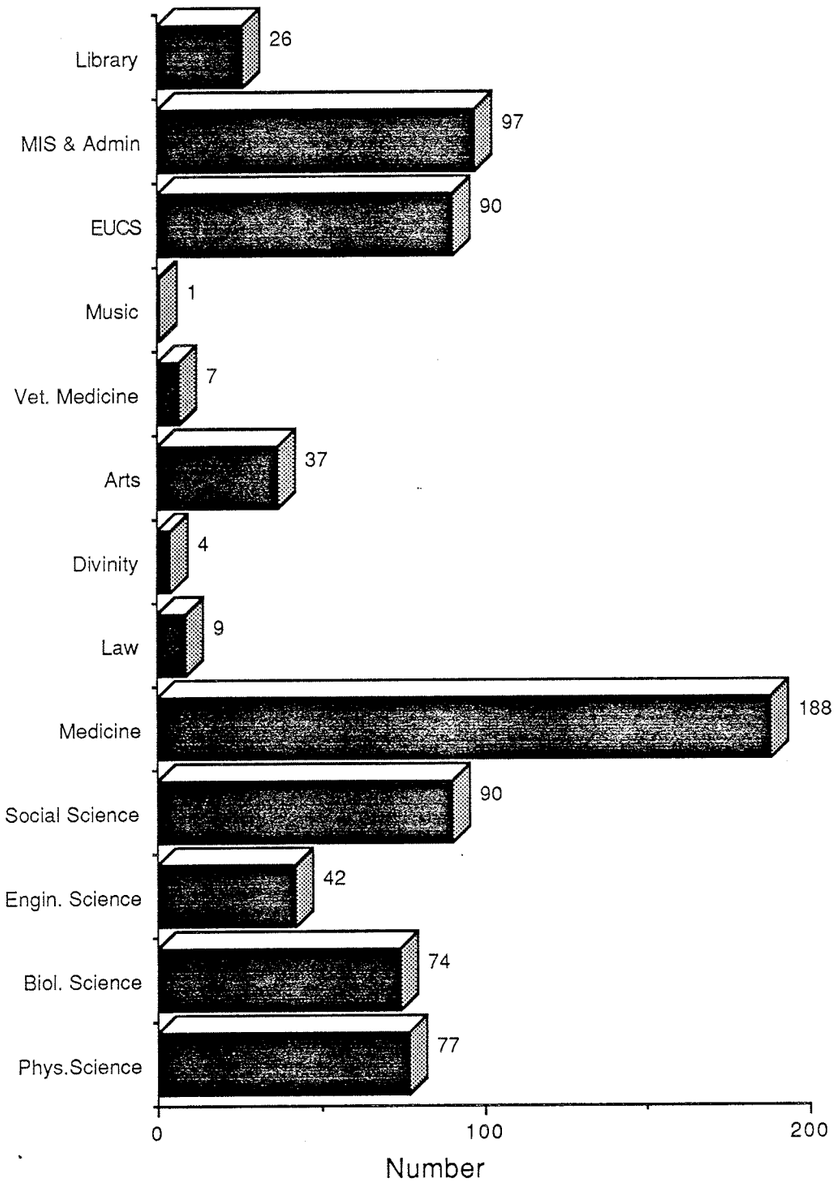





# TYPES OF TERMINALS INSTALLED IN JANUARY 1988



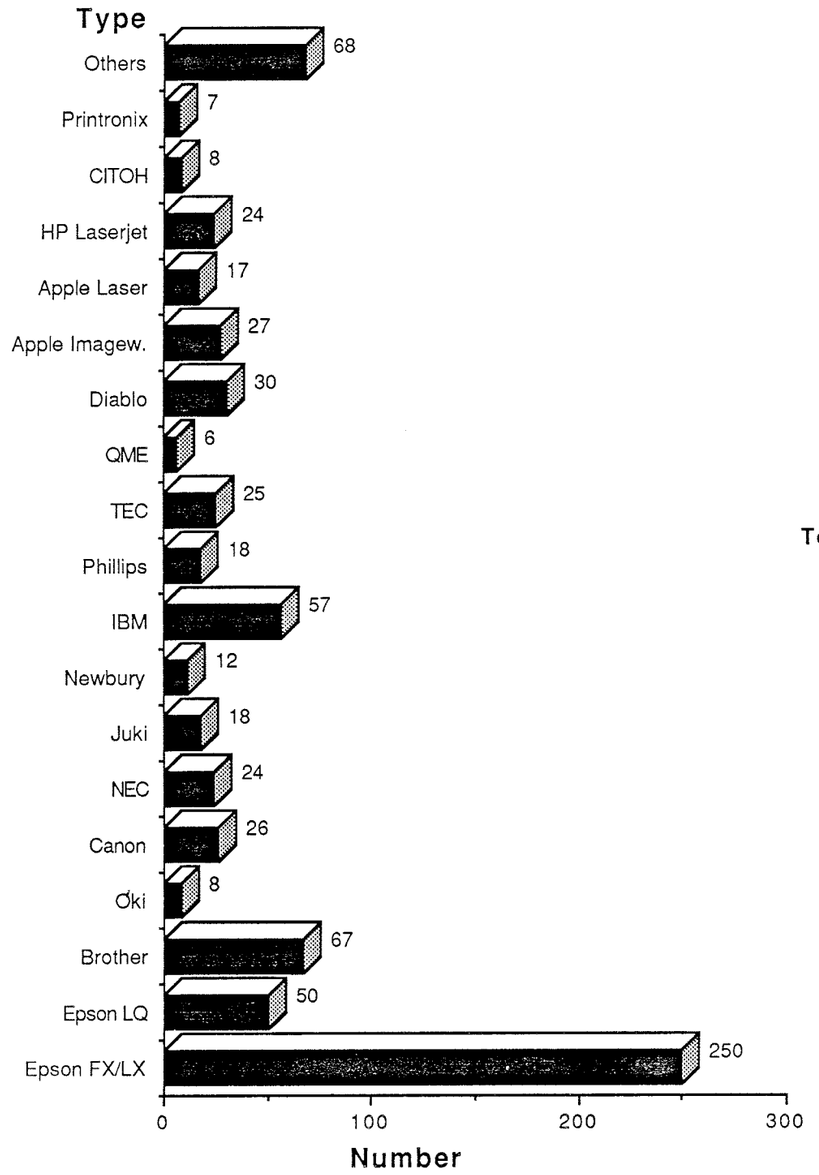
# LOCATION OF PRINTERS INSTALLED IN JANUARY 1988




TOTAL=742



# TYPES OF PRINTERS INSTALLED IN JANUARY 1988




Total = 742

*Appendix 1*

## UNIX and VMS Systems in January 1988

**"Departments" in Edinburgh University with DEC VMS Computer Systems**

Agriculture
Biochemistry
Computer Science
Ecomomics
Edinburgh University Computing Service
Electrical Engineering
Geography
Linguistics
Medical Physic
Physics

**"Departmental" VMS based Computing Facilities**

| | |
|---|---|
| 1* | VAX 8530 |
| 1* | VAX 8350 |
| 1* | VAX 11/780 |
| 6* | VAX 11/750 |
| 8* | MicroVAX 2 |

**"Departments" in Edinburgh University with UNIX Computer Systems**

Architecture
Artificial Intelligence
Artificial Intelligence Applications Institute
Centre for Speech Technology Research
Chemical Engineering
Civil Engineering
Cognitive Science
Computer Science
Edinburgh University Computing Service
Education
Electrical Engineering
Linguistics
Mechanical Engineering
Medical Statistics
Meteorology
Music

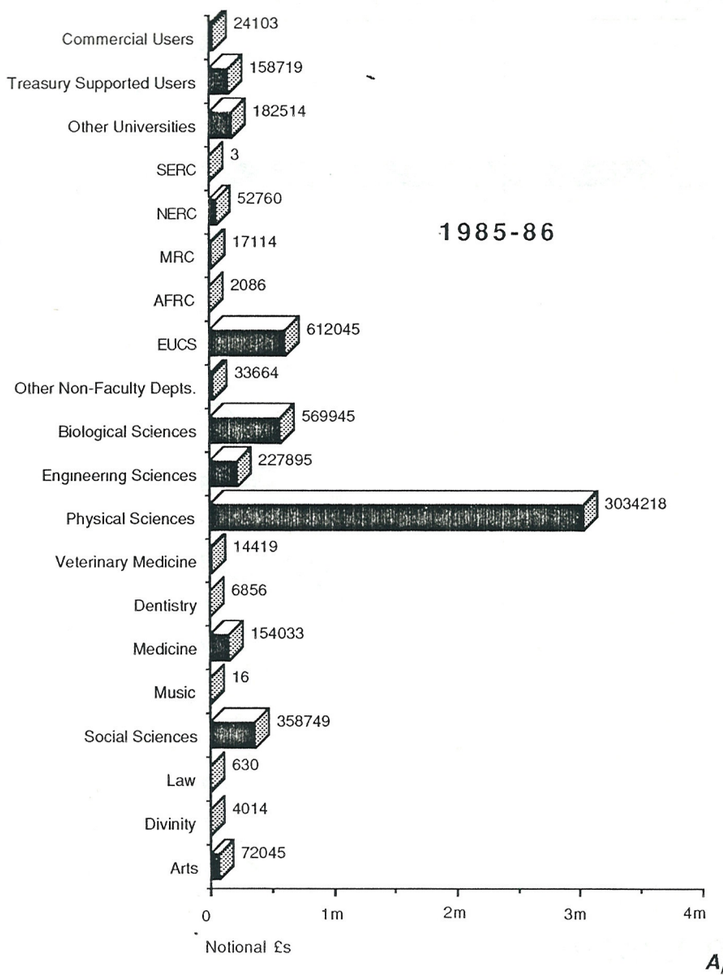
**"Departmental" UNIX based Computing Facilities**

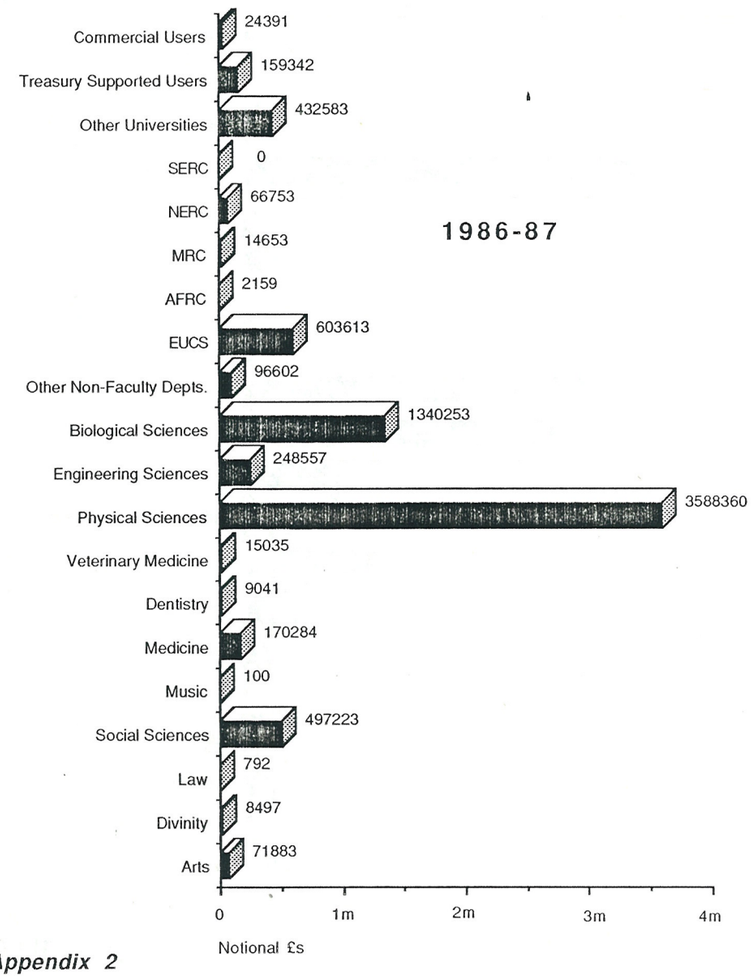
| | |
|---|---|
| >200* | Workstations |
| 1* | Gould 9080 |
| 1* | Gould PN6031 |
| 1* | Gould NP1 |
| 6* | VAX 11/750 |
| 3* | Systime 8750 |
| 3* | GEC 63 |
| 1* | Pyramid 98XE |
| 1* | Orion |
| 5* | Torch XXX |
| 3* | PDP11 |
| 1* | HP 9000/500 |
| 3* | Masscomp |
| 1* | IBM 6150 |

*APPENDIX 2*

# CENTRAL SYSTEMS

# EMAS UTILISATION




*Appendix 2*


*Appendix 2*

## EMAS TOP 20 USER DEPARTMENTS (notional £s)

| | 1986-87 | | 1985-86 | |
|---|---|---|---|---|
| 1. | Physics | 1305747 | Physics | 1625062 |
| 2. | Animal Genetics | 1121734 | EUCS | 612075 |
| 3. | Geophysics | 608394 | Geophysics | 523478 |
| 4. | EUCS | 603614 | Chemistry | 386773 |
| 5. | Chemistry | 583180 | Animal Genetics | 344667 |
| 6. | Mathematics | 580687 | Computer Science | 212990 |
| 7. | Educ. Sociology | 221626 | Meteorology | 129027 |
| 8. | Meteorology | 218860 | Forestry & Nat.Res. | 124635 |
| 9. | Computer Science | 192260 | Educ.Sociology | 106840 |
| 10. | Civil Engineering | 130756 | Civil Engineering | 97937 |
| 11. | Forestry & Nat.Res. | 110165 | Mathematics | 92776 |
| 12. | Chemical Engineering | 54486 | Psychology | 69497 |
| 13. | Medical Statistics | 53852 | Medical Phy. & Engin. | 56696 |
| 14. | Statistics | 53477 | S.C.R.I. | 56105 |
| 15. | Psychology | 51868 | Mech.Engineering | 51476 |
| 16. | S.C.R.I. | 51761 | Glasgow Statistics | 45210 |
| 17. | Glasgow Comp. Science | 49994 | Electrical Engin. | 42340 |
| 18. | Seismology | 49132 | Molecular Biology | 40111 |
| 19. | Economics | 48450 | Economic History | 38743 |
| 20. | Economic History | 42889 | Seismology | 37401 |

## ERCVAX TOP 20 USER DEPARTMENTS (notional £s)

| | 1986-87 | | 1985-86 | |
|---|---|---|---|---|
| 1. | Educ.Sociology | 60486 | Educ.Sociology | 82027 |
| 2. | Civil Engineering | 50005 | EUCS | 23170 |
| 3. | Physics | 34653 | Molecular Biology | 12210 |
| 4. | EUCS | 21738 | Education | 4436 |
| 5. | Geology | 13927 | Computer Science | 3752 |
| 6. | Molecular Biology | 7511 | SIA Ltd. | 2568 |
| 7. | Computer Science | 3722 | Economics | 2511 |
| 8. | Geophysics | 3421 | Biochemistry | 1982 |
| 9. | Animal Genetics | 2747 | Medical Statistics | 1974 |
| 10. | A.P.G.R. | 2289 | Astra Clinical | 1339 |
| 11. | Botany | 1942 | Brain Metabolism | 1337 |
| 12. | Biochemistry | 1423 | Animal Genetics | 1167 |
| 13. | Economics | 1339 | Scottish Office C.S. | 1156 |
| 14. | Brain Metabolism | 1196 | Botany | 912 |
| 15. | Archaeology | 989 | Archaeology | 876 |
| 16. | Medical Statistics | 874 | Glasgow Virology | 819 |
| 17. | Business Studies | 803 | Mammalian Genome | 757 |
| 18. | Seismology | 690 | Lothian Reg. Council | 716 |
| 19. | Animal Health | 678 | Glasgow Genetics | 519 |
| 20. | Mammalian Genome | 671 | Artificial Intelligence | 514 |

## CURRENT PACKAGE AND LANGUAGE PROVISION ON CENTRAL SERVICES

### EMAS

#### PACKAGES

| | | | |
|---|---|---|---|
| AGRLIST | AGRSPSSX | ASPEX | BLISS |
| BMDP | CAMAPED | CAMAPGB1 | CAMAPGB2 |
| CAMFRAME | CAMGRID | CATALOG | CENSUS |
| CLUSCOM | CLUSTAN | CONCORD | DATAC |
| DATALIB | DECRYPT | DRAWPICTURE | DSIGNX |
| EASYGRAPH | EDEX | ENCRYPT | FACSIMILE |
| FAMULUS | GAZ | GAZF | GENSTAT |
| GIMMS | GINO | GKS | GLIM |
| GPCP | HERF | INGRID | ISCOL |
| LAYOUT | LASERCHECK | LIMDEP | MAXLIKE |
| MDSX | MINISQ | MINITAB | MLP |
| NAG | NOTICE | POSTSEND | PRESEND |
| SASPAC | SCRIBE | SCSS | SGCP |
| SHAZAM | SIR | SPIDER | SPSSGRAPH |
| SPSSX | SUPERCARP | SYMAP | SYMTRAN |
| SYMVU | TSA | TSP | UMAPIT |
| VARCL | | | |

#### LANGUAGES

| | | | |
|---|---|---|---|
| BASIC | FORTRAN | IMP | PASCAL |
| SIMULA | | | |

### ERCVAX

#### PACKAGES

| | | | |
|---|---|---|---|
| CHAM | DRAWPICTURE | EDWIN | ELIOPOULOS |
| GKS | LAYOUT | LIMDEP | LUSAS |
| NAG | ORACLE | PAFEC | PHOENICS |
| REDUCE | RGSP | SAAM | SAS |
| SAS/GRAPH | SCA | SCIONIC | SCRIBE |
| SIR | SPIDER | SPSSGRAPH | SPSSX |
| STADEN | TOOLPACK | UNIRAS | UWGCG |

#### LANGUAGES

| | | | |
|---|---|---|---|
| C | FORTRAN | IMP77 | MODULA |
| PASCAL | PROLOG | SIMULA | |

### ITS-GOULD

#### PACKAGES

| | | |
|---|---|---|
| INGRES | SPICE | TEX |

#### LANGUAGES

| | | | |
|---|---|---|---|
| C | C++ | COMMON C | COMMON LISP |
| COMMON FORTRAN | COMMON PASCAL | ML | |

## TOP TWENTY PLU PACKAGES on EMAS

1987-88 (Aug87-Mar88)

| | Package | Total Cost | No. of Runs |
|---|---|---|---|
| 1. | SPSSX | 102024 | 32037 |
| 2. | BMDP | 29046 | 10116 |
| 3. | MINITAB | 20809 | 20233 |
| 4. | GENSTAT | 20797 | 17218 |
| 5. | GPCP | 18727 | 2244 |
| 6. | SIR | 6304 | 936 |
| 7. | CATALOG | 1912 | 3954 |
| 8. | GLIM | 1894 | 1795 |
| 9. | SIMULA | 1873 | 321 |
| 10. | SCSS | 1779 | 1124 |
| 11. | SHAZAM | 1413 | 1191 |
| 12. | GIMMS | 1339 | 1098 |
| 13. | SASPAC | 1040 | 865 |
| 14. | TSP | 812 | 987 |
| 15. | SYMVU | 753 | 1305 |
| 16. | MLP | 336 | 334 |
| 17. | FACSIMILE | 272 | 272 |
| 18. | SPSSGRAPH | 254 | 243 |
| 19. | CLUSTAN | 226 | 437 |
| 20. | BASIC | 202 | 251 |

1986-87

| | Package | Total Cost | No. of Runs |
|---|---|---|---|
| 1. | SPSSX | 168558 | 43281 |
| 2. | BMDP | 111079 | 14413 |
| 3. | GENSTAT | 52122 | 21162 |
| 4. | MINITAB | 35423 | 19709 |
| 5. | GPCP | 17719 | 1802 |
| 6. | LIMDEP | 17069 | 254 |
| 7. | VARCL | 14953 | 2102 |
| 8. | GLIM | 7035 | 3473 |
| 9. | CATALOG | 6136 | 5846 |
| 10. | GIMMS | 5778 | 1329 |
| 11. | GINO | 4911 | 5467 |
| 12. | LISREL | 4670 | 485 |
| 13. | SIR | 3326 | 339 |
| 14. | TSP | 3274 | 2150 |
| 15. | SASPAC | 3115 | 2361 |
| 16. | SCSS | 3100 | 2481 |
| 17. | SHAZAM | 1746 | 696 |
| 18. | SYMVU | 1586 | 1731 |
| 19. | ASPEX | 1351 | 227 |
| 20. | REML | 1008 | 498 |

## TOP PLU PACKAGES on ERCVAX

**1987-88 (Aug87-Mar88)**

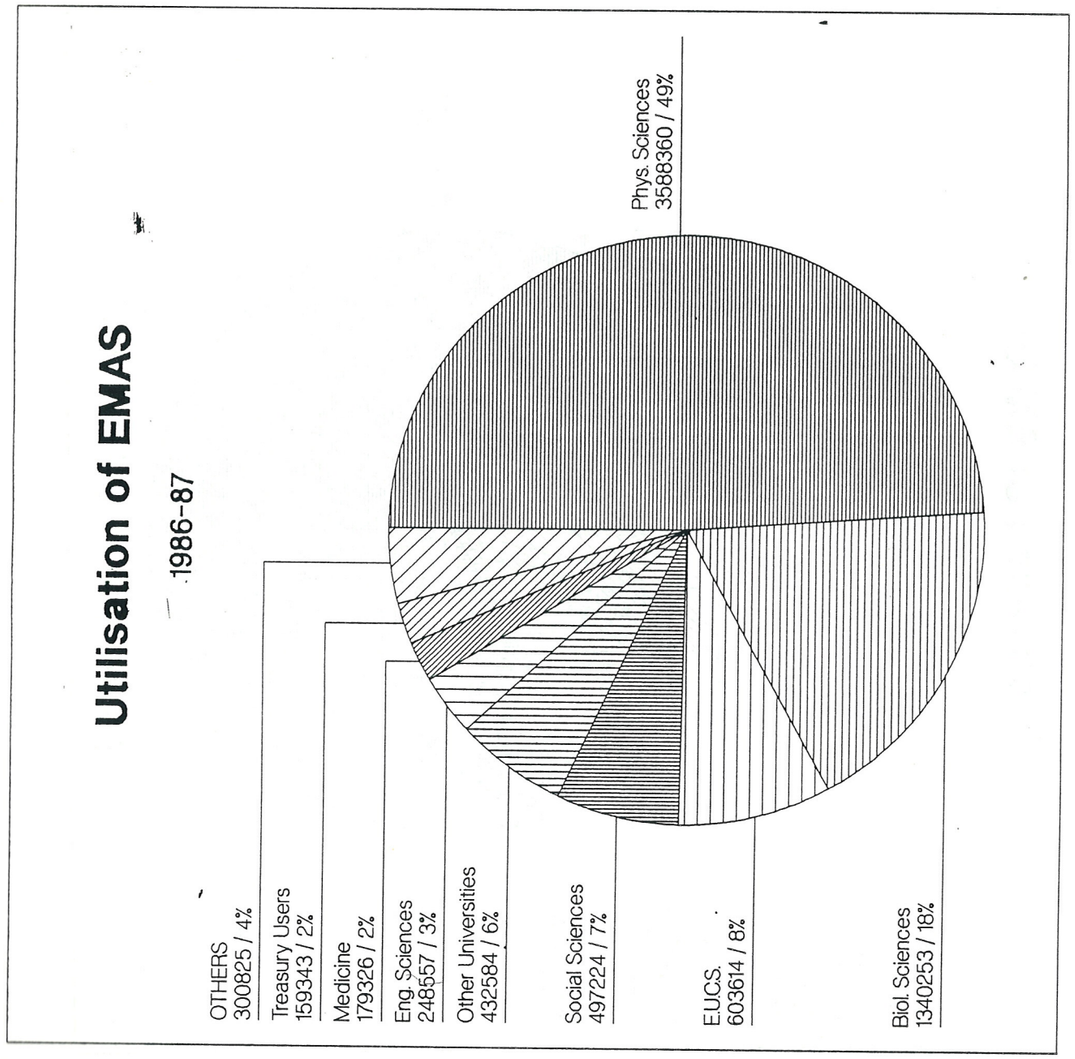
| | Package | Total Cost | No. of Runs |
|---|---|---|---|
| 1. | LUSAS | 53724 | 257 |
| 2. | SIR | 28614 | 10450 |
| 3. | SAS | 6940 | 1006 |
| 5. | ORACLE | 3380 | 3540 |
| 6. | SPSSX | 1784 | 3422 |
| 7. | REDUCE | 335 | 381 |
| 8. | LIMDEP | 20 | 19 |
| 9. | PAFEC | 6 | 74 |
| 10. | RGSP | - | 4 |

**1986-87**

| | Package | Total Cost | No. of Runs |
|---|---|---|---|
| 1. | SAS | 39696 | 1713 |
| 2. | SIR | 38926 | 14980 |
| 3. | SPSSX | 19612 | 4007 |
| 4. | ORACLE | 2878 | 3682 |

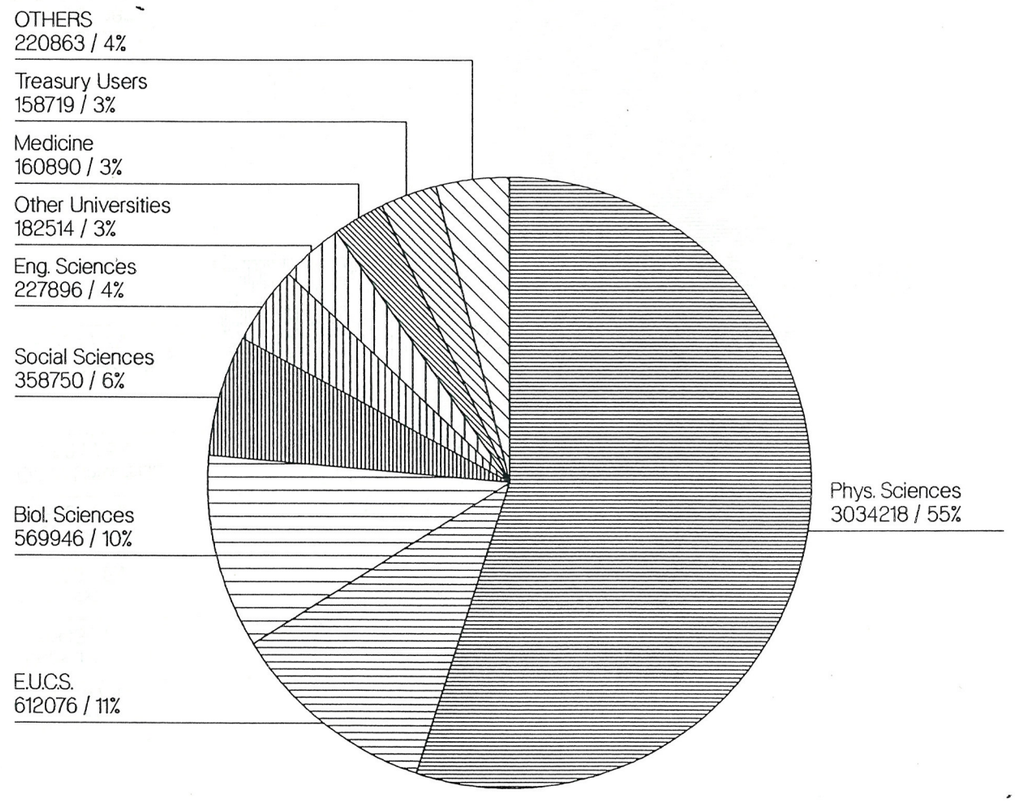
**1985-86**

| | Package | Total Cost | No. of Runs |
|---|---|---|---|
| 1. | SPSSX | 78668 | 4954 |
| 2. | SIR | 37585 | 8117 |
| 3. | SAS | 20837 | 1499 |
| 4. | ORACLE | 414 | 179 |



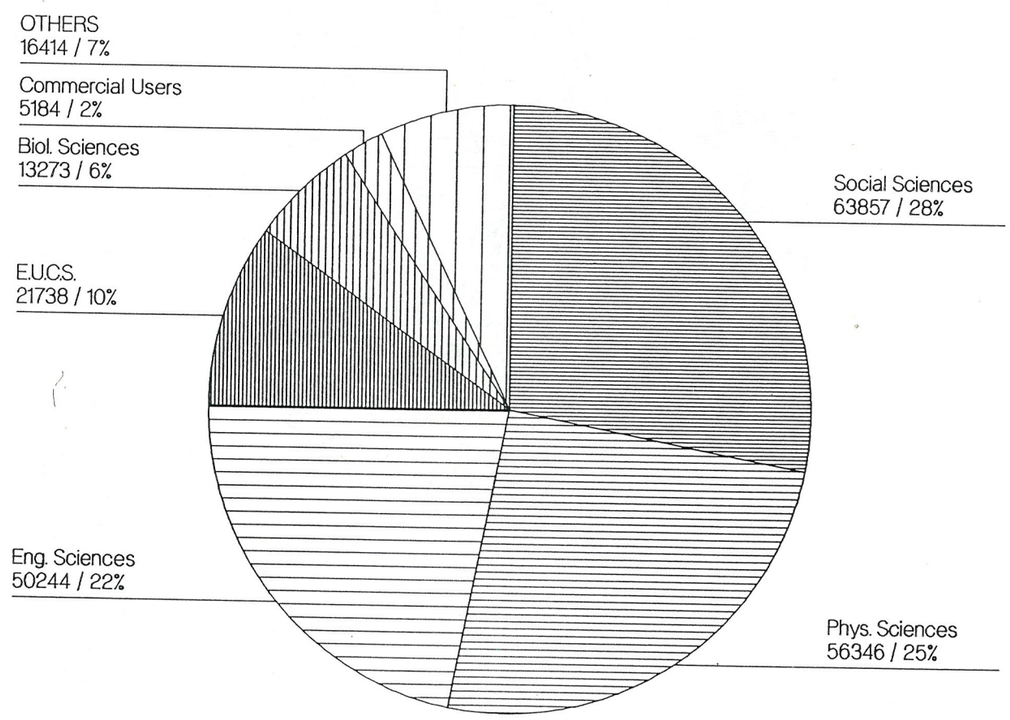
# Utilisation of EMAS

1985-86




# Utilisation of ERCVAX

1986-87



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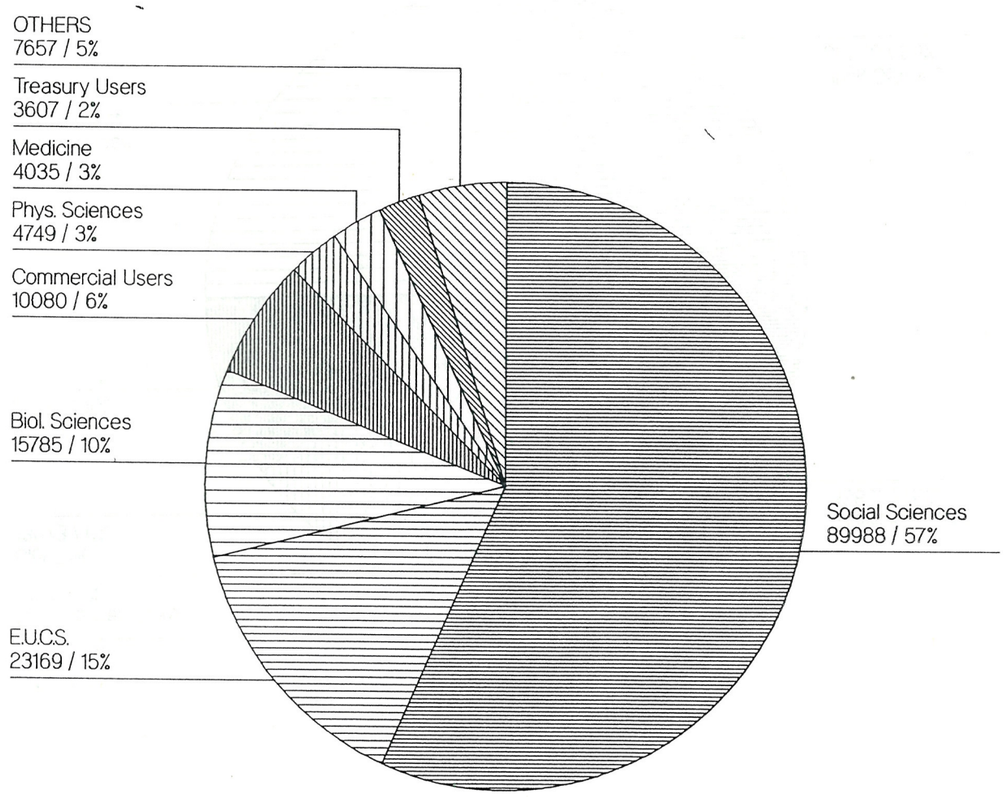
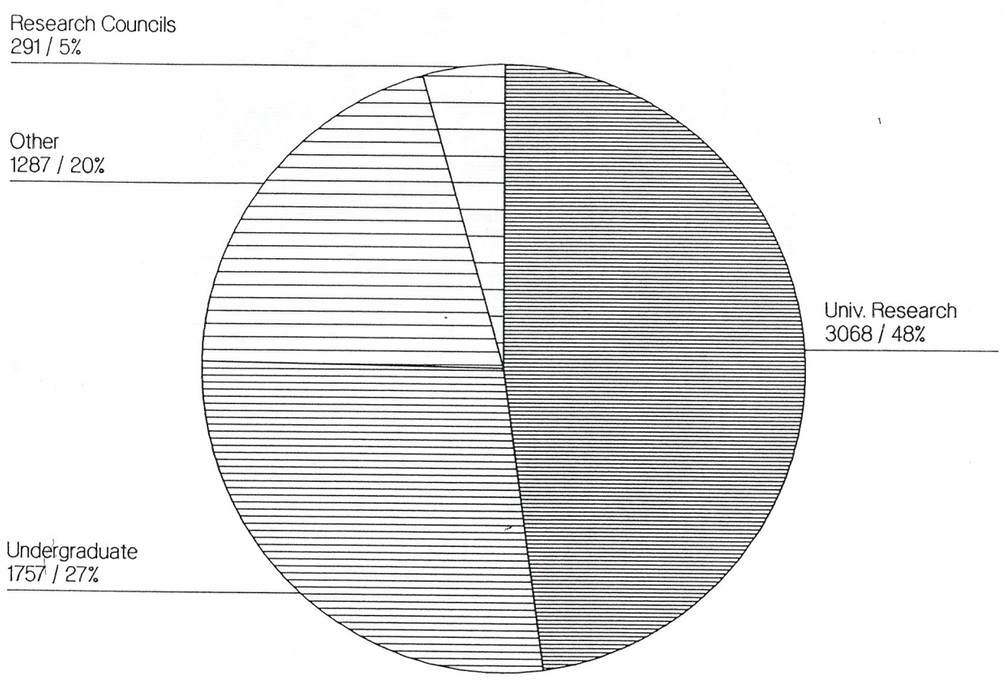
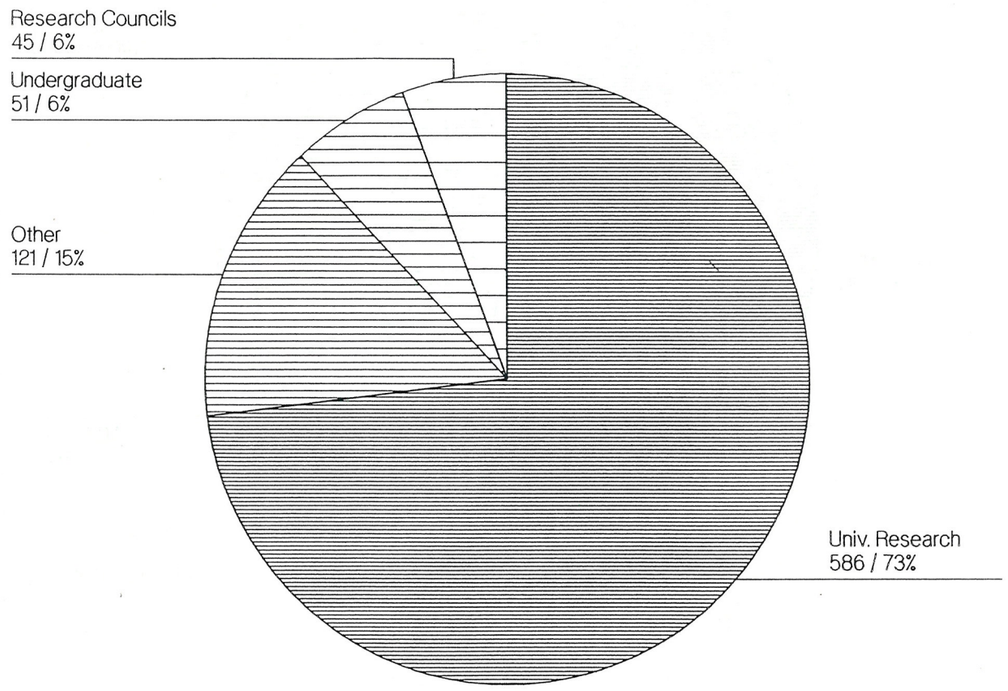
1985-86



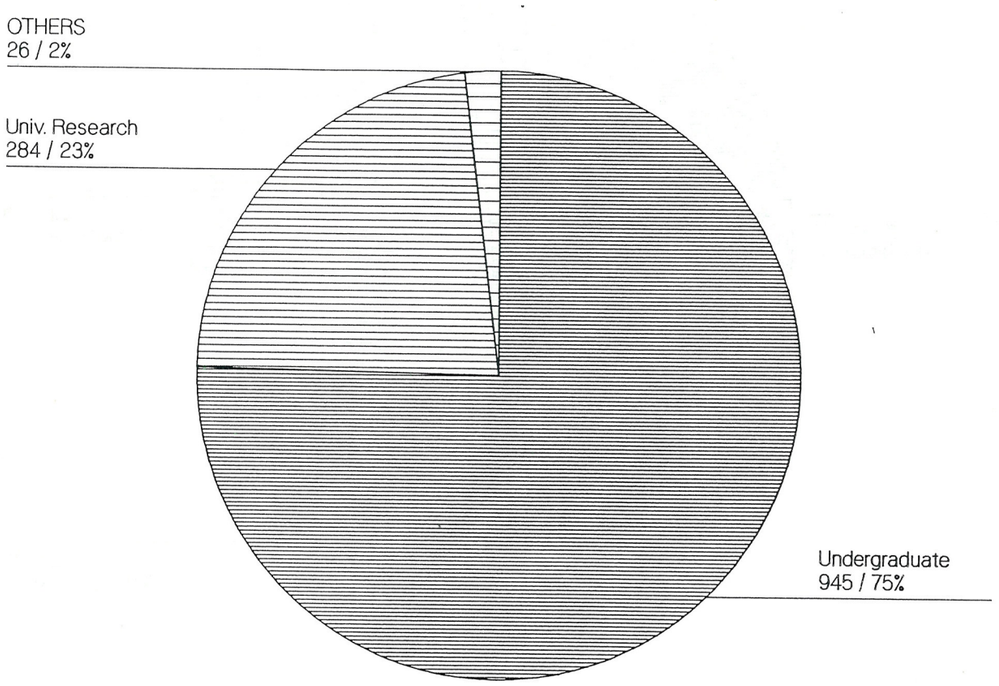

# Registered Usercodes - EMAS



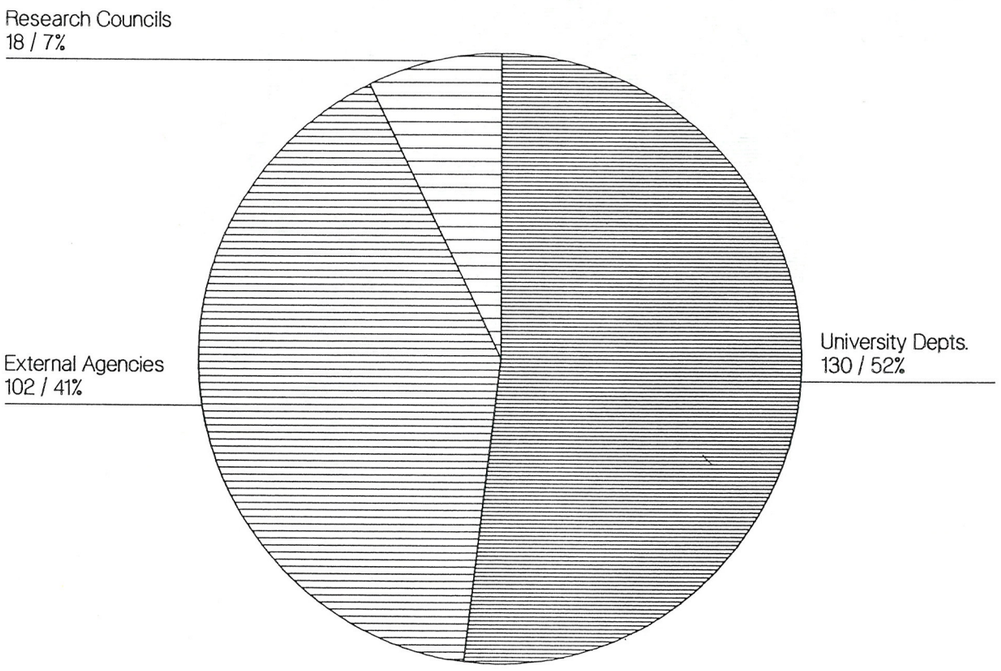
# Registered Usercodes - VMS



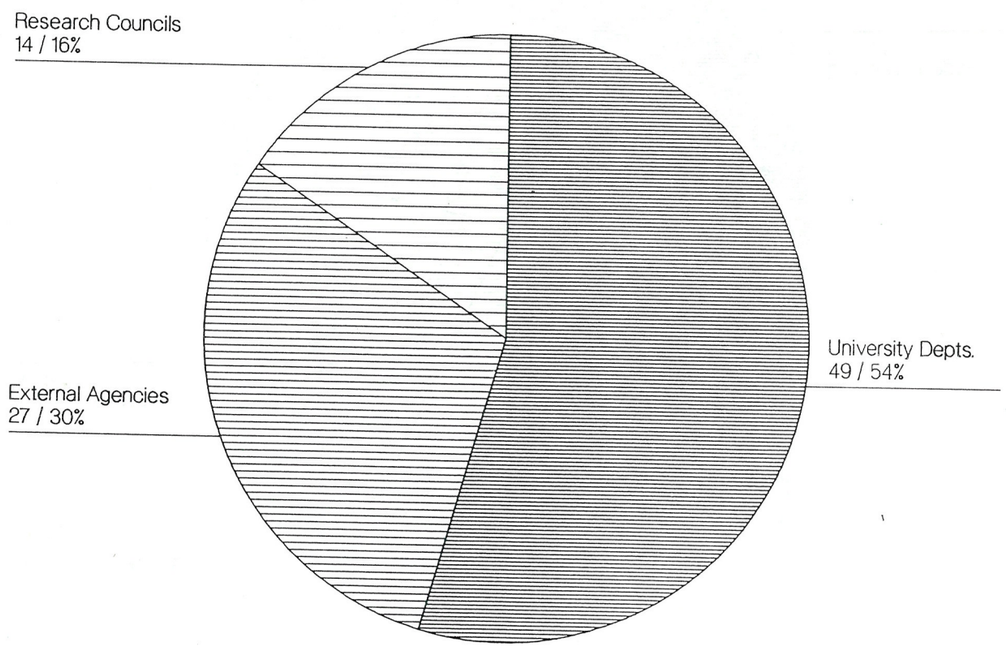

# Registered Usercodes - UNIX



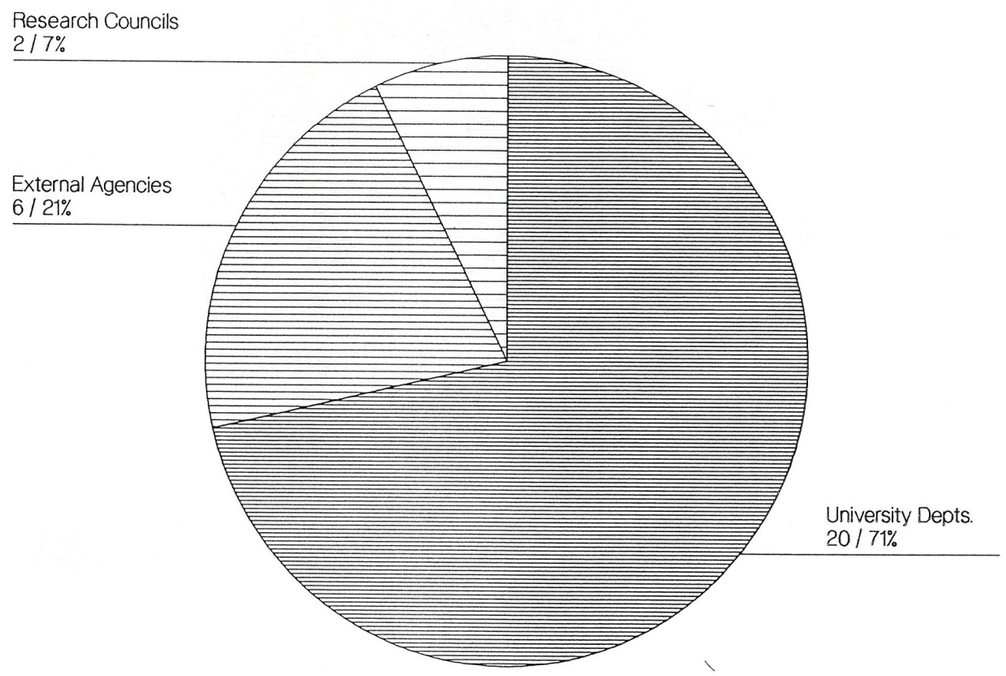
## Discrete User Communities - EMAS




## Discrete User Communities - VMS



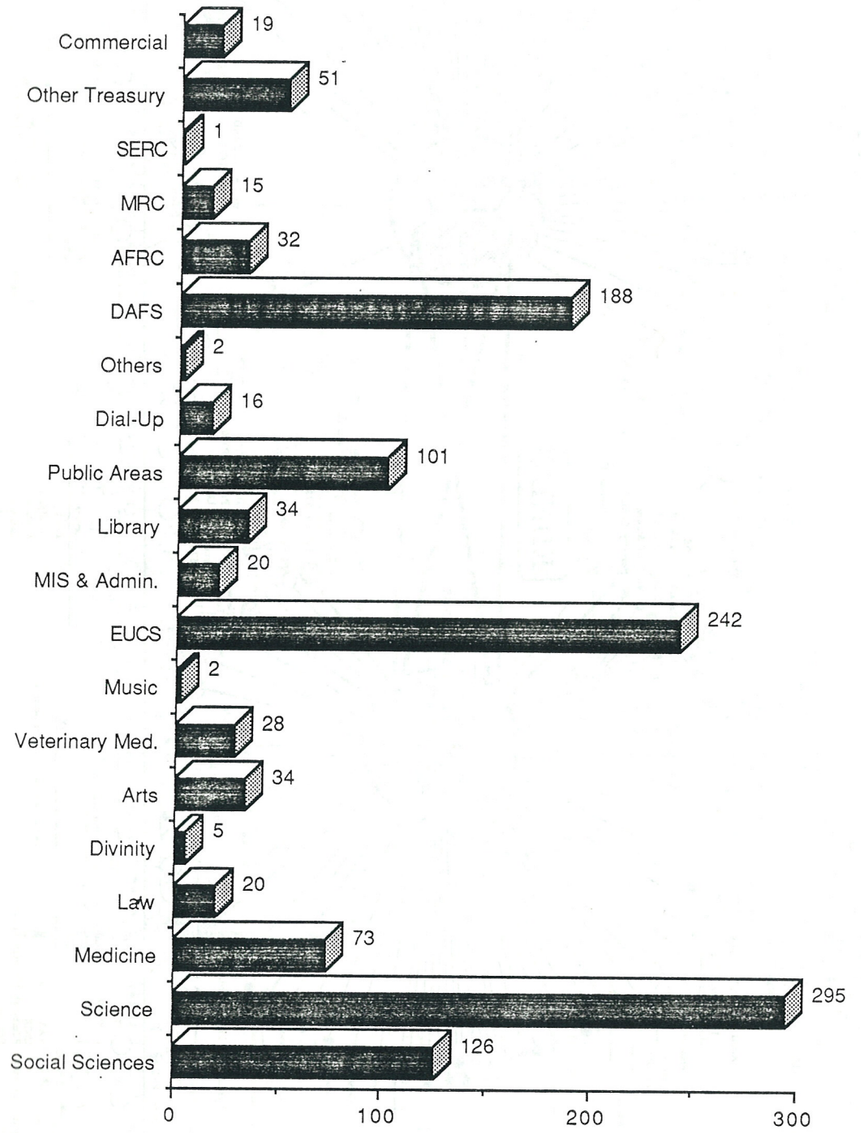
## Discrete User Communities - UNIX




*APPENDIX 3*

# NETWORKING

# EDNET X25 PAD CONNECTIONS IN FEBRUARY 1988




*Appendix 3*

JOINT ACADEMIC NETWORK JANET

# EDINBURGH UNIVERSITY COMPUTING SERVICE
## Communications Network-EDNET

| | | |
|---|---|---|
| Ednet Supports | 1987 | (1985) |
| Host Systems | 38 | ( 33) |
| Synchronous Connections | 175 | (100) |
| Asynchronous Connections | 2525 | (1521) |

(C)PSE- (Campus) Packet Switches
Network Host Systems
Remote Systems
CAMTEC PADs
Workstations
Ethernet/ DECNET

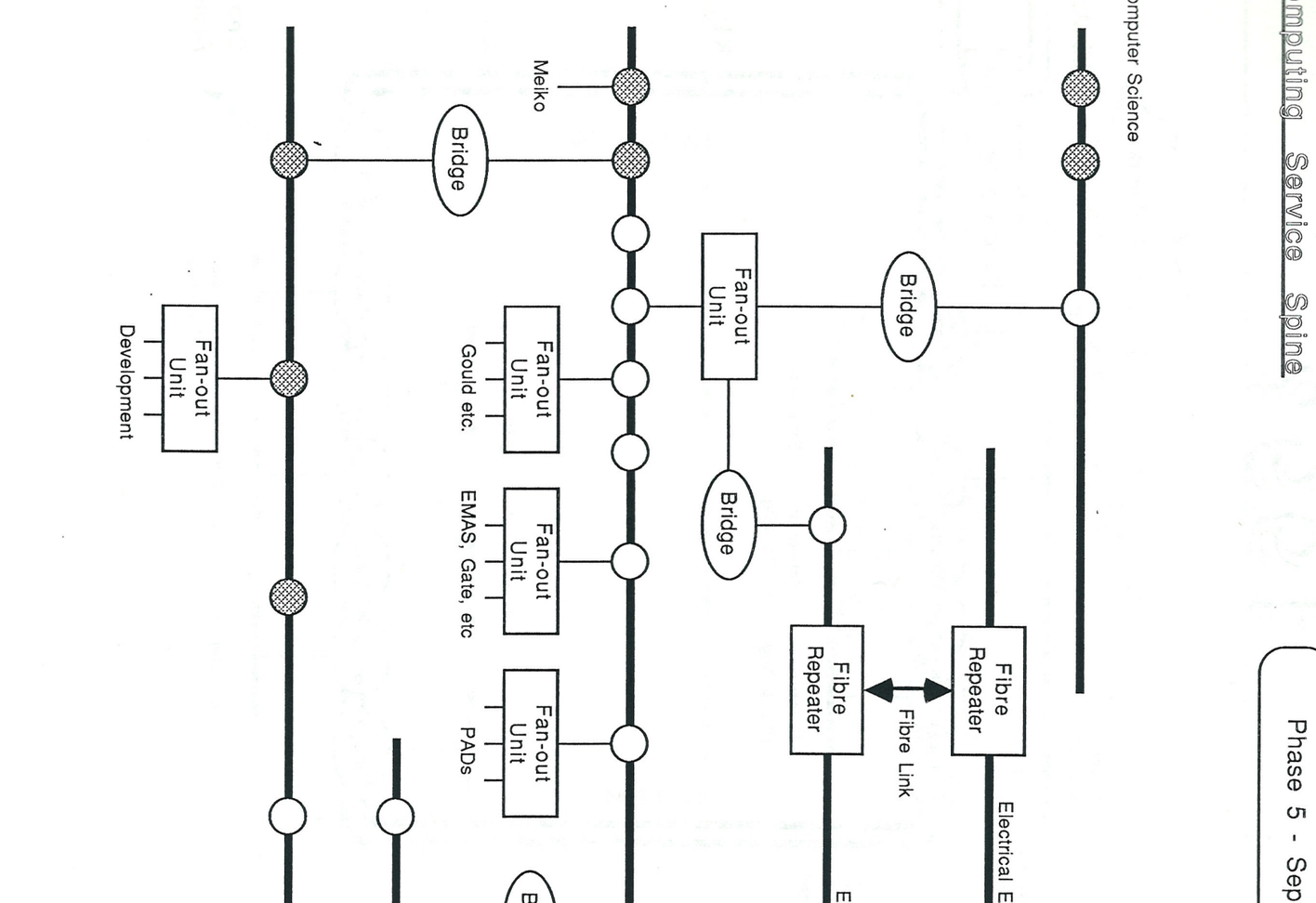
J.P.Livingstone August 1987

*Diagram 10*

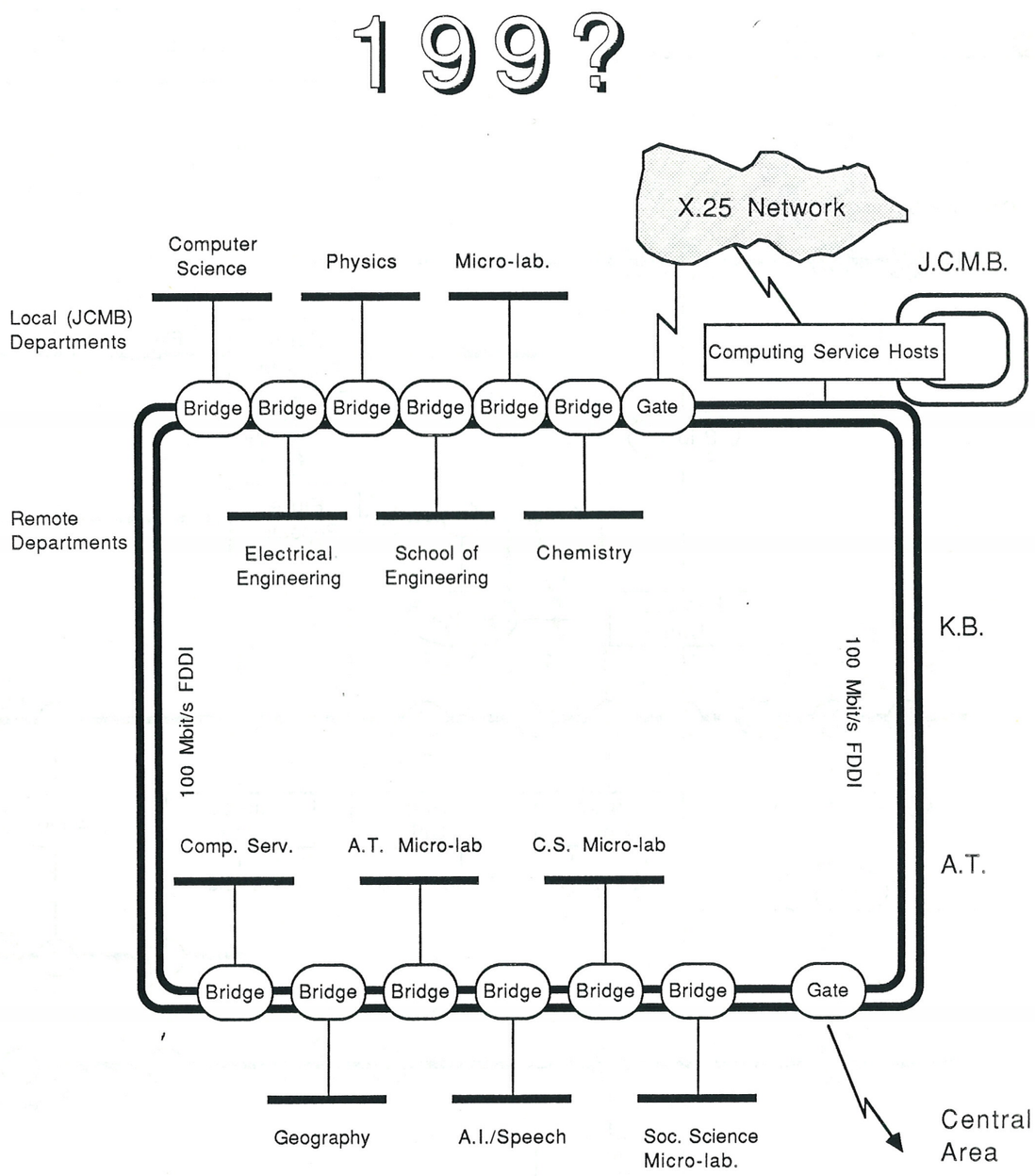
EDNET
KING'S BUILDINGS
APPLETON TOWER
EDINBURGH UNIVERSITY LIBRARY
Edinburgh Janet PSB
Telepac
GEC 4190
GEC 4160
GEC 4065
GEAC 8000
AMDAHL 470 EMAS
VAX 8500 VMS
VAX 750 UNIX
VAX 780 Micro VAXs VMS
VAX 11/ 750 UNIX
VAX 11/780
Systime 8750
PDP11/40
PDP11/10
PDP11/45
Network Pilestore
Network Info. Torch
ERTE PDP11/40
IBM 4341 VM/CMS
Slow Devices
MRC Clinical & Population Cytogenetics Unit
GOULD GEC 63s PN9080 UNIX
Hewlett Packard HP320 UNIX
Symbollos 3670
ALICE
ICL 3930 VME (ALICE)
MicroVAX VMS
VAX 11/750 VMS
Geography DECNET
A.I. Systime 8750 UNIX
CAMTEC PAD (SWITCH)
Xerox P.Serv.
C.S.T.R. VAX 11/750 UNIX
A.I. GEC 63 UNIX
A.I. VAX 11/750 UNIX
Xerox Wkstns.
SUN Wkstn. UNIX
Gould PN6031 UNIX
Xerox Workstations
Masscomp
SUN Workstations UNIX
Department of Artificial Intelligence
Centre for Speech Technology Research
Department of Artificial Intelligence Forresthill
Artificial Intelligence Applications Institute
80,South Bridge
Department of Computer Science
Department of Electrical Engineering
Integrated Systems Group
Edinburgh Microfabrication Facility
Bridge Ethernet PADs
Whitechapel Workstation UNIX
Pyramid 90XC UNIX
CS. A.P. M/Cs
Orion UNIX
IT School
Computer Science
Physics
Physics VAX 11/750 VMS
Physics MicroVax VMS Meiko Par.Proc.
Medical School
Geology
Zoology
Genetics
Computer Science
Electrical Engineering
Mechanical Engineering
Chemistry
Engineering
Forestry & NatResources
Science Faculty
Science Faculty Office
Pollock Halls
High School Yards
Royal Edinburgh Hospital
Scottish Crop Research Inst. Invergowrie
Edinburgh Physics
Kelvin Lab VAX 11/780 VMS
Paisley College VAX 11/750 VMS
Darcsbury JANET PSE GEC 4190
UMRCC PSB GEC 4190
Rutherford JANET PSE GEC 4190
Newcastle CPSE GEC 4065
Scottish Marine Biological Association Oban
Institute of Terrestrial Ecol.
Bush Estate
Banchory
British Geological Survey
Royal Observatory
GEC 63 UNIX
VAX 11/780 VMS
St.Andrew's Univ. VAX 11/780 VMS
Stirling Univ.CPSE GEC 4160
Heriot Watt Univ.CPSE GEC 4160
Aberdeen University CPSE GEC 4065
Glasgow Univ.CPSE GEC 4190
Strathclyde Univ.CPSE GEC 4190
Dundee Univ. CPSE GEC 4160
School of Agriculture VAX 750 VMS
Institute of Animal Physiology and Genetics Research
Prime 750
Prime 550
Scottish Agricultural Statistical Service Prime 550
Bush Estate ESCA APAD
Scottish Ins.of Ag.Eng
Macaulay Land Use Research Institute
SCRI Pentlandfield
Vet Field Station
Forestry Commission N.R.S.
West of Scotland College of Agriculture
PSS/IPSS Gateway PDP 11/34
To/From British Telecom's PSS/IPSS Network
New College
Erskine Medical
Western General Hosp.
CEGS
Law
A.I.
BSCA
Darwin
Genetics
Engineering
Zoology
Geology
JCMB
King's Bldngs
CTVM
VPS
RDVS
Erskine Library
Medical Statistics Unit PDP 11/44 UNIX
Main Library
Biochemistry Vax 11/750 VMS
Western General Hospital
Medical Faculty
Economics MicroVAX VMS
Business Studies,B.P.
Social Science Faculty
Research Centre for Social Sc.
Psychology Acorn Econet
Centre for Educational Soc.
Archaeology
Old College
Royal Dick Vet School
Data Processing Unit IBM 4341 VM/CMS
ASET Data General MV4000
59, George Sq.
Appleton Tower CAMTEC PADs
Roxburgh Street
Computer Science A.T.
A.T. Microlab
Gould PN9080 UNIX
Edinburgh Portable Compilers
Gould PN9080 UNIX
Linguistics Vax 11/750 VMS
Centre for Cognitive Science
VAX 11/750 UNIX
SUN Wkstn. UNIX
North Buccleuch Place
ERCC KB CAMTEC PADs
ERCC LAN
Xerox Wkstns.
White-chapel
SUN File-servers
SUN Workstations UNIX
SUN Workstations UNIX
SUN Workstations UNIX
SUN Workstations UNIX
SUN Workstations UNIX
SUN Workstations UNIX
Systime 8750 UNIX
Hewlett Packard HP9000 UNIX
VAX 11/750 UNIX

# Computing Service Spine

Phase 5 - Sept/Oct




Spine Schematic Phase 5 14/3/88




*APPENDIX 4*

# COMPUTING AND TEACHING

*Appendix 4*

# Computing and Teaching

The following contains an overview of the use of computing within the University of Edinburgh as an aid for teaching purposes. It does not cover every application described at departmental meetings or in departmental strategy statements and is intended only to give a broader impression than is given in the initial report.

## 1. Faculty of Social Sciences

Computers are used as aids for teaching in nearly every department in the Faculty. A variety of solutions have been adopted although a large proportion of the work is basic word processing.

Architecture have adopted a network of Whitechapel workstations running under UNIX and using software written by EdCAAD. In this particular discipline very little "off-the-shelf" software is available hence the reliance on their own resources. 'The C' and PROLOG programming languages and UNIX tools are used in their teaching as are commercial word processing packages.

Geography concentrate their teaching on their departmental DEC VAX 11/750 and MicroVAX both running under VMS and use package software such as Oracle. In 1985 they introduced a M.Sc. course in Geographic Information Systems, the only one of its kind in the UK, an undertaking only possible because they had their own facilities. Undergraduate Geography students also make heavy use of computing facilities for statistics, mapping, cartographic design, database management and word processing.

The method and content of teaching in Business Studies has been transformed by the advent of computers in industry. Computer usage is a major component of their courses. Their 50 MBA students average 40 hours each on a micro as part of their course. Because their teaching must be relevant to students when they enter business, they are committed to using hardware and software based on IBM PC standards. Accounting and Business Methods and Economics have adopted an approach similar to that of Business Studies.

The Department of Psychology currently has an ECONET local area network with BBC micros attached for teaching purposes from second year onwards, and they still make extensive use of EMAS. They expect however to move in the near future to a strategy based on more modern equipment.

Sociology, Social Policy and Social Work and Social Anthropology also make substantial use of EMAS for teaching purposes particularly in the use of the SPSSX package but it is expected that other areas of their teaching requirement will be satisfied in future by the new Social Studies micro laboratory consisting mainly of Apple Macintoshes. Economic and Social History have standardised on Apple Macs for teaching purposes and these were the chosen machines for the departments involvement in the Computers in Teaching Initiative. The main benefit that they see from this choice is the short learning curve involved in new students getting to grips with these systems and the user friendly facilities offered.

## 2. Faculty of Science

As might be expected, computers are used widely throughout this faculty for teaching purposes. Although many courses are still based on central multi-access services, there has been a recent trend towards the use of local facilities usually because of the increased reliability and improved graphics facilities available on microcomputers and workstations. The cost and effort involved in maintaining a local teaching laboratory has, however, encouraged departments such as

Chemistry and Mathematics to continue to base their teaching on centrally managed systems. A recent development is the establishment of a jointly funded and managed microlaboratory located in the James Clerk Maxwell Building where costs have been shared and where there has been a contribution from central funds.

Of course computing is the very essence of teaching in Computer Science. Students learn about many aspects of computing from the design of hardware, through architecture, system software and programming to applications and the theoretical foundations of the subject. The teaching is supported by practical work which students undertake using a variety of systems and the introduction of personal workstations for this work has resulted in a move away from mainframes. There are however, some economic arguments in favour of using mainframes for some of their activities and at present these are supported on the departmental VAX and on the School of I.T. Gould.

Artificial Intelligence moved away from EMAS because of the lack of software maintenance for Prolog and now base much of their first and second year teaching on the School of I.T. Gould UNIX service using the AI languages Prolog, Lisp and Pop11/Poplog. Third and fourth year honours courses use specialised resources within the department for vision and robotic modules.

Teaching in the Centre for Cognitive Science is a doctoral programme scheme, consisting of a one year taught course followed by graduate supervisions and seminar teaching for PhD candidates. An important component of the taught course is an introduction to symbolic programming which involves lectures and practical work in either LISP or PROLOG. The main part of this teaching uses C-PROLOG on their Unix VAX with a minority of more advanced students using INTERLISP on the XEROX D-machines.

Within Electrical Engineering, computing is a key element through all years of the undergraduate and graduate programme. Formal laboratory exercises in the first three years of the undergraduate curriculum teach elements of general programming, microprocessor programming for control and measurement applications and the use of applications programs for design and simulation. Many honours year projects also have a significant computing involvement and the MSc. programme makes heavy use of computing for CAD in both formal exercises and project work. Most of Electrical Engineering's teaching load is dealt with on in-house systems, their first system being acquired in 1978 to support the teaching of microprocessor design a type of service necessary for a laboratory environment which could not be satisfied by the existing central service.

In the Department of Physics all undergraduate teaching in computing is accommodated on their VAX 11/750 running VMS. Until the beginning of the 1980s, computing played only an informal part in the Physics degree with some students attending Computer Science courses as part of their first year. Now, an introduction to computing (FORTRAN) is part of the third year laboratory course and students are expected to use computers in the analysis of laboratory results. There is also an advanced computational methods optional course in the Final Honours year, and a number of undergraduate laboratory experiments are controlled by micro-computers usually BBCs.

The Department of Zoology makes small use of computers (EMAS and microcomputers) in two of their third year laboratory classes concerning biological models and statistical analysis. Botany have only a few individuals making use of simple computer models in teaching, for example of enzyme kinetics.

In Chemistry microcomputers are used in connection with a few laboratory teaching experiments, and other experiments involve modest use of EMAS for data analysis. They also give a short course in Fortran Programming and the use of the EMAS operating system to third year students. There is relatively little use of computers in lectures, or of computer-based learning activities.

Mathematics use computers for teaching of first year and later for third and fourth year Honours students as well as for third year Chemical Engineers. The computer facilities required



differ from course to course with much use being made of the central Appleton Tower microlab and some, because of its dependence on large scale computations, is done on central mainframes.

Very little use is made of computers in undergraduate teaching in Meteorology although there is some use of BBC micros in Laboratory classes. If resources can be found to generate computer aided learning material then this is likely to change dramatically. At present their MSc. in Remote Sensing and Image Processing Technology is taught using both EMAS and a sub-section of the Computer Science Ethernet, on which the Meteorology department has a 160 Mbyte filestore and three APMs as graphics workstations. This situation is far from satisfactory as it involves students in learning several operating systems.

Within Chemical Engineering, students learn to use computers from the first year onwards in connection with classes and laboratory projects and for the preparation of reports. Design teaching and projects require the use of in-house packages as well as the students own programs. Teaching in this department is based on local micro and workstation facilities and on central mainframe services.

The Department of Geology received a UGC/Computer Board Computers in Teaching Initiative award in 1985 which allowed them to install a network of 12 microcomputers for teaching purposes. A second award was received in 1986 to develop software for a joint project with the Heriot Watt University and although their use of computers for normal classwork is low at the moment, it is expected to grow substantially as a result of the experiences gained from these projects. Within the Department of Genetics, their MSc./ Diploma in Animal Breeding, and Honours, students are taught computing and they make considerable use of central services.

## 3. Faculty of Medicine

Many departments stated that their teaching was dependent on students relating directly to patients and the human contact factor was crtitical. They could not see how this aspect could ever be replaced by computers.

Views on computers in teaching within the Faculty were mixed. Some had difficulty in seeing any relevance except for producing teaching aids such as slides. Others saw possible uses, particularly using new technology such as interactive video discs, but lacked the effort to establish the new material. There are however, departments such as Biochemistry who have used computers in their teaching for some time and have a well established base. There are some signs that "off-the-shelf" software is becoming available in certain areas, for example programs relating to self-assessment and teaching in Dermatology, which might impact on the use of computers in medical teaching.

Where new technology might help is in the area of communications. The Faculty is widely distributed and it is often necessary for members of staff to teach at a different location from where they are normally based. An electronic method of transferring messages, papers and essays could save some considerable amount of time and effort.

## 4. Faculty of Law

The personal computers within the Faculty are used mainly for word processing and their main use for teaching purposes is the preparation of teaching material. The BBCs are also used by staff and students to access external databases such as Lexis and the local Library Catalogue. One of them is also being used for the development of programs for computer assisted learning.

In the coming session, an "office system" module will be offered in one of their courses and they would like to duplicate a commercial law environment for teaching purposes.

## 5. Faculty of Divinity

Their use of computing for undergraduate teaching has been limited by the lack of equipment and support staff. They felt that the Computing Service could play a bigger role in teaching students to use word processing or other standard packages. The ruling that undergraduates should be taught computing by their own departments was in their view an anachronism, dating back to 1963 when only Computer Science students needed such teaching, which should be reviewed. They had observed that many students seemed shy of keyboards and they were working on overcoming this problem.

Computers are generally used for the production of handouts using multi-lingual word processors and two teaching aids have been developed in the Department of New Testament Language, Literature and Theology. One is a programme to help students who are beginning their study of Greek and the other involves a set of prescribed Greek texts in which each word is grammatically tagged.

They were ready to take advantage of any well proven teaching programmes that became available but at the moment there is a lack of suitable material in this field.

## 6. Faculty of Arts

Given the extremely limited provision of equipment and support resource throughout the Faculty it is perhaps understandable that computing has made very little impact on their teaching practices. The main use is word processing for the preparation of teaching materials in a variety of languages by staff and the production of essays by students.

Some elementary steps have been taken into the field of computer aided learning and this area was of particular interest to the language departments who see Computer Assisted Language Learning (CALL) as being a vital provision for the future. They see themselves, the Language Learning Centre, the Teaching Learning and Assessment Centre and the Computing Service being jointly involved in this activity.

For the last seven years within the Department of English Literature, their annual intake of post graduate students have been given a compulsory hands-on computer familiarisation one-day course which has been followed up by a voluntary five week course (one full morning a week) which has had an approximate 87% take-up. This has been carried out in conjunction with the Computing Service's Training Unit. They intend to introduce similar training for all undergraduates and staff.

Islamic Studies produce first year Arabic texts using an Arabic word processing package. They envisage that currently available CAL material for the teaching of Arabic will be developed and incorporated into their teaching programme. The Department of Philosophy has a proof checker programme which is used in the teaching of logic. Seventy of their students are provided with a disc which contains an exercise to be carried out on the Sirius systems in the Appleton Tower Micro Laboratory

The Department of Linguistics has made substantial use of computers for teaching purposes. They initially used EMAS for text and statistical analysis using packages such as SPSS, MDSX, Genstat and BMDP. Demand for this has recently tailed off although many of their post-graduate research students use SCRIBE on EMAS for the text processing of their theses. Most of their current teaching requirement is satisfied on departmental systems. Several undergraduate modules in experimental phonetics, speech analysis and synthesis, speech technology and natural language processing use their computing facilities as do several modules on taught post-graduate (M. Sc.) courses in Phonetics, General Linguistics and Information Technology.



## 7. Faculty of Veterinary Medicine

In certain areas computing is well established in the teaching practices of the Vets but overall its penetration is limited.

Some of their teaching material is prepared using word processors and facilities such as Notice on EMAS for producing diagrams.

In preclinical Veterinary Science, computing has been used in both undergraduate practical classes (Veterinary Pharmacology and Physiology; B.Sc. Neuroscience) and post graduate classes ( M.Sc. Neuroscience).

The Department of Veterinary Clinical Studies makes use of microcomputers for diet formulation in the second year of the veterinary course. Also, their clinical/epidemiological DBMS is demonstrated to fourth and final year students. Some final year students use the database in their clinical projects and some of their students are now beginning to word process essays.

Although they see future benefits from Computer Aided Learning, they do not have the resources to establish any material. Veterinary Pathology made an unsuccessful bid for CIT funds in 1986 which involved the use of computers in new approaches to the teaching of pathology for the Honours degree in Pathological Sciences. Their bid included a laboratory of microcomputers and staff resource and the requirement stated in that bid is still applicable. The provision of such a facility would have been a major step forward in the use of computers in teaching in Veterinary Medicine.

Since 1986, Honours students in Veterinary Pathology have joined with the Honours course in Molecular Biology for certain topics which includes a module on the use of computers in biology.

## 8. Faculty of Music

The Music Faculty's Electronic Studio has been built up to a very high standard in the past and current year and will play a significant part in teaching both at undergraduate and postgraduate level.

*APPENDIX 5*

# COMPUTING AND RESEARCH

*Appendix 5*

# Computing and Research

The following contains an overview of the use of computing within the University of Edinburgh as an aid for research purposes. It does not cover every application described at departmental meetings or in departmental strategy statements and is intended only to give a broader impression than is given in the initial report.

## 1. Faculty of Social Sciences

As with teaching, within the Faculty of Social Science many different solutions have been adopted for research purposes.

EdCAAD have their own DEC VAX 11/750 and numerous workstations all running under UNIX. Their research involves Intelligent Knowledge Based Systems and cognition in computer graphics and they have shared research interests with other departments which are expected to increase. Their computing policy is to maintain a relative independence of manufacturer supplied software packages and to move increasingly towards the use of single user workstations e.g. SUN and Whitechapels

Much of Geography's research involves large data sets such as World Trade figures, landscape models etc. Current developments are in the area of modelling, simulation and the application of database and GIS technology to practical problems. The department is an important component in the ESRC funded Regional Research Laboratory (RRL). Like their teaching, Geography's Research is based on VMS and packages but there is also a substantial amount of bespoke software produced within the department. They have out of necessity developed skills in database design and software interfacing in the development of systems for map and air photo library cataloguing and tools to provide graphic manipulation of databases. They are also involved in image processing based on a GEMS system. As a result of the lack of power within the department, consideration is being given to moving PhD research projects, geographic modellers and other heavy processing to the ERCVAX.

Much of the research facilities available in the Department of Business Studies which are based primarily on the IBM PC standard, have been bought from money earned on the open marketplace. Some use is made of packages on EMAS and these are felt adequate but cumbersome. They make some access of commercial databases of financial information but are constrained by the expense of such an activity.

Accounting and Business Methods have a number of research projects which are developing the use of computer assisted learning for their students together with several projects which use expert systems software or statistical packages for analysing data. These are again based on IBM PCs. Economics concentrate much of their research on their VMS based MicroVAX which they hope to link to the laboratory of IBM PCs to use as a local filestore.

Economic and Social History have taken a major role in the development of computer-based methodologies for best practice social science history over the past 15 years notably through the work on the demography and analysis of the 1851 census of Britain and the SERC/ESRC supported record linkage project. Extensive use is made of database analysis and until recently, the bulk of this work took place on central mainframes. However, it is now possible to handle much of it on desk-top systems, in this case Apple Macintoshes, but the size of the datasets being manipulated and the investment in bespoke software will mean a continued use of a central service for some time.

Social Anthropology have made use of EMAS although most of of their research activity is now micro (IBM PC) based. A great deal of use is made of text processors and standard packages such as spreadsheets and databases.

Research has a high profile within the Department of Sociology and the teaching of computer-aided research skills has formed a major part of their courses in research methodology. In terms of staff research, there are a number of large scale projects which make use of micro and mainframe facilities. On the mainframes, SPSS-X is used and the micro versions of this package are currently being evaluated.

Psychology replaced a DEC PDP11 for research purposes with 68000 based systems. These have not been a great success and consideration is being given to moving to other systems. Currently the department places a heavy reliance on television recording equipment for data logging frequently analysed frame by frame which is very time consuming and they are interested in developments in this field.

For the Centre for Educational Sociology the role of computing is central and crucial.Much of their data is held on EMAS for analysis using a number of statistical packages such as SPSS-X, GLIM, SAS, LISREL, etc. In some cases, data is down loaded on to Apple Macintosh microcomputers. Research staff make use of external sources to link with in-house data and the Data Library is a vital link in their research.

The RCSS has a complex remit and its current computing situation reflects those needs. Research analysis needs are met almost entirely by central mainframes where they operate with large datasets, generally manipulated by packages. Security of data and maintenance of software are their main reasons for concentrating on mainframes.

## 2. Faculty of Science

Computing is an integral tool in research work throughout the Faculty of Science. There are those departments who are researching into various aspects of computing itself and they use computers to research into computing!

Computer Science carry out research in all the areas in which they teach including hardware design, architecture, system software, programming, applications, and the theoretical foundations of the subject. In-house facilities are used for nearly all of their research work with use of central services having been reduced substantially.

Externally funded research in Artificial Intelligence is now carried out on workstations, files servers and mini-computers funded by the Research Councils and by the Alvey Programme. The value of this equipment is approx. £1m. Over half the research of the Centre for Cognitive Science makes use of computing in areas such as grammar development and natural language processing which involves the use of Prolog on their VAX, SUN workstations and on Macintoshes. They also carry out statistical analysis on EMAS and on-line monitoring of experimental data on a BBC micro network.

The very significant part played by research funding in building up computing resources within Electrical Engineering testifies to the critical role which computing plays in many areas of engineering research. Without facilities for effective CAD and computer simulation, the research programmes of many PhD students and staff would not be possible. The less obvious, but important role played by computing, is in the production of the proposals, papers and other documentation needed to attract both students and funds and to disseminate the results of research.

Physics have been using computers for data acquisition since the late 1960s and most research groups now have several small machines dedicated to data acquisition which are connected to the departmental VAX or to EDNET. The Department has been a major user of the central services over the 20 years but there has been a strong move towards placing more computing power in laboratories and offices. In addition, the department continues its development of computing in physics research although the emphasis has changed from multi-tasking real-time systems of the 1970s to the more recent interest in powerful specialised machines using novel architectures.



One of the major occupations of the Department of Geology is the collection and processing of geo-chemical data for final preparation in the form of graphs, tables or formulae. Since 1975 they have been involved in real-time data acquisition and numerical modelling of geological processes has become a prominent feature of their computer usage in recent years. Also, they have just installed a computer facility dedicated to image processing which is likely to develop in collaboration with other departments.

All aspects of the research work of the Department of Chemical Engineering are heavily dependent on computing and the largest research group, in process simulation and design, is essentially entirely computer based. Other experimental work makes extensive use of both laboratory and mainframe systems.

In Meteorology the most demanding research work in terms of computing power is Diagnostic Studies. During the year, this accounts for about 4000 "jobs/sessions" on EMAS and the department currently holds about 200 magnetic tapes in the EUCS machine room. Current modelling studies in the department use two machines the DAP and the Cyber 205, at UMRCC. Work on parallel versions of meteorological models continues on the Meiko.

In Mathematics, some of their research work involves computation in an essential way and this research is heavily dependent on centralised resources (EMAS). Their reasons for using EMAS are that it provides an excellent environment for programme development and testing which accounts for the majority of the time staff spend on computing. Within the immediate future, they plan to take advantage of the Meiko for large scale work in several areas.

About three-quarters of the academic staff in Chemistry use computers routinely in their research. Microcomputers are mainly used in connection with particular experiments for control and data collection and analysis. Some of the data is transferred from the micros to EMAS. Many groups use mainframes (mainly EMAS) for analysis of data, refining theoretical models or performing simulation calculations. There is also a significant and increasing use of EMAS for document production and for graph plotting. One Group does quantum chemistry work on the Cray XMP at the Rutherford Laboratory.

For research purposes, computers are mainly used in the Botany department for text processing, data acquisition, data processing, statistical analysis and image analysis, graph plotting and for molecular database searches.

Zoology has wide research interests only some of which use computing. Their main use is for data collection, sorting, storage and manipulation, graphics for papers and theses, word processing and statistical analysis. The department is completely dependent on EMAS for large scale data analysis and storage. In Genetics, computing is a major component of the research in the areas of animal breeding and molecular genetics involving DNA sequence work. They make a very substantial use of central services for this work.

Many areas of Agricultural research are crucialy dependant on computing and computing techniques including numerical calculations, communications, control and operation of instruments, graphics, computer aided design, image processing, information retrieval, data bases, data logging, mathematical modelling, statistics and word processing.

## 3. Faculty of Medicine

In terms of number of users, the main use of computing by many researchers within the Faculty of Medicine is for word processing and statistical analysis. There are however a number of areas where highly sophisticated computing technology is being intensively developed and used in for example, the Departments of Biochemistry, Medicine and Medical Physics and Medical Engineering, Respiratory Medicine and the MRC Cytogentics Unit at the Western General. Real-time data acquisition and analysis and image analysis are major activities in these areas and in several others .

Statistical Analysis is a major use of computing within the Faculty. The Medical Statistics Unit acts as a focus for advice on statistical techniques. In addition to this Unit, a number of Departments make use of central University Computing Services for statistical analysis using packages such as SPSS, BMDP and Minitab. Amongst others these include Psychiatry, Geriatric Medicine the various Dentistry departments, Scottish Cancer Trials and Pathology. A substantial amount of other statistical work is carried out on microcomputers using a variety of software solutions.

A growing use of computers in Medicine is for database management. This is primarily carried out on dedicated systems with large numbers of microcomputers being used and very little use made of central services for this activity. The lack of affordable, easy access to central services plus the "unfriendly" user interface compared with micro systems, have been major inhibiting factors which have encouraged self sufficiency in this area.

Although central mainframe services have provided a vehicle primarily for statistical analysis for medics, much of the Faculty was doubtful about their relevance to their research. Out of necessity, a large proportion of their research must be done in-situ, in real time and only after the data has been captured can it then be transferred for further analysis. This and the costs involved in connecting many areas of the Faculty to the University's communications network has led to many self-sufficient pockets of expertise. In recent years the spread of communications connections into the various medical areas has led to an increasing use of central systems and one of the newer facilities, which is now being seen as an essential requirement for the future by many in the Faculty, is electronic mail. The dispersed nature of departments and the increasing amount of collaborative work within the University and outside make access to facilities such as electronic mail highly desirable for the future. At the moment, the critical number of network connections necessary to offer an effective system, don't exist. Document interchange which in the longer term might merge with electronic mail is needed but at the moment easily accessible facsimile transfer facilities would satisfy much of their requirement to improve inter-site communications.

Another facility currently available on central services which is of growing interest is the DNA sequence library. Biochemistry and the Cytogenetics Unit already make use of this facility.

Nearly all word processing is carried out on microcomputers with no one hardware or software standard applying throughout. Wordstar, based on IBM PCs or compatibles, dominates possibly because of its role within Health Board computing policy but there are a number of BBCs used for this purpose as well and a variety of other options including a number of Apple Macintoshes whose usability has appealed to a number of users particularly the MRC Unit of Reproductive Biology.

## 4. Faculty of Law

As with teaching, the major use is wordprocessing for producing research reports and network access to external facilities but some use is also made for the creation of databases on local microcomputers and to a lesser extent on the central mainframe services. No real use has been made of standard database packages with most of the information being compiled using only the standard editing facilities.

## 5. Faculty of Divinity

In addition to the highly specialised foreign language word processors used, there are several other categories of current computing use in the Faculty's research work. They include large files (up to 5 Mbytes) of ancient texts on EMAS, the use of text searching and concordance software, statistical packages for literary statistics and a local Ibycus machine with a 550 Mbytes CD-Rom collection of texts in Greek and other languages. This facility which was seen as a major step forward, is being used for concordance purposes and stylometric and syntactical analysis of the Greek New Testament and related literature. A postgraduate student is also



making use of dBase3 on a microcomputer for his research in recent history of missions material.

Communications facilities are also used for local and external access to databases for bibliographic searching and for the use of electronic Mail.

## 6. Faculty of Arts

As in teaching, computing for research purposes within this Faculty is limited by lack of resources. The degree of involvement varies considerably and again, the Department of Lingusitics is the major user of computing. Their facilities which include a Departmental VAX 11/750, are used for research projects for undergraduate honours dissertations, research and data analysis by post-graduate research students, research on various projects funded through the Centre for Speech Technology and for personal research by members of staff. A considerable amount of real-time computing is involved in the work of this department and in Phonetics, most speech analysis and synthesis is now done using digital signal processing and real-time sampling/playback of speech waveforms. Many areas of General Linguistics and psycholinguistics have interests in common with Artificial Intelligence and Cognitive Science and many technological applications combine requirements from several areas of linguistics, computing and engineering.

The School of Scottish Studies makes use of microcomputers to service their archives and publications. Their systems have network access and some use is also made of Catalog on EMAS. Within the Department of Celtic individual members of staff have been involved in projects which have employed computing. For example, a member of staff has developed a programme for the revision of the spelling of the Gaelic Bible and some research students have on their own initiative employed EMAS in their work.

Individual members of staff in the French Department use computers in three ways: 1) for word processing 2) for access to databases and 3) for the production of concordances. Personal computers used have generally been either privately owned or situated outwith the Department!

The Department of History was able to purchase several Apple Macintosh systems as a result of the special funds made available through the UGC's Research Selectivity exercise. Prior to this they had limited to a departmental secretarial system. These systems are used entirely for research projects conducted by members of staff and it is thought that material currently being assembled and held on disc in this country and abroad, is likely to revolutionise historical research methods in coming years.

Many researchers within this Faculty make use of personal computers for word processing research papers, statistical analysis, bibliographies etc.

## 7. Faculty of Veterinary Medicine

Computers are used extensively for real-time data capture and analysis in the research work of every department in the Faculty. Word processing and statistical packages are now used routinely be members of staff.

In Clinical Veterinary Studies computing is a major and necessary analytical part of epidemiological research and microcomputer programmes are being developed for epidemiological modelling.

Veterinary Pathology work closely with the Department of Molecular Biology in DNA sequencing and central mainframes are used for data analysis by all departments.

## 8. Faculty of Music

A SUN workstation running under UNIX is equipped with a floating point processor, analogue to digital converter and a 700 Mbyte file store in the Electronic Studio. They also have an Atari

1040 micro which is attractive because of its MIDI interface. The SUN is used for signal processing, music synthesis and analysis. Other U.K. institutions are active in this field are Durham and Nottingham but the main European centre is in Paris. Many U.S. institutions use VAX, PDP11 and SUNs for similar purposes.

The SUN requires 7-12 hours of computation to synthesize 10 seconds of music and generates very large volumes of data as sampling takes place at 44.1 Khz, 16 bits wide.



*APPENDIX 6*

# IMPROVEMENTS DESIRED

*Appendix 6*

# Improvements Desired

The following contains an overview of likely developments and improvements sought within each faculty. It does not cover every requirement stated at departmental meetings or in departmental strategy statements and is intended only to give a broader impression than is given in the initial report.

## 1. Faculty of Social Sciences

Within the Faculty of Social Science, most departments saw an increase in the use of computers in teaching and research over the next 10 years and "more of everything" will be required.

A continuing growth in student use of word processing for essays and the like, is generally envisaged. The trend is toward teaching this on micros which have a more "user-friendly" interface which cuts down the amount of tuition time involved in getting new students started. This is an important factor in all areas of computers in teaching as the more time staff and students spend learning to use computers, the less time they have to spend on their own subject.

A need to provide basic keyboard skills for all new students was identified and the concept of a wired campus with students submitting essays electronically had its attractions in some departments but many felt it was not desirable to eliminate the personal contact possible with the current system. It was pointed out that if students were expected to submit word processed papers, then it would be necessary to ensure that they were provided with appropriate access to facilities and support to enable them to do so. A common system solution for all undergraduates was considered and there was some support for the suggestion that Fresher's week should be used to provide courses on basic keyboard skills possibly provided by the Computing Service.

A growing use of shared laboratories of microcomputers is also envisaged. In the departments who make use of the existing IBM PC laboratories, Business Studies, Accounting and Business Methods and Economics, a need is seen for a third facility. The new Social Studies microlab facility is already oversubscribed and further expansion will be required.

Until packages such as SPSSX are demonstrably as useful on a micro as they are on a mainframe, departments such as Sociology will continue to have a need for access to central services for teaching purposes.

Expert systems, more mature than todays technology can offer will be of importance to many Social Scientists and there is increasingly, collaboration between departments in this Faculty and those in the School of Information Technology for certain courses and research projects. For example, a joint course between the departments of Accounting and Business Methods and Artificial Intelligence is being established. EdCAAD and the departments of Geography and Psychology have already well established links with other disciplines within the University. This will mean students accessing facilities from a distance and effective communications between departments will be crucial.

Nearly every department saw the use of electronic Mail on a local, national and international basis as being a major requirement for the future. The use of Mail would would enhance the joint drafting of papers on an intra and inter-university basis and could save staff time. It was also believed that the use of Mail, particularly on an international basis, could reduce considerably timescales for joint research projects.

A frequently stated requirement was better access to external databases and the desire to have the ability to capture some of their data and manipulate it locally. The funding of this capability

could however be a major overhead and current costs prohibited effective use of important sources of information.

SPSSX access for the manipulation of large databases would continue to be a research requirement and although it was expected that some of this would transfer to PCs within the ten year time frame there would continue to be a need for a secure central archive for data.

Many departments within Social Science saw the Regional Research Laboratory (RRL) and the Data Library as continuing to be increasingly important facilities for their research purposes.

The possibility of fully electronic surveying which was already being done elsewhere, was of interest particularly for the RCSS.

Many departments have a need to analyse qualitative data and are hoping that suitable software will become available for such a purpose.

Each department had its own specific area where they expect major developments to occur over the next 10 years. For example, within Geography the main areas for development include larger and more comprehensive data sources, statistical analysis, graphical presentation in the form of maps, charts and diagrams, image processing, modelling and simulation and artificial intelligence techniques. Architecture and EdCAAD see a need for fast parallel processing to support the integration of graphical images related to design knowledge.

Business Studies would hope to reach the level of American Business Schools where every student place is fitted with a micro.

The need for a continuing secure centrally managed archive store was stated by nearly every department.

The central provision of packages which were too expensive to consider on an individual basis was another stated requirement but many felt that the user interface across the network to centrally provided packages must be improved. It was also felt that the same packages should be supported across a range of systems. This Faculty strongly emphasised the need for the computer to be "a tool". Bibliographic and text analysis and retrieval packages would be useful in many areas of this Faculty.

A need for more micros, workstations and more widely available, "cheaper" network connections for staff and teaching purposes were common requirements. A central library of software that can be taken out on loan was suggested and better central support for software provision, licensing and the application of software to "do the job".

It was suggested that data input was the biggest barrier to research. Document or optical character, reading facilities were required.

More shared micro laboratories for teaching purposes were sought by most.

Architecture saw a need for large bed plotters and digitisers.

Network connections in lecture theatres were asked for. Geography asked for an ADA compiler, expressing concern over the way in which the previous ADA facility was withdrawn without prior warning. They also would like to see a way of moving from sequential to parallel processing and they would like to see co-operative processing across networks.

A package for qualitative analysis was asked for and the need to hide the detail of computing from students.

## 2. Faculty of Science

All departments see a continued substantial expansion in demand that will be constrained only by



funding limitations. Improved communications within the University and with the major external networks was of high priority throughout. It was also a quite common prediction from Science departments that UNIX would be of primary importance for the next ten years and that there will be an increasing move towards distributed computing with high speed integrated access to any central facilities being see as an essential part of the overall arrangement. It was felt that centrally managed systems which offered facilities comparable to those provided on departmental and desk top systems could prove attractive in view of the management overhead which would be removed from departments.

The use of desk-top high powered personal workstations is expected to expand over the next 10 years by most departments. These will bring with them a funding problem as they will require regular updating if the university is to remain at the forefront of academic teaching. The introduction of a university wide high-speed networked would be welcomed by most of the Faculty particularly if it offers access to a centrally managed file server although it was emphasised that a hierarchical file serving mechanism would be required if this arrangement was to be effective. The interface to any central file server should be functionally rich and consistent with departmental facilities. Security of data would be of paramount importance.

The use of AI based tools, especially expert system shells was increasing and it was suggested that it could no longer be claimed that these were of interest only to the Deaprtment of A.I. and should be centrally supported.

Computer Aided Learning brought a mixed reaction but some departments felt there was untapped potential in this area. The provision within lecture theatres of real time audio-visual display of output from any computer on the network was suggested as desirable.

Improved word-processing facilities, allowing integration of text and graphics, transferable between machines and output devices was sought. High quality output devices of phototypesetting quality would be of general interest. Document production was expected to universally increase.

More software site licences administered by the Computing Service were also felt to be a major requirement. The present arrangements for the procurement of hardware were felt to be in need of improvement as the process can take up to a year by the time funds are obtained and approval given.

Powerful computer facilities based on novel architectures will be required for the solution of particular problems in computational physics but they are also of interest to several other departments within Science and other faculties. Much of the work on these new parallel architecture systems is into new areas of research which were not previously large scale users of central facilities. Current users of central services for large scale conventional computing will therefore require continuing access to such facilities.

A mechanism for speeding up the installation of data cabling was asked for by several departments and a general installation programme was suggested.

In a variety of ways, several departments stated that, given the trend in the ratio of software to hardware costs, it was felt important for the central facilities and the individual user that investment in software was preserved as far as possible and that the choice of new machines should be based less on hardware performance than on the software committment to support and development of the operating system and compatibility with a range of machines. A smooth transition to any new environment was demanded by all current users of central services.

The tailoring of standard operating environments required structuring. For each supported operating system, there needed to be a hierarchical scheme for implementing local modifications to avoid conflicts in an integrated environment.

Given the rapid development in hardware capability, systems which allow gradual evolution rather than monolithic systems should be chosen.

User friendly data base management systems would be of benefit to several departments and interactive graphical tools required improvement. The transfer of graphical images between institutions is likely to become important for many departments.

Electronic Mail had become important rather than just useful to most of the faculty and was essential for the future.

### 3. Faculty of Medicine

Apart from improved communications they all want "more of everything". Although many of the likely developments and improvements sought related to research work and many failed to see the relevance of computers in teaching, it was felt that as the increased computer awareness of new students infiltrates the Faculty, there will be pressure for an increased use and new possibilities for computers in teaching will be opened up.

Video disc technology is already being introduced in the Department of Pathology and it is possible that this new technology could make an impact on Medical teaching practices. Access to these facilities in student halls of residence and in libraries would be desirable.

Self Teaching and assessment systems might be required to cope with staff reductions. These will not always be readily available and effort combining the skills of academic clinical staff and computing professionals will be needed to produce them.

Expert systems were frequently of interest but some reassurance about their effectiveness is required.

This Faculty saw an increasing need to access facilities such as those offered by the existing central services for statistical analysis, database management and Mail. However, because of the need to carry out much research work close to a patient, it is likely that most of the growth will continue to be in microcomputers although it is expected that more of these will be networked in future.

Respiratory Medicine saw an increased use of specialised real-time on-line computing for the analysis of complex biological data, leading to diagnostic decisions and on-line monitoring of investigations involving the whole patient. It is likely that more medical instrumentaion will be supplied with an integrated microprocessor but there will continue to be a need for developments in new fields which will demand standard microprocessor products, using bespoke software and interfaced to locally engineered instrumentation.

Increasingly sophisticated imaging techniques will become a necessity in many areas and the ability to transmit these images between researchers might impact upon networking requirements. Medical Physics and Medical Engineering have had a long term involvement in this area and their view for the future is that the most demanding numerical computing tasks are still likely to be associated with image reconstruction and display and because communications with a central service are unlikely to be fast enough for the large data sets involved, they feel it essential that array processing or parallel computing is available on-site.

Modelling and simulation is another area where growth is seen over the next ten years

Data input will continue to be a major requirement and concern was expressed over the future of the Data Preparation service. Tools to aid the input of survey forms, patient records and other hard copy information, will be needed in future.

Data collection, management and analysis and the ability to share the data and results are areas which will grow over the next ten years. Large amounts of secure data storage with appropriate packages to manipulate it will be required and centralised databases for reference, given suitable access mechanisms could be widely beneficial.



Facilities such as graph plotters, high speed and very high quality printers and desk top publishing systems to assist with the production of lecture materials such as O.H.P.s, papers and other documents were popular demands

The demand for much improved online access to bibliographic databases such as MEDLINE and local storage and availability of some of the information was a universal. Better access to information in the Erskine Medical Library was another.

Direct, widespread access to information from Health Service computing facilities for research purposes is desperately needed and would save a considerable amount of time and effort throughout the Faculty as there is much duplication of effort at the moment manually transferring information between systems.

Enhanced "user-friendly" facilities throughout with better teaching of computer skills to members of the Faculty with expert advice readily available were felt to be essential by most departments for the future.

### 4. Faculty of Law

The Faculty expects the use of computers in teaching and research to expand greatly over the next decade. Many Law Schools, including Edinburgh are already working on CAL packages for use by their students; by the turn of the century, these are expected to be an important element in Law teaching.

They would like to see every member of staff provided with a desk-top work station which was networked into a Faculty facility such as a mini-computer acting as a central fileserver with links to the main University network.

Considerable interest is being shown in the creation of expert systems and it is expected that these will eventually be of central importance for Law teaching and research which involves the analysis of enormous amounts of complex data.

The use of databases in legal research is also expected to be an area of major growth.

This Faculty would welcome a greater degree of integration of their computing facilities. At present, ignoring the equipment owned by academic staff, they have six different makes of computer within this small Faculty and sharing of information is difficult.

They require their own facilities which would enable them to develop databases for use on their own or in conjunction with expert systems. These databases need to be accessible by individuals throughout the Faculty, elsewhere in this University and from the outside world.

They also have vast amounts of information in their Library such as case reports and historical material which could usefully be stored and manipulated on-line. Input of this information to a computer is the main drawback and technologies such as optical character and document readers were of particular interest to them. These would have to be sophisticated facilities because of the widely varying typefaces used on their documents.

### 5. Faculty of Divinity

Divinity expect a very considerable increase in locally sited micros connected to each other and to mainframe facilities with a gateway for Mail and file transfer etc. An even heavier uptake of computing by staff and postgraduates is expected but the major change will come in the need to extend facilities to undergraduates.

They will expect undergraduates to be able to make use of packages and facilities used by postgraduates and staff. They will be expected to use microcomputers to produce language exercises and to hand in written work and to obtain additional help in learning. This will require additional equipment and instruction arrangements and EUCS assistance is desirable.

Instruction to staff and students should be offered in standard packages and in terms that are easily understood.

There is a lack of available course material in this discipline and programming assistance will be required to establish appropriate packages. This will be time consuming and expensive but an early start to a long term plan is desirable.

They would like to see much better screen resolution for the graphics needed to display foreign language character sets and integrated software packages for multi-lingual word processing, text storage and searching, for concordance work and for parsing and dictionaries is desirable.

They would also appreciate a common user interface on local and central systems.

Much improved access to large databases being built up in the U.S.A is needed. This type of facility is taken for granted in the States and the cumbersome method of access here is a disincentive to foreign students.

Additional facilities should preferably be local micro/workstation based with good communications access to the outside world and additional high quality and lower quality, fast printers are needed. Better access to facilities is urgently required. The lack of public micro facilities with similar capabilities to those in New College which closes at 5.30pm., is a severe restriction on the work of staff and students.

## 6. Faculty of Arts

Having gained a flavour for the opportunities opened up by new technology, this Faculty now sees many areas where beneficial developments could take place. In many departments, likely developments and improvements sought are dependent on funds being made available to allow the necessary equipment to be bought and maintained. In some cases, all they are looking for is additional microcomputers for wordprocessing for staff and students but in this faculty, these would be major improvements in the current provision and would permit developments which are constrained at the moment as a result of a lack of adequate resources. The general message was that all staff should have access to a workstation and adequate teaching facilities should be provided possibly in the shape of faculty microcomputer laboratories.

Throughout the Faculty, a widespread increase in communications is desired. Easy, fast access to bibliographic databases, Bulletin Boards and the exchange of information with colleagues around the world are common requirements.

English Literature see literature teaching aids developing from their present unsophisticated state and specialist word processors which combine aspects of indexing and concordancing to facilitate literary and stylistic analysis and identification. They also expect to see very large literary texts become available on CD ROM. Several of the foreign language departments saw similar develops as being desirable.

Increasingly sophisticated Optical Character and Document Readers will be very important for this Faculty as much existing material needs to be input for further analysis. At the other end of the process, high quality output devices and desk-top publishing systems need to be widely available.

Free format natural language text databases which permit sophisticated manipulation and analysis, will be essential for a number of departments.

Computer Aided Learning was of interest in many areas particularly in the language departments



and it is expected that this will have a major impact on teaching practices over the next 10 years if sufficient facilities are made available for teaching purposes.

Induction courses properly geared to the needs of this Faculty, for staff and students with little computing experience, would be welcomed throughout.

In Linguistics likely developments and the improvements they require are highly complex and include access to A.I. languages and fast parallel architecture machines for neural network type modelling. They also require access to image processors, and are seeking more powerful multi-windowed colour graphics facilities with better interaction with applications packages. They also see, in addition to CAL developments, computing being utilised for the production of continuous assessment materials, allowing the setting and marking of multiple-choice tests, and the productions of remedial or specimen answers.

Multi-lingual capabilities in all application areas will be required for this faculty.

All departments wish to see better access to faculty and central administrative records. A common accounting package was also widely asked for with direct access to the status of departmental funds. Database managements systems for student and course records incorporating spreadsheet facilities for student marks, mark standardisation and forward projection of results.

Also, all departments require access to "user-friendly" desk top publishing systems for the production of research reports and teaching materials.

## 7. Faculty of Veterinary Medicine

The role of computing is likely to increase in both teaching and research in Veterinary departments.

In Veterinary Preclinical Sciences teaching they will be moved by circumstances and desire to introduce more computers into undergraduate practical classes. In research, they aim to provide each member of staff with at least one microcomputer and they are relying on the continued existence of a large central computing facility in Edinburgh. They also expect image processing in quantitative anatomy to be a growth area.

Veterinary Clinical Studies expect their DBMS to become more valuable as the number of cases stored in it increases. In view of the growing use of microcomputers by general veterinary practitioners as management tools and clinical recording systems, they expect to train students in this area.

They see a need to develop expert diagnostic systems and feel recent developments such as relational database management systems with an expert system component, could be exploited.

They also expect to introduce the use of spreadsheets as databases and a means of elementary disease modelling, into the veterinary curriculum. Microcomputer based herd health and productivity schemes will also increase in importance as will technical and economic disease models.

All of these developments will expect an increased qualitative input from Computing Service staff.

Increased equipment and communications links will increase the departments use of central services.

There are attempts to develop a unified, national clinical recording system which could involve input from bar code systems direct to a DBMS. There might also be a role for optical character readers in this system.

Veterinary Pathology would like to see preclinical records automated on a Faculty wide basis.

Systems involved in environmental health (eg. those that record temperature, humidity, cough rates ) could be used more than previously.



*APPENDIX 7*

# SURVEY OF STAFF AND POST GRADS.

AND POST GRAD SURVEY OF STAFF

Appendix X

## Results from Individual Staff and Post-Graduate Computing Survey.

Please note that no firm conclusions should be drawn from the results of this survey alone. They need to be looked at along with information gathered elsewhere in the planning exercise. The following breakdown is all that was needed for the Planning Group's purposes. If further breakdowns are required then they can be provided on request.

### 1.Distribution and Returns

A total of **6359** survey forms were issued. Of these **1917 or 30.14%** were returned.

**1.1 Forms Issued**

The forms were issued to the following:

| | *No.Issued* | *as a % of total Issued* | *No. of Returns* | *as a % of no. Issued to group* |
|---|---|---|---|---|
| University Staff (excl. Manual Grade) | 4368 | 68.69% | 1488 | 34.06% |
| PGs under Supervision | 1816 | 28.55% | 275 | 15.14% |
| Externals | 175 | 2.75% | 154 | 88.00% |

**1.2 Returns by Faculty and other Groupings**

| | *No of Returns* | *as a% of total Returns* |
|---|---|---|
| 1. Science | 503 | 26.23% |
| 2. Medicine | 378 | 19.71% |
| 3. Social Science | 206 | 10.74% |
| 4. M.I.S.(Admin.etc) | 165 | 8.60% |
| 5. External | 154 | 8.03% |
| 6. Arts | 141 | 7.35% |
| 7. Library | 82 | 4.27% |
| 8. Vets | 75 | 3.91% |
| 9. Computing Service | 71 | 3.70% |
| 10. Law | 48 | 2.50% |
| 11. Dentistry | 33 | 1.72% |
| 12. Others | 31 | 1.67% |
| 13. Divinity | 19 | 0.99% |
| 14. Music | 10 | 0.52% |
| 15. Unknown | 1 | 0.05% |

**1.2 Returns by Staff Categorgy**

| | *No of Return* | *as a % of total returns* |
|---|---|---|
| Academic | 569 | 29.68% |
| Clerical | 380 | 19.82% |
| Academic Related | 276 | 14.39% |
| Post Graduate | 275 | 14.34% |
| Technical | 196 | 10.22% |
| No response to status | 157 | 8.18% |
| Others | 64 | 3.33% |

### 2. Computer Use. and Non-Users

In response to the question **"Do you use computers in your University work?"**, the following responses were received.

| | *No of Returns* | *as a % of total returns* | *as a % of total Issued* |
|---|---|---|---|
| YES | 1409 | 73.50% | 22.15% |
| NO | 493 | 25.71% | 7.75% |
| No Response | 15 | 0.78% | 0.23% |

### 3. Non-Users

Of those who replied saying they didn't use computers at work, to the following questions the **3 replies** to which most answered **YES** were:

**3.1. Is it because?**

| | *No. who replied YES.* | *as a % of all who replied as NON-USERS* |
|---|---|---|
| a) You would like to but haven't time to learn? | 186 | 37.72% |
| b) You haven't really looked into the possibility | 147 | 29.81% |
| c) It wasn't possible to gain access to a computer | 127 | 25.76% |

**3.2. Would you use a computer if?**

| | *No. who replied YES.* | *as a % of all who replied as NON-USERS* |
|---|---|---|
| a) The right system was available for your work? | 262 | 53.14% |
| b) It was more accessible? | 240 | 48.68% |
| c) It was easier to use? | 193 | 39.14% |

**3.3. Could you envisage your work in future making use of?**

| | *No. who replied YES.* | *as a % of all who replied as NON-USERS* |
|---|---|---|
| a) A computer to produce letters or documents | 298 | 60.44% |
| b) A computer to produce graphics for illustrations or charts | 240 | 48.68% |
| c) Carry out statistical analysis | 215 | 43.61% |

### 3.4 Home Computer use

**3.4.1** In response to the question **"Have you used a computer at home or elsewhere?"**

| | *No. who replied.* | *as a % of all who replied as NON-USERS* |
|---|---|---|
| YES | 211 | 42.79% |
| NO | 269 | 54.56% |
| No response | 13 | 2.63% |

**3.4.2** Of those who said they had used a computer at home the following were the **top 5** makes listed.

| | *No. who replied.* | *as a % of all who replied YES to 3.4.1* |
|---|---|---|
| 1. BBC Micro | 51 | 24.17% |
| 2. Amstrad | 49 | 23.22% |
| 3. IBM PC or Clone | 20 | 9.47% |
| 4. Sinclair Spectrum | 13 | 6.16% |
| 5. Apple Macintosh | 12 | 5.68% |

## 4. Computer Users

**4.1** Those who said they were computer users were asked what machines they used as a tool in the following areas. Some users used more than one machine in the same area.

**4.1.1. In Teaching**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 306 | 21.71% |
| EMAS | 103 | 7.31% |
| Dept.MUM | 79 | 5.60% |
| Workstations | 42 | 2.98% |
| Unix Gould | 26 | 1.84% |
| Others | 23 | 1.63% |
| ERCVAX | 15 | 1.06% |

**4.1.2. In Research**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 655 | 46.48% |
| EMAS | 482 | 34.20% |
| Dept.MUM | 232 | 16.46% |
| Workstations | 133 | 9.43% |
| ERCVAX | 116 | 8.23% |
| Others | 103 | 7.31% |
| Unix Gould | 26 | 4.75% |

**4.1.3. In Administration**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 547 | 38.82% |
| Dept. MUM | 156 | 11.07% |
| EMAS | 154 | 10.92% |
| Others | 42 | 2.98% |
| Workstations | 38 | 2.69% |
| ERCVAX | 30 | 2.12% |
| Unix Gould | 25 | 1.77% |

**4.1.4. In Computing Support**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| EMAS | 113 | 8.01% |
| Micros | 112 | 7.94% |
| ERCVAX | 72 | 5.11% |
| Dept.MUM | 70 | 4.96% |
| Unix Gould | 44 | 3.12% |
| Others | 29 | 2.05% |
| Workstations | 28 | 1.98% |

**4.1.5. In Other Areas**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 123 | 8.72% |
| Others | 111 | 7.87% |
| Dept.MUM | 103 | 7.31% |
| EMAS | 86 | 6.10% |
| ERCVAX | 46 | 3.26% |
| Unix Gould | 31 | 2.20% |
| Workstations | 11 | 0.78% |

**4.2 What do you use the computer for?**

Those who said they were Users were asked what applications they carried out on computers and what their frequency was. The following applications were carried out **on at least a weekly basis:**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Text (word) processing | 988 | 70.12% |
| Electronic Mail | 522 | 37.04% |
| As a Network Terminal | 444 | 31.50% |
| Database management | 406 | 28.81% |
| Program development | 358 | 25.40% |
| File Transfers | 355 | 25.19% |
| Statistical Analysis | 327 | 23.20% |
| Graphical material | 321 | 22.77% |
| Lab Data Acquis. & control | 217 | 15.39% |
| News | 204 | 14.47% |
| Modelling and simulation | 179 | 12.70% |
| Large Number processing | 179 | 12.70% |
| Information Systems | 140 | 9.93% |
| Others | 96 | 6.80% |
| Accounting systems | 70 | 4.96% |
| Computer Aided Design | 46 | 3.25% |
| Image Processing | 46 | 3.25% |

**4.3 What systems are these activities carried out on?**

The **top 3 systems** on which most of those who responded as users said they carried out these applications on, were:

**4.3.1 Text (word) processing**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 853 | 60.53% |
| EMAS | 237 | 16.82% |
| Dept.MUM | 179 | 12.70% |

**4.3.2 Electronic Mail**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| EMAS | 404 | 28.67% |
| Dept.MUM | 182 | 12.91% |
| Micro | 90 | 6.38% |

**4.3.3 As a Network Terminal**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 228 | 16.18% |
| EMAS | 152 | 10.78% |
| Dept.MUM | 108 | 7.66% |

**4.3.4 Database management**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 339 | 24.05% |
| EMAS | 156 | 11.07% |
| Dept.MUM | 94 | 6.67% |

**4.3.5 Program development**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 213 | 15.11% |
| EMAS | 172 | 12.20% |
| Dept.MUM | 155 | 11.00% |

**4.3.6 File Transfers**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| EMAS | 367 | 26.04% |
| Micros | 194 | 13.76% |
| Dept.MUM | 157 | 11.14% |

**4.3.7 Statistical Analysis**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| EMAS | 321 | 22.78% |
| Micros | 312 | 22.14% |
| Dept.MUM | 85 | 6.03% |

**4.3.7 Graphical material**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 298 | 21.14% |
| EMAS | 242 | 17.17% |
| Dept.Mum | 72 | 5.11% |

**4.3.8 Lab. Data Acquisition & control**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 204 | 14.47% |
| Dept.MUM | 36 | 2.55% |
| Workstations | 16 | 1.13% |

**4.3.9 News**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| EMAS | 109 | 7.73% |
| Dept.MUM | 92 | 6.52% |
| Others | 26 | 1.84% |

**4.3.10 Modelling and simulation.**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| EMAS | 116 | 8.23% |
| Micros | 74 | 5.25% |
| Dept.MUM | 61 | 4.32% |

**4.3.11 Large Scale Numerical processing**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| EMAS | 162 | 11.49% |
| Dept.MUM | 55 | 3.90% |
| Micros | 28 | 1.98% |

**4.3.12 Information Systems**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| EMAS | 79 | 5.60% |
| Micros | 49 | 3.47% |
| Dept.MUM | 37 | 2.62% |

**4.3.13 Others**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 39 | 2.76% |
| Dept.MUM | 34 | 2.41% |
| Others | 29 | 2.05% |

**4.3.13 Accounting systems**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 90 | 6.38% |
| Dept.MUM | 15 | 1.06% |
| EMAS | 8 | 0.56% |

**4.3.14 Computer Aided Design**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 29 | 2.05% |
| Workstations | 26 | 1.84% |
| Dept.MUM | 16 | 1.13% |

**4.3.15 Image Processing**

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| Micros | 29 | 2.05% |
| Workstations | 20 | 1.41% |
| Others | 20 | 1.41% |

## 5. Microcomputer Users

Out of the total number of Computer Users **(1409)** who completed the survey forms, **1076** or **76.36%** said they used Microcomputers.

### 5.1 Hardware

Of those who responded as microcomputer users, the most common hardware systems used were as follows. Some users made use of more than one type of hardware:

| | *No. who replied.* | *as a % of all who replied as MICRO USERS* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|---|
| a) IBM PC or Clone | 496 | 46.09% | 35.20% |
| b) BBC Micro | 271 | 25.18% | 19.23% |
| c) Apricot/Sirius | 245 | 22.76% | 17.38% |
| d) Apple Macintosh | 165 | 15.33% | 11.71% |
| e) Amstrad | 62 | 5.76% | 4.40% |
| f) Atari | 26 | 2.41% | 1.84% |
| g) Cromemco | 17 | 1.57% | 1.20% |
| h) QL/Sinclair | 12 | 1.11% | 0.85% |
| i) Others | 10 | 0.92% | 0.70% |

### 5.2 Applications Software

Of those who responded as microcomputer users and who gave details, the most common applications software used on each of these hardware systems were:

| | | *No. who replied.* | *as a % of all who replied as MICRO USERS* |
|---|---|---|---|
| **a) IBM PC or Clone** | Wordcraft | 152 | 14.12% |
| | Wordstar | 90 | 8.36% |
| | Supercalc | 37 | 3.43% |
| **b) BBC Micro** | View | 75 | 6.97% |
| | Wordwise | 55 | 6.13% |
| | Xtalk | 42 | 3.90% |
| **c) Apricot/Sirius** | Offload | 82 | 7.62% |
| | Wordcraft | 66 | 6.13% |
| | Wordstar | 25 | 2.32% |
| **d) Apple Macintosh** | Macwrite | 90 | 8.36% |
| | Macdraw | 54 | 5.01% |
| | Cricketgraph | 32 | 2.97% |
| **e) Amstrad** | Locoscript | 40 | 3.71% |
| | Amstat | 8 | 0.74% |
| | Wordstar | 7 | 0.65% |

## 6. Workstations

Out of the total number of Computer Users **(1409)** who completed the survey forms, 179 or **12.70% used Workstations.**

### 6.1 Hardware

Of those who responded as workstation users, the most common hardware systems used were as follows. Some users made use of more than one type of hardware:

| | *No. who replied.* | *as a % of all who replied as WKSTN. USERS* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|---|
| a) SUN | 108 | 60.33% | 7.66% |
| b) Xerox | 23 | 12.84% | 1.63% |
| c) Whitechapel | 13 | 7.26% | 0.92% |
| d) Vaxstation | 5 | 2.79% | 0.35% |
| e) Acorn | 3 | 1.67% | 0.21% |
| f) Unspecified | 55 | 30.72% | 3.90% |

### 6.2 Applications Software

Of those who responded as workstation users and who gave details, the most common applications software used on each of these hardware systems were:

| | | *No. who replied.* | *as a % of all who replied as WKSTN. USERS* |
|---|---|---|---|
| **a) SUN** | C compiler | 35 | 19.55% |
| | Prolog | 20 | 11.17% |
| | TEX/LATEX | 20 | 11.17% |
| **b) Xerox** | Sketch | 10 | 5.58% |
| | TEDIT | 7 | 3.91% |
| | Interlisp | 5 | 2.79% |
| **c) Whitechapel** | C compiler | 5 | 2.79% |
| | Prolog | 3 | 1.67% |
| | Stag | 3 | 1.67% |

## 7. Multi - User Minis

Out of the total number of Computer Users **(1409)** who completed the survey forms, **416 or 29.52% used Departmental Multi-User Minis.**

**7.1**

**********

**TO BE COMPLETED**

**********

## 8.EMAS USERS

Out of the total number of Computer Users **(1409)** who completed the survey forms, **702 or 49.82% used EMAS.**

### 8.1 Software Used

The **top 3 items of software** most frequently used by those who resonded as EMAS users were:

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| a) MAIL | 305 | 43.44% |
| b) SPSSX | 154 | 21.93% |
| c) Fortran | 123 | 17.52% |

### 8.2 Bespoke Software

Those users who responded as EMAS users gave the following responses to questions relating to locally produced software.

#### 8.2.1 Self Produced Programmes

All who responded as EMAS users were asked "Did They have any programs written by themselves?"

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| **YES** | 308 | 43.87% |
| **NO** | 363 | 51.70% |

**If they replied "YES" to last question, who used these programs?**

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| Themselves | 287 | 40.88% |
| Students | 108 | 15.38% |
| Colleagues In Department | 141 | 20.08% |
| Other sites in University | 60 | 8.54% |
| External users | 59 | 8.40% |

#### 8.2.2 IMP Programmes

All who responded as EMAS users were asked "Did they have any programmes written in IMP?" The responses were as follows:

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 130 | 18.51% |
| NO | 433 | 61.68% |
| Don't Know! | 50 | 7.12% |
| No Response | 89 | 12.67% |

If they replied "YES" to the last question, did any of these IMP programmes use Store Mapping?

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 43 | 6.12% |
| NO | 53 | 7.54% |
| Don't Know | 30 | 4.27% |
| No response | 4 | 0.56% |

#### 8.2.3 Fortran Programmes

All who responded as EMAS users were asked "Did they have any programmes written in Fortran ?" The responses were as follows:

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 240 | 34.18% |
| NO | 315 | 44.87% |
| Don't Know | 34 | 4.84% |
| No Response | 113 | 16.09% |

All who replied as EMAS users were asked, "did any of their Fortran Programmes invoke the "DATASPACE" command?"

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 18 | 2.56% |
| No | 405 | 57.69% |
| Don't Know | 76 | 10.82% |
| No Response | 203 | 28.91% |

#### 8.2.4 Mixed Language Programmes

All who responded as EMAS users were asked, "Did they use mixed language programming?"

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 51 | 7.26% |
| NO | 476 | 67.80% |
| Don't know | 63 | 8.97% |
| No Response | 112 | 15.95% |

#### 8.2.5 Dynamic Loading

All those who responded as EMAS users were asked,"Did they use dynamic loading (linking) of programme suites?"

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 60 | 8.54% |
| NO | 398 | 56.69% |
| Don't Know | 163 | 23.21% |
| No Response | 81 | 11.53% |

#### 8.2.6 CALL EMAS Commands

All who responded as EMAS users were asked,"Did any of their programmes execute EMAS commands from within programmes?"

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 170 | 24.21% |
| NO | 360 | 51.28% |
| Don't Know | 81 | 24.50% |
| No Response | 91 | 12.96% |

#### 8.2.7 Other Programmes

All who responded as EMAS users were asked "Did they use any programmes not written by themselves which were not supported by the Computing Service?

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 184 | 26.21% |
| NO | 380 | 54.13% |
| Don't Know | 54 | 7.69% |
| No Response | 84 | 11.96% |

**Those who said "YES" to the last question, were asked "were they written in ?"**
(The same user could have programmes written in more than one)

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| IMP | 63 | 8.97% |
| Fortran | 115 | 16.38% |
| Other | 15 | 2.13% |
| Don't Know | 17 | 2.42% |

**Was the source code available?**

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 125 | 17.80% |
| NO | 21 | 2.99% |
| Don't Know | 68 | 9.68% |

**Did they know the Author?**

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 148 | 21.08% |
| NO | 30 | 4.27% |
| Don't Know | 32 | 4.55% |

If Yes, would the au be willing or able to convert them?

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 34 | 4.84% |
| NO | 56 | 7.69% |
| Don't Know | 77 | 10.96% |

**Did they know if commercial software was available to do the same job?**

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 20 | 2.84% |
| NO | 98 | 13.96% |
| Don't Know | 83 | 11.82% |

### 8.3 Transfer

#### 8.3.1 Difficulties

All who responded as EMAS Users were asked " Were there any facilities they anticipated difficulty in making the transfer to a new system?"

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| YES | 60 | 8.54% |
| No | 312 | 44.44% |
| Don't Know | 235 | 33.47% |
| No Response | 95 | 13.53% |

#### 8.3.2 What was the difficulty?

All who responded as EMAS users were asked "would the difficulty be?" The following replied YES to the question.

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| - Time taken | 109 | 15.52% |
| - Lack of resources | 38 | 5.41% |
| - Lack of expertise | 83 | 11.82% |
| - Problems due to EMAS specific features | 59 | 8.40% |
| - Other reasons | 18 | 2.56% |
| - No Response | 395 | 56.26% |

### 8.3.3 Timescales
All who responded as EMAS users were asked "how long would it take you to transfer?

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| Hours | 45 | 6.41% |
| Days | 52 | 7.40% |
| Weeks | 53 | 7.54% |
| Months | 20 | 2.84% |
| No Response | 532 | 75.78% |

### 8.3.4 Computing Service support
All who responded as EMAS users were asked, "would you need help from the Computing Service?"

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| No | 33 | 4.70% |
| Advice Only | 182 | 25.92% |
| Programming Assistance | 24 | 3.41% |
| No response | 463 | 65.95% |

### 8.3.5 Aids to Transfer
All who responded as EMAS users were asked to list aids to assist to make the transfer more easily. The top 3 listed were:

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| Documentation | 24 | 3.41% |
| On-Line Help | 6 | 0.85% |
| Quicker Archiving | 4 | 0.56% |

### 8.4 The Future of EMAS.

### 8.4.1 ERCC Review Committee recommendation.
Of all who responded as EMAS users the following replied "YES" to the questions relating to the future of EMAS

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| Those who felt a minimal service should be maintained beyond 1990 only for as long as users required it to transfer to other options. | 404 | 57.54% |
| Those who felt EMAS should continue to be a major, but the main service, beyond 1990 for as long as there was a demonstrable user requirement for such a service. | 122 | 17.37% |
| Those who felt EMAS should be abandoned completely as early as possible after the installation of replacement systems. | 39 | 5.55% |
| No Response | 137 | 19.51% |

### 8.4.2 Features of EMAS to continue
All who responded as EMAS users were asked which features must be supported on any replacement system? The following were the top 3 features.

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| MAIL | 68 | 9.68% |
| Easygraph | 19 | 2.70% |
| Fortran | 18 | 2.56% |

### 8.4.3 Features of EMAS to be avoided
All who responded as EMAS users were asked which features should be avoided on any replacement system? The top 2 features were

| | *No. who replied.* | *as a % of all who replied as EMAS USERS* |
|---|---|---|
| Line Editors | 10 | 0.14% |
| Uniqueness | 10 | 0.14% |

## 9. VMS USERS
Out of the total number of Computer Users (1409) who completed the survey forms, 237 or 16.82% used VMS.

### 9.1 Software Used
Of those who responded as VMS users, the 3 items of software most frequently used were:

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| MAIL | 48 | 20.25% |
| Fortran | 46 | 19.40% |
| Oracle | 25 | 10.54% |

### 9.2 Central and Departmental VMS
Those who responded as VMS users were asked to state which systems they used.

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| ERCVAX service | 121 | 51.05% |
| Departmental VMS service | 119 | 50.21% |

### 9.3 Special Features
All who responded as VMS users were asked if they had any programmes which used the following VMS features?

| | | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|---|
| System Services | YES | 29 | 12.23% |
| | NO | 44 | 18.56% |
| | Don't Know | 56 | 23.62% |
| | No response | 108 | 45.56% |
| VMS File structures | YES | 27 | 11.39% |
| | NO | 46 | 19.40% |
| | Don't Know | 52 | 21.94% |
| | No response | 125 | 47.25% |
| VMS extensions to Fortran | YES | 26 | 10.97% |
| | NO | 46 | 19.40% |
| | Don't Know | 52 | 21.94% |
| | No Response | 124 | 52.32% |

### 9.4 Transfer

### 9.4.1Difficulties
Those who responded as VMS users were asked "if the central VAX was replaced, were there facilities where they anticipated difficulty in making a transfer?"

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| YES | 14 | 5.90% |
| NO | 69 | 29.11% |
| Don't Know | 45 | 18.98% |
| No response | 109 | 45.99% |

### 9.4.2 What would the difficulty be?
All who responded as VMS users were asked "Would the difficulty be?"

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| - Time taken | 7 | 2.95% |
| - Lack of resources | 5 | 2.10% |
| - Lack of expertise | 6 | 2.53% |
| - Problems due to VMS specific features | 3 | 1.26% |
| - Other | 2 | 0.84% |
| - No Response | 214 | 90.29% |

### 9.4.3 Timescales
All who responded as VMS users were asked "How long would it take you to transfer?"

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| Hours | 5 | 2.10% |
| Days | 12 | 5.06% |
| Weeks | 8 | 3.37% |
| Months | 5 | 2.10% |
| No response | 207 | 87.34% |

### 9.4.4 Computing Service Support
All who responded as VMS users were asked "Would you need help from the Computing Service?"

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| No | 12 | 5.06% |
| Advice only | 23 | 9.70% |
| Programming Assistance | 5 | 2.10% |
| No Response | 197 | 83.12% |

### 9.5 Portability
All who responded as VMS users were asked the following questions.

Was the ability to import and export software and data files to and from a wide community of other VMS sites important?

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| Yes | 101 | 42.61% |
| NO | 103 | 43.45% |
| No Response | 33 | 13.92% |

How frequently did they transfer data to and from other sites?

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| Daily | 7 | 2.95% |
| Weekly | 28 | 11.81% |
| Monthly or less | 121 | 51.05% |
| No Response | 81 | 34.17% |

### 9.6 Future of Central VMS Service.
All who respnded as VMS users were asked the following questions about the future of the service. Those who replied "YES" were as follows:

| | *No. who replied.* | *as a % of all who replied as VMS USERS* |
|---|---|---|
| Should it be Enhanced | 131 | 55.27% |
| Replaced by an alternative | 4 | 1.68% |
| You don't mind as long as all the packages and facilities are there. | 52 | 21.94% |
| No response | 50 | 21.09% |

## 10. UNIX UXERS
Out of the total number of Computer Users **(1409)** who completed the survey forms, **211 or 14.95% used UNIX.**

### 10.1 Software used
Of all those who responded as UNIX users, the **top 3 Items of software** listed were:

| | *No. who replied.* | *as a % of all who replied as UNIX USERS* |
|---|---|---|
| C compiler | 58 | 27.48% |
| MAIL | 46 | 21.80% |
| LATEX | 26 | 12.32% |

### 10.2 Central and Departmental UNIX Services
Those who responded as UNIX users were asked which systems they used.:

| | *No. who replied.* | *as a % of all who replied as UNIX USERS* |
|---|---|---|
| ITS Gould service | 77 | 36.49% |
| Departmental UNIX | 164 | 77.72% |

### 10.3 UNIX Investment
All those who responded as UNIX users were asked about future investment in UNIX systems.

### 10.3.1 Which Systems
Those who answered "YES" to "Did they believe further UNIX investment should go into? were:

| | *No. who replied.* | *as a % of all who replied as UNIX USERS* |
|---|---|---|
| Central Services | 66 | 31.27% |
| Dept. MUMs | 116 | 54.97% |
| Single User Wkstation | 120 | 56.87% |
| Other | 9 | 4.26% |

### 10.3.2 UNIX Interface
Those who answered "YES" In the last question to Central Services, were asked "would a UNIX interface on a basically non- UNIX service (eg. AMDAHL UTS) be?. Those who answered "YES" were as follows:

| | *No. who replied.* | *as a % of all who replied as UNIX USERS* |
|---|---|---|
| A useful Feature | 32 | 15.16% |
| Would prefer a UNIX specific service | 21 | 9.95% |
| Of no interest | 8 | 3.79% |
| No Response | 5 | 2.36% |

### 10.4 Portability
All who responded as UNIX users were asked the following questions.

Was the ability to import and export software to and from a wide community important?

| | *No. who replied.* | *as a % of all who replied as UNIX USERS* |
|---|---|---|
| YES | 113 | 53.55% |
| NO | 66 | 31.27% |
| No Response | 32 | 15.16% |

How frequently did they transfer data?

| | *No. who replied.* | *as a % of all who replied as UNIX USERS* |
|---|---|---|
| Daily | 18 | 8.53% |
| Weekly | 41 | 19.43% |
| Monthly or less | 99 | 46.91% |
| No response | 53 | 25.11% |

## 11. EXTERNAL US
Out of the total number of Computer Users (1409) who completed the survey forms, 268 or **19.02% used external services.**

### 11.1 Frequency
They were asked to specify which external systems they used and the frequency of use

| | *No. who replied.* | *as a % of all who replied as External USERS* |
|---|---|---|
| Daily | 36 | 13.43% |
| Weekly | 34 | 12.68% |
| Monthly or less | 42 | 15.67% |
| No Response | 156 | 58.20% |

### 11.2 External Operating Systems
The most common external operating system used was:

| | *No. who replied.* | *as a % of all who replied as External USERS* |
|---|---|---|
| VMS | 23 | 8.58%. |

### 11.3 External Applications Software
The most common external application software used was:

| | *No. who replied.* | *as a % of all who replied as External USERS* |
|---|---|---|
| Fortran | 6 | 2.23% |

### 11.4 Desireable Facilities
Those who responded as external users were asked to list facilities which they have used and would like to see made available in Edinburgh: The most common response was:

| | *No. who replied.* | *as a % of all who replied as External USERS* |
|---|---|---|
| Access to Library databases | 10 | 3.73% |

## 12. Collaboration

All who responded as Computer Users were asked if their work involved collaboration with other Universities? The responses were as follows:

| | *No. who replied.* | *as a % of all who replied as Computer USERS* |
|---|---|---|
| YES | 474 | 33.64% |
| NO | 833 | 59.11% |
| No Response | 102 | 7.23% |

Those who said "YES" to the last question were asked "would the installation of the same systems in Edinburgh make collaboration more fruitful?"

| | *No. who replied.* | *as a % of all who replied as Computer USERS* |
|---|---|---|
| YES | 117 | 8.30% |
| YES Marginally | 227 | 16.11% |
| NO | 108 | 7.66% |
| No Response | 22 | 1.56% |

## 13. Specialised Central Services

All those who responded as computer users were asked questions about various possibilities for specialised central services.

### 13.1 Parallel/Concurrent Devices

#### 13.1.1 Access to High Powered Processors

All who responded as computer users were asked if they would find it useful to have easy access to a high powered central processor (eg Vector, Parallel)

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| YES | 181 | 12.84% |
| NO | 328 | 23.27% |
| Don'T Know | 615 | 43.64% |
| No Response | 285 | 20.22% |

Of those who replied " YES" to the previous question, they were asked if they would find it useful

| | | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|---|
| **In the short term?** | YES | 103 | 7.31% |
| | NO | 15 | 1.06% |
| | Don't Know | 4 | 0.28% |
| | No Response | 59 | 4.18% |
| **In the long term?** | YES | 126 | 8.94% |
| | NO | 6 | 0.42% |
| | Don't Know | 2 | 0.14% |
| | No Response | 47 | 3.33% |

#### 13.1.2 EMAS DAPS

All who responded as Computer Users were asked "Did you use the DAPs on EMAS?"

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| YES | 43 | 3.05% |
| NO | 954 | 67.70% |
| No Response | 412 | 29.24% |

Those who said "NO" to the previous question were asked "was there a clear reason for not doing so?". The responses were as follows.

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| They had no need | 243 | 17.24% |
| They didn't understand what they offered | 167 | 11.85% |
| They had no obvious future. | 12 | 0.85% |
| Other reasons | 79 | 5.60% |
| No response | 453 | 32.15% |

All who responded as Computer Users were asked if they use or were they considering using the Meiko?

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| YES | 79 | 5.06% |
| NO | 605 | 42.93% |

### 13.2 Integrated Environment

All who responded as Computer Users were asked the following questions about possible new integrated invironments.

#### 13.2.1 Integrated processing

All who responded as Computer Users were asked if they would find it find it useful to be able to have central and local processors working on the same problem simultaneously without having to know about it?

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| YES | 431 | 30.58% |
| NO | 229 | 16.25% |
| Don't Know | 445 | 31.58% |
| No Response | 304 | 21.57% |

#### 13.2.2 Central Filestore/Server

All who responded as Computer Users were asked if they would find it useful to have easy access to a central filestore or fileserver?

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| YES | 552 | 39.17% |
| NO | 154 | 10.92% |
| Don't Know | 351 | 24.91% |
| No Response | 352 | 24.98% |

### 13.3 Specialised Input/Output Devices

All who responded as Computer Users were asked if they would find it useful to have easy access to centrally provided specialised input/output devices such as:

| | | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|---|
| Graph Plotters up to A3 | YES | 591 | 41.94% |
| | NO | 322 | 22.85% |
| Graph Plotters greater than A3 | YES | 161 | 11.42% |
| | NO | 572 | 40.80% |
| Fast Line printers | YES | 541 | 38.39% |
| | NO | 347 | 24.62% |
| Document Quality printers which were able to produce final output from documents prepared on a departmental system without conversion. | YES | 816 | 57.91% |
| | NO | 194 | 13.76% |
| Laser printers which were able to produce text and graphics in the same document | YES | 798 | 56.63% |
| | NO | 203 | 14.40% |
| Document Readers | YES | 388 | 27.53% |
| | NO | 203 | 29.31% |
| Optical Character Readers | YES | 270 | 19.16% |
| | NO | 472 | 33.49% |
| Facsimile transfer | YES | 335 | 23.77% |
| | NO | 419 | 29.73% |
| Speech Input | YES | 166 | 11.78% |
| | NO | 506 | 35.91% |
| Networked Phototypesetter | YES | 337 | 23.91% |
| | NO | 427 | 30.30% |

All who responded as Computer Users were asked what other facilities of this type they might find useful . The main items listed were:

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| CD ROM | 25 | 1.77% |
| WORM Output | 14 | 0.99% |

### 13.4 Essential Features

All who responded as Computer Users were asked what features of EMAS and ERCVAX must be supported on any new systems. The following 3 items came top.

| | *No. who replied.* | *as a % of all who replied as COMPUTER USERS* |
|---|---|---|
| IMP | 21 | 1.49% |
| MAIL | 14 | 0.99% |
| Graphic | 11 | 0.78% |

*APPENDIX 8*

# DEPARTMENTAL COMPUTING OFFICERS

*Appendix 8*

## Departmental Computing Officers
**May 1988**

The following is a breakdown of departmental Computing Officers (AD scale), provided by the Personnel Office.

| | |
|---|---|
| Computer Science | 8 |
| Electrical Engineering | 2 |
| Artficial Intelligence | 4 |
| Mechanical Engineering | 1 |
| Business Studies | 3 |
| Geography | 4 |
| Library | 1 |
| MIS | 6 |
| AIAI | 20 |

The following is a breakdown of departmental Computing Support Officers (CD scale)

| | |
|---|---|
| Linguistics | 1 |
| General Practice | 2 |
| Medical Statistics | 2 |
| Preventative Dentistry | 1 |
| Computer Science | 1 |
| Electrical Engineering | 1 |
| Centre for Educational Sociology | 1 |
| Library | 1 |
| MIS | 2 |

Clearly there are staff on other grades who are employed full time on computing but it is impossible to identify them from the grading structures. Further investigations are needed to arrive at a more accurate total for the amount of staff resource dedicated to computing support.

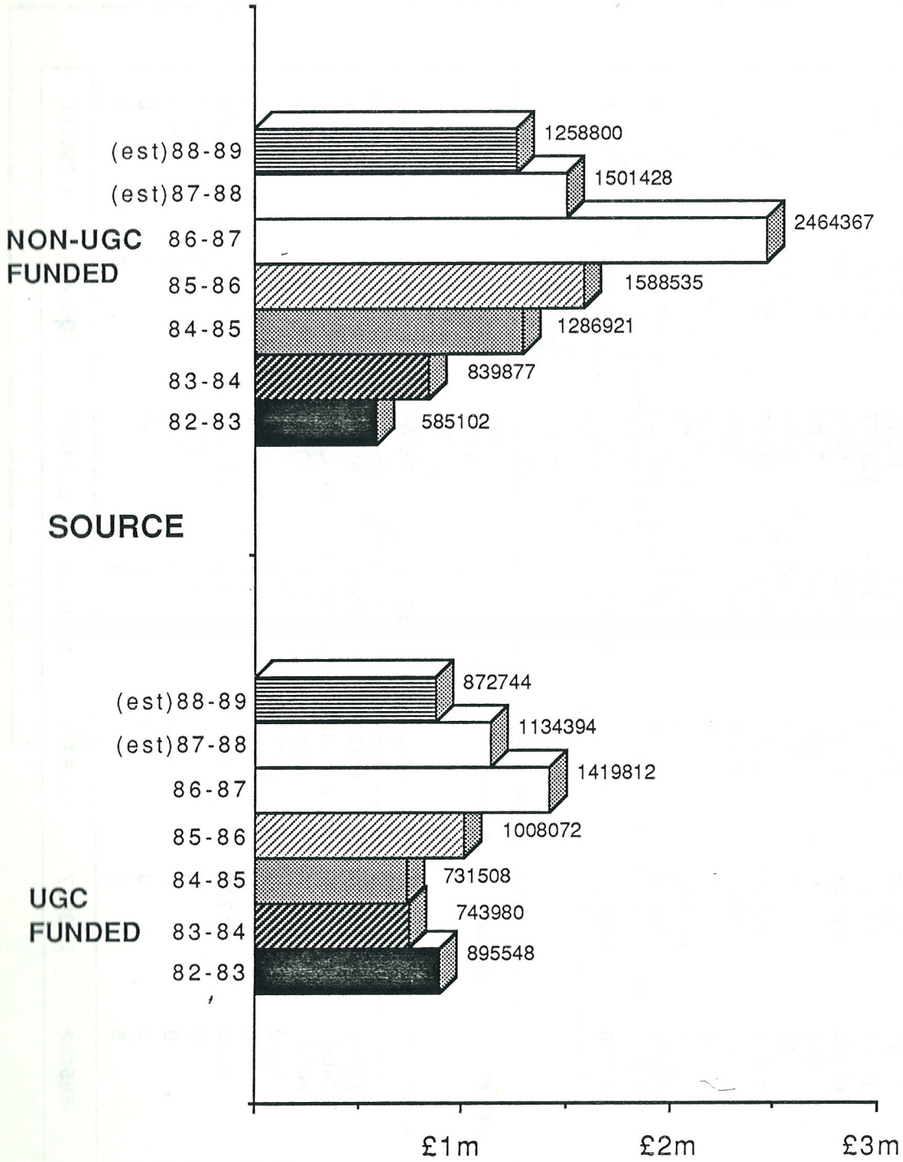
*APPENDIX 9*

# DEPARTMENTAL COMPUTING EXPENDITURE

*APPENDIX 9*

# HARDWARE ACUISITION EXPENDITURE

# HARDWARE EXPENDITURE




*Appendix 9*

## UGC / Non UGC Hardware Expenditure

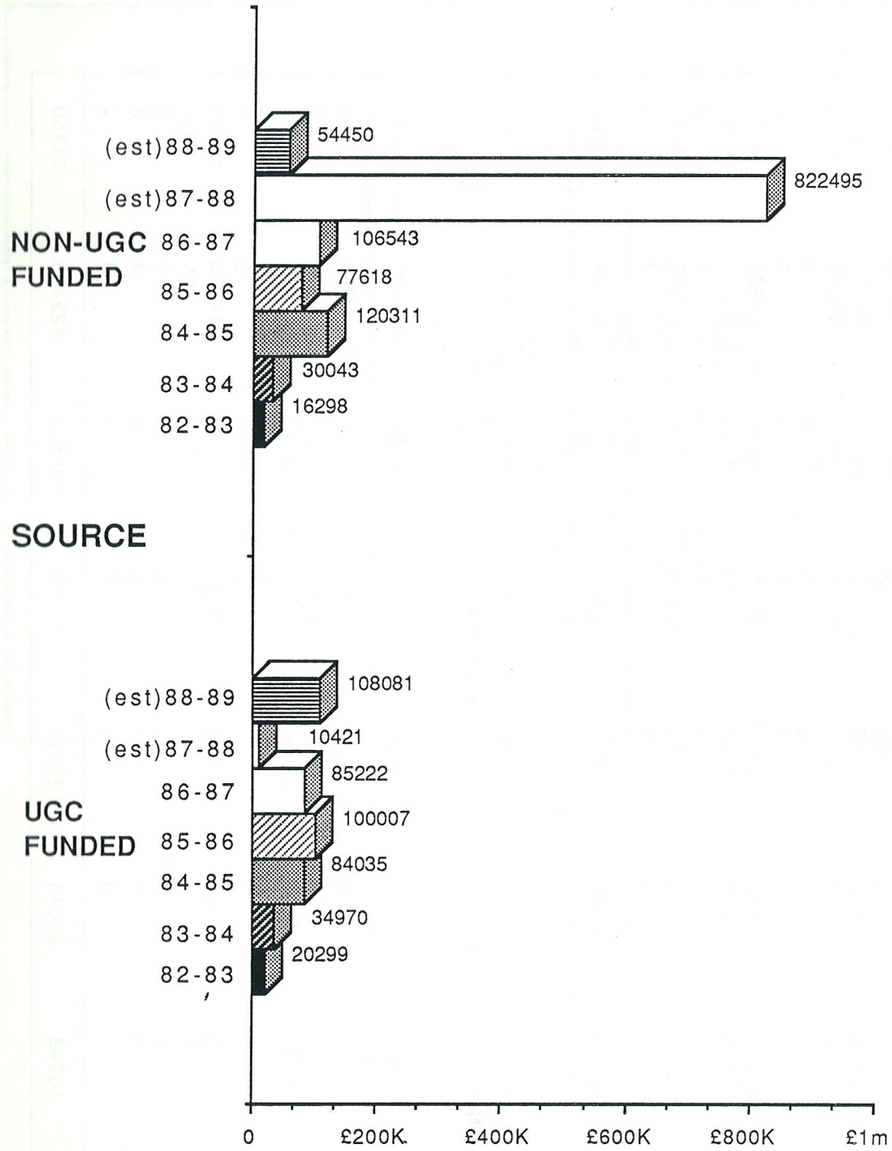
| | UGC Funded Hardware Acquisitions (£Sterling) | | | | | | |
|---|---|---|---|---|---|---|---|
| Faculty | 1982-83 | 83-84 | 84-85 | 85-86 | 86-87 | 87-88(est) | 88-89(est) |
| Social Science | 39497 | 82360 | 55438 | 63395 | 91932 | 62250 | 110000 |
| Science | 298121 | 411046 | 348268 | 607951 | 692577 | 587085 | 435390 |
| Medicine | 86590 | 46306 | 66758 | 67005 | 110064 | 64149 | 28754 |
| Law | 650 | 0 | 17000 | 8500 | 7500 | 16000 | 30000 |
| Divinity | 442 | 0 | 800 | 5134 | 6421 | 7000 | 0 |
| Arts | 94748 | 19699 | 48914 | 52399 | 51030 | 55110 | 28100 |
| Vets | 500 | 3069 | 6330 | 9888 | 1088 | 4000 | 1000 |
| Music | 0 | 0 | 0 | 0 | 0 | 4000 | 1000 |
| MIS & Admin | 0 | 120000 | 142000 | 165000 | 181000 | 175000 | 155000 |
| Library | 375000 | 61500 | 46000 | 28800 | 278200 | 179800 | 83500 |
| Total | 895548 | 743980 | 731508 | 1008072 | 1419812 | 1134394 | 872744 |

| | NON-UGC Funded Hardware Acquisitions | | | | | | |
|---|---|---|---|---|---|---|---|
| Faculty | 1982-83 | 83-84 | 84-85 | 85-86 | 86-87 | 87-88(est) | 88-89(est) |
| Social Science | 76213 | 79569 | 14132 | 42614 | 60314 | 42079 | 78100 |
| Science | 484692 | 739997 | 819088 | 1392085 | 2048607 | 1734500 | 1112000 |
| Medicine | 20197 | 12586 | 22391 | 17374 | 73183 | 31327 | 5700 |
| Law | 1000 | 3000 | 10000 | 5000 | 3500 | 5000 | 6000 |
| Divinity | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arts | 3000 | 4725 | 415810 | 125862 | 277563 | 52522 | 56000 |
| Vets | 0 | 0 | 5500 | 5600 | 1200 | 1000 | 1000 |
| Music | 0 | 0 | 0 | 0 | 0 | 35000 | 0 |
| MIS & Admin | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Library | 0 | 0 | 0 | 0 | | 0 | 0 |
| Total | 585102 | 839877 | 1286921 | 1588535 | 2464367 | 1901428 | 1258800 |

*APPENDIX 9*

# SOFTWARE ACUISITION EXPENDITURE

# SOFTWARE EXPENDITURE




*Appendix 9*

## UGC / Non UGC Software Expenditure

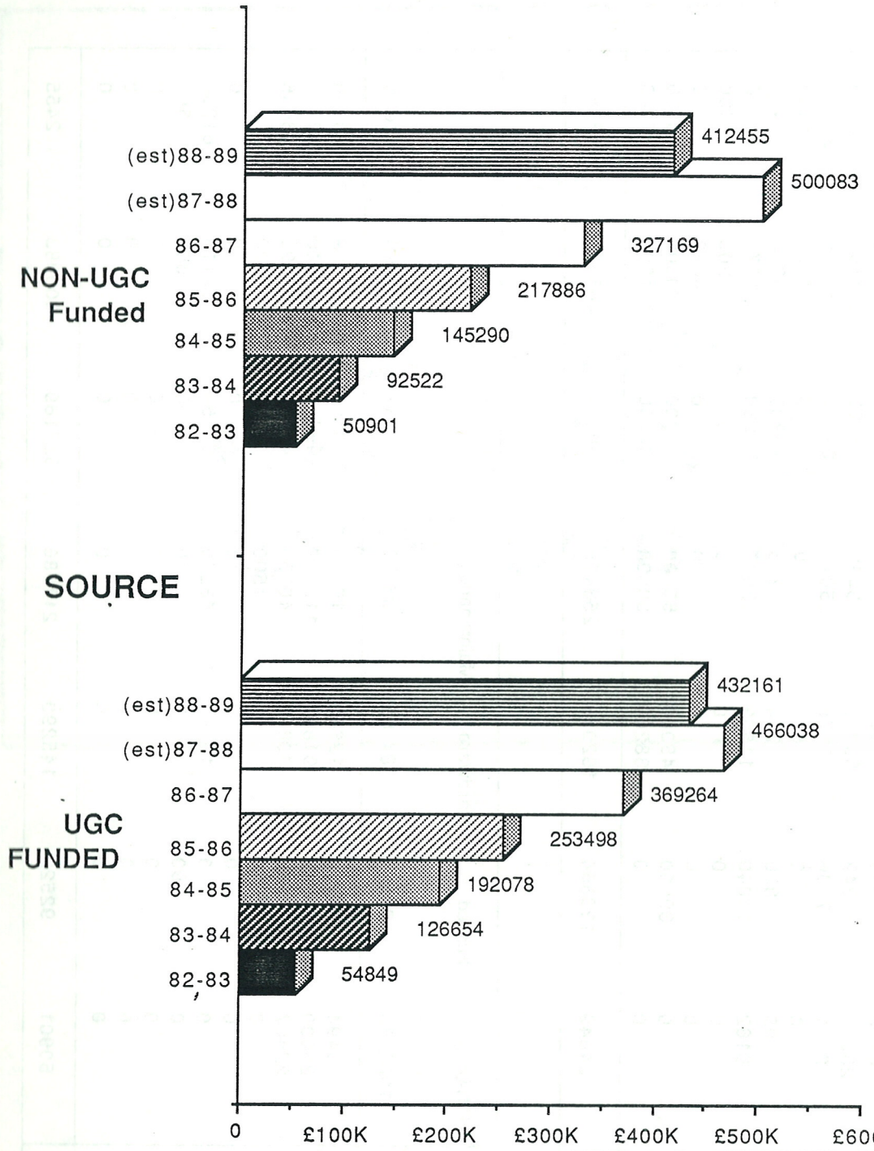
| Faculty | UGC Funded Software Acquisitions (£Sterling) 1982-83 | 83-84 | 84-85 | 85-86 | 86-87 | 87-88(est) | 88-89(est) |
|---|---|---|---|---|---|---|---|
| Social Science | 0 | 900 | 5062 | 243 | 18218 | 10887 | 7500 |
| Science | 3586 | 7550 | 6246 | 39936 | 26412 | 15158 | 30910 |
| Medicine | 3226 | 2062 | 5465 | 10117 | 7097 | 10872 | 4900 |
| Law | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Divinity | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arts | 13387 | 258 | 1262 | 2711 | 6495 | 1634 | 4271 |
| Vets | 100 | 200 | 1000 | 2000 | 500 | 470 | 500 |
| Music | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MIS & Admin | 0 | 24000 | 65000 | 45000 | 26500 | 65000 | 60000 |
| Library | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 20299 | 34970 | 84035 | 100007 | 85222 | 104021 | 108081 |

| Faculty | NON-UGC Funded Software Acquisitions 1982-83 | 83-84 | 84-85 | 85-86 | 86-87 | 87-88(est) | 88-89(est) |
|---|---|---|---|---|---|---|---|
| Social Science | 0 | 0 | 214 | 312 | 6375 | 560 | 2350 |
| Science | 2000 | 23900 | 8200 | 10204 | 28542 | 786758 | 34000 |
| Medicine | 14298 | 6000 | 10597 | 15817 | 19167 | 20827 | 4800 |
| Law | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Divinity | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arts | 0 | 143 | 101100 | 50985 | 52359 | 14150 | 13000 |
| Vets | 0 | 0 | 200 | 300 | 100 | 200 | 300 |
| Music | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MIS & Admin | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Library | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 16298 | 30043 | 120311 | 77618 | 106543 | 822495 | 54450 |

*APPENDIX 9*

# HARDWARE MAINTENANCE EXPENDITURE

# HARDWARE MAINTENANCE EXPENDITURE



## UGC / Non UGC Hardware Maintenance Expenditure

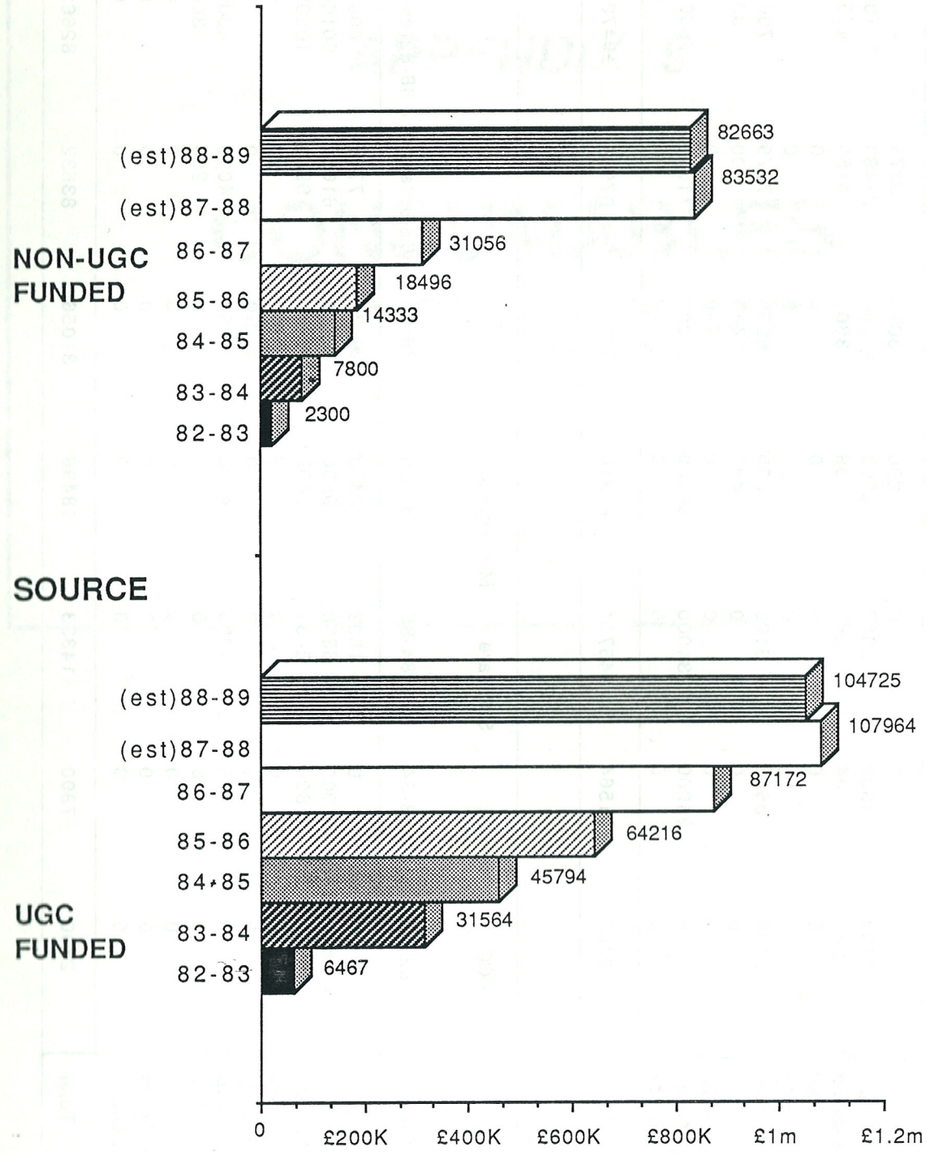
| Faculty | UGC Funded 1982-84 | Hardware 83-84 | Maintenance 84-85 | 85-86 | (£Sterling) 86-87 | 87-88(est) | 88-89(est) |
|---|---|---|---|---|---|---|---|
| Social Science | 4470 | 7039 | 3481 | 4791 | 10479 | 9588 | 15031 |
| Science | 28611 | 49549 | 69845 | 95433 | 157828 | 207194 | 168950 |
| Medicine | 12511 | 17196 | 20275 | 25010 | 32818 | 33778 | 28950 |
| Law | 0 | 0 | 0 | 0 | 0 | 1000 | 4000 |
| Divinity | 95 | 830 | 714 | 775 | 800 | 9900 | 4400 |
| Arts | 9162 | 13040 | 11563 | 13989 | 22339 | 21678 | 23430 |
| Vets | 0 | 0 | 0 | 0 | 0 | 300 | 400 |
| Music | 0 | 0 | 0 | 0 | 0 | 8600 | 0 |
| MIS & Admin | 0 | 39000 | 48000 | 55000 | 57000 | 60000 | 68000 |
| Library | 0 | 0 | 38200 | 58500 | 88000 | 114000 | 119000 |
| Total | 54849 | 126654 | 192078 | 253498 | 369264 | 466038 | 432161 |

| Faculty | NON-UGC Funded 1982-83 | Hardware 83-84 | Maintenance 84-85 | 85-86 | 86-87 | 87-88(est) | 88-89(est) |
|---|---|---|---|---|---|---|---|
| Social Science | 3494 | 4740 | 12649 | 16750 | 20750 | 57939 | 20000 |
| Science | 25000 | 59037 | 91801 | 115317 | 196401 | 321840 | 283790 |
| Medicine | 22407 | 28655 | 30840 | 40550 | 49914 | 55190 | 46955 |
| Law | 0 | 0 | 0 | 1500 | 2500 | 2500 | 0 |
| Divinity | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arts | 0 | 0 | 10000 | 43229 | 57454 | 62114 | 61200 |
| Vets | 0 | 90 | 0 | 540 | 150 | 500 | 500 |
| Music | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MIS & Admin | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Library | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 50901 | 92522 | 145290 | 217886 | 327169 | 500083 | 412455 |

*APPENDIX 9*

# SOFTWARE MAINTENANCE EXPENDITURE

# SOFTWARE MAINTENANCE EXPENDITURE




*Appendix 9*

## UGC / Non UGC Software Maintenance Expenditure

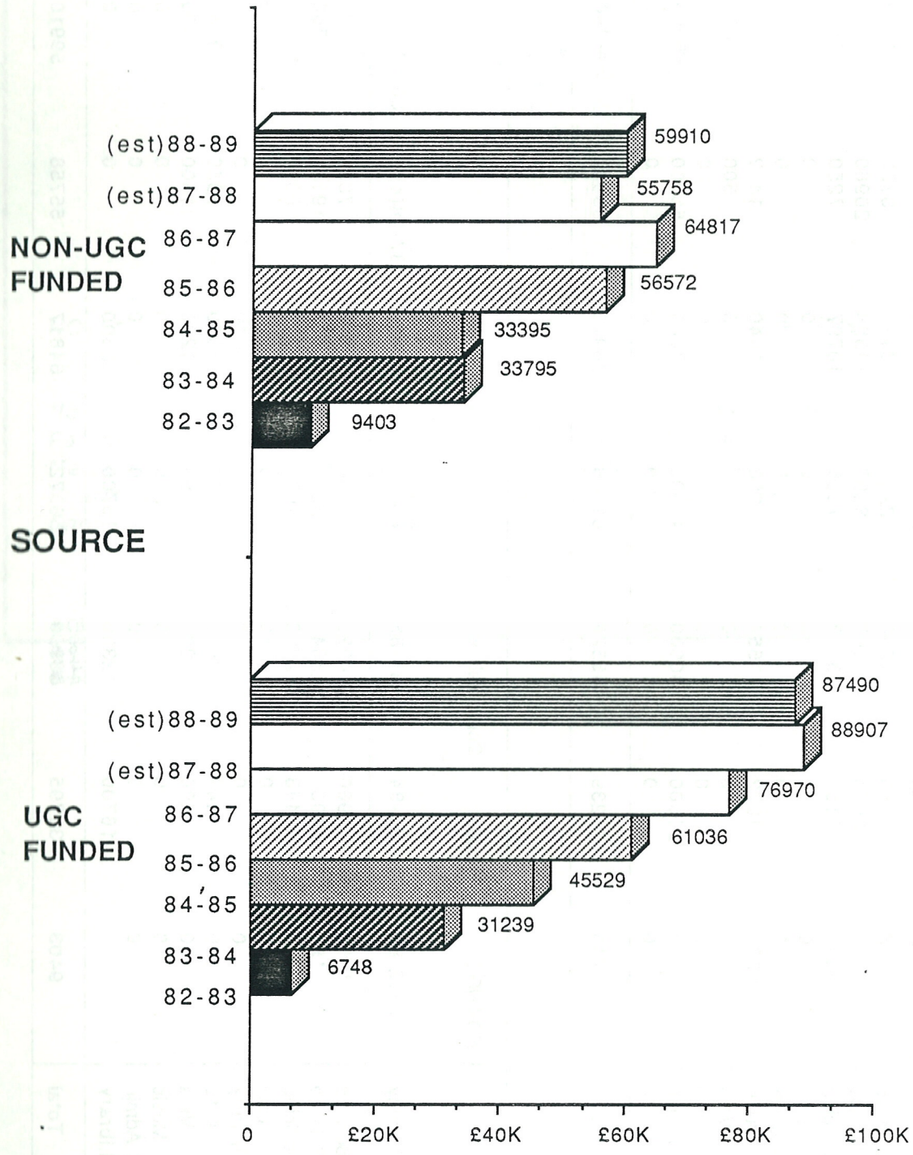
| Faculty | UGC Funded 1982-83 | Software 83-84 | Maintenance 84-85 | 85-86 | 86-87 | 87-889(est) | 88-899est) |
|---|---|---|---|---|---|---|---|
| Social Science | 0 | 0 | 0 | 290 | 3670 | 3875 | 4975 |
| Science | 4000 | 4000 | 8307 | 8993 | 14558 | 21460 | 11700 |
| Medicine | 287 | 64 | 387 | 396 | 3607 | 4150 | 4750 |
| Law | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Divinity | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arts | 2180 | 3500 | 3100 | 4050 | 5850 | 7279 | 7000 |
| Vets | 0 | 0 | 0 | 487 | 487 | 200 | 300 |
| Music | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MIS & Admin | 0 | 24000 | 34000 | 50000 | 59000 | 71000 | 76000 |
| Library | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 6467 | 31564 | 45794 | 64216 | 87172 | 107964 | 104725 |

| Faculty | NON-UGC Funded 1982-83 | Software 83-84 | Maintenance 84-85 | 85-86 | 86-87 | 87-88(est) | 88-89(est) |
|---|---|---|---|---|---|---|---|
| Social Science | 0 | 0 | 1602 | 2498 | 9877 | 7711 | 8000 |
| Science | 500 | 6000 | 6300 | 9500 | 13934 | 61658 | 60100 |
| Medicine | 1800 | 1800 | 2431 | 2498 | 3245 | 9963 | 10263 |
| Law | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Divinity | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arts | 0 | 0 | 4000 | 4000 | 4000 | 4000 | 4000 |
| Vets | 0 | 0 | 0 | 0 | 0 | 200 | 300 |
| Music | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MIS & Admin | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Library | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2300 | 7800 | 14333 | 18496 | 31056 | 83532 | 82663 |

*APPENDIX 9*

# CONSUMABLES EXPENDITURE

# CONSUMABLES EXPENDITURE




*Appendix 9*

## UGC / Non UGC Consumables Expenditure

| Faculty | UGC Funded Consumables 1982-83 | 83-84 | 84-85 | 85-86 | 86-87 | 87-889(est) | 88-899est) |
|---|---|---|---|---|---|---|---|
| Social Science | 75 | 710 | 1550 | 2287 | 3175 | 3755 | 4530 |
| Science | 2000 | 2000 | 7307 | 8993 | 14558 | 20960 | 10200 |
| Medicine | 2381 | 6157 | 5118 | 7358 | 10797 | 7250 | 5500 |
| Law | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Divinity | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arts | 2292 | 1372 | 1554 | 1398 | 1440 | 1442 | 1460 |
| Vets | 0 | 0 | 0 | 0 | 0 | 500 | 800 |
| Music | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MIS & Admin | 0 | 21000 | 30000 | 41000 | 47000 | 55000 | 65000 |
| Library | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 6748 | 31239 | 45529 | 61036 | 76970 | 88907 | 87490 |

| Faculty | NON-UGC Funded Consumables 1982-83 | 83-84 | 84-85 | 85-86 | 86-87 | 87-88(est) | 88-89(est) |
|---|---|---|---|---|---|---|---|
| Social Science | 1956 | 2960 | 4222 | 5304 | 7241 | 7834 | 9770 |
| Science | 150 | 4050 | 8345 | 13025 | 15270 | 19150 | 20750 |
| Medicine | 6997 | 9443 | 12726 | 14981 | 18006 | 19315 | 17930 |
| Law | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Divinity | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arts | 200 | 442 | 6672 | 6512 | 7500 | 7859 | 9460 |
| Vets | 100 | 200 | 200 | 50 | 1200 | 1600 | 2000 |
| Music | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MIS & Admin | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Library | | 16700 | 12300 | 16700 | 15600 | 0 | 0 |
| Total | 9403 | 33795 | 44665 | 56572 | 64817 | 55758 | 59910 |

# APPENDIX 9

*NOTE* The Centre for Speech Technology is included in the Arts Faculty. AIAI in Science.*

*No returns were received from Archaeology, Pre-Clinical Vets, Vet. Pathology, Business Studies, Nursing Studies, Education, Brain Metabolism, Obstetrics, Gastorintestinal Unit,Haematology, Clinical Pharmacology, Fire Safety, Mechanical Engineering, Wave Power, Civil Engineering, Molecular Biology,*