LONDON BOROUGHS' MANAGEMENT SERVICES UNIT

Computer Division

London Borough of Haringey Long Term Computer Project

Report on the Initial Study

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Contents

A

Introduction

A. INTRODUCTION

1. Background and Aims

As the result of an examination carried out by the Haringey Borough Council of its needs for computer facilities, it was decided in 1967 to commission a study in depth of the Borough's information and data processing requirements. In order to allow sufficient time for this study and for the consideration of any major recommendations which might result, a short-term strategy was also adopted of acquiring basic computer services which could be implemented in the shortest possible time.

Hence for its immediate requirements, the Borough joined the North-East London Computer Group, then consisting of Tower Hamlets and Hackney, and it assigned the task of making the long-term study to the London Boroughs' Management Services Unit. It was stipulated that this study when formulating proposals, should take account of the latest developments in computers and related techniques.

The terms of reference for the study as defined in a joint memorandum prepared by Mr. J. Owen, Borough Treasurer of Haringey and Mr. H.J. Dive, Director of the L.B.M.S.U., were as follows:-

"To determine the possibility of setting up and maintaining borough information files in association with an integrated system for all the clerical, administrative and accounting functions of the Council. It will also examine the problems of collecting data and providing access to it, the required equipment, systems and programs and the possibilities of utilising high level programming languages and other aids. An indication will be given of costs and the likelihood of participation by other authorities."

SECTION B of this report, in describing the problems of management and the current weaknesses in the information base, should serve to indicate why it was considered necessary to commission the study in the first place and to demonstrate the vital need which clearly exists.

SECTION C describes how it is practicable to meet the objectives defined in the first sentence of these terms of reference and *Section E* describes the implementation of these in terms of the equipment and techniques required. The benefits to be expected are described in *Section D* and the questions of cost and the need for the participation of other authorities are embodied in *Sections F and G.*

The report represents the culmination of nearly 10 man-years of systems analysis effort on the project which has now become generally known as the Haringey Long Term Computer Study. Considerable interest, extending far beyond the London area, has been aroused by the study and to meet the many requests for information a First Report was produced in June 1968. This report was circulated amongst all London authorities and was also distributed widely by the IMTA and later published in Local Government Finance.

2. Conduct of Study

Two main lines of enquiry had to be pursued in carrying out the project:-

(1) A technical study

(2) A systems study

2.1 THE TECHNICAL STUDY

The technical study had as its objective the determination of what computer facilities were available or becoming available and what would be the technical problems involved in utilising these facilities. Contacts were initially made with eight computer manufacturers, but detailed discussions have eventually taken place with only six of these, the others showing no interest or withdrawing after preliminary discussion. The study of related equipment concerned with data transmission, data capture, and micro-film storage has necessitated contacts with many other manufacturers. The results of these investigations were issued as a series of technical reports under the following titles:

(a) Data transmission

(b) Document reading

(c) Data terminals

(d) Data capturing (a review of all other methods of getting data into a computer).

(e) Micro-film techniques for storage and retrieval of computer data and results.

(f) Computer requirements in a multi-access system

(g) Computer facilities available (a review of manufacturers' equipment ('hardware'), their standard program facilities ('software') and of their relevant experience).

The relevant findings are embodied in *Section E* of this report.

2.2 THE SYSTEMS STUDY

The systems study was directed to ascertaining the present pattern of information usage of the authority both for the purposes of management information and control and also for carrying out the day-to-day routine tasks.

The first stage of this study, which was completed in May 1968, consisted of a detailed factual survey of every Council department, in order to obtain an overall view of the authority's functions.

In the first place it was necessary to gain a proper understanding of the full range of Haringey services, and the problems encountered in providing them. All professional and administrative procedures were therefore studied and defined. Particular attention was paid to the use of information at every level, by listing the records maintained and the communications and contacts regularly made. Only in this way was it possible to see the interaction of all services in perspective.

Eighteen departmental reports were produced. Complete sets of documents (forms used, clerical instructions, etc.)

were collected for each department and details of all records, together with the communications and contacts involved in their use, were then recorded on specially designed forms to facilitate subsequent analysis.

The analysis stage concentrated on determining the points of contact and inter-dependence of the authority's functions notably in respect of information. Three further reports were produced at this stage:

Property Records

Personal Records

Internal Records

These reports represent the factual basis for *Section B* of this report, the whole of which is concerned with effecting a synthesis between the requirements as revealed in the systems study and the practicabilities ascertained in the technical study.

3. Relevance of the Study to Other London Boroughs

Since the original question of participation by other authorities has emerged as being of fundamental significance to the further development of the project, an attempt has been made in *Appendix 1* to indicate the scale of activities at Haringey together with some general statistics about the Borough and the resources of the Authority. These statistics should serve as a starting point for any authority wishing to make some comparison between its own scale of operations and facilities and those of Haringey.

In terms of functions exercised, the major difference to be found within the London area concerns the responsibility for the education service, where the twelve Inner London authorities are not education authorities. Statistics relating to the education service have therefore been shown separately. A further significant difference is in the extent of any direct labour activity – Haringey has a large direct labour force, which is engaged primarily on minor capital works together with repairs and maintenance. In general, a great deal of common ground can clearly be establishe between the group of Inner London Boroughs and similar between the Outer London Boroughs. Even between a Inner and an Outer Borough, the effect of the existence o a local education service will be apparent more upon th volume of activities of the rest of the departmen (especially Building Works and Treasurer's) than on the functions. The problems of management and contr defined in the next section are relevant to all, and th proposed computer solutions are also generally applicabl

To justify the proposed computer facilities for any othe London Borough, and to resolve the points relevant to an detailed application of the general principles, must imply proper study of the organisation of each such prospectiv partner. The experience gained in carrying out this presen study will, however, ensure that these further studies can b carried out effectively and expeditiously.

4. Acknowledgements

The L.B.M.S.U. would like to thank the many organisation and individuals who have contributed to the execution o this project thus far.

In the equipment sphere many organisations have supplie literature and given demonstrations; six major computer manufacturers have organised seminars, given presentations and made high level staff available for discussions.

At Haringey, co-operation has readily been accorded by all levels of staff and much valuable advice and assistance received in carrying out the investigations. The support and encouragement of all Chief Officers, and particularly from the Borough Treasurer and the Chief Executive Officer has been much appreciated.

Valuable discussions have taken place with other local authorities, notably West Sussex in this country, and the counties of Alameda, San Francisco and Santa Clara in the U.S.A.

Support and advice from LAMSAC, the IMTA, and the District Audit must also be gratefully acknowledged.

B

General Analysis of Information Requirements

B. GENERAL ANALYSIS OF INFORMATION REQUIREMENTS

1. Responsibilities of the Local Authority

1.1 GENERAL

Any consideration of the organisation and information needs of a local authority must recognise the diversity and complexity of the authority's responsibilities. These responsibilities can be stated in general terms as being the welfare of the population, the maintenance and improvement of the environment, and the provision of certain essential community services and amenities.

To discharge these responsibilities, in association with the other public authorities in the area, each local authority has evolved an organisation capable of carrying out the broad functions of policy-making, management, provision of services to the public and the necessary supporting activities. The nature of these functions must therefore be examined.

1.2 POLICY-MAKING

The main areas within which policies must be determined are:

(a) Long-term objectives, the pattern of growth in services and their financial implications.

(b) Short-term objectives and their financial implications (i.e. within the periods covered by published budgets).

(c) The resolution of competing claims on resources, and the establishment of priorities.

(d) Interpretation of discretionary powers and definition of acceptable levels of service.

(e) Authorisation of the procurement of resources needed to fulfil objectives.

(f) Definition of levels of delegation and appropriate methods of control.

(g) The methods of communicating with the public and determining the appropriate degree of involvement in decision making.

(h) Staffing, conditions of service and personnel relations.

1.3 THE MANAGERIAL FUNCTION

The managerial function in local government may be viewed as the control of the achievement of the policy objectives. The principal activities are therefore:-

(a) Interpretation of policy to staff and to the public.

(b) Preparing plans for the execution of policy.

(c) Providing resources required by the plans.

(d) Control of the progress of work done and services provided.

(e) Control of the quality of work done or services provided against policy standards (e.g. in consistency and fairness in relations with the public).

(f) Evaluating current developments in professional and technical methods, and recommending their adoption as appropriate.

(g) Providing and controlling administrative support.

(h) Training, motivating and ensuring the welfare of staff.

(i) Advising on changes and extensions to policy.

1.4 THE OPERATIONAL FUNCTION

The operational function is the directly productive, resource-consuming element in the organisation, to which virtually every officer and employee contributes. Operational tasks may broadly be classified as follows :-

(a) Personal casework

(b) Technical projects

(c) Routine personal services

(d) Routine technical and maintenance services

(e) Specialised administrative support for each service

(f) General clerical and administrative support

The immediate local control of these tasks represents a vital extension of the managerial function, differing only in the degree of contact with individual items of work and in the time-scale within which control can be exercised.

1.5 PRACTICAL IMPLICATIONS

It is not possible to attribute these functions precisely to particular groups of individuals. Generally policy-making is the task of Members acting in close association with chief officers, and management is the task of chief, deputy chief and principal officers. But no policy of delegation, however rigidly adhered to, could keep the three levels of function entirely separate. Contributions to the policy-making function will in fact arise from all levels in the organisation.

1.6 INFORMATION REQUIREMENTS

The information requirements at each level differ principally in detail and scope. At the operational level, detailed information is required within a limited scope, in order to accomplish and supervise the job in hand. The information needed relates directly to the subject matter of the task, i.e. people and property in the case of services direct to the public, resources and accounts in the case of supporting activities. When the execution of operational tasks is recorded, further information is in fact created, for the benefit of the next person participating in the task, of the person requesting the task, or of the accountant.

The managerial function requires summary information about the performance of the professional and administrative tasks. In addition, details are needed about important or exceptional cases, either because they demand an interpretation of policy, or because for reasons of size, expense, or public sensitivity, additional supervision appears to be necessary. The information required here,

therefore, is essentially an abstract of the 'operational' information, some of which may be provided on a routine basis, and some requested ad hoc. With such information, the officer of managerial status can discover for example whether the resources at his disposal should be redeployed or augmented.

To the strategic policy-making function periodic summaries and abstracts of 'operational' information are again relevant, but should be supplemented where possible by similar abstracts relating to neighbouring or comparable areas, and by an analysis of the environment (physical, social, technical and financial) in which the authority is working. An analysis of this kind may involve the use of data provided by other organisations, and the collection of data by special surveys. It involves the identification of trends and their projection into the future. It involves discovering the needs and preferences of people. The feasibility of alternative strategies should be tested, and a feedback of the progress of eventual policies organised and controlled.

The remainder of this Section of the report is an examination of the present information arrangements having regard to the requirements indicated above.

2. The Current Information Base for the Council's Activities

2.1 THE PRESENT ARRANGEMENTS

The current situation concerning the usage and availability of information has been discussed fully in the three Analysis Reports on Property, Personal and Internal records. It is thought that the weaknesses in the present arrangements are the natural consequence of primarily manual methods of record-keeping in scattered offices where pressure of work is often considerable. In general there is little circulation of information between departments and even in some cases between sections of a department. There is no pressure on autonomous departments to supply information to other departments and little encouragement to seek information from other departments as an alternative to carrying out independent investigations. The consequences in terms of the duplication of records are obvious on investigation, and, moreover, these records are not in fact perfect duplicates - there are inconsistencies in terms of completeness, currency and hence accuracy.

Some of the principal findings, published in the Analysis Reports, are summarised below.

2.2 THE BASIC CLASSIFICATIONS

In the first place a distinction is apparent between the Council's services to the public, for which information about property and people is generally required, and the Council's supporting or 'internal' activities, for which the basic records are of work, staff, resources and accounts.

Figure 1 (page 9) shows a list of direct contacts with the public arising from the Council's services and other responsibilities in connection with property. These contacts represent the principal reasons for keeping property records. It will be noted that in almost every case personal details appear in conjunction with the activity, and that these most typically are concerned with the present occupier. Where payments are made for the service, other than on a cash basis, personal accounts are opened, income assessments being made in certain cases. Activities involving no direct contacts with the public, such as the provision of street lighting have been excluded from this listing.

In figure 2 (page 10) further contacts with the public are listed, in connection with services which are solely personal. Personal records are maintained for the purpose of regulating the continuity of the service. Services whose consumers may remain anonymous (such as baths), or which are strictly non-recurring (such as cremation), have been omitted from the list because they do not normally give rise to permanent active records about individuals.

Figure 3 (page 11) presents a classification of records characteristically maintained in the course of internal activities. The most general group of these activities is shown first in the row entitled 'Administrative support for revenue services'—this embraces the majority of administrative work. Below this are shown three groups of activities which necessitate the maintenance of significantly different records, viz. the planning and execution of major capital projects, the provision of repair and maintenance services which call for manual labour, and specialised financial services. Records kept in connection with these internal activities are listed in four columns, as follows:

(a) WORK: documents stating the terms of reference for services or for individual items of work, plans or programmes of work to be done, records or summaries of work done of services given—much of this information is of course required in the 'managerial' context.

(b) BASIC ASSETS: documents defining the limits of the Council's capacity for carrying out tasks—normally these 'basic assets' represent permanent or semi-permanent resources or constraints, but in the context or repair and maintenance they represent the items upon which work has to be done.

(c) RESOURCES: documents recording the procurement and maintenance of resources (including staff).

(d) ACCOUNTING: documents recording the financial aspects of all transactions.

It may be seen that there are a few areas where the 'internal' records legitimately overlap with the 'external'. The valuation list, for example, is an invaluable record of property besides being the basic authority for the Council's rating income. This method of classification serves to explain the need for records of various types, and helps also to provide the background to the discussion of the inadequacies in present record-keeping arrangements.

(FIGURE 1) PRINCIPAL COUNCIL SERVICES AND RESPONSIBILITIES IN CONNECTION WITH LAND AND PROPERTY

Services	Associated Records			
	concerning Properties	concerning People	concerning Personal Debtors Records	concerning Income Assessments
Planning permissions	All types	Owners or occupiers (Actual or prospective)	No	
Building regulations	All types	Owners or occupiers (Actual or prospective)	No	
Local Land Charges: registration, searches and allied enquiries	All types	Owners or occupiers (Actual or prospective)	Some	No
Development planning (land use etc)	All properties in the Borough	–	No	
Acquisition and clearance of land for redevelopment	All properties in certain areas	Tenants needing rehousing. Owners, other interested parties	No	
Acquisition of properties for housing	Dwellings	Owners, tenants	No	
Rate collection (valuation)	All properties in the Borough	Ratepayers (occupiers, owners or agents)	Yes	Rebate applicants
Housing accommodation	Council dwellings	Tenants and applicants	Yes	Rebate applicants
Housing advances	Private dwellings	Owner-occupiers	Yes	Yes
Improvements grants	Private dwellings	Owner-occupiers	No	
Public Health:				
Certificates of Disrepair	Private dwellings	Owners and tenants	No	
Overcrowding	Private dwellings	Owners and tenants	No	
Statutory Notices	Private dwellings	Owners and tenants	No	
Inspection and registration of Offices, Shops, Factories	Commercial premises	Traders and employers	No	
Public Control:			No	
Inspection of Trading Premises	Commercial premises	Traders and employers	No	
Licensing	Commercial premises	Traders and employers	No	
Refuse Collection: Agreements, hire of containers	Commercial premises	Traders and employers	Yes	No
Leasing of Council Properties	Commercial premises	Traders and employers	Yes	No
Allotments	Council allotments	Tenants	Yes	No
Letting of public halls and rooms, sports fields, swimming baths; catering for private functions	Halls, rooms, pitches, etc.	Hirers	Yes	No

(FIGURE 2) PRINCIPAL PERSONAL SERVICES

Services	Associated Records		
	concerning People	concerning Personal Debtors Accounts	concerning Income Assessments
Ante - and post-natal clinics, midwifery	Mothers and babies	No	
Infant welfare, vaccination	Mothers and babies	No	
Care of unsupported mothers	Mothers and babies	Yes	Yes
Day nurseries	Mothers and babies	Yes	Yes
Special clinics, e.g. ophthalmic, chiropody, ear, nose and throat	Children, Old people etc.	No	
School Health Inspections - general - dental	All children in Council schools	No	
Health visiting	All types of people	No	
Home nursing	All types of people	No	
Home Helps	All types of people	Yes	Yes
Recuperative holidays	All types of people	Some	Yes
Mental Health Service	All types of people	Some	Yes
Children's Services	Children and parents	Some	Yes
Welfare Services	Handicapped, old people homeless families	Some	Yes
Pre-school scheduling	Infants	No	
Primary Schooling	Pupils	No	
Secondary Schooling	Pupils	No	
Private Schooling - finanical assistance	Pupils	Yes	Yes
School Welfare - maintenance grants, free clothing, etc.	Some pupils	Yes	Yes
School Meals	Pupils	No	Yes
Careers and employment	School leavers (up to 18)	Unemployment benefit	No
Further education awards	Students resident in the borough	Grants, awards	Yes
Further education	Students educated in the Borough	Recoupment from another local authority	No
Adult education	Adults	No	
Supervision of outworkers	Adults	No	
Lending of books and gramophone records	Borrowers	No	
Registration of births, deaths and marriages	Families	No	
Registration of electors	Adults	No	
Dog and other licences	Adults	Yes	No
Court cases	Debtors, traders, families, etc.	Some	No

(FIGURE 3) PRINCIPAL INTERNAL SERVICES

Activities	Associated Records			
	Work	Basic Assets	Resources	Accounts
Administrative support for revenue services	Statutory and discretionary responsibilities Government directives Council policy Committee reports Services provided-statistics and returns	Annual estimates staff establishments Accommodation Inventories	Officers, employees Teachers Equipment, supplies Utilities, services Internal work requisitions	Revenue expenditure and income a/cs Payroll Creditors and debtors a/cs cash income, petty cash Recoupment, adjustments between authorities.
Capital projects – planning, design and construction (assumed to be (contracted)	Plans, specifications bills of quantities Activity networks Progress charts	Regional development plan Town planning data bases: land use, surveys, models Capital budget	Tenders Contracts	Capital accounts Site valuations Contractors' accounts
Repair and maintenance Minor works, Jobbing services	Work programmes Job definitions Inspection reports Work requisitions	Roads, public lighting, etc. Buildings Mechanical equipment	Labour Stores Vehicle and plant pools Purchases Sub-contracts	Job costing Manual workers' payroll Bonus Stores and transport charging Creditors' accounts Debtors' accounts for rechargeable work
Financial services	Financial regulations Audit programmes	Capital accounts Valuation list	Rating Grant claims Rents, fees and charges Loans pool Bank balance	Lenders accounts Internal funds Insurance Cash accounts Superannuation Payment of pensions.

2.3 PROPERTY RECORDS

(i) There is very little circulation between departments of information about property within the borough, except for property acquired and managed by the Council. The lack of such co-ordination is most noticeable in relation to commercial premises, records of which are maintained independently by the following departments:

Borough Treasurer (rating)

Town Clerk (valuation: council lettings)

Town Clerk (public control)

Town Clerk (licences)

Public Health (Office, Shop & Railway Premises Act inspections, etc.)

Cleansing (refuse collection agreements)

Education (youth employment service)

Town Planning (land use register)

Significant discrepancies have been found between most of these records, some of which contain information which is seriously out-of-date, or are otherwise incomplete. There is a clear need here for a central pool of information available to departments or sections according to the requirements of each.

(ii) The procedures for answering enquiries, which almost inevitably accompany a search for local land charges are particularly cumbersome, as they involve reference to four departments (Town Planning, Borough Engineer, Public Health, Borough Treasurer). Considerable time could be saved by establishing a central register of the relevant information - this would also be of positive value to the departments concerned.

(iii) The Town Planning department has no routine access to the information produced by the other departments. Up-to-date information about land use, rateable values, the issue of improvement grants, and the social services are of great importance to town planning - this could all be made available by other Council departments.

(iv) There are no complete physical descriptions of roads, sewers, buildings and other installations available to those sections responsible for maintenance. This type of information is useful in supplementing the often imprecise requests for work to be done, and can often reduce the amount of preliminary inspection, or at least ensure that the work is referred to the appropriate department or section. Further it is invaluable whenever systematic improvements or replacements are planned.

2.4 PERSONAL RECORDS

(i) There is also very little circulation between departments of information about persons living or using council facilities within the borough. Valuable exceptions are the lists of births and deaths circulated by the Child Health section and the lists of tenancy changes circulated by the Housing department. As can be seen from Figure 2, however, very few sets of personal records are mutually exclusive, particularly since records of children normally include names of the parents, most case-work records include names of next-of-kin, and income assessments and housing records require some details of dependants. Consequently the possible inter-action of differing sets of personal records is very extensive. Present routine arrangements take no effective account of this interaction.

(ii) Information regarding personal movements revealed every day to the Rating section, and annually to the Electoral Registration Officer, is not acquired by other sections to enable them to amend their files. Even where notification of lettings and other movements is made available by the Housing department, it is made in the form of a standard comprehensive document, which each other section must read completely in order to discover the information relevant to its own particular needs. This is basically because no one department has any definite means of knowing which households are receiving services from any other.

As a result, the records kept of any household may be out-of-step in different departments, or even in different sections of the same department. Consequently fruitless appointments are arranged and abortive visits and inspections are made. Such errors invariably waste time and money and reveal inefficiency to the public; occasionally they cause further distress to bereaved persons.

Even movements within the borough may lead to an unnecessary dislocation in social services if the recipient fails to make all the necessary contacts. A further consequence is that records which in the nature of things tend to remain inactive for considerable periods (e.g. those in respect of 'toddlers' library borrowers and housing applicants) are not eliminated, so that their size becomes misleading to policy-makers and a deterrent to effective clerical action.

Within the social services, a section acquiring new cases has to discover for itself what is known to other sections and departments about the persons concerned. Not only is this a slow process, but it serves to disrupt the work in progress in the departments so approached.

(iii) The most significant area of record duplication concerns infants and school children. The Education department relies largely on information from the Health department for its pre-school scheduling, while the Health department relies entirely on Education for information about school placements to organise appointments for school health medicals and teenage inoculations. The information duplicated is essentially for administrative and non-professional purposes, and regular notifications are transmitted between the departments. However, a survey of the files concerned showed that the two departments are substantially out of step. The sheer size of the task of maintenance and cross-checking (some 60,000 records are involved in all) defeats these ends.

2.5 "INTERNAL" RECORDS : WORK, RESOURCES AND ACCOUNTS

(i) Many of these records are essentially transitory (e.g. works requisitions, timesheets and absence notifications) and are required primarily for communication between departments. Transmission of this information is an essential part of routine administration and under a manual system this requires the physical movement of documents - a process conducive to delay, and to the compilation and maintenance of duplicate filing systems distinguishable only by the sequence of their records.

In some cases, in order to serve differing but over-lapping interests in one subject in several places, records are copied or abstracted, thus facilitating access to information by a variety of means (e.g. chronological or alphabetical). In this way permanent records are created, such as job ledgers which have no lasting importance and sickness histories which are, or should be, complete duplicates of permanent records in other departments. In other cases indexes are produced and must then be kept up to date.

(ii) The requirements of a centralised accounting and costing system involve the transmission of information regarding the orders placed with suppliers and with jobbing sections, and the present computer system does nothing to obviate this necessity. From time to time difficulties also arise because, to save the need for copies, prime documents (e.g. wages time sheets, stores requisitions and the like) are used and retained in the centralised system and are therefore no longer directly available to assist departments undertaking detailed examination of cost items. Most departments also find it necessary to supplement the current computer tabulations with information regarding commitments, pending the introduction of a computerised commitment system.

(iii) There is no systematic method of recording work done on individual highways, buildings, etc. It would be helpful to build up a comprehensive historical record of repairs and expenditure in order to assess the comparative costs of maintaining different structures and materials. There is no regular feedback of such information to the Borough Architect, other than that arising from specific isolated complaints.

(iv) There is a significant lack of routine summary reporting on work and services except where specifically required by committees.

2.6 GENERAL DIFFICULTIES IN DATA HANDLING

(i) It is very evident that the manipulation of major filing systems, particularly in the Health and Education departments, is a most burdensome operation. The most time-consuming jobs are not those which require professional attention, nor do they even often touch upon the professional content of the files. They are mainly mechanical tasks of locating and re-ordering files, of re-arranging the presentation of information for a variety of purposes, of drawing up lists and schedules according to simple criteria, and of addressing mail and other communications. Many of these routine tasks can be accomplished or avoided by automation.

(ii) There is of course no easy way of scanning and analysing large files of clerical records; accordingly such tasks are only undertaken infrequently and then at considerable cost.

3. Problems of Management and Control

Levels of management within the authority have been described in Section B.1. To enable such a structure to function, it is essential that each level of management should be provided with information which corresponds to its span of control and accountability. The basic subject matter is the same for all levels - what differs is the scope, the amount of detail, and above all the time-scale. Each time-scale should be planned to enable the manager to take effective remedial action rather than simply to provide a record of accountability.

As essential pre-requisite for management control is the definition of standards and yardsticks whereby performance can be evaluated. Such standards might be based on detailed measurement, analysis of past performance, and comparison with other organisations.

In common with the experience of local authorities generally, there has as yet been comparatively little progress towards the production of this type of information which is the foundation of modern management. The attempts which have been made to replace the informal methods of control, appropriate to the smaller authority of previous years, by any other method capable of encompassing the scale of present-day activities have met with little success.

In the individual departments there is a general scarcity of routine summary reporting, either to Chief Officers or to Committees. Such summaries as are produced are available only periodically and after some delay. Yet the amount of money being spent on services demands a level of efficiency that can only be achieved through a high standard of management.

Reporting made available to facilitate the co-ordination of services is even scarcer. Attention is now being paid to the interdependence of departments, and Haringey is one of the first London Boroughs to have appointed a Chief Executive. It is therefore clear that this kind of reporting must be developed.

With the present methods of information handling and communications within the authority, it is doubtful whether, even if the extremely onerous task of summary reporting were attempted, it would be possible to produce accurate information to the time-cycles required for effective action. In the circumstances, undue regard is often paid to the only sources of information which are available, such as statistics and Ministry returns which may be inappropriate to the needs of local control.

The checking of invoices is another example at a much lower level. The process is important providing the extent is reasonable and economic in detail; but it needs to be complemented by greater emphasis on the control of orders before expenditure is committed.

There is still insufficient linking of financial reporting with other reporting and this may be seen particularly in the context of the use of the kind of standards and yardsticks mentioned. Of themselves, reports comparing expenditure with estimates can give no indication of the Council's efficiency in employing certain resources to produce certain results. A significant example of this problem is provided by the prevailing attitude towards the annual estimates. Considerable effort goes into the necessary task of avoiding over-spending; but less effort is usually applied to the equally necessary task of ensuring that targets are set and achieved so that the Council can be satisfied that expenditure is justified and represents good value for money spent within the estimates

A programme of action is therefore needed to resolve the following problems:

(a) There is at present no accurate data-base for the authority's work.

(b) There are at present too few yardsticks and defined measures for use in a management reporting system and little possibility of obtaining any other than those susceptible to direct physical measurement (e.g. bonus targets) because of the inadequacies of the present data-base.

(c) The means of communication, recording of data and analysis are not sufficiently flexible or timely to enable a management reporting system to function successfully even where yardsticks are available.

The increased size of local authorities requires that attention should be paid to information *as a resource in itself;* that there should be a central policy for the requirements, classification, circulation, storage and use of information just as there is a declared policy in financial or building regulations. The aims of this central policy should be to make available all items of information to all legitimately interested parties in the contexts of their policy-making, managerial, and operational functions.

This proposal takes account of the growing recognition of the interdependence of departments and the need for a logical system to serve as a basis for routine co-operation. Additionally, the Council's handling of personal records and property records should be in itself an exercise in good public relations.

4. The Role of a Computer

The problems of record keeping and the requests for flexible analysis and timely reporting defined in B.3 above, can only be resolved by the use of large scale computer systems which will not only store vast quantities of information, but will facilitate the data acquisition and retrieval process, and function additionally as communication systems.

This implies a large computer equipped with mass storage devices and linked to all major departments by tele-communications.

The borough will store on the computer any information needed to fulfil this centralising function - basically the common items of information relevant to the work of more than one department, and cross-references to more extensive files of information maintained in each department. Additional data will be supplied to the

computer for the purpose of routine data processing operations. The computer itself will supply the facilities for the checking, retrieval, analysis and summarising of the information which it holds.

In general terms the advantage of such a computer sytem will be:

(a) To achieve standardisation of recording and referencing in the most critical and public areas of information, namely people and property, within a logical framework and with proper cross-indexing.

(b) To achieve a similar logical framework for internal records, in order to extend the scope of integrated data processing.

(c) To achieve better communications and co-operation between departments, and thus to provide a more efficient and humane service to the public.

(d) To reduce the present effort on acquiri transmitting, copying, re-organising, extracting a analysing information.

(e) To lay the foundations of a progressive system reporting on operational functions for managerial a strategic requirements.

It must be emphasised that a 'management informati system' (to use the current jargon), cannot spring overnight. The essential foundation is to systematise t 'operational' information, in such a way that the abstrac and analyses needed for management can be developed. due course it may become possible to produce much of t information needed for the making of policy, but as the needs will never be entirely predictable such informati cannot be made to arrive automatically. The co-ordinati of operational and management information systems on regional basis would be an ideal.

C

The Proposed Computer System

1. ESSENTIAL FEATURES
2. DATA TERMINALS
3. THE DATA BANK
    1. General
    2. Contents
    3. Identification and Retrieval of Records
    4. Standardisation
4. THE PRINCIPAL OPPORTUNITIES OF THE SYSTEM
5. CONSTRAINTS UPON THE SYSTEM
6. REALISATION OF THE COMPUTER SYSTEM
7. THE NUCLEUS
8. THE EXTENSIONS
9. SITING OF TERMINALS
10. CONCLUSION

C. THE PROPOSED COMPUTER SYSTEM

1. Essential Features

In the opening paragraph of this report it was indicated that to meet its immediate or 'short term' requirements for computer facilities, Haringey had become a member of the North East London Computer Group. This Group operates a LEO III system, and it is convenient in thinking of the features of the proposed new system to make comparisons with that now existing.

Design of the LEO III systems was limited, as described in Section IV (2) of the First Report, to the serial processing of data in batches, which imposes problems on the user in terms of timing and documentation. Although the 'suites' of programs have been integrated to a degree still in advance of other British local government computer systems, the operation of each program is limited by the amount and variety of data available at any one time. As a result it is impracticable to give automatic effect to all the facets of each item of data submitted. Furthermore, the delays inherent in the key punching of data, and the printing of results at the computer centre, have to be accepted.

Two essential features distinguish the proposed system from the present LEO III system: telecommunication links between council offices and the computer, and a massive capacity for data storage of several hundred millions of characters all accessible within a fraction of a second. The implications of these two features are revolutionary.

The total amount of data in the current version of the permanent files in the Haringey 'short-term' system is the equivalent to some 40 million 'bytes'. (Generally a 'byte' is the equivalent of an alpha-numeric character). This is all stored on magnetic tape and any section of it can only be retrieved by the program written specially to process that particular set of data. It would probably be possible in an emergency to locate and present any item of information in the system within half-an-hour, but the economics of using this type of computer do not permit such an approach. Instead, the user concerned with a particular item must wait until the next prescribed time for processing the file he wants, or must rely upon the documentation produced in the course of a previous run. Within any one second the computer can read and use, optimally, about 30,000 characters from magnetic tape, but these can only be the next 30,000 characters on any tape that is currently loaded for reading.

The proposed system envisages ultimately a total data bank of about 300 million bytes 'on-line' (i.e., immediately accessible to the computer). This figure may in due course be extended, and in any case will be supplemented by additional data on magnetic tape.

In the future therefore the user can take advantage of the following benefits:-

(a) An increase of at least eight-fold in the total data available within the computer system.

(b) An increase of about 1,000 fold in the choice of data which can be accessible within one second.

(c) An increase (due to higher reading speeds) of 7 to 30 fold in the amount of data which can be read and used within one second.

(d) The ability to communicate with the computer direct from his own department.

At this point the reader is referred to *Appendix 2,* the outline diagram of an 'Information System for Local Government'. In this diagram the main elements of the system are shown in conceptual form - the actual equipment required is described in Section E of this report. The following paragraphs examine the role of the data terminals and the data bank, discuss their implications for systems design, and outline the objectives of the main elements of the project.

2. Data Terminals

Data terminals are out-stations of a computer system, situated in the user offices and connected to the central computer by telephone lines. The terminals most likely to be used in local government consist of teletypewriter sets, with or without a cathode ray display panel. Other specialised types of terminals are available, for example receipting or accounting machines adapted for telecommunication. Most of these machines may optionally be fitted with slow paper tape readers and punches.

Typical uses to which terminals may be put are as follows:-

(a) Interrogation of a computer file by the user, to display or print the whole or part of a specific record either identified by a unique keyword, or selected from records conforming to specified parameters.

(b) Amendment of records thus retrieved, and insertion of new records—data submitted can be checked by visual inspection before processing the amendment.

(c) Inspection of a series of records forming a list of items requiring action, and signifying to the computer which of a series of pre-programmed actions is required, or what action is being taken manually.

(d) Using the computer for essential calculations required in the office procedures (e.g. apportionment of rates) and subsequent updating of files.

(e) Requesting the computer to carry out specific non-routine tasks, such as the scanning and analysis of files which will take too much time and/or produce too much printed output for the response to return immediately to the terminal.

(f) Transmission of data punched locally on paper tape.

Additionally, the computer may initiate messages, for example in the following contexts:-

(g) Urgent reports from a batch processing run, e.g. data vetting queries on payroll requiring immediate action.

(h) Copies of transactions initiated at another terminal.

(i) Instructions or other urgent notifications arising out of a transaction initiated at another terminal.

Working in this environment, the computer user may put himself 'on-line' to the computer, and may use it to

conduct operations in 'real time' (i.e. quickly enough not to delay relevant transactions). Hence this type of system is often known as an 'on line' or 'real time' system.

3. The Data Bank

3.1 GENERAL

The foundation of the proposed computer system is the 'Data Bank', that is to say, the network of data files on which the computer operates comprising the greater portion of the logical data base described in *Section B.*

It thus represents a central filing system for the whole authority—a pool of information to which each department contributes what it can, and from which it takes what it needs.

Each department has by this means access to the best and latest information relevant to its problems which may have been acquired by any other department or section. It may subject any file in the Data Bank to which it is allowed access to casual interrogations and analyses, or it may place a 'standing order' to have all new information of certain types relayed to it as a matter of course.

In addition, the Data Bank is the basis for the computer's routine data processing activities and permits a high degree of integration between functions, in that all points of contact and cross-reference are actively noted.

The Data Bank will thus replace all organised and homogeneous files that are used as the basis for routine procedures which may be transferred to the computer, and also any files which exist in order to provide indexing or cross-referencing facilities.

3.2. CONTENTS

The logical organisation of the Data Bank is shown in the table at Figure 5. In that table files needed on the computer are listed in six categories:-

A Indexes, to facilitate access to records by name and/or address where possible rather than by code numbers.

B General, being complete lists of all properties and people (i.e. individuals and families who live in Haringey or use Haringey services) recorded in the system. These files will serve to connect all necessary references to each property, or person, either in or out of the computer system, and in addition will hold basic details such as land use or date of birth. These files have no analogue within the present manual system.

C Special, being files of properties and people grouped for specific purposes, e.g. rating or electoral registration. These files represent those in Figures 1 and 2, in *Section, B* which may usefully be transferred to the computer.

D,E Current, corresponding to such files listed in Figure 3 as may usefully be tranferred to the computer. Files listed under D consist of records which are likely to be fairly permanent; records in files under E are unlikely to endure for more than a few weeks.

F Historical, being records of movements compiled over a period of time, to which the need for rapid access justifies maintenance on the computer. Any file may contain cross-references to manual records. Files maintained fo system housekeeping purposes only are not shown, e.g cross-reference lists, file and record maps, indexe indicating the physical location of records on-line, and fil copies for system recovery procedures.

Whilst Figure 5 shows the content of the Data Bank an indicates the way in which the files may be regarded fron the users' point of view, it is probable that the layout of th actual information and files in the system will differ fron the picture thus presented. The type of direct access device used for storage will have a material influence on the fil design, and so will the software facilities.

3.3 IDENTIFICATION AND RETRIEVAL OF RECORDS

The indexes and the two general files are the only file which must be sequenced alphabetically. The street an property records will be based on a strict alphabetica sequence of street names but surnames will also b converted into a phonetic code, to allow for commo mis-hearings and mis-spellings. Techniques developed in th U.S.A. to select records corresponding most closely to th data submitted will almost certainly be used; in this contex basic identifiers such as initials, address, age and sex ma also be adopted.

Apart from the indexes, files may require a system o unique record identification. Where such a system currently in use, as for example in the Rates Office, tha system may almost certainly be retained if desired. I addition, all property and personal files may be accesse entirely through names and addresses.

For example, the Mortgage office may use a numerica coding system for its accounts. Then each account may b accessed directly by use of the account number, an normally will be for routine batch processes such as postin receipts. Alternatively, in the context of an enquiry, th account could be accessed either by the mortgagor's nam or by the property address since the general property an personal files will cross-refer to each other. Hence it will b seen that the use of the files within the system will n longer be completely dependent on coding methods.

3.4 STANDARDISATION

All files will be designed to a standard pattern, and each fil will incorporate a description of itself. This will help t make it possible to write standard programs to accomplis basic tasks such as record retrieval, updating and analysis o any file. These are functions which are likely to be initiate through data terminals. All files will therefore be open t such functions, (subject to the requirements fo information privacy described below in C5) except tha Indexes and Historical files will only be amended an extended as an automatic by-product of movements o other files. Ideally all files will be 'on-line' to the compute system, and thus directly accessible at any time, but th cost of mass data storage may necessitate some constraints Certain files, for which constant availability cannot b justified, may be stored on media such as magnetic tape fo use when required.

4. The Principal Opportunities of the System

The scope of the opportunities provided by telecommunications and mass storage may now be summarised as follows:

(a) By increasing the quantity of information held within the computer system, and by making the majority of this information immediately accessible, the user can employ the computer to operate a larger central filing system. This sets out to meet the need outlined in *Section B.*

(b) In so doing, none of the facilities required for batch processing will be impaired in any way. Opportunities will arise however for cross-referencing between files, and for capturing data and presenting results piecemeal on demand, which must have a profound influence on systems design. The trend will therefore be away from batch processing towards 'demand processing' and the degree of integration of procedures will be greatly increased.

(c) The old problem of communication between man and machine will be taken a significant step nearer to its solution. The user can make his own contact with his own files, and to the permitted extent with other people's, and has thus far better control over the files and can place greater reliance upon them. The computer thus becomes, through the terminal, a part of the office equipment and its constant availability will make its use a vital part of office routine.

5. Constraints upon the System

At the same time, the very power of the system calls for certain essential safeguards. Information about staff and private individuals will be stored in the computer Data Bank and will thus be potentially available for use and mis-use by a wider range of officers than at present. In order to exploit any of the beneficial possibilities of such an arrangement, the accompanying risks must be carefully examined and isolated. These risks can be classified as follows:-

(a) If data input to the system is erroneous it can have a wider circulation and do more damage than within a manual system.

(b) Information which is in some degree confidential (such as the state of a personal account, the nature of certain contacts with social service departments, and possibly some items of medical history) could be acquired either accidentally or deliberately by a Council officer to whose work it is not relevant.

(c) Information about individuals could be imparted to other organisations without the consent of the individuals concerned.

At the present time interest in the privacy aspect of data banks is growing, and no organisation responsible for designing or controlling a data bank can afford to ignore these risks. Item (a) is undeniable, but can be minimised by improved methods of data capturing and vetting. In particular, if sensitive data is entered in the data bank via a terminal, the officer making the submission will have the opportunity to check that the data has been set up correctly before releasing it to the system.

Item (b) is customarily handled by allocating priority levels to data (either to files, individual records, or individual items within records), and by allocating passwords to authorised users.

A security system is established whereby each file becomes the reponsibility of one or more offices (or nominated officers) and permission to use part or all of the information it contains may be granted by them to other offices (or officers). In addition, permission may be extended to cover the alteration of information. All such permission is notified to the computer, which is programmed to restrict access to the data bank according to the rules. The program is informed of the source of each on-line enquiry (i.e. from which terminal the message has been received). In addition, individual users may identify themselves by means of passwords. The user may change his password when he thinks fit, and can be told at what time and on what terminal the password was last used. Such methods are in extensive use in the U.S.A.

It should also be borne in mind that a computer system of this kind can be programmed to monitor all terminal transactions. Periodic reports are in any event essential in order to review the level of traffic before any modification or extension of the network. They may also, however, make a useful contribution towards system security and audit. These and other technical and managerial means of restricting access constitute a formidable list of security measures.

Item (c) has some wider implications. The pamphlet 'Computers and Freedom' recently published by the Conservative Research Department (one of the contributors being the M.P. for Hornsey) is fairly representative of much current thought regarding these potential dangers, and makes several useful proposals for improving and regularising the rights of the individual in this context. It is interesting to note that the authors consider that the methods of dealing with (b) above, as outlined are likely to be successful. Councils will no doubt wish to consider these proposals, particularly those relating to (c) above, even if there are no immediate plans to bring them on to the Statute Book.

6. Realisation of the Computer Systems

It will be appreciated that the creation of a data bank on the lines suggested will take several years to accomplish. For this reason alone it is necessary to give some thought to the question of priorities between the various files of information and the data processing activities which depend on them. Additional considerations, such as the basic justification for purchasing the equipment, and the apportioning of costs between boroughs and within boroughs have led to the formulation of a proposal to implement the full system in two stages. These stages may be called the 'Nucleus' and the 'Extensions'.

The Nucleus comprises a group of basic computer applications selected with the following considerations in mind:-

(a) Establishment of a basic work-load for the system

which will produce measurable benefits and thus justify the initial capital outlay.

(b) Identification of a group of data processing activities whose cost can in general be charged to the basic administration of the Council (especially financial administration), in that they benefit all or the majority of Council services—hence the implementation of the full Nucleus will have an impact on all departments.

(c) The need to reduce overall costs by replacing the LEO III facilities.

(d) The choice of applications which can most readily be implemented in the new environment, i.e. those where the basic disciplines are most understood and where for this reason initial difficulties can be handled more readily. Generally this (coupled with item (c)) tends to mean that existing financial applications form a substantial proportion of the Nucleus.

The Extensions, by implication therefore, are computer applications having relevance to, and therefore requiring to be financed by, individual departments or groups of departments.

7. The Nucleus

It is proposed that the Nucleus shall involve the setting up of the following files:

General property file, and street index.

Ratepayers', mortgagors', tenants' and other debtors' accounts.

Income assessment.

General personal file, to the extent implied by the above items, with name index.

Staff, teachers and pensioners, with name index.

Established posts.

Suppliers, contracts, orders, regular payments and creditors' accounts.

Stores, vehicles and plant.

Works requisitions and job progressing records.

Expenditure and budgetary control records.

Highways and council property—physical descriptions and maintenance histories.

Index of business organisations.

Further details of these files will be found at Appendix 5; their total size is likely to be of the order of 100 million bytes. They will be available for enquiries and routine information distribution as described above, and will also provide the basis for data processing applications in the following areas:

Rates, mortgages, rents and all credit income accounting.

Income assessment.

Payroll.

Personnel and establishment work for officers and employees but not teachers.

Payment of creditors, progressing of orders and checking of invoices.

Stores accounting and control.

Transport accounting and control.

Job progressing and costing, bonus calculations.

Full accounting related to objectives and achievements.

The Data Bank required for the Nucleus includes almost all of the internal records which are most necessary for managerial control. Although there may appear to be little that is new about the choice of these early applications for data processing, it will be seen later that the new equipment permits each work area to be considered in the wider context of a general information system. There is complete coverage of the properties in the borough, and the organisation of the property records achieves a considerable degree of integration. Consequently the scope of each task has been widened and the detailed working has many radically new features. These are described in some detail in *Appendix 3.*

8. The Extensions

The following applications should be given consideration

Development of the general personal file, by way of electoral registration, and the production of lists appointment schedules, etc. for infants, schoolchildren students, housing applicants and social service cases.

Information service for town planning and control functions, based on a file of parcel or site records with cross-references to property records, the register of local land charges, files of planning decisions and other data relevant to property enquiries, and facilities to append data from surveys and other sources.

Personnel records for teachers.

Further financial tasks—control of loans pool and internal funds, long-term budgeting.

Notes on these extensions are given in *Appendix 4* but it is emphasised that in these matters it will be necessary for individual justification of the projects to be presented for approval. It is therefore possible that as development occurs and other applications become technically possible, these, if they are attractive administratively, socially and financially, may compete for early implementation. The list above is therefore not exhaustive and is subject to variation in this way. The matter is discussed further in *Section F.*

9. Siting of Terminals

No outline of the systems for the Nucleus would be complete without a summary of the uses of terminals and some assessment of their probable siting. At this stage, however, it is important to treat any proposals in this direction as provisional. In the first place, until systems have been discussed and agreed with users, the precise functions of terminals cannot be finalised. In the second place, where terminals will give access to information not previously available, it is just not possible to estimate the extent to which they will be utilised. Third, each

department will need to consider how many terminals might be required, and of what kind they should be.

The preliminary recommendations shown at Figure 4 below must be particularly tentative in view of the projected re-organisation of departmental administration at Haringey, and the re-location of some staff which will be entailed. Since no firm plans for these changes have been published, the siting proposals relate to present departments in their present places.

Common administrative functions likely to entail terminal usage will be:-

(a) Staff record keeping

(b) Ordering

(c) Internal works requisitions progressing

(d) Accounting and budgetary control

The most important special uses will be:-

(e) Administration of computer files (e.g. setting up new records, and maintenance of the system).

(f) Control of personal accounts: interrogation, calculations and transactions.

(g) Job control and stock control.

10. Conclusion

The computer applications proposed in the above in no way represent the sum total of the opportunities for applying a computer to routine tasks within a London Borough. There has, for instance, not been sufficient time to investigate the potential of the computer in engineering or architectural design, or the application of critical path techniques to the planning stages of several concurrent capital projects. Nor have the problems of library book cataloguing and charging been studied in any detail. There can be little doubt that further possibilities and extensions will emerge in the course of discussions with the officers who will be concerned with each work area. It is hoped, however, that enough examples have been given to demonstrate the immense power and versatility of the computer system being put forward.

(FIGURE 4)

A. Possible sites for terminals:

Department	Section	Terminals	Additional access for
Town Clerk	Admin.	1	
	Establishment	1	
B. Treasurer	Rates	2	
	Income	1	
	Admin. (payroll)	1	
	Costing	1	
	Accounting	1	
	Audit	1	
	General enquiry office	1	
	Cashiers	3	
	Data Preparation	1	
B. Engineer	BE Admin.	1	
	Building Works Admin.	1	
	Planning and control	1	
	Depots - Highgate	1	
	Hornsey	1	
	Clyde Road	2	
B. Architect	Minor Works	1	Town Planning
Education	Finance	1	
	Sites and buildings	1	
Housing	Repairs and maintenance	1	Cemeteries
	Letting	1)	Welfare
	Accounts	1)	Parks
			Baths
Health	Accounts	1)	Catering
	Environmental health admin.	1)	Entertainments
	Child health	1)	
Cleansing & Transport	Admin.	1	
Children's	Admin.	1	
Libraries	Headquarters	1	

B. Line requirements:

Location	Lines	Terminals
Civic Centre	1	3
Station Road	2	8
Hornsey T.H.	2	5
Tottenham T.H. (incl. Clyde Road)	2	8
Trinity Road (Establishment)	1	1
Somerset Road (Education)	1	2
Park Road (Cleansing)	1	1
Philip Lane (Children's)	1	1
Fryatt Road (Housing R & M)	1	1
Bruce Castle (Libraries)	1	1
Highgate Depot	1	1
Hornsey Depot	1	1
Totals	15	33

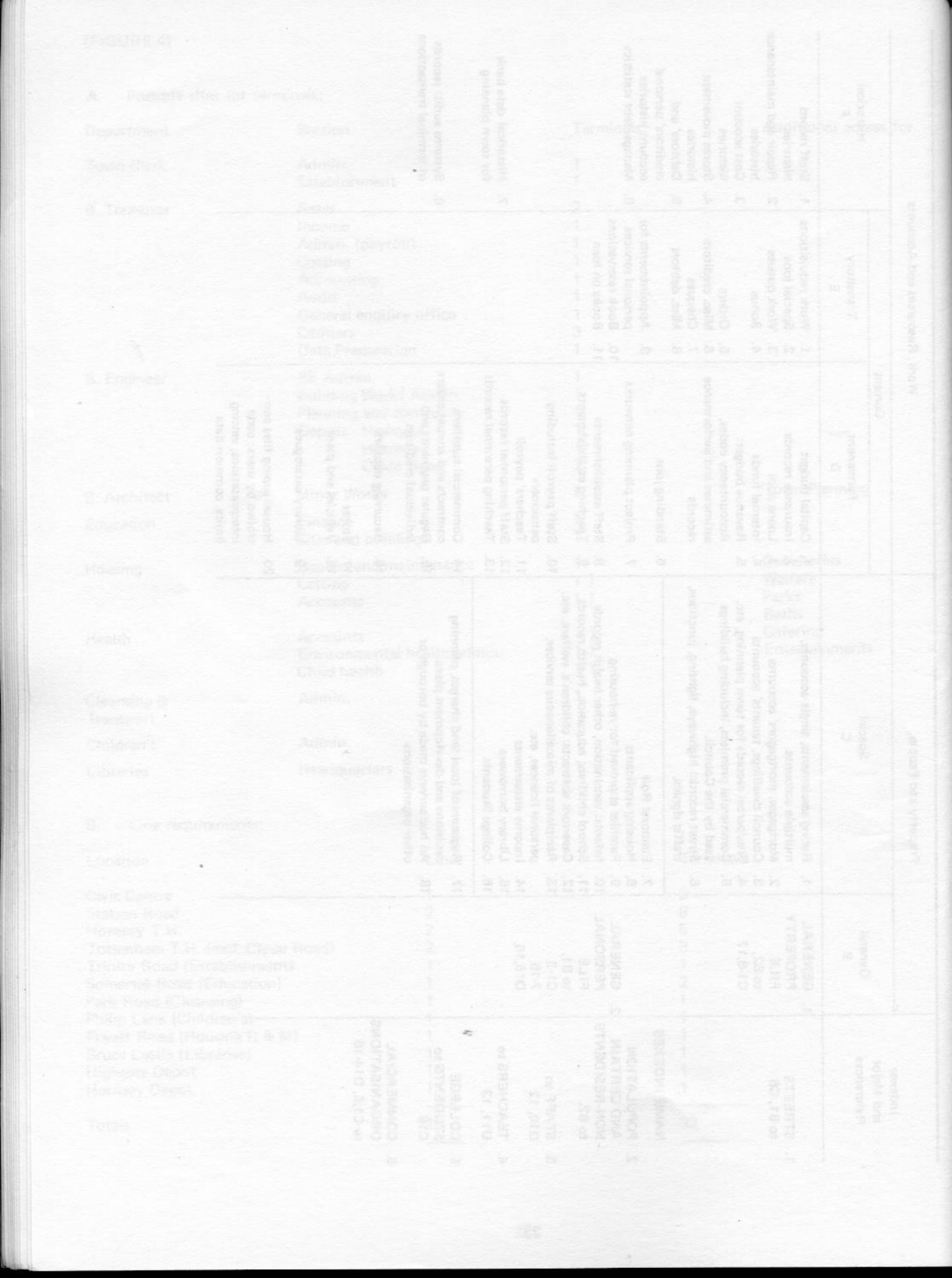
(FIGURE 5) LONDON BOROUGH OF HARINGEY—COMPUTER DATA BANK

Indexes and Major References	Property and People		Work, Resources and Accounts		
			Current		Historical
	General B	Special C	Permanent D	Transitory E	F
1. STREETS to B1, C6	1. GENERAL PROPERTY FILE to B2, C1-6,17	1. Rating assessments, single accounts, multiple accounts. 2. Mortgages, mortgagors' accounts 3. Council dwellings, tenants' accounts 4. Site/parcel records for town planning, etc. 5. Commercial premises, including buildings used by the Council. 6. Street records: highways, lighting, junctions, traffic signals.	1. Capital budget 2. Insurance records 3. Loans pool 4. Internal funds 5. Revenue budget: Accountancy codes, estimates and performance records	1. Work requisitions 2. Special jobs 3. Work queues 4. Bonus	1. Staff record histories 2. Repair and maintenance histories 3. Cost account histories 4. Stores movement histories 5. Debtors' and creditors' personal account histories 6. Management statistics
NAME INDEXES		7. Electoral Roll 8. Housing applicants	6. Standing jobs	5. Orders 6. Misc. creditors 7. Cheques 8. Misc. debtors	
2. POPULATION AND CERTAIN NON-RESIDENTS to B2.	2. GENERAL PERSONAL FILE to B1, C1-3 7-15 D15,16	9. Families approved for re-housing 10. Infants: vaccination, other health records 11. School children: education, health records 12. Casework abstracts: children's, welfare, etc. 13. Recipients of miscellaneous services, personal licences, etc. 14. Income assessments 15. Library borrowers 16. College Students	7. Project planning networks 8. Staff establishments 9. Teaching establishments 10. Staff payroll including pensioners 11. Teachers' payroll 12. Staff personnel records 13. Teaching personnel records	9. Appointments for personal services 10. Book reservations 11. Books on loan	
3. STAFF to D10, 12					7. Historical data bank for town planning
4. TEACHERS to D11, 13					
5. COLLEGE STUDENTS to C16		17. Registers of local land charges, planning decisions and development plans. 18. Ad hoc surveys made by borough or other organisations	14. Commercial suppliers, contracts and annual orders 15. Regular payments and individual creditors		8. Systems audit: records of terminal transactions
6. COMMERCIAL ORGANISATIONS to C1,5, D14-16			16. Recurring debtors 17. Stores 18. Vehicles and plant 19. Library catalogues 20. Housekeeping files controlled by users: code interpretations, vetting limits, common data.		

D

Benefits of the Proposed System

1. GENERAL BENEFITS
2. ADVANTAGES AT THE POLICY-MAKING LEVEL
   1. The Relevance of the Computer System
   2. A Specimen Case
   3. Conclusion
3. ADVANTAGES AT THE MANAGERIAL LEVEL
4. ECONOMIES AT THE OPERATIONAL LEVEL
5. EVALUATION OF ECONOMIES



D. BENEFITS OF THE PROPOSED SYSTEM

1. General Benefits

The possible benefits to be derived from the London Government amalgamations of 1965 stem mainly from the theoretical economies in administration possible with larger units of organisation. To achieve these benefits it is essential that there should be an effective policy for the co-ordination of the Council's resources, particularly of information; without the possession and intelligent use of the most up-to-date information there is no basis for efficient management and proper policy decisions.

The most important conclusion to be drawn from the study conducted at Haringey is that the prime requirements of the co-ordination of the Council's resources of information and the provision of adequate internal communications have not as yet been achieved. Only the creation of a policy which will provide these gives hope of improving the level of effectiveness and efficiency throughout the authority. The computer system put forward in this report is an instrument which can make such a policy effective, and the validity of the present proposals must be judged in that context.

The purpose of this section of the report is to outline the long-term advantages of adopting the proposals, and also to indicate how far, even in the short-term, such a course may be expected to pay its way. It is a measure of the versatility of the electronic computer that while setting out to fulfil long-term objectives in the essentially unquantifiable realm of 'management information', it can be employed to accomplish so much work at an operational level that substantial economies in expenditure and improvements in service could be made available at a very early stage. In setting out below the advantages and benefits, the full implications of the systems proposed are taken into account, both the Nucleus and the Extensions. The benefits to be expected from the Extensions may well be the more important eventually, though at this stage their full potential is impossible to estimate. The main benefits to be expected are:-

(a) CENTRALISED RECORD SYSTEM

An improvement in efficiency arising from the availability of central files of information on property, people and internal transactions, which are maintained for the benefit of all departments. Each department will contribute to these files in order to take advantage for itself of the data handling and processing facilities of the computer system, and, subject to security restrictions, will benefit by gaining access without additional effort to information supplied by other departments. These centralised records will accordingly have the advantages of accuracy, currency and consistency, and of maximum circulation and availability.

(b) PUBLIC RELATIONS

Better co-operation and communication between departments and hence a better service to the public. This will be true not only in areas where co-operation is clearly vital, such as the planning and execution of redevelopment schemes, but also in areas where services are regarded as independent, and where the only common ground is an interest in the same people or properties. For example, if a Haringey resident gives non-confidential information to one department, he should be able to rely on other departments being supplied with any part of that information which is relevant to their own services and responsibilities. This will additionally serve to protect the Council against mistakes and even dishonesty on the part of the public, and enable it the better to discharge its controlling and regulating functions.

(c) PRODUCTIVITY

Economies based on increased productivity. Such economies may take the form either of more work being done for the same cost, or of the same work being done at reduced cost, or a combination of the two. Stabilisation of staff establishments in the face of increased work is a noticeable and characteristic result of many computer applications at the present time.

Economies are discussed more fully in D.4 below.

(d) PLANNING

Access to more of the information relevant to planning and strategic functions, together with the means of manipulating it by analysis. The making of one better decision or the avoidance of one serious error, as a result of a better information service, may produce profound benefits. The risks attached to long-term planning could well be substantially reduced. It should not be overlooked that some of the information likely to become available could possibly prove an embarrassment to the Council, in that further potential demands on services might be revealed. Even if such demands could not currently be met, however, foreknowledge of them could enable appropriate steps to be taken at an early date. An example of the use of the computer system for strategic planning is given at D.2 below.

(e) MANAGERIAL CONTROL

Senior officers will be provided with regular information about their services and expenditure as a direct by-product of operational tasks allocated to the computer. They will thus have the opportunity to improve their control over the activities and resources for which they are responsible. In addition to the value of the computer as an executive tool, its introduction invariably brings benefits in the form of standardisation of methods and measurability of performance.

Furthermore, there will be more comprehensive and up-to-date information available about the environment in which services are being given, so that senior officers can judge better whether the priorities of their objectives are correct, and direct the efforts of their staff towards tasks requiring most urgent attention.

The use of the computer for managerial control is further discussed at D.3 below.

(f) STAFFING

An enhancement of the Council's capacity to recruit and retain staff of good quality. Local government's present employment difficulties are based to a considerable extent on the popular image of offices in which old-fashioned methods are used. The long-term computer project should

do much to dispel this image, and to serve as a positive attraction to staff.

2. Advantages at the Policy-Making Level

2.1. THE RELEVANCE OF THE COMPUTER SYSTEM

Most problems of policy are likely to be specially related to the characteristics of a particular case. It is not possible, therefore, to claim that the computer system will necessarily yield immediate and helpful results in every instance. Nevertheless, the basic facilities offered by the system, viz. the assembly of relevant facts and the provision of means of analysing and using them, will provide assistance where the data stored in the computer holds the essential ingredients for a solution or a partial solution.

Basically, policy-making assistance falls into two main classes:

(a) The production of data which contributes to the important factual background of the considerations.

(b) Extrapolations of the effect of taking different decisions.

Since the construction of a comprehensive data bank must be developed gradually, the assistance provided to policy-making can be expected to expand over a period of time.

2.2 A SPECIMEN CASE

(i) The following example illustrates the kind of aids to decisions which will become available. Let it be supposed that the Council are concerned with a site and properties which have been represented as unfit by the M.O.H. The site is one of appreciable area and there are alternative uses to which it might be put and these involve different timescales for redevelopment. If necessary, an addition to the site could be purchased by agreement. It appears that if developed for housing there might be considerations of school needs, transport and shopping facilities, whilst development for business or commercial purposes might give rise to a need for a road improvement scheme.

(ii) There will be a considerable amount of basic data contributing to the factual background which can be produced to assist in such a case and this will include:-

(a) An analysis of the property in the area showing sizes and rateable values.

(b) A list of occupiers.

(c) A list of known owners.

(d) Details of businesses carried on and other land uses.

(e) Details of all Council interests in the area, e.g. council dwellings and properties mortgaged to the Council.

(f) Details of households for which information is held for any Council purpose.

(g) Details of any planning decisions, building permissions and improvement grants made recently affecting the area.

(h) A synopsis of any pertinent questionnaires or surveys recorded in the historical data bank for to planning, relating, for example, to employment, traffic leisure activities.

Additionally, routine information provided management purposes about the volume and level of wo carried out by the Council would assist policy-makers deciding to what extent the work involved was within t capacity of the Council's resources.

(iii) Matters of policy involved in the above situatio might be said to include the following:-

(a) Whether to redevelop for housing purposes or f commercial purposes. To assist with the answer to such problem the computer system might be expected t facilitate a cost analysis of the projects. This would involv for example, the costs of acquisition, re-housing, si clearance and, assuming the existence of suitable yardstick of constructing buildings and associated facilities. addition, the computer might be used to assess the impa of each project in a wider context, e.g. on the Council services as a whole, and to provide analyses of comparab areas which might have been developed in a similar manne to either of the alternatives.

(b) Whether to acquire the additional area which coul be purchased. Here the computer system could be expecte to cope readily with the problem of producing an amendments to calculations made in respect of th principal area to ascertain the effect of adding the extr part.

2.3 CONCLUSION

Necessarily in a report such as this an example must b expressed in general terms, but when it is borne in min that in matters such as the foregoing the computer take virtually no regard for the sheer volume of calculation or o the number of individual records which may be involved then it may be apparent just how powerful is the assistanc which it can give. Indeed the limitations to the assistance li more in the ability of the users to provide the right dat and to think out their requirements than in the capacity o the machine.

3. Advantages at the Managerial Level

An on-line computer system such as that proposed in thi report can no longer be considered as extraneous to th organisation but becomes, in effect, a vital part of th whole—it constitutes the basic central filing system, i performs the majority of routine clerical procedures, it i the means by which data is captured, and information an results distributed. Because so much of the work an records of the local authority is reflected in such computer system this presents an unparalleled opportunit for monitoring the whole organisation. Furthermore, thi monitoring process can be a natural by-product of th directly productive tasks and not a task in its own righ requiring additional clerical resources. The implications fo management are far-reaching. It becomes possible fo "management by exception" reporting techniques t become more than just an aspiration and for effectiv control to become a reality. The problems of scale, o geographical separation and of remoteness from the scen

of the detailed activities, which are necessarily a feature of any large organisation, will be greatly diminished by the improved facilities for the flow of information and better communications.

The availability of records of operational tasks (planned, in progress and completed) should engender increased confidence based on a detailed knowledge of workloads, of performance and available resources. Thus in the case of the system proposed for progressing jobs assigned to works departments, it should be possible for the officer in charge to examine at any time the list of items waiting to be executed by any particular works section. Additionally the department requiring the execution of a job would be able to examine the same list to discover whether it had yet been commenced.

It is of course possible to obtain the same information at the present time but only as a result of a series of enquiries, written or by telephone, involving appreciable time and perhaps a number of people. To obtain fully current information by manual methods is scarcely possible since, while the information is being collected, the situation is constantly changing by new requisitions, commencements and completions. Since the origin of all communications with the computer can be identified, in all cases to a specific departmental section and in some cases to individuals (where personal passwords are employed), very detailed measurements of workloads will be possible.

The continued analysis of performance should lead to a refinement in the various measures and yardsticks used in making comparisons and widen the areas in which measures can be produced and then applied; thus continual pressure can be exerted to improve standards and increase productivity.

4. Economies at the Operational Level

Economies are expected because the following tasks will be eliminated or greatly reduced.

(a) ABORTIVE WORK

Because of improved circulation of information, less time will be spent in carrying out independent enquiries and investigations in each department, and in carrying out fruitless procedures based on out-of-date information. Inquiries to another department, for example, can be limited to those cases of which that department is *known* to have records.

(b) RECORD-KEEPING

Because of the increased scope and instant availability of computer-based information to departments, there should be far less need to supplement computer files with manual records of staff, expenditure, etc. Similarly, duplication in record-keeping by two or more departments can normally be eliminated.

(c) FILE MANAGEMENT

It will be possible to simplify some filing systems by using the computer to maintain indexes and cross-references and to produce specific information where necessary. Hence present time-consuming devices for grouping, copying and re-arranging sets of records can in many cases be abolished.

(d) ROUTINE SEARCHES AND COMMUNICATIONS

The capacity of the computer to produce details of people fulfilling certain criteria, and to print their names and addresses on standard documents will greatly reduce the amount of clerical work in those departments which deal with personal records and the need to circulate information to other departments and to the public.

(e) PEAKS OF WORK

In many cases peaks of work may be reduced, e.g. annual peaks in connection with the academic year, annual estimates and final balancing, and weekly peaks in connection with present computer batch processing operations.

(f) MANUAL ANALYSIS OF INFORMATION

Work carried out at present in totalling or analysing items on records can in future be done by the computer.

(g) DUPLICATION OF COMPUTER FUNCTIONS

Work which duplicates a computer function (e.g. manual cheque production, manual re-calculation in rates and payroll), necessary now because of the inflexible timing of the present computer system will tend to disappear as the computer becomes permanently accessible for such tasks.

5. Evaluation of Economies

There are many areas of local government activity in which present performance is limited by cost rather than by demand. In such areas as different as welfare services and building maintenance, increased productivity is to be sought primarily in order to get more work done—unless of course political pressures dictate a reduction in expenditure at all costs. In other areas, however, principally concerned with administrative and financial support, there is no case for achieving a larger end-product, rather than a better or a cheaper one. In these areas there is in fact an incentive either to release staff for more directly productive work or to effect straightforward cuts in expenditure.

Economies can of course only be made by agreement of the details with the departments concerned. At the present time detailed proposals regarding computer systems have not been discussed. Certain outline proposals have however been considered in relation to the Borough Treasurer's department, and it has been agreed that a net saving of £50,000 is likely to result from the Nucleus alone.

Staff savings generally will be looked for principally in all those departments and sections responsible for accounts, wages, supplies and personal record-keeping. The more significant of these are listed below:

Department	Sections affected by:	
	Nucleus	Extensions
Town Clerk's	Establishment	Land charges Electoral registration
Children's		Admin. (statistics and lists)
Education	Income assessment Sites and buildings Admin. (payroll, accounts)	Staffing School meals College staff Welfare
Engineer's	Admin. (BE & BW: ordering, payroll, accounts, job progressing)	Project control
Health	Accounts, wages & supplies	Infectious diseases Clinics Child health (record-keeping, appointments) All producing statistics
Housing	Admin. (rent accounting) Rent rebates	Waiting list
Treasurer's	Admin. (payroll)	Admin. (teachers' assessments, superannuation)
	Income (throughout) Costing Accountancy (payments, estimates) Audit	Accountancy (loans, budgeting)
Welfare		Admin. (statistics and lists)

E

Computer Facilities and Other Equipment Required

1. BRIEF SUMMARY OF REQUIREMENTS
2. GENERAL REQUIREMENTS–HARDWARE AND SOFTWARE
    1. Telecommunications
    2. Mass Storage
    3. Information Channels into and out of the Computer
    4. The Ability to 'Multiprogram'
    5. Internal Store Size
    6. Software Requirements
    7. Speed of Operation
    8. Precautions against System Breakdown
3. CRITICAL FACTORS IN SELECTING THE MANUFACTURER
4. PROPOSALS FOR BENCHMARK TESTS OF PERFORMANCE AND RELIABILITY
    1. General Description
    2. Points to be Tested

E. COMPUTER FACILITIES AND OTHER EQUIPMENT REQUIRED

1. Brief Summary of Requirements

A series of technical reports produced in connection with this study has considered various technical problems in detail. The purpose of this section is to deal generally with the hardware and software requirements for an on-line information system; necessarily its content must represent a compromise between a highly detailed technical exposition and a treatment so over-simplified as to present a distorted account of the crucial technical factors involved. Where it is possible to explain the terminology, this is done on the first occasion each term is used, but thereafter considerations of brevity require that the shorter technical expression is used wherever appropriate. For those desirous of a more technical treatment than that which follows, Technical Report 6 is a more appropriate replacement; for those not wishing to pursue even the technical sections below, the basic requirements can however be summarised briefly as:

(a) Devices to store very large files, the contents of which must be quickly available if remote enquiries are to be serviced within acceptable time scales. As an example of the storage capacity required, to obtain any one rating account implies storing about 50,000 accounts—some 18 million characters of information in all.

(b) The facility for linking a computer to a telecommunications network and the provision of terminal devices suitable for input or reception of data rather than speech.

(c) A central computer unit fast enough to allow its normal work to be interrupted by these incoming calls, to service them without undue delay and then to be able to continue from where it has been interrupted.

(d) Highly specialised stored programs (software) to organise the internal functions of the computer in such a way that:

the interruptions referred to in (c) can be accommodated.

during the intervals between calls the computer is still effectively utilised.

incoming messages are assembled and identified.

internal queues are formed of messages awaiting processing and replies awaiting transmission.

replies are transmitted to the appropriate points in the correct format for the type of terminal concerned.

(e) A large main memory to accommodate the specialised organisational software in addition to the programs needed to service on-line enquiries, the programs needed to carry out background batch processing tasks, and the basic operating system.

(f) All the more usual requirements for magnetic tape devices, high speed printers, etc. which are still relevant for those batch processing tasks that remain, e.g. printing rate demands, pay slips, and cheques.

(g) Reliability of equipment; organisation of equipment in such a way that even if some parts are unusable at any particular time, it can continue to give a service.

The critical factors in selecting equipment are summarised in E.3 below; the major features are discussed in more technical terms in E.2.

A brief review of the equipment offered by six manufacturers is given at Appendix 6.

2. General Requirements—Hardware and Software

2.1 TELECOMMUNICATIONS

Three different aspects need consideration in relation to the telecommunications network. These are: first, the remote terminal units themselves; second, the communication lines needed to connect these to the computer centre; and third, the equipment and facilities needed to connect the lines to the computer itself.

Terminals are of two principal types—the 'teletypewriter' form of terminal which is basically, as the name implies, a typewriter capable of attachment to a communication line, and the 'video' terminal which comprises a keyboard, a local store and a screen like a television screen which is used to display information to the operator.

These two types of unit may best be compared in considering the way in which they are used.

With a teletypewriter, the operator types input messages on the keyboard. These are transmitted to the computer, character by character as they are typed, and simultaneously printed on the paper as with a normal typewriter. Output messages from the computer are also transmitted character by character and typed as they are received (the keyboard being locked while this takes place).

Two fundamental disadvantages are inherent in this type of operation. First, all transmission is at typing speed, thereby causing the line to be occupied for a comparatively long time. The operator has also to wait while the reply is typed out. Second, if the operator makes a mistake in an input message, the error will be transmitted to the computer. Corrective action may involve retransmission of the entire message.

The video terminals are operated in a fundamentally different way. As the operator types out an input message, it is accumulated in the local store and also appears on the screen. The operator can at any time go back and correct errors by overwriting; only when he is satisfied that the message is complete and correct does he press a special key which causes a fast 'burst' transmission of the entire message. Output messages from the computer are also transmitted by this 'burst' method to the local store, and appear virtually instantaneously on the screen.

This type of terminal overcomes the disadvantages of the teletypewriter, in that line occupation is brief and errors can be corrected before transmission. It may introduce another disadvantage, in that no record of transactions is available, but this can be overcome by attaching a printer or typewriter to provide a 'hard copy'.

Video terminals are more expensive than teletypewriter

terminals and utilisation must therefore be higher to justify them. It is probable that the system will have to support both types of terminal.

Lines to connect the terminals to the computer centre are provided by the G.P.O., who have a virtual monopoly in this field. Lines may be either 'public' or 'leased'. Public lines use the normal telephone or telex exchanges and dialling is necessary to establish calls. This is a particular disadvantage in the case of computer-initiated output messages, since automatic dialling by computer is not currently allowed by the G.P.O. Leased lines, however, are for the exclusive use of the lessee, do not use the publi exchange switching,and do not require dialling. Public line have comparatively low rents but carry a call charge base on the time lines are actually in use, whereas leased line have a higher rent dependent on distance involved but carr no call charges. It is, in some cases, possible to lease a lin for part of the day only at a lower rent.

Line facilities are available to operate at variou transmission speeds. The facilities are briefly summarised i Figure 6.

(FIGURE 6) G.P.O. LINE FACILITIES

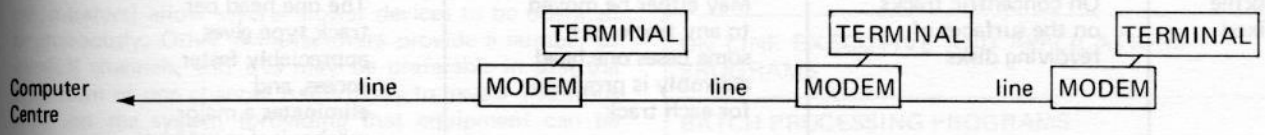
Service	Type of line utilised	Maximum Speed of transmission		Terminal equipment
		Bauds	Characters per second (approx.)	
Datel 100	Telegraph circuits— either telex or leased	110	10	Teletypewriters with or without paper tape
Datel 200	Telephone circuits— either public or leased	200	20	Teletypewriters with or without paper tape
Datel 600	Telephone circuits— either public or leased	600 or up to 1,200 on leased lines	60 or 120	Video terminals, paper tape, magnetic tape
Datel 2400	Leased telephone lines	2,400	240	Video terminals, paper tape, magnetic tape
Datel 4800	Leased telephone lines (under development)	4,800	480	Under development— possibly line printers and magnetic tape
High Speed Links	Special 'wide— band' lines (where available)	48,000	—	Satellite computers

Telephone lines (but not telegraph lines) require devices known as 'modems' at each end of the line, to convert the digital signals to a form which can be handled by a line originally designed for voice transmission.

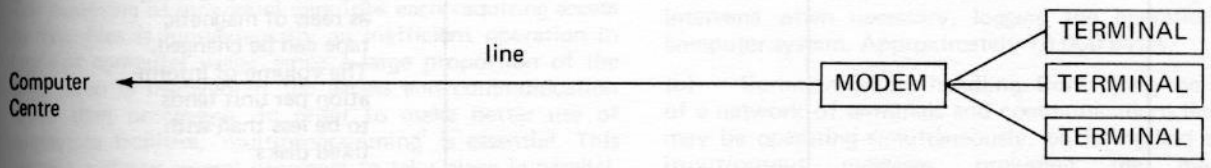
It is possible to operate several terminals on one line, subject to the restriction that only one message from one terminal can be transmitted at once. This may cause delays with highly used teletypewriters, but with video terminals, where message transmission time is a small proportion of terminal utilisation time, this may not be so significant and the system is more useful.

Two methods are available:-

(a) 'Multidrop'—where terminals are 'dropped' at intervals along one line. This facility is only available from the G.P.O. if the geographical arrangements are suitable.



(b) 'Fanout'—where several terminals in one building share a common line.



This facility will usually require some control hardware in addition to the modem.

A further point connected with lines concerns the direction of message transmission. There are three ways in which lines may be used.

(i) Duplex—simultaneous two way transmission.

(ii) Half-Duplex—transmission in both directions but not simultaneously.

(iii) Simplex—one way transmission only.

The choice of facilities used affects the control equipment at both ends of the line, and in some cases involves a special '4-wire' line for duplex working. For terminal operation half duplex is the normal mode, since operation is essentially 'conversational'—two-way simultaneous working is not required. However, if full duplex control equipment is used even if the operational needs are only for half-duplex operation the time taken to reverse direction of transmission is much reduced. This is especially significant if 'polling' is in use (see below).

The third aspect of telecommunications to be considered is that of connecting the lines to the computer itself. Since it is not usually practicable to give each line an independent path into the computer, a device has to be provided to concentrate messages and by interleaving techniques route them along a single high speed path into the computer store. This device must be capable of handling all the different types of line used in the system. Software will be required in the computer itself to deal with the messages and pass each one to the user program as a self-contained entity.

There may be a further requirement for 'polling'. If it is not possible for all terminals to operate simultaneously (either because of the line-sharing mentioned above, or because of a limit imposed by maximum throughput rate of the concentrator) a system is required to control the access of terminals. This will not be described in detail here, but is usually carried out by software which sends signals to all terminals in turn, asking in effect if they wish to transmit a message. This process goes on until the system (or any one line) is loaded to capacity when polling on the whole system (or on that one line) ceases temporarily.

Some concentrators have stored program facilities, and this enables some of the software associated with communications handling to be located in the concentrator rather than in the computer store. This is obviously a desirable feature, but necessarily adds to the cost.

2.2 MASS STORAGE

This is of fundamental importance. To implement an information system of the scope envisaged will eventually call for storage capacity of several hundred million characters per authority. In order to give a reasonable service on a high percentage of enquiries the greater part of this information must be on-line at one time. The access time must be reasonable (preferably less than one-tenth of a second) and sufficient information paths between this store and the processor must be provided to ensure that serious 'bottlenecks' are not present.

Mass stores are of several types. Ideally such a store should not involve any mechanical operation to record or retrieve information. Examples of this type of store are the core store, thin film store and plated wire store used as main internal stores in computers. However, this type of storage is very expensive, and provision of it in the quantity required is not yet a feasible proposition.

Because of this, various types of 'direct access store' involving some mechanical movement have been developed. These all use the principle of magnetic recording, and usually have a number of magnetic read/record head assemblies. To access information, it is necessary to move mechanically a head assembly to the information, or the information to a head assembly, or more often a combination of the two, and then transfer the information to the computer. The mechanical operation is the principal factor in determining the access time.

Various types of device have been produced, and main characteristics are summarised in Figure 7.

(FIGURE 7) CHARACTERISTICS OF DIRECT ACCESS STORES

Type of Store	Method of holding information	Read/Record head movement	Remarks
Diskfile (Fixed	On concentric tracks on the surfaces of revolving disks	May either be moved to any track, or in some cases one head assembly is provided for each track	The one head per track type gives appreciably faster access, and eliminates a major mechanical movement
Diskfile (replaceable)	as with fixed	Head assemblies are moved to the required track	The disk stacks are removeable and replaceable with others, as reels of magnetic tape can be changed. The volume of information per unit tends to be less than with fixed disks
Drum	On parallel tracks round the surface of a revolving drum	May either be moved to any track or (more usually) there may be one assembly for each track	Access times tend to be rather faster than with disks but capacities are often lower
Magnetic cards	On parallel tracks on magnetic cards which are extracted from a holder and wrapped round a drum for reading and recording	Once the card is selected the equipment behaves essentially as a drum through normally a moving head is used	Cards are held in magazines which are replaceable as with disk stacks. The volume of information which may be held is high but access is generally slower than with the other equipment mentioned

If replaceable devices are in use, it may be possible to have less on-line storage capacity on the installation, keeping less frequently used information off-line in a library and loading it when required. These devices also have the advantage that, should a device fail, it may be possible for the information loaded on it to be transferred to another device for processing.

Use of direct access devices requires care since, for example, the size of blocks of data has to be related to physical factors such as track sizes if any efficiency in holding information is required. Penalties for inefficient data organisation can be severe and, if the blocks used are too small, up to 30% of the rated capacity may be lost. It should, however, be possible, with good organisation, to obtain 90-95% of the rated capacity, though the further overheads mentioned below have also to be considered.

Files of information will require some scheme of indexing to facilitate location of required data. In addition, files whose contents are changing will usually require 'overflow' areas to allow for expansion. Typically, perhaps 10% of available (as distinct from rated) capacity may be required for indexing and up to 10% for overflow. Because indexes are commonly held on the device itself, and because of the possibilities of overflow, several accesses may be required to obtain any specified item of data.

As a final point, it should be mentioned that most direct access devices can also be used to store and process files in a serial manner like magnetic tape.

2.3 INFORMATION CHANNELS INTO AND OUT OF THE COMPUTER

The number and flexibility of information channels is of great importance. These must provide facilities for connection of the telecommunications network, the mass storage, and conventional devices such as magnetic tape, paper tape, printers, etc. The connection of telecommunications has been mentioned above, and the factors affecting other channel requirements are given here.

Mass storage must be provided with sufficient channels to allow a number of parallel accesses. The precise number will depend upon the number of enquiries that are likely to be processed concurrently, which itself will depend on the terminal loading and the response time required.

For other devices, the number of channels decides the number of devices which can be used simultaneously. This

is mainly relevant in batch processing work.

Some manufacturers provide channels of several different types–e.g. 'selectors' allowing single transfers from high speed devices and 'multiplexors', which by use of interleaving techniques (as for communications concentrators) allow several slower devices to be operated simultaneously. Other manufacturers provide a number of identical channels, and this may be preferable in that the breakdown of one channel is less likely to have a disastrous effect on the system (providing that equipment can be easily or automatically switched from one channel to another).

2.4 THE ABILITY TO 'MULIPROGRAM'

The answering of individual enquiries each requiring access to data files is fundamentally an inefficient operation in terms of computer usage, since a large proportion of the time taken is involved in file access and communication rather than processing. In order to make better use of computing facilities, 'multiprogramming' is essential. This technique allows several processes to take place in parallel. While some processes are involved in file access, thus leaving the calculation facilities free, others can use these latter facilities. File accesses themselves may be overlapped if channels are available. Essentially one is able to mix together different batch processing routines and to mix on-line work with batch processing.

The foregoing constitutes multiprogramming as usually understood, but the type of operation contemplated for the scheme at present under consideration seems likely to necessitate two extensions of these usual facilities. The first is 'multi-threading', a technique whereby the program controlling the servicing of enquiries may control the concurrent processing of several enquiries–this is in effect multiprogramming *within* one of the user's programs. The second is 're-entrant programming', whereby, if several concurrent enquiries require the same routine, the relevant program instructions need not be duplicated in store, but may operate upon several alternative data areas allocated to specific enquiries.

Multiprogramming involves both hardware ability and software control. The software for conventional multiprogramming is normally provided by the manufacturer, but that for multi-threading and re-entrant programming may have to be provided by the user.

2.5 INTERNAL STORE SIZE

Following from the above, a large main store size is required to allow efficient use of the system. The software support required for a system of this nature tends to be large in terms of store occupation, quite apart form the store used for application work. A typical use of store might be illustrated as indicated at the top of the next column.

The different 'partitions' are described below, indications of store sizes in bytes are to give possible orders of magnitude only.

(a) Operating system. Controlling multiprogramming, performing input/output and associated error recovery, buffering and queueing of input/output for batch processing work, informing the human operator of

OPERATING SYSTEM
COMMUNICATIONS HANDLING ROUTINES
FILE HANDLING ROUTINES
ON LINE EXECUTIVE AND APPLICATIONS PROGRAMS
BATCH PROCESSING PROGRAMS
SPOOLING PROGRAMS

situations needing his attention and allowing him to intervene when necessary, logging the operation of the computer system. Approximately 70,000 bytes.

(b) Communications handling. Controlling the handling of a network of terminals and communications lines which may be operating simultaneously, buffering and queueing input/output messages, providing the means of communicating with the required routines at individual message level. Approximately 30,000 bytes.

(c) File handling. Controlling the access to all direct access devices, including buffering, queuing and space for file directories. Approximately 75,000 bytes.

(d) On-line programs. Controlling the processing of enquiries. Providing message queueing and 'multi-threading' facilities if necessary, providing buffer areas for handling messages currently being processed, providing routines to process individual messages, performing security checks, logging messages and providing links with (b) and (c) above. About 85,000 bytes.

(e) Batch processing. Programs to handle work which is fundamentally of a batch nature and would give no substantial benefits if carried out in an on-line mode. Such programs would normally use direct access storage devices in serial mode and magnetic tape files. Approximately 70,000 bytes.

(f) Spooling. Programs to convert batch data and results between magnetic storage devices and slow input/output media, e.g. paper tape and printers. Approximately 10,000 bytes.

It will be seen that a large core store is required–at least 260,000 bytes for on-line work alone, and at least 340,000 bytes if batch processing is also done. If any sophisticated work is to be tackled it would be desirable to have available about 524,000 bytes (a commonly available store size).

2.6 SOFTWARE REQUIREMENTS

Some basic points concerning software have been mentioned above. However, further points about the operating system and other software can be made here.

(a) Operating system. The basic facilities have been mentioned. In addition, the operating system must provide other facilities, in some cases carried out by routines called into store only when required ('non-resident' routines). The principal facilities are:

(i) Scheduling of batch processing work (the ability to

take lists of jobs to be done, and schedule these as equipment becomes available).

(ii) Allocation of store and equipment to batch work, and release of this when no longer required.

(iii) Re-allocation of data areas holding messages to different routines involved in their processing. (This avoids a considerable amount of movement around the store as messages are acted upon by different routines in the course of on-line work).

(b) Other (non-resident) software. The most important remaining software is that concerned with the compilation and proving of programs. It is essential that facilities are provided to:

(i) Compile programs efficiently from a high-level language (preferably full COBOL)—also that most of all of the facilities of the language are implemented (reduced versions often being inefficient).

(ii) Aid 'debugging' or program testing by providing print-out facilities related to source language programs covering:

dumping of store areas during execution,

tracing paths through the program,

printing information from magnetic files.

(iii) Set up trial data on magnetic files and also simulate terminal input for testing on-line programs.

(iv) Enable programs to be written in modules which can be compiled and tested either independently or in combination.

Attention should also be paid to the extent to which the software can function in the event of a breakdown of some part of the equipment, and also the extent to which it remains efficient if the system grows.

2.7 SPEED OF OPERATION

One of the more important timing factors to consider is the response time to enquiries from terminals, (i.e. the time between completion of an input message and the start of the reply appearing). A very short response time (e.g. half a second) is probably unnecessary, since the operator's reactions are not fast enough to make use of this. On the other hand, a long response time (say 15 seconds) will make the operator impatient and may discourage use of the facilities, particularly if long 'conversations' are involved. A response time of up to 8 seconds seems a reasonable target to aim at.

The factors governing response time are:

(a) Terminal loading—Frequency of use of terminals, the extent to which line-sharing is used, and the capacity of the concentrator.

(b) Size of store available for message queues.

(c) Timings of direct access devices, and number of concurrent accesses possible.

(d) Extent to which multithreading and re-entrant programming is used.

(e) Processing speed of computer—this factor is unlikely to present serious problems.

A further important aspect of timing is the batch throughput which can be obtained. This depends on:

(f) Amount of core store available for multiprogrammed batch work.

(g) Number of concurrent device transfers possible.

(h) Processing speed, since this affects the amount of processor time left over after on-line work.

2.8 PRECAUTIONS AGAINST SYSTEM BREAKDOWN

The effect of system breakdown is far more critical on an on-line system than on a batch system. If a batch system is unusable for three or four hours, this can often be recovered by extra working time without noticeably affecting the production of results. If, however, an information system is out of action for this time, the effect is immediately apparent.

There is no way of assuring 100% reliability. Even if every component of the system is duplicated, the possibility that both the standby and the main system develop a fault at the same time still exists, but this is very unlikely. However, this approach is obviously very expensive, and also very wasteful since equipment is lying idle for much of the time.

An alternative approach that is currently popular is to design a system so that a restricted service can be provided even if part of the system is out of action. This is known as 'graceful degradation'. It is in general provided by modular construction of equipment, i.e. the provision of many small units rather than one large one. It is akin to the principle of the four engined aircraft, which can fly on three or even two engines if necessary.

The extent to which such provision is made varies from one manufacturer to another and some of the methods adopted are outlined below:

(a) Dual processor systems. Such systems have two processors sharing the same core store, backing store and input/output devices. The design is such that both processors are needed to handle normal work, but a degraded service can be given by one processor only. Dual processor systems are expensive.

(b) Twin computers. It is possible to house two similar computers in one building so that each has access to all peripheral devices. One can be used primarily for on-line working and the other for batch processing and program testing. If either computer becomes unserviceable the other can be used for whichever task is the more urgent at the time. This approach is less powerful than the dual processor system in that the central processors and main stores are not independently interchangeable, and all operating system software has to be duplicated.

(c) Core store modularity. In some systems core modules are independent, and one module out of service will not affect the others.

(d) Switchable channels. Where two diskfiles are attached each to one separate channel, then if one of the channels becomes unusable the information on that diskfile

is unusable also. If, however, they are connected so that either diskfile can be used via either channel, then if one channel becomes unserviceable, both diskfiles are still accessible (though not simultaneously) via the remaining channel. Similar considerations apply to other devices.

(e) Replaceable direct access devices. If one fixed diskfile becomes unusable, the information held on it is inaccessible. If, however, the drive for one replaceable diskfile becomes unusable, the diskpack can be loaded on another drive.

Similarly with magnetic card magazines.

(f) Software. The ability of the software to function in a degraded environment is an important factor in maintaining a service.

(g) Program and data protection. All data and programs should be recoverable in the case of as many kinds of faults as possible.

These are the main factors affecting 'graceful degradation', and they form important considerations in the choice of a manufacturer. The conventional 'standby' approach which consists of using a similar computer belonging to the manufacturer or another user is not normally feasible in on-line work. Nevertheless, special considerations would apply if two organisations had identical systems. Here, if a direct inter-computer high speed link was provided it would be possible for one computer to handle a reduced service for both organisations. Here again, this would not help if it was the terminal network which became unusable and a successful standby service would also depend on the faulty computer complex at least being able to channel all data and telecommunications through to the other one.

3. Critical Factors in Selecting the Manufacturer

This section lists and briefly expands on a number of factors which should be borne in mind in selecting the manufacturer(s) from whom to buy equipment. The order in which factors are considered does not necessarily indicate their priority.

(a) ABILITY TO PROVIDE THE BASIC HARDWARE AND SOFTWARE REQUIREMENTS SPECIFIED IN E.2.

This is obviously of fundamental importance and nothing more need be said here.

(b) MODULARITY OF EQUIPMENT

This may be of particular concern in examining the extent to which it is possible to start with less hardware than will eventually be required and gradually build up to a full system without major difficulties caused by expansion. This may involve processor compatibility within a range, since it may be possible to start with a smaller processor and exchange it for a larger one later. Modularity of equipment is also relevant when considering system breakdown.

(c) COST OF EQUIPMENT

Not only the capital cost should be considered. Other important factors are comparisons of rental terms, and the cost penalty, if any, for enhancements made after initial installation—e.g. upgrading of processor.

(d) SOFTWARE PROVIDED

Here the essential factor is the scope of the work done by standard software, and hence the amount which has to be done by application-oriented software, particularly in the matters of communications and file handling, and the control of multi-threading. It has also to be ascertained whether the manufacturer is prepared to produce or assist with production of nonstandard software.

(e) EXPERIENCE

The experience of the manufacturer in on-line work is especially relevant, notably in connection with application-oriented software.

(f) CURRENT STATE AND DEMONSTRABILITY

It is important to ascertain the extent to which equipment, and particularly software, is currently developed and working, and the ability of the manufacturer to demonstrate this is vital.

(g) SUPPORT

The value of the support offered by the manufacturer in systems design, programming, training and equipment maintenance must also be assessed.

4. Proposals for Benchmark Tests of Performance and Reliability

4.1 GENERAL INTRODUCTION

The purpose of benchmark tests is to obtain some information with which to check manufacturers' claims for the performance of their products (both hardware and software) and to aid in the estimation of store requirements, running times and programming times.

The usual approach to benchmark testing is to present to the manufacturer a specification of a small program which embodies as many features as possible of the main application for which the computer is to be used. The manufacturer is required to write, prove, and run this program (with user-supplied data), and to provide details of programming times, computer time used in trials, running time of the final program and, of course, the results produced by the program.

A fundamental point about benchmarks is that, in order to be of any great value, they must reflect as many aspects of the main computer applications as possible. This is not difficult with conventional batch systems, but with on-line systems problems arise. It is reasonable to expect the manufacturer to demonstrate that his computer is capable of servicing enquiries from a few terminals and retrieving information from files to answer these, but it is generally not reasonable at present to expect a demonstration of a system supporting as many terminals as is envisaged. Not only is the manufacturer unlikely to have such an installation available for demonstration purposes, but the work involved in demonstrating would be of the same order of magnitude as the implementation of the proposed system.

With batch processing, the performance of a subset of the system is of great assistance in evaluating the performance of the whole system. With on-line processing, however, this

is not so, since the main critical factors in the system (e.g. response time) are very dependent on such matters as the loading in terms of the number of terminals, the number of enquiries handled, and the size of queue areas allocated for message handling.

Thus a benchmark test alone cannot be expected to demonstrate the performance of the final system, in particular whether it is capable of handling the likely enquiries or whether it may become overloaded. However, a technique which may be of assistance here is that of simulation.

Simulation requires that a program is written which serves as a 'model' of the proposed system. Parameters are fed to this program which can then report on the performance of the system—response times, queue loadings, etc., under various conditions.

The writing of a simulation program is a complex process, but can be eased if the manufacturer provides one of a number of special high level languages (e.g. SIMULA, CSL) specially designed to assist this process. It can, however, be a very valuable technique provided that its limitations are recognised. The main ones are:-

(a) The time taken to write and debug a complex simulation program even with the aid of a simulation language may mean that its scope is unduly restricted.

(b) There is a danger of incorrect simplification. In simulation it is necessary to make certain assumptions and simplifications concerning the proposed system. If this is not done with great care, simplifications may be made which change the performance radically and invalidate the results.

One further point should be made concerning benchmarks. This is that benchmark programs are often written by manufacturers' programmers, and usually a manufacturer will use very high grade staff on this work. This may mean that estimates of programming time based on benchmarks may be unrealistically low. To avoid this, any benchmark should include at least one program (probably in a high level language) written by an average member of the user's programming staff.

4.2 POINTS TO BE TESTED

Subject to the above limitations on the scope of benchmarks in evaluating the performance of on-line work, the following are points which should (inter alia) be borne in mind as factors to be tested

(a) The ability to access information on a direct access device, using software-provided indexes and user indexes, by means of a COBOL program. Also the ability to update, expand, contract and re-organise such information by means of COBOL programs.

(b) The ability to accept messages from terminals and send messages to terminals, also using a COBOL program.

(c) The feasibility of multi-threading and re-entrant programming, allowing the control routines to be in assembly language if necessary, but having the processing routines written in COBOL.

(d) The compilation, debugging, and especially running times of a COBOL program or programs containing a mix of instructions oriented towards the batch processing work to be done. These programs should in particular test all input/output devices, and involve changes in data format (e.g. fixed field to variable field).

(e) The manufacturer should be expected to demonstrate multiprogramming, operating systems, etc. Any software proposed must be capable of demonstration by July, 1969.

In view of the importance which must be attached to the question of selection, it is intended to request the Ministry of Technology for assistance in the design, supervision and evaluation of the benchmark tests.

F

Partnership with Other Authorities

1. THE NECESSITY FOR PLANNING FOR AN 'ON-LINE' SYSTEM FROM THE OUTSET
2. THE OVERHEADS OF ON-LINE PROCESSING
3. THE NECESSITY FOR PARTNERSHIP
4. THE IMPLICATIONS OF SHARING
5. PRINCIPLES FOR SHARING ARRANGEMENTS
6. ADMINISTRATIVE CONTROL OF THE CONSORTIUM

F. PARTNERSHIP WITH OTHER AUTHORITIES

1. The Necessity for planning for an 'On-Line' System from the Outset

The general requirements for on-line processing have been described in Section E above. The need for those hardware facilities directly related to real-time working is clear. Less apparent, however, without the benefit of detailed study of the problem, is the major impact upon the more conventional parts of the computer hardware and also the new kinds of software problems which are presented.

It is not simply a question of adding terminals to an existing computer system, nor can on-line working be contemplated as a later extension, the planning and details of which can be deferred. At the very least it is essential to plan the batch processing applications in such a way that those aspects which will later become on-line transactions are treated separately and are not bound up in those batch programs which will still remain. Systems design is likely to be so radically different, because of the potential of the terminals for data capture and for reducing routine output, that for many applications complete re-writing of programs would be necessary in order to utilise terminal facilities. As far as the technical design is concerned, the problems of a completely different software environment and of more complex file and record structures with their associated retrieval problems, would also militate against an evolutionary approach. Thus, if on-line working is to be considered as a future prospect it must be clearly implied from the beginning of the project and all development must be oriented towards it.

2. The Overheads of On-line Processing

The impact of the real-time requirements on conventional hardware has already been referred to above—by far the most significant aspect is the requirement for a large core store. In Section E, an attempt has been made to show how this need for a large store arises in terms of the standard software which must be present and the space for supporting programs, message buffers and so on which must be provided. It would appear that in order to be able to support any kind of real-time system at all, a store size of or equivalent to, 262K (i.e. 262 thousand) bytes is necessary and that to support an on-line system which goes beyond servicing enquiries together with receiving and storing data for subsequent processing, i.e. to permit on-line updating and calculation a store of, or equivalent to, 524K bytes is more appropriate. Since the size of store which can be supported is one of the essential distinctions between different models in each manufacturer's range, this storage problem emerges as being one of the most significant factors in determining the level of equipment cost at which it is possible to realise the objectives set out in Section C.

To take a specific example, there are two well known computer ranges whose lower limits are within the scope of individual boroughs—the System 4 of ICL and the 360 series of IBM. A fairly large local authority (population 250,000) might contemplate batch processing with limited terminal facilities and this would imply using either a system 4/50 or a 360/40, each with 262K bytes of storage. To progress to the more advanced on-line system, (ignoring the costs of any increase in the number of lines or terminals and the probable increased requirements for direct access storage), would imply changing both these central processors and enlarging the store to 542K bytes. This implies changing the 4/50 for a 4/70 and the 360/40 for a 360/65 (or possibly for a 360/50 if that represented the limit of further storage expansion required and was considered adequate in terms of selector channel capacity). The capital costs would be:-

Change	Processor Difference	Additional Storage (262 KB to 524 KB)	Total
4/50 to 4/70	£ 85,000	£120,000	£205,000
360/40 to 360/50	£ 75,000	£140,000	£215,000
360/40 to 360/65	£190,000	£180,000	£370,000

An alternative solution which might also be considered would be to install another processor with the same storage capacity and to link these processors in such a way that the normal mode of operation was for one computer to service the on-line network and for the other to do batch processing and program testing. If the appropriate switching channels were fitted to the peripheral devices, this arrangement would have the added advantage of safeguarding the terminal service against the breakdown of the central processor. Ignoring such channels, the costs involved in duplication are:-

Processor	Cost
4/50	£200,000
360/40	£260,000
360/50	£335,000

3. The Necessity for Partnership

It has been shown that the increase in the hardware cost attributable to the requirement for extensive real-time capability might range from £200,000 to £370,000 depending upon the manufacturer and model concerned, and *this takes no account of the extra development costs* which the more advanced facilities would necessarily imply.

It is therefore considered unlikely that many single local authorities (and certainly no London authority other than the GLC) would justify the extra expenditure involved. It is also considered unlikely that these costs will fall so

significantly as to invalidate these conclusions within the foreseeable future. Thus the options would appear to be clear: a London Borough must either abandon the possibility of achieving this level of development or must participate in some shared arrangement.

4. The Implications of Sharing

If the increased cost of an on-line system is to be made acceptable by sharing then the full benefit of the large increments in computer capacity can be most effectively utilised. A very large extension of central computer facilities could be provided, including facilities for batch processing, at the cost only of additional shift working. It would, of course, be necessary for any partner authority to pay for the terminals and data links and direct access storage which would be 'dedicated' to its use. In such a case storage for, say, 100 million bytes of information could involve an annual rental of some £15,000 and each terminal £800 p.a. or £1,800 p.a. according to whether it was a teletype or video terminal.

It is estimated that it would be practicable for up to five or six London Boroughs to share in a consortium, but this must be tentative pending a closer assessment of likely activity.

5. Principles for Sharing Arrangements

In considering the mechanics of any consortium which is set up under the aegis of the LBMSU to put a new computer system into effect, it is important to attempt a definition of the principles which might be accepted as guidelines for determining the details of such an arrangement. The problems which must be solved are those of control and finance within a framework which provides for reasonable stability but gives appropriate flexibility to the member authorities.

The following principles are recommended:

(a) ACCEPTANCE OF COMMON SYSTEM

The acceptance of common systems, not only for the Nucleus but also for the Extensions, should be based upon an appreciation of the economic advantages to be obtained in sharing development costs. Full participation in the systems design and real involvement of borough staff at all levels is essential to achieving these ends. It must, however, be possible for a completely different application to be programmed for a single member, if the costs of doing so are met by the authority concerned.

(b) FLEXIBILITY OF DEVELOPMENT

Provision must be made for allowing different rates of development for each member, and for the implementation of specifically local applications as required. Due consideration must be given to facilitating programming by borough staff, particularly in the technical spheres. Local data preparation must also be possible.

(c) FINANCIAL JUSTIFICATION

The survey reports required initially for each prospective partner will indicate the broad financial justification for the Nucleus system; all Extensions and any new applications undertaken for an authority should be financially justified to that authority by the department concerned and a mechanism for monitoring the success in achieving the claimed savings should be established.

(d) PRIORITIES

A basic timetable for the implementation of the Nucleus should be agreed at the outset and subsequently there should be a clearly defined system for establishing priorities *within each authority*— this should apply to requirements for development, implementation and maintenance work. If demand exceeds the resources that can be made available, so that problems arise of priorities *between* authorities, priority should normally be given to the projects of most general interest.

(e) SHARING OF COMMON DEVELOPMENT COSTS AND ESSENTIAL SUPPORT SERVICES

The development and maintenance costs for the Nucleus and all applications accepted as coming within the joint approach, together with the basic utility software, should be shared by all the participants. The rateable value of each borough has often been used in the past as the basis for this apportionment, but consideration should now be given to other bases which might more closely correspond with the demands made upon the scheme by each authority.

(f) SHARING OR OPERATIONAL COSTS

From the outset, the computer facilities should be regarded as composed of 'common' equipment and of 'dedicated' equipment, the former comprising the central processor, main store and the batch processing peripherals, and the latter comprising the direct access storage, the line control equipment and terminals required by each member together with the magnetic tapes and discs used. The rentals (including maintenance) of dedicated equipment would be borne directly by each borough concerned.

The common equipment costs together with the running costs of the installation should be pooled. The pooled costs should initially be shared on the same basis as the development costs but this method should be superseded in due course by one based upon the amount of use after the Nucleus has been implemented.

(g) APPORTIONMENT OF IMPLEMENTATION COSTS

The costs of implementation will depend upon the assistance given by borough staff, the complexity of conversion problems arising from exisiting records and systems, and upon the amount of training required. Pooling is not therefore considered appropriate: each borough should pay directly for staff and facilities used. Initially, however, some pooling may be necessary in order to establish the organisation required to provide basic services.

6. Administrative Control of the Consortium

Principles (c) and (d) above provide for the determination of local priorities and the control of the rate of growth of the Extentions to be directly exercised by each authority concerned; thus the important policy decisions relating to the effective use and the justification for the growth in each

member authority's activities will not be a matter for the managing committee of the consortium. The LBMSU would simply be providing a service on an agreed basis and this implies that a managing body is required primarily to rule on certain aspects of day-to-day administration. It would seem that the present mechanism of an Advisory Body of Officers together with a Steering Panel of Members would still be appropriate, although the Advisory Body might possibly need to be enlarged from time to time to reflect the increased scope of the new scheme for affecting all departments of the authorities; it would also greatly facilitate the administration if the Steering Panel was delegated full authority by the constituent Councils over routine aspects.

G

Costs

1. NUMBER OF USERS
2. CAPITAL COSTS
    1. The Machine Configuration
    2. Conclusions
3. REVENUE COSTS
    1. Rental versus Purchase
    2. Development Costs
    3. Implementation
    4. Maintenance of Programs
    5. Operating Costs
    6. Support Services
    7. Terminal and Line Costs
    8. Run-down of LEO III Installation
4. AGGREGATE COSTS
    1. Growth in Cost Levels
    2. Costs with Fully Operational Nucleus

6

Costs

1. NUMBER OF USERS
2. CAPITAL COSTS
   1. The Meshing Configuration
   2. Conclusions
3. REVENUE COSTS
   1. Rental versus Purchase
   2. Development Costs
   3. Implementation
   4. Maintenance of Programs
   5. Operating Costs
   6. Support Services
   7. Terminal and Line Costs
   8. Numbers of LEO III Installation
4. AGGREGATE COSTS
   1. Growth in Cost Levels
   2. Costs with Fully Operational Nucleus

G. COSTS

1. Number of Users

It has already been indicated that as many as six London Boroughs could form a practicable group for a single on-line computer consortium. It has also been stated, however, that all boroughs are not equal in their requirements—the principal variable factors being the education service and the extent of direct labour activities. With a mixture of Inner and Outer Boroughs the question of the sixth borough might well represent the difference between two and three shift working on the installation. For the purposes of this section, estimates of total costs for the Nucleus have been prepared on the basis of four, five or six members, assuming that the 'mix' is not so heavily weighted by Outer Boroughs and by those having large direct labour forces that the third shift is necessary; the technical practicability of having six is not however in doubt.

2. Capital Costs

2.1 THE MACHINE CONFIGURATION

The central configuration required can be regarded as consisting of four parts i.e. the central processor (or processors) with main core store, the batch processing peripherals, the communications interface (line controls, etc.) and the on-line direct access storage, these latter two parts being 'dedicated' to individual boroughs. For the purpose of informal quotations by manufacturers, the following outline specification was prepared:-

(a) CENTRAL PROCESSOR(S)

Must be capable of having a main memory of at least 524K bytes (or equivalent)—although 262K might be acceptable for each of a pair of linked computers—and be able to support the channel demands made by the large random access backing stores and by the terminal traffic. Must be capable of expansion or of replacement by a compatible larger computer.

(b) BATCH PROCESSING PERIPHERALS

Should provide for:-

5 x 60 KB/sec magnetic tape decks

2 small replaceable disk storage units or comparable facilities

2 x 1,000 line per minute printers

2 x 1,000 c.p.s. paper tape readers

1 x 400 c.p.m. card reader

(c) DIRECT ACCESS STORAGE

Devices providing for the storage of 10 million bytes upwards to be quoted—these to be fixed or replaceable according to the capability of each manufacturer.

(d) COMMUNICATIONS

Manufacturers should indicate the consequences of attaching up to 120 half-duplex communication lines assuming that all terminals linked would be slow to medium speed devices.

The computers for which information was supplied by the various manufacturers were:-

Burroughs	6500
Honeywell	4200
I.C.L.	4/50, 4/70
I.B.M.	360/40, 360/50, 360/65
N.C.R.	Century 200
Univac	418/III

These figures were sought solely to obtain some idea of the cost levels appropriate to each of the basic parts referred to above and it is not intended to quote the detailed figures for any manufacturers at this stage. It must not necessarily be assumed that the final machines quoted by each of these manufacturers will be the same as above, particularly since the merits of duplicating the central processor and main store have not been fully investigated.

2.2 CONCLUSIONS

(i) Central processor plus main memory costs range from £404,000 to £744,000, with the cost of store accounting for over 60% of the total.

(ii) Batch processing peripheral costs range from £184,000 to £204,000.

(iii) The cost of direct access storage varies greatly depending first upon access time and transfer rates and second upon whether it is fixed (drums or disks) or reloadable. It is possible however to obtain reloadable devices, with acceptable access times and with reasonably fast transfer rates, holding on-line effectively 200 million bytes of information for about £110,000 i.e. at slightly over $\frac{1}{8}$ penny per byte. Fixed devices vary considerably between manufacturers.

(iv) It is very difficult to generalise about the costs of the communications interface. Manufacturers differ greatly in the increments by which additional line capacity can be added to their processors—from single control devices for each line, through devices which allow for 16, 32 or even further lines to be added. The number of separate devices between the input modem and the computer is also extremely variable and it is necessary to define precisely the mixture of terminals before any definite costings can be made; however it should prove possible to cater for up to 50 or so lines for about £ 25,000 and 100 or so for about £50,000—this excludes the costs of modems and any special line adaptors required.

For the purpose of producing estimates of the annual cost involved the following capital costs have been assumed:

Central processor plus main memory	£530,000
Batch processing peripherals	£190,000
Communications interface	£ 50,000
	£770,000

(Equivalent on a rental basis to £215,000 p.a.)

Direct access storage requirements will vary directly with the number of members of the consortium and on the basis of the 100 million bytes estimated for a 'Haringey

equivalent authority' on the Nucleus, the estimated capital costs are:

400 million bytes for 4 members	£220,000
500 million bytes for 5 members	£275,000
600 million bytes for 6 members	£330,000

(Equivalent on a rental basis to £15,500 p.a. per member)

Thus aggregate capital costs would be of the following order:

4 members	£ 990,000
5 members	£1,045,000
6 members	£1,100,000

Although these cost levels will be used in pricing the Nucleus it should be realised that all this equipment may not necessarily be required from the outset. For example, the duplicate printer can at least await the build-up to a significant batch processing load and the replaceable disk stores (which are intended for program storage and work areas) could be deferred so long as there was spare storage capacity available on the main direct access storage. Apart from this flexibility, there is also the general question of basic differences between the various manufacturers in the size of the steps involved in adding both storage and communications capacity—the increments by which it is possible to build up to the full main core memory are particularly significant since this element could well account for about £300,000 of the total price. If a linked processor system is finally recommended this would provide for still further flexibility in building up the installation.

3. Revenue Costs

3.1 RENTAL VERSUS PURCHASE

To provide flexibility during the development period it is recommended that purchase should not be considered except possibly for those parts of the new installation which are certain not to be changed within the first five years of growth. Rental has accordingly been assumed when producing annual costs below.

3.2 DEVELOPMENT COSTS

It is extremely difficult to estimate development costs of the project at this stage, partly because firm specifications of the details of each application relating to the Nucleus can only be arrived at after all prospective members of the new consortium have been fully consulted, but primarily because the configuration which will be used is not yet known. Manufacturers' claims for their environmental software and their programming techniques have not yet been put to the test as this is only practicable in the context of a definite tender; development costs of environmental software could prove to be the most significant single item. It may emerge that the manufacturers offering the cheaper equipment have not produced adequate software and it will be necessary to put a value on any manufacturer's software which can be shown to exist, to be fully proved and to meet the requirements of the project; these values must then be included in any comparison of the quotations.

If it is assumed that it will prove necessary to modify and supplement the manufacturer's software to a significant extent then 24-30 man-years might represent the effort required.

For the development of the detailed applications within the Nucleus, 40 to 50 man-years have been estimated. Thus to complete the project to that stage, development costs of the order of £250,000–£300,000 are envisaged.

3.3 IMPLEMENTATION

Apart from the question of training there will be the problem of file conversion, the temporary running of parallel systems and the preparation of additional data for inclusion in the Data Bank. This must be edited and standardised.

Conversion programs to deal with records on the existing computer will be needed.

It is suggested that there would be advantages in a large measure of involvement of an authority's own staff in this work and that staff saved should form the teams for implementation of succeeding projects.

It would still however be necessary for the L.B.M.S.U. to provide the initial implementation team and this is estimated to cost £17,000 per annum.

3.4 MAINTENANCE OF PROGRAMS

Experience has shown that because of statutory requirements, local re-organisations and desirable refinements of systems, program changes are inevitable.

The work of amending will be assisted and minimised by the use of high level languages and modular programming techniques but even so, after the first year of operational running, provision must be made for a team fully devoted to this work. £17,000 p.a. has been estimated as the cost.

3.5 OPERATING COSTS

For the purpose of estimating costs only, it has been assumed that the new computer could be at Southgate Road where the present LEO III is housed.

Compared with the present installation, operating costs might vary for the following reasons:-

(a) Stationery costs should be lower.

(b) Maintenance rates, though less for comparable items, would increase due to the greater amount of equipment.

With more sophisticated software however the present controlling and operating staff should be adequate for the increased number of authorities and greater volume of overall use.

For two shift working a total operating cost of £105,000 has therefore been assumed (comparable with the present cost of £98,000).

3.6 SUPPORT SERVICES

To achieve success on a project of this scale will call for a considerable effort in support of the main operational and development activities, primarily on education and training. The new system will imply a revolution in the approach to many aspects of the routine tasks of the whole authority by

the officers concerned. At the management level, the need to demonstrate the implications of the new techniques and to instil confidence in their use is paramount if the full potential is to be realised. It is therefore envisaged that a central training team should be provided to supplement the internal training resources of the consortium members. This central team would also be responsible for all external documentation—training manuals, clerical handbooks, etc. An annual expenditure of the order of £16,000 has been assumed.

3.7 TERMINAL AND LINE COSTS

The types of terminal which are envisaged for the implementation of the Nucleus are all slow to medium-speed devices not requiring expensive G.P.O. wide band circuits and all capable of being operated with the present Datel services which are already well proven. The costs of attaching each terminal can be broken into four basic components i.e. rental costs of line adaptor at computer end, modems at each end, terminal rental and line rental. This is a considerable over-simplification and disregards completely the possibilities of attaching more than one terminal to a line and also the problems arising from some types of video terminals which require control units at the user end, but will in general overstate rather than understate costs.

Some specimen annual rentals are:-

Type of Terminal	At up to 6 miles distance from centre	At up to 12 miles distance from centre
Teletype	£ 800	£ 842
Video	£1,750	£1,870
Video and teletype	£1,816	£1,936
Paper tape reader/ punch and teletype	£ 850	£ 892

For the purposes of the Nucleus it is considered that members might well require a mixture of 10 terminals fairly quickly with a gradual build up to about 30 terminals when completely operational. An average total cost of £1,500 per annum has been assumed per terminal, thus annual charges for terminals will grow from £15,000 to £45,000 for each authority.

3.8 RUN-DOWN OF LEO III INSTALLATION

No major reduction in current costs will be possible until 1971/72 when the work involved in decimalisation will be completed. The transfer to the new project of about £33,000 of programming and implementation resources could then be planned.

Further reductions in cost will depend upon the rate of transfer of Nucleus applications to the new computer, which would seem to depend as much upon the rate of change which can be tolerated by the staff of the member authorities as upon technical feasibility and finance. A cut-back to one-shift operation could however make a contribution of about £25,000 a year and it is possible to contemplate phasing out the LEO III completely during the financial year 1973/74.

4. Aggregate Costs

4.1. GROWTH IN COST LEVELS

From what has been said previously in this report it will be realised that a stage will be reached by 1974/75 or possibly earlier, when the Nucleus projects will be fully operational and the question of extensions will be that which is paramount. The complete Nucleus would appear to be a convenient level at which to attempt an estimate of annual costs since, as explained, it is intended that the cost of extensions should be individually justified.

However in progressing to this level of expenditure there will be a number of major jumps in the annual figures. These render impracticable any attempt to provide year by year figures at this stage, since the factors causing the jumps depend upon major questions as yet unresolved.

The factors which will effect the rate of growth may however be summarised as follows:-

(a) After the tender has been approved and the development teams are set up, which in itself calls for a major jump in the expenditure level, the next increase will arise when the senior staff are recruited for the operating and support teams.

(b) The next level is reached when the new equipment is installed and the on-line network is gradually established, closely followed by the first applications in each authority. At this stage the full operating and support teams are required together with the central implementation team.

(c) Following this the final stage in completing the Nucleus will be the extension to two-shift operation and the need for a central maintenance team. By this time the bulk of the £250,000–£300,000 development costs will have been expended and the development teams would be available to start work on the Extensions.

It is the experience of all on-line implementations so far, that when the facility is made available, its utility quickly leads to increased demand and additional use. Estimates of the amount of use to be anticipated have usually been much below the actual and large loadings have occurred much earlier than was envisaged by the system designers. This may perhaps be almost inevitable because of the nature of the problem and because there is no current system to offer a firm basis for comparison. It will be clear that the new service opens up entirely new opportunities, and that the more successful it is in proving that 'instant' information is possible, that initial fears or prejudices are unjustified and that confidence can be placed in it, the greater will be the further demands.

The architecture of the basic software must be planned to take account of these factors, but on the other hand it would be unwise to overestimate the hardware requirements at the beginning.

It will be the intention to build into the system means of measuring and analysing the load established. Such measurements will indicate the success with which on-line demands are met, and the extent to which current capacity is being stretched and will provide useful evidence when

further additions to the installation are considered.

4.2 COSTS WITH FULLY OPERATIONAL NUCLEUS

Assuming growth on such a basis the costs at the suggested level with a fully operational Nucleus may be summarised as follows:

	£	
Rental of computer (excluding mass storage)	215,00m	(see G.2.2. (iv))
Central Implementation Team	17,000	(see G.3.3)
Maintenance Team	17,000	(see G.3.4)
Operating costs	105,000	(see G.3.5)
Support Team	16,000	(see G.3.6)
Administration	18,000	
	388,000	

If it is also assumed that the costs of development teams working upon Extensions would be met jointly the cost of these should be added, i.e

	100,000
	£488,000

These would be the costs to be pooled and shared on an agreed basis by participating authorities.

In addition each authority might be expected to incur individual costs as follows:-

	£	
Rental of dedicated mass storage	15,500	(see G.2.2 (iv))
Terminal rentals	say 45,000	(see G.3.7)
Data preparation (either own costs or share of central facility)	7,500	
	68,000	

From these figures the cost to an authority taking an average share of the expenses may be calculated as follows:

	Number of participating authorities		
	4	5	6
	£	£	£
Share of pooled expenditure	122,000	97,600	81,000
Individual costs	68,000	68,000	69,000
	190,000	165,600	149,300

H

Plan for Implementation

1. IMMEDIATE TASKS
2. A TIMESCALE FOR COMPLETION OF THE NUCLEUS

H. A PLAN FOR IMPLEMENTATION

1. Immediate Tasks

Following the preparation of this report it is planned to commence work upon the specification of equipment, software requirements and the benchmark tests which must be carried out by manufacturers. At the same time surveys will be made of two important aspects of the general study which it was not possible to cover in time for inclusion in this report. These are the questions of modular programming techniques, and the problems of information interchange with the Banks, Giro and possibly others such as the G.L.C.

There will also be work to be undertaken in holding general training and information seminars for various levels of borough staff and for members. Manufacturers will be asked to organise demonstrations as appropriate. Preliminary negotiations will be held with the G.P.O. for the provision of communication facilities.

Further than this, comparison surveys will be undertaken for prospective partners and working parties will be set up to commence the task of defining details of major systems likely to become early applications.

2. A timescale for completion of the Nucleus

It is envisaged that the evaluation of the tenders from manufacturers and the assessment of the benchmark tests may lead to a decision on the equipment and an order by December 1969.

The major steps likely to follow are indicated below.

(i) DELIVERY OF COMPUTER

The first key date to be determined is the delivery date of the new computer. Following the placing of an order it is envisaged that the remainder of the financial year 1969/70 will be taken up with detailed training on the chosen machine using the manufacturer's facilities, and the recruitment of the additional staff required for detailed development work. It is thus clear that development work does not really start until 1970/71. The problems of forecasting the amount of basic (i.e. non-application) software to be written have already been described, but much of this work is of fundamental importance for all applications and indeed represents the framework within which these applications will be developed. It is therefore essential to allow sufficient time prior to delivery for the work to be substantially complete. Thus, if it is assumed that three development teams are set up in April, 1970, delivery of the machine should not be sought before October, 1971. The programming of the first 'live' application and the development of special conversion programs to bridge the gap between the LEO III system and the new system should be proceeding in parallel with this basic task.

(ii) INSTALLATION TRIALS

The first three months after delivery of the installation may well be taken up with proving the initial communications network and then, once the complete configuration has been fully tested, proving the basic software and the programs for the first applications. It must be appreciated that no manufacturer will be able to supply an on-line computer system on which to run trials, and all such work prior to the installation will have to be done on a 'simulated' basis. This necessarily implies that in the case of an on-line system it is not possible, at the present stage of development, to have sufficient work fully tested before delivery to achieve speedy transfer of operational status.

(iii) OPERATIONAL TRIALS

During the transitional period, it is intended each week to copy certain LEO III files (e.g. rating and accountacy) to the real-time system for interrogation via terminals, and a special conversion program will be needed for this. Thus early experience in using the terminals and proving the enquiry system would be obtained without risk—all the familiar printed results being available from the old system and no actual processing being dependent on the new. This technique could be used until complete transfer of each application concerned had taken place.

(iv) THE FIRST 'LIVE' APPLICATION

It is possible to schedule the first live application for April, 1972, ideally this should be one which is reasonably self-contained—rates has a number of attractions on this score and it also provides a major foundation for the property record, but this decision must, of course, depend upon the members of the consortium.

(v) PHASING OUT OF LEO III

If the momentum of development work is maintained and that rate of growth can be sustained by the consortium members, one-shift operation on the LEO III might be achievable in 1973 and its total replacement by the end of that financial year.

J

Conclusions and Recommendations

1. CONCLUSIONS
2. RECOMMENDATIONS

7

Conclusions and Recommendations

J. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

(i) This report has set out to show how an on-line computer system is relevant to the mangement, communication and information needs of a modern local authority. The emphasis has been upon the provision of a basic facility to be used during the routine work of all departments and on its acceptance as 'part of the office furniture'. Further developments must necessarily depend upon a solid foundation of factual information achieved in such an environment.

(ii) There is continuous growth in the number of local government activities which are limited by cost or availability of resources. The computer project now proposed can play an important part in achieving the cost savings together with increased productivity which are vitally necessary.

(iii) The extensions to the basic system, described in Appendix 4, lead to material benefits in operational, managerial and policy-making functions. It must be realised, however, that no system which depends upon programs which have to be written in advance can ever provide 'instant management information', in the sense that it will answer all questions for which it was not prepared. Nevertheless, the provision for generalised analyses of comprehensive, accurate and consistent records relating to the whole of the authority's activities will bring a new dimension to management control and significantly increase the extent to which it is practicable for ad hoc information to be obtained at short notice.

(iv) The cost of the proposed facilities is not high when related to the foreseeable output and the overall potential. Even if only four authorities join together to form a consortium the proposals could be economically viable; with five authorities a comparison of costs in Haringey's case would be:-

The Annual cost as calculated in Section G on a basis of 5 participating authorities is (This allows for development of extensions to the system though not for specific hardware which may then be required).	£165,600
The present annual cost to Haringey of computer facilities is approximately (The greater part of the work performed would be transferred to the new system.)	£120,000
The estimated annual saving agreed for the Treasurer's department alone as a result of the new system is given in Section D as	£ 50,000
	£170,000

This is clearly not a precise comparison because on the one hand some part of the existing expenditure by the authority would continue for a limited period after the completion of the Nucleus.

On the other hand it is clear that economies must arise at the operational level in all departments which will benefit from the basic service. Further, no attempt has been made to put a value upon the most important benefits which the system must yield in connection with the managerial and policy-making functions. It seems clear, however, that even judged by the 'hard cash' yardstick an overall saving will accrue.

(v) To realise the project will constitute a major technical task requiring considerable resources and will necessitate co-operation on a grand scale. A technological revolution of this magnitude will only be successful if as much attention is given to the sociological and personal problems involved, as to the technical. This calls for a major programme of education and also for appreciation of the rate of change which can be accepted by the staff concerned. New systems take time to be assimilated and at every step it is essential to ensure that those concerned are made fully aware of what the system has to offer and of how to use it. Considerable momentum and enthusiasm has now been stimulated by the far-sightedness of Haringey Council in commissioning this study; a large measure of acceptance has already been established and there are keen expectations concerning the further developments. It is considered that the on-line system is now technologically feasible, is practicable and will prove economically viable.

The immediate work in 1969/70 leading to the acceptance of a firm tender and the further planning of systems is expected to cost £40,000 assuming that four boroughs are concerned at this stage. In addition comparative surveys will be needed in any borough joining in the project and £6,000 each has already been quoted to Hackney and to Tower Hamlets for this purpose.

2. Recommendations

So far as Haringey Borough Council is concerned the following recommendations are made for the further progress of the project:-

(1) That the Council accept the principle of an on-line information system as described, and authorise continuation of the project.

(2) That other boroughs be invited to full participation, sharing costs in simple proportions during the ensuing year, and that preference should be given in the first place to Hackney and Tower Hamlets who are partners in the present North East London Computer Scheme.

(3) That the London Boroughs' Management Services Unit be authorised specifically to

(i) prepare a tender specification giving requirements for both hardware and software and also details of the benchmark tests required.

(ii) proceed with the evaluation of tenders.

(iii) enter into negotiations with the G.P.O. regarding communication lines.

(4) That any boroughs entering into full participation in

the scheme be invited to take part in studies of outline systems to be undertaken by Working Parties.

(5) That in addition to those boroughs which might enter into full participation in the scheme, facilities be offered to other authorities which might wish to join only in the software development.

(6) That with the object of furthering the wider benefit of Local Government and to stimulate further interest in participation by other London Boroughs, approval be given to the circulation of this report at a charge to be fixed by the Council.

This report was presented to the Management Services Committee of the London Borough of Haringey on 31st January, 1969. The Committee accepted the recommendations and the charge referred to in item 6 was set at £5. 5. 0d. with a discount for bulk orders.