COMMISSION OF THE EUROPEAN COMMUNITIES

information management

Final report on project 2 : extension and revision of the COST / accounting scheme to interactive systems of the network

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A B S T R A C T

In the past it has been virtually impossible to draw up cost/accounting schemes in matrix form since information on cost for information and documentation was rather sparse. Now the situation has changed and the author of the report was able to develop a cost matrix which is mainly based on the experience of a number of experts in this field. The basic cost matrix is designed to be flexible enough so that its application in a variety of environments will cause no problems. The applicability of the cost matrix is tested in a number of different applications. The instructions given for using the cost matrix will facilitate its applications.

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FINAL REPORT ON PROJECT 2 : EXTENSION AND REVISION OF THE COST/ACCOUNTING SCHEME TO INTERACTIVE SYSTEMS OF THE NETWORK

MANAGEMENT SUMMARY

Purpose of the scheme.

The purpose of the cost-accounting scheme described in this report is to provide a practical method for the collection and analysis of cost data on computer-based information systems. Previous cost studies have tended to adopt different approaches for the collection and analysis of such data, so that the results have not been truly comparable. Here is the basis for a common approach.

It is recognized that cost studies may be carried out for a variety of purposes, each of which may call for analysis to a different level of detail. In some cases, moreover, it may be desirable to adjust or normalize certain costs in order to compare the characteristics of one system against another. No single, rigidly-structured cost analysis scheme would be acceptable for all these situations. The scheme proposed here comprises a set of tools that can be adapted to the needs of different types of cost study, yet which should ensure reproducible results, with a high degree of comparability.

Sources

The cost analysis scheme embodies much experience gained from previous work, notably the surveys of Allaire, Drees, Dubois and Peeters, Schwuchow, and Vickers. The EFAG 1 project report,* which reviewed these surveys, also contributed many useful ideas, especially with regard to the application of accountancy procedures. The basic philosophy of

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* Final report on project 1 : Analysis of various cost studies in connection with EURONET. N.V. System Dynamics S.A. (February 1976). This report contains full bibliographic details of the other sources mentioned here.

the scheme owes much to the work of Price, whose report in 1971 described the development of a 'building-block'system for unit costing, which had evolved in actual use in USA Government circles.

Explanation of the scheme

The scheme is essentially analytic, its first principle being that any cost study should begin with the accounts of the system, and establish their composition, rather than use local estimates of the costs associated with each activity.

The first step in using the scheme is to complete a standard form of cost matrix, using global costs obtained from each system's accounts. Classification schedules are provided which enumerate and define the cost types to be presented in each column of the matrix, and the activities or cost centres to be shown in each row. The schedules list 50 cost types and 64 activities.

This basic cost matrix can then be expanded, horizontally or vertically, to the level of detail required, which will depend on the type of cost study and the availability of data.

To analyse output costs a further matrix is prepared in which input costs are apportioned between the services provided.

The scheme recognizes two types of indirect costs :

(1) Indirect System Costs, which arise from activities that do not contribute directly to input and output operations, but which ensure the operational viability of the system;

(2) Indirect Organizational Costs, corresponding to what are often called overheads (administration, accommodation, etc.), which are often outside the control of the system manager or designer.

Procedures or guidelines are laid down for the apportionment of indirect costs and input costs; for the amortization of equipment costs; for collecting data on staff costs; and for dealing with the special problems of the costs of document acquisition, computer processing, software, administration, and development.

A useful feature of the matrix layout is that it facilitates unit costing at three levels, based on direct costs only, on direct costs plus indirect system costs, or on total costs. A schedule of production unit and activity unit costs is provided in an Appendix.

It is envisaged that cost studies will often need to be supported with information about the systems concerned, and a checklist of qualitative factors is supplied for this purpose.

The application of the main components of the scheme is illustrated on the next page.

Applications of the scheme

As mentioned above, cost studies may be carried out for a variety of purposes, and the scheme has been designed so that it can be easily adapted for different situations. Possible objectives of a cost study include :

(1) To inform people generally on the structure of costs within systems and to highlight which costs are important and which are not;

(2) To provide data for very broad planning at a macro level;

(3) To provide data for planning a particular new system;

(4) To provide standard definitions and rules for use in costing systems;

(5) To provide cost standards for a management control system for a particular organization;

(6) To provide assistance in the setting of tariffs;

(7) To provide guidance for further, more detailed, cost studies;

(8) To compare alternative system configurations from the viewpoint of costs, either at the macro level or at the level of unit costs.

COST TYPES AS DEFINED IN CLASSIFICATION SCHEDULES

UNIT COSTS

ACTIVITIES (COST CENTRES) AS DEFINED IN CLASSIFICATION SCHEDULES

	STAFF A	MATERIALS B	EQUIPMENT C	SUBTOTAL D	INDIRECT SYSTEM COSTS E	SUBTOTAL F	INDIRECT ORGANIZATIONAL COSTS G	TOTALS H
INPUT	90000	30000	24000	144000	16000	160000	80000	240000
OUTPUT	10000	8500	17500	36000	4000	40000	20000	60000
INDIRECT SYSTEM COSTS	6000	6000	8000	20000				
INDIRECT ORGANIZATIONAL COSTS	70000	10000	20000	100000				
TOTALS	176000	54500	69500	300000				

BASIC COST MATRIX FROM WHICH CAN BE DERIVED EXPANDED MATRIX

EXPANDED COST MATRIX

	STAFF A	MATERIALS B	EQUIPMENT C	SUBTOTAL D	INDIRECT SYSTEM COSTS E	SUBTOTAL F	INDIRECT ORGANIZATIONAL COSTS G	TOTALS H
ACQUISITION (A.1)	8000	20000	2000	30000				
INPUT PROCESSING - INTELLECTUAL (A.2)	60000	1000	3000	64000				
INPUT PROCESSING - MECHANICAL (A.3)	20000	6000	18000	44000	16000	160000	80000	240000
FILE STORAGE (A.4)	2000	3000	1000	6000				
RETROSPECTIVE SEARCHING (A.5)	1000	1000	2500	4500				
SDI (A.6)	3000	2000	4000	9000	4000	40000	20000	60000
SECONDARY PUBLICATIONS (A.8)	6000	5500	11000	22500				
INDIRECT SYSTEM COSTS (C.4-6)	6000	6000	8000	20000				
INDIRECT ORGANIZATIONAL COSTS (C.7-9)	70000	10000	20000	100000				
TOTALS	176000	54500	69500	300000				

	A STAFF	B MATERIALS	C EQUIPMENT	OS SUBTOTAL	DI INPUT COSTS	DIS SUBTOTAL	E INDIRECT SYSTEM COSTS	F SUBTOTAL	G INDIRECT ORGANIZATIONAL COSTS	H TOTAL
RETROSPECTIVE SEARCHING	1000	1000	2500	4500	30000	34500	500	35000	2500	37500
SDI	3000	2000	4000	9000	60000	69000	1000	70000	5000	75000
SECONDARY PUBLICATIONS	6000	5500	11000	22500	150000	172500	2500	175000	12500	187500
TOTAL	10000	8500	17500	36000	240000	276000	4000	280000	20000	300000

OUTPUT COST MATRIX

OUTPUT UNIT COSTS

APPLICATION OF THE COST ANALYSIS SCHEME

The report also describes how the scheme should be applied to different types of individual system, which are categorized as data-base producers, data-base processors, and self-contained (or mixed) systems. Provision is included in the classification schedules for cost elements which arise in the case of cooperative systems and networks, and on-line systems. The application of the scheme to these complex situations is explained. As a test of the scheme's capabilities, the cost data available from the TITUS and IRRD networks has been matched against the cost element definitions of the scheme, and a chapter is devoted to a demonstration of how the matrices and sub-matrices for such systems could be prepared.

A final point to be emphasized is that the fundamental limitation of any cost-accounting scheme is the extent to which system managers are willing and able to provide the necessary data.

Recommendations

Although the cost-accounting scheme is based on sound accounting principles, and incorporates much experience from previous work, it should not be regarded as an ultimate panacea to the problems of cost data collection and analysis. It needs to be developed and refined in the light of practical experience gained in its use. The report recommends that a standing committee or conference be established to exchange experience of use of the scheme, and to update and extend it accordingly.

1. INTRODUCTION AND TERMS OF REFERENCE

This report is the final report of the study "Project 2: Extension and revision of the cost/accounting scheme to interactive systems of the network".

The project specification is reproduced in Appendix 4, but it may be helpful to repeat here the primary objective of the study:

> "To draw up standard costing/accounting schemes applicable to all types of computerized documentation systems which could be integrated into EURONET."

The author of the present report, having carried out cost studies on mechanized information systems. is well aware of the problems that arise in collecting and analysing cost data from such systems, and the scheme proposed in this report is presented as a practical (if not ideal) solution in the light of that experience. The fundamental limitation of any cost-accounting scheme is the extent to which system managers are willing and able to provide the necessary data. The level of detail and accuracy that can be achieved within a cost study is as much dependent on the cooperation and/or motivation of the systems concerned, as on the design of the cost-accounting scheme. It is believed that the scheme presented here incorporates sufficient flexibility to cope with this limitation in a way that will meet the requirements of most cost studies.

The first premise of the scheme is that cost analysis should be based on the accounts of the system as a whole, and not on the apparent costs of individual activities. The scheme employs a standard form of cost matrix, which can be expanded to various levels of detail according to the purpose for which it is

applied. Classification schedules are provided which define the activities and cost types to be presented in the rows and columns of the matrices. Standard procedures are proposed for the apportionment of indirect costs, and guidelines are laid down for amortization and depreciation. Standard methods for calculating unit costs are also proposed.

The underlying philosophy is that cost analysis of information systems can be carried out for a variety of purposes, each of which may call for a different approach and may be subject to different constraints. No single, rigidly-structured cost analysis scheme could satisfy all these requirements. The scheme proposed here comprises a set of tools that can be used in various ways to meet the demands of different situations. Thus it can be adapted, for example, for use in general cost studies which are intended to throw light on the structure of system costs, or in detailed comparisons between the costs of alternative system configurations; it can be applied to the costs of individual systems, or to those of cooperative networks.

2. REVIEW OF PREVIOUS WORK

Although a great deal had been written about the costs and costing of mechanized information systems prior to 1970, there was a marked upsurge of interest in the subject around that time which led to the commissioning of a number of detailed surveys. Those of Allaire, Drees, Dubois & Peeters, Schwuchow, and Vickers* have been reviewed and compared in detail in the EFAG 1 report+. Also worthy of special mention here is the work of Price, whose report described "the philosophy, development and practice of a so-called 'building block system for unit costing' which had evolved in actual use in USA Government circles for several years. The latter publication, together with the continuing work of the Studiengruppe für Systemforschung and the recently published survey by Mme Allaire, have exerted a considerable influence on the thinking embodied in the present report. The evidence of these publications, to which can now be added the EFAG 1 report, points to a growing concensus of views on the basic principles to be followed in conducting cost studies. The present project has provided a timely opportunity to incorporate these principles, together with other kinds of experience gained in the cost surveys mentioned, into a working cost accounting scheme.

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* Details of the references mentioned in this report can be found in Appendix 6.

+ Final report on Project 1 : Analysis of various cost studies in connection with EURONET. N.V. System Dynamics S.A. (February 1976)

3. ACCOUNTING PRACTICE IN OPERATIONAL SYSTEMS

During the course of this project, meetings were held with representatives from the following systems, in order to learn sufficient about their accounting methods to make the cost accounting scheme compatible:

Excerpta Medica
INSPEC
DIMDI
Space Documentation Service (ESRIN)
CNRS
TITUS
TRRL

The first two systems on the above list are of a more commercial character than the rest, and are developing fairly elaborate computer-based management information systems, from which data could be derived that would be more than sufficiently detailed for use in the cost-accounting scheme proposed here. The accounting system at CNRS owes much to the experience gained by Mme Allaire in the course of her cost survey, and would also be capable of providing data on staff, materials and equip- costs to a fine degree of precision. Some details of the TITUS and TRRL accounting systems are presented in Chapter 6. A point worth noting here, however, is that certain government establishments such as TRRL employ accounting procedures which will inevitably cause problems with cost surveys, as only global figures are available for the main overheads.

Generally speaking, however, the results of these interviews were encouraging. In the early 70s, most of these centres were pleased enough if their systems were operating effectively; the attention paid to the principles of good management accounting was minimal, and

accurate cost data was almost unobtainable. Now, the picture has changed, and nearly all of the systems examined have greatly improved accounting procedures. It was also encouraging to find a widespread interest in the value of comparative cost studies.

4. THE COST-ACCOUNTING SCHEME

4.1 Introduction

In designing this cost-accounting scheme, full consideration has been given to several key factors which were listed in the EFAG 1 report (p. 10 et seq.) :

(1) the need to define clearly the objectives of any cost study;

(2) the need to delimit the scope of any cost study;

(3) the problem of non-homogeneity of information systems;

(4) the choice between the statistical and case study approaches;

(5) the need to apply the principles of accountancy to system cost studies.

With regard to the first factor above, the same report (P.83) suggests the following possible uses of cost analysis:

(1) To inform people generally on the structure of costs within systems and to highlight which costs are important and which are not;

(2) To provide data for very broad planning at a macro level;

(3) To provide data for planning a particular new system;

(4) To provide standard definitions and rules for use in costing systems;

(5) To provide cost standards for a management control system for a particular organization;

(6) To provide assistance in the setting of tariffs;

(7) To provide guidance for further, more detailed, cost studies.

To this list might be added the following:

(8) To compare alternative system configurations from the viewpoint of costs, either at the macro level or at the level of unit costs.

It is evident that no single cost-accounting scheme could serve all these possible objectives, especially when the factors listed above are taken into consideration.

The solution proposed here is to provide a set of tools that can be used in various ways to meet the requirements of different situations. The cost-accounting scheme comprises a classification of cost types, activities, and unit costs, together with a standard method of presenting and analysing cost data. The classification scheme is in three parts as shown in outline in Tables A, B and C, and in detail in Appendices 1, 2 and 3. The cost-accounting method includes the following elements:

- a simple form of matrix for the presentation of global costs;
- guidelines for the preparation of sub-matrices at various levels of detail;
- recommended methods for data collection on staff costs;
- standard procedures for the apportionment of indirect costs;
- guidelines for amortization and depreciation.

Table A - CLASSIFICATION OUTLINE (see Appendix 1)

COST TYPES

These are essentially cost types as employed in accounting, and which should appear in some form in the budget and accounts of an information centre or its parent organization:

DIRECT COSTS (i.e. costs which are associated totally with the activity being studied)

- Staff
- Materials
- Equipment

INDIRECT SYSTEM COSTS (i.e. the costs of activities which are necessary to the operation of the system, but which do not directly contribute to input and output functions)

- System administration (including staff training, user training, advisory work, marketing and promotion, and network coordination)
- System maintenance (including thesaurus maintenance program maintenance, revision of manuals, etc.)
- System development (development and improvement of the system and its services).

INDIRECT ORGANIZATIONAL COSTS (OVERHEADS)

- Administration
- Accommodation
- General overheads

Table B - CLASSIFICATION OUTLINE (see Appendix 2)

ACTIVITIES

These relate to input and output functions of the system:

INPUT

- Acquisition
- Input processing - intellectual
- Input processing - mechanical
- File storage

OUTPUT

- Retrospective searches
- SDI
- Group SDI
- Secondary publications
- Machine-readable services
- Primary source services

Table C - CLASSIFICATION OUTLINE (see Appendix 3)

UNIT COSTS

The schedule of production unit and activity unit costs follows the arrangement of the Activities schedule (Appendix 2). Production units only are listed here:

ACQUISITION

Average cost per document acquired
Average cost per reference (in machine-readable form).

INPUT PROCESSING - INTELLECTUAL

Average cost of intellectual processing per item.

INPUT PROCESSING - MECHANICAL

Average data preparation cost per item.
Average data preparation cost per 1000 characters.
Average cost per item added to data base.

OUTPUT - RETROSPECTIVE SEARCHING

Average cost per search.
Average communications cost per search.

OUTPUT - SDI

Average cost per profile per run/issue.
Variable cost per profile per run/issue.

OUTPUT - GROUP SDI

Average cost per output listing per run/issue.
Average cost per output listing per run/issue per user.
Variable cost per output listing per run/issue.

OUTPUT - SECONDARY PUBLICATIONS

Average cost per reference printed.

Average cost per page.

Average cost per reference per copy.

Variable cost per reference per copy.

OUTPUT - MACHINE-READABLE SERVICES

Average cost per copy.

Average cost per reference per copy.

OUTPUT - PRIMARY SOURCE SERVICES

Average cost per document supplied.

4.2 The cost-accounting method

In this section, an outline is given of the method proposed. The remainder of this Chapter comprises the rules and guidelines for its application, which is illustrated in Chapter 5 with a series of worked examples for various cost analysis problems.

The method is based on an analytic approach, using a cost matrix, the advantages of which have been strongly argued in the EFAG 1 report (p.115), and also advocated Price, Schwuchow, Allaire and others. By taking as a starting point the accounts of the system itself, the integrity of the overall cost picture can be largely assured. This statement requires qualification, however, in that the extent to which accounting figures can be used depends on the conditions in which the cost study is carried out. There are three basic conditions:

(1) comparison of systems using common cost accounting practices;

(2) comparison on basis of actual costs, but without common accounting practices;

(3) comparison on basis of contrived parity.

An example of the first condition is to be found in Germany, where a number of systems have adopted common cost accounting procedures so that valid comparisons may be made between them. A willingness on the part of the organizations concerned to modify their accounting procedures is a prerequisite to cost comparisons of this type. It is assumed that such ideal conditions will seldom apply so far as the method described here is concerned.

Condition (2) arises where it is necessary to compare the real costs of two or more systems, without masking the effect of local differences in cost factors, e.g.

variations in salary levels or computer charges in different locations. In applying the cost analysis method proposed here, figures that appear in the accounts of each system might need to be redistributed to match the definitions given, but the total cost for each system would correspond to the figure shown in its accounts.

Condition (3) is in a sense the 'worst case'. Here one is trying to compare a number of systems in such a way as to cancel out all differences due to idiosyncratic accounting practices, and local factors. The purpose may be to compare the notional cost structure of different systems, or to look at the cost of systems that provide similar outputs but with different levels of quality. It is to meet this condition that methods are proposed for converting available cost figures to an equivalent basis. This will often mean considerable adjustment of the figures that appear in a system's accounts.

The method to be described here is intended as a means of studying the costs of an information system, rather than of the parent organization. It is assumed that there will be more interest in the assessment or comparison of costs associated with input activities and output services, and the method is designed accordingly.

The starting point is the simplest possible cost matrix, in which the columns are cost types and the rows are cost centres, including the input and output

activities whose costs are being analysed

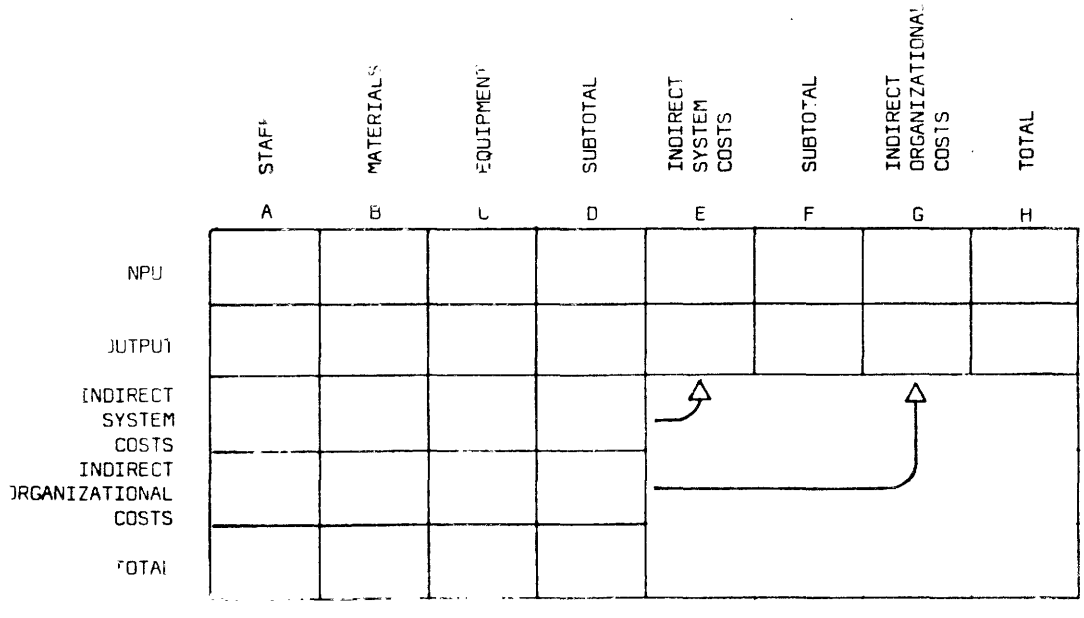


Fig. Basic Cost Matrix

The first step is to assemble the direct costs (staff materials, equipment) for all input and output activities. Indirect costs are then apportioned between input and output, and the total cost of each set of activities is finally obtained.

The cost figures in each column must include where applicable the cost elements shown in Appendix 1 and must relate to the input and output activities in Appendix 2. The method of apportionment of indirect costs is indicated in later parts of this chapter together with guidelines on special problem areas such as computer processing costs.

The expressions Indirect System Costs and Indirect Organizational Costs are an attempt to avoid the ambiguity of other terms. Indirect System Costs are essentially those which do not contribute directly to the input and output functions but over which the

system manager should have control Indirect Organizational Costs are essentially external to the system, and may often be completely outside the control of the system manager. These concepts are discussed in more detail in section 4.5

The way in which these indirect costs should be apportioned is indicated in sections 4.13 and 4 14

To draw up a cost matrix even at this gross level may demand a lot of work in adapting cost figures available from a system's accounts, to comply with the definitions, methods of apportionment, and standards for amortization laid down in this scheme. Yet all this provides is a minimal display of a cost structure that can be used for comparison with an equivalent display for a system performing the same activities. Or it can be used as a basis for calculating certain unit costs, and it should be noted that this form of matrix is designed to permit unit costing at three levels

(1) based on costs relating to intrinsic qualities of the system using the subtotals in column D

(2) based on costs including those which relate to system administration and development using the subtotals in column F

(3) based on total costs, including those governed by the organization rather than the system using the figures in column H

The basic matrix provides a starting point from which a series of submatrices can be derived for the purposes of more detailed analysis Input activities can be subdivided at various levels using the classification scheme Similarly the matrix can be expanded horizontally to show a breakdown of cost

elements under each cost type. The limiting factor in such expansion will normally be the degree of detail available from the cost records of the system itself, but activity analysis techniques can be applied to determine the proportions of staff effort assignable (see 4.8). The total cost of each set of component activities must of course correspond to the total shown in the original basic matrix.

To calculate the unit costs of output operations, a submatrix has to be drawn in which input costs are treated as a fixed cost and apportioned between output activities. Standard methods for doing this are proposed in section 4.15

4.3 Comparability of cost matrices

As pointed out in section 4.1, this cost-accounting method is not presented as a universal means of collecting data from all mechanized systems in such a way that valid comparisons can be made between all of them. To make any valid comparisons, certain rules must be followed. The first, as stated in section 4.2, is to base the cost matrix on global accounting figures. The second is that in any cost analysis study, the composition of the cost figures in every cell of the matrix must comprise the same or equivalent elements. The systems themselves may be very differently designed, and indeed the whole purpose of cost analysis may be to examine trade-offs between one set of procedures and another. But the same rules must be applied to the construction of the cost matrices for each.

4.4 Direct costs

The EFAG 1 report (p. 107) provides a definition of direct costs as 'costs which are directly and fully associated with an input function or an output service whose cost is of interest'.

It will be noted from Table A that, for the purposes of this scheme, only staff, materials and equipment costs are treated as direct costs, these being the only components over which the system designer will normally have any jurisdiction.

4.4.1 Accommodation costs

Accommodation costs have been deliberately excluded from direct costs, even though this may be contrary to conventional accounting practice. The main reason for this is that accommodation costs do not directly reflect the character of the system. Admittedly, a system which required less space for staff and equipment might be preferable to one that required more. But such an advantage could easily be outweighed by differences in location - for example, the cost per square metre of office space in the centre of London would be greater than that in a provincial town (by a factor greater than the difference in salary levels between the two).

A further reason for not treating accommodation costs as direct costs is that any method of apportioning them to different input and output activities will in many cases be artificial - especially where staff are engaged in a mixture of activities.

It is recognized that the practice advocated here is different from that of the cost-accounting schemes developed by Schwuchow and Allaire, where accommodation costs are treated together with staff, materials and equipment as components of all cost centres.

Provision for accommodation costs is included here under Indirect Organizational Costs (C.8), where it is recognized that the system may have to bear not only the cost of the space it occupies itself, but also a share of the accommodation costs of the parent organization.

4.5 Indirect costs

Again quoting the EFAG 1 report (p.120), indirect costs are those which can be identified partially with the activity being studied and also with other activities. As mentioned earlier, two types of indirect costs are recognized in this cost-accounting scheme:

(I) Indirect System Costs, which arise from activities that do not contribute directly to input and output operations, but which ensure the operational viability of the system. Included here are the costs of participation in a collaborative network.

(II) Indirect Organizational Costs, corresponding to what are often called overheads (administration, accommodation, etc.). Although the system could not function without the facilities covered here, their nature and cost are often pre-imposed, and outside the control of the system manager or designer.

It is considered that these two types of indirect cost will conveniently match the cost figures available in cases where the system operates within a larger organization which performs other functions. Where the system is the sole function of the organization, there will be less distinction between some of the elements of these two cost types.

The other justification for separating indirect costs in this way is that it permits unit costing at three levels (as mentioned under 4.2) which correspond to the most common expected requirements of the cost-accounting scheme.

4.6 Administration and supervisory costs

It will be noted that the classification scheme has provision for three types of administration and supervisory costs. Some explanation of these is necessary, and Fig. 2 shows where these costs would arise within a typical organizational structure:

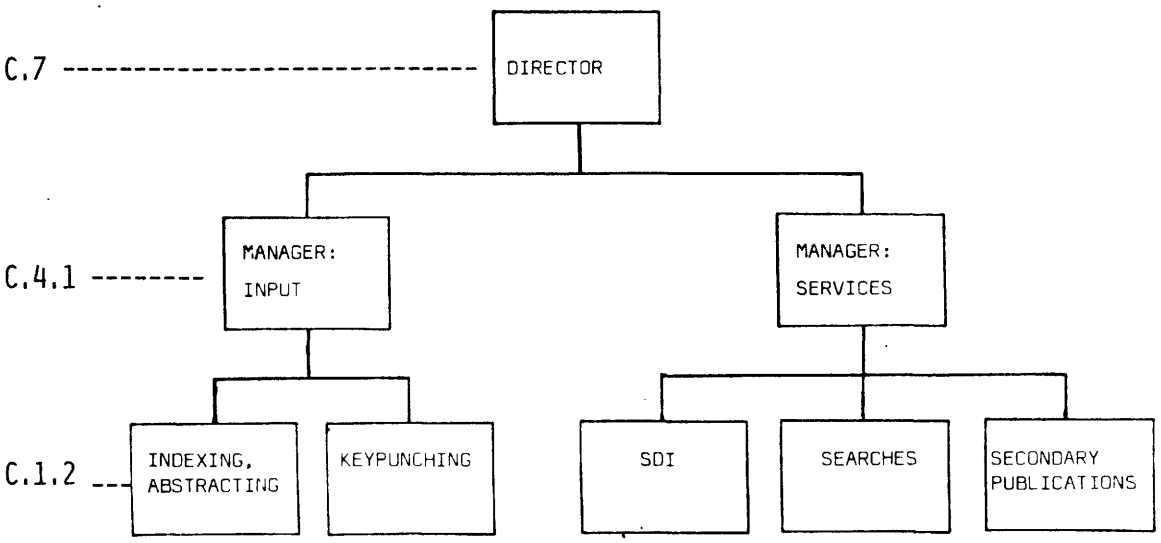


Fig.2 - Organizational structure

At the operational level, C.1.2 (Supervisory Costs) covers the cost of supervision of a section or unit performing a specific function. Sometimes the person in charge will be doing the same work as the production staff.

C.4.1 (Administration) is intended to cover the cost of administrative staff responsible for a branch or department performing several functions.

C.7 (Administration) is intended to cover the cost of general administration. If the organization exists solely to run the system, this will be the entire cost of the head of the organization together with any other staff concerned solely with administration (e.g. accountants, assistants, secretaries). But where the system is only one of several functions within the organization, the system will bear only part of these administrative costs - its share often being decided by internal policy.

4.7 Document acquisition costs

This cost element has caused difficulty with cost surveys, because (a) some systems have access to documents at no cost (e.g. if they are associated with an existing library); and (b) some types of documents, such as certain official reports, are supplied free. Free access to documents could well be a vital factor in deciding, on the basis of a cost comparison, between producing a data base in one location or another, so there can be no general rule that an imputed cost should always be shown in such cases. Indeed, the use of imputed costs would imply contravening the basic principle of the cost matrix, which is that it should be based on real costs as shown in the budget or accounts of the organization concerned. The guiding principle must therefore be that only real costs should be included under this heading.

The EFAG 1 report (p. 112) suggests that provision should be made for separate costing of different types of input item, such as books, journal articles,

conference papers etc. This would seem to imply that these document types should also be separately identified under acquisition costs. Although such differentiation might be useful in certain cases, we do not consider it necessary as a general rule, and do not believe that there would be a consistent relationship between document types and the cost of creating machine-readable references for them

4.8 Data collection on staff costs

When preparing sub-matrices for detailed cost analysis (as described in the later sections of Chapter 5), problems will frequently arise in obtaining a breakdown of direct costs, and especially staff costs, for specific activities. Experience of several cost surveys has shown that the aggregate of staff costs attributed to each activity by system managers often does not match the total costs shown in the organization's accounts With the introduction of improved cost-accounting in some major systems, as mentioned in Chapter 3, this problem will be avoided. But where an accurate breakdown for staff costs is not available, it will be necessary to determine the proportions of time spent (and hence cost) by means of activity sampling. In its simplest form, this would entail designing a simple work diary, to be completed each day by all the staff concerned. Columns would be provided for each activity in which these staff might be engaged, and they would be required to record daily the proportion of their time (or number of hours) spent on each. Such an investigation must be continued for a sufficient length of time to avoid inaccuracy due to cyclic variations in the pattern of work.

4.9 Computer processing costs

The determination of computer processing costs in a way that permits fair comparison between one system and another is fraught with difficulties. The guiding principle for the basic cost matrix should always be to use the true costs as shown in the accounts of the organization. Blind obedience to this principle in the case of computer costs could, however, lead to startling anomalies.

The author of this report recalls visiting a system in the USA where the computer had been purchased outright with a Government grant After the year of purchase, no computer costs appeared in the annual accounts, other than the costs of operating staff, maintenance, and ancillary equipment. Valid comparison between the operating costs of this system and any other was obviously impossible on this basis.

In situations where it is necessary to compare systems with widely differing charging practices, some standard method is required for determining an imputed cost for computer processing, unless the charging practice is a significant factor in choosing between one system and another In other words, if the purpose of costing is to determine the cheapest environment in which a system might be run, then it would be foolish to suppress the fact that computer time was cheaper in one location than another. A special case that arises here would be a comparison involving the use of an in-house computer as against using a commercial computer bureau. Even if the two computer configurations were identical, the in-house facility would appear cheaper (if charged for on a cost-recovery basis) than the commercial service which would include a profit element)

A logical approach to the determination of equivalent computer costs is proposed in the EFAG 1 report (p. 111), and it is suggested that this be adopted as a guideline. The two requirements are:

(a) to determine how much of the computer configuration is assignable to the system or to the specific task that is being costed;

(b) to apply a standard method of charging for this.

It is suggested that regardless of whether the computer is purchased or rented, the basis for charging should be the equivalent rental. If this is impossible, then a five-year depreciation should always be chosen.

To meet the first requirement, some estimate of what percentage of total computer usage is accounted for by the information system can be arrived at by reference to computer logs, system flow charts, and discussion with those responsible. All other costs associated with the operation of the computer must also be apportioned between the information system and other users.

The problem of determining comparable costs for on-line computing is especially difficult. The method of charging for on-line computer use is usually based on a complex algorithm built into the operating system of the computer itself. To compare accurately the costs of two such systems, one would have to study these algorithms and adjust the resulting figures as necessary.

To sum up, there can be no single rule for the treatment of computer processing costs. The method must be tailored according to the purpose of the cost analysis. Where imputed costs have to be assigned, the guidelines given above should be applied.

4.10 Amortization of equipment costs

Types of equipment whose costs may be relevant to mechanized information systems are shown in the classification of cost types (C.3). In some organizations, and indeed in normal accounting practice, different lifetimes are assumed for different types of equipment, and their costs are amortized accordingly. The difficulty of imposing a standard set of depreciation periods on all organizations would be disproportionate to the effect this would have on the accuracy of cost studies of mechanized systems. It is therefore proposed that where equipment costs have to be presented on a common basis, the equivalent rental should be shown. Where this is impossible, a five-year depreciation should be applied.

4.11 Start-up and development costs

Two main headings are provided for these costs under C.6 in the classification. Start-up costs are esentially those of designing and implementing the system at the beginning of its life (during which maintenance costs will be incurred - see C.5). Development costs are those associated with the improvement of the system and/or the services it provides, once it has been put into operation.

With regard to start-up costs, the comments in the EFAG 1 report (p. 106) are worth repeating here:

> "With a new product or a new service introduction in a commercial situation (start-up costs) would constitute capital investment and would be amortized over the expected life of the new product or service. With mechanized information systems one is normally not dealing with a fully commercial situation and it is likely to be

extremely difficult to deal with such items as grants or subsidies given to systems while they are in a transient state."

The subsequent conclusion that future cost surveys will be confined to systems which have reached a relatively steady state is not accepted here. The scheme accordingly includes provision for identifying such costs even though they will seldom be comparable from one system to another, and it will often be difficult to determine where start-up costs end and operational costs begin. Insofar as it is possible to determine a value for such costs, it is suggested that they be amortized over the first five years of the system's life, but this guideline may not be applicable in the case of software, the special problems of which are discussed in the next section

With regard to development costs, two further guidelines proposed by the EFAG 1 report (p 108) are endorsed here:

(1) If development work is carried out by internal staff fully employed on an on-going basis on this type of work then the costs should not be amortized

(2) If the development work in a given year is of a one-time nature (a clear example would be if the work had been subcontracted) then the costs for that year should be amortized Five years would appear to be the appropriate period for amortization

12 Software costs

The cost of software may be that of

(a) specifying writing, testing and debugging a completely new set of programmes

(b) purchasing an available package (with possibly an additional cost of modification or conversion for a different computer), or

(c) renting or leasing an available package

These costs can be substantial, and in the case of minicomputer systems at the present time can be of the same order as the computer itself.

A fourth possibility is that the software might be obtained at no cost at all, although the recipient would still have to bear the cost of maintaining and/or possibly modifying it.

There can surely be no rational way of converting the costs arising from such a variety of situations to a comparable form. If one were comparing two systems where situations (b) and (c) applied, it would be reasonable to amortize the purchase price over 5 years as suggested above. In other cases it may be better to separate software costs from the overall analysis rather than cause undue distortion of unit costs.

It will be noted that the classification scheme includes provision for routine software maintenance under C.5.3. The cost of new programs that are needed during the life of a system (e.g. a reformatting program for new data base) should be treated as a development cost as indicated in the previous section.

4.13 Apportionment of Indirect System Costs

Indirect System Costs were defined earlier (section 4.5) as those which do not contribute directly to input and output operations, but which ensure the operational viability of the system. It could be argued that certain development costs were specifically

related to input or output (such as an investigation of improved data preparation techniques) and that the cost of such work should be shown against the activity concerned. But ultimately all development work benefits the system as a whole. The rule for the apportionment of Indirect System Costs is therefore that they should be divided between input and output on the basis of the total direct costs of these two sets of activities. Where necessary, the same rule can be applied in distributing Indirect System Costs in any sub-matrix where component input and output activities are shown.

4.14 Apportionment of Indirect Organizational Costs

Indirect Organizational Costs almost invariably present problems in comparative cost analysis studies. Their composition and form of presentation vary widely according to the nature of the organization in which the system is established. Their character and quantity vary from one location to another. In some organizations, such as the U.K. Civil Service, no breakdown of overheads is available for individual establishments; the only figure available is a percentage overhead to be applied to all salaries.

The classification scheme recognizes three types of Indirect Organizational Cost: Administration; Accommodation; and General Overheads. Some cost analysis schemes such as that of CNRS apportion these types of cost in different ways. For example, administration costs may be apportioned according to the number of staff administered, for a given activity; accommodation costs may be apportioned according to the space occupied by the staff and equipment required for each activity. Such methods clearly tend to be more **fair** than other, more arbitary, methods of apportionment. They are not considered appropriate for this cost analysis scheme, however, mainly because

it would so often be impractical to apply them; especially where the only available figure for overheads is in the form of a percentage assignable to salaries.

The guideline proposed here, then, is that Indirect Organizational Costs should be apportioned between input and output activities on the basis of the total costs shown in column F of the basic matrix (i.e. direct costs plus Indirect System Costs). Apart from its practical simplicity, it can be argued that since staff costs are a dominant component of direct costs, the net result of applying this rule will tend to be similar to that of applying more elaborate methods of apportionment as mentioned above.

4.15 Apportionment of input costs

The cost matrix described on p.13 offers a way of presenting the overall cost structure of a system; and can be expanded to various levels of detail for the calculation of input unit costs. Before the unit costs of output can be determined, some share of the input costs must be allocated to each service, and a second type of matrix is required (see Fig. 3), in which the columns are still cost types, but the rows are output services. Again the matrix is designed to allow for the calculation of unit costs at different levels, including or excluding indirect costs.

	STAFF A	MATERIALS B	EQUIPMENT C	SUBTOTAL DS	INPUT COST DI	SUBTOTAL DIS	INDIRECT SYSTEM COSTS E	SUBTOTAL F	INDIRECT ORGANIZATIONAL COSTS G	TOTAL H
RETROSPECTIVE SEARCHING										
SDI										
SECONDARY PUBLICATIONS										
TOTALS										

Fig.3 Cost matrix for analysis of output costs

A variety of methods for the apportionment of input costs between different services can be considered:

(1) The EFAG 1 report (p.110), recommends apportionment on the basis of a standard usage level, which could be defined as that level which if increased by 1% will cause a 1% drop in unit cost.

(2) Apportionment on the basis of turnover of each service.

(3) Apportionment on the basis of the number of items of output distributed by each service.

(4) Apportionment based on economic factors, e.g. charging less of the input cost to services which need to be more competitively priced.

(5) Apportionment on the basis of the direct operating costs of each service.

All of these methods are valid, and each may be preferred in certain situations. Each has its limitations. Method (1) requires fairly detailed calculations to plot the unit cost/usage curve for each system; (2) would be misleading in the case of a system which provided free or subsidized services; (3) assigns an equivalent value to each item carried by a service, whether it be the result of a specific search, or a secondary publication; (4) is appropriate to a price-setting situation, but not as a general method; (5) is crude and will often be inequitable, but has the merit of being universally applicable.

The guideline for apportionment must be that any of the above methods may be used in specific circumstances, but as a basis for general comparison, method (5) is preferred, and input costs should be apportioned on the basis of the total direct costs (staff, materials, equipment) for each service. This apportionment can only be applied to the total cost of each service and hence to each unit of production. There would be little point in allocating some part of the input cost in calculating, for example, the unit costs of SDI profile formulation.

A further proviso is that input costs should only be apportioned among services which are dependent on the input concerned. Hence primary source services would not normally be required to bear part of these costs.

4.16 Calculation of unit costs

As pointed out in section 4.2, the basic cost matrix includes columns for three cost totals for each activity:

(1) a subtotal of direct costs only (col. D);

(2) a subtotal of direct costs plus indirect system costs (col. F);

(3) a total of direct costs plus indirect system costs plus indirect organizational costs (col. H).

One of the advantages of this arrangement is that it facilitates unit costing at three levels. In particular, it is possible to calculate unit costs based on direct costs only (level (1)) which reflect the intrinsic qualities of the system; or based on total costs (level (3)) which reflect the characteristics of the parent organization.

The number of possibilities thus offered is more than one is likely to require in practice. In Appendix 3 a schedule of unit cost formulae is presented, which is believed to offer an adequate selection for practical purposes. The arrangement of activities within this schedule follows that of Appendix 2, and two types of unit cost are proposed:

(1) Production unit costs - the unit costs of the end products of each set of activities - including, in the case of output unit costs, an apportionment of the input cost;

(2) Activity unit costs - the unit costs of activities which contribute to each end product.

Either type of unit cost can be calculated on the basis of any of the three cost levels listed above, but in practice the most significant results would be

production unit costs based on level 3, and activity unit costs based on level 1. Thus the cost parameters listed in the first column of Appendix 3 will have different values according to the type of unit cost required.

A further variation that may be introduced into unit costing is that it can be based on actual cost figures, derived from the accounts of the system; or on costs that have been adjusted or normalized in some way. Again, the choice depends on the purpose of the cost analysis. If unit costs are required for tarification, then obviously they should be based on the actual operating costs of the organization - although the system manager may also want to know how the unit costs would vary with different volumes of production.

If, on the other hand, unit costs are needed as a basis for comparison between one system and another, it will usually be necessary to adjust certain costs in such a way as to make the comparison valid. This will be especially true where the aim is to compare the cost performance of two systems providing outputs of different quality.

Previous sections of this Chapter have dealt with methods for adjusting certain cost figures to a standard level (e.g. for amortization of equipment costs). A further adjustment is necessary in order to arrive at comparable unit costs for output, in that a standard usage level must be adopted. Without this correction, even two systems using the same data base would show very different unit costs per search if one were performing, say, ten times as many searches as the other.

The EFAG 1 report (p. 110) suggests that the most practicable way of defining a standard usage level for mechanized information systems is that level which if increased by 1% will cause a 1% drop in unit cost. This definition is recommended for the purposes of this cost accounting method, although as indicated in section 4.15, it is not regarded as necessary for the apportionment of input costs.

Special care will be necessary in the calculation of unit costs for cooperative networks. If, however, the basic cost matrix is drawn up on the lines suggested in section 5.5, it will be possible to apply the guidelines suggested here, and to use the formulae shown in Appendix 3. Indirect costs arising from administration of the network will be apportioned between the participating centres, and the total input cost will be apportioned between their output activities.

4.17 Qualitative factors

The project specification requires that the cost-accounting scheme should embrace the acquisition of all quantitative and qualitative data used in the calculation of unit costs. The quantitative data required is tabulated in Appendices 1, 2 and 3, and to some extent most of the qualitative factors are implicit in those schedules, i.e. if a cost is shown for a computer terminal, then evidently the system uses a terminal. But as stressed in the EFAG 1 report and elsewhere, cost analysis is only meaningful if the characteristics of each system are taken into account.

The EFAG 1 report (p. 103) suggests the use of a classification scheme for these qualitative characteristics in which each aspect would be assigned a ranking scale. To develop such a classification as a practical working tool would require more time than the present project allows. In order that information on qualitative characteristics may be collected on a systematic basis, a simple checklist is provided in Table D. This is derived from other available schemes, notably the schedule devised by Allaire (which is extremely detailed) and the OECD 'Inventory of Major Information Systems and Services in Science and Technology'.

Table D - CHECKLIST OF QUALITATIVE CHARACTERISTICS

Organizational details

Name of centre or system
Name of parent organization
Legal status of organization
Method of financing
Date of first operation of system
Present operational status
Planned development

Area and purpose of system

Subject area and coverage
Purpose of system
Form of cooperation with other systems
Availability of services

Form of input materials

Sources (books, journals, patents, reports, audio-visual records etc.)
Method of acquisition (purchase, donation, exchange)
Machine-readable data-base used
Languages accepted

Services provided (see Appendix 2, items A.5 - A.10)

Technical details

GENERAL
Computer: make and configuration
Software used (package or specially developed)
Communications facilities used for on-line operation, including terminals

INPUT

Working language(s) of system

Record content and structure (author, title, abstract, classification, keywords, etc.)

Classification/indexing scheme used

Type/length of abstracts

Use of author abstracts

Translation techniques used

Method of data preparation (punch cards, paper tape, magnetic tape encoding, OCR etc.; on-line off-line input)

Data preparation carried out in-house/externally

Correction procedures used

Computer validation of input - techniques used

File storage method(s)

OUTPUT

Retrospective searching - mode of operation (on-line or batch); form of output; response time; method of checking.

SDI - form and frequency of output.

Secondary publications - methods of composition and reproduction; form and content.

Machine-readable services - record format and content; machine code used.

Availability of translations.

5. APPLICATIONS OF THE SCHEME

5.1 Introduction

The first requirement in the application of this or any other cost analysis scheme is to determine the objectives of the cost study. In particular, it is necessary to decide:

(a) What use is going to be made of the results?

(b) What areas of cost is the study to concentrate on?

(c) What degree of accuracy is required?

It must also be remembered that this scheme provides a basis for the collection, analysis and comparison of costs only, without making any direct allowance for differences in the quality of what each system produces. Nor does it show revenue, or analyse the economic viability of systems.

5.2 Constructing the basic matrix

In most cases, cost analysis studies should be based on actual costs incurred, rather than forecasts as shown in a budget. In either situation, however, the figures need to be carefully examined to ascertain how they were calculated. Where necessary, they may need to be adjusted or redistributed so that their composition matches the definitions laid down in the classification scheme, and complies with the guidelines in Chapter 4. The extent to which adjustment is necessary will depend on the conditions under which the cost study is to be carried out (see section 4.2).

A typical matrix is shown in Fig. 4.

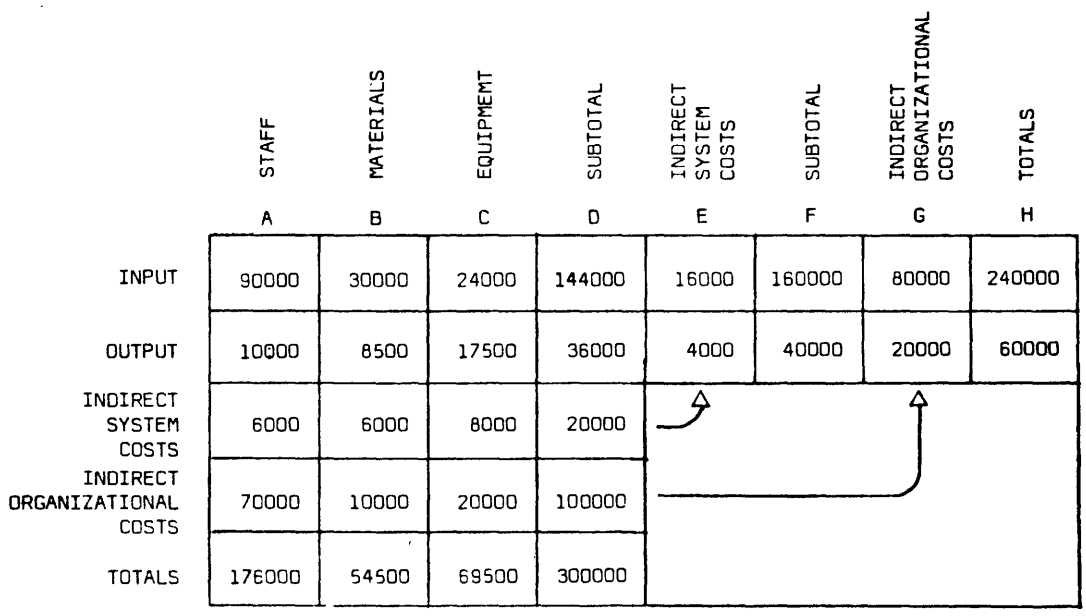


Fig.4 - Typical cost matrix

In the example, it can be seen how the Indirect System Costs, assembled under staff, materials, and equipment, are totalled and then apportioned between the input and output rows in column E. Indirect Organizational Costs are similarly treated, and then apportioned on the basis of the column F figures. As mentioned in section 4.14, a breakdown of Indirect Organizational Costs by staff, materials, and equipment may sometimes be unavailable, in which case only a total figure can be entered in column D.

The next stage would be to expand the matrix to whatever level of detail was required. Either columns or rows may be subdivided, but the most common need will be to expand the rows. Taking the example of Fig. 4,

this might become as shown in Fig. 5.

	STAFF A	MATERIALS B	EQUIPMENT C	SUBTOTAL D	INDIRECT SYSTEM COSTS E	SUBTOTAL F	INDIRECT ORGANIZATIONAL COSTS G	TOTALS H
ACQUISITION (A.1)	8000	20000	2000	30000				
INPUT PROCESSING - INTELLECTUAL (A.2)	60000	1000	3000	64000	16000	160000	80000	240000
INPUT PROCESSING - MECHANICAL (A.3)	20000	6000	18000	44000				
FILE STORAGE (A.4)	2000	3000	1000	6000				
RETROSPECTIVE SEARCHING (A.5)	1000	1000	2500	4500				
SDI (A.6)	3000	2000	4000	9000	4000	40000	20000	60000
SECONDARY PUBLICATIONS (A.8)	6000	5500	11000	22500				
INDIRECT SYSTEM COSTS (C.4-6)	6000	6000	8000	20000				
INDIRECT. ORGANIZATIONAL COSTS (C.7-9)	70000	10000	20000	100000				
TOTALS	176000	54500	69500	300000				

Fig.5 - Expanded matrix

Note: The grand total at the bottom of column D should always correspond to the total shown in the organization's accounts, except where equipment costs have been adjusted to standard rates of amortization (see section 4.10).

Unless the organization can provide a detailed breakdown of staff costs from its own records, the figures in column A will have to be determined by activity sampling, as described in section 4.8.

It will be noted that, in Fig. 5, analysis of the costs of each activity is not continued beyond column D. Detailed unit costs may be calculated on the basis of the direct cost subtotals in column D, but it is assumed that to the right of this column (so far as input is concerned) the most useful unit cost will be the total cost per item added to the data base. In dealing with output costs, however, it will often be necessary to determine unit costs which reflect the total cost of production of each service.

It is worth mentioning at this point that the matrix shown in Fig. 5 is very similar to the most recent form of matrix developed by Schwuchow, as shown in Appendix 5.

To analyse output costs, a further matrix is required in which input costs are apportioned between output services, as discussed in section 4.15. This is illustrated in Fig. 6.

	STAFF A	MATERIALS B	EQUIPMENT C	SUBTOTAL DS	INPUT COSTS DI	SUBTOTAL DIS	INDIRECT SYSTEM COSTS E	SUBTOTAL F	INDIRECT ORGANIZATIONAL COSTS G	TOTAL H
RETROSPECTIVE SEARCHING	1000	1000	2500	4500	30000	34500	500	35000	2500	37500
SDI	3000	2000	4000	9000	60000	69000	1000	70000	5000	75000
SECONDARY PUBLICATIONS	6000	5500	11000	22500	150000	172500	2500	175000	12500	187500
TOTAL	10000	8500	17500	36000	240000	276000	4000	280000	20000	300000

Fig.6 - Analysis of output costs

In Fig. 6 , the input costs have been apportioned between the output activities on the basis of their direct costs, and are then added to them to give the subtotals in column DIS. Indirect System Costs are then apportioned on the basis of these figures, and Indirect Organizational Costs on the basis of the subtotals in column F. The total at the foo· of column H corresponds to the total figure shown in the original basic matrix (Fig. 4).

5. 3 Inter-system comparisons

The EFAG 1 Report (p.83 et seq) has drawn attention to the non-homogeneity of mechanized information systems, and the limits which this places on the validity of cost comparisons. In section 4.2 of this report, the different conditions under which cost studies may be carried out are discussed. The essential point here is that the extent to which costs should be normalized to allow inter-system comparisons depends on the purpose of the investigation.

Certain fundamental rules will always apply:

(1) cost figures should always relate the same time period for every system that is being studied;

(2) the composition of each cost element involved in the study should be identical or equivalent.

Such firm rules cannot be applied, however, in other areas. A guideline for the calculation of computer processing costs on a common basis is presented in section 4.9, but it is not suggested that the charging rate for a given machine will always be the same. This will be affected, for example, by the load factor of each computer.

The basis for calculation of staff costs is indicated in the classification scheme, but it is not suggested that all staff costs should be adjusted to standard salary scales - although this may be required in certain circumstances.

In any international cost study, there is the problem of currency conversion. The convention in previous cost studies has usually been to convert all costs to US dollars or, in an EEC environment, into units of account. The results thus obtained are only valid so long as exchange rates remain stable.

5.4 Application to different system types

In published cost studies, such as those of Vickers and Allaire, three basic categories of system have been recognized:

(1) Data-base producers which in many but not all cases compile a data base mainly in order to produce secondary publications (the production of magnetic tapes being regarded as a supplementary activity). The main exceptions would be co-operative systems such as IRRD.

(2) Data-base processors which are essentially organizations that purchase data bases in machine-readable form, and use them to provide services such as retrospective searching and SDI.

(3) Self-contained (or mixed) systems (often private rather than public) which prepare their own data-bases and use these to provide various services.

These categories are not mutually exclusive, but are adequate for the purposes of demonstrating how the cost-accounting scheme might be applied in different situations.

In the case of data-base producers (other than co-operative systems), the basic and expanded cost matrices should follow the pattern shown in Figs. 4 and 5. Note that not all cost elements listed in the classification scheme will be applicable in every case. For example, item A.3.2.1 (file conversion) will normally appear only in the case of data-base processors.

The cost matrices will be more complex in cases where several data-bases are produced and corresponding outputs are generated from them, but this is merely a matter of inserting more rows in the matrix. The result would be as shown in Fig. 7:

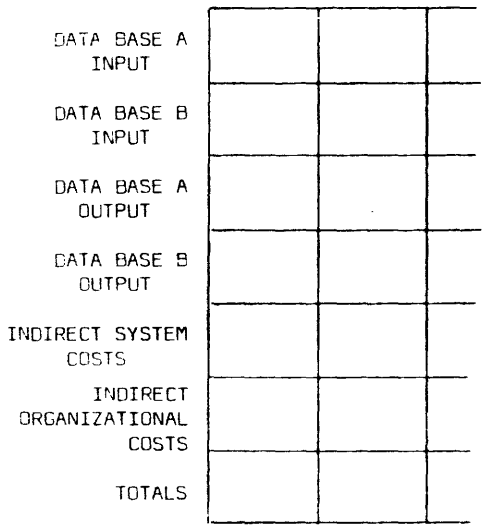


Fig.7

Indirect costs should be apportioned between all these input and output activities in exactly the same way as was shown in section 5.2.

The assumption here is that the cost study unit is the system rather than the data base - contrary to a suggestion made in section 7.4.2 of the EFAG 1 report. Presentation of all the relevant costs in one matrix at this stage of analysis should give a clearer picture of the overall cost structure, and will make it easier to observe the rule that total expenditure shown on the matrix should match the total shown in the accounts.

To analyse the output costs of systems in this category, however, it will be necessary to prepare separate matrices in which the input costs of each data base are allocated to the corresponding output services. The form of each matrix will correspond to that shown in Fig.8 :

	A	B	C	DS	DI	DIS	E	F	G	H
SECONDARY PUBLICATION A										
TAPE SERVICE A										
TOTAL										

	A	B	C	DS	DI	DIS	E	F	G	H
SECONDARY PUBLICATION B										
TAPE SERVICE B										
TOTAL										

Fig.8

Moving on to the second system category, data-base processors, the basic matrix will again resemble Fig. 4 , except that the greater part of the input cost will appear under Materials. In the expanded matrix, the input costs will appear as acquisition costs (A.1), possibly with file conversion costs (A.3.2.1) and some file storage costs (A.4). In other respects, the expanded matrix can be constructed in the same way as Fig. 5 , and a matrix for the analysis of output costs would follow the example of Fig. 6.

Where several data-bases are acquired and processed, the same procedure will apply as in the case described above for a data-base producer. On the basic matrix, each data base would be shown as a separate input row, and its cost would be allocated to the appropriate output service or services in a series of output cost matrices as shown in Fig. 8. Indirect costs would be apportioned as shown in Fig.6.

Cost analysis of self-contained systems requires no special explanation, as it is on such systems that the examples shown in section 5.2 are based.

5.5 Cooperative systems and networks

Cost comparison between individual systems is difficult enough because of their inhomogeneity. Networks, which are in effect complex groupings of systems, are even more individual in character, which makes it even harder to effect fair comparisons between the cost of one network and another. Since there will often be no general accounting system for the network as a whole, it will be difficult to treat the network itself as a study unit and to comply with the basic requirement of this cost analysis scheme, which is to use the system's

accounts as a starting point. Another complication is that costs are sometimes concealed as exchanges in kind between one part of the network and another.

For the purposes of costing, it is necessary to recognize that cooperative networks vary greatly in their degree of centralization. At one end of the spectrum there are fully decentralized networks such as IRRD in which nearly all of the work is done by the participating centres, with only a minimal administrative secretariat. At the other extreme there are highly centralized networks, in which input may be contributed by several collaborating centres, but nearly all the processing and administration are carried out by a central system.

The latter type of network will in some cases be easily accomodated by the cost analysis scheme, and indeed may be treated in almost the same way as a system which employs outside abstractors or indexers. For a decentralized type of network, however, it will be necessary to adapt the cost matrix to some extent.

The general rule is to begin with the accounts of the participating centres, and to draw up a basic matrix for each. The costs of any separate unit which is established solely for the purposes of the network must be separately identified and analysed. These various sets of figures can then be combined to show the cost structure for the network as a whole.

It is essential that the final picture should show <u>all</u> costs incurred at all locations, relating to the operation of the network. Unit costs of outputs must be based only on the cost of their production, and should not reflect the cost of their purchase by one centre from another.

Chapter 6 describes tests in which the cost analysis scheme has been applied to the cost elements available in two existing cooperative networks, TITUS and IRRD, and to a third, hypothetical network with characteristics intermediate between the other two. The procedures outlined there serve also as a demonstration of how the tools provided in this report can be adapted to widely differing types of situation.

It will be noted that the classification scheme includes provision both for the costs of network participation (C.4.6) and network administration (C.7.2)

5.6 On-line systems

Three quite different types of system have to be considered under the heading of "on-line systems" :

(a) local, in-house systems, where several terminals (often on site) are connected by dedicated lines to a computer (e.g. ISIS, TITUS 1) ;

(b) 'independent' networks, where not only the computer system, but most of the communications and terminal equipment is owned and operated by one organization (e.g. ESRO/SDC) ;

(c) Systems connected to users via public networks (e.g. MEDLINE, LOCKHEED, SDC, and soon, EURONET).

A common feature of all these types of system will be the high cost of fast-access file storage. They will vary considerably, however, in the volume of communications cost to be borne by the system. This will be relatively small in types (a) and (c), but large in the case of (b). With type (c), the greater part of the communications cost will be borne by the user, rather than the system.

Despite these variations, a similar approach can be adopted in analysing the costs of such systems, and provision has been made in the classification scheme for the special cost elements that they entail.

Within the basic matrix, these cost elements can be combined with other equipment costs relating to input and output. In any expanded matrix, however, it would almost certainly be desirable to identify them separately, so that their contribution to unit costs can be seen.

Equipment for remote access (C.3.3) is classified as part of Equipment Costs (C.3), and is subdivided into C.3.3.1 Terminals and C.3.3.2 Communications equipment. These elements can thus be shown as separate columns, intersecting which will be both input activities, (in the case of on-line input) and output activities, which will be mainly Retrospective Searching. Within this area, activities relating to Communications (A.5.5) can be separately identified.

5.7 Tarification

The project specification makes no reference to the possible use of the cost accounting scheme for the purposes of tarification, but it is worth noting that the scheme would be eminently suitable for such an application. As pointed out in section 4.16, the structure of the cost matrix permits unit cost calculation at three levels, one being a level which reflects the total organizational cost of production of each output service.

It must be remembered, however, that this scheme is concerned solely with the collection and analysis of cost data. No account is taken of income in any form (including subsidies or grants) which would strongly influence pricing policy.

6. TESTING THE SCHEME

6.1 Introduction

The project specification requires that the cost analysis scheme should be tested in at least two co-operative information systems (networks). If the end product of this study had been a structured questionnaire for the collection of data, a positve check could have been carried out without difficulty, but the highly flexible nature of the cost analysis scheme proposed in this report precludes any fully conclusive test. It is adaptable to almost any exercise involving the collection and analysis of cost data and the test can be little more than a demonstration of how the tools provided can be applied.

In the following sections, a description is given of how the scheme could be applied to two existing networks: the TITUS network of the Institut Textile de France, which is highly centralized; and the International Road Research Documentation (IRRD) network, which is very decentralized. In addition, the application of the scheme to a hypothetical network, intermediate in character between the other two, will be examined. In the case of TITUS and IRRD, the cost elements recorded in the accounts of each system will be related to the cost elements identified in the scheme, and an indication will be given of the way in which available figures would have to be modified to fit the scheme. Also, the kinds of cost matrix that could be drawn will be demonstrated.

The test will be meaningful to the extent that it will show how the cost analysis scheme is compatible with actual figures known to be available from the two existing networks. What it will not prove is that all system managers will be prepared to provide on request cost data to the level of detail required for any particular cost study. The only real test will be practical application of the scheme.

6.2 The TITUS System

TITUS is the brainchild of the Institut Textile de France, and is in many respects a very advanced computer-based information system. The original TITUS was superseded in October 1973 by TITUS 2, which in turn was superseded in January 1975 by TITUS 2 bis. TITUS 3 will be introduced later in 1976. A unique feature of the system is ability to translate abstracts automatically into English, French, German or Spanish. The software has now been adopted and used by other organizations, and is likely to find wide application within EURONET.

All computer processing for TITUS is carried out on a UNIDATA 7730 computer at the ITF headquarters in Paris. This is linked by a dedicated line to ZTDI in Dusseldorf, so that these two centres have direct on-line access to the system. As from September 1976, dial-up access to the system will be possible via the CYCLADES network.

The main cooperating centres are in Belgium, Germany, Italy, Spain, United Kingdom and United States, each of which has a team of specialists to prepare input. In general, input is prepared at the cost of the country concerned. The centres purchase from ITF the output services they require (searches, SDI, magnetic tapes, etc.).

ITF operates a computer-based cost-accounting system, with a fairly detailed cost classification which applies throughout the organization (i.e. not only to its documentation activities). All employees complete a weekly work-sheet showing the number of hours spent on each type of activity and the corresponding cost code. Payments for equipment rental, materials, external services, accommodation, taxes etc., are also recorded and assigned similar codes. The computer system then provides detailed tabulations of all costs relating to each code, and apportions indirect costs to each activity.

It should be mentioned that, like most organizations, ITF has its own interpretation of 'frais généraux' (overheads), and includes in this category, for example, computer processing costs. The cost-accounting scheme makes it possible, however, to extract these figures separately for each activity, so that they could be presented in a different way within the cost matrix format proposed in this report.

The ITF cost classification uses a three-level code. All costs relating to the documentation centre are first assigned to one of two classes:

- constitution du fonds documentaire;
- constitution de documentation pour la recherche.

These are subdivided by a series of activity codes, which in turn are subdivided to a greater degree of precision. Part of the classification is shown below, with an indication of the corresponding headings from Appendices 1 and 2.*

Activity	Sub-classification	Equivalent
Archivage documents bibliographiques	-	Document storage (A.1.2).
Indexation de documents	Sub-divided by data-base	Input processing - intellectual (A.2) + Input processing - mechanical (A.3) + File storage (A.4).
Selection documentaire	Question	Retrospective searching (A.5)
	Profil	Also Retrospective searching (A.5)
	Bibliographie	
	Consultations de documents	Primary source services (A.10)

* In the time available it was not possible to check the definition of all the ITF activities. Certain assumptions have therefore been made in showing equivalents.

Activity	Sub-classification	Equivalent
Gestion thesaurus	Sub-divided by language	Maintenance of classification scheme etc (C.5.1)
Cooperation TITUS	Subdivided by cooperating centre	Network administration (C.7.2)
Reprographie	Paid/free	Office equipment (C.3.4) or Reproduction (A.6.3, A.7.3, A.8.4 depending on purpose)

The above examples should be sufficient to show how the cost elements recognized by ITF can quite easily be related to the classification proposed in this report.

Now let us consider how the cost analysis scheme could be applied to the TITUS network. The first point to be made is that no accounts exist for the network as a whole. Thus it would be contrary to the principles laid down in Chapter 4 to prepare a single basic cost matrix for the network. The starting point must be the accounts of ITF and each cooperating centre, from which separate basic matrices can be compiled as shown in earlier examples. These can then be expanded as necessary according to the requirements of the cost study, and it can be mentioned in this context that ITF have carried out detailed studies of their own operations and have data on the cost of specific operations to a finer breakdown than is available from their cost accounting scheme.

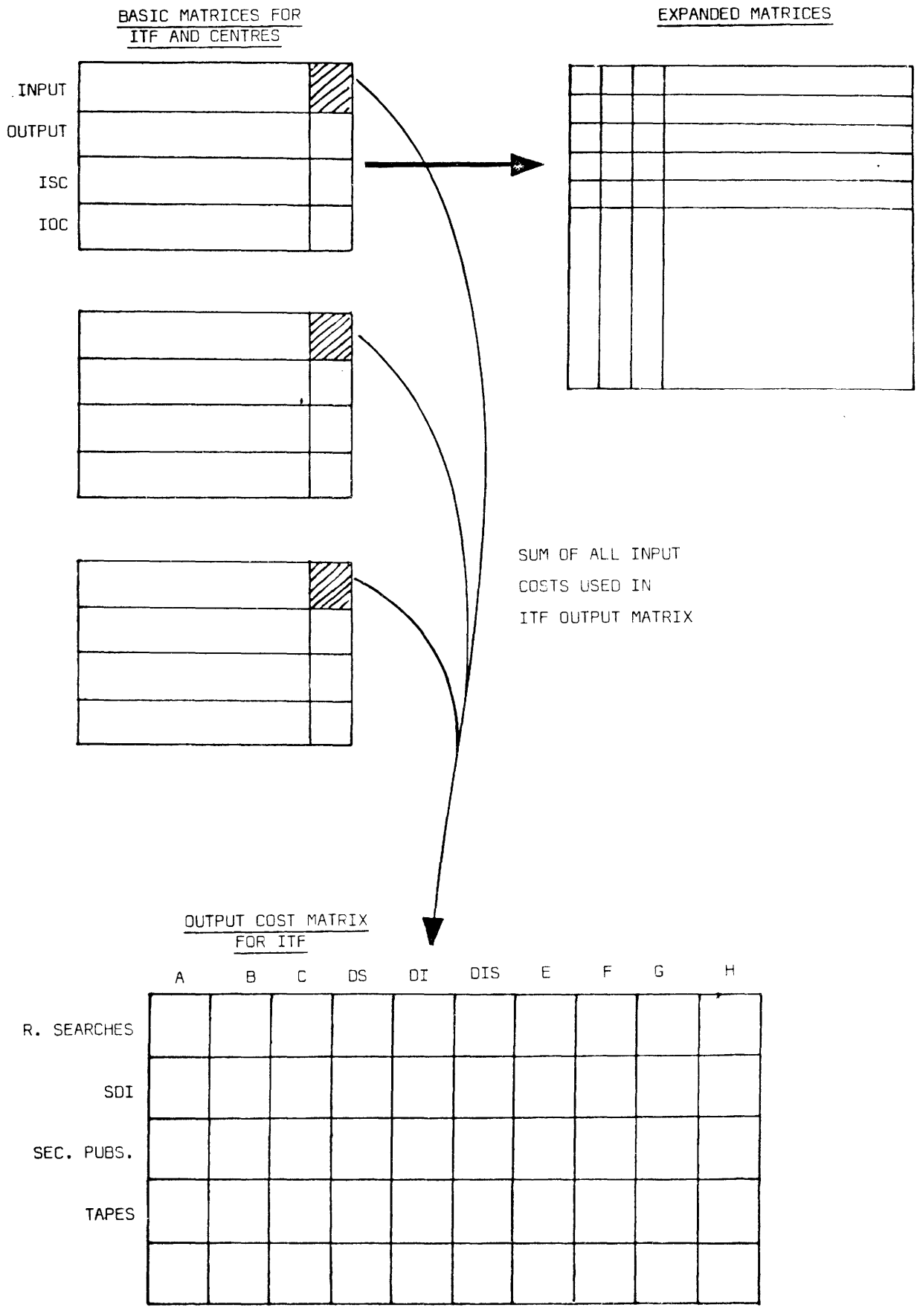
The cost matrices for each cooperating centre would include costs of locally generated services, some of which could be regarded as products of the network and treated accordingly. They should also include the cost of services purchased from ITF, which in effect substitute for services which they would otherwise have to generate themselves

The actual production costs of TITUS output can only be shown, however, by preparing an output cost matrix in which the input cost (to be apportioned between various output services) would be the total expenditure on input borne by ITF and the centres This same input cost total could be used to determine an average cost per input item

From the total costs identified in this output matrix the unit costs of output could be calculated

The suggested procedure for cost analysis of the TITUS network is shown diagrammatically in Fig 9

Fig.9 - Cost analysis procedure for TITUS network



6.3 The IRRD Network

The IRRD network first became operational in 1965. At present there are 16 participating countries, of which three (France, Germany, and UK) act as coordinating centres. Central administration is provided by a small secretariat within OECD, supported by committees comprising members' representatives. The data base is purchased and used by a further 16 subscribers. The organization of the network is illustrated in Fig. 10.

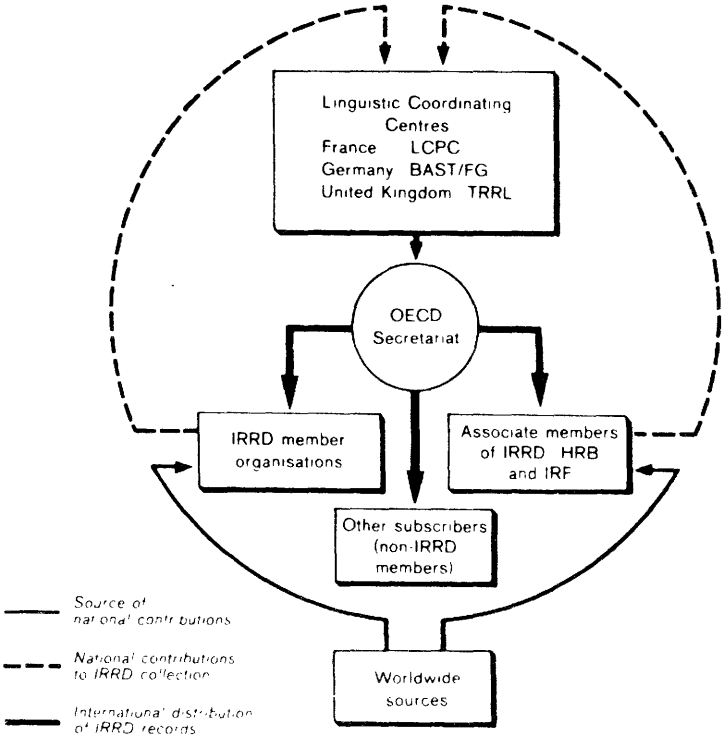


Fig.10 - IRRD Network

The member countries prepare input records on worksheets or in machine-readable form, which are forwarded to one of the coordinating centres according to the language used (English, French or German*). Magnetic tapes are prepared each month at these centres, and then merged to form a single tape, copies of which are sent out to all members and subscribing centres Copies of a line-printer listing of the contents of each tape are also distributed. There is no centralized provision of user services; these are all provided by the individual centres.

Member countries prepare the input at their own expense, and all tape recipients pay for the service The work of preparing the merged master tape is carried out by the UK Transport & Road Research Laboratory (TRRL) under sub-contract to OECD the cost being offset against the UK subscription

For the purposes of the present test, only the accounting system of TRRL has been examined. This is a Government research establishment, and its accounting procedures are laid down by the Civil Service No detailed breakdown of the indirect costs of this establishment are available; these are treated as part of the total administrative costs of the Civil Service, and are apportioned on the basis of salary costs. So far as direct costs are concerned however it is possible to relate the cost

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* Spanish will shortly become the fourth working language of the network

headings used within the TRRL Library to the classification scheme in Appendices 1 and 2:

Cost heading	Equivalent
Data bank input	Input processing - intellectual (A.2) + Input processing mechanical (A.3).
Internal technical enquiries)) External technical enquiries)	Retrospective searching (A.5)
Library services	Primary source services (A-10)
Translations & interpreting	(Not part of mechanized system
Development work	On-going development (C.6.2)
International aspects	Network participation (C.4.6)
Indirect time	Administration (C.4.1)

A tabulation of expenditure under the above headings is printed out monthly by a computer-based accounting system

Cost figures available under the above headings would only permit analysis at a fairly general level. A more detailed breakdown can be obtained from records kept by the Library itself Library budget estimates provide a breakdown to the level shown in the following example extracted from a lengthy document covering all Library

and IRRD activities:

TRRL Abstracting

- Scanning, selecting, abstracting, indexing, editing abstracts and summaries, etc.
- Translating German and French abstracts
- Keyboarding TRRL input and the translated abstracts, checking, and creation of magnetic tape
- Development costs of TRRL's system.

The cost analysis of the IRRD network requires a somewhat different approach from that suggested for TITUS. The distribution of effort within the network is different, and there is a separate administrative unit. Again, no accounts exist for the network as a whole, so the first step must be to compile separate cost matrices for each contributing centre. These can be expanded as necessary for detailed analysis. Each will include, under Input costs, not only the cost of locally-prepared input but also the subscription cost of the IRRD tape (C.2.2). Under Indirect System Costs they will show an element of network participation cost (C.4.6). The input portions of the cost matrices from each centre could then be assembled within an IRRD matrix, as shown in Fig. 11 . The total cost of the OECD administrative effort would be apportioned (in col. I) between the total input cost for all centres, and the output cost (i.e. the OECD expenditure on tape merging, copying and distribution*). The resulting total input cost (in col. J) could be used to determine the overall unit cost

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* Although no funds are transferred in payment for this work, its contract value would have to be shown in the matrix.

of input for the network.

	STAFF A	MATERIALS B	EQUIPMENT C	SUBTOTAL D	INDIRECT SYSTEM COSTS E	SUBTOTAL F	INDIRECT ORGANIZATIONAL COSTS G	TOTAL H	NETWORK ADMIN. (C.7.2) I	TOTAL J
INPUT (CENTRE 1)										
INPUT (CENTRE 2)										
INPUT (CENTRE 3)										
INPUT (CENTRE 4)										
....										
OUTPUT • MACHINE-READABLE SERVICES (A.9)										

Fig.11 - IRRD cost matrix

Apart from the output cost shown in the IRRD matrix (Fig. 11), all other output costs would appear in the cost matrices for the cooperating centres (and other tape subscribers, if so desired), and unit costs of output would have to be based on these.

6.4 Network X

The above examples, based on existing networks, are relatively straightforward in that they are, respectively, highly centralized on the one hand and highly decentralized on the other. To complete this demonstration of how the cost accounting scheme can be applied to networks, it may be useful to present a hypothetical intermediate example, which we shall call Network X.

Network X comprises a number of national centres which prepare input relating to their national literature. There is a central unit which coordinates the activities of the network, and which merges all the input to form a data-base, copies of which are supplied as magnetic tapes to the national centres. The central unit also produces a secondary publication from the data-base. One of the national centres operates an on-line retrieval system, which is connected to a communications network (EURONET, perhaps?). Some of the national centres operate local SDI services.

The first step in analysing the costs of such a network, as in the previous examples, would be to draw up a basic matrix for each of the national centres, and for the central unit. In this way, the total expenditure at each location is recorded in standard form, with local overheads apportioned according to the guidelines of the scheme. From these basic matrices, expanded matrices could be prepared to analyse the costs of each centre in more detail.

Unit costs of input activities can be calculated from the matrix for each national centre, on the basis of its local costs, divided by the total number of items in the data base. The unit cost as experienced by each centre would seem to be more meaningful than a unit cost for the whole network.

To analyse output costs, a combined matrix would have to be drawn up for the whole network. Into this would go the production costs of each output service, by taking the appropriate lines from the matrices for the national centres. Thus the cost of running the on-line retrospective search facility would be transfered to the network matrix, as would the costs incurred by the central unit in merging the tapes and producing the secondary publication. The costs of local SDI services would appear as separate lines. Between all these activities, the total input cost incurred by all centres would have to be apportioned on the basis of the direct costs of each output service, as would the costs of network administration borne by the central unit. From the figures in this network matrix, unit costs for each output could be calculated.

The matrices for each national centre may include the cost of services purchased from other centres (e.g. for retrospective searches) or from the central unit. Assuming that the purpose of the analysis is to determine the production costs of each service, these purchase costs should not be transferred to the network matrix. To do so would distort the results, in that a cost would be recorded twice for the same activity. It should be noted, therefore, that the total shown at the foot of column J in the network matrix would not equal the sum of all the total expenditures shown in each basic matrix.

The cost analysis procedure described above is shown diagrammatically in Fig. 12.

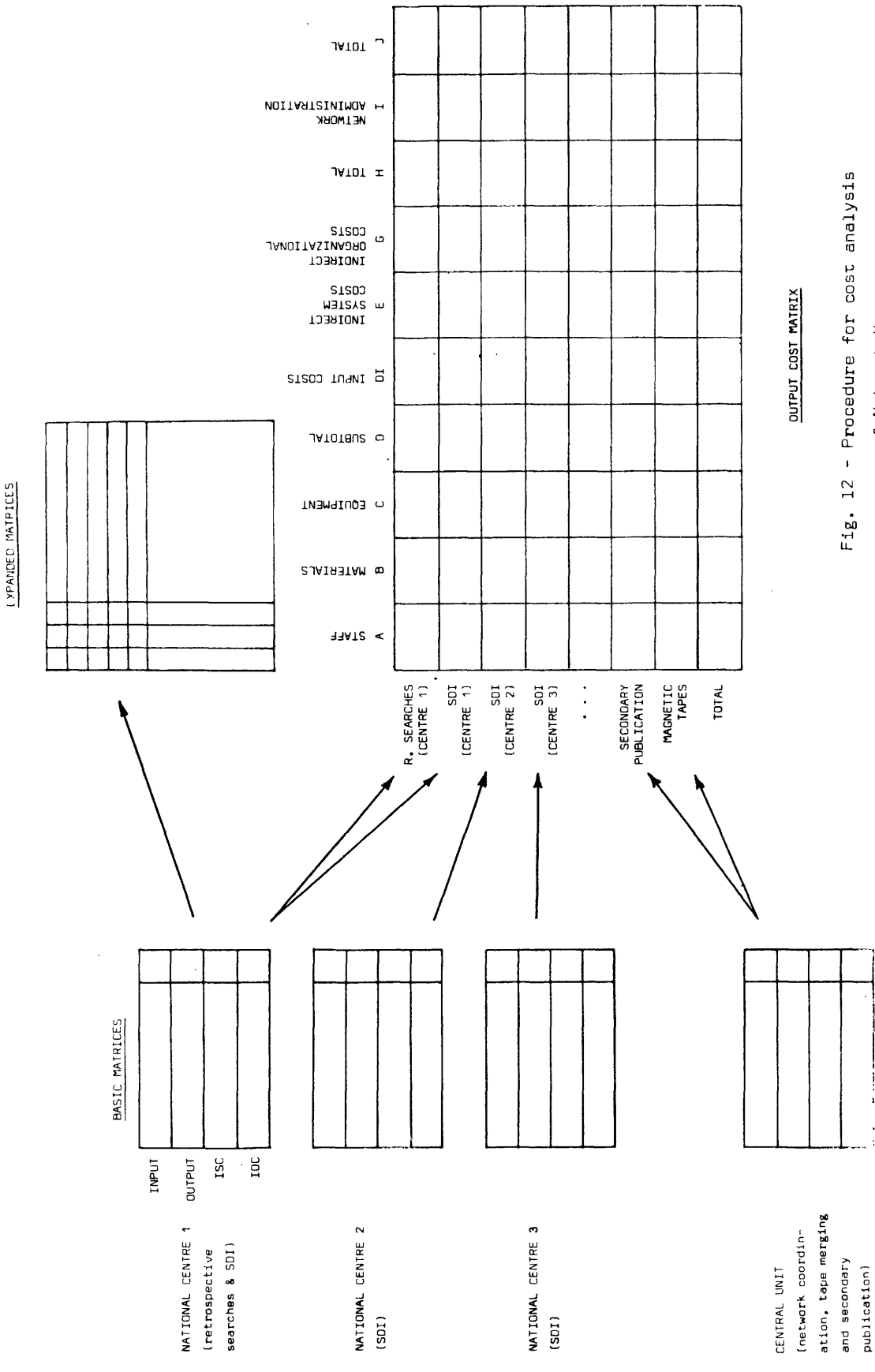


Fig. 12 - Procedure for cost analysis of Network X.

7. RECOMMENDATIONS

The cost-accounting scheme described in this report is presented as a practical working tool. It is based on sound accounting principles, and incorporates much experience gained from past cost surveys. It has been designed to be adaptable to a variety of cost study situations.

It should not, however, be regarded as an ultimate panacea to the problems of cost data collection and analysis. If it is to be used in practice, it needs to be developed and refined in the light of future experience. The classification schedules (like any others) will need to be modified and extended to respond to changing technology.

It is therefore recommended that a standing committee or conference be established to exchange experience on the use of the scheme, and to update and extend it accordingly.

APPENDIX 1 - CLASSIFICATION OF COST TYPES

Note: all costs should be for one year of operation

DIRECT COSTS		See section 4.4.
C.1	STAFF COSTS	Staff cost categories shown below apply only to staff concerned with the information system itself. The staff cost element of indirect organizational costs (incl. administration, finance, transport etc.) should be presented as a single figure under C.1. including the related costs indicated under C.1.1.
C.1.1	Production staff	Salary costs associated with a specified activity, plus statutory and other related costs, including welfare contributions, government levies, superannuation costs, holiday loadings, etc. (See section 4.8).
C.1.2	Supervisory staff	Costs of supervisory staff necessary for the execution of the work (see section 4.6)
C.1.3	External collaborators	Payments to external indexers, abstractors, editors, translators, etc. contributing directly to the activities which are being costed
C.1.4	Consultants	Consultants' fees for work which contributed directly to the activity concerned.
C.1.5	Other	To include temporary staff, and redundancy payments.

C.2	MATERIALS COSTS	
C.2.1	Source documents	Cost of publications and documents purchased to provide input to the system.
C.2.1.1	Copyright payments	Fees paid for reproduction of abstracts from secondary publications.
C.2.2	Input in machine-readable form	Cost of data-bases on magnetic tape or other media.
C.2.2.1	Royalties	Fees paid to tape supplier(s) related to volume of use.
C.2.3	EDP materials	Cost of punched cards, paper tape, magnetic tape, output stationery, etc
C.2.4	Office stationery	
C.2.5	Other materials costs	
C.3	EQUIPMENT COSTS	
C.3.1	Computer installation	Purchase or rental of computer (see section 4.9) together with peripheral equipment that may be regarded as part of the computer configuration (incl input/output devices, storage devices, photocomposition machines etc.) Note that costs of computer operating staff should be shown under C.1
C.3.1.1	Ancillary services	Air-conditioning, stand-by power supplies etc
C.3.1.2	Servicing and maintenance	Maintenance costs of all equipment included in C.3.1 and C.3.1.1

C.3.2	Data preparation equipment	Card punches, paper-tape punches, magnetic tape encoders, key-to-disc systems (see section 4.10).
C.3.2.1	Servicing and maintenance	Maintenance costs of all equipment included in C.3.2.
C.3.3	Equipment for remote access	
C.3.3.1	Terminals	To include teletype or VDU terminals, together with associated printers, tape readers etc. (see section 4.10).
C.3.3.2	Communications equipment	Purchase or rental of all telecommunications equipment or services needed to provide remote access, including concentrators, multiplexors, minicomputers for message switching, code conversion etc., front-end processors for the main computer, telephone lines.
C.3.4	Office equipment	Typewriters, photocopiers, etc. (see section 4.10).
C.3.4.1	Servicing and maintenance	
C.3.5	External services	Costs of data preparation, computer processing, output processing (incl. COM output), typesetting, printing, distribution, carried out by external agencies or bureaux. (Note - C.1.3 covers payments to people; C.3.5 covers payments for equipment-based services).
C.3.6	Other equipment costs	

INDIRECT SYSTEM COSTS

See section 4.5.

C.4 SYSTEM ADMINISTRATION

C.4.1	Administration	Administrative staff costs not attributable to specific system activities, or to support activities shown below (see section 4.6).
C.4.2	Staff training	Cost of sending system staff on relevant training courses (in-house or external) and associated administrative costs.
C.4.3	User training	Cost of running courses, semininars, etc., and producing publications to explain system and its use.
C.4.4	Advisory work	Staff costs attributable to correspondence, meetings with visitors, etc. of an advisory nature (i.e. helping others to set up or run information systems).
C.4.5	Marketing/promotion	Costs of promoting use of system, to include costs of staff, advertising, exhibitions, literature, etc.
C.4.6	Network participation	Administrative costs attributable to participation in a network, e.g. attendance at meetings. See also 7.2.
C.4.7	Other admin. costs	To include travel costs borne by the system.

C.5	SYSTEM MAINTENANCE	(i.e. keeping the system in good working order).
C.5.1	Maintenance of classification scheme, thesaurus or indexing vocabulary	Includes intellectual tasks of revision and up-dating, and reprographic work.
C.5.2	System documentation	Costs associated with maintenance, updating, reproduction and distribution of system operating manuals and program documentation.
C.5.3	Computer program maintenance	Includes routine debugging, and modifications required as the result of changes to computer configuration or its operating system.
C.5.4	Other	
C.6	SYSTEM DEVELOPMENT	
C.6.1	Original design and development	Includes feasibility studies, definition of subject scope, system design, programming (see 4.12), thesaurus compilation, testing, initial staff recruitment and training, and implementation of system (see section 4.11).
C.6.2	On-going development	Costs associated with system evaluation, and on-going development and improvement of system, including program development (see sections 4.11 and 4.12).

INDIRECT ORGANIZATIONAL COSTS (OVERHEADS)

C.7	ADMINISTRATION	
C.7.1	Administration of parent organization	Allocated portion of salary costs of administration of the parent organization (see section 4.6).
C.7.2	Network administration	Use only for cost studies of cooperative networks. Include here all costs of central administration or secretariat.
C.8	ACCOMMODATION	See section 4.4.1.
C.8.1	System accommodation	Costs relating to accommodation used by system - rent, rates, maintenance, decorating, cleaning, caretaking, heating, water, furniture, etc.
C.8.2	Organizational accommodation	Portion of accommodation costs of parent organization, assigned as overhead to system costs.
C.9	GENERAL OVERHEADS	Cost relating to the organization as a whole, including: - staff recruitment, training - conferences and meetings - transport and travel - hospitality and entertainment - research and development (not directly related to system under consideration) - marketing, publicity (for the organization rather than the sytem)

- postage, telephones, telex
- insurance
- taxes
- depreciation
- bank charges
- subscriptions to external organizations

APPENDIX 2 - CLASSIFICATION OF ACTIVITIES

Note: the costs of each activity should be for one year of operation.

INPUT

A.1	ACQUISITION	
A.1.1	Selecting, ordering and receiving publications	Selection and purchase of literature to be used as input to the system, including ordering procedures, placing and renewing subscriptions; dealing with receipt of publications (see section 4.7).
A.1.2	Document storage	Organizing and maintaining collection of documents acquired primarily as input.
A.1.3	Ordering and receiving data in machine-readable form.	Obtaining, by purchase or subscription, input on magnetic tapes or other media. (Storage of machine-readable files to go under A.4).
A.2	INPUT PROCESSING - INTELLECTUAL	
A.2.1	Scanning & selection	Scanning of incoming publications and selecting items for input to system. Checking for duplication of input.
A.2.2	Document representation	
A.2.2.1	Descriptive cataloguing	Preparation of bibliographical descriptions.
A.2.2.2	Indexing/ classification	Subject analysis of document content, and its expression in the indexing language of the system. Includes tagging of words within the document reference or abstract, and title enrichment.

A.2.2.3	Abstracting	
A.2.2.4	Translation	Translation of references, keywords and/or abstracts (whether original or taken from other sources) into language(s) of system. Include also transliteration.
A.2.3	Processing of numerical data	Categorization of data, and assignment to system record format.
A.2.4	Quality control	Final checking and editing of input before conversion to machine-readable form.
A.2.5	Other	

A.3 INPUT PROCESSING - MECHANICAL

A.3.1	Data preparation	
A.3.1.1	Keyboarding	Transcription of records into machine-readable form, using off-line or on-line methods. For OCR, use this cost heading for both typing and OCR scanning.
A.3.1.2	Verification	Second-pass keyboarding of same data as for A.3.1.1, and re-punching of records found to be incorrect.
A.3.1.3	Proof-reading	Visual checking of records printed out in the course of keyboarding (e.g. on a tape-typewriter) or output from the computer.
A.3.1.4	Correction	Correction or re-punching of machine-readable records found to be incorrect by visual checking, as distinct from verification.
A.3.1.5	Other	

A.3.2	Computer input processing	
A.3.2.1	File conversion	Conversion of records acquired in machine-readable form to format required by system.
A.3.2.2	Validation	Automatic checking of input for errors of format, terminology, spelling etc. and print-out or display of input with the error indications.
A.3.3.3	File creation, up-dating or editing	Addition, deletion or modification of records on a computer file. Include here cost of recording medium (tapes, discs, etc.). Include also merging of different data bases, and creation of inverted files from serial files.
A.3.3.4	Other	
A.4	FILE STORAGE	
A.4.1	Off-line storage	Storage and maintenance of tapes or discs, including routine regeneration to avoid data loss.
A.4.2	On-line storage	Storage and maintenance of files on discs or other media for immediate computer access.
A.4.3	Other	

OUTPUT

A.5	RETROSPECTIVE SEARCHING	Extraction from retrospective file of references relevant to specific search requests.
A.5.1	Search formulation	Translation of enquiry into statement of search request in form required by system, and revision of the search statement as a result of user feedback.
A.5.2	Computer processing	All operations involved in retrospective searches, including search formulation (in the case of on-line systems only), thesaurus look-up, file interrogation, and output.
A.5.3	Evaluation of output	Checking computer output for relevance to enquiry, and editing as necessary.
A.5.4	Information analysis	Preparation of critical reviews, or state-of-the-art reports based on output from the system.
A.5.5	Communications (on-line systems)	Communication between the computer and the searcher, to the extent that the associated costs are borne by the system.
A.5.6	Mailing and distribution	Delivery of output from search system to users.
A.5.7	Other	
A.6	SDI	Dissemination of current information to meet individual requirements.
A.6.1	Profile formulation	Interaction with users to determine requirements, and construction of interest profiles in form required by system.

A.6.1.1	Profile updating	Analysis of feedback from users and preparation of amended profiles.
A.6.2	Computer processing	All operations involved in running SDI searches, including profile matching, and output.
A.6.3	Reproduction	Reproduction (e.g. photocopying) of line printer output.
A.6.4	Mailing and distribution	Delivery of output from SDI system to users.
A.6.5	Other	
A.7	GROUP SDI	Dissemination of current information to match interests of defined user groups.
A.7.1	Profile formulation	Construction of macro-profiles in form required by system.
A.7.1.1	Profile updating	Analysis of feedback from users and preparation of amended macro-profiles.
A.7.2	Computer processing	All operations involved in running group SDI searches, including profile matching, and output.
A.7.3	Reproduction	Reproduction of computer output.
A.7.4	Mailing and distribution	Delivery of output to users
A.7.5	Other	

A.8	SECONDARY PUBLICATIONS	Dissemination of current information in the form of published information bulletins or abstracts journals.
A.8.1	Copy preparation and editing	All manual operations involved in preparing material for printing.
A.8.2	Computer processing and composition	All computer operations involved in organizing input into subject categories and in required order, and composition of pages to prepare masters for reproduction.
A.8.3	Index production	Production of reproducible output for a printed index including sorting and formatting, and output.
A.8.4	Printing and binding	Reproduction of output from line printer, photo-typesetting machine etc., for production of information bulletins or abstracts journals. Note special cost heading C.3.5 for external services, should be used for cost of external printing etc.
A.8.5	Mailing and distribution	Delivery of output to users.
A.8.6	Other	
A.9	MACHINE-READABLE SERVICES	
A.9.1	Data-base reproduction	Production of multiple copies of magnetic tapes or other machine-readable media for external use, including processing to remove unwanted data such as typesetting signals.
A.9.2	Mailing and distribution	Delivery of data-base copies to users.

A.9.3 Other

A.10	PRIMARY SOURCE SERVICES	Supply of documents, in hard-copy or micro-form, of which records are held in the system.

APPENDIX 3 - UNIT COSTS

For explanation of unit cost calculation methods see Section 4.16

For definition of cost elements in 'Parameters' column Appendix 2.

PARAMETERS	PRODUCTION UNIT COST	ACTIVITY UNIT COSTS
ACQUISITION		
(a) Cost of selecting, ordering and receiving publications (A.1.1)	Average cost per document acquired $= \frac{a}{b}$	
(b) No. of documents acquired per year		
(c) Cost of ordering and receiving data in machine-readable form (A.1.3)		
(d) No. of document references per year.	Average cost per reference $= \frac{c}{d}$	
INPUT PROCESSING - INTELLECTUAL		
(a) Cost of scanning & selection (A.2.1)	Average cost of intellectual processing per item $= \frac{a + b + c + d + e + f + g}{h}$	
(b) Cost of descriptive cataloguing (A.2.2.1)		Average cost of cataloguing $= \frac{b}{h}$
(c) Cost of indexing (A.2.2.2)		Average cost of indexing $= \frac{c}{h}$
(d) Cost of abstracting (A.2.2.3)		Average cost of abstracting $= \frac{d}{h}$
(e) Cost of translating (A.2.2.4)		Average cost of translating $= \frac{e}{h}$

(f) Cost of quality control (A.2.4)		
(g) Other costs of input processing (A.2.5)		
(h) No. of items processed per year		
INPUT PROCESSING - MECHANICAL		
(a) Cost of keyboarding (A.3.1.1)	Average data preparation cost per item $= \frac{a + b + c + d + e}{f}$	Average keyboarding cost $= \frac{a}{f}$
(b) Cost of verification (A.3.1.2)		Average verification cost $= \frac{b}{f}$
(c) Cost of proof-reading (A.3.1.3)		Average correction cost $= \frac{c + d}{f}$
(d) Cost of correction (A.3.1.4)		
(e) Other costs (A.3.1.5)		
(f) No. of items input per year		
(g) Average no. of characters per record	Average data preparation cost per 1000 characters $= \frac{a + b + c + d + e}{f \times g} \times 1000$	
(h) Cost of computer validation and file creation (A.3.2.2 and 3.2.3)	Average cost per item added to data base $= \frac{a + b + c + d + e + h + j}{f}$	Average cost of computer input processing $= \frac{h + j}{f}$
(i) Cost of file conversion (A.3.2.1)		
(j) Other costs (A.3.2.4)		

OUTPUT - RETROSPECTIVE SEARCHING		
(a) Cost of search formulation (A.5.1)	Average cost per search $= \frac{a + b + c + d + e + f + g}{h}$	Average cost of search formulation $= \frac{a}{h}$
(b) Cost of computer processing (A.5.2)		Average cost of computer processing $= \frac{b}{h}$
(c) Cost of output evaluation (A.5.3)		
(d) Communications costs - on-line systems only (A.5.5)	Average communications cost per search $= \frac{d}{h}$	
(e) Costs of mailing and distribution (A.5.6)		
(f) Other costs (A.5.7)		
(g) Input cost, as apportioned (see sections 4.15 and 5.2)		
(h) No. of searches per year (see section 4.16 re standard usage level)		
OUTPUT - SDI		
(a) Cost of profile formulation (A.6.1)	Average cost per profile per run/issue $= \frac{b + c + d + e + f + g}{h \times j}$	Average profile formulation cost $= \frac{a}{i}$
(b) Cost of profile updating (A.6.1.1)		Average cost of profile updating $= \frac{b}{h}$

(c) Cost of computer processing (A.6.2)	Variable cost per profile per run/issue $= \frac{b + c + d + e + f}{h \times j}$	Average cost of computer processing per profile $= \frac{c}{h}$
(d) Cost of reproduction (A.6.3)		
(e) Cost of mailing & distribution (A.6.4)		
(f) Other SDI costs (A.6.5)		
(g) Input cost, as apportioned (see sections 4.15 and 5.2)		
(h) No. of operational profiles (for profiles added during year count as fractions representing time in operation e.g. 9 months = .75). See section 4.16 re standard usage level.		
(i) No. of new profiles added during year.		
(j) Frequency (= No. of output runs/issues per year).		
(k) Average no. of search terms per profile		Average processing cost per search term per run $= \frac{c}{k \times j}$

OUTPUT - GROUP SDI

(a) Cost of profile formulation (A.7.1)	Average cost per output listing per run/issue $= \frac{b + c + d + e + f + g}{h \times j}$	Average profile formulation cost $= \frac{a}{i}$
(b) Cost of profile updating (A.7.1.1)		Average cost of profile updating $= \frac{b}{h}$
(c) Cost of computer processing (A.7.2)	Average cost per output listing per run/issue per user $= \frac{b + c + d + e + f + g}{h \times j \times k}$	Average cost of computer processing per profile $= \frac{c}{h}$
(d) Cost of reproduction (A.7.3)		
(e) Cost of mailing & distribution (A.7.4)	Variable cost per output listing per run/issue $= \frac{b + c + d + e + f}{h \times j}$	
(f) Other group SDI costs (A.7.5)		
(g) Input cost, as apportioned (see sections 4.15 and 5.2)		
(h) No. of operational macro- profiles (for profiles added during year, count as fractions representing time in operation e.g. 9 months = .75)		
(i) No. of new profiles added during year.		
(j) Frequency (= no. of output runs/issues per year).		
(k) No. of subscribers/ users		

OUTPUT - SECONDARY PUBLICATIONS

(a) Cost of copy preparation and editing (A.8.1)	Average cost per reference printed $= \frac{a + b + c + d + e + f + g}{h}$
(b) Cost of computer processing and composition (A.8.2)	
(c) Cost of index production (A.8.3)	Average cost per page $= \frac{a + b + c + d + e + f + g}{i}$
(d) Cost of printing & binding (A.8.4)	
(e) Cost of mailing & distribution (A.8.5)	Average cost per reference per copy $= \frac{a + b + c + d + e + f + g}{h \times j}$
(f) Other costs (A.8.6)	
(g) Input cost, as apportioned (see sections 4.15 and 5.2)	
(h) No. of references printed per year	Variable cost per reference per copy $= \frac{a + b + c + d + e + f}{h \times j}$
(i) No. of pages printed per year	
(j) No. of subscribers/ recipients.	

OUTPUT - MACHINE READABLE SERVICES	
(a) Cost of data-base reproduction (A.9.1)	Average cost per copy $= \frac{a + b + c}{d}$
(b) Cost of mailing & distribution (A.9.2)	Average cost per reference per copy $= \frac{a + b + c}{d \times e}$
(c) Other costs (A.9.3)	
(d) No. of data-base copies produced	
(e) No. of references per year.	
OUTPUT - PRIMARY SOURCE SERVICES	
(a) Cost of supplying documents (A.10).	Average cost per document supplied $= \frac{a}{b}$
(b) No. of copies supplied per year	

APPENDIX 4 - SPECIFICATION OF PROJECT 2

PROJECT 2: EXTENSION AND REVISION OF THE COST/ACCOUNTING SCHEME TO INTERACTIVE SYSTEMS OF THE NETWORK

A. Objectives

- To draw up standard costing/accounting schemes applicable to all types of computerised documentation systems which could be integrated into EURONET.
- The extension of the costing/accounting schemes must make it possible to include:
  - specific cost of an information network of any possible structure;
  - specific cost of any type of processing system; on-line or off-line;
  - cost of any type of input or output.
- The costing/accounting schemes must embrace the acquisition of all quantitative or qualitative data used in the calculation of total unit cost, on a standard basis and capable of interpreting variations and disparities.

B. Source Material

- The Costs of Mechanized Information Systems. - P. Vickers; a study carried out for the OECD Directorate for Scientific Affairs, 1974.
- The Costs of Scientific and Technical Information and Documentation Systems. - G. Drees; a study carried out for the CIDST-Brussels Working Party on Pricing, 1974.
- Costs of Automatic Processing of Documentary Information. - G. Dubois and E. Peeters; a report presented at the National Conference on Documentation, Brussels, May 1974.
- Enquete sur les Couts des Systemes de Documentation Automatique. - Bureau National de l'Information Scientifique et Technique, Paris, May 1975.

- Kostenschemata fur Dokumentationseinrichtungen. - Robert Funk, Werner Schwuchow and Gerd Tittelbach; - Nachr. Dok. 25 (1974), No. 4, pages 161-167.
- Collecting and reporting real Costs of Information Systems. - D. S. Price; report sponsored by the Special Interest Group on Costs, Budgeting and Economics at the 1971 Annual Meeting of the American Society for Information Science.

C. Details of Project

- Revise and extend the existing schemes to take account of the costs relative to the production process of a given documentary product, whatever the system used. The documentary product should include:
  - current awareness
  - SDI
  - retrospective searches
  - data base on-line or on magnetic tape.
- Divide the cost scheme into as many separate sub-sections as are necessary to cover the various categories of systems which will have been identified (in Project 1).

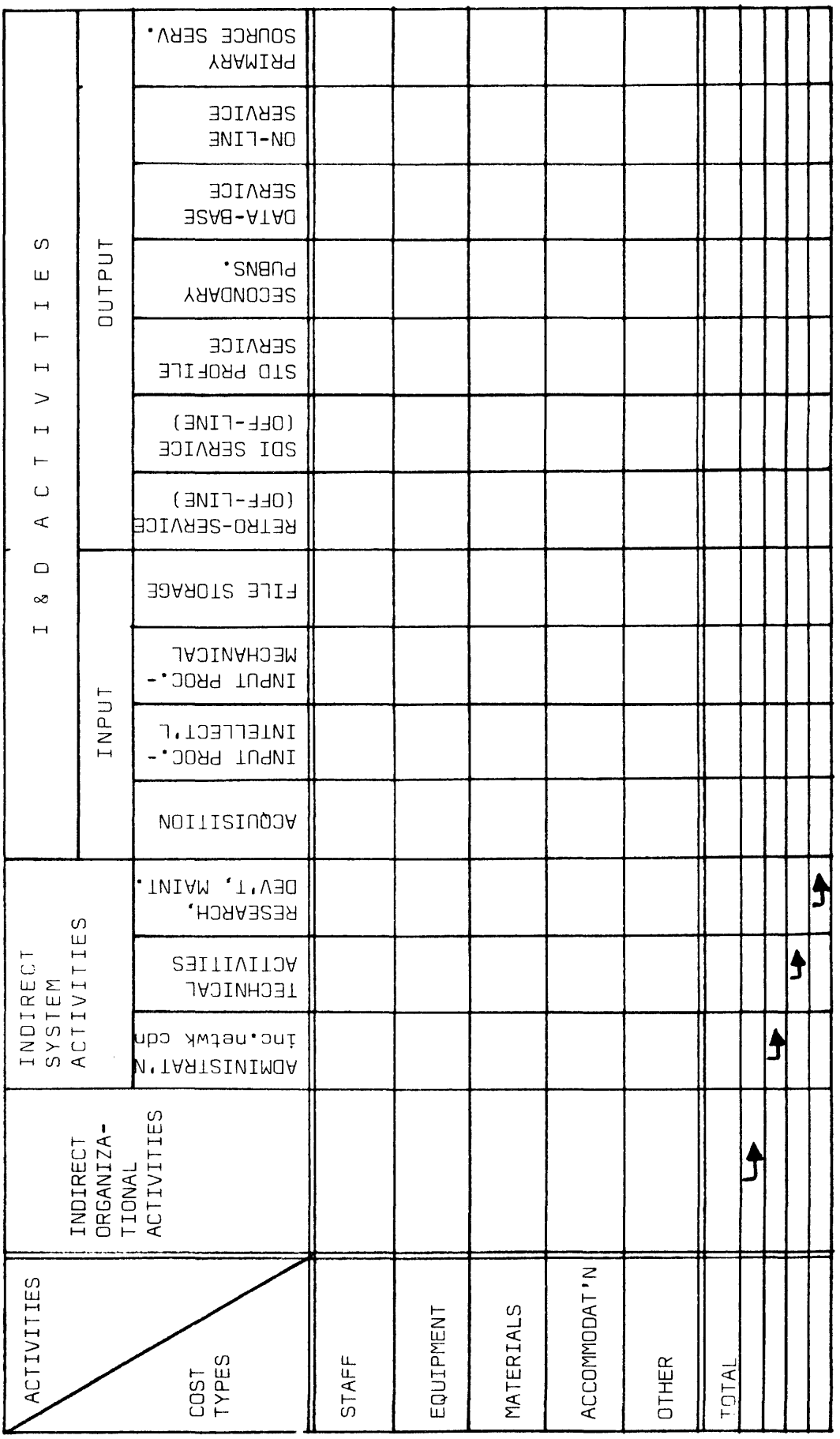
The cost scheme should:

- cover the unit cost of each function in each application instead of the overall cost of the function;
- permit an analysis of total unit costs;
- lay down the standards for the allocation of overheads and variable indirect costs with a view to the assessment of total costs;
- be tested at least in two cooperative information systems (networks).

APPENDIX 5 - COST MATRIX

DEVELOPED BY GERMAN SURVEY

The cost matrix used by the Studiengruppe für Systemforschung has gone through several stages of development. The latest version reproduced below is referred to in section 5.2 of this report.



APPENDIX 6 - REFERENCES

Allaire, E. 'Enquete sur les couts des systemes de documentation automatique en France'. Bureau National de l'Information Scientifique et Technique (December 1975).

Drees, G. 'The costs of scientific and technical information and documentation systems'. Study carried out for the CIDST - Brussels Working Party on Pricing (1974).

Dubois, G. & E. Peeters 'Cost of automatic processing of documentary information'. Report presented at National Conference on Documentation, Brussels (1974).

Funk, R., W. Schwuchow & G. Tittelbach ' Kostenschemata für Dokumentationseinrichtungen' Nachr. Dok., vol. 25, No. 4, p. 161-7 (1974); continued as Funk, Genth & Schwuchow (same title) in Nachr. Dok., vol. 27, No. 1, p.23-29 (1976).

Price, D. S. 'Collecting and reporting real costs of information systems'. Report sponsored by the Special Interest Group on Costs, Budgeting and Economics at the 1971 meeting of the American Society for Information Science.

Schwuchow, W. The matrix reproduced as Appendix 5 was obtained as a private communication. See also Funk et al above.

N.V. System Dynamics SA. 'Analysis of various cost studies in connection with EURONET' (February 1976).

Vickers, P. 'The costs of mechanized information systems'. Study carried out for the OECD Directorate for Scientific Affairs (1974).

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