Computerised accounting: a case study in research organisations

This item was submitted to Loughborough University's Institutional Repository by the/ an author.

Additional Information:

- A Master’s Thesis. Submitted in partial fulfilment of the requirements for the award of Master of Philosophy at Loughborough University.

Metadata Record: [https://dspace.lboro.ac.uk/2134/26971](https://dspace.lboro.ac.uk/2134/26971)

Publisher: © David J. Croft

Rights: This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 2.5 Generic (CC BY-NC-ND 2.5) licence. Full details of this licence are available at: http://creativecommons.org/licenses/by-nc-nd/2.5/

Please cite the published version.
This item was submitted to Loughborough University as an MPhil thesis by the author and is made available in the Institutional Repository (https://dspace.lboro.ac.uk/) under the following Creative Commons Licence conditions.

For the full text of this licence, please go to:
http://creativecommons.org/licenses/by-nc-nd/2.5/
COMPUTERISED ACCOUNTING: A CASE STUDY IN RESEARCH ORGANISATIONS

By

DAVID J. CROFT

A Master's Thesis submitted in partial fulfilment of the requirements for the award of Master of Philosophy of the Loughborough University of Technology (November 1984).
Preface

Within the U.K. there is a group of companies whose operations are almost wholly concerned with research and development. These organisations have a number of special planning and control problems. The objective of this study is to investigate these special problems and to consider the application of computerised accounting facilities in a research environment.

The first stage in this process is an investigation of the special planning and control requirements of research organisations. This is the result of personal experiences, the use of a questionnaire, and visits to other research organisations.

Having defined the scenario of this research the next stage is the identification of the role of the accounting system as part of the planning and control procedures in use. Following on from which the general application of computerised accounting systems is considered, firstly by identifying the steps involved in the introduction of a new system and secondly, reviewing some of the more commonly used software packages.

The process of accounting system change is one which most companies will go through at intervals. It will occur when the initial decision is made to switch from a manual to a computerised solution, and again when an existing system becomes deficient and a decision is made to replace or upgrade it. The time and effort involved in changing a system is often considerable. For this reason companies may try to shortcut some of the stages involved but this can have unfortunate consequences. To conclude, two case studies are presented which indicate some of the perils and possibilities associated with change.
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface:</td>
<td></td>
</tr>
<tr>
<td>Introduction:</td>
<td></td>
</tr>
<tr>
<td>Legal Status</td>
<td>2</td>
</tr>
<tr>
<td>Organisation Structure</td>
<td>2</td>
</tr>
<tr>
<td>Pricing and Demand</td>
<td>2</td>
</tr>
<tr>
<td>Funding</td>
<td>4</td>
</tr>
<tr>
<td>Capital Investment</td>
<td>6</td>
</tr>
<tr>
<td>Basic Research</td>
<td>7</td>
</tr>
<tr>
<td>Review</td>
<td>7</td>
</tr>
<tr>
<td>Chapter One</td>
<td></td>
</tr>
<tr>
<td>Planning and Control</td>
<td>9</td>
</tr>
<tr>
<td>Long Term (Strategic) Planning</td>
<td>9</td>
</tr>
<tr>
<td>Medium Term (Budgeting) Planning</td>
<td>11</td>
</tr>
<tr>
<td>Short Term Planning and Control</td>
<td>13</td>
</tr>
<tr>
<td>Professional Control</td>
<td>14</td>
</tr>
<tr>
<td>The Accountants Role</td>
<td>14</td>
</tr>
<tr>
<td>Planning and Control of Different Production Processes</td>
<td>16</td>
</tr>
<tr>
<td>Planning and Control of Research and Development Activities</td>
<td>16</td>
</tr>
<tr>
<td>Review</td>
<td>20</td>
</tr>
<tr>
<td>Chapter Two:</td>
<td></td>
</tr>
<tr>
<td>Systems Analysis, Design and Implementation</td>
<td>22</td>
</tr>
<tr>
<td>Feasibility Study/Systems Analysis</td>
<td>23</td>
</tr>
<tr>
<td>Systems Analysis</td>
<td>25</td>
</tr>
<tr>
<td>Evaluation of proposals</td>
<td>31</td>
</tr>
<tr>
<td>Implementation</td>
<td>36</td>
</tr>
<tr>
<td>Documentation</td>
<td>40</td>
</tr>
<tr>
<td>Review</td>
<td>41</td>
</tr>
<tr>
<td>Chapter Three:</td>
<td></td>
</tr>
<tr>
<td>Computerised Accounting</td>
<td>42</td>
</tr>
<tr>
<td>Nominal/General Ledger</td>
<td>43</td>
</tr>
<tr>
<td>Sales Ledger</td>
<td>46</td>
</tr>
<tr>
<td>Purchase (Bought) Ledger</td>
<td>48</td>
</tr>
<tr>
<td>Management Accounting</td>
<td>50</td>
</tr>
<tr>
<td>Review</td>
<td>53</td>
</tr>
<tr>
<td>Case Study: BNF Metals Technology Centre</td>
<td>56</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>----</td>
</tr>
<tr>
<td>Background</td>
<td>57</td>
</tr>
<tr>
<td>Systems Analysis</td>
<td>58</td>
</tr>
<tr>
<td>Proposals and Review</td>
<td>61</td>
</tr>
<tr>
<td>Specification, Programming and Implementation</td>
<td>62</td>
</tr>
<tr>
<td>Review</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Case Study: The Shirley Institute</th>
<th>63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td>64</td>
</tr>
<tr>
<td>Years 1980/81</td>
<td>65</td>
</tr>
<tr>
<td>Years 1982 to 1984</td>
<td>67</td>
</tr>
<tr>
<td>Review</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attachment 1. Questionnaire to AICRO Members</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft of Questionnaire to AICRO Members</td>
<td></td>
</tr>
<tr>
<td>Summary of Questionnaire results sent to AICRO Members</td>
<td>73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attachment 2. Transfer Pricing in a Research Organisation</th>
<th>79</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Published in Management Accounts April 1984)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attachment 3. Medium Term Planning and Control in Research</th>
<th>84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisations (Submitted to Management Accounting)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attachment 4. A case study in Integrating Financial and</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Accounts</td>
<td></td>
</tr>
<tr>
<td>(Accepted for publication by Management Accounting)</td>
<td></td>
</tr>
<tr>
<td>Figure 1.</td>
<td>Research Organisation Structure</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Figure 1.(i)</td>
<td>Planning and Control Systems</td>
</tr>
<tr>
<td>Figure 1.(ii)</td>
<td>The Accountants position within the organisation</td>
</tr>
<tr>
<td>Figure 1.(iii)</td>
<td>Planning and Control of different Production Processes</td>
</tr>
<tr>
<td>Figure 2.(i)</td>
<td>Sub-System Analysis</td>
</tr>
<tr>
<td>Figure 2.(ii)</td>
<td>Purchase Ledger Sub-System</td>
</tr>
<tr>
<td>Figure 2.(iii)</td>
<td>Accounting System with Manual Purchase Ledger</td>
</tr>
<tr>
<td>Figure 2.(iv)</td>
<td>Accounting System with Computerised Purchase Ledger</td>
</tr>
<tr>
<td>Figure 2.(v)</td>
<td>Ranking Proposals</td>
</tr>
<tr>
<td>Figure 3.(i)</td>
<td>General Ledger</td>
</tr>
<tr>
<td>Figure 3.(ii)</td>
<td>Sales Ledger</td>
</tr>
<tr>
<td>Figure 3.(iii)</td>
<td>Purchase Ledger</td>
</tr>
<tr>
<td>Figure 3.(iv)</td>
<td>Comparison of Two General Ledger Systems</td>
</tr>
<tr>
<td>Figure A1(i)</td>
<td>BNF Accounts Hierarchy</td>
</tr>
<tr>
<td>Figure 1. (Attachment 2)</td>
<td>Current vs Basic Research Activity</td>
</tr>
<tr>
<td>Figure 1. (Attachment 3)</td>
<td>Operating Budget Procedures</td>
</tr>
<tr>
<td>Figure 1. (Attachment 4)</td>
<td>Basic Elements of Accounting Systems</td>
</tr>
<tr>
<td>Figure 2. (Attachment 4)</td>
<td>Integrated Financial/Management Accounting Configuration</td>
</tr>
</tbody>
</table>
INTRODUCTION

Research and development activities are carried out by a number of different types of organisation, for example the government, individuals, manufacturing organisations, and independent research organisations. This study deals with the case of independent research organisations and specifically the case of the British Non-ferrous Metals Research Association (BNF). However, a large part applies equally well to the other types of organisation identified above.

The characteristic which distinguishes independent research organisations is that the major part of their income is derived from research work contracted for by a third party. Organisations of this type tend to specialise in a particular skill area, or to support a particular industry. Examples of these two types are the Welding Institute and BNF. The Welding Institute concentrates on the development and use across the industry of welding techniques. BNF, on the other hand, provides support to the non-ferrous metals industry, and will work on almost any problem area within that industry.

There are two associations which bring together independent research organisations. One is the Council of Directors of Research Associations (CDRA), the other is the Association of Independent Contract Research Organisations (AICRO). The following list of AICRO members indicates the range of activities which are involved:
- BCIRA - Ferrous foundry and casting operations.
- BNF - Non-ferrous metals.
- BHRA - Hydromechanics.
- ERA Technology Ltd - Electromagnetics.
- Fulmer Research Institute Ltd - Materials Technology.
- Hazelton Laboratories Europe Ltd - Biology and Chemistry.
- International Research and Development Co Ltd - Electrical and mechanical engineering.
- Inveresk Research International - Pharmacology and Toxicology.
- MIRA - Motor Industry.
- Ricardo Consulting Engineers Ltd - Engine developments.
- Robertson Research International - Earth sciences.
- Shirley Institute - Textiles.
- The Welding Institute - Welding technology.

Both AICRO and CDRA act as pressure groups representing the interests of research organisations, particularly in matters where there is a common interest; for example, in respect of government policies on support for research and development activity and the attitude of the Inland Revenue.
Legal Status

There are two types of legal form in which research organisations are set up. The first type is the 'normal' limited company form, commonly associated with business organisations. In this type of set up, there are a group of shareholders who have invested money with the objective of gaining a financial return. In the previous list this type of organisation can be identified by the use of the word Ltd at the end of the company name.

Organisation Structure

There are basically two ways in which research activities may be organised; these are matrix type and functional type structures. A matrix organisation is one in which staff are brought together in project teams. The most often quoted example of this is the American space programme, for which project teams are formed to undertake each space launch. The advantage of this approach is that it brings together a group of people with a single objective, but it is only suitable when the project is a large one which will utilise a number of people full time for a considerable period.

In general, the projects undertaken by research organisations do not require the attention of more than one or two staff on a full time basis plus ad hoc assistance. Because of this, it is not appropriate to form project teams, so instead staff are grouped together on a functional basis, see figure 1.

The operating implications of this approach are that a flexible structure is created, which allows a number of specialist sections to work on any research project while at the same time bringing together staff with a particular speciality into a single responsible unit. The details of how work is planned and how responsibilities are assigned for control purposes are discussed in chapter 1.

Pricing and Demand

Research organisations occupy an unusual position in the market. There is a very limited amount of competition, usually only one or two organisations will have the expertise required to undertake a particular piece of research. Potential customers do however have three basic options. To do the work in-house if they have their own research department, to use an independent research organisation, or not doing the job at all. There are a number of factors which influence the demand for contract research, including the state of the economy, government policy and the growth and decline of particular industries.
Research Organisation Structure

Fig 1.

Managing Director

Finance Director/
Company Secretary

Research Director

Administration
Site Services

Personnel

Accounts

Specialist Research Areas *

* Specialist Research Areas at BNF:
  - Applied Chemistry
  - Plating and Finishing
  - Corrosion and Protection
  - Process Control
  - Energy Control
  - Process Instrumentation
  - Metallurgy
  - Plant Development
  - Casting
  - Automatic Shape Process
The effect of the general level of activity in the economy is an unusual one. In periods of growth, companies may expand their own research and development departments and place less work with research organisations, and vice versa in a depression. In fact, over the period of the current recession (1978–1983) a number of large companies have actually disbanded the whole of their research departments. Examples of this in the non-ferrous metals sector are BICC (Shepherds Bush), IMI (Yorkshire and Birmingham) and Delta Metals (Ipswich). Obviously, this will be counterbalanced by the general lack of funds in a period of depressed trading conditions.

The government is a very large sponsor of research and development both through direct contracts and through schemes designed to encourage research by industry. Government funded work can vary up to 50% of a particular organisation's total activity: consequently a change of government or policy can have a significant effect.

Organisations which are set up to support particular industries can find themselves in difficulties if that industry changes radically. For example, the textile industry in the UK has been profoundly depressed over the last twenty years, radically affecting the commercial funding available.

Similarly, the use of metals is gradually declining as more applications are identified for plastics, a process which is having implications for the future of BNF. This process can to some extent be limited by casting the operations of an organisation over as wide an area as possible, including overseas customers and related industries.

Research organisations tend to take a very simplistic approach to pricing, utilising cost based methods. This is reflected in the method used to price and charge for government contracts. This topic is more fully considered in the following section, in which the sources of funding available to research organisations are reviewed.

**Funding**

Research organisations as the name implies, obtain the major part of their funds from research projects. There are however, several different ways in which research projects can be funded, and there are a number of spin-off activities which can provide significant amounts of revenue. The following list is not exhaustive but indicates the available sources of funds:
Commerci ally funded research:

Individual companies or groups of interested companies may sponsor a particular piece of research. A research project can last from a few months to a number of years and cost, at today's prices, anything from ten thousand pounds to several hundred thousand pounds. The term research project is therefore a very wide one which refers only to the methodology of the work involved.

In recent years there has been a significant reduction in this type of activity for two reasons. First and most obvious, there has not been much money available in British industry to finance research projects. This depressed condition can be clearly seen in the large number of redundancies and company closures which have occurred. Any growth in commercial research work has therefore been limited to those industries which have been successful, such as oil exploration. The second factor which has had a major effect is the disappearance of a large number of small firms, and the takeover of others. The number of potential sponsors has been reduced and the average size of companies has increased; with a larger proportion of these companies, because of their size, having their own research and development departments.

Government sponsored research:

The government is a major consumer for research organisations, either matching commercial sponsorship or providing a single source of funding. The majority of this support is provided on a cost plus basis, and utilises standard procedures for the review, approval, and control of projects, and for contract payments [13,14]. This provides a basis which allows the government to operate efficiently, but at the same time forces the research organisation to adopt a particular accounting treatment for government projects.

There is a move being made towards establishing government contracts on a more commercial basis, and this option has been taken up by a number of AICRO member companies. Whether or not it becomes the normal approach remains to be seen.

Membership subscriptions:

In the section of this introduction which discussed the legal status of research organisations, the subject of members was considered. This source of funds only applies to non-profit making organisations, but can provide a significant proportion of income. Member companies generally pay an annual subscription towards the cost of agreed information services and/or research work.
Commercial Projects:

Research organisations may involve themselves directly in commercial activities by selling consultancy services or manufacturing specialist products. This type of activity can become an important part of an organisation's funding, to some extent replacing research activity. It is not unusual for research organisations to set up separate companies to exploit particular innovations to reduce the commercial risks involved.

One factor which can limit the extent to which commercial activities are pursued is the need to maintain the goodwill of research customers. Almost inevitably, commercial developments overlap with the activities of research customers to a greater or lesser extent. Pursuing an aggressive commercial policy is therefore often incompatible with maintaining goodwill, and a more tempered policy has to be adopted. This can be achieved by, in certain cases, forming a joint company, liaison in the supply of equipment or manufacturing licences.

Other activities:

Organisations may involve themselves in other activities as profitable opportunities arise. The range of activities undertaken by a particular organisation will depend on its expertise, facilities and the demand for its services.

A falling demand for an organisation's services often leads to a hunt for potential new areas, sometimes belatedly. The sort of spin-offs which are often part of a research organisation's portfolio include organising conferences, library and information services, and providing consultancy services under the various government supported schemes.

Capital Investment

Research work very often utilises advanced technology, which is inevitably expensive. To a certain extent this favours the independent research organisation which can utilise items of research equipment on a variety of projects. The need to invest in capital equipment is, however, a considerable financial strain on research organisations, and this situation is likely to continue.

One response to this is the organisation of research projects to involve companies with specific expertise or facilities who can contribute the use of these assets in exchange for access to research findings. This is described as an in-kind contribution, and represents a type of barter situation.
Basic Research

Research organisations by definition generate the majority of their income by undertaking research contracts. Researches which are in progress and generating income at a point in time are described as current researches. However, before a research proposal is produced a certain amount of background work will be required. This effort designed to translate an initial idea or inquiry into a research proposal with a planned methodology is called basic research.

The need to undertake basic research is accepted by the government in the costing formula used to calculate payments on research contracts. This type of work is usually undertaken by research staff as a part of their activities, and this presents a number of problems in organising and planning of work. Because at any time there is a choice to be made between basic and current research, which represents a trade off between future and current income. This subject is considered again in the following chapter on planning and control and is also discussed in Croft and Finlay [7].

Review

All organisations have particular characteristics which influence the way in which planning and control is implemented. Whilst research organisations have peculiarities in their legal status, methods of financing, organisational structure, and sphere of activity which means that each has peculiar requirements; the overriding factor is the nature of research work. Researches may last from a few months to several years. They may be closely determined for, example, in the case of a testing programme, or be very loosely defined where the work concerned is speculative.

The objective of this thesis is to consider computerised accounting within the environment of research organisations. In doing this the following chapters concentrate on the three elements which are most important in this process.

Chapter One presents a very brief review of planning and control procedures and then considers the unusual aspects of research organisations information requirements which may be significant in the design of an accounting system. Chapter Two reviews in detail the procedures involved in choosing and implementing a computer based system, and attempts to identify the major pitfalls in this procedure. Finally Chapter Three considers the essential nature of computer based accounting packages and identifies the similarity between the computerised solutions applied to each of the major accounting sub-systems.

Chapters 1-3 provide the necessary information for reviewing the
implementation of computerised accounting in research organisations. The case studies which follow are narratives, which highlight the need for a disciplined approach to systems stressed in Chapter 2, and the requirement for an understanding of both particular environmental constraints (Chapter 1) and of the specific application (Chapter 3).
Planning and control are the tools of management which are used to achieve business objectives, this process can be expressed in a simple flowchart see fig 1.(i).

The longer the timescale the greater the number of variables which are involved and the more difficult they are to predict. Specific planning techniques are required to meet the differing problems which arise in the various time periods. These techniques can be roughly grouped into three categories of planning, long-term (often 1+ years), medium-term (1 year), and short-term (month, week, day, hour). These planning techniques represent a portfolio from which an organisation will draw in order to meet its particular operating requirements.

The whole process of planning and control depends on the efficient supply of information. The accountant plays a major part in the planning and control process, both as a source of information, and as the holder of particular skills. This central role is inevitable because almost all organisations employ some planning and control measures which are expressed in monetary terms. The only major exception to this, until recently, was the government, but the accountant has now been accepted as an important figure within the public sector, as there has been an increased demand for financial accountability and value for money.

Research organisations have certain unusual characteristics which have been described in the introduction. The accountant needs to develop planning and control procedures which give management effective control and which are efficient to operate. The response of accountants in research organisations was investigated in a questionnaire to AICRO members, see attachment 1. The results indicate that similar solutions have been adopted by most AICRO members, but that there is a trade-off between the effort applied to information systems and the sophistication of the planning and control techniques which are available.

Long Term (Strategic) Planning

Strategic planning is the name given to planning which usually looks ahead more than one year. As the name implies strategy planning involves the consideration of major parts of the business in order to achieve company growth, security, profitability, etc. A fuller discussion of this subject can be found in Glueck [10].

In a large organisation there may be a strategy planner or department whose major function is to conduct this activity, but in a smaller business this task will probably form a part of the duties of senior management.
INPUT → PROCESS → OUTPUT

MODEL

ACTION → REVIEW → VARIANCE ANALYSIS → COMPARISON ACTUAL/BUDGET → BUDGET

OBJECTIVES
The strategy planning function requires a particular expertise as it involves liaison, co-ordination, interpretation and communication with all levels of staff and a variety of disciplines. The inputs to the strategic plan will come from sales, engineering, marketing and any other function which will be affected by product, facility or legal changes. One part of strategic planning is the analysis of the product life cycle, which moves through the phases of development, introduction, production and finally run down. The whole process of strategy planning is geared to the development of a long term plan; in order to highlight potential problems and opportunities and to provide a basis for strategic decisions.

There are two techniques which justify special mention because they will provide a major part of the information input to the strategic plan; and will also be used to provide information for ad hoc strategic decisions. They are product planning which will be carried out by the marketing department and capital investment appraisal.

The role of the product planner is to assess the market to provide information on existing products and product proposals. Some type of product planning is essential to the survival and growth of almost all business organisations. The larger the organisation in general, the less flexible product changes are, and consequently the more important is the product planning function.

The second area of expertise which will interface with the strategic plan is the analysis of capital investment proposals. The responsibility for this activity is usually assigned to the accounts or finance function. As well as assessing the technical side of any capital proposal it is also necessary to evaluate the potential return in order to rank alternative investments. The various techniques available have been very thoroughly documented and discussed, see for example Haley and Schall [12], and although no single approach has been identified as universally correct, it is generally accepted that some type of analysis is essential.

Medium Term (Budgeting) Planning

The medium term is the time period which is generally given the greatest attention by planners. It is the detailed expression of strategic planning and it forms the basis against which short term control is exercised.

The most important medium term planning tool is the budget. In most organisations the budget is a detailed plan which covers all the activities of the organisation for a 12 month period. This can be a specific 12 month period or it may be a continually updated plan covering the following 12 months, this is described as a rolling budget. The potential and pitfalls of budgeting have been
The budget quantifies in financial terms the result of the planned activities of the organisation; and because the emphasis is on monetary measurement, the responsibility for co-ordinating the budget normally rests with the accounts department.

The usual method of preparing a budget is to begin with sales forecasts which can then be translated into a forecast income. The sales forecast will also determine production requirements, direct materials, direct labour and facilities. In most manufacturing operations detailed forecasts of direct costs are made for each product and because of the repetitive nature of manufacturing operations these can be described as standards. A particular product volume can therefore be represented as containing a certain level of standard labour and standard materials and therefore having a certain standard cost. An allowance is usually added for the likely wastage that will occur: this is called authorised off-standard and from these two elements direct costs can be forecast. By adding a forecast for fixed operating costs a complete forecasted operating statement for the following 12 months can be prepared, based on forecast sales volumes.

The process of budgeting is an iterative one. After the first plan has been prepared, the result will be presented to senior management. It is very likely that at least part of the plan will be unacceptable and there follows a process of changes and re-submission until an acceptable budget is reached.

The essential feature of the budget is that it is a financial plan prepared in a very high level of detail. As a result it can be used to monitor performance for control purpose.

The budget is a very important part of modern business. However, because it concentrates on financial variables it has been criticised as being inappropriate in situations in which there are no directly measurable financial benefits, for example indirect/overhead type activities. In response a number of techniques have been developed which concentrate on factors which are not directly quantifiable, three of these techniques have gained some level of acceptance, as follows:

Zero Base Budgeting:

Zero base budgeting (ZBB) is an approach which was developed by Peter Pyhrr [28,29] at Texas Instruments, this methodology concentrates on the principle that there is always an alternative to the present situation. The first stage in ZBB is the development of a number of decision packages reflecting alternative strategies, for example in-house/outsourcing, or centralisation/decentralisation.
Each decision package will examine key activities in the form what is done, by whom and how? It is the systematic investigation of activities and alternatives which forms the basis of ZBB.

Management by Objective:

Management by objective (MBO) is a technique developed from behavioural theory, particularly the work of McGregor [11], the central theme being that the route to improved performance is through increasing motivation. To achieve this, MBO suggests that a manager develops with his staff a number of agreed objectives and a plan of action. It is the process of discussion and subsequent evaluation which it is suggested will lead to increased motivation.

Cost/Benefit Analysis:

Cost/benefit analysis is an approach developed by economists to value the benefits associated with socially desirable projects such as the building of a new hospital. The procedure involves imputing a benefit in money terms for services which are not directly paid for. A discussion of this topic of public finance can be found in Musgrave & Musgrave [21].

In practice these methods have not been generally adopted in business for two main reasons. The first reason is that there is considerable doubt about their effectiveness and they cannot in any case be considered as substitutes for budgeting. The second reason is that considerable expertise is needed to implement any of these methods and this is not generally available.

Annual Accounts

The annual accounts provide operating performance information prepared on a standard basis which is made available to shareholders and other interested bodies. The annual accounts represent in effect the performance of an organisation's management and this is how they are interpreted by shareholders. Continually bad reports can lead to changes in senior management through the Annual General Meeting.

Short Term Planning & Control

It is very important for most business organisations to have recent performance information, because in the context of modern business a small variation from plan can be very significant financially. For example, a stoppage of one hour on a motor vehicle assembly line could result in lost output valued at
£200,000. The aim therefore, is to provide information which will assist in keeping day to day operations under close control.

In the short term planning means the day to day organisation of production activities. This is an area usually outside the scope of the accounting function; however the accountant will be very closely involved in measuring and reporting on the results of this activity.

There are two types of performance measurement which are generally employed. The first type is the monitoring of a particular variable against plan over a very short period i.e. the output of a production line may be reported every hour.

The second approach is to report the performance of all the production variables covered by the budget and to analyse the variation between actual and planned. This element of management accounting is very important because the interpretation of this information should lead to corrective action if necessary.

An important part of this procedure is the communication of information to management and to the shop floor. This process has two sides to it. Firstly it is necessary to explain figures for them to have any value and secondly, by discussing the management accounts relevant information may be gained which can make the financial analysis more valid and at the same time, gain acceptance for any resulting corrective action.

Professional Control

Control over an organisation's activities occurs in two ways, formal and informal. All the above methods which have been considered are formal controls but in all organisations there will be some informal control in the form of group or self control. Mintzberg [20] identified this feature and termed it professional control, because it is more obvious in a situation in which a person has professional standards to maintain, such as accountancy.

The Accountant's Role

Effective planning and control in all but the smallest business organisations depends on the formal management information systems. The accountant has a very important role to play in the management information system as a source of basic financial information, as an interpreter of performance results through the analysis of variances from budget and as a co-ordinator in developing budgets.
THE ACCOUNTANTS POSITION WITHIN THE ORGANISATION

Figure 1.(ii)

General Managers

Line Managers

Management Accountant

Financial Accountant

Financial Director/
Company Secretary

Informal (operating) Responsibilities
The demands on the accountant are reflected in his position within an organisation's structure. Fig 1.(ii) shows the general case. The position of the accountant is such that he can provide a service to line managers but is independent and responsible to senior management.

Planning and Control of Different Production Processes

The previous parts of this chapter have described briefly a number of the formal planning and control techniques which are in general usage. In any particular situation these techniques will need to be adopted in a way which maximises their effectiveness.

The factor which will affect the method of planning and control to the greatest extent is the nature of the production activity. This can be reviewed by considering three basic types of production activity, mass production, batch production and specialist activities, see figure 1(iii).

What Fig 1(iii) shows is that the nature of the production activity will affect the emphasis and the availability of formal planning and control measures. It is the responsibility of the accountant to identify the measures appropriate in a particular situation and to see that they are properly implemented.

Systems Planning:

All business activities require some form of planning and control and this applies equally well to the development and implementation of new systems. An overall policy needs to be defined in order that priorities can be set and consistent progress achieved. A set of guidelines for this activity have been drawn up by IBM [17].

Planning and Control of Research and Development Activities

The main features of independent contract research organisations have been described in the introduction. These characteristics to a large extent determine the appropriate planning and control methods and this is supported by the results of the questionnaire (attachment 1) which showed that a very similar approach is common among AICRO members.

Long Term Planning:

Strategic planning in research organisations does not involve consideration of new product introductions in the recognised sense of a product life cycle because each research represents a new
### Features: (typical)

<table>
<thead>
<tr>
<th></th>
<th>Mass Production</th>
<th>Batch Production</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units Produced</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Capital Investment</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Organisation Size</td>
<td>Large</td>
<td>Medium</td>
<td>Small</td>
</tr>
<tr>
<td>Product Lines</td>
<td>Few</td>
<td>Medium</td>
<td>Large No.</td>
</tr>
<tr>
<td>Stocks</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>

### Strategic Planning:

<table>
<thead>
<tr>
<th></th>
<th>Mass Production</th>
<th>Batch Production</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance</td>
<td>High</td>
<td>Medium</td>
<td>Variable</td>
</tr>
<tr>
<td>Product Introductions</td>
<td>Infrequent</td>
<td>Variable</td>
<td>Continual</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Low</td>
<td>Medium</td>
<td>Variable</td>
</tr>
</tbody>
</table>

### Budgetting:

<table>
<thead>
<tr>
<th></th>
<th>Mass Production</th>
<th>Batch Production</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Standards</td>
<td>Yes</td>
<td>Yes</td>
<td>Forecast</td>
</tr>
<tr>
<td>Fixed Costs &amp; Total Cost</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Sales Forecast Accuracy</td>
<td>High</td>
<td>Variable</td>
<td>Low</td>
</tr>
</tbody>
</table>

### Short Term

<table>
<thead>
<tr>
<th></th>
<th>Mass Production</th>
<th>Batch Production</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring of Variables</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Importance</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Professional Control</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
product. Rather the emphasis is on technological developments and identifying shifts in the emphasis of major funding sources. Planning will therefore concentrate on the analysis of market trends and underlying financial trends within the organisation.

Medium Term Planning:

The process of budgeting in a research organisation does not follow the normal route for a number of reasons, as follows:–

(i) Each research project is in part unique and it is therefore impossible to generate production standards, only forecasts. This means that direct labour and material costs cannot be expressed in terms of volume X standard and the reporting of actual vs. budget also cannot adopt the usual variance analysis by product approach.

(ii) A sales forecast can be prepared for manufacturing organisations by considering current sales levels and by undertaking market research. The accuracy of this type of forecasting depends to a large extent on the law of large numbers. Forecasting the sales of research organisations is very difficult as they have a relatively small number of high value transactions. The loss of a single contract can have a very significant effect on total income. For example, at BNF one particular subscription represents about 8% of income (1983). Difficulties therefore arise in using the sales forecast as a basis for planning. However, it is essential to maintain some sort of forecast information to identify potential shortfalls or bottlenecks in available research facilities.

(iii) The most important factor of production for research activity is research labour. There are important implications stemming from this because research labour is largely fixed in the short term.

For example, a scientist who has specialised in a very particular subject for several years may be difficult to assign or re-allocate when that project finishes. Similarly if any scientist leaves he may be very difficult to replace and any replacement can be expected to take several months to absorb the current status of a particular project.

What research organisations try to do is to generate knock-on type projects, which are spin-offs either from a current research, or share a common basic research. An example of this at BNF is work being done on measurement using ultra-sound. The first application of this work was the monitoring of grain size in copper rod production and this has been extended to cover copper tube and aluminium and the development of prototype monitoring equipment for commercial manufacture.
The overall effect of this research labour constraint is to limit the flexibility available in defining spheres of activity, to make sudden changes in staffing in response to demand very difficult and to place great importance on maintaining a continuity in the development of research programmes.

(iv) Research organisations need to undertake basic research in order to generate future work. In most organisations this activity is the responsibility of the technical section head and an allowance for this needs to be made in any operating plan.

These special features mean that budgeting for research organisations requires a different approach from the general case described earlier in this chapter. Because the sales forecast is very uncertain and the factors of production are fixed, it is inappropriate to begin the budget with the sales forecast. Instead the first step is to determine the costs of the organisation. Once this has been done, the income needed to cover costs can be calculated and this can be expressed in terms of the recovery required per member of the research staff.

The result of this process is that a budget is prepared which has three major control variables, the level of overheads, the level of utilisation of direct labour and the recovery rate required on direct labour activity. The budget can then be tested against the sales forecast to see if it is achievable and to identify problems in particular areas of activity.

Short Term Planning and Control:

The short term control which can be exercised over research activities is very limited. The level of overheads and the utilisation of direct labour are the only variables which can be easily measured and reported. The utilisation of direct labour can be monitored by analysing the timesheets prepared by direct staff and comparing the actual bookings with budget. Overheads can be simply monitored by comparing invoices received and accrued charges against the budgeted figure.

To further monitor the performance of research organisations requires a large amount of systems effort. There are two other short term control measures which can be used but which are not employed in all cases because of the trade-off between the effort required and the potential benefits. The two control methods concerned are the monitoring of the actual vs. forecast spend on individual research projects and the monitoring of actual vs. budgeted contribution for individual research sections.

The detailed monitoring of research projects is very difficult because at any one time there may be upwards of 50 researches in progress and the forecasting of effort on research projects is in itself an art, rather than a science. Some type of monitoring can be undertaken as a project approaches its financial limit but at
that stage it may be too late for corrective action to be taken.

The measurement of the contribution made by individual research sections is potentially a very useful tool but it requires considerable effort to set up and has one special problem. Projects which involve more than one section will generate transfers of services. The price associated with this is described as the transfer price. Deriving the appropriate transfer price poses a problem.

There are two solutions to the transfer pricing problem which can be shown to give an optional return to the firm as a whole. These are the economics approach which shows that a maximising situation can be achieved by transferring goods or services at marginal cost and secondly the mathematical approach which, using linear programming methods, shows that an optimal position is achieved by pricing transfers at market price.

The criticism of both of these approaches is that they are not consistent with the motivation of profit responsible managers. In the case of the marginal cost transfer price the cost centre selling the goods or service will be able to achieve a better price in the market place. While in the case of the mathematical solution, a manager buying in from another part of the same organisation will expect to receive a discount especially if there are economies in transportation, selling or other overhead costs. To achieve either of these transfer price levels it is argued that central administrative control is required.

Attachment 2 considers the transfer pricing system at BNF where a market price system has been adopted and which works well because the organisation is small and there is a general awareness of the need to maximise the overall company return. Attachment 2 also reviews the problem of transfers of services on basic research which adds a further complication to this problem in research organisations.

The practical difficulties in operating a contribution measure are emphasised by the results of the questionnaire, see Attachment 1, which showed that only two members of AICRO use this method. The most important day to day method of control is professional control, which is based on the generally high level of education and professional training of research staff. This was emphasised in the questionnaire replies; Attachment 1 and implies a very informal control of day to day operations.

Review

Research organisations employ a portfolio of planning and control techniques most of which are employed in many if not all business organisations, although not in an identical form.
The next two chapters consider respectively systems analysis, design and implementation, and computerised accounting. It is in the design of the general ledger system that the peculiarities of the planning and control techniques in use play a part, and this is highlighted in the approach taken by BNF and the Shirley Institute - case studies 1 and 2.
Chapter Two: Systems Analysis, Design & Implementation

The process of systems analysis, design and implementation will follow the detection of a problem. The various stages in the process have been thoroughly documented, and the effort required at each stage in a big system has been investigated. An example of this work can be found in Parkin [25].

Est/Effort %

<table>
<thead>
<tr>
<th>Stage</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation (feasibility study)</td>
<td>5</td>
</tr>
<tr>
<td>Systems Analysis</td>
<td>10</td>
</tr>
<tr>
<td>Systems Specification</td>
<td>10</td>
</tr>
<tr>
<td>Programming</td>
<td>15</td>
</tr>
<tr>
<td>Testing</td>
<td>30</td>
</tr>
<tr>
<td>Implementation/Documentation</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

The above stages will apply to the introduction of any complicated information system, including an accounting system. A general review of business systems can be found in Clifton [5]. Although the accountant is a user who very often has only a low level understanding of computer systems, it is nevertheless important for the user to be involved in any system changes. There are three distinct types of involvement which will be considered under separate headings:

(i) The first area of involvement considered below is in the preparation of a feasibility study and systems analysis. This involves the formal recognition of a problem or potential problem and the preparation of a statement of requirements which can be used as the basis for the development and appraisal of detailed proposed solutions.

(ii) The decision stage which involves raising proposals, investigation and deciding upon the best available course of action.

(iii) Finally the user involvement in the testing and implementation of a new system, including training and documentation.
Feasibility Study/ Systems Analysis

The feasibility study will be prompted by an awareness to an existing or potential problem and is a formal and precise re-statement of this problem. Without this formalised approach a number of difficulties can appear at later stages; this is emphasised in the BNF Case Study. The feasibility study or systems investigation as it is sometimes called, can be broken down into four areas.

**Systems Objectives:**

The feasibility study should analyse precisely the objectives of the system, this involves looking in detail at the various functions carried out. For an accounting system, this can be achieved by considering the various processing requirements and system outputs, e.g. the timing and content of management accounts, the payment schedules for trade creditors and the processing of debtors information are all requirements which can be precisely stated in terms of content, method and time (weeks/days/hours).

The benefit of this process is that it focuses the attention of the user on what he actually needs, rather than what he thinks he needs. This is very important as it then makes it possible to identify whether or not a problem actually exists.

**Problems and Opportunities:**

The feasibility study is initiated by the existence of a problem which needs to be precisely defined to identify if it is 'real' and to judge its importance. For example, a feasibility study may have been initiated by a desire for more up-to-date information from the accounting system. This generalised statement needs to be expanded to include details about what information is needed, how quickly and why it is needed within that timescale. Very often information is requested without an adequate reason and this type of analysis should stop effort being wasted in providing superfluous reports.

Following on from this, it is also appropriate to identify areas in which a system may be improved but which are not essential. Most accountants do things which they feel could be improved upon but on their own do not justify the expense of a major change. Examples of this type of activity include using the accounting system as a forecasting tool, for preparation of the capital register and control of the company pension scheme. All of these activities will be done in some way; but very often the systems used will be manual and can be improved upon.
The result of this analysis should be a clear understanding of why a system is proposed, what is essential and what could be incorporated into a new system.

Statement of Requirements:

The feasibility study should expand on the objectives of the system already identified, by exploring each information output to find out who uses the information and why. This is a first step towards a much more detailed investigation which will form part of the systems analysis.

Putting this together with the systems objectives and the problems and opportunities already identified, provides a fairly detailed view of the current system and proposed changes.

Feasibility Report:

The final part of the feasibility study is an analysis of whether what is proposed is possible and if so at what cost. This analysis is unlikely to provide a yes or no decision but by asking a series of questions, it provides the basis for a recommendation on whether or not to carry on to the systems analysis stage. The feasibility report will answer three types of question; is the proposal technically, operationally and economically feasible?

The technical feasibility refers to the hardware and systems software which will be necessary. This can be reviewed by considering the likely processing, input and storage requirements. Technical constraints are unlikely to be an absolute factor given the developments which have been made in computing technology but this analysis should provide an idea of any additional facilities which will be required.

The operation of any system depends to a very large extent on the attitudes of the employees and management. Change inevitably creates conflict and the potential for conflict therefore needs to be identified by considering the changes which will be imposed if the proposal is adopted.

The final constraint is cost, made up of the purchase price plus subsequent operating costs of both hardware and software, which can only be estimated at this stage. There may also be indirect costs associated with change, for example, delays in invoicing during the changeover period. If these are significant they should be quantified.

The feasibility study should provide management with the information necessary for a decision on whether to continue to a systems analysis. The final point to consider is who should undertake the feasibility study? There are basically three alternative routes; to employ a systems specialist from outside,
to use an in-house systems specialist or to rely on the user. There is a trade-off in each of these alternatives between cost, local knowledge, expertise in systems work and day to day pressures so no general rule can be applied; this problem is discussed in Parkin [26].

Systems Analysis

The next step after the feasibility study is to produce a systems analysis. The purpose of the systems analysis is to define the system requirements in much greater detail than the feasibility study, so that proposed solutions can be prepared to include a high level of technical and financial detail.

The systems analysis stage can be divided into four parts, as suggested by O'Brien [4]. These in turn consider in detail the organisation structure, the information system under review, the present system and the proposed system. To make a comparison with economics this procedure is a macro to micro analysis, starting with an overview of the organisation and refining this down to consider the activities of small groups and individuals within the organisation.

Analysis of the Organisation:

The analysis of the organisation is an introduction to the environment in which the information system operates. The areas which need to be covered can be considered in the form of a checklist:-

- The history of the organisation.
- The industry within which the company operates.
- Interest groups e.g. consumer groups, EEC, etc.
- The organisation's strategies and goals.
- Operating policies and practices.
- Major operating systems.
- Information systems.

This checklist is not exclusive and any information about the organisation and environment which will affect the preparation of new systems proposals should be included.

Analysis of Major Information Sub-systems:

Within any big information system there are a number of sub-systems and these need to be identified and investigated. Each sub-system can be broken down as shown in fig 2.(i).

An accounting system is composed of a large number of sub-systems. Identifying all of these is very important because any changes
INPUT
(Transaction Records)

OPERATION
(Operating Systems)

OUTPUT
(Sub-System Product)

RESOURCES
(Knowledge, facility, information etc)
made may have secondary effects which are not immediately obvious. Examples of sub-systems in an accounting system include the purchase ledger function, preparation and payment of salaries, production of management accounts and credit control. Using the format shown in fig. 2.(i) and applying it to the purchase ledger function leads to the analysis shown in fig.2.(ii).

In the systems analysis stage this information will be prepared for every sub-system, providing a detailed analysis of how the current system works and also a test bed against which a proposed system can be checked.

Present System Analysis and Proposed System Analysis:

The final part of the systems analysis is a comparison of the systems design of the present and proposed systems. This is done by flowcharting the present and proposed situations and examining in detail the differences between them.

Flowcharting of any system involves identifying the inputs to the system and recognising the storage, processing and control procedures which are undertaken before the output stage is reached. Fig.2.(iii) shows as an example a simplified flowchart of an imaginary accounting system in which there are three inputs, cash book, purchase invoices and sales invoices which are all input on a weekly batch basis.

Taking the example shown in fig.2.(iii) let us assume that a major change is proposed, which is the replacement of the current purchase ledger system with a new on-line system which will be used to produce the necessary inputs into the period transactions file.

Flowcharting the new system after this proposed change provides us with fig.2.(iv). By comparing fig.2.(iii) with fig.2.(iv) the differences between these two systems can be highlighted.

(i) A facility has been created to input purchase invoices daily on-line.

(ii) New operating procedures have been defined for the bought ledger system.

(iii) The interface between the bought ledger and other accounting systems has been amended.

(iv) The requirement for validation and editing of the merged file for posting to the general ledger has changed because of the validation procedures in the new bought ledger system.

This analysis forces the identification of exactly what is wanted and how it is going to be achieved. This can be a very time consuming and expensive exercise but it is essential to ensure
ACCOUNTING SYSTEM WITH MANUAL PURCHASE LEDGER

Figure 2(iii)

- Purchase Invoices
- Cash Book
- Sales Ledger

Transaction File (period) → Edit

Transaction File (YTD) → Validation

Reports
ACCOUNTING SYSTEM WITH COMPUTERISED PURCHASE LEDGER

Figure 2(iv)

- Purchase Invoices
- Cash Book
- Sales Ledger
- Transaction File (period)
- Transaction File (YTD)
- Validation
- Edit
- Reports
that any new system which is implemented will work efficiently.

Deciding who should be responsible for this work poses a problem very similar to who should undertake the feasibility study. The choices are the same in-house or external supplier, which in the case of an accounting system will mean an accountant with some systems knowledge or a systems/computing specialist.

Any person undertaking a systems analysis needs to have a good knowledge of systems and exposure to previous systems analysis work. But in all instances the company accountant will need to be fully involved in providing information.

The objective of this stage is to provide a statement which can be used as the basis for detailed systems specification by software houses, in-house departments and/or computer bureau.

Evaluation of Proposals
------------------

Obtaining and evaluating proposals for a new computer system is the second area of user involvement. There are three parts to this; obtaining proposals from potential suppliers, evaluating these proposals and finally deciding upon the strategy to be adopted.

Computing facilities consist of hardware which includes the computer and peripherals and software which is the term used for the operating and application programs. The hardware and software in use in any particular application must obviously be compatible.

There are a number of permutations of hardware and software which may be considered:

- A software package bought to run on existing hardware.
- Customised software purchased to run on existing hardware. In-house developments to run on existing hardware.
- The above alternatives for new software may also require uprating/replacement of existing hardware, or purchasing of dedicated hardware.
- A decision may be made to outsource the work to a computer bureau.

With the continual reduction in the price of computer hardware, it is becoming more and more common for the software chosen to determine the hardware rather than the other way around. Whichever of the hardware and software alternatives are considered, the procedure involved in evaluating proposals will be very similar.
Identification of Potential Suppliers:

There are a number of ways of identifying potential suppliers, including the use of consultants, enquiries through computer manufacturers and the use of software directories. Whichever of these routes is chosen, the number of potential suppliers identified will probably need to be whittled down before detailed quotations/system specifications are requested. This can be done fairly simply on a number of bases, as follows:

- Estimated Cost
- Compatibility with current hardware.
- Compatibility with current operating systems.

Often applying these three criteria will not filter out enough potential suppliers. If this is the case, then those remaining will need to be reduced on the basis of reputation, or some other way, possibly randomly. The selection of an accounting system will often fall into this category. The NCC software directory [22] for integrated software packages currently (Aug 1983) has 336 entries. If we apply the constraint that the system must be a general ledger, suitable for use on a popular mini-computer such as the DEC PDP-11, there are 13 possible suppliers listed. This is probably too many to review thoroughly and some other sort of filtering would therefore be needed.

The choice of potential suppliers is an important function, because there are differences between the products on offer which can only be identified with detailed analysis. At the same time, the most efficient solution might be dismissed without consideration because of the need to restrict the number of proposals evaluated. There is no certain way of ensuring that this does not happen.

A further complication may be that there is an in-house computing department which has the capacity to do development work. In such cases it is probably best to treat the computing department as another potential supplier and to follow the same procedures for proposal gathering and review, discussed below, as for an external supplier.

Systems Proposals:

Having chosen a number of potential suppliers, the next step is to circulate the systems specification that has been prepared, with a request for proposals to be received by a certain date. Most suppliers will probably wish to visit to clear up any grey areas or points not covered by the systems specification. The objective is to obtain a number of detailed proposals which can be analysed and reviewed leading eventually to a final decision to purchase a particular system, or to remain with the existing facility.

The form and content of the proposals will vary slightly between the different software suppliers. Software houses supplying
packages tend to take the view that a particular company's requirements can be fitted to their package. Their proposals therefore are usually based on a standard document which identifies the major systems feature, prefaced by a short statement saying how a particular company's operations would be tackled. The result of this tends to be that proposals are not very helpful and a large amount of time and effort is required to complete a comprehensive review.

The second possible source is the preparation by an outside supplier of dedicated software. This is a very expensive option because of the programming effort required; and consequently tends only to be adopted when the application is unique or very highly specialised and no package solution is available. What occurs very frequently, is that a small amount of dedicated software is proposed to support a basic package. In this situation, the proposals generated tend to have the same deficiencies as the complete package solution, with the exception that particular problem areas where dedicated software is proposed will have been more carefully reviewed in order to justify the additional expenditure.

A proposal prepared by an in-house department should include all the information expected from an outside supplier, including initial and recurring costs and a timescale for the introduction of the new system. The existence of personal relationships can lead to a less professional attitude being taken towards internally generated proposals in terms of presentation and scrutiny. This should be avoided, as far as possible, by applying the same criteria in assessing both internally and externally generated proposals.

The use of a computer bureau may also be a possible option but this approach will not be reviewed here, because it is unlikely that a company will be willing to have a system such as its accounting system, which is a major source of information, run by an outside organisation. Specialist parts of the accounting function such as payroll and credit control are quite often operated by bureau, especially in small companies. In these cases the bureau system may have special advantages in terms of security and specialist skills and facilities. In America, bureau systems have been taken one step further and specialist computer service companies may be employed to work alongside an organisation's staff in providing a particular service. This has not happened in Britain so far.

Proposal Review:

The next step is to review the proposals received. Each proposal will differ in respect of cost and the facilities it offers and the problem is to identify the best alternative. The review process can be considered at two levels:
(i) Does the proposal fulfil all the basic requirements identified?

(ii) Analysing in detail the costs and benefits of each proposal and applying some form of decision rule.

By the time the proposal stage has been reached, if a systems analysis has been done properly, there should be no obviously unsuitable proposals received. It is possible however that there may be some element in a proposal which after a brief examination can be identified as unacceptable.

The BNF study provides an example of this. The experience at BNF was that although the accounting package proposals could be used to provide the facilities required by BNF because of the way the package worked it was very unwieldy as a tool and would have required an unacceptable level of effort to operate.

After this fairly brief analysis of proposals, the next stage is a much fuller investigation. The first steps in this will probably be a visit by the proposers to explain further, particular features and capabilities. By this time it should be fairly clear how each proposal should work in practice. To back this up, it should be possible to visit an installation of any package and to run a test pack of data. The design of a test pack is very important and should be used to illustrate what happens when things go wrong, as well as when they go right. This can be achieved by deliberately including errors within the test pack to highlight the validation and error correction facilities of the system.

At the end of this exercise, the potential user should have a clear idea of exactly how each proposal would be operated. The sub-systems analysis prepared as part of the systems analysis can be used as a checklist to ensure that each part of the proposed new system has been considered. The next difficulty to be overcome is how to choose between alternative proposals. There is no definitive method which can be used but the decision process should be undertaken in a logical manner.

One approach to decision making is to produce a statement which tries to represent numerically the relative merits of different proposals. The first step in this is to list the criteria which are considered important, for example:

The initial cost and maintenance charges.

The ability of the supplier to provide training and necessary support.

The results of the test pack running.

Potential further applications of the system.
### RANKING PROPOSALS

Fig 2(v)

<table>
<thead>
<tr>
<th>Priority</th>
<th>Ranking</th>
<th>Proposal 1</th>
<th></th>
<th>Proposal 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Achievement</td>
<td>Result</td>
<td>Achievement</td>
<td>Result</td>
</tr>
<tr>
<td>1. Cost</td>
<td>10</td>
<td>8</td>
<td>80</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>2. Reporting</td>
<td>9</td>
<td>7</td>
<td>63</td>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>Capabilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. User</td>
<td>7</td>
<td>4</td>
<td>28</td>
<td>8</td>
<td>56</td>
</tr>
<tr>
<td>Friendliness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. etc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

xx

xx
Capability of the system to meet changing workloads.

Reporting capabilities and potential for development.

Timescale (Especially if development work is required).

In any situation there will be priorities which can be ranked in terms of the importance stressed on particular characteristics. For example if cost were considered the most important feature, it could be given a rating of 10. Similarly if there were no current plans for further computerisation, the potential for further applications of the system might be given a rating of 2.

Having arrived at an ordered list of objectives, the next step involves assessing how well each proposal satisfies the individual objectives and translating this into a score on a defined scale. For example, if the objective was completely satisfied, a score of 10 might be awarded, the score being reduced down to zero with reducing levels of satisfaction. The results of this exercise can be expressed in a table format, fig 2. (v).

Multiplying the achieved score by the ranking placed on that particular priority and adding the results, gives a total which can be compared between proposals. This represents an attempt at assessing the benefits of each system in an objective form. It is not an ideal method but it does have the advantage that it forces the evaluation to be made over a full range of priorities, rather than a decision being reached after only particular items have been considered.

A decision table such as this alongside a written report considering the features of each proposal, should enable the correct decision to be taken. But there can be no guarantee and inevitably there will be unforeseen factors which might have altered the decision reached.

Implementation

Once a decision has been made to proceed with a new or modified system, the next step is to plan the change. There are two elements to this, the facility changeover and the introduction of new operating systems.

The facility changeover covers the delivery and installation of new hardware and any commissioning type activity required. The responsibility for this will lie with the supplier and in-house computer staff and service departments.

The second facet is the adoption of new operating procedures, which covers the delivery of new software, the testing of this software and changing over to new operating procedures. This will involve internal computer staff, the software supplier, and the
user, and the success of this activity will depend to a large extent on effective planning and control.

Planning for a change should link the supplier and user to the best advantage. The most often adopted approach is to form a steering committee containing representatives of both sides who have a sound understanding of what is required and can plan accordingly. It is also usual for the supplier to nominate a project leader to whom all technical questions can be relayed.

One commonly used technique to plan complicated inter-related activities is critical path analysis (CPA). This method requires that all dependent relationships be identified and expressed diagramatically, so that a logical plan can be drawn up against which progress can be measured.

During the process of change there are three major activities:

(i) System testing to reduce the number of problems which arise when the changeover is made.

(ii) Changing over from the old to the new method.

(iii) Properly training all staff involved, so that they can deal with the unexpected as well as the day to day routines.

System Testing:

System testing is the running of programs in a planned way, to identify any bugs or errors and to check that they will operate as expected. The amount of time and effort required on systems testing will be a function of the accuracy and clarity of the systems specification, the amount of completely new programming work and the complexity of the application.

Testing of a software package will concentrate on those areas in which the specific application makes special demands and where the new software interfaces with existing programs. The testing of in-house prepared software or of custom written programs will need to be far more rigorous than for packaged software, because there will be new and untried elements and there is therefore likely to be a greater number of problems.

Systems testing involves running data through various parts of the system and seeing exactly what happens. There are two types of data which can be used for this, actual data and test data prepared specially to include errors and anomalies. Ideally, testing should be undertaken using both types of data. Inevitably not all the potential problems will be identified but by following a carefully planned test procedure these can be minimised. Taking an accounting system as an example, the various areas for testing will include:
Within an accounting system there will be a number of checks on the feasibility and validity of entries. For example, there will be a check on the double entry procedure to ensure that for every debit there is a matching credit. All of these automatic validating and checking procedures need to be tested to ensure that they work properly.

The interface between new and existing programs needs to be tested. For example, a new nominal / general ledger package may be required to interface with existing bought ledger and sales ledger software. Unless each element of the software has been bought from the same supplier, there are likely to be problems associated with the interface.

Any special facilities of the new system will need to be tested to make sure they work properly. An accounting system may, for example, have the facility to make automatic postings and this type of feature needs to be checked to ensure it works correctly in all situations.

Each sub-system identified in the systems analysis needs to be checked to make sure that it conforms to the systems specification. The systems analysis can be used here as a checklist for the testing of the operating routines in detail.

The reports to be produced by the system need to be run so that their content can be tested against the systems specifications. And also because there may have been inaccuracies in the specification and this provides a last chance to look at what is to be produced, and make small changes if appropriate.

Finally, the programs' file handling capabilities need to be checked to ensure that there is adequate file space, and should file space become a constraint, then the correct error message is given. The need for file space must be carefully checked because each new application will have different demands.

Most of all system testing must be thoroughly planned and executed or major problems can arise at a later stage, at which time the cost and time required to put them right can be much greater.

Training:

Effective training is a very important part of the implementation process and it can begin as early as the system specification stage, through consultation with staff, making them aware of the possibility of change. Training is usually considered as a transfer of necessary skills but it can also be used to overcome resistance to change and to motivate. There are four areas in which training effort can be directed, to provide an overview to senior management, staff awareness, staff training and on-the-job training.
The first area to consider is the education of senior management to make them aware of the effects of the change and the possibilities of the new system. One way of doing this with an accounting package, is to take senior managers to see an existing installation from which an immediate idea can be gleaned of the total package.

The second area for training, is to make all staff aware of the changes which will be taking place and why. This can probably be best tackled by a formal presentation, covering in detail all the areas which will affect staff working routines. It is very easy to assume that people have more knowledge than they actually do. In the case of an accounting system, individual members of staff are likely to have a thorough understanding of their own job but may be unaware of exactly how they fit into the whole. A presentation can be used not only as part of a training programme but also to increase the motivation and satisfaction of staff by increasing their understanding.

The most obvious training need is for job training, to teach staff the detailed requirements of the new operating system. There are two ways this can be done, by formal teaching and through a 'sit-by-me' approach.

After the changeover to the new method of operations, there will still be a need for training to cover new problems as they arise and to develop the skills and expertise of staff and managers, so that the benefits from the change are maximised.

With an in-house developed installation there is an opportunity to extend training as a need is identified. With externally supplied software, the initial contract will include a certain training allocation. This is usually quoted in terms of a number of training days for different types of training but it can be more flexibly stated. For example, McCormack and Dodge [6] quote a number of training units which can then be utilised as required by the customer, to give different types of training over a chosen period of time.

Changeover:

The changeover period will inevitably be one of organised chaos in which previously unforeseen problems arise. There are four basic approaches which can be adopted in effecting the changeover, pilot installation, parallel running, gradual or immediate.

Use is made of a pilot installation usually only only when a system is common to a number of locations, for example in bank branches. In dealing with a central accounting function this approach is probably inappropriate. The other three methods are however distinctly possible.
Parallel running involves operating the old and new systems side by side. In theory, this is a very good arrangement, as it allows the new system to be set up and run for a period of time without worrying about failure. But in practice, there are a number of difficulties. There may be a considerable amount of effort required if the input format or timescales of the two systems are different. For example switching from a monthly to an on-line input might mean doubling the administrative effort required. And secondly if the new system has been designed to produce a different type of report, is it correct to continue issuing the old style report?

It may be possible to implement changes gradually to spread the workload and problems over a longer period. This may not be possible when dealing with an outside supplier who is delivering a package but could be ideally suited to an in-house development in which new facilities are tested and become available over a period of time.

The final type of changeover is the use of a cut-off. As the name implies, this involves simultaneously shutting down the old system and commencing with the new. This is to some extent unsuitable for accounting systems, which must comply with legal requirements concerning the security and continuity of information. At the same time an accounting system does to a degree have a start and finish date, the accounting year-end and it may be appropriate to use this as a cut-off point.

Documentation.

One final point to consider is the documentation of the system and system maintenance. It is very important that a system should be fully documented and this should include back-up procedures should there be a failure at some point. This is an area in which packaged software will almost always out-perform any other option. For example, the costs of documenting the MMS General Ledger Systems supplied in the U.K. by Package Programs Ltd. [24], has to date been spread across 3500 installations.

A particular danger exists with in-house prepared software, which is that its details may be retained by the particular person responsible. This is a feasible state of affairs which may operate perfectly well until that person leaves the organisation.

The whole process of implementation is a very complicated one, in which there are numerous inter-relationships and a number of different possible courses of action. The most important element is therefore that the whole process should be planned and controlled by a selected group, with appropriate skills and knowledge of the situation.
Review

This chapter has considered the various stages in implementing any new computer system. Failure to attend properly to any of these stages can lead to problems, many of which are highlighted in the two case studies described towards the end of the thesis.

There are a number of accounting systems which not only have to work as individual systems but which also need to be integrated. The general characteristics and supply of these systems are considered in chapter three.
The tremendous advances which have been made in micro electronics have led to a reduction in the cost of computer hardware. This in turn has made the use of computers in business applications far more attractive, with a consequent rapid growth in the number of organisations supplying business software.

The various alternative hardware/software options have been considered in chapter two. This chapter will concentrate on the nature of accounting systems and in particular accounting packages which are now the most popular software approach. Six accounting packages were reviewed, mainframe packages supplied by Wootton, Jeffreys & Partners [33], Host Computer Services [16], and Package Programs Ltd. [24]; and three micro-computer packages supplied by Sage [31], BOS [3] and Peachtree [27]. The three mainframe packages were those considered by the BNF Metals Technology Centre, see the BNF case study which follows. The micro packages are three of those most widely used and are available on a variety of different machines. All fit the basic definition of an accounting package as described in this chapter.

The description "accounting package" is used to describe computer software which is purchased off the shelf and which can be used in a number of different situations without the need for program changes. There are a large number of packages available, covering all makes and sizes of computer, ranging from a package for the Sinclair Spectrum priced at £20, up to the MMS package available from PPL, which is suitable for a variety of mainframes and priced at over £55,000. Evidence of how many potential suppliers there are can be seen in any reference text such as the ICL software directory [18], by making an enquiry of the NCC database [22], or simply by noting the number of advertisements placed in accountancy, business and computing journals.

The reason for this large number of potential suppliers is mainly the size of the market. Any organisation which uses money as a currency and in which there is some formal accountability, will need to keep accounting records. And although every accounting system will have particular requirements, it is possible to design a package which can be adapted to suit a large number of applications. The most common constraint which will determine a particular package as unsuitable is size. The software purchased must be compatible with the hardware, which in turn must have adequate storage capacity to cope with the number of transactions taking place.

The operations of an accounts department can be broken down into a number of functions and this same breakdown is used by software suppliers. When a reference is made to a computerised accounting system, it will nearly always refer to a computerised nominal/general ledger. But it may also refer to computerisation
of some or all of the other major accounting functions, which are as follows:—

Purchase (Bought) Ledger
Sales Ledger
Management Accounting
Payroll
Forecasting
Fixed Assets

Most business organisations that have invested in computerisation of their nominal/general ledger will proceed to computerise all or some of the above. The fixed asset, payroll and forecasting functions may be satisfied by specific packages or in the case of payroll and forecasting by the use of a spreadsheet type program. Whichever approach is adopted, these functions will usually be considered as separate entities because they can be treated as stand-alone activities. On the other hand the sales, purchase and management accounting functions will need to be integrated with the nominal/general ledger. Because of this requirement, the term accounting package will be used here to cover these four activities.

The rest of this chapter will be devoted to considering how computerised nominal/general, sales and purchase ledgers work and how the general ledger format can be extended for management accounting purposes.

Nominal/General Ledger

The term nominal ledger refers to the financial accounts. As soon as these are expanded to include accounts for management accounting purposes, then the broader term general ledger is appropriate. It is usual for a general ledger approach to be adopted and this term will be used from here onwards.

Not all computerised general ledgers work in quite the same way, as some are more sophisticated than others. But it is possible to identify a typical general ledger system as containing three major elements which are the chart of accounts file, transactions file and reports produced.

Chart of Accounts:

In a manual system each financial account is normally assigned a number, which is used to cross-reference the transactions posted from ledgers. In a computerised system, a file of account names and numbers has to be set up for the same reason.

(i) Using a double entry system each transaction will have two entries, to appropriate account codes.
(ii) The account number entered into the transaction file can be validated against the chart of accounts, to make sure that it is real and that it can accept the particular type of transaction.

(iii) A hierarchy of accounts can be set up, facilitating the preparation of summary reports.

(iv) The chart of accounts file may be used to hold additional information. This topic will be considered further in the discussion of management accounting.

The chart of accounts file is usually set up and maintained by the user and it is this part of the system which allows most of the tailoring available to meet specific applications.

Transactions File:

The general ledger must contain a record of all the transactions of the business in exactly the same way as a manual system. For each transaction there must be two entries, a debit and a credit, following the principles of double entry book-keeping. When a transaction is posted it will be in the form of a record, the exact contents of which will vary between systems. A typical record will contain the following fields:

- Account code
- Date
- Transaction reference
- Amount
- Source Book
- Account Type

After the details of a transaction are entered, they will usually be validated against the chart of accounts file as mentioned previously. There will also follow other validation to check the double entry procedure and to identify any punching errors. When the transaction file has been agreed it can then be merged with the year to date general ledger. This file will contain 'at least' the transactions for the current financial year to date, usually sorted by account number, date and source book.

Reports:

The third part of the system to consider is the preparation and content of reports. This is an area in which there can be significant differences between packages. Packages for micro computers usually contain a number of specific report programs, for example:

- Chart of accounts listing
- Year to date transaction summary
Figure 3.(i)

Input

Transaction file (Period)

Edit

Validation

Transaction file (YTD)

(Period & YTD) File

Reports

Chart of Accounts

Validation

Input
Period transaction report
Account number investigation (for audit purposes)
Trial balance

In larger packages, a report generator may be provided which allows the user to produce the financial reports listed above and also to generate specific management accounting reports. The relationships between these three elements is shown in fig 3.(i).

Sales Ledger

The term sales ledger refers to the preparation of sales invoices, entry of sales information into the general ledger and debtors analysis. The procedure involved is very similar in principle to the general ledger and can be broken down into equivalent component parts of customer file, transactions input and reports.

Customer File:

In order to obtain the maximum benefit from computerisation of the sales ledger, it is necessary to set up a customer file. This is used as a source of information for the preparation of invoices, the analysis of customers and of debtors. The customer file will normally contain information about all customers to whom some sort of credit is given, including the following details:

- Customer name
- Address
- Telephone number
- Reference

Transaction File:

The day to day entries which are made will vary according to the facilities associated with the particular software. In the most comprehensive examples, details of orders, goods delivered and payments made will be input. This will allow the system to be used as an order book, for drafting delivery notes and invoices and for the analysis of debtors.

The sales ledger must interface with the general ledger in which a record of all invoices prepared and payments received must be maintained. Invoices prepared by the system must be coded according to the appropriate debtors control and sales accounts and a file of these transactions must be prepared containing the required fields of information per. the general ledger format.
SALES LEDGER

Figure 3(ii)

Input -> Sales Ledger (period) -> Edit

Output to General Ledger

Sales Ledger (YTD) -> Validation

(Period & YTD) File

Customer File

Input -> Validation

Reports
Reports:

The reports produced by the system will obviously depend on the facilities of the particular package. The following is a possible list:

- Orders received.
- Outstanding orders.
- Deliveries.
- Invoiced amounts.
- Outstanding debtors by customer/period.
- Customer analysis.

The flowchart fig 3.(ii) indicates the relationships between these three elements of the sales ledger.

Purchase (Bought) Ledger

The purchase ledger section records invoices, obtains the necessary approvals and makes payments to suppliers.

The procedure adopted by computer solutions can be broken down into three parts, supplier details, transaction records and reports.

Supplier Details:

In order to operate a computerised purchase ledger a record of all suppliers who grant credit is required. This register will usually include the following supplier details:

- Company name.
- Address.
- Telephone number.
- Banking details.
- Payment terms.
- Reference.

This information will be used to provide a record of supplies from individual creditors and to make payments.

Transaction Information:

Most purchase ledgers work in the same way and have very similar capabilities. There will be two types of transactions recorded, invoices received (including credits) and payments made. All invoices received will be entered into the system and identified by the supplier reference. This builds up a record of invoices from a particular supplier. Secondly, using the dates of the invoices input and the customer payment schedule, the system may
be used to produce due for payment information.

Reports:

The features of most purchase ledger systems are, as mentioned above, very similar. The one area in which they do vary is in the ability to automatically print bank giros and/or cheques. In smaller systems this facility may not exist and preparation of forms for payment will then need to be done manually.

The reports which will normally be produced are as follows:

- Invoices received.
- Payments.
- Customer analysis.
- Creditors ageing analysis.
- Bank giros/cheques.

The flowchart fig 3.(iii) indicates the relationship between these three elements of the purchase ledger system.

For an organisation wishing to implement an integrated financial accounting system, the interfaces between the three elements of general, sales and purchase ledgers will be very important. It is essential that the elements of the system are compatible and this may well mean that all three systems are purchased from a single supplier. One micro software package (SAGE) has tackled this particular problem as a priority and supplies all three programs on a single diskette.

Management Accounting

The management accounting function can encompass a wide variety of activities. In the context of an accounting package the term is used to describe the activity of planning and reporting on operating performance.

Some management accounting information can be obtained directly from the financial accounting system, for example, details of overhead costs and product sales. This may be adequate for certain organisations particularly those without manufacturing operations. However, for other organisations this is inadequate and some additional system is required to provide information about performance. There are basically two alternative approaches to this problem; the preparation of software specific to a company or industry, or the development of a general solution.

The most common approach among software houses has been to develop a solution to a particular type of problem. For example, the package supplied by Diskus (9) to the Shirley Institute (case study 2) was originally designed for the building industry. In
particular two elements, payroll and job costing, have been designed and written to mirror the manual procedures in use. This approach is limited because it does not have the capability to provide management information in a wide variety of situations.

The second type of software is akin to the developments being undertaken at BNF (case study 1). The concept of this type of approach is that management accounting is a data collecting and reporting system and that it is possible to build a framework which can cope with a variety of situations.

To this end there would appear to be three essential elements:

(i) The facility to record labour bookings from job cards and/or timesheets.

(ii) The chart of accounts file should allow additional project related information to be entered. This information could be budgets, standards, sales value, etc. The important point here is that this information should be accessible by any report program, thereby extending the scope of the management information system.

(iii) Each business organisation has different reporting needs and ideally any package which aims to satisfy management requirements should include a report generator facility, enabling the user to format his own reports.

Providing these three elements exist it should be possible in theory for a management accounting package to be designed which can be used in a wide variety of situations. Fig 3.(iv) is a very simplified representation of the management accounting systems being developed by BNF and the Shirley Institute and shows these different approaches. From Fig 3.(iv) a number of obvious differences emerge:

Because the BNF system is designed to be an integrated system, there are a number of automatic posting facilities and a specifically designed coding system, which reduces the amount and size of the transactions input required.

The project costing system in use at the Shirley Institute is an additional system and not integral to the general ledger.

The chart of accounts file is very different between the two systems. The BNF system has been designed very much with management accounting as a priority and the contents therefore reflect this:
COMPARISON OF TWO GENERAL LEDGER SYSTEMS

Figure 3(iv)

BNF

SHIRLEY INSTITUTE

Input(1)

Nominal File (2)

Project Cost File

Chart of Accounts (3)

Reports (4)

Input(1)

General Ledger (2)

Chart of Accounts (3)

Reports (4)
<table>
<thead>
<tr>
<th>Chart of Accounts Content</th>
<th>Shirley Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>-------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Project Code</td>
<td>Project Code</td>
</tr>
<tr>
<td>Mnemonics</td>
<td>Mnemonics</td>
</tr>
<tr>
<td>Description</td>
<td>Budget Fields</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Prior Year Figures</td>
</tr>
<tr>
<td>Overhead Rate</td>
<td>Start Date</td>
</tr>
<tr>
<td>Internal Allocation</td>
<td>Finish Date</td>
</tr>
<tr>
<td>External Allocation</td>
<td></td>
</tr>
<tr>
<td>Start Date</td>
<td></td>
</tr>
<tr>
<td>Finish Date</td>
<td></td>
</tr>
<tr>
<td>Customer Name/Ref</td>
<td></td>
</tr>
<tr>
<td>Government Support</td>
<td></td>
</tr>
<tr>
<td>Contract Limit'</td>
<td></td>
</tr>
<tr>
<td>Claims Limit</td>
<td></td>
</tr>
<tr>
<td>Invoicing Frequency</td>
<td></td>
</tr>
<tr>
<td>Booking Restrictions</td>
<td></td>
</tr>
<tr>
<td>Calculation for Invoicing</td>
<td></td>
</tr>
<tr>
<td>Income Calculation (Management Accounting)</td>
<td></td>
</tr>
</tbody>
</table>

The BNF system suffers from the lack of a report generator which restricts the system, as compared with the commercial Diskus system. However, the additional information available in the chart of accounts allows more sophisticated management accounting procedures, including the calculation of sectional (profit centre) contribution.

The process of reviewing and deciding upon an accounting system has been considered in Chapter Two. Management information is likely to have a high priority among the requirements against which proposals are evaluated and may act as a significant filter in determining the suitability of individual proposals. Research organisations provide a clear example of this in the way that project costing requirements must be met. If this requirement cannot be fulfilled by a particular package, then it can be immediately identified as unsuitable for use in a research environment. The case studies of BNF and the Shirley Institute which follow, highlight this point.

Review

The general characteristics of the main accounting systems have been reviewed in this chapter. These systems, although apparently very similar, cannot at present be satisfied by a single accounting package; they require a suite of integrated programs.

The three factors which are likely to have the greatest influence on the choice of software are, the available computing facilities, the size of the application and the specific reporting requirements. For example, the management accounting requirements have been the major constraint in
determining the general ledger system details at BNF.
Case Studies

1. BNF Metals Technology Centre

2. The Shirley Institute

These case studies are essentially a narrative of events which took place during periods of computerisation, and the development of computer solutions to basic accounting applications. A general critique of the major events only is included. The purpose of the case studies being to illustrate the dysfunctional potential of systems development which is mismanaged.
BNF Metals Technology Centre - A Case Study

Background

BNF Metals Technology Centre (BNF) is a service company whose main business is the supply of research and technical services to the non-ferrous metals industry. Based on a single site at Wantage, Oxon, BNF employs approximately 170 persons and has an annual turnover of around £2.5 million (1983).

BNF was established in 1921, and between that time and 1970 it developed steadily relying on three basic types of income: membership subscriptions, contributions from industry for group researches and Government grants. During this period a manual accounting system was established to handle the working requirements of this mix of activities.

Around 1970 the activities of BNF and the sources of funding available for research began to change in two main ways. The Government changed from operating a grant system to a contract system as a method of supporting research activities. This increased the need for financial information for invoicing and overhead calculation purposes. And secondly, during the sixties and seventies there was a very strong movement among industrial organisations to join together to obtain benefits of scale. This movement created larger organisations which tended to undertake a greater amount of their own research activity. The market for research services changed from a large number of small firms without their own research programmes, to a few large organisations who tended to have their own research departments. The operations of BNF had to change accordingly, and the result was that BNF diversified into a number of subsidiary areas in order to replace the lost income from group subscriptions to research.

The effect of these changes on the accounting function was to increase the workload. Diversification meant that there was a greater number of individual projects to monitor, the change in the method of Government support had increased the reporting requirements of Government, and the switch from research to other activities increased the demands on the sales and purchase ledger functions. The result was that the accounting function became a bottleneck unable to cope efficiently with the demands placed upon it.

The response to this was to introduce a computerised accounting system. This was a 'copy' of a system in use at another research establishment, and was programmed and implemented by the BNF computer department on the Prime 300 computer then in use at BNF (1974). At the time this was being done the system was seen as a stop-gap which would enable the BNF accounts department to improve its efficiency, removing the bottlenecks by computerising certain
manual functions. Allowing plans to be made for a computer system which would increase further the application of computer facilities and provide far more sophisticated management reporting.

By the middle of 1980 the demands on the existing systems could not be met efficiently and the investigation of alternative software became a priority.

Systems Analysis

The senior management at BNF decided at this time to commission a statement of requirements for a new computer based accounting system from Thornton Baker, Chartered Accountants. Following visits to BNF by Thornton Baker personnel this document was prepared and accepted in April 1981.

The purpose of this document was to bring together the requirements at BNF in a format and level of detail needed for software houses to prepare detailed proposals. The contents of this prepared statement followed the lines of the systems analysis (Chapter 2), including an introduction to BNF, a description of the present system and future requirements. In hindsight there were however three major deficiencies in this document for which both BNF and Thornton Baker must shoulder blame.

Firstly, no formal investigation/feasibility study had been prepared by BNF staff. The result of this was that the systems analysis was approached without a properly defined statement of what was required, rather there was a general feeling of what was wanted. This is reflected in the statement of requirements which contains a list of 12 items specified for the new system. If a systems investigation had been carried out beforehand at least 6 of the requirements listed would have been radically changed.

Secondly, there was a major deficiency in the way the sub-systems analysis was carried out. This topic is considered in chapter 2 in which the rigorous analysis of sub-systems is identified as a key feature of systems analysis.

The description of each sub-system in the statement of requirements was very limited and does not contain all the necessary information. What is implied is that for each accounting sub-system the general situation applies, i.e. the sales ledger operates in the same way as other sales ledgers, the cash book is typical of all cash books, etc. This is a dangerous assumption to make because anomalies in the operations of a single sub-system can invalidate the suitability of a particular proposal.

The last major discrepancy is the absence from the statement of requirements of any attempt to draft the type of reports which were to be required from the system. By attempting to design draft
final report forms a number of benefits can be gained. BNF management would have been required to think more deeply about their exact requirements, the Thornton Baker representative would have been given a better understanding of what was proposed, and it would have provided the software houses with another very relevant test for their proposals.

Proposals and Review

In April 1981, BNF was operating a Prime 500 series computer for the development of Status a data storage and retrieval system for which BNF has the Prime agency. BNF itself was also using Status to provide a non-ferrous metals information service, in addition the accounting system originally installed on the Prime 300 and sundry other in-house developed programs were being operated. Because of the commitment to Prime associated with the development and sale of Status, the proposed new accounting system was expected to be run on Prime. This factor provided a very severe limitation on possible suppliers so that no other filtering of potential suppliers was required.

The Thornton Baker specification was circulated to four software houses who were asked to respond with detailed proposals by the end of May 1981. The four suppliers were:

- Package Programs Limited (PPL) [24]
- Wootton, Jeffreys and Partners [33]
- Host computer services [16]
- BNF Computer Department

Proposals were received from all four organisations, and they were invited to visit and discuss their proposals with the Finance Director. Following this brief review the proposals of Wootton, Jeffreys and Partners and Host computer services were rejected on the basis of cost. Emphasis was placed on reviewing the PPL proposal to see if it could provide the facilities required by BNF.

A visit was made by the Finance Director of BNF to a PPL installation, following which a PPL representative was invited to BNF to give a presentation to a wider audience of BNF staff including computing personnel. Because package proposals concentrate on the way in which a package operates in a general sense, the presentation at BNF was to be used to consider in detail how BNF's operations could be fitted to the PPL package.

At the meeting to review the PPL proposal a number of features of BNF's operations were considered which appeared to cast doubt on the suitability of the proposal:

BNF has a requirement to cost each research project individually which is achieved by having two systems, a costing system and a
5 digit code number (X XXX X)

Prefix 0/9
(Nominal Ledger/Financial Accounts)

- Overhead Costs
- Employment Costs
- Capital
- Direct Materials (automatic posting from project accounts)

Prefix 1 - 8
(Project Codes)

- Labour booking (timesheets x rates file)
- Direct materials and project expenses
nominal system which are highly integrated. This is reflected in the hierarchy of accounts, fig A.1(i).

The PPL system is basically a financial/nominal system and could not provide an integrated approach. To utilise the MMS nominal ledger BNF would have had to set up two nominal ledgers with individual account structures, which would have almost doubled the effort required in data preparation and entry.

BNF requires a very flexible ad hoc reporting system. Each research project and overhead code when investigated needs to provide transaction details defined by source book and material category. The PPL system like most packaged systems, works on a hierarchy of accounts basis. For each level of detail required an additional level of hierarchy is needed in the code structure. Because of the additional information requirements at BNF an enormous number of accounts would have been needed, with the corresponding problems of file space, coding and data input.

The required account codes at BNF would have been roughly as follows:

<table>
<thead>
<tr>
<th>Section</th>
<th>X 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>X 250</td>
</tr>
<tr>
<td>Material Code</td>
<td>X 10</td>
</tr>
</tbody>
</table>

80,000 account codes

In order to report on projects two types of information are required, details of the financial transactions associated with that project obtained from the costing system, and certain information about each contract including contract value, contract period, etc.

The PPL system is designed for an environment in which there is only one relevant source of information, the nominal system. Because of this the report generator associated with the PPL system would not have been able to supply the required management reports.

The result of this analysis was that the PPL proposal was dismissed as unsuitable. The most important lesson from this experience is the need to review proposals in depth, because it is very easy to spend a lot of money on deteriorating rather than improving information systems. If the systems analysis had been rigorously undertaken then these unusual sub-systems should have emerged in the statement of requirements, which would hopefully have saved time and effort for both the potential suppliers and BNF.
Specification, Programming and Implementation

The senior management at BNF now found themselves with only two possible options, to retain the existing system or to proceed with in-house developments. A decision was made to pursue the latter course. A systems specification was prepared by the BNF accounts department in conjunction with the computer department and senior research staff. This document became the basis for programming work which followed, but was also unfortunately deficient in certain respects:-

The accounts department had inadequate knowledge and experience of systems specification work. The result of this was that the specification was not as detailed and precise as it should have been.

Agreement to proceed with an in-house development was received late in 1981 which clashed with the year-end accounts. The systems specification could not therefore be started until April 1982 and was not reviewed until June/July 1982, which represented a considerable time lag.

There are a number of interest groups who impose constraints on the way in which BNF can operate. In specifying the new accounting system it was assumed that the Government would accept the format changes for their purposes. In the event one of the changes specified was not accepted and this led to further systems modifications.

After the systems specification had been prepared and considered by those staff affected, it was agreed to proceed with in-house programming. During the period July - November 1982 the major part of the programming work was completed, to the extent that the two systems were run in parallel during November and December. The new system was adopted to run from January 1st, 1983 and although not finished it was expected to be 95% completed by March 1983.

However, instead of this two factors affected the ability of the computer department to finish the work. Firstly, a key member of staff resigned and then a very large order was received for a library system for the DHSS. The result of these events and a continuing high level of external demand during 1983 was that despite considerable pressure the accounting system at December 1983 was still in an incomplete state.

The lesson to be learned from this is that in-house developments must be treated in the same way as an outside supplier. A strict timetable should be drawn up in order to ensure that development work is planned and controlled.

The delay in completing the programming also delayed the process of training and education. A certain amount of training has been undertaken but it is not possible to educate people properly when
there are deficiencies and errors in the reports produced.

Review

The accounting systems at BNF have been through a period of change typical of many if not most business organisations. Moving from manual record keeping to a computerised record keeping system, and finally to an integrated record keeping and management information system. The process reviewed in this case study was the change from a computerised general ledger used purely for record keeping purposes, towards a general ledger providing sophisticated management reports integrated with contract and sales ledger systems.

BNF provides a slightly unusual case study because after reviewing the available package software the only alternative to no action was to undertake dedicated programming work. Development of one-off systems is not unusual in certain applications, but the general ledger is usually a fairly standard application ideally suited to the package approach.

The experience of BNF highlights many of the potential problems of in-house development. Most notably the problems of lack of expertise and project management, especially when computing resources are shared between in-house development, maintenance and work for third parties. The net result was that the project was late starting, and having reached a stage beyond the system it replaced has largely been left and not fully developed. Still missing at the end of 1984 from the original specification were some of the planned performance reports and pro-forma contract invoicing.
The Shirley Institute - A Case Study

---

Background

The Shirley Institute is an independent contract research organisation whose main business is textiles research and development. Based on a main site at Didsbury, Manchester, the organisation employs approximately 200 people and in 1981-2 had an annual turnover of roughly £2.5 million. The financial success of the Shirley Institute is inevitably tied up with the performance of the British textiles industry. This has led to difficult trading conditions in recent years, which have been offset to a certain extent by diversification and export.

The organisation and accounting procedures used by the Shirley Institute follow the pattern of independent research organisations, identified in the introduction. The activities of the organisation are undertaken by four main operating divisions, which are then sub-divided into profit/responsibility centres.

The costs associated with each research are recorded using a job card system. This requires the recording of all purchase invoices and also the manual transposition of timesheet information onto the appropriate job card. Although this system has proved adequate, there is a general recognition that there is potential for improvement.

Firstly, the sheer volume of transactions which need to be transposed to job cards, demands considerable manual effort and is a relatively slow process. Secondly, although the job card provides the basis for control of costs on the project and for invoicing purposes (in most cases) there is a limit to the effective use which can be made of this information compared with a computerised data storage and reporting system.

This second consideration was the most important in initiating the first effort by the Shirley Institute to utilise a computer in its accounting department. This decision was made in 1980/81 and coincided with two other important events, the appointment of a new Managing Director and a stark realisation of the increasingly competitive business environment which was very strongly reflected in the trading results.

The history of this endeavour has not been altogether happy and can be sub-divided into two parts, roughly corresponding to the years 1980-81 and 1982-84.
Years 1980-81.

Although prior to 1980 computers had been used in research work, there was no member of staff with a specialised knowledge or experience of the use of computers for information storage and retrieval systems. The response of the Managing Director to this was to appoint a consultant to undertake a systems specification and to recommend a suitable hardware/software package.

The terms of reference which were given to the consultant were to produce a computerised system to replace the manually maintained job cards and which was capable of development into a sophisticated management information system. He approached this brief from two angles. Firstly, by investigating the existing job card system and talking to the various users of the project costing information, a vague systems design was formulated. Secondly, contact was made with a number of micro computer manufacturers and business software suppliers and a number of available business systems were identified.

The result of this effort was a review document which identified eight potential hardware/software packages. The review of these packages which was reported was cursory, and covered the available financial accounting software, the potential for management accounting, hardware configuration and price.

On the basis of this very brief document a decision was made based on two criteria only. Firstly, none of the packages identified offered exactly what was required for management accounting purposes, which meant that no package provided an obvious solution. So that in the event a decision was made entirely on the basis of cost, and the cheapest proposed solution was adopted. This was to purchase a Cromenco Z-28 with an 11mb hard disc to run a BOS operating system and BOS Auto Clerk package programmed in Micro Cobol.

Following the purchase of the Cromenco an attempt was made to computerise the project costing system. Unfortunately this failed for a number of reasons:-

The software design was extremely complicated and the software was not completely suitable. The possibility of additional programming was considered, but was rejected because of the cost of programming in Micro Cobol.

The back-up for the Cromenco hardware was found to be inadequate and there was a loss of confidence as regards its ability and desirability.

The system design called for considerable amounts of data to be stored in the computer. The 11mb configuration purchased was found to have inadequate mass storage capabilities.
The result of these three major problems was that this approach was abandoned, the Cromenco hardware was passed over to be utilised by the research departments and the manual systems were retained.

With hindsight the reasons for this failure can be clearly seen and represent risks to any new computer user. First of all, the consultant used had a very limited experience of accounting systems and was even less qualified to report on the very complicated application of accounting systems in research organisations. The result of his discussions with potential users of the system was that a very grandiose scheme was designed which recognised a number of potential requirements, which can be described as 'wants' rather than 'needs'.

The second major error was to go ahead with a specific proposal without being certain that it could provide the required facilities. For example, it was not possible to run a test pack of data in order to get to grips with the problems which were later experienced.

The third error was to make a choice explicitly on the basis of cost, and without reference to other factors such as back-up facilities, product development and reputation.

All of these problems could have been avoided if a slower more methodical approach had been taken. This is more surprising because a computer consultant with specialist systems knowledge was employed. However, it does emphasise the point that research organisations do have particular management information requirements which need understanding.

Years 1982-84

This failure coincided with a particularly bad trading period. The net result of which was the departure of both the Managing Director and Systems Consultant.

The position of Managing Director was filled by Dr Alisdair McLean on secondment from ICI fibres. He shared along with the Company Secretary a commitment to the use of computer systems. However, neither possessed an in-depth knowledge of the application of computers to accountancy. The wheel had turned full circle with the exception that the experience of the first attempt at computerisation had shown vividly the potential for disaster which exists.

The first approach this time was made to three groups of 'experts' to obtain proposals these were Spicer and Pegler the Company's auditors, the National Computing Centre, and IBM. Out of the responses it was hoped that some clear avenue for action would appear.
The responses from the NCC and Spicer and Pegler were dismissed either as too expensive or providing inadequate information, and it was left to IBM to come up with a potential solution. The recommendation from IBM was for a system marketed by Diskus [9] a software house based in Warrington. Diskus markets an accounting package designed specifically for the construction industry which tackles two of the major problems of project costing, recording and reporting the cost of individual jobs, and entry of labour booking information into the system.

Representatives from the Shirley Institute were able to see this system operating at Diskus and to run a test pack of data, after which they were satisfied that with modifications the system could be used in a research environment, and Diskus were asked to prepare a proposal to cover the cost of the basic package plus any tailoring required.

Various other options were investigated to a greater or lesser extent, including discussions with a software house to supply bespoke software, and visits to other research organisations to discuss solutions in use. The final result was that the proposal by Diskus which was very price competitive and supported by IBM, was accepted. An order was placed for Diskus software to be supplied to run on an IBM system 38 mini computer.

The proposal called for the system to be installed on a modular basis beginning with the payroll and nominal ledger programs, followed by the sales and purchase ledgers and finally the project costing system. It was planned to have all the modules installed prior to an accounting year-end to allow a period of parallel running followed by a year-end cut-off.

In the event the process of implementation began in mid 1983, and at the year-end 30.09.83 only the payroll and nominal ledger systems were complete. A timetable was set which required the remaining modules to be fully operative by 30.06.84, following which a three month period of parallel running was planned before a complete changeover was made at the year-end 30.09.84. The process of parallel running is inevitably very expensive in terms of the effort required, and this in turn restricted the amount of time available for development and implementation of the remaining modules.

As well as the setting up required such as the generation of supplier and customer files a certain amount of problem solving was required. For example, the transfer pricing problem (appendix 1) is one problem which still has to be tackled. The Shirley Institute is in a very strong position from the point of view that there is a fixed price for the development work required. However, it is still possible that problems will persist beyond 30.09.84.

The Shirley Institute staff have been very impressed both by the service of Diskus and the support of IBM, and they are confident
that they will achieve a satisfactory solution this time. There are however a number of points arising from the approach taken which could have lead to problems.

The project costing system is a module wholly separate from the nominal ledger, and in the standard software there is no automatic posting facility between project costs and direct materials. Similarly there is no validation between these two sets of accounts.

The nominal ledger has only three input sources available, sales ledger, purchase ledger and cash book. This may be adequate for some organisations, but may prove restrictive especially as regards enquiries for audit trail purposes. In general, the adoption of a source code as part of each transaction record would appear to be the best solution available within packaged software.

The lack of an initial specification covering the development of the system for performance monitoring and planning purposes may have hidden difficulties. Until these applications have been thought through and reviewed by Diskus, there exists a potential for further problems.

The implementation and parallel running of the system has created additional demands and pressures on the accounts staff. This has to an extent compounded any reservations which in particular the older members of staff have towards computers, and which has been reflected in the commitment given to this part of their work.

Review

The Shirley Institute had until 1982 wholly manual accounting project control systems. After an abortive attempt to develop the use of a computer for administration purposes around a Cromenco machine, a second programme has been initiated utilising an IBM system 38 and Diskus software.

The lessons which can be learnt from the experiences of the Shirley Institute have been learnt by many companies using computers for the first time. The most obvious lesson is that it is much more difficult to make the change than it may appear. Even so called 'experts' can produce systems which are less functional than existing manual systems, and to ensure that the benefits of computerisation are achieved requires considerable effort and expertise. Several peculiarities of research have been highlighted which increase the difficulty but in any application there will be variations or peculiarities which create special problems.

At the end of 1984 the process of implementing the various Diskus modules was still underway and in particular the project costing system was still not fully operational.
Review of Attachments

Attachment 1. Questionnaire to AICRO Members.

A questionnaire was sent to each of the 13 members of AICRO who are listed at the beginning of this thesis, from whom 10 replies were received. The questionnaire was intended to investigate organisation, planning and control procedures, and computerised accounting solutions in research organisations. The results of this survey have been used in the introduction and in Chapter One. Attachment 1 includes a copy of the questionnaire and a summary of the results which was issued to AICRO members.

Attachment 2. Transfer Pricing in a Research Organisation.

In many cases the use of computers has allowed more detailed performance analysis which in turn has required the use of transfer pricing. Attachment 2 considers the use of transfer pricing within research organisations, and in particular the solution adopted by BNF Metals Technology Centre.

Attachment 3. Medium Term Planning and Control in Research Organisations.

Chapter 1 contains a general view of medium term planning and control measures. This article considers in more detail the peculiarities of research organisations and draws upon the results of the questionnaire, attachment 1.

Attachment 4. A Case Study in Integrating Financial and Management Accounts.

In many instances a package solution may be the best way of meeting an organisation's accounting requirements. However this may not be true of research organisations. Attachment 4 considers how a computerised solution was found which integrated the financial and management accounts at BNF. The second half of this attachment is largely a repeat of part of the BNF case study.
ATTACHMENT 1. QUESTIONNAIRE TO MEMBERS OF AICRO

(i) Draft of a Questionnaire sent to the Financial Directors of all AICRO Members.

(ii) Summary of Questionnaire Results: Issued to AICRO Members.
1. Please indicate whether the descriptions in (a), (b) and (c) reflect the structure of your organisation.

(a) The responsibility for day to day operating decisions is delegated to research staff, and not held in any central services section.

Yes/Other (please comment)

(b) Personnel are grouped into functional sections, are responsible to the senior person in that section, and do not move between sections.

Yes/Other (please comment)

(c) Research staff are expected to work to a certain professional standard and are not supervised on a daily basis.

Yes/Other (please comment)

2. When you generate sales budgets what procedure do you follow?

(a) Build up the total by referring to individual contracts which are firm or probable for the budget year.

Yes/No

(b) Target each operating unit based on prior years performance.

Yes/No

(c) Target each operating unit based on the direct labour available in that unit.

Yes/No

(d) Other - please specify.
3. Do you record the costs of each research?

Yes/No (delete as appropriate)

If Yes:- (Please tick the appropriate answer for i, ii, and iii)

(i) How is labour charged to a research?

Hours X individual hourly rate
Hours X hourly rate for grade of employee
Hours X hourly rate for all direct staff
Other - please specify

(ii) How are overheads charged to a project?

Based on labour hours
Based on labour cost
Other - please specify

(iii) What type of costing do you use?

Full absorption
Manufacturing overhead only
Contribution approach
Other - please specify

4. What performance measures do you use for evaluating projects and staff? If you use more than one method please reply accordingly.

<table>
<thead>
<tr>
<th></th>
<th>Project Performance</th>
<th>Staff Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecast vs. Actual Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecast vs. Actual Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P.E.R.T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (please specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. How is basic research planned? i.e. work designed to generate ideas for future proposals.

Is there a separate group of people responsible for this activity?
Yes/No

Is there an annual budget?
Yes/No

Is the spend on basic research closely controlled?
Yes/No

6. Does the accounting function make use of computing facilities?
Yes/No

If Yes:-

(i) Is the machine used mainly for research work?
Yes/No

(ii) Please complete the following table indicating which functions are performed mainly on a computer, and the source of the program used.

<table>
<thead>
<tr>
<th>Software</th>
<th>Software</th>
<th>Bureau</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written</td>
<td>Bought as a</td>
<td>Facility</td>
</tr>
<tr>
<td>In-House</td>
<td>Package</td>
<td></td>
</tr>
</tbody>
</table>

Financial Accounts
---

Research Costing
---

Management Accounts
---

Please indicate if you would be willing to participate at a later date in a more detailed comparison of the accounting systems of research organisations.
Yes/No
(ii) SUMMARY OF QUESTIONNAIRE RESULTS

1. Organisation and Control

Expertise is the major asset of research organisations, and correspondingly forms the basis of the organisation structure in all the companies surveyed.

A typical structure is as shown:

```
Senior Staff

Research Manager       Research Manager       Company Secretary/Controller

Research Areas         Research Areas            Accounts          Personnel

[Diagram showing organisational structure]
```

Research activity can be described as unstructured because each project or enquiry is unique in some part. This disbars the use of techniques for control based on the repetition of standard activities, and places the emphasis on the control exercised by project managers/section heads who possess a technical understanding of the work being done; and on self control.

In all the replies received research staff were seen as working to professional standards. This is a very important informal control and one which must be recognised in the design and use of any formal control procedure. The level of professional control is seen as being directly related to the experience and position of the individual.

One area in which professional control is very important is in the maintenance of the quality of work done. Only one organisation surveyed employs formal quality control checks on a regular basis. It is difficult to perceive how this could be achieved in other research organisations because of the problems associated with measuring the quality of research work.
2. Budgeting and Forecasting

Sales Forecasting

In manufacturing organisations sales forecasts can be expressed as a forecast quantity for each product type/model. This approach needs to be varied for research organisations because only one of each product type is produced.

The way in which this is done is to identify the individual firm contracts for the period under review and then to consider those proposals which will probably also realise income.

In order to analyse the 'probable' income one organisation assigns probability factors to each proposal as a way of generating a total sales forecast figure. This technique has the advantage that it formally recognises that all the proposals under consideration are unlikely to generate income as hoped for.

Another way of achieving this is to limit the sales forecast so that it only includes projects which have reached an advanced stage in negotiations.

However the 'probable' income is analysed it is very important not to be mislead by a high level of proposals, which can very easily distort the likely future income. If it is tackled thoroughly the sales forecast is a very important planning tool and should be maintained on a rolling basis in order to highlight potential difficulties as early as possible.

Budgeting

Setting operating budgets is another area in which the unstructured nature of research activity creates particular difficulties, because it complicates the use of engineered standards.

Eight out of ten replies indicated that budget targets are expressed in a form which relates direct labour to overhead recovery, and in six out of eight of these cases budget targets are related to prior year performance.

Expressed in an alternative way we can say the following:

1. Budgeted overhead recovery is treated as a function of the time or cost of research staff (or both).

2. The level of recovery of research staff is generally targetted on the level achieved in the previous period.
Because there is no use of engineered standards, one of the possible pitfalls is the development of organisational slack. Slack in this context is defined as the budget target based on prior year performance compared with what is achievable.

If for example during a period of recession labour utilisation drops by 25% then it is likely that some of this fall will be reflected in the following year's budget target, rather than the actual achievable for the forthcoming period being separately assessed. The development of slack is generally associated with indirect activities but it can equally well exist in direct unstructured situations.

3. Costing

Costing is an area which offers a considerable freedom in approach, and this is reflected in the responses to the questionnaire shown below:

How is direct labour time costed?                      No. of replies
1. Hours X individual hourly rate                        5
2. Hours X rate for grade of employee                    3
3. Composite rate for all staff(hours)                   1
4. Departmental rate(hours)                              1

How are overheads charged?
1. Percentage of labour cost                              6
2. Charge per hour                                        3
3. Composite(related to above)                            1

What type of costing system is used?
1. Full absorption                                       9
2. Contribution                                          2
3. Standard project costing                               1

*Two organisations use both a contribution and full absorption basis.

From the above it can be seen that a number of different approaches have been adopted by AICRO members. However the most
widely used approach is to cost labour at individual hourly rates and apply a percentage overhead to this.

Each situation will need to be separately considered, but there are two factors which will be relevant in all cases:

The costing method adopted must reflect the way work is to be quoted and charged for, and should reflect any specific operating and customer requirements.

The relative costs attributed to the time of staff at different levels of salary of different types, or of different grades needs to be considered. This feature can have all sorts of side effects, for example if excessive costs are related to senior staff it can affect recruitment policy, which can then have other serious long-term effects. Another example is the costing of workshop services which can become disproportionately expensive compared with external suppliers unless they are costed as a separate entity.

The almost universal adoption of a full absorption approach reflects the fact that a lot of research work done is charged at cost, and also the difficulties associated with the use of other measures such as contribution.

4. Performance Measures

<table>
<thead>
<tr>
<th>Performance Measures</th>
<th>Total</th>
<th>Ranked 1</th>
<th>Ranked 2</th>
<th>Ranked 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>10</td>
<td>7</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Income</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Contribution</td>
<td>2</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Labour Utilisation</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Profit per Project</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Other Efficiency Measures</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

The above table shows the various performance measures which have been identified in the replies received, and the relative importance placed upon each one.

Given that all but one organisation uses full absorption costing it is not surprising that some cost derived performance measure is used in all cases. The use of performance measures will of course need to be complementary to the way in which the budget is prepared, the organisation structure, and the delegation of responsibility.

In decentralised manufacturing organisations the use of a contribution approach is very often seen as being the most appropriate method. A contribution by section measure can
certainly be very useful by determining those areas making the greatest contribution, and identifying those areas becoming more or less important. There are however specific problems which inhibit its use in research organisations as follows:

- The complexity of costing the internal transfer of services.
- The need to relate the potential benefits of this type of measure to the possible additional administrative effort needed.

Apart from these two approaches there are a number of efficiency ratios which can be adopted. For example analysis of the time spent on different types of work by research staff, or of the level of direct:indirect activity.

5. Basic Research

Basic research is the development of ideas and techniques to a state of knowledge at which a proposal can be made to a sponsoring body. The answers to the question concerning the way this is carried out are shown below:

Is there a separate group responsible for basic research?
Yes 2 No 7 N/A 1

Is there an annual budget? Yes 6 No 3 N/A 1

Are individual basic researches costed?
Yes 8 No 1 N/A 1

In most cases basic researches are individually costed, however two organisations which do this have no budget for basic research. This probably reflects the fact that a lot of information about individual projects is retained as part of a total costing system, at the same time only a limited amount of attention is given to the control of basic research.

The lack of importance placed on the control of basic research is probably because it is a very inexact area, and any action taken will have a very delayed effect. Basic research, however, is an essential feature in the long-term success of a research organisation, and probably there is an inadequate level of attention paid to its control. For example it would seem obvious to have at certain fixed intervals an evaluation of all basic researches, their costs to date, commercial potential, and a timescale for development to a proposal stage. But the questionnaire responses indicate that such an analysis is more the exception than the rule.
6. Computing Facilities

Research is usually thought of as a prime example of a situation in which computers are heavily used, because of the potential for their use in the analysis of data. But it appears that the functions of information storage and retrieval are more important. The results of the questionnaire were as follows:

Do you have an in-house computing facility?
Yes 9 No 1

Is this facility used mainly for research work?
Yes 3 No 6

This response indicates that in 6 out of 9 cases it is the data handling requirements of administrative systems which are the major computer users.

The second part of this question was designed to try and identify the various accounting software solutions which have been adopted. From personal experience I believe that research organisations have a number of peculiarities which make it very difficult to apply standard solutions, and this is supported by the replies received:

<table>
<thead>
<tr>
<th>Accounts Development</th>
<th>Financial Accounts</th>
<th>Research Costing</th>
<th>Management Accounts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-house development</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Package</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Tailored package</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Bureau</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Dedicated software</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>By hand</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Although on financial grounds the purchase of package software often appears the best solution, the particular requirements of research costing and management accounting mean that this requires very careful consideration. For example one organisation described the attempt at using a package solution as a disaster area.

The results of the questionnaire seem to indicate that the problems of research organisations cannot be easily solved, and that no best way exists. However, if a company is looking to improve its current practice an obvious first step would appear to be consideration of the methods of other research organisations who are solving similar problems.
As the operations of business organisations become more complicated and grow, there is a loss in efficiency resulting from the lengthening lines of communication, and a loss of motivation as the performance of an individual or small group becomes insignificant in relation to the organisation as a whole. One response to this is to delegate decisions downwards to smaller sub units, thereby shortening the lines of communication and hopefully increasing the motivation of individual operating units.

Inevitably there are also drawbacks associated with this approach, one of these is the problem of costing the transfer of goods and services which may occur between operating units. This topic is referred to as the transfer pricing problem. This essay is concerned with the way the transfer pricing problem has been tackled at BNF Metals Technology Centre, and in particular the way that features of BNFs' operations have determined the approach adopted.

BNF is an independent contract research organisation working primarily in the non-ferrous metals industry. It is a relatively small organisation employing 160-180 persons on a single site at Wantage (OXON), and with an annual turnover of around £2.5 million.

Because of the very specialised nature of the work undertaken operating decisions are delegated down to small groups of technical staff of 5-15 persons, each group representing a particular specialist technical area.

For the purposes of budgeting and performance measurement each section is treated as a profit centre, this involves recording and reporting the costs and income of each section. One element of this is the recording and valuation of the transfer of services between sections. In particular there are three features of BNFs' activities which have influenced the transfer pricing system adopted:–

(i) The complexity and number of internal transfers.

(ii) The efficiency of internal communications.

(iii) The problems created by the fact that most production staff are also engaged in basic research activities which are expected to yield 'future' income.

Research work is by definition unique, each new research will cover some ground not previously investigated by BNF. Similarly internal transfers do not follow a recognised pattern, but are in the nature of requests as and when the need for a particular skill arises. For example:
Provision of chemical analysis services to support the work of casting investigators.

The supply of instrument technology for the control of various metallurgical processes.

The result of this flexible working arrangement is that there are a large number of internal transfers of widely differing values, and each one is to a certain extent unique. This means that although these transactions can be individually recorded, it is not possible because of their number and complexity to adopt a formal internal order system. Conversely for the same reasons the accounting system adopts a standardised approach to costing the recorded transactions.

The second feature which has an influence over the transfer price is the size of BNF, this has a direct effect on the way the transfer pricing system is understood and profit centre reporting is used. BNF is a relatively small organisation based on a very highly educated staff (over 50% of all staff have a first degree or higher qualification). There is therefore a very efficient communication system, and a very high level of understanding generally about the way that the sectional profit measurement operates.

The approach adopted by BNF has been to cost internal transfers at the same rate as is used to charge the customer. This method is termed market price transfer pricing, using this approach the section supplying the service is remunerated at cost plus the project profit rate. In the theoretical work on the use of a market based transfer price, considerable weight is placed on the possible adverse effects on motivation which may result because no additional reward is given to the section generating the work. And consequently it is argued there is no incentive for operating sections to trade internally, or alternatively this may have to be a centralised policy which will restrict the decision making freedom of the section manager. Within BNF these criticisms do not apply because of the communications system. All section heads are aware of the need to trade internally when possible, and no formal system of control is therefore needed. Secondly although no additional benefit is attributed to the section generating the work the section heads are aware that profit performance is not the only measure in use, and that the income generated by each section is also recorded and reported separately. There is one operational feature which is peculiar to research organisations and which creates problems for transfer pricing. This is that most staff as well as being engaged in direct productive activity are also engaged on basic research work, developing new ideas to a stage at which they can be presented to potential sponsors as research proposals. In most business organisations this activity is undertaken by a separate research and development/product development section. What this means is that the section manager has a portfolio of projects, some of which are current researches
CURRENT VS. BASIC RESEARCH ACTIVITY

Figure 1.

A + B = Total Income for each mix of work
A = Income from current research
B = Income from prospective research

No exact scales or discount rates are used - the graph indicates the associated trends.

\( X \) = the optional mix of prospective/current research which will maximise the financial return to BNF.
which are income earning and some which are prospective researches which may lead to future income. We can express this graphically, see fig.1. (Attachment 2).

There are a number of implicit assumptions within this analysis, it does however indicate that there is a trade-off between current and future income. The section manager has in effect to balance the working of his section to achieve a satisfactory level of current and future performance.

Internal transfers of services on prospective researches can occur in exactly the same way as transfers on current researches. There is however one fundamental difference which is that there is no current income and no certain future income attached to prospective research projects. The question therefore arises how do we define a transfer price for prospective research because there is no easily available market price equivalent. The approach adopted at BNF has been to use a 'negotiated' transfer price. After discussions with the section heads it appeared that they accepted that a transfer price for prospective research should be lower than generally used for current researches reflecting the fact that there is some sort of premium attached to current research. The rate which has therefore been used has been the budgeted recovery rate for current research excluding the budgeted profit element.

This is not an attempt to define a theoretically optimal solution to the transfer pricing problem. But what it does provide is a solution which is seen as satisfactory among the research staff, and at the same time may reflect fairly closely the opportunity cost associated with the section managers operating decision to undertake a particular portfolio of current and prospective research.

Conclusion

What hopefully appears from the above case study is that the particular features of an organisation will influence the appropriate transfer pricing approach, and that there is therefore no best way.

There have been a considerable number of empirical studies of transfer pricing. A good example of which is a study made by Livesey of companies in the Manchester area. Of the 232 firms who responded 100 used some form of transfer pricing the breakdown of the different techniques is shown below.
<table>
<thead>
<tr>
<th>Method</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Cost</td>
<td>34</td>
</tr>
<tr>
<td>Full Cost +</td>
<td>27</td>
</tr>
<tr>
<td>Market Price</td>
<td>15</td>
</tr>
<tr>
<td>Negotiation</td>
<td>15</td>
</tr>
<tr>
<td>Variable Cost</td>
<td>9</td>
</tr>
</tbody>
</table>

This study showed that firms of varying sizes and with very different production methods used transfer pricing. Not surprisingly it also showed that a wide variety of different techniques were used, which we suggest is due to the fact that the transfer price must fit the particular features of the organisation in which it is being used, and that a single theoretically optimal solution does not exist.


Tomkins, C - Financial Planning in Divisionalised Companies Accountancy Age, 1973 [32]
ATTACHMENT 3

Medium Term Planning & Control in Research Organisations

by

David Croft and Paul N Finlay

The application of management accounting techniques needs to be flexible, responding to the demands of particular situations. A good example of this is the budgeting and control procedures of the independent research organisations, which because of their activities have been forced to adopt an atypical approach.

Independent research organisations as the description suggests, supply research and development expertise. They usually either develop close links with a particular industry, for example MIRA (motor industry) and the Shirley Institute (textiles) or specialise in a particular technical skill such as the Welding Institute, and BHRA (hydromechanics).

The processes involved in a particular research by definition involve an element of uniqueness, and the exact nature of the end product cannot be predicted with certainty. For such unstructured activities (Derner 1977) [8] it is unlikely that cybernetic controls alone would be suitable (Otley & Berry 1980) [23], although some could be necessary. What this means in terms of planning and control procedures can be investigated by looking at the way in which an annual operating budget is defined, and at the control variables in use.

As part of a study of the accounting systems in research organisations conducted under the auspices of the ICMA higher degree scheme, a questionnaire was sent to the members of the Association of Independant Contract Research Organisations (AICRO). Of 10 organisations contacted 8 replies were received. The following description of budgetary control procedures represents the approach identified by this survey as that generally adopted by organisations carrying out contract research work.

Fig 1. (Attachment 3) illustrates in the form of a flowchart, the process of budgeting in a research organisation compared with the typical textbook approach applicable to most manufacturing organisations.

Planning (Annual Budget)

In a 'typical' approach the budget is a logical progression, beginning with the definition of certain budget assumptions and targets such as inflation, efficiency, pay awards, etc, and a sales forecast. The resulting costs and income of a business can
Fig 1. Operating Budget Procedures

MANUFACTURING ORGANISATION

- Budget Assumptions → Sales Forecast
- Production Costs → Product Standards
- Overhead Expenses
- Budget Consolidation
- Budget Review/Acceptance

CONTROL VARIABLES
Product Standards
Forecast Sales
Budget Overheads (Contribution)

RESEARCH ORGANISATION

- Sales Forecast → Budget Assumptions
- Manpower Budget
- Employment Costs
- Overhead Expenses
- Budget Consolidation
- Budget Review/Acceptance

CONTROL VARIABLES
Facility Utilisation
Forecast Sales
Budget Overheads (Contribution)
then be calculated by combining this information with historic data and by applying production standards. The process of achieving an acceptable budget is then an iteration in which the variables are the budget targets and alternative operating strategies.

Producing an annual budget in a research organisation involves following a different process, as illustrated by the flowchart. There are five main reasons for this:

(i) The sales forecast requires a different approach because it is made up of a small number of unique events. Instead of forecasting sales of X000s units, a list of current and proposed research contracts needs to be drawn up and the funding available for the budget year. The major problem in forecasting is that there can be a very high level of variability in the level of probable research funds translated into firm research contracts.

(ii) By definition research involves original work, and there are no production standards as such. This makes it impossible to translate the sales forecast into direct costs in the same way as for a manufacturing organisation.

(iii) The most important asset in a research organisation is the store of expertise embodied in its staff. To a large extent this is fixed in the short and medium term and equates to a production facility; except that the flexibility for utilising this facility by additional shifts or an increased line speed, does not exist. In preparing the budget it is necessary to check that the sales forecast can be achieved by the facilities existing, and this is the function of the manpower budget.

(iv) The main purpose of scientific staff is to undertake current research work. There will however, be other demands on their time including administration, reading journals and basic research. Basic research is an unusual concept; it is the research necessary to generate proposals for future commercial research work. There is an element of self regulation in the effort applied to this activity, the lower the level of current research the greater the time available for basic research, which should in turn generate future commercial research. This concept has been discussed by Croft & Finlay (1984). These various demands on research time need to be reflected in the budget assumptions and manpower budget.

(v) There is only a limited amount of flexibility available in the medium term, which results from the long timescale associated with research work, and the high level of fixed costs associated with both facilities and staffing. This emphasises the need for long term planning, and on-going appraisal of industry's research needs.

The result of these various factors is that the cost and revenue sides of the budget are defined independently, and are then
brought together at the budget consolidation stage. Whereas in the conventional approach the direct cost element is largely defined by the sales forecast. This means that a completely different approach to timing and procedures has to be taken, and it increases the emphasis placed on the budget consolidation exercise, which becomes a very complicated activity receiving inputs from four sources, overhead costs, employment costs, manpower budgets, and the sales forecast.

There is also a reduction in the relative importance of the operating budget compared with strategic planning. This arises because research organisations cannot react quickly to change, yet must be seen to be at the forefront of technology.

Control

Integral to the formulation and presentation of budget information are the control variables in use. In a manufacturing environment the most commonly applied controls are:

- **Volume** - actual vs. planned units.
- **Efficiency** - actual vs. potential.
- **Cost** - actual vs. standard (labour, materials, scrap, etc).

These control variables can be used because the production process is repeated a large number of times, and can therefore be standardised. In research work the product and production processes are not of this type, and a different approach is required. The survey of AICRO members investigated the various controls employed in research organisations, and revealed that there are three types of measure in use, project cost control, labour utilisation, and sectional contribution.

**Project Cost Control:**

All the members of AICRO have some form of project cost recording system, either computerised or a manual job card system. This forms the basis for what is seen as the most important control, which is the monitoring of the actual costs of a research compared with the contract value.

**Labour Utilisation:**

The most important asset of any research organisation is its staff. The capacity to undertake research work is a function of the abilities of the staff, and the staff time available. The second control measure which is in use in a majority of AICRO establishments, is the analysis of potential and actual labour utilisation. This is achieved by analysing the timesheet bookings made by research staff in each period between income earning and
indirect activities.

Contribution:

The third technique which is used by only two out of ten AICRO members is the measurement of contribution. This is calculated as (income - direct costs) for individual operating units and is appropriate only if operating decisions have been delegated to unit managers.

This particular technique appears to be appropriate because it is consistent with the organisation structure of all the AICRO members. Unfortunately there are a number of accounting and data handling problems which have to be overcome, and which have contributed to the limited usage. The most important of these problems are the recognition of income and profit on long-term contracts, and the need to account for the internal transfer of services.

The three techniques above represent the portfolio of formal control measures adopted within research organisations, but in all organisations there are also informal controls associated with the behaviour of individuals and groups.

This particular feature was investigated in the questionnaire, and in all cases the individuals commitment to maintain professional standards was seen as important, as recognised and described by Mintzberg (1981)[20]. The existence of this informal control needs to be recognised in order that it can be complemented by the formal control procedures adopted.

Summary

The comparison of budgeting and control procedures in a research organisation with the textbook/ manufacturing approach is an example of one of the basic facets of management accounting, which is the need to adapt appropriate planning and control procedures to a particular situation.

Defining the appropriate techniques is one part of this but there are a number of other elements which are also important, and which are highlighted in this example:

In different situations the emphasis on particular formal planning and control techniques will vary. In the case of research organisations the requirement to anticipate industry's changing needs and the limited operating strategies available, means that strategic planning assumes a greater than normal importance.

Control techniques must reflect responsibilities. The use of a contribution measure in research organisations is desirable
because it does reflect the operating situation.

Informal controls must be recognised in order that they should be complemented by the formal control system. This is especially so in 'professional' type organisations, and also applies to the control of administration activities.

References

Croft, D.J. and Finlay, P.N - 'Transfer Pricing in a Research Organisation' Management Accounting pp32-33 April 1984. [7]


Otley, D.T. and Berry, A.J. - 'Control, Organisation and Accounting' Accounting, Organisation and Society vol No.2 pp231-246 1980. [23]

ATTACHMENT 4

A Case Study in Integrating Financial and Management Accounts

by

David Croft and Paul N Finlay

The rapid developments which have been made in computer technology have caused businesses to completely review how and where computers are used. The most obvious effect of this has been the increase in the use of computers. However, there is a second important effect which is that the developments in computer hardware have made possible improvements in data handling and storage techniques, which in turn have enabled more sophisticated applications software to be developed. This may be of special relevance to the accountant who is considering the possibility of systems development particularly the integration of financial and management accounts.

The revolution which has occurred in 'chip' technology has been well publicised, and the result can be clearly seen in the performance/price of the current generation of computers which compared with their predecessors have faster processing capabilities, increased amounts of core storage and improved data handling facilities. The reduced cost of computers has inevitably increased the size of the market and this in turn has encouraged new organisations to enter, increasing competition and forcing prices down even further. This feature is particularly obvious in the case of software suppliers because of the small amount of initial capital required to enter the market place. Inevitably this has had some adverse effects, notably the confusion of purchasers who are presented with a great number of potential hardware/software options. The process of identifying and choosing between potential suppliers which can be very difficult, is thereby further complicated.

There are probably three main reasons for changing from a manual to a computer based system, image, cost and efficiency. Managers should be constantly looking at the cost and efficiency of their current manual and computer systems, and considering the possibilities for improving and integrating them.

Accounting provides a very good example of the potential for the use of computers, because it is an application which generally involves a high volume of fairly simple transactions. Which in most cases means that a computer can provide the most efficient means of data handling and storage. The use of computers for financial accounting has in recent years become the norm. The use of computers in project costing and management accounting has however lagged behind.

The major reason for the rapid adoption of computer systems for financial accounting compared with management accounting and
Project costing, is that it is a very standardised application. In all financial accounting systems there are three basic elements, the chart of accounts, transaction records, and report requirements, see fig 1. (Attachment 4). Project costing and management accounting are to a much larger extent techniques which have to be adapted to particular situations. This has limited the use made of computers and tended to lead to the development of particular applications software or of specialist packages which mirror the manual techniques in use in a particular industry. But with the advances in computing technology the accountant should now be considering what improvements can be made to accounting systems, and whether it is possible and desirable to integrate financial and management accounting systems.

Fig 1. Basic Elements of Accounting Systems

A Case Study - BNF Metals Technology Centre (BNF)

BNF is a relatively small organisation (turnover £2.5 million) whose main activity is the supply of research and development services to the non-ferrous metals industry. In 1981 a computerised financial accounting/project costing system was in use, but due to various commercial pressures the effectiveness of this system in providing management information was called into question.

The first response to this was to investigate the various accounting software packages available which it would have been possible to run on BNF's existing Prime computer. After a thorough review of a number of established packages involving the company auditors and BNF's own computing staff, the conclusion was reached that because of particular situational requirements at BNF it was highly unlikely that a suitable package would be identified. The reaction to this was to review the possibility of extending and developing the existing computer systems utilising the expertise of BNF's own computer department.

The first stage of this review was to look at the basic elements of BNF's financial and management accounting systems, to
Figure 2. Integrated Financial/Management Accounting Configuration (attachment 4).

Financial Accounts

Chart of Accounts
Account No
Description
Hierarchy
Budget

Transactions File (Nominal Account reference Ledger)
Amount
Date
Voucher/reference

Reports:
Nominal Ledger Report
Balance Sheet etc.

Management Accounts

Project File
Project No
Description
Responsibility (Hierarchy)
Value (Budget)
Income recognition formula

Transactions File
Project reference
Amount
Date
Voucher/reference

Reports:
Booking analysis, project status
Trading statement, contribution of section.
investigate the possibility of their integration. During this exercise it was recognised that the configuration of both systems was essentially the same, and that by expanding the existing chart of accounts file the potential existed to develop an integrated financial/management accounting system. This equivalence is shown in fig 2. (Attachment 4).

The procedure adopted at BNF has been to superimpose the management accounting system onto the financial accounting system. This means that there is a single chart of accounts which contains both the financial and project account references, and a single transactions file/general ledger containing both the financial accounting transactions and costing records:

To achieve this integration the same format has to be used for both the financial and project account references, and similarly for the financial and costing transaction records.

The enhancement of the management accounting system has been undertaken by expanding the chart of accounts file to include a number of additional information fields, the most important of which are the project value, current year allocation, and income recognition formula. Using this additional information a number of sophisticated report formats have been devised, the most important of which is the calculation of actual sectional contribution, comparison with budget and analysis of variances. To provide this type of reporting was previously impossible because of the complicated calculations involved.

Making these changes has not been without problems. The most notable technical problems which have had to be answered were as follows:

Ensuring that appropriate validation procedures were provided for the security of the financial accounts, and to check the bookings into both the financial and management systems.

Recognising income and work in progress on long term contracts in-line with the financial accounting procedures.

Accounting for the transfer of services between sections in calculating sectional contribution. (The problem of transfer pricing in a research organisation has been described in an earlier article)

Defining the system so that the financial and management accounts can be reconciled.

The integration of the financial and management accounting systems at BNF is now virtually completed. The main benefits are in the improved management information and the extra time available because of reduced data preparation, which can be used to make effective use of this information.
Conclusion

In order to take full advantage of the developments in computer technology managers need to be constantly reviewing the potential for computerising or improving on computerised systems. Unfortunately the process of change is beset with potential problems, most of which are serious.

Accountants should always be looking to improve their systems and this should include the potential for integrating management and financial accounts. The possibility may not be obvious especially in a production organisation, but by reviewing the essential elements of each system, as at BNF, basic similarities may be discovered.

Croft, D.J. and Finlay, P.N. - Transfer Pricing in a Research Organisation Management Accounting pp32-33 April 1984 [7]
<table>
<thead>
<tr>
<th>References</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Abdel-Khalik, A.H. and Lusk, E.J. - 'Transfer Pricing - a Synthesis'</td>
<td>83</td>
</tr>
<tr>
<td>Accounting Review, January 1974</td>
<td></td>
</tr>
<tr>
<td>(2) Amey, L.R. and Eggington, D.A. - Management Accounting: A Conceptual Approach</td>
<td>12</td>
</tr>
<tr>
<td>Longman, 1973</td>
<td></td>
</tr>
<tr>
<td>(3) B O S - Micro Products Software Limited, 87-89 Saffron Hill, London EC1</td>
<td>42</td>
</tr>
<tr>
<td>Richard D. Irwin, 1980 (Chapters 9 to 13)</td>
<td></td>
</tr>
<tr>
<td>Prentice Hall, 1978 (Chapters 7, 8 and 9)</td>
<td></td>
</tr>
<tr>
<td>(6) McCormack and Dodge (formerly RTZ Computer Services) 39 l Redcliffe Street, Bristol, BS99 7AL</td>
<td>39</td>
</tr>
<tr>
<td>(7) Croft, D.J. and Finlay, P.N. - Transfer Pricing 7,89,94 in a Research Organisation</td>
<td></td>
</tr>
<tr>
<td>Management Accounting, April 1984, pages 32/3</td>
<td></td>
</tr>
<tr>
<td>Irwin, 1977 (Chapter 7)</td>
<td></td>
</tr>
<tr>
<td>(9) Diskus - Diskus Computer Services Maypole Industrial Estate, Wigan WN2 5XJ</td>
<td>50</td>
</tr>
<tr>
<td>(10) Gluek, W.F. - Business Policy and Strategic Management</td>
<td>9</td>
</tr>
<tr>
<td>McGraw-Hill Kogakusha, 1980 - 3rd edition (Chapter 1, pages 3-33)</td>
<td></td>
</tr>
<tr>
<td>(11) McGregor, D. - The Human Side of Enterprise</td>
<td>13</td>
</tr>
<tr>
<td>McGraw-Hill, 1960</td>
<td></td>
</tr>
<tr>
<td>McGraw-Hill</td>
<td></td>
</tr>
</tbody>
</table>
(13) H.M.S.O. - Review Board for Government Contracts  


(15) Hofstede, G.H. - The Game of Budget Control  
Tavistock, 1968  

(16) HOST - Hooper Systems and Technology Ltd.,  
St.Martins House, 31-35 Clarendon Road, Watford, Herts WD1 1JA  

(17) IBM - Business Systems Planning: An Overview  

(18) I.C.L. - I.C.L. Directory of Software  

(19) Livesey, F. - The Pricing of Internal Transfers  
The Accountant, July 1967  

(20) Mintzberg, H. - 'Organisation Design - Fashion or Fit?'  

McGraw-Hill, second edition 1976 (Chapters 7 and 8)  

(22) NCC - The National Computing Centre  
Oxford Road, Manchester M1 7ED  

(23) Otley, D.T. and Berry, A.J. - Control Organisation and Accounting  
Accounting, Organisation and Society, Vol no.2, pages 231-246, 1980  

(24) P.P.L. - Package Programs Limited  
91 Blackfriars Road, London SE1 8HW  

(25) Parkin, A. - Systems Analysis  
Edwin Arnold, 1980 (Chapter 2)  

(26) Parkin, A. - Systems Management  
Edwin Arnold, 1980 (Chapter 3)
(27) Peachtree - Peachtree Software International Ltd, 99 King Street, Maidenhead, Berks SL6 1YF

(28) Pyhrr, P. - Zero Base Budgeting: A Practical Management Tool for Evaluating Expenses

John Wiley. 1973

(29) Pyhrr, P. - Contemporary Issues in Cost and Management Accounting: A Discipline in Transition

Ed, Anton, H.R. 1978

(30) Ridgeway, V.F. - 'Dysfunctional Consequences of Performance Measurement'

Administrative Science Quarterly, 03.09.81

(31) SAGE - Sage Systems Limited

Hawick Industrial Estate, Newcastle upon Tyne NE6 1AS

(32) Tomkins, C. - Financial Planning in Divisionalised Companies

Accountancy Age, 1973

(33) Wootton, Jeffreys and Partners - Cemetery Pales, Woking, Surrey