COMPUTER-BASED MANAGEMENT INFORMATION SYSTEMS:

SOME FACTORS IN THEIR DESIGN AND IMPLEMENTATION.

by

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ABSTRACT

This thesis describes an investigation into the design and implementation of computer-based Management Information Systems (MIS).

Some background is given on the relationships between management, information and computers. The MIS project is described in terms of the stages of the project, the people involved, the techniques and strategy used and the interaction with the authority structure of the organisation in which it is developed.

An investigation, using three approaches, of a particular MIS project is described. First, a detailed case study is given, covering the first five years of the project, up to the present date. The case study concentrates on the managerial techniques used in the MIS project and the strategy used in the development of the MIS rather than the technical details of the MIS. Secondly, a description is given of a pilot model, of part of the MIS, which was designed and implemented as part of this investigation. The pilot model was written for use on a PDP-7 computer with a graphical display. It was used to educate and involve managers. Thirdly, a description is given of a questionnaire survey which was carried out among users and potential users of the MIS. The survey investigated both the attitudes of managers to the MIS and possible influences on these attitudes.

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CHAPTER 1

INTRODUCTION

The problem investigated in this thesis is the design and implementation of a computer-based Management Information System (MIS). This is a rapidly expanding application area for computers and one in which the users' reactions have been least favourable (66). The problem is extremely complex and there is a variety of aspects to tackle and approaches to use. For example, it can be approached either as a management problem or as a computer problem. Each of these approaches has its own techniques for dealing with the problem.

As yet not a great deal of research has been published in this field. An extensive bibliography is given in reference (11), but many of the publications listed are concerned with MIS and management in general rather than computer-based MIS. A good overall picture of the problem from the management sociology point of view is given by Mumford and Ward (12). More detailed studies are described in such examples as Morton (13)(from the computer usage point of view) and Hebden, Rose and Scott (14) (from the sociological point of view).

Papers and books are now being published regularly on the subject of computer-based MIS but they include few case studies or research reports. When case studies are published they usually contain details of the system itself rather than the techniques used in its design and implementation, e.g. (67). This is unfortunate, since, given the variety of organizations which exist, one would expect the methods used in the MIS project to be more widely applicable than the end product. Two

notable exceptions to the general omission of methods are Rosove (32) and Mann and Williams (27). The main variable which differentiates those methods which are recommended (not necessarily in case studies) is the extent to which line managers are involved in the design of the system. This ranges from complete design by the managers with the computer men only providing technical advice and programming (15), to complete design by the systems analysts (16).

Because of the ill-defined nature of this field of research some time is spent on discussing how managers, information and computers are related (Chapters 2 and 3). In Chapter 4 the design and implementation of a computer-based MIS are described in terms which it is hoped are applicable to most if not all MIS projects. This chapter is based partly on the literature and partly on the MIS project described in Chapter 5.

Chapters 5, 6 and 7 describe research which concentrated on one particular MIS but which considered several different aspects of the MIS project. It is viewed primarily as a managerial problem which can be approached in different ways rather than a problem in a particular academic discipline. In order to study different aspects, it was necessary to adopt the techniques most appropriate to each aspect. Thus state diagrams and file descriptions are used for the computer aspects (Appendix A) and the sort of questionnaire used in sociology, for the management reactions. The variation between firms and the complexity of the problem are such that many case studies are needed to produce valid generalisations and basic theory. It would be a lifetime's work for an individual (and perhaps even for a research group) to carry out all the case studies necessary. Valid generalisation, then, must wait for the

publication of case studies which can be compared. It is hoped that this thesis will not only be a source of data for such generalisation but will also provide some ideas, sufficiently general to be applied by those involved in the production of a computer-based MIS. The main emphasis is on managerial or organizational techniques, which should be more widely applicable than the detailed structure of the system.

The case study (Chapter 5) is concerned with the Television Management Information System (TMIS) being developed by the Television Service of the BBC. The system is now (1970) fairly large and complex and provides information for all levels of management. The problems found include many which will occur in all such projects, but others, such as sales and market problems, will be considerably different. Some problems, such as the artistic nature of much of the BBC's product, make this project even more difficult than most. The accessibility of the system and the cooperativeness of the Computer Project Team in Television Service were vital factors in the choice of case study.

A pilot model of part of TMIS was produced in cooperation with one of the potential users of TMIS and members of the Computer Project Team (Chapter 6). The requirements were specified mainly by the potential user, and the computer systems design and programming were done by the author, for a PDP-7 computer with a visual display. The pilot model was intended to educate and involve managers in the Television Service as well as providing a model of part of TMIS. It was also intended to evaluate the usefulness to managers of a computer with a graphical display.

As another approach to studying the TMIS project, a questionnaire survey was carried out by the author (Chapter 7). This survey sought the reactions of users and potential users of TMIS, to computers and to the TMIS project. It was hoped to evaluate the success of the project in satisfying its "customers" and to evaluate some of the techniques used in the project. The main interest was in influences, on the users' attitudes, which could be controlled by those implementing the MIS. The controllable factors, which were expected to be influences, were education of the users about TMIS and their involvement with it.

CHAPTER 2

Management and Information

This chapter gives a background against which to set the greater detail of subsequent chapters. It describes the work of a manager in an organisation. "Organisation" is used to include industrial firms (both production and servicing), governmental organisations, national services (such as medical and broadcasting) etc. This wide scope is given to the term because I believe that the basic operations of management are very much alike in all such organisations. This similarity certainly applies to the information-handling operations described later in this chapter.

2.1 Management

Before one can enter into the problem of management information systems, one must have a fairly clear picture of what management itself is. Obtaining this picture is not a simple procedure as the number of definitions of management is almost as large as the number of books on the subject. There is no simple and complete definition of management because the term covers a variety of jobs and all managers bring their own personal styles to their job. There are, however, some common features which can be expressed fairly simply.

The basic task has been expressed by Drucker as to "make economic resources economically productive" (1). This is the common goal of all management whether in profit-making or non-profit-making organisations. A variety of organisations will have a variety of main goals but they will all be constrained in the way in which they achieve these various goals by the common goal described. Many of the goals which a manager

has will be sub-goals of the main one of his organisation, but some will be outside its scope and may even conflict with it, e.g. a manager's goals of personal ambition may clash with the organisation's goals.

2.2 Planning and Control

The procedures by which the manager tries to achieve his goals can be grouped under the two headings, Planning and Control. The division between the two is not a simple, straightforward one but can be applied at different levels in a hierarchy. For example, a series of actions under the general heading of control can be divided into detection of a deviation from the plan, planning how to deal with the deviation and control of this new sub-plan. A sub-division of a general planning procedure could be a complete planning and control cycle in the task of collecting information for the general plan.

Consider, for the moment, the simplified view of the job of management as the achievement of one basic organisational goal. The planning part of the job is that in which the basic goal is split up into a number of sub-goals and the available resources are divided among the sub-goals (Figure 2.1). The achievement of the sub-goals will usually be delegated to subordinate managers and the control phase of the manager's job occurs when he compares the results produced by his subordinates with the goals he has set them.

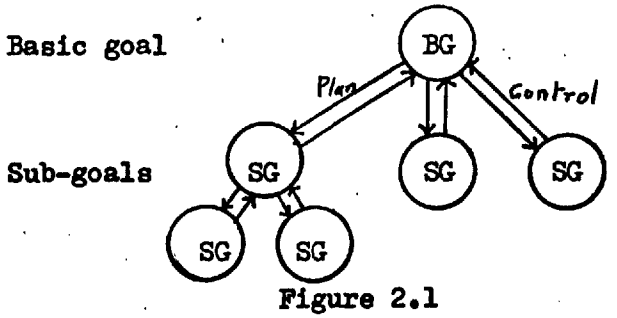


Figure 2.1

The arrows in Figure 2.1 show the flows of information in the use and control of a plan. If the plan is a simple one it may not have to be split up and may be implemented by the manager himself.

This hierarchy of goals is reflected in the "organisation charts" showing the authority relationship between managers in the organisation (a simplified version is given in Figure 2.2).

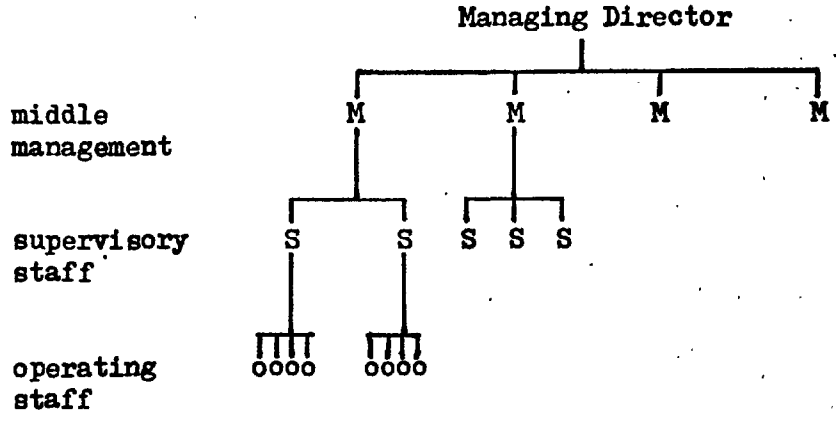


Figure 2.2

At the lowest levels of the hierarchy of Figure 2.1 the subgoals are operating instructions with no further subdivision needed and in a small organisation the initial plan may be in terms of operating instructions.

These hierarchies are obviously only approximations to real life. Even if an organisation did have a completely defined structure as in Figure 2.2 it would be highly unlikely that it had a simple goal structure with all sub-goals subordinate to a single basic goal. In practice most organisations do not have a completely defined organisation structure or goal structure. Most organisations have a number of basic goals some of which may never be stated explicitly. As long as they do not conflict with one another, these goals may be dealt with separately as a Figure 2.1. If they do conflict, there may be compromise within the firm and

adaptation of the goals (as described in (2)), or sequential consideration of the goals (as described in (3)). The latter theory appears to describe better what actually happens and this method may well be easier and more economic for an organisation than trying to coordinate conflicting goals.

2.3 Problem Solving and Decision Making

The achievement of each of the goals or sub-goals can be described as a problem-solving or decision-making procedure. Decision making is frequently used (especially in OR) as the basic term for what managers do. This usually involves considerable distortion from its everyday meaning, in order to include as many aspects of management as possible. Therefore the term "problem solving" will be used here, as it usually embraces a wider range of activities.

The problem finding and solving procedure can be split up into a number of steps, e.g.

1) Become aware of the problem.
2) Collect information on the problem and the goals which it affects.
3) Generate possible solutions (alternative courses of action) from information on the problem and decision rules from information on the goals.
4) Chose a solution (make the decision) by applying the decision rules to the alternatives.
5) Implement the solution by splitting it up into sub-problems and delegating solution of them where necessary.
6) Monitor and control the implementation.

The planning phase covers steps 2 to 5 and the control phase is step 6.

Step 1

This step has received comparatively little attention in the literature. Recent research (4) suggests that the manager works on problems presented to him far more often than on problems which he finds for himself. In a simple hierarchy such as that in Figure 2.1, it is obvious that all managers apart from the very top level, receive their problems from their superiors. Even in the more realistic case of multiple basic goals and conflicting goals there is a general tendency to set problems for lower levels. The problems which are handed down may be budgets which must be kept to, production levels which must be reached, a reduction in staff turnover to be achieved, etc. Problems may also be passed on horizontally in an organisational hierarchy. One of the jobs of a manager is to cooperate with his colleagues and as most managers prefer to have a reputation for being helpful, they will usually accept problems and enquiries from their colleagues. I think very few managers would claim to have any difficulty in obtaining problems. Indeed, one view of the purpose of a business organisation is that of "assigning problems to the most qualified individuals"(5). If the manager does have more problems than he can handle at once he has to place them in some order of priority which involves taking them to step 2.

Step 2

Having found or been given a problem the manager then has to obtain detailed information about it. Problems in management are very rarely completely defined although some recent techniques, such as Management by Objectives (6), attempt to increase the accuracy of definition of problems handed down to subordinates. Information must be obtained not only about the structure of the problem but also about which of the

organisation's goals it affects and how. If these goals are not known in sufficient detail, information must be obtained about them also. The manager's information on goals will often be collected continuously and informally from interactions with other managers in the firm, particularly when the goals are implicit to the firm rather than actually stated. The manager, at this point, may set off problem solving cycles at lower levels in the hierarchy by giving the problem of obtaining information in certain areas to his subordinates. He must also obtain information on what resources are available for the solution of the problem. Since obtaining information involves the use of resources, such as his own and other people's time, he must decide how much effort will be put into this step.

Steps 3 and 4

Having obtained sufficient information the manager will then produce a solution or solutions to his problem. If the problem is one which occurs regularly or is one of a common type he may have established procedures for dealing with it. If the problem is similar to previous ones a solution may be produced by adapting the standard procedures. If it is a completely new type of problem the manager will have to work out the whole solution. In this case it is more likely that he will attempt to produce a number of alternative solutions.

Ideally the decision rules should include a measure of the relative importance of the goals which are affected by this problem. From this and the results produced by the solutions, the rules would give a value for each solution. The solution with the highest value is the one chosen. In practice the decision rules will rarely be as explicit as this. Even when the decision is based on something as explicit and quantitative as financial return on an investment a number of different evaluation rules could be

used, e.g., discounted cash flow, net present worth, pay-back period. When the goals are less well defined, such as improvement of employee morale, maintenance of good customer relations, the manager will have to rely on his perception of the priority of the goals and intuition to decide how well the solutions satisfy the goals.

In some cases, perhaps even in most (3), the manager will apply his decision rules to each solution as it is produced rather than treating steps 3 and 4 as separate. In this case he may have some minimum value which a solution must exceed to be acceptable and when an acceptable solution is produced no further solutions are tried. If solutions are expensive to produce and particularly if the problem is posed in terms of a minimum acceptable goal, this method may be the most economic for the organisation. ~~Speed at which problems are solved is also a criterion for success as a manager and this makes the sequential consideration of solutions even more attractive to him.~~ Where the speed at which problems are solved is also a criterion for success as a manager this makes the sequential consideration of solutions even more attractive. This cyclic process between steps 3 and 4 may be extended back to step 2 if no acceptable solutions are found. This can also be done if it is expensive to obtain information and some solutions can be generated from only small amounts of information. Only if these first solutions are not acceptable is more information obtained.

Step 5

In the implementation stage the main information flow is from the manager to the rest of the organisation. If the solution needs his superior's approval it must first be communicated to him. When the solution is ready for implementation it is passed on to those who will have to work on it. A complicated solution will have to be split up and sections assigned to different people. It may be that the "solution" is to divide the original problem up into parts and give them to other people to solve. Each part will

include either detailed instructions, or goals and the resources available with which to achieve those goals. It is at this stage that delegation and motivation enter the manager's job. When a problem is handed down for solution he delegates authority over that sub-problem to a subordinate and in all parts of the implementation he must motivate those who have to carry out the implementation, to do their job well.

Step 6

In order that the implementation will follow the lines he has planned, the manager must control it. Some form of control may have been included in the solution specification such as a budget or a deadline, controlling the resources or time available respectively. Also he may have included a requirement to report back to him when some variable in the solution goes beyond certain limits, i.e. management by exception. He may ask for routine reports to be sent to him at regular intervals or he may even monitor progress by direct inspection of the implementation. Deviations from his plan may be handled by minor adjustments or he may have to go through the complete problem solving cycle to deal with the deviation.

2.4 Specialised Functions of Management

Another approach to describing the features of management common to different organisations is to divide management up into its different functions such as production, sales, administration, personnel, etc. That this approach is very widely accepted can be seen from advertisements for management posts. These are almost always divided up under the functions given above. The functional division of management corresponds to the division of the main goal or goals of the firm into sub-goals which correspond to the different functions. Thus problems related to a particular

goal are handled by a particular department within the organisation and a manager moving between corresponding departments in different organisations will supposedly be working on similar problems in each. The similarity of corresponding departments depends to some extent on the overall similarity of the organisations.

The division of the basic goal (e.g. make a profit by producing and selling a particular article) between functional departments, although necessary in large organisations, is one of the ways in which conflicting goals can arise. The departments are very rarely independent of one another. In a manufacturing firm there is a continuous flow of material from the buying department, which buys the raw materials, through the production department, which converts them to the finished product, to the sales department, which passes the finished product on to the customer. Each of the departments will be aiming at the common goal of making economic resources economically productive, but what leads to economies in one department may lead to waste in another department, or for the organisation as a whole. For example, the buying department will wish to buy materials at such a time or in such quantities as will give them the lowest price per unit. If the goals of the buying department were not coordinated with those of the other departments, this could lead to a shortage of materials when the prices were high or too large amounts being bought when discounts are offered. Similarly the production department would like to maintain a steady rate of production in order to make the most economic use of men and machines, whereas the sales department would like production to vary with the amount which they can sell at different times. These particular conflicts can be solved partly by the maintenance of intermediate stocks which act as buffers between departments and partly by the adjustment of departmental goals to coordinate them. This involves either the inclusion of this

coordination in a detailed plan or the flow of information between departments in order to coordinate the solutions they produce for their respective problems.

2.5 Operations on Information

It may be argued that some of the operations described here are carried out on data rather than on information. The difference between data and information is that information implies a recipient who understands it. In an ideal MIS all the data collected would be intended to provide some manager with useful information. The exact point at which data becomes information is a subjective one, depending on the manager receiving the information. The usefulness of the information is also partly subjective in the same way. For the sake of simplicity the word "information" will be used throughout this section but the above distinction should be borne in mind.

The handling of information may be broken down into five basic operations which are described here. In practice the operations will often not be completely separable and may occur in parallel or in a different order than that given here.

1) Collection. In the first place the information must be obtained from somewhere. This may involve recording the state of the object of interest (e.g., the number of items in a store) or in the occurrence of an event (e.g., the completion of a stage in the production of a manufactured article). In management the information may be collected either from within or outside the organisation with varying degrees of difficulty in both cases. Within the organisation there is normally more control over the collection but there is no guarantee that collecting will not be difficult. The collection may be routine, e.g., the daily recording of orders received, goods despatched and payments

received, or it may be specially requested, e.g., a survey on how well safety precautions are being adhered to after an accident. The collection may even occur by chance contact with the information, e.g., hearing of a new process or rival firm in a casual conversation. The main problem in this operation is to decide which information to collect. All information collection requires the use of some resources and value is obtained from information only when it is put to use. Considering the goal of making economic resources economically productive, only that information which has a value higher than the cost of obtaining it should be collected. Although this point has been stressed elsewhere (e.g., (5)), the difficulty of estimating the value gained from the use of information is still great, especially in long range planning.

2) Storage. The storage of information is a comparatively straightforward procedure. The problems include how much should be stored and for how long. These two are closely related to the problem of which information to collect. The value of information for management will, in general, decline with age but some historical information may be essential for planning. The actual form of storage used will depend on the cost of storage and the use to which the information will be put. Another problem is the security of stored information. The value of information can be lost either by its physical destruction or by its use by a rival organisation. The former is guarded against by duplication and safe physical storage, the latter by restricting access to the information. Information storage can be regarded as the memory of the organisation, with data files as its memory of facts and procedure manuals as its habits and learned skills.

3) Processing. The information which a manager wants will often exist (perhaps in his organisation) in a form or at a level of detail other than that which he requires. To give him the information he wants the available information must first be processed. This processing might be as simple as the summation of a lot of detailed information to give him a general picture for the organisation as a whole. Alternatively it could be a complex mathematical analysis to compare different departments or courses of action or to extrapolate the future performance of the organisation from historical information. The number of techniques available for the processing of management information is expanding and adding new specialists to the traditional information handlers (e.g. O.R. scientists and accountants). However, the manager is still the one who has to use the results of this processing and should be aware of its scope and limitations.

4) Retrieval. The collected and stored information will be adequately used only if it can be obtained when required. There are two main requirements in the information retrieval problem. The first of these is to retrive as much as possible of the information which is relevant to an enquiry. The second is to retrieve as little irrelevant information as possible. The way in which this problem is handled is to make the categorisation of the information and the questions, which have to be answered from this information, correspond as closely as possible. Where the questions are predictable and not too varied, this is not difficult, e.g., if questions about what happened on a particular day are going to be asked, the information can be stored by date. If the type of question cannot be specified in advance or there is a large variety of types, the problem becomes more difficult. The categorisation (or

coding) of the information must be complex and flexible but not too difficult to use. The two aspects of information retrieval, mentioned above, usually clash in practice. If one obtains a high proportion of the relevant information one also gets a lot of irrelevant information with it. If one cuts down the irrelevant a greater proportion of the relevant is missed.

5) Transmission. In transmitting information the manager may be sending it up, down or across the organisation. To some extent this operation closes a loop starting with collection because information transmitted by one manager is frequently collected by another. There is a wide range in the methods of transmission and the contents of the information involved. The information may be routine or specially requested, in the form of a report, a letter, a telephone call or a face-to-face conversation. It may be information for somebody else's problem, instructions for the implementation of a solution or the statement of a problem for somebody else. In each case the manager should consider both method and content, in the light of what effect he hopes to produce, because both affect the response.

2.6 Information and Management Systems

In order to carry out all the operations necessary to achieve its goals and solve its problems an organisation requires a constant flow of information. This information flows in to, out of and around the organisation through a great variety of channels which make up the information systems of the organisation. The term system is used here in a general sense to include all ways in which information may be communicated. The information systems may be divided up in a number of ways and interact with a number of the other variables of organisations, as shown below.

2.7 Internal and External Information Systems

Most organisations will have both internal and external systems. The internal system can be regarded as analogous to the central nervous system of the human body. It carries information about the internal state of the organisation from one part to another. Unlike those of the nervous system, the elements of an organisation's information system usually have other jobs to perform as well as the transmission of information (including control signals as information). This can affect the information transmitted (see below). The external information system of an organisation performs a similar function to the sense organs of the human body. This system collects information about the environment, perhaps analyses it and communicates it to the internal system. In this way information is obtained both for solving problems (e.g. what resources are likely to become available) and for setting goals (e.g. how well are other organisations, in the same field, doing). The organisation may have specialised departments to obtain this information, e.g., a market research department, but much of the information will be collected from casual contacts. It is probable that in most organisations the top levels of management are far more concerned with information from outside the firm than are lower levels. At the top levels the "casual" contacts, such as the golf club, may well be deliberately cultivated as sources of information.

2.8 Formal and Informal Systems

The internal information system can be divided into a formal and an informal system. The formal system is the official system which functions according to fairly clearly defined rules (in most cases) and with clearly defined communication channels. This system includes both written and spoken communications which may be routine, the result of some event, requested

or may even occur at random. What distinguishes them is that they all form part of the system which was consciously chosen or designed for the organisation (2). The formal system is usually closely related to the authority structure of the organisation (Figure 2.2). The way in which any two individuals may communicate with one another is governed by their relative organisational positions. The formal communication channels either flow up or down the organisational structure of Figure 2.2 or else between departments which are clearly linked by the operations of the organisation. Any communication between lower levels of unlinked departments may have to travel up one branch of the structure and down another, i.e., via the departmental heads.

The informal system carries information throughout the organisation often more widely than the formal system and is sometimes just as important to the running of the organisation. The informal system functions through social contacts between members of the organisation and these may cut across the authority structure. This system is generally created by accident rather than by design, although since it can be used to further organisational or personal goals certain elements of the system may have been deliberately created. It may take the form of casual conversations over lunch or it may be a regular communication channel between two individuals who do not find "official channels" adequate. The influence of the informal system on the organisation may be quite large. A social group within an organisation may have one member who is accepted as a leader by the others and thus his influence may extend far beyond that due to his position in the authority structure. The importance of this system is acknowledged in references to "the grapevine" and the influence it can have on decisions.

2.9 Functional Division of Information Systems

Information systems can be further subdivided according to the function which they are designed to perform.

The most widely established functional information system in organisations is the accounting system. This system is designed to handle information relating to the financial state of the organisation and has two purposes. The first purpose is to present an accurate picture of the financial state of the organisation to the outside world. The origins of this lie in the legal requirements placed upon organisations, in order to protect the general trading community. It uses historical information to provide a static picture at the end of the financial year. This involves the collection of information from many parts of the organisation, its processing and presentation in a form to facilitate the comparison of different organisations. The details of the processing will vary to some extent between organisations but there are general rules of accounting which are applied. The second purpose of accounting is to provide information to help the manager run the organisation. The scope of this aspect of accounting can be extended to cover a large proportion of the formal information system. Both historical and current information is used to describe what is happening and to predict what will happen. The way in which information is processed and presented and the amount which is dealt with by the accounting department will vary a great deal from organisation to organisation.

The formal information system may also include a number of smaller specialised systems. For example, in a job shop, information on the times required for different operations and the operations to be carried out on different products will be needed to schedule the flow of jobs. When a new

product is being produced there will need to be a considerable information flow between the research and development department and the production department. Such information systems are fairly small in scope but the information they carry is often important to and even duplicated by the main information system of the organisation. Another source of information, but one which is not generally regarded as an information system, is the collection of information which most organisations have on the way in which they operate. This will take the form of procedure manuals, job descriptions etc. For a new arrival in an organisation these could be the main source of information on the goals which he is expected to achieve and the methods he may use. They also help to define the authority structure of the organisation.

An organisation will often have systems designed to extract relevant information from its environment, e.g., a market research department or an audience research department. This department will normally function as part of the formal information system. An informal source of information outside the firm is provided by the professional associations to which managers may belong. These can influence the procedures in an organisation by setting codes of conduct for their members. They will also disseminate useful techniques and even solutions to particular problems.

2.10 Information Systems and Authority/Management Structures

The way in which the formal information system is related to the authority structure influences the way in which information flows. Many of the information channels are between superiors and subordinates and this relationship affects the information in the channel. A subordinate is far less likely to pass on information which will anger his superior as long as the superior is not likely to obtain the information via other channels.

Where the superior has control over the subordinate's promotion the subordinate will naturally emphasise that information which gives a good picture of his performance. The superior in turn may keep information which he thinks the subordinate does not need, to himself because it helps to maintain his authority. The old adage that "knowledge is power" can be applied to the management of organisations. The relationships between departments as well as between individuals can affect the flow of information. If two departments are in competition in some way, e.g. for the use of the organisation's resources, this can restrict or bias the information flowing between them. If information has to be supplied for the solution of a problem affecting the suppliers of the information, they may bias the information so as to produce the solution which they want.

The reverse influence of information flows on authority can also be seen. It may occur when a top manager has a staff officer or department which processes information for him. Initially the staff department just collects information and presents it in the form which the manager needs to make his decisions. Often the solution or plan produced will be in general terms and the staff department will expand it into a greater level of detail before distributing it. They may have to make decisions between alternative ways of implementing the detail of the plan. Thus the staff department are controlling those who carry out the plan although the top manager is the source of authority behind the plan. If the staff department is collecting information from many parts of the organisation, they will probably be the only ones who have all this information. This puts them in a very strong position when there is any disagreement with other departments. This situation may be inevitable when the decision making of one man requires large amounts of information processing both before and as a result of the decision. However ways of avoiding some of these dangers have been suggested (see 2.12).

2.11 Types of Management Structure

Management (or authority) structures have been divided into two types by Burns and Stalker (7). They have called these types mechanistic and organic. In mechanistic organisations the management structure is a clearly defined hierarchy as in Figure 2.2. In organic organisations the hierarchy is less clearly specified and there are more likely to be groups of people working together without any one having overall authority. They show that of these two types, the former is suited to a stable or very slowly changing organisation and the latter to a more rapidly changing organisation.

In a successful mechanistic organisation the information system is likely to be dominated by the formal system with everyone knowing his place and using the official channels of communication. Each manager will receive just the information he needs to handle his sub-problems and only the managing director will have the total picture. The informal system is only likely to play an important part if the formal system fails, for example if the organisation becomes involved in change.

In an organic organisation the formal and informal systems are likely to be used together and it may be difficult to distinguish them. In this sort of organisation (which closely resembles the management system, System 4, proposed by Likert (8)) more managers will have an overall picture of the organisation's position. This gives them the opportunity and often the motivation to coordinate their goals with those of the organisation. In an extreme example of this type of organisation, all sub-goals will be defined in consultation with those who have to achieve them. Thus a greater flow of information, particularly about goals, is needed. Also communication will more often be in the form of general intra-group discussion rather than in individual-to-individual communication. This style of consultation and group

problem solving has been closely linked with business success in studies by Likert. The main gains are better morale, greater individual involvement with the organisation's goals and more reliable information because managers feel less insecure and are less likely to bias information to their advantage. The main drawback of this system appears to be the same as that of management by committee. Unless the chairman or group leader is able to direct the discussion along constructive lines, considerable time can be wasted on side issues of little relevance and on "buck passing". System 4, along with most management systems, seems to pay little attention to the variations in individual personalities and the effects these can have on the system.

Most organisations will not be pure examples of either mechanistic or organic structures but will contain some properties of each. However, one of the two will often be sufficiently dominant to classify the organisation.

2.12 An Independent Information System

Another solution which has been suggested for the problem of bias in information caused by the authority structure, is to separate the information system from the authority structure. This solution has been used by the C.E.G.B. Midlands Region (9 and 10). Their system is concerned with the overhaul and construction of electricity generating plant. It provides control information to monitor a plan and to produce a new or adjusted plan. Information is sent direct from engineers at the work sites to an "Information Centre" where it is processed to produce reports for middle and senior management.

The four principles which were applied in the design of this system may have a general application to management information systems.

1) Information should be a neutral commodity available to all.

2) Information flow should be considered as a separate process from decision making, although closely linked with it at all appropriate levels.

3) All statements about the future are uncertain and therefore should be expressed as probabilities.

4) Quality control should be applied to information and predictions entering the system.

The first of these is often rejected because of interdepartmental friction. The argument used is that if other departments do not know the details of what goes on in a department, they will not complain or interfere. However this situation can lead to even greater trouble if other departments do find out. This situation should not arise if departmental goals and problems are set by a group involving all departmental heads. Principle 2 may be true with respect to the channels or elements in the system for performing the operations on information, but the processes are too closely linked to be separable. The importance of the user of the information (the decision maker) was recognised in the C.E.G.B. system by the involvement of managers at all levels in the design of the system. Principles 3 and 4 are applicable to information systems in general as long as the cost of their application is considered.

This complete separation of the information system is perhaps only worthwhile where communication channels following the authority hierarchy would be long and would introduce considerable bias. The C.E.G.B. system appears to have achieved considerable improvement over the authority structure based system.

CHAPTER 3

Computers and Management Information

This chapter describes the ways in which a computer can be used in the various steps of management problem solving given in Chapter 2. Those characteristics of information processing which make it suitable for computerisation are given in section 3.2. Different types of problem require different ways of supplying information to support their solution. In section 3.3 the characteristics of problems are related to the types of computer system most useful to the managers solving the problems. Section 3.4 considers the effects on management and organisations which have been ascribed to the introduction of computers. The effects considered are integration, formalisation and centralisation. In the final section of this chapter some published cases are reviewed and related to the discussion of section 3.4.

3.1 Computers in Management Problem Solving

The usefulness of computers in the various steps of management problem solving (described in section 2.3) will vary as the information handling content of these steps varies.

In steps 1, 3 & 5 (problem recognition,possible solution generation and solution implementation) there is often a need to generate new information or relationships, i.e., a need for creativity. Thus in these steps the computer can only provide limited help. In step 1 the manager has the original initiative to start the whole process off by recognising a problem. The computer might be said to recognise a problem when it is used for automatic monitoring but this will be included in step 6 (monitoring and

controlling a solution). In step 3 the manager has either to suggest a solution himself or else provide constraints and evaluation criteria which limit the solution and hence go part of the way to defining it. An example of the latter type of solution may occur in production scheduling, e.g. (18). Similarly the decision rules must be defined by a manager, since only managers (influenced by shareholders, directors or voters) can set the goals of the organisation. It is possible that the computer may help in formalising the managers' evaluation criteria into quantitative rules which can be applied to solutions, e.g., in the development and use of such techniques as discounted cash flow. However, the use of quantitative evaluation may not be universally appropriate (29).

In steps 2, 4 and 6 (information collection, solution choice and solution monitoring and control) the emphasis, from the manager's point of view, is on obtaining and processing information. Here the computer can be of considerable help.

The most obvious place for the use of computers in the problem solving process is at step 2. When a manager requires information in the form appropriate for his problem it must be collected, selected, condensed from many sources. The picture is complicated by the fact the implementation of one manager's solution is often the setting of another manager's problem (either by delegation or accident). Thus information provided at step 2 for one manager could be part of step 6 for his superior and a particular application of a computer could be in different steps of two problem solving cycles. As yet, the computer is not widely used for direct collection of information for management use. Thus step 2 involves both manual and computer handling of information. The areas of applicability and limitations on management information handling by computer are described in more detail in

the next three sections. In general, computer-based information systems require the manual collection and input of data. In practice a system such as this usually requires at least as many staff as a purely manual system. There is also a longer delay between collection and analysis because of the card or tape punching stage. This extra delay must be made up by improved processing and distribution. The delay may be reduced by using devices of various sorts from shop floor recording devices, which punch cards or tape automatically, to interactive alphanumeric display terminals. With an interactive terminal the computer can check input data and immediately request corrections (21). One area in which the computer is used for direct data collection is in process control. Much of the data, on such things as pressure, temperature and flow rates in a chemical process, will be ephemeral and used just for controlling the process. However, this data could be analysed to provide information on raw material usage and product output, for managers. Process control could thus form the first stage of a computer-based MIS, as is the case at Mitsui Toatsu Chemicals (17).

In choosing the solution (step 4) the computer can help by expanding and evaluating solutions formulated by managers in step 3. A solution proposed in outline will often have far-reaching results which require a considerable amount of effort to work out. For example, the addition to a schedule of a new television programme which uses forty resources, affects all the departments controlling those resources and probably many of the other programmes in the schedule. A computer can calculate the direct and indirect effects of such a proposal faster than a large team of human information handlers. Where there are no well defined evaluation criteria, this is as far as the computer can go and the manager must evaluate the results of his proposal. If there are well defined criteria, the computer

makes it possible to apply more complicated evaluation rules to an increased number of more complicated solutions. The extent to which all the evaluation criteria are quantifiable decides how far the computer can go in choosing the actual solution (see also section 3.3). In an extreme case the manager could just generate possible solutions without any clear idea of their value and let the computer do all the evaluation. The value of this application depends on the reliability of the evaluation criteria which have to be defined in the first place by the manager. The prime example of the use of computers in this step is simulation. Here a computer model of the problem situation is set up and variables which can be controlled in the real life situation are altered to see what effects this has in the model. This can be a way of producing unexpected information on the problem and the model as well as testing proposed solutions.

In monitoring the implementation of a problem solution, information on the state of the implementation must be collected and compared with the required state. The computer can be used to process the information available into the form needed by the manager to make the comparison between actual and required states. Alternatively the computer can make the comparison and report when there is a deviation greater than some specified limit. The increased speed with which traditional budget and cost analysis can be carried out by computer can make these a current control system instead of a historical reporting system, if they measure the right variables. A detailed breakdown of costs for a project, six weeks after it has finished, may be useful in planning other similar projects but is no help in controlling the project itself. Control can only be effective if costs are reported while the project is in progress; and computers can help in this.

3.2 Information Processing Characteristics and Computers.

Although a computer could be used for most management information processing it is not always profitable to use one. The possible applications of computers can be classified by the characteristics of the information processing involved((22)p.10). The economic feasibility of computer use depends, in the first place, upon these information characteristics. The advantages of a computer system over a manual one lie in speed and capacity of information processing and to some extent in lack of errors in processing. Thus the characteristics which favour (but do not guarantee) the economic feasibility of computerisation are as follows:

(a) There is a large amount of data to be processed in standard repetitive operations.

(b) The data involves a large number of interacting variables. (In general the number of calculations for interacting variables goes up roughly as the square of the number of variables).

(c) Accurate quantified data is available.

(d) Reliability, in terms of few errors in calculations, is required. This presupposes reliable input data and well written and tested programs.

(e) The date processing involves the combination of probabilities or changing probabilities. (It has been shown that the human handling of probabilities usually is far from the ideal mathematical method (30)).

3.3 Problem Characteristics and Computers

Given that the information processing for a problem warrants the use of a computer there are various ways in which the computer can be used. Three characteristics of problems which influence these methods of use are -

(a) predictable / unpredictable form (or information requirements)

(b) predictable / unpredictable timing

(c) immediate solution needed / plenty of time available for solution (urgent / not urgent).

(a) If the form of the problem to be solved cannot be predicted then it is not possible to know which information to store for its solution. The more predictable the form of the problem the easier it is to use a computer to supply the information for its solution. In the limit the solution is predictable too, and can be programmed into the computer system. In between these extremes the computer can supply information with varying degrees of flexibility for varying degrees of unpredictability of problems. The difference between predictable and unpredictable form is much greater for a computer-based information system than for a manual system. Most current computer systems are comparatively inflexible with respect to unpredicted change in form. When a new information requirement occurs, time is needed for systems analysis, programming and testing before a report can be produced. Recent work has aimed at cutting this delay in two ways. One way is to produce a system in which the manager can define his information requirements directly to the system, e.g. (19). The other way is to produce flexible information systems software which could "reduce systems analysis time and almost abolish programming time", (20).

(b) If problems are predictable in timing, information for them can be provided regularly on routine reports (with the provisos on predictability of form, above). The predictability of timing may be relative to the occurrence of particular events rather than chronological time. The reports produced are then event triggered as in exception reporting. For problems for which the form can be predicted but not the time of occurrence,

or the events triggering reports, information can be provided on requested reports of known format and content.

(c) The time available for solution of the problem is the main deciding factor between batch processing and on-line systems, given that the cost of either is justified. If the time available is long a batch processing system will fulfil the requirements. If the time available is short it may still be possible to use a batch processing system for problems with well defined information requirements, by producing routine reports at the right time. When the time is short and the problem has unpredictable form, an interactive terminal can provide the best service. However, a system with such terminals will cost more both in hardware and programming effort. It also has the disadvantage that most managers are not familiar with computers and many do not welcome direct contact with them in the form of terminals. If such an application of computers can provide a significant gain one solution is to employ an "information specialist" to act as an interface between the manager and the computer.

The different types of problem described above are usually associated with different levels of management. In general the higher a manager is in the management hierarchy, the less well defined are the problems he has to solve. At the operating level the problems are usually very well defined, often to the extent of being programmable in Simon's terminology (2). Thus computers are already being widely used at this level for such things as payroll, personnel records, historical accounting. At the middle management level the problems are usually less predictable in form and timing but often recur periodically or even randomly to provide some precedent for solutions. Thus an information system for middle management must be flexible but will still usually be concerned with information from within the organisation.

Most of the computer-based information systems which are being developed at the moment appear to be aimed mainly at this management level. At the top management or strategic level (31) the problems are generally very vaguely defined, cover long time periods and are often "one-off" problems. These difficulties, from the point of view of computer usage, are added to by the fact that a large proportion of the data needed at this level come from outside the organisation. Some work is being done at this level, mainly on company simulation models.

3.4 The Effect of Computers in Management

The three effects which are usually quoted are greater integration, formalisation and centralisation.

In general, integration is likely to occur if a large proportion of an organisation's formal information is transferred to computers. With a computer system it is feasible for each element of data to be collected only once and stored at one location in the system. In a manual system, which may have grown haphazardly, (or in a badly designed computer system) information elements may be collected from more than one source, perhaps at different times, and may be stored in several places at once. As well as involving unnecessary work, this may produce discrepancies between two copies of an element of information. These discrepancies may lead to the loss of considerable management time in arguments over whose information is correct. Integration in a computer-based system deals with the problem, but correspondingly increases the danger resulting from incorrect information in the system. Thus the checking of data going into an integrated computer-based system is vitally important. If integration is carried too far the system produced could be inflexible and uneconomical. If the system is so

integrated that many of the parts are dependent on the structure of other parts, it may be extremely difficult to alter. A change in one part would necessitate changes in many other parts. What is required is integration to the extent of coordinating all parts without making them dependent on one another's structure. It may be more economical, in terms of speed of access, say, to store some information in more than one place at once. This increases the complexity and time spent in updating of this information and can lead to discrepancies again. As well as the integration of factual information, a computer-based system could lead, indirectly, to the integration of goals of different parts of the organisation. The detailed investigation which is necessary for the setting up of a computer-based MIS should consider the goals of the organisation as a whole. It may bring together groups who have never previously considered one another's goals. The improved information flow should increase the knowledge of other departments' goals, whether or not it leads to greater tolerance. Cyert and March (3) have suggested that interdepartmental conflict will tend to increase with improved information. This makes the assumption that departments often do not quarrel because of lack of knowledge of one another's operations, i.e., ignorance acts as an organisational lubricant.

The formalisation introduced by the use of computers can affect management in a number of ways. Here formalisation is used in the sense of definition in precise terms or in numbers rather than vague or subjective terms. The most obvious effect is on the information handled. For example, if an exception reporting system is implemented it is no longer sufficient for the manager to say "report if things go badly". This relies on the judgement of the man to whom the order is given. The computer must be told at exactly what deviation from the plan it must report. Thus formalisation

may mean more work for the manager rather than less. However, it should lead to better results, if not by producing more accurate information, then by making the manager more aware of the limits on the accuracy of his information. An area in which formalisation could have a great effect is in the goals of the organisation and how they relate to the day-to-day operations. In order to specify what information is needed to solve a problem, the goals which have to be achieved in the solution must be specified. The increase in formalisation of goals implies an increase in the formalisation of the decision criteria which are used to judge how well a problem solution achieves these goals. As an example take a firm which has set up the goal of increasing sales of a particular product. A computer model of the market for this product could give an estimate of what is feasible in increased sales and what this would cost. This model could be of much greater complexity than a manual one and, if it is well designed, more accurate. The sub-goals handed down the organisation can now be expressed more formally and accurately in terms of a given percentage increase in sales for a budgeted advertising cost. Thus the decision criteria of the lower manager will be capable of more formal expression. Another possible area of formalisation (or standardisation in this case) is in the procedures of the organisation. The need to collect data with knowledge of its limits of accuracy means that some procedures will have to be specified in greater detail and adhered to more strictly. If a batch-processed report is produced at a particular time, all the data relevant to that report must be in the system in time. Unless the system is unusually flexible in operation, the report will have to go out with information out of date or missing if input data is late. This aspect of formalisation may help when new staff have to be introduced to the procedures because they should all be documented, but it can be a considerable drawback when unexpected events occur.

The centralisation effects of computers in organisations have aroused a considerable debate, e.g. (23). The diversity of opinion among informed practitioners of computing and management would seem to indicate that the introduction of a computer can be followed by either centralisation or decentralisation. Greater centralisation is often possible because the computer can provide higher managers with reports of great scope and with freedom from any bias introduced by intermediate management levels, in a short time. This can only be done if the decisions necessary in the analysis of information for the reports are sufficiently well defined to be programmable. The increased speed of feedback of information can make it possible for a manager to keep a close check on his subordinates. However, the way in which information can be distributed rapidly from a central data-base by a computer makes it easier for lower or more widely dispersed managers to receive the information they need for their decisions. Thus a computer can also aid decentralisation. For example, consider a number of projects or managers competing for the limited resources of an organisation, say, television producers making programmes in an organisation with a limited number of studios, staff, etc. When the number of programmes is large and the resources are highly utilised there has to be a considerable amount of planning. Any alterations have to be tightly and centrally controlled or paid for by buying in extra resources from outside the organisation. If a computer is used it becomes possible to tell each producer what alternatives are feasible and what each costs. Thus the decision making can be decentralised. The overall centralisation or decentralisation effect is probably a result more of the aims of higher management rather than being due solely to the computer.(See also Chapter 5).

The effects described above will not be uniform throughout an organisation which uses computers in a MIS. There obviously cannot be much effect on jobs whose information handling content is very low. One would expect the effects to be most pronounced on individuals or departments whose main job is processing and distributing information. Such a variation in effect has been reported by Hofer (25).

3.5 Examples of the Use of Computers in Management

This section is a brief review of some of the examples which have been published. A recent direct view of some systems is given in (17). From this it is obvious that not all so-called MIS provide information for managers and many of those that do are not very successful.

One system, which appears to have achieved some of the success one would expect of it, is that at IBM (19), (24). The area in which it has not achieved its initial objectives is to get top managers to use display terminals themselves. These managers prefer to work through people rather than by using machines themselves. This agrees with research reported by Hofer in (25). Greater success with displays is reported in (26), but here the use is apparently by lower managers.

With regard to the centralisation/decentralisation issue the evidence is as mixed as the opinions in (23). An early case in which the overall effect was greater centralisation is given in (27). This batch processing system was mainly concerned with the accounting department of a power company. Two further examples of victims of centralisation quoted in (23) are (1) bank managers whose loans to customers could be checked daily by headquarters after a computer system was installed and

(2) warehouse managers in a firm where a general stock control system was implemented on a computer. In (28) a quote from Canadian Pacific Railway Company, who have been using computers since 1954, is given:- "Our philosophy is to decentralise, to put the computer at the service of the man on the spot." An extreme example of a system being designed to prevent central control is given by Carroll in (23). He refers to an on-line system which has been designed so that a supervisor cannot obtain access to his subordinate's detailed information (except through the subordinate's own terminal).

Thus some centralisation or decentralisation may be designed into the system. The only influence of the computer seems to be in a slight correlation between batch processing systems and centralisation, and on-line systems and decentralisation.

CHAPTER 4

The Design and Implementation of a Computer-based MIS

This chapter describes the MIS project from a number of points of view. In section 4.1 it is described as a process and the different stages of the process are outlined. Section 4.2 describes it from the point of view of the people involved; which people should be involved and what their roles are. In section 4.3 some of the techniques which may be used in the project are described and a measure of their usefulness is given. The list is not exhaustive. It includes the most generally applicable ones but not the technical details of computing. The fourth section describes general strategy considerations for the project. The final section (4.5) relates the MIS project to the authority structure of the organisation. Since MIS projects vary considerably from organisation to organisation the judgements offered in this chapter are general guides rather than absolute judgements.

4.1 The Stages in the MIS Project

The stages are considered here as if they were part of a single process, linear in time. In fact with an MIS of any size one will have an evolutionary process with different parts of the system and even different versions of the same part at different stages at any point in time. The process will also be iterative, in that feedback from later stages of some early parts will influence later parts or versions (see reference (32) pp. 41-46 on planned evolution and design iteration). The stages are

1) The Feasibility Study

2) The Investigation

3) The Analysis

4) The Design

5) The Implementation

6) The Evaluation

4.1.1 The Feasibility Study

The aim of this stage is to determine whether it is worth while setting up an MIS project. The study should decide whether it is likely that a computer can profitably be used to provide management information. It would usually be carried out by a small team working for 3 to 6 months. The team needs both knowledge of the organization and knowledge of how computers can be used. A senior manager is needed to give an overall view of the organization. If the organization does not have much experience in the use of computers it is advisable to employ consultants who do. This stage is probably the one in which consultants can be the greatest help. There is a greater need for experience in this stage than in any other because of the difficulty of producing a clear-cut, quantitative case for or against a computer-based MIS and the greater danger caused by an incorrect decision. Once an MIS project has got under way it can be very difficult to stop. Those involved become committed to the project both emotionally and logically in the furtherance of their careers. Those working on the project will find it easier to see further applications of the computer than others will to see the drawbacks in these applications. Also, stopping a project before it reaches completion is a public admission that a wrong decision has been made. This is not an easy admission for anyone, much less for a manager, when in

management the concept of risk is often ignored and any wrong decision is regarded as a failure. This danger can be reduced if any project recommended as a result of the feasibility study is expressed in terms of areas to be studied in detail and a procedure for regular feedback of information for a(regular) feasibility and profitability check, rather than having fixed goals and a fixed budget. This type of project definition also fits in with the idea of an evolutionary MIS. A wrong decision against a computer-based MIS at this stage has less immediate danger but if the matter is ignored for a long time because the decision has been made, the lost opportunity could be a major loss.

In the course of this study the points raised in Chapter 3 should be considered (particularly those in sections 3.2 and 3.3). The major goals and major decision areas of the organization are identified. This may be a simple task if the organization has well defined goals, such as profitability in a business, or a written charter or constitution. Where the goals of the organization are only represented by a consensus of opinion among top management the problem becomes much more difficult. The need for a member of this top management group to be in the study team is evident in such a case. The way in which sub-goals or departmental goals contribute to the major goals also needs to be defined. In the feasibility study these can only be studied in limited detail otherwise the project enters stage 2 without a decision on its feasibility having been made. Each decision area to be considered is a group of related decisions which are grouped together for convenience. The decisions may be related by virtue of common or similar subject matter or information requirements, or by the fact that they are all made by one manager or a particular group of managers. Obviously, the most useful grouping for the design of an MIS is those decisions requiring the same

or similar information. For each of these major decision areas the values of the decisions are estimated together with the possible gains arising from the application of computers. The costs of these applications and the overall loss or gain are estimated. The estimation of costs is a complex problem since the costs of the different applications are not independent. For example two applications may have some common information requirements. In this case the cost of setting up and maintaining a database for the two applications together will not be the sum of the costs of the databases for each application in isolation. The gains in clerical cost saving which justified the early applications of computers in business will probably not be applicable and are certainly not the most productive in justifying an MIS (see Diebold (33)). The aims of an MIS are better expressed in terms of improved decisions, greater profit, greater operating efficiency, better customer satisfaction, etc. It may be that the use of computers becomes necessary to maintain the current level of profitability or efficiency in the face of increasing complexity and size of the organization. In any case it is possible to estimate the costs and results obtained in comparison with a manual system.

4.1.2 The Investigation

The investigation follows on from the feasibility study, continuing in detail what the study did in general. The aim of the investigation stage is to find out what is actually happening in contrast with the analysis stage which decides what ought to happen within the organization.

The division of the organization's major goals into sub-goals or departmental goals and the interpretation of these sub-goals by those who have to achieve them, are investigated. Procedures being used to attain these goals are noted together with the information systems which exist to

sustain these procedures. For the information systems, information flows are recorded in terms of origin, destination, content, form, frequency, purpose and accuracy. This should not be too difficult for the formal (see section 2.8) information system. History files of documents can be examined or the MIS team can be added to the circulation list of documents to investigate the formal system. Although informal information flows are more difficult to trace, the investigation should find out where they are important and what information they carry in the important cases. Particular care should be taken to identify areas where goals and procedures have changed from the official or previously documented ones.

As well as identifying current activities, the investigation can also measure personnel resources available. Those resources which can contribute to the MIS project are work, skills and knowledge. If there are any individuals with time to spare or pools of labour to be tapped, these should be known about. Similarly those whose special skills or knowledge of the organization enable them to make important contributions to the design of the MIS should be identified as soon as possible. Those managers or staff whose main task is information handling, e.g., administrative assistants, are particularly important. Another personnel variable which should be measured is the acceptability of change. This will often be measured only in an informal way, but advance knowledge of which people or departments are likely to be unwilling to change can be very useful. A combined survey of requirements and attitudes towards change would seem to be a useful start to an MIS investigation. However, all the attitude surveys reported in the literature seem to be university research rather than the work of an organization setting up an MIS (7,12,14).

4.1.3 The Analysis

The analysis is carried out on the data collected in stages 1 and 2. Working from the organization's goals, ideal procedures for their achievement are developed together with information systems needed to support these procedures. These ideal procedures and systems are compared with the actual ones and differences noted. These differences may be due to faults in the current systems, errors in identification of the goals involved or errors in the analysis. They will lead to further investigation and analysis to clarify the differences. Thus stages 2 and 3 are very closely linked and will go on to a large extent in parallel.

The analysis will show how well current information systems satisfy the stated needs, and the ideal requirements for achievement of the firm's stated goals. Where these two are different the analysis will show what goals are implicit in the current systems. Feedback to the users of current systems will then show (by the users' reactions) whether the implicit goals have arisen by accident or because the organization's goals have changed for a good reason, such as a change in technology or a change in the market. A current procedure or information system may have been developed to suit a particular manager's style and then become frozen even though the originator has left. Information systems may have arisen to meet certain local needs within the organization and thus there can be unnecessary redundancy in current systems. The analysis should show which information flows are basic and essential regardless of their current form (documents, memos or telephone calls) or route. The differences between the current system and an ideal system are identified as they will guide the decision as to what changes, if any, will be made in designing the computer-based MIS.

4.1.4 The Design

The scope of this stage depends primarily on the project specification produced by the feasibility study and secondarily on the requirements found in stages 2 and 3. The MIS team may have been authorised to recommend new management procedures and organisation or they may be limited to a system which provides information within the current organizational framework. In either case the users of the system will have to be heavily involved with its design but more so in the former case. (see sections 4.2.2 and 4.2.6). Both computer systems and manual procedures will have to be designed as a computer system cannot work in isolation.

The strategy used can be classified by two extreme types called Inductive and Deductive by Rosove (32, pps 34-39). Using an inductive strategy the information is designed just to support or mechanise current procedures. With a deductive strategy the new system is designed solely by logical deduction from the organization's goals. In a good MIS project there should be a balance between these two strategies. A compromise must be reached between a system which is technically efficient for achieving the organization's goals and one which will be easy for the users to understand and adapt to. This compromise will be designed to optimise overall operational efficiency.

The design considerations used in deciding where and how computers should be used in an MIS were described in Chapter 3. In the design stage these are applied to all the decision areas investigated in stage 2. The gains and costs for each area are estimated with potential users of the system (i.e., decision makers in the area concerned). The technical considerations are covered in detail in reference (34). As well as being designed for current efficiency the computer system should be designed to be

flexible. Changes are bound to occur as the system evolves, so it should be designed to be easy to change in input, output and file contents. When a system is being designed and implemented in sections the interfaces between sections which are produced at different times need particular care and forethought. In some cases this will involve predicting the directions in which the system is going to develop.

Manual procedures have to be designed whether or not a computer is used. Data has to be collected, written down on a specially defined form and translated (often) into machine readable form before it can be used in a computer-based MIS. These procedures should be designed to minimise the number of errors in the data. A useful technique in this respect is to give the responsibility for feeding in any item to one of those who will use it when it appears on a report. Operating procedures also have to be designed to get the right report to each user at the right time. These are comparatively easy until there is competition for computer time. Then only the users can sort out the priorities among themselves.

4.1.5 The Implementation

The technical implementation of computer systems is widely covered in the literature (e.g. 34, 35, 51, 52) and will not be considered in detail here. New hardware may have to be bought or time may be available on an existing computer. In either case the needs of the system as it develops will be considered. Where a large MIS is being developed in sections either the computing power available must expand with the system or else a large surplus must be available from the start. The existence of ranges of compatible computers of various sizes (e.g. ICL 1900 and IBM 360) simplify the problem of expanding MISs. The initial system can be

developed on one of the smaller models and transferred to a larger one when it grows too big for the original model. This transfer should be accomplished fairly easily.

The choice between different manufacturers and machines is often resolved by having several manufacturers submit tenders. However, these will depend on the manufacturers appraisal of the MIS project and are likely to be biased in favour of the use of a computer as much as possible. The computer bias can be guarded against by the buyer's submitting a detailed MIS design but this means delay between designing the system and having a computer to run it on. The gap can be filled by hiring a machine or using a service bureau. Another aspect of this choice is the difference between the software and services provided by the different manufacturers. If the choice between manufacturers is decided on this basis the organisation's MIS team can decide what hardware is needed and expand it as necessary. A tender usually assumes a once and for all solution to a defined problem, thus the standard form is not really suitable for an MIS project.

The other side of the technical implementation of a computer-based MIS is the software (in the sense of all programs making up the system). Here there are three basic alternatives to choose from. Firstly the software may be taken from the manufacturer, secondly it can be produced by the user organization and finally it can be produced by a programming firm. In practice these alternatives can be combined. The manufacturer's software may be adapted by the user or combined with other software written by the user or a third party. The choice will be guided by the complexity of the MIS, its departure from standard or average systems and the amount and quality of programming effort available. If the system is a simple or standard one, the manufacturer's software packages can be used and will be cheaper. The more

complex or unusual the system the more rewriting or original programming will have to be done. The possible sources for any extra programming effort needed are programming firms, recruitment of experienced programmers and the training of the organization's own employees. The use of a programming firm eliminates the cost of recuitment or training and, if the firm is carefully chosen, guarantees the quality of the programs produced. The disadvantages are that the cost of the actual programming is higher and the contact between the designers of the system and the programmers may not be as good as if they were within the same organization. If the organization already has a programming department the framework for expansion exists. Experienced programmers will be more expensive and difficult to recruit, but training one's own programming staff can lead to delays for the training and poorer quality programming. Each organization must reach its own balance between these sources depending on what is needed for the MIS and what is available.

The organisational (non-technical) side of the implementation needs as much, if not more, effort and is less easy to define. Not only must any new procedures be distributed to those involved but it must be ensured that these procedures are followed. Saying that a thing must be done in a certain way is not sufficient to ensure that it will be done that way when human beings are involved. The users must be motivated to use the system. Phrased this way it sounds as if motivation is being forced on or given to the users whereas in fact it should arise within them as a result of the design of the system. If the users have been involved in the design of the system from the start, part of this motivational work will already be done (see section 4.2.2) but there will be more to be done at the implementation stage. All users of

the MIS cannot be fully involved in its development so some explanation of the system to them will occur at this stage. Even those who have been involved in the development will not always realise the full implications of the system until it starts operating. Thus there is a need for a constant effort in education of users in the ideas involved in the system, what it is trying to do and what its effects should be. (See also section 4.2.7). If the users are favourably inclined towards the MIS project from the start it will be easier to push the system into use. However, this goodwill is a limited "resource" which can be dissipated by the use of too much pressure. One particularly difficult area for motivation is that in which people have to supply data for the MIS without getting any useful information for themselves. If the design of the system cannot avoid such a situation special care will have to be taken to ensure that those supplying data are aware of the importance of this data.

4.1.6 The Evaluation

The problem of evaluating an MIS depends on the goals which were set for the MIS project. Where these goals are quantitatively defined such as cost savings or decreased inventory, the evaluation is straightforward. Where the goals are less quantitative, such as improved management decision making, the evaluation is considerably more difficult. The first level of evaluation is by the users themselves, to quote Rosove (32, p 116) - "It is desirable, if not almost inevitable, that the users of system themselves evaluate its operations". The final evaluation of the effectiveness of the combination of manager and MIS can only be made by the manager's superior as part of the normal management evaluation. Thus the final evaluation of the MIS as a whole can only be made by the manager at the top of the hierarchy

using the MIS, probably the managing director. However, the manager must have at least some ability to evaluate the work he is doing. The user's evaluation of the system will not be based just on the technical qualities of the system or its potential. It will be based also on how it has been presented to him and adapted for him. Thus the presentation of the system and its adaptation to the user's requirements are vital aspects of the MIS project.

With a long term project, as any large scale MIS is, the evaluation is a continuous or periodic process. If the project is an evolving one the evaluation must evolve with the system. An extreme example of thoroughness in evaluation and control is given by Conway in (36).

4.2 The People in the MIS Project

This section considers the roles of the various people concerned with the MIS project - senior managers, line managers, consultants, systems analysts and programmers. The make-up of the MIS project team and the part played by education are described. The effect on the project of latent social roles, as described by Gouldner (37), is considered.

4.2.1 The Role of Top Management

The ultimate responsibility for the success of the MIS project rests with the top managers. Only they have the authority and the overall view of the organisation to ensure that an interdepartmental project of the scale of an MIS, will be optimised for the organisation as a whole rather than for particular departments. The top managers must show that they are committed to the project in order to motivate the reluctant members of the organisation to support the project. Because of internal politics some people may not believe that the system will actually be implemented until they get orders from the managing director. Since top management sets the goals

of the organization and the MIS project, it must make the final evaluation of the system. The importance of top management involvement is demonstrated in (38) and (39, chapter 11).

4.2.2 The Roles of Line Managers

The line manager has three roles in the MIS project. These are the line manager as user of the system, designer of the system and interpreter to other line managers.

As users or potential users of an MIS managers should consider the jobs they do in terms of their information requirements. They should also consider how these requirements are likely to change in the foreseeable future. These requirements must be communicated to the MIS team and checks made that if these requirements are not yet met, there is a good reason for any omission. When the MIS starts operating, faults should be reported to the MIS team rather than just being used as a reason for ignoring the system. If faults are not reported and corrected the system will never be successful. This will mean some extra work for managers during the design and development period but this should be an investment which will improve their work in the future.

Those managers who are actually in the MIS team have a much bigger part to play in the detailed design of the system. They represent those managers who are unable or unwilling to fulfil the first role mentioned, and the possibly conflicting interests of different departments. The aims and requirements of the user managers must be coordinated and checked for alignment with those of the organization. The managers on the team must also ensure that the system is designed primarily to support the managers in the organization rather than to be just technically efficient.

The managers on the MIS team act as interpreters of the system to the other managers. Users are more likely to be convinced that the system is worthwhile by other managers who have experience of the organization. They are known to the users and can speak their "dialect" where necessary. Also, another manager from the organization is more likely to understand a user's difficulties with the MIS than is a systems analyst. This role is a combination of educating the users, selling the system to them and feeding back their comments to the MIS team.

4.2.3 The Role of Consultants

The role of consultants is that of experts, both to provide expertise in the design of the MIS and to give the authority of expert opinion to changes in the organization and to the new system. Consultants ought to have more experience than the organisation's managers of other firms' information systems and through their recommendations the organization will gain the advantages of interorganization comparison. There is some danger that this interorganization comparison can lead to stereotyped solutions and the overlooking of unique but vital aspects of an organization. It is also possible that consultants could produce a short term solution which will produce good results while they are with the organization. These dangers can be reduced by using a well established consulting firm which cannot afford the damage which such faults would cause to its reputation. As outsiders to the organization consultants should be neutral with respect to any internal politics within the organization. Thus they may be useful in introducing changes which would be fought if one of the organization's departments suggested them. The authority of the consultants' expert opinion will not be universally

accepted. Some managers will consider the fact that they are outsiders as meaning that they cannot really appreciate the organization's problems. Another role which has been suggested for consultants is that of scapegoat for the faults in the MIS. This role is unlikely to be accepted willingly by consultants but I have no doubt that it is considered by many managers.

4.2.4 The Role of Systems Analysts

There is some disagreement on the role of systems analysts. One extreme point of view is that systems analysts are "change agents", responsible for modernising the organization and adapting it to the efficient use of computers (16). This view is usually expressed by systems or computer specialists. The other extreme, that systems analysts can only design computer systems to support problem solutions found by others, is usually expressed by other people claiming to be able to reform the whole of the organization, e.g., OR scientists. In practice the systems analyst will take up a role which depends on his abilities and the definition of systems analyst used by his organization. A less extreme definition, only slightly biassed towards the systems analyst's omniscience is given in (34, Part 1).

Whichever definition is used the systems analyst will usually play the major part in the investigation, analysis and design stages, together with line managers on the MIS team. His specialist role is to translate from management information requirements to computer systems (both hardware and software) and vice versa. He needs a variety of skills and knowledge. For the design of computer systems he needs computer knowledge, for manual support systems he needs O and M knowledge and for managerial systems, O and M and management knowledge. Communication skill is needed

in explaining the potentials and limitations of computers in MIS, to managers. It is reasonable that the systems analyst should point out discrepancies and inconsistencies in management procedures but it is highly unlikely that he will be successful in imposing changes on managers. Approval and, where possible, suggestions for management changes should come from the managers themselves. When producing a system design, the analyst should produce clear and unambiguous descriptions both for managers and programmers, each at the appropriate level of detail.

4.2.5 The Role of Programmers

This role can be summarised as the efficient conversion of the analysts' system designs into computer programs. The programmer needs knowledge of the machine and languages being used and of the software available. The efficiency of the programming lies not only in the speed with which the programs are executed but also the ease with which they can be changed and interfaced with new programs. The programs must be well documented so that newcomers to the system can understand what they do. It is quite likely that the programmer who produced the original program will have left the organization when the time comes to alter it. The programmer should check the design he receives for consistency and efficiency in its use of the computer. He should also design program tests. The manner of division of these later parts of implementation, between systems analysts and programmers, will depend on the job definitions used in the organization. For a detailed description of the programmers job see (32, section 3.4.)

4.2.6 The MIS Team

The MIS team or task-force is an idea which has been used or suggested by a number of apparently successful projects. Examples are the MIS survey in Rolls-Royce (40) and the development of a company model at the Sun Oil Company (41).

This section assumes a single project team or task force. It is realised that in the case of a very large system there may be a number of teams working semi-independently. In a very large organization there may even be a "Systems Department". In any of these cases the factors considered below apply to the group of people producing an MIS. Other facts involved in the control of MIS projects are described in section 4.5.

A variety of skills is needed on the MIS team. The ability and breadth of experience of team members are more important than their job classifications (37 page 171) but these classifications will be used here as a rough guide to type of experience. The team needs at least managers, systems analysts and programmers. While it has been suggested that an MIS can be designed by systems analysts alone (e.g. (16)), this suggestion is usually qualified by specifying supermen as systems analysts, i.e., they should have experience of programming, systems analysis, O and M, line management, accounting, statistics and some knowledge of sociology, psychology, etc. Since individuals with these qualifications are almost as rare as hens' teeth they are only likely to be involved with an MIS project as head of the team or of the entire organization. In practice systems analysts are often promoted programmers with some training in analysis and perhaps some O & M experience. In such cases there is an obvious need for other people with experience of management on the team. The presence on the team of representatives of different departments can also

help in dealing with political disagreements. Some interdepartmental rivalry exists in most organizations and if a project with interdepartmental consequences, such as an MIS, is perceived as favouring one department over another, the resulting conflict can hold back the project. If the conflicting departments all have representatives on the team this should ensure that the MIS remains impartial and that those who complain of favouritism are placated. Other specialists who may be included in the MIS team are accountants, sociologists and psychologists. Accounting has an obvious claim for inclusion since the accounting systems of organizations have been providing information for management for many years. Also many organizations will be already using computers for accounting when they start on a comprehensive MIS. These accounting systems will have to be incorporated in or reconciled with any new systems. Thus an accountant on the team will not only provide accounting expertise but will provide a useful link with existing accounting systems. Sociologists and psychologists have a less clear role to play because there is less experience of applying their disciplines to management. The employment of sociologists on MIS teams and for management in general, is supported in the literature (by sociologists at least) but does not seem to be widely accepted in this country ((12) p.87 and (8)). The theories and models which have been developed apply more to general management than to the design of an MIS but a practical example of the application of sociology to an MIS project is given in an Appendix to (8). Psychological studies of decision making usually deal with fairly simple situations in management game playing, e.g., (42) and this cannot be applied directly. There seems to be little use made of psychology in currently reported MIS projects although the potential of ergonomics appears to be very important. Most managers would probably

claim that they can look after their own "psychological" requirements.

Having decided what people to include in the team the problem of how to get them remains. Line managers may be seconded to the team either full time or part time. In either case it can be difficult to persuade departmental heads to release members of their staff. However, the more difficult it is for their original department to do without them the more useful they will be to the MIS team. This is yet another area where the commitment of top management to the project is vital (cf. section 4.2.1). They must be prepared to invest the best human resources in the project to get the best long term results from it. If a manager is attached to the team full time he will be able to concentrate on the project and become fully involved with it. This may be a drawback if he becomes so involved that he fails to appreciate the users' problems. If the manager is only a part-time member of the team there is a danger that the day-to-day pressures of his line job will cut down on the time spent on the MIS. The urgency of crises which must be solved immediately is difficult to resist in comparison with the demands of projects which may take five years or more to reach completion. Full time team membership would seem to be the best method, with regular contact with other line managers to keep in touch with daily problems. Systems analysts and programmers may be recruited from within or outside the organization. The advantages of recruits from within the organization are -

1) They will be more familiar with the organization's goals and methods. This is a mixed blessing as it may lead to the missing of some useful innovations but is probably useful for systems analysts.
2) They are more likely to stay with the project out of loyalty to the firm. With the current mobility of computer staff this could make an appreciable difference to staff turnover costs.

3) If any staff are displaced by the introduction of the computer some of them can be retrained as analysts or programmers.

4) Internal recruits will not require as high salaries as external recruits.

The disadvantages are -

1) Time for training will be required and this may delay the project.

2) Less experience, particularly of other MIS, may mean that a poorer system is produced and it may take longer to produce.

Unless the project can justify enough expenditure to hire (and keep hiring) a complete team of experienced analysts and programmers the solution is to have experienced external recruits supervising inexperienced internal recruits. Where the organisation already employs computer staff these arguments can be applied to expansion of this staff.

4.2.7 Education

The education involved in the design and implementation of an MIS is an important two way (or even three way) process. The education of users in the ideas of computing and in their own MIS in particular, ought to be as valuable for motivation as for instruction in the use of the system (however, see section 7.8). This process should start well before the system is actually implemented. During the investigation and analysis steps the team should be in regular contact with the users and can start getting them accustomed to computer concepts and how the computer can help them. It is particularly important that any suppliers of data who do not use output from the system are shown the importance of timely and error-free input.

If the MIS team carry out this education it will also educate the team in the workings of the organization and its managers. This education of the team is essential if the system is to be realistically designed for its users rather than being based on an unrealistic model of the organization.

The third way in which the MIS project can involve education is the way in which it can teach managers more about the organization or their own jobs. Although this is a side effect of the project, the fresh insight given to managers in the course of the investigation for an MIS can be very valuable.

4.2.8 Latent Roles

The jobs which individuals fill e.g., systems analyst, production manager, may be described as manifest roles. These roles are usually consciously and formally delineated in terms of job descriptions or contracts. Within and independently of these roles individuals will have different working "styles" or ways of filling their manifest roles. These "styles" were described in detail by Gouldner (37) who called them latent roles. They are latent roles in the sense that although the individual is not aware of playing a role, in certain situations his behaviour follows standard patterns. These latent roles were called by Gouldner Cosmopolitan and Local. The roles are described mainly by three variables as shown.

Variables differentiating the roles	Cosmopolitans	Locals
1) Loyalty to employing organization	Low	High
2) Commitment to specialised or professional skills	High	Low
3) Reference group orientations	Outside organization	Within organization

The reference group is that group by whose standards the cosmopolitan or local judges his own behaviour or work.

The differentiation is not clear in all cases but "the Cosmopolitan" and "The Local" represent regions on a continuum of actually occurring types. Because of their reference groups and loyalties cosmopolitans tend to be more favourably inclined towards change than the locals who tend to prefer stability within the organization. The relationship of the cosmopolitan/local division to the introduction of computer systems has been investigated by Hebden et al. (14). In a comparison of two organizations, they have shown that management attitudes towards computerisation were more favourable in the organization whose managers showed more cosmopolitan characteristics.

Those who have the responsibility for introducing a computer-based MIS will usually be able to do little about altering the proportion of cosmopolitans and locals in the organization as a whole. However, a knowledge of the cosmopolitan/local continuum and where managers are on this continuum, can help in choosing those managers who are going to work on the MIS team or have most contact with it. It may also help by showing which departments will require most effort during the implementation and selling of the system. The mobility and specialist skills of systems analysts and programmers make them a prime example of cosmopolitans. It seems likely that communication between them and cosmopolitan managers will be better than between them and local managers.

4.3 The Techniques Used in the MIS Project

This section outlines the techniques which may be used in the design and implementation of an MIS. They are presented roughly in the order in which they would be used in the stages described in section 4.1. There is

not a one-to-one correspondence as some of the techniques are applicable in more than one stage.

4.3.1 For Data Collection

These techniques will be used mainly in stages 1 and 2. They are interviews, questionnaires, direct observation, self-recording (e.g. diaries), sample documents, extractions from current files or documents, procedure manuals. Interviews are the most obvious and probably the most widely used tool. Systems analysis texts usually stress the importance of interview techniques (e.g. (34) p.50). In interviews data can be collected fairly quickly since the interviewee can summarise the procedures of his department in the form that the interviewer requests. The interview is a flexible technique and unexpected situations can be dealt with as they occur. It is possible to get a greater depth of information in an interview as questions can be rephrased and subjects pursued until all the required detail is obtained.

Questionnaires can cover the same ground but are much less flexible and usually cannot deal very deeply with subjects. If the respondent fails to understand a question, the item of information which that question should collect is lost. For a more detailed comparison of interviews and questionnaires see section 7.2.

Direct observation of what is going on in the organization can be a way to obtain very accurate and up-to-date information. However, it is a very time-consuming process. It is best used in conjunction with other techniques. If the general procedures are obtained from interviews or manuals the MIS investigator will be in a better position to spot discrepancies and learn what happens in exceptional circumstances. This technique can also be

used to supplement interviews when these are carried out in the interviewee's department.

Attendance at committee or other meetings is a good way of observing some of the information flow in the organization.

Self-recording is the keeping of some form of diary by the manager. In order to keep to a minimum the time taken in keeping this diary, it should be designed by the investigators so that most of the data is recorded as checks, figures or single words in the columns of a pre-printed form. This technique has been used successfully in management and organizational research, e.g., by Stewart (43) and Hesseling (44). Such diaries would be particularly useful for such problems as recording enquiries to an information centre in the organization. Self-recording is useful in that it does not require a lot of the investigators' time once the forms have been designed. The design should be carried out in consultation with those who have to fill in the forms in order that the entries are understandable and relevant to their jobs. This technique has proved to have very useful side-effects in giving those who fill in the diaries an objective and often surprising picture of their jobs (43 & 44).

The remaining techniques are simple as long as the data being collected is not regarded as secret, to be kept from anyone not an authorised recipient. Files of past actions and documents are kept in most offices and the MIS team can be put on the circulation lists of relevant current documents. The main danger here is that the MIS team will be swamped with paper until they cannot see the information for the data.

4.3.2 For the Representation and Analysis of Data

Once the data has been collected it must be so arranged and analysed as to present a useful picture for the evaluation of the current information

system and the design of any new system. The analysis is constrained by the representation of the system, which is in turn often constrained by the method of data collection used. This section considers the representation and analysis under two headings, firstly for the organization's structure and, secondly, for the information flows. These techniques will be used in stages 3 and 4 of the MIS project. The extent to which the organization's structure is dealt with in the design stage will depend on the scope given to the project as a result of the feasibility study. Even if changes to the organization's structure are not within its scope, a knowledge of the structure is needed to understand fully the information flows.

Organization structure The most common technique for the representation of the organization's structure is the organization chart (see section 2.2). These charts which show the official authority structure of the organization, i.e., who reports to whom, are easily understandable, compact representations of the organization. Their drawback is that they do not always represent what actually happens. They may be out of date or relationships other than the official ones may be found more effective by the managers who have to work with them.

The faults of the official organization chart are dealt with in the Formalogram (45). This is similar to the organization chart and represents the authority structure of the organization as perceived by its members. It is obtained by asking the questions "To whom do you report?" and "Who reports to you?" of members of the organization. The Formalogram is contrasted with the Informalogram which represents the informal structure of the organization (section 2.8). This is obtained by asking the questions "With whom do you work?" and "With whom do you communicate regularly?".

These two techniques carry the investigation somewhat further than is usually recommended; although most of the information would normally be collected from a slightly different point of view, i.e., what are the current procedures?. The new insight, gained by considering these other aspects of organization structure, should avoid some of the faults which occur if an information system is designed to correspond only to the official structure.

The details of responsibility within the organization structure will be represented as job descriptions in most organizations. These can vary considerably in level of detail. If the organization is using management by objectives or something similar then accurate and up-to-date job descriptions should be easily available (e.g. Appendix in (6)). Where they are not available or sketchy they can be made up from interview data.

The primary tools of analysis are intelligence, experience and common sense, since there are no generally accepted formal or mathematical techniques. These can be applied to the analysis of the organization's structure by comparing it with the goals of the organization and how they can be divided up among departments or split into sub-goals for different departments. The authority structure should reflect the goal structure, i.e., departments dealing with the same or linked goals should have close links with one another. For particular managers, the authority each is given should be compared with the goals he has to achieve or the tasks he has to carry out. Any discrepancies or inconsistencies should be noted and referred to the managers involved. Whether any changes are made or not (and this is up to the managers rather than the MIS team) these inconsistencies will affect the MIS and must be allowed for.

A similar analysis can be carried out on Formalograms and Informalograms. In this case it will relate more to what actually goes on in day-to-day tasks rather than to goals defined at the top of the hierarchy. Differences between the Formalogram and the Informalogram may show scope for restructuring the organization, or a place for new information channels. However, as mentioned previously, not all information channels can be mechanised and there may be good reasons for keeping some procedures and channels informal.

Information Flows. The three aspects of information flow to be considered are the information network, the information elements and the procedures by which elements are generated and used within the network. In order to represent the system completely it would be necessary to obtain the following for each communication event in the system.

1) Origin and destination of the communication.
   When accumulated these give the structure of the information network.
2) The form of the communication, e.g., document, telephone conversation or meeting.
3) The subject of the communication.
4) The nature of the communication, e.g., order, advice, request.
   2, 3 and 4 describe the information elements.
5) The trigger for the communication.
   This may be
   (a) time (which implies the frequency of this type of communication)
   (b) an event (an accumulation then gives the frequency of this event, perhaps as an average and distribution or as a seasonal distribution).

(c) a specific request (an accumulation gives frequencies as in (b))

(See also information links in 6).

6) The use made of the communication.

This may be for action, decision or filing. The use of elements in the production of new elements (an information link) is particularly important in showing the information flow in the network rather than just the document flow.

5 and 6 describe the procedures for generation and use of information elements.

The collection of this data on all communication events in a large organization is obviously beyond the scope of an MIS project. Its collection for part of the organization or for a limited proportion of communication should be possible and would be very valuable. Obviously for formal communications involving reports, memos, etc., it would be a comparatively straightforward, although arduous task.

Research on this subject has been published (44 & 45) but here again it was carried out as research rather than as part of the development of an MIS. Weinshall's work on the Communicogram (45) involved self-recording of communication events by a group of managers. This work and Hesseling's (44) have shown the value of such investigations even before they are applied in the design of an MIS. In Weinshall's work 75% of the events were not recorded by both parties involved, i.e., they could not be remembered a few hours after they had occurred. In about half of the events which were recorded by both parties there was disagreement as to the nature of the communication. It would seem that MIS investigators have little chance of getting an accurate detailed picture of information flows from interviews. Feedback of results such as these to the managers should provoke a valuable

reassessment of communication.

To represent the information network a network diagram, with the nodes representing departments or managers and the arcs representing communication channels, can be used. The usage of the channels (both frequency and volume) should be indicated for analysis of the network. This gives a static picture of the information flows in the organization but it is good for showing the relative information flows between different departments. Eilon's Comchart (46) shows communication as a process rather than a static network. Against a time scale, it shows the origin, destination and a coding of the form and nature of communications. Links between communications can also be shown. Again this may show more detail than is needed for a computer-based MIS but it will show some important points, e.g., the purpose of the information flows, which are missed by the computer style of flowchart.

Analysis of information flows depends on the same basic techniques as that of organization structure. The use of the charts and diagrams described above makes it easier to apply these tools. Analytical techniques have been suggested, e.g., by Carroll (47). Carroll's method applies to a network representing the flow of documents within an organization. When applied to part of the BBC's information system it was less successful than a commonsense approach. Its shortcomings arose because it does not consider explicitly the time sequence of information flows and it does not allow adequately for new data entering the system from many points in the organization. It may be possible to develop analytical methods which will deal with practical cases but they must cope with complex and even illogical networks.

4.3.3 For the System Specification

The techniques described here will be methods of expressing the output from stage 4 in the MIS project (the design) rather than techniques used in actually designing the MIS. An explanation of the techniques of creative thought are beyond the scope of this thesis.

A variety of specifications of the design are needed for the different people who are involved with it. Specifications are needed both for those managers who control the MIS project and for those who will use the system. More detailed specifications are needed for the systems analysts and the programmers. These specifications are the heart of the MIS even more than the computer programs are, since they describe what the system does and how it is used. They express the system regardless of the actual computer or programming languages with which it is implemented.

The specifications for the managers must be in a form which they will understand easily. For most managers this form will be text with diagrams and perhaps flowcharts. However, the most elegant graphs and flowcharts will be of little use if the manager is not familiar with these forms of representation. The managers should also be given samples of any computer input documents or printouts which they will be using. Simple print programs can easily be written to produce mock-ups and these will give managers a much better idea of the printouts than hand drawn printout specifications.

The full specification will have much more detail and will only be used in toto by those designing the system and perhaps the managers authorising it. It will include text, flowcharts, decision tables, sample input and output documents and diagrams. Detailed descriptions of system specifications are given in (34) pp 353-359, (35) volume 3, and (48). Briefly, it will cover the logic of the system, file descriptions, input documents, printouts,

display formats, clerical and operating procedures. Various parts of this specification will be used as communication documents, e.g., between systems analysts and programmers, and so must be written in terms understandable by the recipients.

As well as different levels of description for the different types of people involved with the MIS (e.g., managers, clerks, programmers), there should also be a more general introductory description for newcomers to the project. New members will probably join the MIS team during the project and people, probably other than the designers, will have to maintain the system in later years.

4.3.4 For the Implementation of the MIS.

The implementation will again be considered under the two headings of technical and organisational (see 4.1.5).

The tools for technical implementation (computers, programming languages, software packages) are fully described in easily available literature and so will not be described here. The choice between different computer manufacturers and software sources was considered in 4.1.5. Some further software considerations are given here on techniques rather than sources. The software for an MIS may be produced by writing in assembly language, a high level language such as Cobol or PL/1 or by using a general data management package (49). Assembly language allows the writing of programs which are very efficient in computer usage (but it does not guarantee this). However, it means longer programming and debugging times and it is less easy for a newcomer to understand. High level languages usually produce programs which make less efficient use of the computer but which are easier to write, debug and understand. Programs in high level

languages are also easier to transfer from one type of computer to another. Some high level languages do not have all the facilities of assembly languages, e.g., access to individual bits, but such facilities can be provided as in PL/1. With data management packages even less writing has to be done. Systems can be implemented or altered very quickly as long as they do not have requirements which differ greatly from the usual ones. Thus in the early stages of an MIS when many alterations are likely and a rapid response to managers' design requirements is needed, a data management package will probably be the best tool. As the system design stabilises, the most frequently used parts of it can be re-written for efficiency.

The techniques for the organisational side of the implementation are manuals, lectures, meetings, etc. Manuals and lectures can provide a large amount of information but will probably not be so good for motivating people to use the system. The possibility of a dialogue in a small meeting seems to be more popular with users (see section 7.8). Such meetings should have been occurring throughout the project but they will be more frequent and reach more people during the implementation stage. Training courses at which users could go through the entire process of their contact with the MIS, under supervision, would be ideal but very expensive both in terms of the educator's time and the users' time. A suitable compromise might be the training of some users from each department in this way and making them responsible for educating their colleagues. A memo from the Managing Director on the importance of the new MIS, issued when the system first becomes operational, could be very helpful.

4.4 The Sequencing and Rate of Development

There seems to have been little published on this subject, so this section is based more on deduction than on examples. Rosove (32) is one of

the few authors to deal with this subject.

It is probably not possible to produce a comprehensive MIS as a single project with a predefined completion date except in a very small organization. A comprehensive MIS will cover the whole or a large proportion of the organization. It will take years to complete and will be more valuable if it is regarded as an organizational development project. This is not to say that goals should not be set or plans should not be made for the MIS. The goals are long-term ones and it should be realised from the start that they will change as the MIS develops. The plans for the MIS as a whole will probably be 5-year or 10-year ones, subject to the sort of variations which can occur in a research and development project.

Because of the size of such a project it must be split up in some way to ensure adequate control at all stages in its life. In dividing up the project one may initially:-

1) Provide a subset or provide a pilot (or small-scale) model of the final system. A subset will be a completed part of the final system and will not need altering (unless the goals of the system change). A pilot model will provide only limited services or less detailed information and will have to be completely scrapped to make way for the final system.
2) Provide general information for just one department or provide information for one function across many departments.
3) Choose a particular managerial level for whom to produce information.

These choices may or may not be independent, e.g., a system for one department could be a subset or a pilot model for the complete system.

The (perhaps contradictory) aims in making this choice are the minimisation of total cost, the maximisation of help to management during

the development of the system, the maintenance of morale and support for the project and the minimisation of rewriting and redesigning. The constraints on the choice are the availabilities of the various resources, e.g., money, staff, information on current procedures, helpfulness of users.

4.4.1 Subset versus Pilot Model

A pilot model may be difficult to define because the size and scope of the complete system is not known at the start. Where it can be defined, it can give a picture of what the final system will be like in a fairly short time. This picture should have more impact than a system definition on paper, which is all that would be available in the short term from a large project. This will maintain the interest of management, particularly that of top management, which wants the overall picture. Lessons, applicable to the final system, may be learned during the development of the pilot model; but in applying the lessons, care must be taken that errors do not arise because of differences in scale between the pilot and the full scale system. These errors could be caused by the different amounts of data being handled. For example, in updating a disk file randomly, a large increase in the number of records inserted can cause dramatic increases in running time. Another difficulty with a pilot model is that it may require data collection from many sources. It may be necessary to set up almost as big a data collection system as for the complete MIS. For a system with a limited lifetime this is too high a cost; so for a pilot model the data should be fairly easily available. Against this is the point that if the pilot model is constructed on too small a "scale" it is less likely to provide useful lessons and may be dismissed as a toy by managers.

Although a subset should ideally be a finished part of the final system, in practice a subset will probably have to be altered at some stage in its

life. The main difficulty with a subset is in designing the interfaces with other parts of the system when these other parts are not defined in detail. However, this difficulty should not be any worse than that of designing a pilot model of an incompletely defined final system. The subset approach is ideal for those who will use the initial subset. It provided information for them and keeps them interested from early on in the project but it may lose the interest and support of those whose subsets are developed much later in the project. The lessons learned in developing a subset may help in developing the rest of the system or they may be of very little use. This idea could be used in choosing a subset which is most likely to provide useful lessons for the rest of the system.

Since the development of a pilot model for the whole system would be so difficult the subset approach is the better of these two. A pilot model of a subset could be used to show very quick results as long as this does not seriously delay the main project (see Chapter 6 for an example of this approach).

4.4.2 Department versus Function

This could be a major design decision for the MIS as a whole. One could design departmental or divisional systems involving accounting, stock control, production control, etc. Alternatively one could design an accounting system for the whole organization, a stock control system for the whole organization, etc. There will have to be interfaces between departments and between functions, however the system is designed. The actual design will depend on the size and interdependence of the divisions and how they can be split for information requirements in a logical way which minimises interface problems. With large independent divisions it will be best

to produce divisional information systems with each division having its own database. With small or closely linked divisions or departments functional systems covering the whole organization are better. Only the largest firms (in this country) need consider the first alternative as some of the important advantages of an integrated system depend on having a system covering all departments. For the system to be economicalas well as integrated it should handle any function in the same way in all departments. Data is often available in functional form anyway, as in an existing accounting system. Such existing systems can constrain the design of the MIS to avoid having to replace every information system in the organization.
Even when designing functional systems it can be useful to introduce these initially in just one or two departments. A new system is likely to create extra work for the users until it is properly "run-in" and limiting some of this extra work to a few departments would be an advantage.

4.4.3 Managerial Level

It can reasonably be claimed that the greatest potential gain from the use of computers lies in helping top management. Their decisions certainly involve very large amounts of money and if these decisions can be improved the gains should be correspondingly large. However, the top managers are the most difficult to help as their decisions are much less well defined. Also, for senior managers, information is usually needed in an aggregated form. Since the detailed information has to be collected before the aggregation process and since the computer is well suited to this process it seems sensible to provide the detailed information to those who need it, as soon as it has been collected. Operating data is usually well defined, as are the decision criteria and goals at this level. Thus an MIS should be implemented starting

at the bottom of the management hierarchy and working up, even though it was probably designed from the top down (see 4.1.2). More and more complete aggregations and analyses can then be built on a solid database. The basic data has to be reliable and to a known level of accuracy before any confidence can be based on aggregations.

4.4.4 Rate of Development

Decisions on the rate of development depend, within the rate of what is possible, on a trade-off between long term and short term gains and between technical and social efficiency (insofar as these can be separated).

A rapid development will enable the project to show results quickly and hence maintain the support of top management more easily. The dangers with a rapid development are that bugs in the system may be missed and be much more difficult to correct later, and resistance from the people affected by the system may be greater. If people are forced to change too quickly their ways of working without understanding why, they will resist the changes. This resistance will also be built up by faults in the system.

With a slower development the project team can involve the users more and educate them as the project progresses. There is also more opportunity to find the bugs in the system before it reaches the full operational state. The project team must develop a negative feedback situation, i.e., errors found by the users cause corrections of the faults rather than uncorrected faults leading to a build up of frustration and misuse of the system which causes further errors and so on. The danger here is that it could be a long time before any concrete results are produced and too much consultatation can lead to continual revision of requirements. There is then a danger of losing support and interest in the system.

Thus it is necessary to convince top management (if they do not realise it already) of the long term gains and the need to allow time for the organization to adapt to the changes. At the same time users should be persuaded to define their requirements of the system, as quickly as possible.

4.5 The Interaction of the MIS Project with the Organization's Structure

This interaction can be divided up under three headings:-

1) The influence of the type of organization structure on the MIS project.
2) The effect of the organizational position of the manager(s) controlling the project.
3) The effect of the MIS project on the organization's structure.

Of these, 3 was considered in section 3.4, and 1 and 2 are considered here.

4.5.1 The Influence of Organization Structure on the MIS Project

The work of Burns and Stalker (7), as mentioned in section 2.11, has shown the existence of two types of management structure which have different capacities for adapting to change. The mechanistic organization is inflexible and difficult to change while the organic organization is flexible and easier to change.

According to Burns and Stalker, when a mechanistic organization does adapt to innovation it tries to minimise the effect on the organization. It does this by having just one department deal with the change. This could be a new department set up specially and fitted into the organizational structure or it could be an existing department. In the case of an MIS this solution is obviously inappropriate since management information flows throughout the organization and changes confined to one department are unlikely to be adequate. A mechanistic system does have one advantage in the speed at which changes can be disseminated if the manager at the top of the

hierarchy orders them. The danger is that overt obedience will cover dissatisfaction which can lead to a badly implemented and badly used system.

In an organic organization the lack of a clearly defined hierarchy means that members of the organization have to reassess their relative positions from day to day or job to job. Any changes to the organization as a whole are readily included in this process. Also important is the expectation that all members of the organization need a wide knowledge of what is going on, to carry out their jobs. This, together with the existence of many horizontal as well as vertical communication channels in the organic organization, facilitate the feedback from users to designers which is necessary to produce an effective MIS. The consultation needed to define and authorise changes in an organic organization may slow down the development of a MIS but it is far more likely to produce a system acceptable to managers.

The introduction of a computer-based MIS will usually lead to changes in information handling procedures and will often be associated with other management changes, as in the project described in Chapter 5. Thus the adaptability of the organization is one of the factors to be considered in estimating the amount of time and effort needed for the project. Also if differences between departments are known these should influence the allocation of effort to be spent on the different departments. Some work on the relation between organization structure and computer projects has been done by Hebden et al. (14). For those who have the opportunity it would be useful to set up organic authority structure where possible or to influence existing structures in the organic direction. One obvious candidate for such methods is the team or department setting up the MIS. In an

interdisciplinary team various members will be able to contribute to each part of the project and all members of the team should be aware of what is going on in the project and what the overall aims are - an organic situation. An alternative, more mechanistic way of organising a MIS project is to divide the team or department into strict functional divisions, e.g., managers, systems analysts and programmers. Each then has responsibilities for one aspect of the project and is likely to be less aware of the overall problem and less committed to the project as a whole.

4.5.2 The effect of the Organizational Position of the MIS Project

If a group which is designing an overall MIS for an organization, is wholly contained in or controlled by one department of the organization, it would be surprising if the system were not biased towards the beliefs and goals of that department. Such biases have been noted, for example in (23), particularly where the MIS has been designed by the Comptrollers department. For example, a system developed under the control of the Chief Accountant is likely to provide excellent accounting information but may not provide such good production control information, perhaps using accounting jargon. A system developed entirely by the computing or O.R. department is likely to be machine oriented or technically very sophisticated, using jargon which will put all non-technical managers off. Locating the MIS project in one department can also have dangers in the field of internal politics. Any department which has control of such a project gains not only the prestige of the project but also has to investigate the workings of other departments. Both these factors could lead to considerable antagonism from other departments. Because of this the MIS project should be neutral with respect to any "power blocks" which exist in the organization.

The mixed department and mixed discipline philosophy, advocated in section 4.2, for setting up the team should also be applied to the control of the project. This can be done by having a steering committee to set the goals of the project and approve its results. This committee should contain senior managers representing all the major departments or divisions of the organization affected by the MIS project. This should give both impartiality with respect to different departments and top management involvement. The use of steering committees in MIS projects has been reported (41 and 50).

CHAPTER 5

The BBC Television MIS Project

This chapter describes the development of a computer-based MIS in the BBC Television Service. It is based on documentation produced by the project team responsible for this MIS, and on numerous meetings with members of the team and line managers of the BBC. A large proportion of the meetings I attended were between members of the project team and line managers and were concerned with the implementation of the Television MIS. These meetings were supplemented by many informal contacts, with members of the project team and a few other middle level managers, in regular visits to the BBC over nearly three years.

Section 5.1 describes the BBC Television Service in outline to provide background for the rest of the chapter. Sections 5.2 to 5.7 give a history of the Television Service MIS project in roughly chronological order. Some departures from this order are made in order to bring together descriptions of certain aspects of the project. Section 5.8 describes the changes resulting from this MIS and comments on them. Section 5.9 offers some general comments on this MIS project. (In this and the following chapters a spelling distinction is made between a television programme and a computer program.)

5.1 The BBC Television Service

This section describes the BBC Television Service as it was at the start of the MIS project. Most of this description is still true (in 1970). Changes which have taken place are described in later sections of this chapter, mainly in section 5.5.

The BBC is a non-profit making public service. It produces, buys, transmits and sells radio and television programmes. In many cases the production and buying of programmes is completely separate from the transmission since programmes can be kept for years on videotape or film. Approximately 85% of programmes produced by the Television Service are pre-recorded rather than transmitted live. The basic aims of the BBC, as expressed in the Corporation's Royal Charter, are "to inform, educate and entertain".

The BBC's main source of revenue is the licence fee payable by all owners of radio and television receivers. In 1969 this gave the Television Service a budget of £60 million (55).

The relation between the BBC's output of products and its income, is indirect and operates over a fairly long time scale. Its products are not paid for on receipt and there is no way of calculating a profit on them. A calculation of any form of return for money spent is extremely difficult for a number of reasons. One measure of return on a particular television programme can be obtained by estimating the number of people who watched that programme. However, the different ways of measuring this do not always yield the same result (as can be seen by comparing the audience figures published by the BBC and by Independent Television). Further complications to the issue of return are the questions of how much a programme was enjoyed by those who watched it and what artistic standard it reached. As a result of this complexity of measurement of return BBC Television has considerable freedom, within its total budget, in the spending of its money. The only control it can apply internally is based on a human value judgement on whether its programmes are worth what they cost. To quote a past Controller of Television Programmes, the most formidable administrative problem in

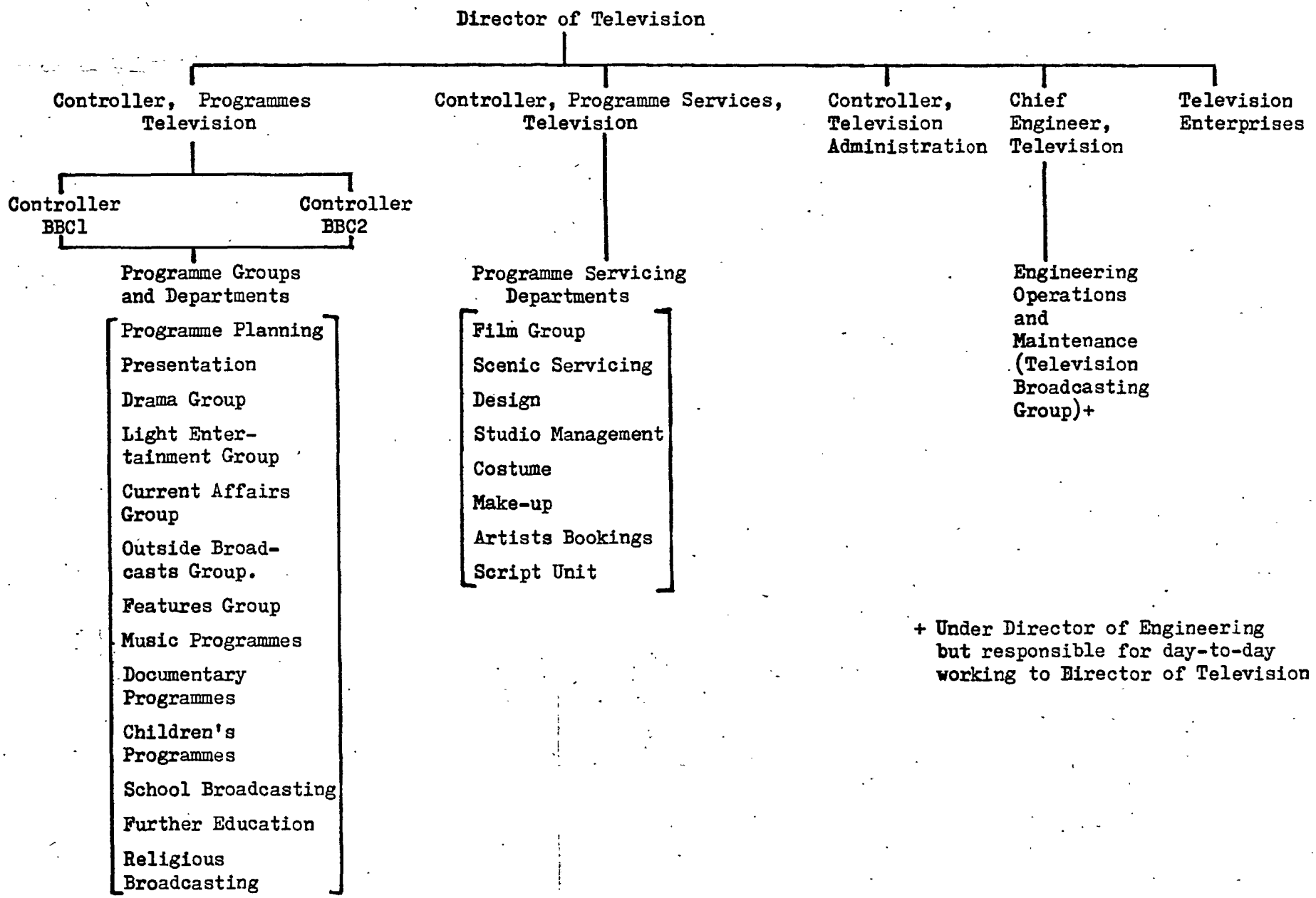

Director of Television
Controller, Programmes Television
Controller, Programme Services, Television
Controller, Television Administration
Chief Engineer, Television
Television Enterprises
Controller BBC1
Controller BBC2
Programme Groups and Departments
Programme Planning
Presentation
Drama Group
Light Entertainment Group
Current Affairs Group
Outside Broadcasts Group.
Features Group
Music Programmes
Documentary Programmes
Children's Programmes
School Broadcasting
Further Education
Religious Broadcasting
Programme Servicing Departments
Film Group
Scenic Servicing
Design
Studio Management
Costume
Make-up
Artists Bookings
Script Unit
Engineering Operations and Maintenance (Television Broadcasting Group)+
+ Under Director of Engineering but responsible for day-to-day working to Director of Television

Figure 5.1

television is "How does one reconcile accounting with creativity?" (53).

Organizational Structure

The organization chart for BBC Television (as it was in the early stages of the MIS project) is given in Figure 5.1 (this is an example of the type of chart shown in Figure 2.2). The heart of the organization is, of course, that part which produces programmes. Overall responsibility for programmes lies with Controller, Programmes, Television and under him the two Channel Controllers who have responsibility for programmes on the two transmission channels, BBC1 and BBC2. The departments which produce programmes are divided up according to the type of programme they produce, as shown in Figure 5.1. The groups are further divided into departments, e.g. Drama Group consists of Drama Plays, Drama Series and Drama Serials. The programme servicing and engineering departments provide the various services and resources (apart from production staff) which are used in the production of programmes. Engineering departments also maintain television equipment. Television Administration provide a general administrative service to the Television Service, in finance, accounting and various subsidiary activities such as arranging accommodation. Television Enterprises sells programmes made by the BBC, buys programmes for transmission by the BBC and functions as a merchandising agency.

The organizational structure within the departments varies from department to department as do job descriptions (even between one production department and another). A production department may contain some or all of the following categories of staff: producers, assistant producers, directors, production assistants, producers' assistants, script or story editors, administrative assistants and an Organiser. For example, an executive

producer may have the responsibility for a series of programmes and under him a series of production teams, one for each programme and each headed by a director or an assistant producer. The production team is set up from the pool of available staff by the Head of Department and the Organiser in consultation with the producer. The Organiser's job is an administrative one involving a considerable amount of information handling and liaison with other departments. The title aptly describes the job. In the line of authority from Programme Controller down to producer it depends very much on the individuals concerned how authority is delegated. In general, considerable authority is delegated to the producer who has full authority over his programmes. Production teams often only work together for one programme or one series of programmes. Thus there is a frequent restructuring at the lower levels. The list of production departments changes as different classifications of programmes become appropriate. A large number of informal information-flows between departments is needed for the production of a programme. In the organisation of programme production the Television Service is a decentralised organic system. There is some sign of more mechanistic hierarchies in planning and administrative departments. These hierarchies were not examined in detail.

The production departments are effectively in competition for the resources and services supplied by the servicing and engineering departments. The authority for dividing the available resources among programmes and production departments lies with the three Programme Controllers. In this they are supported by Programme Planning Department. The production departments offer suggestions for programmes to the Channel Controllers, who then compose transmission plans from the programmes they select. Every transmission plan requires a production plan to meet it and one of Programme Planning's function

is to advise the Controllers on the formation of such plans and on the resulting use of the major resources. This function involves the processing of large amounts of information. Programme Planning also provides the Controllers with cost information showing the costs of proposed transmission plans. The scheduling of resources and the alterations to such schedules is also handled by Planning. Although these schedules are produced in consultation with the departments involved, Planning is in a position of considerable authority over the schedules. This comes partly from authority delegated by Controllers and partly from the amount of information collected in Planning, giving them an overall view (cf. section 2.10).

Planning and Control of Programme Production

Operational expenditure in the BBC is controlled by means of a system of annual departmental rates, to cover the expenditure on established departments, and programme money, to be spent directly on the production of programmes. Each department is given an authorized number of posts which it is allowed to fill. These posts, together with its other budgeted expenditure, form the department's rate. The services provided to production departments from the servicing departments' rates are known as the "below the line" costs of programmes. The "above the line costs" are paid out of Programme Allowance. The total programme money is initially divided into Programme Allowance, to be spent by producers on their programmes, and various reserves. These reserves cover such things as hire of film units, scenery construction done outside the BBC and reserves to be used at the Channel Controllers' discretion to cover special projects and unforeseen events.

The initial source of information on programmes, used in the planning system, is the Programme Budget Estimate (known as the P.B.E). This document

contains estimates of the different resources and services required (there are over 100 of these below the line items which may be requested), Programme Allowance (P.A.) required and descriptive information such as title, duration, producer, etc. The P.B.E. is prepared by the producer, often with the help of the departmental Organiser, and submitted for the Controller's consideration. These P.B.E.'s form the bases of Offers Meetings, which are held quarterly. Offers Meetings are held by each Channel Controller with each contributing production department six months before the start of the quarter being considered. The aims of the Offers Meetings were stated in the investigation for the MIS (see 5.3) as follows:-

(a) To enable Controllers to make a regular review of the programmes they want to transmit in a given quarter

(b) to exercise editorial control

(c) to give formal agreement to the proposed work of production departments for the quarter

(d) to review production staff availability in relation to output (of programmes) required

(e) to review stockpile holdings

(f) to authorise provisional allocations of money and resources for each programme accepted, and so to provide a basis for detailed planning.

Expressed in slightly more general terms this can be taken to describe the planning side of a Channel Controller's job. The information on which these meetings are based goes from production departments to Controllers via Programme Planning. After the Offers Meetings, Programme Planning organise meetings with production and servicing departments to consider in more detail

the resource requirements of accepted programmes. As a result of decisions taken at these meetings and Offers Meetings, Planning produce production schedules for production and servicing departments. As the time of production comes nearer more detailed P.B.E.'s and amendments to P.B.E.'s are sent to Programme Planning who incorporate the amendments in subsequent issues of the production schedules. Large numbers of amendments occur, most of which have to be approved by one of the Controllers. During the planning cycle for one quarter 160 amendment memos were received between the initial issuing of the production schedules, about 17 weeks before the start of the quarter, and a point 10 weeks before the start of the quarter. One memo might well deal with several amendments. At the time of the start of the MIS project the work of calculating and assessing resource requirements was undertaken manually and occupied a major part of the time of six planning assistants. Since the alteration of one resource requirement may have repercussions on the use of other resources this process is extremely complex. Production schedules of various types (i.e. dealing with different resources such as studios and film crews) are produced right up to the day of production. The primacy of programme production is generally acknowledged and requests for extra resources are met whenever possible, if necessary by hiring extra staff and facilities. In the later stages of the programme's production cycle some of the amendments to its resource usage are arranged directly between the producer and the servicing department. After production the actual amounts of resources used (referred to as "actuals") are returned, in the case of some resources to Programme Planning and of nearly all resources to the cost accounting section of Finance Division. (Finance Division is a central division of the BBC, i.e. not part of Radio or Television). These "actuals" are returned at varying times after production, usually from 1 to 12

weeks after. Reports on resource usage are produced in Planning at least three weeks after production for Planning's own use. The producer receives two types of report on his programmes. One is from Finance Division, listing all the Programme Allowance (P.A.) expenditure and based on figures which the producer supplied himself. P.A. expenditure is notionally recovered against transmitted programmes at the time of transmission. Because of the pre-recording of programmes this recovery occurs after the money is actually spent (in some cases a long time after). Because of this the producer receives reports on his P.A. costs twice, once after production and a second time after transmission of his programme. The control and reporting on P.A. is fairly tight and there is fairly quick feedback of costs. The other report received by the producer is the costed P.B.E. This comes from the cost accounting section from six to twelve weeks after production of the programme and gives the amount and cost of internal resources actually used. A producer may well be in the middle of his next programme or may even have left the BBC by the time his costed P.B.E. arrives. With the slower feedback of below the line costs goes a correspondingly less tight control.

In connection with the production of programmes there are three accounting systems. The Television Accountants Department deals with creditors and debtors to the BBC and handles payments made by the producer to people outside the BBC. The Finance Group in Programme Planning deals with the planning and reporting of P.A. expenditure for the programme Controllers. In particular it produces the P.A. cost of proposed and actual transmission schedules. The cost accounting section deals with the costing of resources internal to the BBC.

5.2 The Formation and Aims of the MIS Project

The BBC Television Service has expanded rapidly since its postwar restart. Some measure of this is given by the increase in the number of television licences from 14,000 in 1947 to 14,000,000 in 1967. Along with this expansion in revenue there has been an expansion in size, in the number of broadcast hours and in the technical complexity of television. Such things as the formation of Independent (Commercial)Television, a second BBC channel and the introduction of colour television have meant that the Television Service has existed in a state of almost continuous change and expansion. The rate of increase of revenue has not been constant however. In 1960 the rise in the number of television licences began to level off (55 p.134), although the number is still rising. Rising costs did not level off.

As one possible means of combating the problem the Television Service considered the use of computers. To control the computer project a Computer Steering Group was set up, in 1966. This consisted of representatives, at the Controller level, of production, servicing, engineering and administration departments, plus an executive secretary. Controller, BBC2 was chairman of the Steering Group. This group ensured that senior management was in regular contact with and had control of the MIS project when it was decided on. The high managerial level of the control of the project was reinforced later when Controller, BBC2 became Director of Programmes, while retaining chairmanship of Steering Group. In February 1966 a working party was set up to carry out a preliminary survey on the use of computers in the Television Service (in effect a feasibility study). The working party consisted of ten members, mainly deputies or senior subordinates of members of Steering Group, plus an O & M specialist and two systems analysts. The systems analysts were engaged specifically for this survey. The working party was chaired by the executive

secretary of Steering Group. The survey was carried out with the co-operation of all departments in about twelve weeks and a report was produced for Steering Group. This report concluded that computers could help the Television Service in a number of ways. These applications were justified not so much by reductions in staff or the speeding up of current operations but by the complexity of the Television Service, which was rapidly increasing beyond the possibility of manual solution. It was also believed that computers could help in the better utilization of available resources. The report saw the problems ahead.

> "Machines by themselves do not offer "instant salvation". Their help is directly related to the extent to which people wish to use their facilities, and are prepared to effect changes of organisation, attitude and method. This is a gradual process, directly affecting the speed of implementation". (63)

The initial computer applications proposed in the preliminary survey report were:-

1) To help Channel Controllers in planning the Transmission Pattern (the schedule of transmitted programmes).
2) The planning of resource usage in programme production.
3) Providing information on stocks and sales in Television Enterprises.
4) Planning of scenery construction.

Of these, (2) was said to be "a key application, the most difficult and the most far reaching". It was intended that these applications should collectively form an integrated system in the long run. One of the terms of reference for the preliminary survey report had been to see how computers could be applied in developing the P.B.E. system. The report stated that this required more detailed study in association with the other work proposed.

It was also noted that the Finance Division were proposing to use a computer for processing P.A. information. The total duration of these initial projects was estimated as two years. The initial computer testing could be done on the ICL 1909 which the BBC already owned. Other areas of application were recommended for further study.

Steering Group endorsed the report and the Computer Project Team, responsible to Steering Group, was set up in October, 1966. This date is referred to below as the start of the project.

5.3 The Computer Project Team and Communication

When it was first set up the Team consisted of six line managers (four full-time and two part-time) and four systems analysts. The managers represented the production departments, Programme Planning, servicing, engineering, Television Administration departments and the BBC's central O & M department. The executive secretary of Steering Group also held the position of Computer Project Manager. The skills represented on the Computer Project Team included systems analysis, O & M, accountancy, studio management, resource usage planning, engineering and programme management. The management and systems analysis sides of the team were completely integrated, to the extent of sharing offices as well as projects. As the MIS project and the team expanded, the team fragmented to some extent but the close working relationship between managers and systems analysts was maintained. The proportions of systems analysts and managers on the Team full-time have varied only slightly from the initial half and half to two thirds systems analysts and one third managers. Throughout the project there have been a few line managers attached as part-time members of the Project team. The turnover of Team members has not been high, that of line managers on the team being particularly

low. Three of the original four line managers are still with the team. Out of a total of eight who have served full time on the Team only two have left it (but have not left the BBC). The number of systems analysts has expanded from four to ten in the four years of the team's existence and a total of sixteen analysts have worked on the team. Almost all of the systems analysts were recruited from outside the BBC. There was not much experience of computers in the Television Service previous to this project. Only one of the original four systems analysts is still with the team. This turnover does not seem particularly high when compared with the current mobility of computer staff. It is perhaps significant that of the six systems analysts who have left the Computer Project Team, three are still with the BBC.

All systems analysts and programmers in the BBC were members of the Organisation Methods and Grading Department (now of the Management Services Group) under the Director of Administration. Systems analysts were assigned full-time to the Project Team but programmers were not. The systems analysts appeared, to line managers, as members of the Television Service. Because of this they were more favourably received than if they had appeared as members of another part of the BBC. When programming effort was required by the project, programmers were assigned to particular jobs by the central programming department. This resulted in a lesser commitment to the project on the part of the programmers than on the part of the systems analysts. Because of the volume and urgency of some of the programming, the services of a programming firm were employed for several parts of the system.

At the same time as the Project Team was created, so called "Focal Points" were nominated in all departments. These were generally middle level managers who were to be the main points of contact between the Team and the rest of the

Television Service. They were to contribute experience and ideas to the team's work and to keep their own departments informed about the MIS project. In production departments the Organisers were nominated as "Focal Points". Also about this time a series of "Communication Sessions" or "Involvement Meetings" was held. This was aimed at widening the understanding of computers in general and of this project in particular, and at obtaining the involvement and help of the Television Service in general. Some 150 middle and senior managers attended these meetings. A similar series of meetings was held a year later. Since the start of the project, monthly newsletters have been issued to all "Focal Points".

Further details of communication procedures at specific stages in the project are given below.

5.4 The Early Stages of the Project: Investigation and Independent Applications

The first major task of the Project Team was to investigate and document current procedures in the Television Service. This detailed survey sought to document the information flows and information handling procedures involved in the planning, scheduling and costing of resource usage. Since money was included as one of the resources this survey covered a large proportion of the formal information system of the Television Service. (The line between formal and informal information systems is particularly hard to draw in Television, because a significant proportion of the official scheduling in the later stages of programme production is carried out by telephone or direct contact). All relevant documents and some regular verbal information flows were included in the documentation of the survey. The documentation produced was in narrative form with flowcharts and lists of documents in support. The narratives were all checked with the managers of the

departments involved to produce an agreed statement of procedures. Narrative was used as the main form of description as this was found to be more widely comprehensible than flowcharts. The survey was also used to find out management's requirements for information on resource usage. As well as describing the current information system, the team analysed some of the data in it. For example, the accuracy of PBE estimates was investigated by comparing estimates for a sample of programmes, at standard points in the production cycle, with the actual resource usages. The difference between estimate and actual varied widely, being over 50% of the estimate in about 30% of the cases.

In parallel with this survey (but starting about 6 months later) three small independent computer applications were being developed by the team. These three were Transmission Pattern, the Material Available Catalogue (a list of programmes available for transmission, containing relevant data on the programmes) and the first phase of the Television Enterprises application (see section 5.2). The first two of these developed from the first proposed application in the preliminary report. These applications were chosen because it was thought they were useful, self-contained applications which would show some results in a reasonably short time and so sustain interest and involvement. They would also provide experience in the use of computers both for the Project Team and for the Television Service. Although these applications started out in isolation it was intended that eventually they would be parts of the integrated system outlined in the preliminary report. The Television Enterprises application was an exception to this because Television Enterprises as a sales organisation is relatively independent from the rest of the Television Service. The

Transmission Pattern application was confined to Programme Planning and Channel Controllers for both use and data collection. The technical part of this application was operational about two years after it started and was in use after about two and a half years. The delays between technical completion and actual use were caused by delays in collecting data to go in the system and in defining the way it should be used. The Material Available application was shelved just over a year after it was started. There were two reasons for this. One was that a major use of this system, that of retrieving available programmes satisfying certain criteria, could be handled more cost effectively by a manually operated edge-punched card system which was implemented. The other reason was that not all the basic data needed for the system were easily available. New systems at a lower level in the information hierarchy were needed first. The Enterprises application developed successfully as a separate system and the first phase reached the operational stage after two and three quarter years.

Approximately one year after the start of the project two further small independent applications were started. The first of these was to help control the loan of material from the Film Library. It kept track of stocks and overdue loans and its use was confined to the Film Library. The first version reached the stage of parallel running in about 20 months and following alterations it was in operational use after 27 months. The other of these small applications was the Script Catalogue. This deals with the catalogue of scripts which Drama Group have commissioned or bought in advance, without any immediate plans for production i.e. they do not have a producer or a place in the advance production plans. The Script Catalogue system reached operational running within 21 months.

Although these small systems are in use they are not regarded as finished in the sense that they cannot be extended or improved. Amendments and extensions are being discussed or designed for all the above systems. Members of the Project Team worked on these applications in parallel with the main information system. This is one of the factors contributing to the fairly long times taken on these applications. In nearly all cases, a substantial part of the time taken was required for collecting the data needed to run these systems operationally.

Two further fringe activities played a part in the Computer Project. These were in the nature of long term research into the way in which computers could be used by the Television Service. The first of these was the visual display pilot model developed at Imperial College and described in Chapter 6. The second was an experimental study of the scheduling of studios by computer. This was initially carried out by a consultant and later transferred to Imperial College (56).

5.5 The Development of TMIS and the Management Changes

As ideas on an integrated management information system developed it was given the name TMIS (for Television Management Information System).

By the end of the first year of the Computer Project the survey was complete and an outline of a comprehensive MIS was being developed. This outline centred on the planning, controlling and costing of programme production and was based on the P.B.E. system (see section 5.1). Thus this system included the second recommended application in the preliminary report and also fulfilled one more of the terms of reference of the preliminary study (see 5.2). The outline system was approved by Steering Group in December 1967. During 1968 the details of the system were filled in. (They are described here in the past tense although many of the descriptions still appl

Changes to the system are described in subsequent sections). Descriptions of TMIS usually centred on the files it contained, perhaps because these were more concrete and easily described than uses to which the system was to be put. This is certainly the most useful form of description for designing a computer-based system such as TMIS. The files have a close correspondence but not a one to one correspondence with the functions of TMIS. The file-oriented form of description is used here. Only major data files are included in this description. Files which were just indices to other files or conversion tables are not included.

Initially TMIS contained three files. These were the Programme File, the Facility File, and the Loading File. The Programme File contained details of programmes as they are supplied on P.B.E.s or amendments to P.B.E.s, each programme being identified by a unique Project Number. Three figures were recorded for each resource usage. The first was the original estimate for the programme (perhaps an average for a whole strand of programmes), the second was the current estimate (to be updated during the course of production), and the third was the actual resource usage. Actuals were to be supplied by servicing and engineering departments. The Facility File contained details of the resources and facilities available for the use of programmes. The details included such things as the maximum amount allowed on a P.B.E. and costs. Thus a costed P.B.E. could be printed after production by combining data from these two files. From these files TMIS was to supply operating plans and statements for programmes, and for production departments, by accumulating data from all programmes produced by that department. These reports were to be used in the

planning and controlling of production departments by the head of department, and of programmes by the producer. The Loading File contained data on the load on resources. For each week and each resource it contained the capacity and the total requirement together with a list of the Project Numbers of the programmes using that resource in that week. The Loading File also contained the possible "spreads" of resource usage (see Appendix A, Section 5.1 on spreads). Printouts produced from the Loading File were designed for the annual plan of resource loads, the examination of the load on a chosen resource over a chosen period, the assessment of the effect of production schedule changes on resource loads and the examination of the programmes contributing to a resource load in any week.

The operation of TMIS was introduced to the Television Service in what was called the "January/March Experiment". This involved the system in handling data on programmes in just two production departments during the quarter January to March, 1969. In the experimental system only the Programme and Facility Files were available. Thus the first version of the system was a subset involving only some departments (cf section 4.4). This strategy enabled both computer and manual systems to be introduced and tested without causing widespread disruption. Data collection for TMIS had to be introduced into all the servicing and engineering departments and into the production departments involved. This was not a heavy load on the servicing and engineering departments as only a few programmes were involved. In many cases this involved changing the format of documents which had previously been returned to the cost accounting department, and speeding up this return considerably.

This was undertaken in cooperation with the cost accounting department so that only one return was made for TMIS and the manual cost accounting. In some departments, data collecting procedures had to be introduced where previously there had been none. In the months leading up to the January/March Experiment and throughout a large part of 1969 a considerable amount of effort was spent by the Project Team in ensuring the prompt return of accurate actuals (i.e. actual use of resources). To handle the input for TMIS the Input Control Section was created, in the Television Service, headed by a member of the cost accounting department with experience in dealing with actuals. Initially the only printouts produced were Operating Plans and Operating Statements for strands of programmes and for the two production departments involved in the "experiment". The Strand Operating Plans were effectively copies and accumulations of P.B.E.s. The Strand Operating Statements were costed P.B.E.s and accumulations of costed P.B.E.s, comprising estimates and actuals. The main difference between TMIS Statements and costed P.B.E.s was that the producer could have the TMIS Statement by the end of the week following the week of production instead of six weeks or more after. Discussions on the printouts produced during the "experiment" were mainly between members of the Project Team and the Organisers in the two production departments involved.

As a result of the survey of current information systems, the Computer Project Team made a number of suggestions on new planning and control methods in the Television Service. These changes were necessary in order to carry out the requirement of more efficient use of resources, stated in the terms of reference of the preliminary study.

These suggestions involved rationalising the complex costing system and improving its efficiency by using TMIS. The first suggestions were that some of the distinctions between the above the line and the below the line costs (described in section 5.1) should be removed. All the costs of a programme should be controlled together at the time of production, the programme Controllers being ultimately responsible for all programme costs. The relating of Transmission Pattern costs to the cost of the production schedule and the stockpile of programmes was to be confined to Programme Planning. These suggestions would reduce a considerable amount of duplicated work on the costing of programmes (see section 5.1 for the three manual accounting systems involved). They would also provide knowledge of costs at the time at which they were incurred and hence increase the ability to control costs. Also all costs should be considered in relation to budgets based on production plans. This had not been the case in all departments previously. These suggestions were approved and some of them were embodied in TMIS as described above. It was also suggested that servicing and engineering departments (and production departments for production staff) should be responsible for recovering all their costs through charges to programmes. This had been carried out purely as an accounting exercise in the cost accounting department previously. Not all overhead costs had been included in the exercise, some had been hidden in the departmental rates. The Project Team's suggestion meant that all costs would be covered by charges to programmes. It was also suggested that the planning and accounting periods should be re-organised. Sufficient information was available sufficiently long in advance for annual planning to be more

appropriate than quarterly planning. The production planning year ran from October to September and the transmission planning year from January to December, while the BBC's finances were controlled on the financial year. It was suggested that these should all coincide with the financial year. TMIS was made sufficiently flexible for the printouts (and hence the planning period) to be varied on request. The suggestions on cost recovery and planning periods were later approved (see below).

While all this was going on a firm of management consultants was called in by the Chairman of the Board of Governors of the BBC, to advise the BBC as a whole on its management of resources. This was in May 1968. When the consultants started work in the Television Service they acknowledged that the work already done by the Project Team was of immense help to them. When their recommendations were published at the end of 1968 they endorsed everything which had been suggested by the Team. The main difference between their proposals and those of the Project Team was in their greater emphasis on the relationship between the information supplied to managers on the cost of alternatives and the actual decisions made. Their main proposal was given the name Decision Costing. It was based on the budgetary system proposed by the Project Team but reorganised some of the supply of information to fit it more closely to decisions which had to be made, e.g. a producer having to choose between filmed or studio production. The difference between the costs fixed before the time of decision and those which could be affected by the decision was stressed. The consultants also emphasised the point that managers should only be held responsible for those costs about which they know or are able to find out. The

consultants also offered proposals on the development of improved management procedures. The organisation of accounting should be rationalised under the new post of Chief Accountant, corresponding to the conceptual rationalisation of accounting in TMIS. The Director of Television should become the Managing Director of Television and Controller, Programmes should be Director, Programmes, thus emphasising the importance of programme production. This was associated with the relating of all Television expenditure to programme production. The consultants' proposals were approved and the effects on the technical development of TMIS are noted below (5.6). The consultants contributed a great deal to the TMIS project in terms of involvement of managers and acceptance of the new systems. The fact that they, who had been authorised from the very top of the BBC hierarchy, were supporting the ideas proposed by the Project Team gave these ideas greater impetus.

5.6 Development of TMIS from the Experiment to Full Scale Implementation.

During the January/March Experiment all data arriving at the Data Control Section was logged. In this way a check was kept on the speed of feedback. Where data was late the departments concerned were chased by or received help from the Project Team as appropriate. As no major faults were found with the system it was extended to include other departments. Thus the Experiment became in fact the first section of the first working version of TMIS. It became clear during this period that a number of alterations would have to be made to the system both to plug loopholes found during the experimental period and to allow for the consultants' proposals. The main amendment to the computer system was that four values would be recorded in the Programme File for each resource

usage instead of three. The extra value was to be the amount of resource usage agreed between the servicing department and the producer before production i.e. the fixed price, in resource terms, quoted by servicing departments. In the budgetary system this was to be the cost charged to the programme and the recovery cost for servicing departments. This was in line with the idea of making the producer responsible for the costs which he actually knew about and could control.

Other difficulties were caused by the complexity of the Television Service. The basic entity in TMIS at this stage was the programme record in the Programme File, indexed by the Project Number. In the previous manual systems some departments did not use Project Numbers to refer to programmes. In some departments separate numbers were used, e.g. the recording number in the videotape recording department, and in other departments the programme's title was used. The standardisation of references to programmes, so that everybody used Project Numbers was a long task. Also, some expenses on scripts and research had to be met before it was certain that a programme was going to be produced, i.e. before a Project Number was issued. Although all resources for all programmes had standard records in TMIS the details of costing varied from department to department. Some departments' costs were entirely internal (i.e. all financed by the departmental rate), some were a mixture of internal and external (i.e. partly financed by Programme Allowance). Some servicing departments were able to give fixed price quotes to producers and others had to charge the cost per hour used by the producer (e.g. so much per hour spent in the studio). Control procedures varied from department to department (even from one production department to another). Some programmes were made all in one piece, others were made up

of 'inserts' in a framework. These 'inserts' might be made long before the rest of the programme in which they were used and some might never be used. Appropriate information handling procedures, costing standards and budget responsibilities had to be developed in all these different cases. Complete standardisation was neither possible nor advisable.

In spite of all these complexities, which had to be resolved in the long run, it was decided to bring a revised version of TMIS to a fully operational state for 1st October, 1969, to coincide with the introduction of total costing and cost recovery. Therefore, the first version of TMIS was extended to cover at least some programmes in all departments to give the Television Service practice in the use of printouts and the supplying of data. After a long period of evening and weekend working by the systems analysts in the Project Team the second version of TMIS came into operation only two days late. It had been hoped to have P.B.E.s on file for the whole year from 1st October 1969. Although not all P.B.E.s for the year were obtained in time it was possible to produce Operating Plan printouts covering the first six months of the year.

All the printouts produced at this time (programme and production department Operating Plans and Statements) were delivered and explained, where necessary, by members of the Project Team. Initially these deliveries and explanations were to Organisers and other administrative staff in production departments. Queries from the recipients of the printouts arose on a number of points. They were caused by misunderstanding of the new system, misuse of the system, a few errors in the system but above all else by incorrect or late data for TMIS. This incorrect or missing data produced considerable mistrust of the

printouts and reluctance to use them. One of the main sources of incorrect data was in fact the Finance Division's computer system, which provided data on details of external payments made on behalf of programmes (P.A. expenditure). Procedures for the use of the printouts had not yet been decided on at this stage and in many departments producers did not see printouts for several months after the start of operational running. The distrust produced by bad data, as described above, was the understandable reason given for withholding printouts from producers at first. A number of the queries were concerned with the organisational use of TMIS rather than TMIS itself. One typical example was the problem of a budget for a strand of programmes which ran across the boundary between accounting periods. If the senior producer was responsible for the total strand budget and could vary the costs of individual programmes within that total budget, he might put the more expensive programmes at the beginning of the strand. The TMIS Operating Statement which compared actual costs with strand average estimates would then show that strand as overspent at the end of the first accounting period. Such problems could only be referred back to senior management for decision.

This organisational implementation stage required so much work that some of the extensions of TMIS (see section 5.7) were delayed in starting. At this time the Project Team had expanded to five line managers and eight systems analysts full time plus several line managers attached to the Team part time.

5.7 Further Developments of TMIS (1969-1970)

The Loading File (described in section 5.5) was ready for use in October 1969, and load printouts were produced for the six month period from 1st October. The work involved in introducing the printouts of resource loads was not as extensive as that for the programme printouts since the former were only used within Programme Planning at first. Both the Programme File and the Loading File were used in preparing an annual plan for the financial year 1970/71. Not all the P.B.E.s for the year were available, so dummy P.B.E.s containing what Programme Planning expected would be required were prepared by them. The usefulness of the Loading File is particularly susceptible to missing P.B.E.s. A true assessment of the load on resources requires every P.B.E. to be there. The 1970/71 annual plan suffered considerably in this respect but it provided valuable lessons for future annual plans. In order to improve the planning for 1971/72 the Project Team proposed new ways of using the information already stored in TMIS to help in producing the next annual plan. These were aimed at removing a lot of the paperwork load from Programme Planning and production departments and enabling it to be done before the main Offers Meetings (see 5.1), now taking place in November of each year. (Review Offers Meetings are held in the following May.) A first attempt at an annual plan could now be obtained by copying the preceding year's data but allowing for any increase in costs. Specific planned changes could then be added to the plan to make it realistic. The detailed work on the new plan was to be aided by a program which would produce average estimates and costs for any list of programmes supplied. New organisational procedures were agreed

between the Chief Accountant, Programme Planning and the Project Team. These are now (October 1970) in use.

In parallel with this work on annual plans TMIS was being developed in a number of other ways. One of the most important of these other developments was based on the Cost File. The purpose of the Cost File is to produce Operating Budgets and Statements for production departments (for production staff), servicing and engineering departments. These should assist in controlling their costs in relation to the requirements placed upon the department. The Cost File contains data on resource capacities and requirements, both fixed costs (derived from the department's annual rate) and variable costs (overtime, hiring and materials) and costs recovered through charges to programmes. The Operating Budgets are produced as part of the annual plan and the Operating Statements compare actual costs with budgets and with costs recovered. The Cost File is linked with other parts of TMIS by taking data from the Programme and Facility Files and by having some input in common with the Loading File. It also takes some input from the BBC salaries computer system (not part of TMIS) and has some direct (i.e. manually supplied) input. As well as Operating Budgets for individual departments it produces summaries for all production, all servicing and all engineering departments. This file too was technically operational for some time before it could be used, because of the time taken to produce the data it required.

During the year following the start of full scale implementation of TMIS several changes were made to the Programme File part of the system. The data recorded for each programme was extended to include transmission

data such as transmission date and transmission strand code to link the Programme File with the Transmission Pattern File (see 5.4). Data is taken from the Transmission Pattern File to update the Programme File. The Programme File was also made more flexible in taking in actuals, so that P.A. expenditure by servicing departments could be reported directly to TMIS as it occurred. Previously it was collected by the producer and submitted as his estimate of external costs after production was complete.

During this year the ratio of useful management information produced to systems work done increased rapidly. The emphasis shifted from data collection to report production now that a large data base had been built up. Many new reports were produced from the Programme File. It became possible for a producer to request a printout showing him the current state of his programme compared with the original P.B.E. and comparing the actual costs with the estimates when the programme is complete. The range of Operating Plans and Statements was extended to include summaries for the two channels (BBC1 and BBC2) and for the Television Service as a whole. Reports were produced for servicing and engineering departments comparing their charges to programmes with actual costs, programme by programme. Another report listed P.B.E. resource bids for each programme, by servicing or engineering department. This enables the servicing departments to check whether these bids are within reasonable limits. This report shortened information channels previously going via Programme Planning. It was received with great enthusiasm by the servicing departments. Reports showing P.A. charges to programmes from servicing departments and lists of programmes produced and transmitted each week are produced by TMIS for Finance Division.

Both of these are used as punching documents for the Finance Division P.A. system. A report can now be produced analysing programme stocks (i.e. programmes produced but not yet transmitted). The system now enables Channel Controllers and the Director of Programmes to consider together and relate transmission plans, programme stocks and production plans in a comprehensive annual plan. Further reports are produced from the Loading File to help servicing and engineering managers to plan and control the work in their departments. All together the various parts of TMIS (including the independent applications) produce over 40 different reports.

During this year the full-time Project Team expanded to ten systems analysts and six line managers (not including the Data Input Section). It also divided to some extent, with an engineering group coming into existence within the team. One engineering subsystem, reporting on videotape recording is already in operation. Further investigations are going on into extensions of TMIS and improvement of the current version.

5.8 Changes and Potential Changes Resulting from TMIS

Some of the changes described here have taken place already and others have been made possible by the introduction of TMIS. Some of the potential changes are planned to take place and at least one has been decided against. The comparisons are all with the pre-TMIS situation.

Changes for Senior Management (particularly Programme Management)

TMIS gives senior management the ability to :-

1. Make longer range plans based on realistic data, i.e. accumulations of previous actuals (these should be more accurate than the estimates in the manual system, see 5.4).
2. Consider more alternative plans. The speed at which changes in plan can be evaluated by the manager using TMIS enables him to consider far more alternatives. TMIS now offers a service by which a fairly large number of alterations to the production plan can be submitted in one afternoon, and the full effects on the resource loads and costs can be seen the following morning. In an emergency these effects could be demonstrated even more quickly.
3. Control in greater detail i.e. centralise control.
4. Delegate all detailed decisions within budgetary limits i.e. decentralise control.

These last two changes are mutually exclusive but either is possible. With budgets and statements being easily available for all levels of management, the controllers could trace over-spendings which show up on the overall statements down to the level of the most detailed statements. This would centralise far more control in the controllers than was the previous case. Alternatively the controllers could concern themselves solely with total departmental budgets (in the field of financial control rather than editorial control). By making more information available at lower levels TMIS gives managers at lower levels (i.e. producers) the ability to improve control. Hence the restrictions, necessary to coordinate lower level decisions where adequate information had not previously been available, could be relaxed. It is planned that the second of these two alternatives will be applied. Producers will be

allowed to convert a large proportion of their budgets as they wish among a large number of resources. Certain resources which require detailed scheduling in advance, e.g. studios will not be included in this convertibility.

Changes for Production Staff

1. There can be greater flexibility within budgets (see convertibility above) but tighter discipline on total costs. This tighter discipline will not be a new policy but will be an old policy which becomes workable now that TMIS supplies data on costs early enough for the production staff to be able to control them.
2. There will be closer contact between production and servicing departments at the planning stage. Production departments will get quicker feedback from servicing departments on the feasibility of production plans and amendments to them.
3. In the early versions of TMIS, producers have to supply more detailed data on programmes at an early stage of the production cycle, i.e. on the P.B.E. for the Offers Meeting. This is being improved by helping the producers with printouts of averages for previous P.B.E.s.
4. Producers should be made more aware of the costs of the alternatives which they have to consider. This is not universally popular with producers, some of whom feel that this will detract from the quality of the programmes they produce (see also the reactions to TMIS reported in Chapter 7).

Changes for Servicing and Engineering Departments

1. Better data are available with which to make departmental plans. These come from P.B.E.s submitted for the annual plan and provide servicing departments with their total load and with details of what is requested on each P.B.E.
2. More effort is required in supplying data accurately and on time.
3. As with production departments, these departments should have a better idea of where their money is being spent both from their departmental budgets and from charges to programmes.

Changes for Programme Planning

1. A large amount of tedious data handling will be done for them by TMIS.
2. The data handling abilities of TMIS make possible the coordinated planning of the loads on many resources. Previously only a few major resources could be planned in this way.
3. Programme Planning have lost part of their previous role. Some of the coordinating and information handling jobs in which Planning acted as an intermediary between production and servicing departments and Controllers have been taken over by TMIS.

The main advantageous changes resulting from the introduction of TMIS can be seen to come from the increased awareness of the repercussions of decisions made. If a producer makes decisions which result in his overspending his budget for one programme in a series, he soon knows how much he will have to cut back on the rest of the programmes.

If a Channel Controller approves a special programme after production schedules have been drawn up, the affect of this decision on resource loads and other programmes competing for those resources can quickly be shown. The disadvantages are that a certain amount of extra clerical work is involved and producers will have to spend time working on costs, which they might have spent on creative programme production. The latter is really an inevitable result of the BBC's financial position. A similar computer-based MIS has been set up by NHK, the Japanese broadcasting corporation (64). This initially paid no attention to costs, but then NHK has considerably more money than the BBC. Another disadvantage which has been ascribed, by members of the Television Service, to costing on production rather than on transmission, is that this reduces flexibility for balancing the books. Since the books referred to gave a hypothetical cost of transmission and bore little relation to controlling what the Television Service actually spends this disadvantage seems of little consequence.

5.9 Comments on TMIS

This section does not attempt to be a complete evaluation of TMIS. If such an evaluation is possible it can only be carried out by Steering Group and the Managing Director, who are the only ones in a position to see its overall effect on the Television Service. A straightforward before-and-after comparison will not show the full value of TMIS. TMIS is the Television Service's response to a changing situation (the levelling off of income while costs are increasing and the increasing complexity of the Television Service). As such, its total value can be judged only by comparing the situation with TMIS to a hypothetical situation without TMIS.

It is extremely unlikely that the total costing and cost recovery system could be operated effectively without a computer. A manual version would require a small army of clerical staff and would propogate far more errors than TMIS. Whether the total costing and cost recovery system is worthwhile can only be judged properly by senior management and then only in the long term. The way in which the reserves, which were kept in the manual system for various purposes, included expected overspending shows that the previous control system was under some strain. Another level at which the system can be evaluated is that of the users' satisfaction with it. The questionnaire survey described in Chapter 7 goes some way towards this. TMIS certainly appears to be a valuable addition to the Television Service. If the facilities now offered by TMIS are compared with the aims of Offers Meetings (section 5.1) it can be seen how TMIS could help with all these aims apart from the second one, concerning editorial control. Whether TMIS is as valuable as it appears to be will depend on how it is used in practice.

The TMIS project can be judged to some extent by the speed with which it reached its current position and the effort expended in doing so. TMIS is probably unusual in that it started from scratch with the intention of being an integrated information system (63) rather than developing from the standard data processing systems (salaries, accounts etc). After four years it is only just getting into its full stride. However, it has had a number of obstacles which do justify the time scale. TMIS has had to develop in phase with a considerable overhaul of the Television Service's management methods. In fact most of the holdups, where there have been holdups, have been on the management side rather than on the

technical side of TMIS. The original estimates for the duration of projects have been considerably exceeded and some of this is due to longer than expected systems time and programming time. However, revised deadlines have generally been met, though at the expense of a considerable amount of overtime on the part of the Project Team. Thus technical systems have been held to deadlines in nearly all cases and then often had to wait for the data they needed or for decisions on how they should be used.

At one meeting on TMIS it was stated by a manager (not a member of the Team) that "...the idea is to get the document working and decide responsibilities later". I do not think that this fairly common attitude represents any fundamental opposition to TMIS. It represents rather an unfamiliarity with computers and printouts and a desire not to let them disrupt the day-to-day working of the Television Service before they can be understood and fitted in. The preparation for the use of printouts (i.e. deciding exact procedures for distribution and use) is not as apparently urgent as getting the current programmes transmitted and recorded. This does not mean that general requirements were not defined before the system was designed, but these requirements had not been thought through by the users as far as deciding operating procedures. Also when the Television Service is in the state of flux which it has been in for the last few years, it is not surprising that some managers take the attitude "I will believe in it when I see it happen". However, the implementation of TMIS could have been speeded up by more preparation and commitment on the part of line managers in general.

The dilemma of the Project Team in this situation is a particularly difficult one. They can see what appear to be obvious requirements to them. If they implement the requirements they see, they can produce a usable MIS quite quickly. Since the line managers on the Team are experienced BBC staff such a system would almost certainly be extremely useful. However the real value of an MIS depends on how well it is used, so the potential users have to be convinced of its usefulness. The correct balance has to be achieved between leading the user managers and forcing them, which would certainly antagonise them and ruin the value of the MIS. The Computer Project Team has been successfully leading BBC Television during most of the Team's existence.

There was an increased interest in TMIS when official rulings were made by senior management, such as the one declaring that total costing would be used from 1st October, 1969. The management consultants speeded up the implementation of TMIS to some extent. Their main help lay more in convincing senior management of the usefulness of TMIS rather than convincing lower management. At the lower management levels there was sometimes extreme scepticism about the consultants' suggestions.

The Project Team put a lot of work into communicating the ideas of TMIS and involving managers, particularly the "Focal Points" (see 5.3). The effectiveness of this is shown by the questionnaire survey (chapter 7). The communication from the "Focal Points" to the rest of their departments was not so good. This situation could be improved by more contact between Project Team members and a wide cross-section of the Television Service staff, but this would require an increase in the size of the Team or a reduction in the pace of the project. There is clearly a need for the spreading of knowledge about TMIS by those who have had frequent

contacts with the Project Team. Although a monthly newsletter is published by the Project Team and a copy sent to each department, apparently only a few people in each department see it. Two editions of "Total Costing, A Guide for Producers" have been widely circulated. These have concentrated on costing and have only touched incidently on TMIS. A simple descriptive guide to the workings of TMIS distributed widely throughout the Television Service would probably go a long way towards removing the lack of widespread communication. Such a guide, using simple straightforward language for description and cartoons for light relief, was produced for the first phase of the Television Enterprises system.

The organisational position, under an interdepartmental Steering Group, and the interdepartmental nature of the Project Team have undoubtedly helped the project. The only flaw in the interdepartmental nature of the team is that it did not include a producer until nearly four years after its start. The importance of producers in the BBC and the fact that TMIS was supposed to be used by producers made this a fairly serious flaw. Interdepartmental conflict has shown itself, and although it does have its place it could have had serious effects on the TMIS project had that become deeply involved in such conflict. Some problems of this nature were connected with the implementation of TMIS. For example, there was concern in production departments that servicing departments would make a profit at the production departments' expense through cost recovery. Production departments were also concerned about having to bear the costs arising from changes, dictated by Programme Planning in reducing total costs. On the other hand doubts were expressed in Planning

as to whether producers would control their costs even when given information on them. As with many other problems associated with TMIS, these can only be resolved by decisions made by managers.

CHAPTER 6

The Pilot Model

This chapter describes a project in which a pilot model of part of the BBC MIS was designed and programmed for a small computer (a PDP-7) with a visual display. The pilot model was given the name RAPS, standing for Resource Allocation and Project Scheduling. The aims of the project are described in section 6.1 and the development of RAPS in section 6.2. Sections 6.3 to 6.5 give the uses made of RAPS in demonstrations to managers, tests on its effectiveness for cost saving in the Television Service and in ergonomic tests. Some background on the technical details of RAPS is given in section 6.6. Section 6.7 compares and contrasts RAPS and the corresponding parts of TMIS. Section 6.8 draws some conclusions on the RAPS project.

A full description of RAPS from the user's point of view is given in Appendix A. This project was also reported in (65).

6.1 The Aims of the RAPS Project

The aims for the pilot model fall into two categories: those concerned with the education and involvement of managers in the Television Service and those concerned with the applicability of computers to management problems. In the first of these categories the aims of the RAPS project were similar to those of the independent applications described in section 5.4. RAPS was intended to provide demonstrations for managers at all levels, to educate them in the potential use of computers in the Television Service and to involve the potential users in the design of RAPS. In the second category of aims it was hoped to test the applicability

of a computer-driven visual display with a light-pen to certain planning problems in the Television Service. The problems considered were those handled by Programme Planning in the planning of resource loads. It was also hoped to identify and perhaps solve some of the problems likely to be met by the full scale MIS.

6.2 The Development of RAPS

The idea of applying a computer with a visual display to the Television Service's planning problems arose while the Project Team was producing an outline MIS in 1967. Around the same time, the Team came into contact with the Management Group in the Centre for Computing and Automation at Imperial College, who were also interested in the usefulness to managers of computer-driven visual displays. As a result of this contact an outline specification was produced (by P. L. Cloot) for a system based on a PDP-7 computer with a visual display at Imperial College. It was then agreed to set up a joint project to develop an experimental system, mainly for demonstration purposes. A potential user of such a system in Programme Planning was brought into the project. A detailed specification was developed by this manager and myself with help from members of the Project Team and jointly supervised by P.L. Cloot and the Manager of the Computer Project Team. In this way the system was designed to be as close as possible to the real life situation, within the limits of the equipment available. The system design was produced in sections so that some programming could be carried out before the specification was complete. The order used was:-

1. Basic data specification (what details were required on resources and programmes).

2. Visual display format and manipulations using the display.

3. Printed output formats.

In spite of this planned development it was still necessary to do a certain amount of re-programming of some sections. The changes in the specification from the original outline to the final specification can be briefly explained as follows:

1. The data entities handled by the system became more complex. More details than was first thought were required to specify both resources and projects.

2. The facilities offered by RAPS became less complex. This was partly because the final specification had more fixed detail and did not need to cope with such variable situations, e.g. fixed instead of variable time scales.

3. Printed reports for circulation were added because a full scale system could not rely on visual displays to communicate with all the managers involved.

4. A section to calculate the costs of the resource loads was added to correspond to the BBC's costing system. All the costing was in fact based on the "above the line" costs. (See section 5.1).

The final users' specification for RAPS is given in Appendix A and the detailed program specification in reference (57).

The data to be used for the demonstrations were provided by Programme Planning. The data on programmes were taken from current P.B.E.s and the resource data were based on Planning's current work. These data were obtained quite quickly from within Planning. This is in contrast with the amount of effort and interdepartmental discussion needed to agree resource capacities for TMIS. One change in the system, as described in Appendix A,

had to be made as a result of the use of this live data. The loads on the resources were greater than the total capacities in many weeks (8 out of 13 weeks for Design) and the system spent a lot of time printing out multiple overload messages. A message switch was added so that by typing OFF while RAPS was in the P state (see Appendix A) these messages could be switched off. If ON was then typed all the resources were checked for overloads, appropriate messages were typed and the system then behaved as described in Appendix A. This shows the importance of checking the system with live data.

The project lasted approximately 12½ months from the sending of the initial outline specification to the Project Team, to the first demonstration of RAPS to senior managers. During this time I spent about 1½ months of working time on the systems analysis and design of RAPS and about 6 months on the programming and documentation. The total man-months expended on systems analysis and design was much larger when the contributions from Programme Planning and the Project Team are added on. The total was approximately 6 man-months. The total time span of the project could have been reduced if a larger, more reliable computer had been available (see also 6.4).

6.3 Demonstrations of RAPS to BBC Managers

Demonstration of RAPS were given to BBC managers by the manager involved in its design. The fact that the demonstrations were presented by someone with whom the managers were used to working, and who could express the problems in familiar terms was important in communicating the ideas behind RAPS. These demonstrations were presented to members of almost all levels of management within the BBC. Five demonstrations were given to a total of approximately 90 managers, ranging from producers and planning

assistants to the Director General of the BBC. The demonstrations aroused considerable interest at a time when the TMIS project was in an early stage of development and had no working programs to demonstrate. The spread of interest could be seen in the way in which an initial pair of demonstrations for about 30 people had to be expanded in order to allow everyone who so wished to attend.

Most of the facilities available in RAPS were demonstrated and the methods for the solution of several typical planning problems were shown. The demonstrations showed:-

1. The altering of a programme's resource requirements.
2. The replacement of one programme by another.
3. The investigation of peaks of resource usage and their smoothing by re-scheduling programmes.
4. The effects on external costs of changing resource capacities or changing unit costs.
5. The insertion of a new programme into the best week from a resource usage point of view.

Some of these problems were ones which had actually occurred a few months previously. These drew both appreciative comments and comments on aspects of the problems with which the computer could not deal, e.g. a temperamental producer's refusing to change the production week of his programme. The manager giving the demonstration estimated that the operations he had carried out in 20 minutes with RAPS would have taken about 40 working hours in the manual system.

The demonstrations helped considerably in showing managers both the advantages and the limitations of a computer system. The interest generated

by the demonstrations was apparent in later contacts between members of the Project Team and those who had attended. This was particularly noted by the Project Team Manager in contacts with senior managers. This interest seemed to help the TMIS project at the time of the demonstrations. Also, the questionnaire survey, carried out nearly two years later, offered further evidence that these demonstrations helped in improving attitudes to the use of computers in the Television Service (section 7.7).

6.4 The Effectiveness of RAPS for Cost Saving

A test was carried out, by the manager involved in the design of RAPS and myself, to see what savings could be made in external resource costs (the costs displayed to the right of the histograms in Figure 3, Appendix A) using RAPS. These would be effectively savings in marginal costs for the Television Service. Data from actual programmes were used to set up a situation in which the resource load was above the internal capacity in some weeks and below it in others for Design, Costume and Make-up. Initially, Construction was above the internal capacity and Shooting well below the internal capacity in all weeks. Thus only Design, Costume and Make-up contributed to changes in cost when programmes were re-scheduled. RAPS was altered to display the costs in units of £100 as a preliminary test had shown that units of £1000 did not give sufficient sensitivity to changes in production week for a single programme.

A new programme was added with a total resource cost of £3,500 calculated at the external cost rates. Of this cost £700 was for Design, Costume and Make-up. The production week of this additional programme was altered and the total resource costs were noted for each alternative production week. The variation in the sum of the costs of Design,

Costume and Make-up covered a range of £200 in a total of approximately £17,000. Additional film load was added to a "project", which listed contingency reserves of resources, so that the histogram for Shooting was above the internal capacity in some weeks. Varying the production week of an existing programme, with a resource cost of £6,600, gave total costs covering a range of £1900 in approximately £88,000 for the four resources (not including Construction).

This test showed that, in the situation considered, savings of 1 to 2% of external resource costs could be obtained by re-scheduling one programme. Thus the average difference between random placing of a programme and optimum placing would be about ½ to 1% (approximately £1000 for the resources considered). (This assumes a symmetrical distribution of costs between the best and the worst.) The addition of one programme to a calculated schedule would give better than random results in the manual system. If several were added at short notice, the uncertainty about resource loads would tend to produce a result approaching that of random placing. Thus if several programmes have to be added after the resource loads have been calculated (as often happens) the above figures give a rough idea of how much could be saved using a system such as RAPS. This argument only applies strictly when the resource load is distributed about the internal capacity as described above. Since with live data the internal capacity was exceeded in nearly all weeks for all resources such savings could not be made directly. However, in practice the quality of work bought or hired decreases as the hiring load increases, i.e. the best people are hired first. This could be represented by an external cost which increases with the load on the resource, i.e. the

cost of obtaining one unit of good quality increases as the load increases. Then cost savings could be shown for any level of load above the internal capacity. Any costs saved by re-scheduling with a full scale system will depend on the actual loads and capacities and how costs and qualities vary with increasing loads. Therefore this test with RAPS can only give an order of magnitude for the costs which could be saved. However, the manager involved considered that useful savings could be made with such a system. The saving of planning assistants' time on jobs that need to be done could be considerable as indicated in 6.3.

6.5 The Ease of Use of RAPS

This study concentrated on the interface between the computer and the user and was carried out by P. R. Wilkins (58). Its aims were to assess the difficulties a user might have with the system and to make recommendations as to how these difficulties might be removed or reduced. The five subjects used in this study were post-graduate students of computing science but they were not experienced in the use of visual displays. The results obtained should be applicable, in terms of operational difficulties, to most users of such a system. The major difficulty with most managers would be in persuading them to use it in the first place, rather than the difficulties they would have in using it.

Although most of the user errors which were observed would tend to die away as the user became more experienced with the system, there are a number of ways in which the system could be improved to reduce these errors. The main change, aimed at simplifying operations for the user, could be handled in two ways. One way would be to transfer the input of

instructions from the teletype to the light pen wherever possible. In order to display sufficient information for this alternative to work, the display would have to be "paged". That is, different displays or pages of information, e.g. histograms or lists of light buttons, would be available and the different pages would be called up using light buttons. This would enable alterations to resource data to be made in the same way as alterations to project data and would enable switching between the states of RAPS without using the teletype. This assumes that a non-typing manager would use the system personally. Alternatively, all instructions could be entered via the teletype and the manager would have a typist as an assistant in using the system. (This approach was taken for the demonstrations described in section 6.3). The compromise between maximising the amount and the clarity of the information displayed may have favoured the amount over the clarity in RAPS. The closeness, and even overlap occasionally, of the histograms did cause some complaints. Again the clarity can be improved by paging the information displayed or, if the application warrants the expense, by dividing the information up between several display screens.

6.6 Technical Details of RAPS

A brief background to the technical details is given here and a detailed program specification is given in reference (57).

The system was implemented on a PDP-7 computer with a 340 CRT display, a 370 light pen, an ASR 33 teletype, a paper tape reader and punch. The PDP-7 had a core store of 8K 18 bit words. 225 words were used for the resource file, 2150 for the project file, 1455 for the display file and the rest for program. The program was coded entirely in assembly language

without using any standard subroutines other than those to generate characters on the visual display. This was done because of the small core store and absence of any backing store such as magnetic tape or disk. Fortran II was available on the PDP-7 but was not used for a number of reasons. Firstly, the Fortran Object Time System (standard routines which had to be included) occupied a quarter of the core store, leaving only 6K words for RAPS and its data. Secondly, the Fortran compiler would generate less efficient code (i.e. occupying more core store) than I would using assembly language. Finally, some assembly programming would have to be done in any case, both to drive the visual display and to pack the data in as small a space as possible. RAPS was only just fitted in by reducing the number of projects it could deal with from the requested 120 down to 113.

The program was made as modular as possible with the idea of making it easier to alter and easier to program in the first place. However, the need for efficiency in store utilisation meant that it had to be adapted as closely as possible to the particular BBC requirements for the demonstrations. Thus altering the number of resources dealt with or the time period considered would involve quite a lot of programming. Altering the structure of the resource or project records would require the rewriting of virtually the whole programme. The formats of the printouts or the display, or the costing algorithm could be changed fairly easily. The emphasis on compactness has also been at the expense of speed of running and safety. The speed of running is not of great importance as RAPS can carry out most of the operations which it is called upon to do before the user can think of the next. Although RAPS is not completely fool-proof it

will spot or prevent most errors, e.g. error messages are given for invalid data and some conflicting actions are prevented by turning off the light-pen at appropriate times. In its role as a demonstration model, the few loopholes are of little importance since the demonstrations are worked out in advance and rehearsed. In a full scale system these loopholes would have to be plugged.

6.7 RAPS and TMIS

In modelling TMIS, RAPS covers the Programme, Facility and Loading Files, but contains much less detail than TMIS. Its use corresponds mainly to the use of Loading File printouts for smoothing the loads on resources. Thus displays of histograms have been replaced by lines of figures on printed reports. The planning carried out with the Loading File occurs from 18 to 3 months before production. Therefore there is time to consider a number of alternatives using a batch processing system with overnight turnaround (i.e. reports requested one day are available the following morning). It is not possible to consider as many alternatives as with a visual display system, but with some preliminary scheduling, done with old printouts before the computer is used for a new load, many more alternatives can be considered than in the manual system, when a new programme is added. The resource load smoothing system within TMIS is considerably cheaper than a visual display system would have been. At the time at which the Loading File was implemented there was neither hardware nor software available for running a visual display from an ICL 1900. The BBC would have had to buy an extra computer and invest a lot of time and effort in developing sophisticated software or else wait until the manufacturer produced them. In either case, the first task would be to

set up a file of suitable data. This could be done in a batch-processing system. The use of a visual display for the short term scheduling of resources (i.e. in the last two or three months before production) is still under consideration.

Although no visual display has been used in TMIS so far, RAPS has made some contributions. The representation of programme resource usage, varying over time, as totals and "spread" percentages (Appendix A, section 5.1) which I developed for RAPS is used in TMIS. The only difference is that TMIS holds one list of spreads for all resources instead of a list for each resource as in RAPS. This reduces the total storage space needed for spreads. The Overload Factors Report (Appendix A, Figure 4) is used almost unchanged in TMIS. Discussions on the specification for TMIS were going on while the specification of RAPS was being developed. The ideas developed in RAPS helped to clarify some of those used in TMIS.

6.8 Conclusions

RAPS has proved useful both in involving managers in the BBC Computer Project and in developing ideas for TMIS. It shows both the general usefulness of such pilot models and the dangers inherent in them. Some of the major difficulties with TMIS could not be shown by a pilot model such as this, e.g. the work required to agree and collect operational data for the full scale system. The BBC - Imperial College link in this project has been fruitful both for providing ideas for the Project Team and for providing real life problems for the Management Group.

A system such as RAPS would be more useful where a smaller number of projects, with resource requirements varying with time, had to be scheduled

at fairly short notice. The human pattern matching ability could then be put to greater use in fitting project resource profiles to resources available.

CHAPTER 7

The User Survey

This chapter describes a questionnaire survey which was carried out among managers in the BBC Television Service. It was concerned mainly with the computer-based MIS described in chapter 5.

The aims of the survey are given in section 7.1 and its design in section 7.2. The implementation of the survey is described in sections 7.3 and 7.4. Section 7.5 describes the analysis methods used. The results are discussed in detail in sections 7.6 to 7.10 and summarised in section 7.11.

7.1 The Aims of the User Survey

As mentioned above (section 4.1.6) there are two levels (at least) at which an MIS can be evaluated. The overall performance can only be evaluated at the managing director level, if at all. The users' satisfaction with the system, which is one expression of their attitude to the system, can be measured at lower management levels. This measurement was one of the aims of the survey. It was also intended to identify, where possible, what influences had affected their attitudes. In this survey the main interest was in influences which can be controlled by those designing and implementing an MIS. Others had to be measured in case they masked the effect of controllable influences.

Ideally one would like to measure an attitude on a single favourable/unfavourable scale so that influences can be compared with a single score on this scale. However, attitudes are not such simple things and are not

so easily measured. This survey was not intended to show the detailed structure of attitudes to TMIS in the Television Service. It measured attitude and satisfaction in terms of how the respondent saw the use of computers affecting:-

(1) the amount and quality of work done by the respondent

(2) the interest of the respondent's job

(3) the centralisation of authority in the Television Service

(4) the freedom of the respondent's department

(5) the Television Service as a whole.

The first two of these are obvious measures of a user's satisfaction with an MIS. The third is one which is often associated with the use of computers (e.g. (23)) and it may form part of the user's attitude to TMIS. The fourth is closely associated with the third and was considered relevant as a result of comments, made in the BBC, on changes in the freedom of production departments and the control of requests from producers to servicing departments by Programme Planning. The fifth measure attempted to elicit an overall feeling for or against the use of computers in the Television Service.

The two most commonly quoted influences which may produce more favourable attitudes are education on the MIS project and involvement with it (as mentioned in sections 4.2.2. and 4.2.7, also (12), (15), (27)). Therefore, the survey investigated the contact of the respondent with TMIS, the Project Team and the management consultants, and his opinion of the information he had received on TMIS and the management changes.

Attitudes to computers can also depend on a number of less controllable variables (12, pp. 120-138). Such variables are age, sex, level of

qualifications and previous experience of computers. These variables were recorded where possible in this survey. Previous work (14) has related attitudes to computer-based MIS to the "cosmopolitan/local" classification of Gouldner (37). Some of the indicators of cosmopolitanism (formal qualifications, number of previous jobs and membership of professional organisations) were recorded to see if they could be related to attitudes to TMIS.

7.2 The Design of the Survey

The first problem to consider in designing such a survey is what form it should take. The three alternatives are interviews, questionnaires and direct observation. Of these, the third imposes the researcher's ideas on the subjects least. This is because questionnaires and interviews collect data only within a comparatively rigid framework implicit in the questions, while observation does not have such a rigid framework. However, the observer's beliefs about what is relevant can affect, to a lesser extent, what he observes and records. The drawback to observation is that some situations of interest to the observer may never arise in practice. The observer can collect no data on these situations. Observation usually involves least disturbance to the subject and certainly takes up his time the least. It is particularly useful in the early stages of a study when insufficient is known to set up the framework of questions for interviews or questionnaires. Unstructured interviews or discussions are similar to observation in that they have almost no framework decided in advance. The data collected depends as much on what the subject considers is relevant as what the researcher wishes to collect. Observation and discussion were used in collecting some of the material for Chapter 5 and

in developing the initial ideas for the survey described in this chapter. In order to collect information on specific ideas, which may not come to the surface in the normal course of events, one of the first two methods must be employed. The choice between the two is influenced both by the aims of the research and by practical considerations (59, p.30), (60). Questionnaires are less expensive and can be widely distributed in a short time thus allowing the survey to cover more people. They require less skill to administer and collect data more uniformly if adequately designed and tested. In an interview the responses obtained may be influenced by the tone of voice in which the questions are asked or by the way in which questions are explained. Since it is difficult to maintain the same tone of voice and the same wording of explanations from interview to interview (unless one is a skilled interviewer), the results obtained are less uniform than with a questionnaire. Using a questionnaire, all the subjects receive exactly the same questions. Their disadvantages are that they are less flexible and generally cannot investigate a subject to the same depth as interviews. However, interviews require much more of the respondent's time to reach this depth.

The questionnaire method was chosen for this survey mainly for practical reasons. When the idea of interviewing managers involved in the January/March experiment (section 5.5.) was originally suggested it was considered inadvisable in the Television Service. This was because there had been numerous interviews in the recent past from the Project Team, the management consultants and the O. & M. department of the BBC. A questionnaire survey, which would take up less of the managers' time, was later agreed to. The problem of minimising the disturbance to the

Television Service was an important consideration throughout this survey. The use of questionnaires also reduced any effect of my lack of experience in conducting surveys. The questionnaire could be designed and checked before it was administered. With an interview this would only be possible in part.

The questionnaire used is given in Appendix B. The first section of the questionnaire is concerned with attitudes to the use of computers in the Television Service and controllable influences. The second section is concerned with background and uncontrollable influences. The third section is concerned with data for subdividing the responses within the Television Service and with some of the variables measuring cosmopolitanism.

It was realised that there is a general dislike of filling in printed forms in the BBC. This was evident when input documents for TMIS were introduced. Thus every effort was made to make the questionnaire acceptable to BBC staff, in order to get a reasonable response rate. The majority of questions are in closed form (answers given for the respondent to choose between) in order to minimise the time required to complete the questionnaire. The number of questions was kept as low as possible. Some possibly intrusive questions (e.g. sex and age) were omitted because it was thought that these would antagonise a significant number of the recipients of the questionnaire. Questions concerning the Television Service come first in the hope of gaining the respondent's interest. Personal details were left to the end in the hope of getting partially completed questionnaires from those who were not prepared to give personal details. Several partially completed questionnaires were

received. The questions on the effects of computers were phrased in general terms to obtain general attitudes rather than specific information. Also, since TMIS was still in its first year of implementation, the respondents did not have a lot of experience with TMIS. Some open-ended questions were included to allow those who so wished to comment more widely. The questionnaire was tried out first on members of the Project Team and then in a pilot survey before the full scale survey.

7.3 The Pilot Survey

The pilot survey was carried out in the two departments involved in the January/March experiment. A list of 15 recipients, including the Head of Department and the Organiser, was produced by the Organiser in each department. These lists were deliberately biased towards those who were likely to reply but not towards those who were likely to comment favourably on TMIS. The questionnaires were distributed in March 1969 and 12 were returned in the following three weeks. A reminder was then sent out and 5 more completed questionnaires were returned. (For comments on the response rate see section 7.6). In the pilot survey the questionnaires went out under a covering letter from myself.

As a result of the responses to the pilot survey a number of alterations were made to the questionnaire. (All question numbers refer to the final version of the questionnaire as in Appendix B.) An extra option was added to each of the two questions on explanatory information: "Have received none" in questions 10 and 15. It had not been realised how many people had not received any explanatory information. Question 18 was added to clarify apparent discrepancies between answers to questions 17 and 19 and to check what the respondents understood by centralisation.

Question 30 was added to help identify any attitude-changing process associated with the introduction of TMIS.

7.4 The Full Scale Survey

The full scale survey was carried out during the period July to September 1970. This was less than one year after the full scale implementation of the first phase of TMIS in October, 1969 (see section 5.6). Thus the results of this survey represent opinions held in what are still the early stages of the project as far as the users are concerned. While it is true that the users' attitudes to the system may change as it is adapted even more closely to their needs and as they come to know it better, it is a truism that first impressions count for a great deal.

A list of 577 recipients, with their office addresses, was obtained from the personnel department of the BBC so that the questionnaire could be addressed personally to the recipients. The sample included 296 members of production departments (see Figure 5.1) ranging from assistant producers to Heads of Departments and including all Organisers in those departments covered. The two departments used in the pilot survey were not included in the full scale survey. Also included were 14 members of Programme Planning. The sample included 161 members of servicing departments, ranging from cameramen, senior make-up supervisors and designers to Heads of Departments. The remaining 120 in the survey were in engineering departments. These were senior engineers, technical managers, administrative assistants and Heads of engineering departments. The sample included a large proportion of production department staff because the first phase of TMIS was intended mainly for the benefit of production departments. Approximately two-thirds of all producers,

assistant producers and editors were included in the survey, together with nearly all heads and administrative managers in production departments. Approximately 80% of those in servicing departments were in posts which were graded on the BBC's management scale, i.e. were classed as managers. All those in other departments were on this management scale.

The questionnaires were numbered so that reminders could be limited to those who had not returned questionnaires and so that the response could be tested for response bias (59, pp. 34-35). The questionnaire was accompanied by a covering letter from the Director of Programmes, as shown in Appendix B, to show that the survey had official approval. The stamped addressed envelope, enclosed with the questionnaire, was addressed to Imperial College to emphasise the fact that individual responses would not be available to senior management in the Television Service.

230 completed questionnaires were returned in the two months following their distribution. A short memo was distributed as a reminder at the beginning of September and a further 42 questionnaires were received during the following three weeks. 268 questionnaires were usable for the analysis described below.

7.5 Methods of Analysis of the Results

The reponses to the survey were coded and transferred to punched cards. A program was written in Fortran IV for a CDC 6600 computer, to analyse the responses. The program would carry out, on request, tabulations, two variable cross-tabulations and three variable tabulations (62, p 208 and pp. 211-217) for any of the responses.

The chi-squared test for significance was used on the cross-tabulations (61, pp.212-221). This test was used because the variables measured by the questions in this survey are measured on nominal scales or ordinal scales. Also the chi-squared test is applicable in all sizes of cross-tabulation, e.g. 2 by 2, 2 by 4 and 4 by 4. To measure the strength of relationships between variables, Goodman and Kruskal's tau (τ) was used. This was chosen because τ can take all values between 0 and 1 for all sizes of cross-tabulations and it has a clear meaning in all cases (61, pp. 232-234). The choice of measure of a relationship's strength is to a large extent arbitrary, as long as the same measure is used in comparing all relationships. Wherever significant relationships are referred to in this chapter, the 5% level of significance is meant, unless otherwise indicated, as is the usual practice (61, pp. 122-125).

Cross-tabulations using the range of responses possible on the questionnaire were usually found to have too few cases per cell for the chi-squared test to be applicable. Thus in most of the cross-tabulations considered below, this range was reduced by combining the responses into a smaller number of groups. For example, in cross tabulations involving question 20 three groups of responses were used: extremely beneficial and slightly beneficial, no effect and mixed effects, slightly adverse and extremely adverse. The responses to the questions on the supply of data to TMIS, the use of printouts and discussions with members of the Project Team were put into two groups: some, none. Those giving no answer or responding "Don't know" were not included in cross tabulations referred to, unless otherwise stated. This was done because the main interest of this survey is in the direction of attitudes (favourable or unfavourable) and possible influences on this direction.

For the sake of brevity in the following sections, questions are referred to as Q19, Q20 etc. instead of question 19, question 20, etc. Responses indicating the usefulness of the computer, good effects caused by the computer and satisfaction with information received are referred to as positive responses.

7.6 Response Rate and Response Bias

The overall response rate of 47% is lower than one would have hoped to get but it is not as low as might have been feared. Oppenheim (59, p 34) gives a range of response rates of 40% to 60% to be expected from those with no special interest in the survey and up to 80% from those specially interested. Sellitz et al (60) give a range of 10% to 50% to be expected from a random sample of the population. One would expect the recipients of this questionnaire to be a specially interested group even if they were not directly involved with TMIS. However, 6 out of 23 replies to the reminder indicated that the recipients had not completed the questionnaire because they thought either they knew too little about the subject or it was not relevant to their jobs. 10 replies indicated that the people concerned had not received the questionnaire, because they were on holiday, on location or had even left the BBC. These reasons are probably not sufficient to account for all the failures to return the questionnaires. It was suggested, by a member of the BBC staff, that some people in the BBC thought that any criticism by them of a project initiated and supported by senior management such as TMIS, would be entered as a "black mark" on their record. If this is true of many people, the results of this survey, in terms of the proportions expressing particular views, will be considerably biased. The number of replies received which are critical of TMIS shows

that this is not universally true but a bias could exist.

The response was examined for possible bias in a number of ways. The response rate was not uniform across all departments of the Television Service. The numbers in individual departments were too small to show anything definite at that level but the division into production, servicing and engineering departments did show significant differences in response rate. The response rates for production and servicing departments were almost the same at 44% and 45% respectively but for engineering departments the response rate was 57%. Perhaps the more numerate engineers were less reluctant to fill in forms or perhaps, because TMIS had affected them less, there were less engineers wishing to critise TMIS. A comparison of the responses to Q20 (on the effect of the use of computers on the Television Service) in the different types of department showed that engineers gave more positive responses but the difference was not statistically significant. This also suggests that the results of the survey may be biased in the favourably-inclined-towards-computers direction. The relationship involving the response rate and the sex of the respondent (obtainable because the questionnaires were numbered) was the opposite to that involving the response rate and the type of department. The response rate from females was significantly lower, while females gave more positive responses than males, but not significantly more positive responses.

In a further attempt to estimate any response bias, the responses were divided up according to the time between the distribution of the questionnaire and its return. There were three groups: those returned in the first month, those returned in the second month and those returned in the third month. The last group consisted of the questionnaires returned

after the reminder had been distributed. The responses to all the questions which feature in the relationships described below were cross-tabulated with the month in which the questionnaire was returned. The only two significant correlations found were with the department of the respondent and discussions with the Project Team (Q13). The correlation with Q13 was quite weak ($\tau = 0.02$). The responses in the second and third months contained a smaller proportion of people who had had discussions with the Project Team. The relationship between month of return and department is shown in Figure 7.1.

Department	Month questionnaire returned		
	1	2	3
Production	50% (98)	66% (19)	29% (12)
Servicing	21% (40)	21% (6)	52% (22)
Engineering	29% (57)	14% (4)	19% (8)
$\tau = 0.04$			

Figure 7.1

It can be seen that servicing departments responded significantly better to the reminder. This does not offer any evidence for a bias in the responses received because servicing departments gave very similar proportions of positive responses to production departments.

Although no other relationships, with time of return, significant at the 5% level were found, there was a slightly lower proportion of positive responses among those who returned questionnaires in the second and third

months. It has been shown that the distribution of opinions among nonresponders is more similar to that among late responders than to that among early responders (59, p.34). Therefore one can obtain a more reliable estimate of the distribution of opinions among the whole sample in the survey by assuming that the distribution among non-responders is the same as for responses returned in the third month. An example of the results of this procedure, using Q20, is shown in Figure 7.2.

Effect of the use of computers	Whole Sample	Questionnaires Returned
Beneficial effect	46%	54%
No effect or mixed effects	18.5%	18.5%
Adverse effect	11%	10.5%
Don't know/no answer	24.5%	17%

Figure 7.2

It can be seen that the difference lies in a smaller proportion of positive responses and a higher proportion of those who could give no definite answer in the whole sample. Also, it was found that a smaller proportion of those who returned questionnaires in the third month had any direct contact with TMIS. Both these last two findings support the idea that failure to return the questionnaire was due to lack of contact with TMIS or lack of knowledge rather than fear of expressing critical views.

Five of the relationships discussed in section 7.7 were examined in responses returned in the third month. The relationships were all in the same direction as those found using all the questionnaires. They were not

statistically significant because of the smaller numbers involved.

Thus it seems that although the responses to this survey are slightly biased in terms of the proportions giving particular responses, the relationships found are still valid.

7.7 Attitudes to the Use of Computers

As explained in section 7.1 this survey is concerned with the respondents' attitudes to computers in terms of their perceptions of how the use of computers affects their jobs and the Television Service. It is not suggested that the responses recorded describe the respondent's attitude in full nor that any one of the questions is a reliable measure of any distinct element of the respondent's personality. However, the questions do correspond to common reactions to the use of computers, e.g. "This system is causing me a lot of unnecessary work" or, "The system is taking away authority over certain matters from department x and giving it to department y". These reactions usually imply approval or disapproval and may be manifestations of a particular attitude to computers. The responses to the questions in this survey show relationships which would be expected if respondents did have a general attitude for or against computers.

It can be seen from the responses (tabulated in Appendix C) that the majority of the respondents see the use of computers having either good or mixed effects in some areas and little effect in others. The majority have had some contact with TMIS on which to base their opinions. The only question to which a majority of negative responses was given, was that on explanatory information about TMIS (Q15). The responses

to Q15 do show some inconsistency. 9 respondents who attended Involvement Meetings and 37 who had had discussions with members of the Project Team indicated that they had received no explanatory information on TMIS. It may be that some respondents restricted their interpretation of "explanatory information" to documents.

In examining attitudes in more detail, Q20, on the effect of the use of computers on the Television Service, was taken as the initial estimate of the respondent's attitude to computers in the Television Service. The responses to six other questions, which might represent other facets of this attitude or influences on the attitude, were cross-tabulated with the responses to Q20. The six questions were Q6 (the usefulness of the computer in previous work), Q8 (the usefulness of new work caused by the computer), Q9 (the effect of the computer on job interest), Q17 (the centralising effect of the use of the computer), Q18 (the direction of authority transfer) and Q19 (the freedom of the respondent's department). Significant relationships were found in all six cases. A typical example is given in Figure 7.3. Responses to Q6 and Q8 were positively related to those to Q20, i.e., those who said that the computer was useful to them were more likely to say that the use of a computer would have a good effect on the Television Service.

Effect of the use of computers on the Television Service	Freedom of respondent's department		
	Less	Unchanged	Greater
Adverse	30% (17)	9% (9)	4% (2)
None or Mixed	34% (19)	21% (20)	6% (3)
Beneficial	36% (20)	69% (66)	91% (48)
τ = 0.08			

Figure 7.3

With Q17 and Q20 it was found that decentralisation and beneficial effects on the Television Service tended to be associated. The responses to Q18 were grouped so that categories 1, 3 and 5 (see Appendix C) formed one, decentralising, group and categories 2, 4,6 and 7 formed a second, centralising, group. This grouping was used for all cross-tabulations where significant relationships were found. The individual categories contained too few responses. The decentralising group were much more likely to think that the effects of the use of computers would be beneficial to the Television Service (see Figure 7.4). This relationship was the strongest one involving Q20. Those who thought that their department would have more

Effect of the use of computers on the Television Service	Direction of authority transfer	
	Centralising	Decentralising
Adverse	24% (9)	5% (2)
None or Mixed	42% (16)	3% (1)
Beneficial	34% (13)	93% (37)
$\tau = 0.37$		

Figure 7.4

freedom to make decisions (Q19) were more likely to think that the use of computers would have a beneficial effect.

These six sets of responses, which were related to Q20, were then cross-tabulated with one another. In all but two cases, significant relationships were found. Figure 7.5 gives the value of τ in each case. The cross-tabulations of Q6 and Q17, and Q8 and Q19 showed a slight

but non-significant relationship in the expected direction.

	Q8	Q9	Q17	Q18	Q19	Q20
Q6	0.14	0.04	(0.02)	0.19	0.03	0.10
Q8		0.04	0.04	0.20	(0.02)	0.08
Q9			0.03	0.23	0.05	0.03
Q17				0.61	0.23	0.03
Q18					0.30	0.37
Q19						0.08

Figure 7.5

In all cases, good effects on the respondent's job, greater freedom for the respondent's department and decentralisation tended to be associated with one another. The values of τ for cross-tabulations involving Q18 are higher than the rest partly as a result of the strength of the relationships and partly as a result of the effect on τ of having a 2-by-3 cross-tabulation instead of 3-by-3. The strength of the relationships is due to the fact that none of the respondents who gave answers to Q18 indicating decentralisation, thought that the new work caused by the computer was a waste of time or that the use of a computer made their job less interesting.

The fact that the responses to these seven questions were all related to one another (with the two exceptions mentioned) suggests that each is partially measuring a general attitude to the use of computers in the Television Service. Further evidence for this general attitude is given by cross-tabulations of the seven questions with Q30 (change in

attitude to computers as a result of contact with TMIS) and with Q29 (effect of the use of computers on society). All seven questions were significantly related to Q30, while none of the possible influences, investigated by other questions, was related to Q30. Positive responses to the seven questions (i.e. good effects and decentralisation) were associated with improved opinions on computers. Improved opinions were most closely associated with good effects on the respondent's job (Q6 and Q8.) Q6, Q17, Q19 and Q20 were all significantly related to Q29, and Q8 was related to Q29 at the 10% level of significance. Q20 was more closely related to Q29 than to any other question apart from Q18. Therefore, the respondent's attitude to computers in the Television Service is fairly closely related to his attitude to computers outside the Television Service.

Thus it appears that most respondents do have a general attitude to the use of computers which is associated with the effect of computers on their own job, their department, the Television Service and society as a whole.

In Q21 a wide variety of reasons were given for the responses to Q20. The elements of these reasons are listed in Appendix C. A lot of the responses included several of these elements, sometimes from more than one of the categories into which they are divided in Appendix C. Qualifications and warnings of possible bad effects were given by many of those who indicated in Q20 that the overall effects would be beneficial. Although "faith" was given as a reason by only three respondents, I would think that faith in the Television Service played a much wider part in producing the high proportion of positive responses. Although TMIS was still new to most respondents and was still in its early stages at the time

of the survey, responses to Q21 often indicated a belief that the project would work out well in the long run. The majority of reasons giving good effects were related to better information and the effects of better information; as one producer summarised it, "Knowledge is strength". The most widespread fear expressed was that the quality of programmes would be reduced, either because the producer had to spend too much time on non-creative work or because of greater standardisation. One respondent saw the danger of the Television Service becoming "a sausage factory of magnetic tape" producing "mind-eroding, dull, predictable (computerised?), and very conveniently categorised, packaged" programmes to be "sold by the yard". The other most widely spread response to Q21 was that the effects of computers depended on the use to which they were put. This was sometimes coupled with the view that in the Television Service there was insufficient expertise of the right kind, to obtain the best advantages from the use of computers.

7.8 Correlations with Attitudes to the Use of Computers

A number of possible influences were found to be related to responses to the questions considered in section 7.7. In most cases, those questions concerned with the usefulness of the computer (Q6 and Q8) were related to the same possible influences. Similarly, those questions concerned with changes in authority distribution (Q17, Q18 and Q19) were all related to the same questions.

Actual contact with TMIS, in terms of providing input data (Q2) or receiving or using printouts (Q3 and Q4) were not significantly related to definite responses to Q20. However, those who had contact with TMIS were less likely to respond "Don't know". A positive correlation was found

between positive responses to Q20 and the respondent's having first seen a TMIS printout more than one month previously (Q5). Cross tabulations of the seven questions related to attitudes with the responses to Q5 in full (i.e. the responses to Q5 were not grouped together) gave some evidence for an improvement of attitude with length of contact with TMIS. There was some slight evidence that attitudes to computers were slightly worse just after initial contact with TMIS and then improved as the respondents became more familiar with TMIS, e.g. Figure 7.6.

Time since first printout seen	Effect of the use of computers on the Television Service		
	Adverse	None or Mixed	Beneficial
Never seen one	15% (5)	26% (9)	59% (20)
1 month or less	21% (5)	38% (9)	42% (10)
2-4 months	12% (3)	16% (4)	72% (18)
6-10 months	14% (5)	23% (8)	63% (22)
1 year or more	7% (2)	7% (2)	84% (24)

Figure 7.6

Q2 and Q3 showed no correlation with any of the seven questions related to attitudes. There was a slight positive correlation between reference to or acquaintance with printouts (Q4 and Q5) and the usefulness of the computer in the respondent's work (Q6). On the other hand, there was a negative correlation between the usefulness of new work caused by the computer (Q8) and receipt of printouts (the first part of Q3). This

relationship is probably spurious as it does not occur if responses from production departments only are used in the cross-tabulation. The relationship occurs because a large number of respondents in servicing and engineering departments gave positive responses to Q8 even though they did not receive printouts. Very few respondents in servicing and engineering departments did receive printouts, making it impossible to test for this negative correlation in those departments. The difference in response to Q8 is probably a departmental one rather than being due to the receipt of printouts. The different forms of contact with TMIS were associated with a smaller proportion of respondents' saying that the use of a computer had no effect on their job interest. Contact with TMIS did not affect the ratio of those with increased job interest to those with decreased job interest.

With one exception no correlations were found between opinions on explanatory information received (Q10 and Q15) and the different aspects of attitudes to oomputers. The exception was a positive correlation between good opinions of the explanatory information concerning TMIS (Q15) and the usefulness of TMIS in work done before its introduction. Thus it appears that most respondents distinguish the effects of computers from the quality of information they have received about them. Conversely, their perceptions of the quality of the information they receive does not influence their attitude to computers.

There are several sources of information which may have influenced the respondent's attitude (regardless of what he thinks about the quality of the information). Those, within the BBC, which were covered by the survey, are McKinsey presentations (lectures with large audiences, Q11),

the Project Team's Involvement Meetings (lectures with smaller audiences and more discussion, Q12), discussions with members of the Project Team (Q13) and demonstrations of the RAPS pilot model (Q14). Q11 showed a significant positive correlation with job interest (Q9), decentralisation (Q17) and departmental freedom (Q19). Q12 showed a positive correlation with usefulness of TMIS in old work (Q6) and Q9. It can be seen from this that the influence does depend on the content of the information. The McKinsey presentations were concerned with costing and management procedures and they influenced responses to Q17 and Q19. The Involvement Meetings were concerned with the use of computers by members of their audiences and they influenced responses to Q6. Respondents appear to find their jobs more interesting if they receive any relevant information. Discussion with a member of the Project Team showed a positive correlation with Q17 and positive correlations, significant at the 10% level, with Q18 and Q20 (see Figure 7.7).

Effect of the use of computers on the Television Service	Discussions with member of Project Team	
	None	1 or more
Adverse	16% (21)	8% (7)
None or Mixed	25% (33)	18% (16)
Beneficial	60% (80)	74% (64)
τ == 0.02		

Figure 7.7

There was also a significant relationship between discussions with Project

Team members and the respondent's job interest. In this case those who had had discussions were less likely to say that TMIS would have no effect on the interest of their job. The ratio of improved job interest to reduced job interest remained almost the same. Attendance at a RAPS demonstration showed positive correlations with Q9, Q17, Q18 and Q19, and with Q20 at the 10% level of significance.

These correlations cannot be taken as proof that the various sources of information have influenced respondents' attitudes. However, considering the nature of the subjects of the questions, it seems likely that the correlations do represent such influences.

Only discussions with members of the Project Team and attendance at a RAPS demonstration showed any correlation with positive responses on the overall effects of computers on the Television Service (Q20). The evidence (particularly from cross-tabulations with Q20) suggests that meetings or discussions involving small numbers of people were most effective in promoting favourable attitudes. However, all the correlations discussed so far in this section were quite weak (τ in the range 0.03 to 0.10).

None of these possible influences within the BBC was significantly related to perceived change in the respondent's opinion of computers (Q30).

Possible outside influences on the respondents' attitudes to computers showed similar correlations to those for possible internal, BBC, influences. Both the effect of computers on commercial services (Q23) and any complaint by the respondent about a computer-produced bill (Q24) were related to Q20 (τ = 0.07 in each case). Good effects on commercial services and absence of complaints about computer-produced bills were associated with beneficial effects on the Television Service. Weaker relationships were found between

Q23 and Q6 and Q8. There were no significant relationships between the possible outside influences and centralisation or departmental freedom in the Television Service.

Previous computer experience showed a small but significant positive correlation with the usefulness of the computer in the respondent's job. It showed correlations with Q9 and Q18 but not with the other aspects of attitudes to computers in the Television Service.

No correlations were found between the questions related to attitudes to computers and the indicators of cosmopolitanism (Q35, Q36 and Q37). The responses to Q35 were too vague to be able to get more than a rough estimate of the number of previous jobs held by the respondent. Responses to Q36 were much clearer, but cross-tabulations of the attitude questions with level of formal education did not show any significant relationships. The organisations listed in response to Q37 included unions and a variety of organisations which may or may not require professional standards from their members. Thus these responses could not be relied upon as indicators of cosmopolitanism. It is doubtful whether level of formal qualifications is an adequate indicator of cosmopolitanism in the BBC. The main concern of the BBC is in communicating with people outside the organisation, and one would expect the vast majority of production staff to be cosmopolitan regardless of their formal qualifications. Thus nothing can be said about the relation between cosmopolitanism and attitudes to computers in this survey.

7.9 Opinions of Explanatory Information

A cross-tabulation of the two questions concerned with explanatory information (Q10 and Q15) shows that information on the new management

procedures and on the computer system are distinguished by the majority of respondents. However, there is a correlation between the two. If the opinions of those who have received some information on both topics are cross tabulated there is a fairly strong positive correlation ($\tau = 0.23$).

Possible influences show surprisingly few significant associations with opinions of explanatory information, other than reducing the number of "None received" responses. None of the internal sources of information (Q11, Q12, Q13, Q14) showed any correlation with opinions on the quality of information received on new management procedures (Q10). Two significant correlations with the quality of information received about the computer system (Q15) were found. These were discussions with members of the Project Team and the usefulness of the computer in work done before its introduction (Q6).

When "None received" was included in the cross tabulations, Q15 showed fairly strong correlations with the reception and use of printouts and a weaker correlation with the provision of input data for TMIS (see Figure 7.8).

Opinion of information on computer system	Number of printouts received	
	None	1 or more
None received	74% (127)	36% (31)
Uninformative	3% (6)	7% (6)
Mixed	10% (17)	16% (14)
Informative	13% (22)	41% (35)
$\tau = 0.14$		

Figure 7.8

This is an indication that explanatory information on TMIS is generally reaching the right people. However, there were a number of people using TMIS who consider that they have received no explanatory information.

Thus it appears that only discussions with Project Team members have a significant effect on the respondents' opinions of the explanatory information they have received. There is a possibility that the length of time which has elapsed since the information was received has an effect on these opinions. The McKinsey presentations were given more than a year before the survey and the Involvement Meetings were even earlier. The effects of these may have faded in comparisonn with those of more recent discussions with members of the Project Team. An alternative, more likely, explanation is that the dialogue occurring in discussions with members of the Project Team makes these discussions more popular than lectures. This idea is supported by some of the suggestions on communication given in response to Q16. Also, it is in these discussions that users of TMIS become involved in its design.

7.10 Further Analysis of Results

This analysis used three-variable (three-question) tabulations as in Glaser and Strauss (62, p.208 and p.212 et seq.) The aim of this analysis was to identify processes which may be involved in the formation or change of attitudes to the use of computers. An example of a possible process is: discussions with Project Team members promote the idea that TMIS will be a decentralising influence, which leads managers to think the effects of computers will be beneficial to the Television Service. Such processes are tested for by comparing the direct relationship between the first and third variables, with the relationship found when the effects of

the second or intervening variable are removed. These effects are removed by looking at the direct relationship in those parts of the sample which have a particular value of the intervening variable (i.e. those who gave a particular response to the question which measures the intervening variable). An example is given in Figure 7.9.

	Discussions with Project Team members (Q13)		
	Some	None	Difference
Expected beneficial effects from computers (Q20)	89% (40)	84% (57)	5%
Expected beneficial effects and:			
Centralisation	83% (19)	79% (38)	4%
Decentralisation	95% (21)	95% (19)	0

Figure 7.9

This tabulation compares the proportion who expected beneficial effects with those who expected adverse effects (Q20) and divides them up according to the responses given to Q13 and Q17. The process being tested is the one described above. The difference column gives a measure of the relationship between Q20 and Q13 in each case. When the effects of Q17 on the relationship are taken into account, it can be seen that the difference is reduced in both cases. This suggests that the variable measured by Q17 is intervening in the relationship between those measured by Q13 and Q20. This is evidence for the process described

above but it is not proof. A theoretical alternative explanation of this tabulation is that the variable measured by Q17 is a cause of those measured by Q13 and Q20. When one considers the actual questions involved, this alternative seems highly unlikely. One would not expect respondents' expectations of decentralisation to cause discussions with Project Team members. Nearly all these discussions were initiated by the Project Team member.

Unfortunately most of these three-variable tabulations contained too few cases in one or more of the cells to provide any evidence on processes. One other process, similar to the one described above, was indicated. This process involved Q19, on the freedom of the respondents department, in place of Q17.

Further evidence was also found on the relationship between responses to Q20 and those respondents for whom the computer was the cause of new work (Q7). It had been found that a negative correlation existed between new work done because of the computer and positive responses to Q20, i.e. those who had new work to do were less likely to think that the use of computers would have a beneficial effect on the Television Service. This was investigated in the tabulation shown in Figure 7.10. It can be seen that discussions with the Project Team almost completely destroy this relationship. Thus one of the ways in which discussion with the Project Team influences attitudes to the computer is by negating the bad effects of new work. This may have occurred while explaining the work, e.g. when Project Team members delivered the first printouts produced by TMIS (see section 5.6).

	New work caused by the computer		
	Yes	No	Difference
Beneficial effects expected from computer use	76% (67)	91% (69)	- 15%
Beneficial effects expected from computer use and:			
Discussions with Project Team member	88% (37)	91% (21)	- 3%
No discussions with Project Team member	65% (30)	91% (48)	- 26%

Figure 7.10

7.11 Summary

It has been shown that managers' beliefs about the effects of the use of computers on the Television Service are associated with their beliefs about the effects on the distribution of authority and the effects on the managers' work. These are the strongest associations found in this survey. This does not necessarily disagree with the findings of Hebden et al. (14, p. 380). Their survey found that beliefs about the effects on the managers' jobs are not a major factor in determining the managers' attitudes to computers. It was not possible to corroborate their findings on cosmopolitanism, as explained in section 7.7. The relationships found were not very strong so the two surveys may have produced compatible results.

Responses to most of the questions concerned with the use of computers in the Television Service were as closely related to opinions on computers in society in general and to external influences, as to one

another. Thus it appears that the opinions of the managers covered by the survey, are as much influenced by their contact with computers in everyday life as by the effects of computers on their jobs. These everyday influences are at least as strong as the influences of the various educatory procedures used in the Television Service.

Of these procedures it was shown that discussion with members of the Project Team was the most popular with the managers and the most effective overall, in improving attitudes to the use of computers. Some evidence was found for a process by which discussions with the Project Team members influence particular aspects of the manager's attitude to computers, and this, in turn, leads to greater expectations of overall beneficial effects from the use of computers. There was also evidence that meetings with Project Team members tended to counteract a deterioration in attitudes to the use of computers which was associated with extra work caused by the computer.

CHAPTER 8

Conclusions

The research described in this thesis has identified factors which helped or hindered the design and implementation of a computer-based MIS in the Television Service of the BBC. A brief description of those factors is given below.

8.1 Organisational and Managerial Factors

The case study (chapter 5) identified the following factors which helped to promote the success of the Television MIS project.

The project was controlled by an interdepartmental Steering Group of senior managers. This ensured that the interests of all types of department were represented in that control and that when the new procedures were implemented there was sufficient authority behind them to sway managers who were reluctant to change.

The Project Team who designed and implemented the MIS consisted of line managers from all types of department and systems analysts. This brought a wide range of skills to bear on the project and helped in ensuring that the system was designed to assist managers in all departments rather than managers in one department, or the computer.

Personal contact between members of the Project Team and the users of the system has been an important factor in the success of the project. This was particularly noticeable in the early stages of the implementation when all printouts were delivered and interpreted by members of the Project Team. Further evidence for the importance of this factor was provided by the survey of users of TMIS (section 8.3).

The case study also identified the following factors which delayed the TMIS project.

The time which elapsed before managerial procedures for the use of TMIS were decided and correct data for TMIS was collected and agreed, could have been reduced if the users had given the TMIS project higher priority than they did. The users did have tasks which needed higher priority than that of assisting the TMIS project, but I think that TMIS could have been given higher priority without seriously disrupting the production and transmission of programmes.

In many cases, those managers who were attached to the Project Team part-time were only able to give a very limited amount of time to the TMIS project, because of the pressures of their other work (even more limited than might be expected). The fact that programmers were members of a central department rather than members of the Project Team hindered communication between systems analysts and programmers and caused difficulties because of the lack of continuity of programmers working on the project. These two factors emphasise the importance of having people working full-time on the MIS project. Part-time management members of a project team will be able to make some contributions but full-time members are essential.

There has been a lack of really widespread communication on TMIS and this may well have contributed to the low priority given by some managers to work done for the TMIS project. Senior management and those in direct contact with the Project Team have been kept well informed by the Team, but the information did not appear to go much further. (This situation has recently (October 1970) been improved by the initiation of a simple-language newsletter produced by the Project Team and widely circulated whenever new developments in the project warrant it).

8.2 The Evolution of TMIS

The evolution of TMIS demonstrates ideas which are probably applicable in many MIS. For a start there is the fact that TMIS is evolutionary. This evolution has enabled a fairly large and complex system to be produced by a team which has only contained about 10 or 12 full-time members for most of its existence. It has made it possible to implement the system without causing any serious disruption in the day-to-day running of the Television Service, an essential requirement for a system in a broadcasting organisation. If just that part of TMIS which has been implemented so far, had been designed and implemented all at once, it would have required a very large project team and would probably have caused considerable disruption.

The evolutionary nature of TMIS has meant that the system had to be designed to be as flexible as possible and that continuity of staff working on the project was important. The management changes which were introduced as a result of the consultants' and the Project Team's suggestions increased the number of system changes necessary during the evolution of TMIS and emphasised the need for flexibility. These changes together with the lack of flexible software (such as data management software) increased the timespan of the project.

The order in which the parts of TMIS were developed is probably applicable to many production (rather than servicing) organisations (see also (68)). The first part to be developed (the Programme File) covered the products of the organisation in descriptive terms and in terms of the resources needed for their production (including money). This gave the ability to cost the products. The system went from this to production

planning and control (the Loading File) and then to departmental budgeting and cost control (the Cost File). The next steps planned for the project are detailed production scheduling and the linking of distribution planning (transmission planning in the case of the Television Service) to the rest of the system. The importance of starting with the products and basic operations on those products is emphasised by the way in which lack of basic information contributed to the postponement of one of the independent applications (Material Available, section 5.4.)

8.3 The Effects of TMIS

It is too soon for a clear picture to have emerged of all the effects which TMIS is having and will have on the Television Service. The improved availability of information should improve planning and control in all departments. The effect which is being aimed at is co-ordination of the Television Service rather than monolithic integration. The decentralisation of authority to producers is now the result of a policy decision rather than the inevitable result of the complexity of the Television Service. The only probable change in departmental roles is that some of the coordination between production and servicing departments previously done by Programme Planning will now be done by the departments themselves, using TMIS.

8.4 The Pilot Model

The pilot model (chapter 6) has shown both the usefulness of such pilot models and the limited usefulness of a computer-driven visual display in the area of TMIS which was modelled. The pilot model successfully involved a potential user and convinced him of the usefulness of visual displays in the Programme Planning Department. It stimulated interest among

those managers to whom it was demonstrated and helped to convince some of them of the potential usefulness of computers in the Television Service. It provided some ideas for the design of TMIS. However, its usefulness could not justify the cost (in both hardware and software) of using a visual display in the equivalent part of TMIS. The pilot model, too, showed the problems arising from the lack of flexible data management software.

8.5 The User Survey

The questionnaire survey of users (chapter 7) provided evidence for the managers' having general attitudes to the use of computers. These attitudes were found to be related to the effects which the use of the computer had on the managers' jobs and the effects which it was expected to have on the distribution of authority in the Television Service. Decentralisation was regarded by most managers as beneficial for the Television Service.

Lectures on TMIS and discussions with members of the Project Team did appear to have a favourable influence on the managers' attitudes to the use of computers. However, this influence was no greater than that of the managers' contacts with computers in everyday life. This implies that those who have the job of implementing an MIS cannot expect to have a major effect on the attitudes of its potential users.

The survey gave further evidence for the importance of personal contact between the designers of the MIS and the users. The most popular and generally successful influence on managers' attitudes was discussion with members of the Project Team. This evidence supports the idea that the involvement of users in the design of an MIS makes them more favourably inclined towards it.

Attendance at demonstrations of the pilot model also appeared to have a favourable influence on attitudes to the use of computers in the Television Service.

The questionnaire survey has also showed that this form of evaluation of an MIS is feasible and could be very useful. Although some of the results of this survey had been observed by members of the Project Team in their discussions with users of TMIS, the questionnaire covered many more people and enabled them to express their opinions anonymously. A much shorter questionnaire than the one used for this survey could be used to measure the users' satisfaction with the system. It could collect suggestions on future developments of the system as well as evaluating the current state of the system and the distribution of information about the system. A sociologist on the project team could provide a useful contribution in this area as well as in the design of the system.

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APPENDIX A

Users' Specification of RAPS (The Pilot Model)

This Appendix was originally published as C.C.A. Computing Science Section Report No.5. It has its own section numbering system and Appendices, separate from the rest of this thesis. All references in this Appendix to sections, Figures and Appendices are references to Appendix A of this thesis only.

R A P S

RESOURCE ALLOCATION AND PROJECT SCHEDULING -

USERS' SPECIFICATION

by

P.M. GRAY

September 1968

One project being undertaken by the Management Group in the Computing Science Section is the evaluation of the use of a graphical display by managers faced with allocation decisions. The project is being carried on in collaboration with BBC Television, and this report is a specification of the pilot system, which is now being used for education, experiment and evaluation. Further reports will be issued to describe the program in detail, and the use made of it. The first of these is C.C.A. Computing Science Section Report No. 6

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1. INTRODUCTION

RAPS is a system designed to help managers schedule projects and allocate resources to the projects with the help of a computer and visual display. We think that this is a very general management problem occurring in both production and service industries. The system has been designed in co-operation with a number of people in BBC Television who are setting up a Management Information System. The BBC-TV Computer project Team are responsible for the design of the MIS and the Programme Planning Department are the potential users of that part of the system for which RAPS is a pilot model. The projects in this case are television programmes. The decisions as to which programmes to produce are made by the Controllers of the two BBC channels. The programmes are produced by the various Production Departments (e.g. Drama: Plays, Light Entertainment: Comedy, Schools) using resources of equipment and staff (e.g. film cameras and crews, costume supervisors) supplied by the various Servicing Departments and money made available for the production of programmes (known as Programme Allowance). Since most (85%) programmes are recorded on video tape most of them can be scheduled independently of transmission time by Programme Planning. The amounts of the resources allocated to each project are decided jointly by Programme Planning, Production Departments and Servicing Departments. It is hoped that a system such as RAPS will help in this scheduling problem.

2. EQUIPMENT TO BE USED

PDP-7 with 8K store, 340 CRT display, 370 light-pen, ASR 33 teletype, paper tape reader and punch.

3. PURPOSE OF SYSTEM

To provide a pilot model and demonstration of a system to facilitate the scheduling and costing of a number of projects. The projects may be serials, series or individual productions and will use a range of available resources with a specified pattern of resource usage over a known period. The CRT display is used to show histograms of resources already allocated on a time scale of thirteen one week periods and to show the total Programme Allowance cost, so that the scheduling of further projects may be made more effectively. The system is designed to be easy to use and difficult to misuse. Error messages are provided in the event of any misuse.

4. PROGRAM FACILITIES

The program is based on two data files: a resource file containing details of the resources and patterns of resource usage, (referred to as 'spreads') and a project file.

4.1 File set-up. Details of the resources available (with their units, capacities and costs) and spreads of resource usage are entered through the typewriter or paper tape reader (See 7.) Details of the projects (with resource requirements and descriptive information) are also entered through the typewriter or paper tape reader. Projects entered will appear on the displayed histograms in the form of allocations of the appropriate resources (See 9.)

4.2 Working facilities. At any time during the use of the program, amendments may be made to certain parts of the resource and project files. Resource availabilities and allocations may be altered and projects may be rescheduled. Details of resource usage may be typed on request for any one resource in any one week, to study potential problem areas (FIG.4). The program has two modes for loading the resources allocated on to the histograms. They may be loaded on the production week of each programme or they may be spread over a period of weeks as specified in the files. The mode for loading may be altered at any time during the use of the program and all projects will be reloaded in the new mode.

4.3 Output facilities. At any time the contents of the files may be punched on to paper tape for subsequent re-reading by the program. Lists of the projects with their resource allocations may be printed out by Production Department in the form of Production Schedules (FIG. 6) or by Servicing Department in the form of Servicing Schedules (FIG. 7).

5. THE DATA BASE

The main items of data are the descriptions of each resource and the project descriptions, which are both referred to as records.

5.1 Resources. Each resource is identified by a name of up to eight characters in length and is defined by the descriptive details as shown in FIG. 1.

The internal capacity (INT.CAP) is the amount of that resource available per week within BBC television (i.e. the establishment) in terms of the units given. The name of the units may be one or two characters long. The total capacity (TOT.CAP.) is the internal capacity plus either the maximum number of supernumerary posts allowed or the maximum external hiring allowed. The SET LIMIT is used in listing the resource usage for one resource in one week to study overloaded weeks in detail. Details of the resource usage of projects using the SET LIMIT or more of the resource in that week are printed (FIG.4). The COST RATE is the cost per unit of the resource which is paid out of servicing reserves. This cost will only apply to supernumerary posts or external hire and is expressed in shillings (S) or pounds (represented by £ because of the keyboard used). The % OFFSET is a measure of the extent to which external costs will be reduced by re-timing of work and adjustment of effective staff levels by the appropriate timing of 'Compensatory Leave' during the quarter being considered. For example, if there is an offset of 60% on a resource, 60% of the total unused resource below the internal capacity line on the histogram is subtracted from the total amount being used above the internal capacity before the external cost is calculated (see 6.5). The SPREADS are distributions of resource usage, one of which is specified for each project using the resource. The figures are percentages of the total amount allocated to the project. They cover a period of six weeks, and up to seven spreads are allowed for each resource.

5.2 Projects. A project may be one programme, a series or a serial. It is identified by a four digit project number, the first two digits specifying the production department (Appendix C). Other details are as shown in FIG. 2.

The title may contain up to twenty characters. The program allowance (PROG. ALL.) is in pounds and may take any value up to 99999. The production weeks (PROD WEEKS) are the weeks in the quarter in which the programs of the project are in a studio for recording or transmission. The five resources considered are film shooting, scenic construction, scenic design, costume and make-up. The total amounts of resource used are given in the units of that resource. If the project is a serial or a series the amounts refer to one episode or one programme of the series. The spread number following a resource refers to the list of spreads in the record for that resource.

6. PROGRAM STATES AND OPERATIONS

RAPS carries out its different types of data manipulation in a number of different states. While in any one of these states it will only recognise instructions (typed messages or light-pen signals (see 6.1)) relevant to that state. Certain user instructions will change the state of the program (see Fig. 8.).

The basic program state is the neutral state, which the program is in when it is first started. The other four states, which may all be reached from the neutral state, are the R, M, P and O states. These may be entered by typing R, M, P or O respectively, followed in each case by carriage return, while the program is in the neutral state. These states may only be entered from the neutral state and to change from one to another the program must go via the neutral state. The R state is used for all of the user's operations on the resource file. The M state is used for alterations to the total P.A. available. Since P.A. is not time dependent within the quarter no histogram is displayed for it and it is not included with the other resources. The P state is used for the user's operations on the project file. It is in this state that the scheduling and planning operations are performed. The O state is used for producing the Production and Servicing Schedules (the major items of output).

All instructions typed in by the user are terminated by a carriage return. In each case the program will respond with a line feed to reassure the user that his instruction was accepted, followed in some cases by further typed information. As far as possible the typewriter tells the user what is to be typed next and an error message is typed out if anything invalid is typed by the user.

7. THE DISPLAY AND LIGHT-PEN OPERATIONS

A typical display is shown in FIG. 3. It has five parts: down the left-hand side is a list of resources, in the centre the histograms show the amount of the resources committed over a period of thirteen weeks, down the right-hand side and above the histograms are cost figures for individual resources and total cost respectively, below the histograms the full details of one project are displayed and to the right of the project details are the control words.

7.1 Use of the Light-pen

The light-pen is used to indicate actions to be carried out by the program. This is done by opening the shutter of the light-pen as it is pointed at various parts of the display in sequence (referred to as 'identifying' these parts of the display). Each valid identification causes a response either on the display or the typewriter, so that the user is confident his action has been recognised.

7.2 Display States

The display may be in one of three states:

(1) Passive

(2) Ready

(3) Active

In the passive state the display does not react to light-pen identifications. It remains in this state until the program enters the P state when the display goes to the ready state. When the display is in the ready state any one of several courses of action may be taken by the user. As soon as he has embarked on one of these courses, the display is in the active state, and only certain sequences of identifications are valid (see 9).

7.3 Identifiable items

There are four parts of the display where identifications may be made with the light-pen:

(1)	RESOURCE	The name of any resource to the left of the histograms.
(2)	WEEK	Any of the week numbers appearing below the histograms.
(3)	PROJECT DETAIL	The word SPREAD which appears in the project description or the name of any of the other details (e.g. PROG. ALL. or DESIGN) except the project number.

(4) The control words ERROR, SPREAD and NON-SPREAD

7.4 Resource Capacities

Capacities are specified when the resource file is set up. If the total capacity of any resource is exceeded in any week, the resource name is underlined (see FIG. 3). The underline remains until enough projects have been rescheduled or cancelled to bring the resource usage below the total capacity. A warning message is also typed when a resource is overloaded, e.g. USAGE OF DESIGN IN WEEK 47 = 241 DY TOT. CAP. = 220 DY. The internal capacity is shown on a histogram by a dotted line and the total capacity by the solid line above this.

7.5 Cost figures

The cost figure displayed to the right of each histogram is the external cost of that resource for the projects being produced in the quarter under consideration. To get this figure, any unused internal resource, i.e. where the histogram drops below the internal capacity, is summed, multiplied by the % OFFSET for that resource and subtracted from the sum of the resource usage above the internal capacity. This result is then multiplied by the external cost per unit (COST RATE) of the resource to give the cost figure which is displayed in units of a thousand pounds. The P.A. in the totals at the top of the display is the sum of the programme allowance of all projects being produced in the quarter and the servicing total is the sum of the external resource costs. When the balance becomes negative this is indicated by the appearance of the word OVERSPENT to the right of the value.

7.6 Control words

The control word ERROR is used to return the display to the ready state, e.g. if the user has identified the wrong project detail.

The control words SPREAD and NON-SPREAD are used to alter the mode of loading of the last three resources (DESIGN, COSTUME and MAKE-UP). SHOOTING and CONSTR. are always loaded on the histograms using the spreads indicated in the project records as this is the current practice. The other three may be loaded on the production week, as in current practice, (the NON-SPREAD mode), or over several weeks using the spreads (SPREAD mode). Only one of the two control words, SPREAD and NON-SPREAD, is displayed at any time, showing in which mode the histograms are loaded. If the one being displayed is identified all the projects are reloaded in the other mode and the other control word is displayed.

8. THE R STATE

After the user has typed R and carriage return in the neutral state, the program goes to the R state and responds with a line feed. The user now has a choice of three things to type: a resource name, READ or PUNCH. If anything else is typed the program responds with a line feed and ?

If a resource name is typed and the details of that resource have already been entered, they are printed out as shown in FIG. 1. If the details of the resource are not in the file the program produces the left-hand part of FIG. 1 line by line. The user must type the "value" of the description followed by a carriage return, e.g. DY and carriage return, 180 and carriage return, for each line. If less than seven spreads are required the user may type carriage return only instead of a spread and this resource record will be regarded as complete. If seven spreads are typed in the program will type a message to indicate that this resource record is full and will then return to the basic R state. If the user wishes to cancel a resource while typing in its details, he types $ followed by carriage return instead of any of the details apart from a spread. This causes the program to return to the basic R state without keeping the details of the resource. However, once the value for the % OFFSET has been typed in and accepted by the program the resource cannot be cancelled.

If alterations are to be made to a resource record already in the file, these are typed in after the current information on that resource has been produced by the program. Any of the details may be altered apart from the resource name and the spreads. To make these alterations the user must type the whole line corresponding to the detail to be altered followed by carriage return. Spreads may not be altered but new spreads may be added if there are less than seven already defined. The program will respond with a line feed after accepting an alteration. Alterations will continue to be accepted until the user types a line containing carriage return only, when the program returns to the basic R state.

The program checks the values typed in both for a new resource and for alterations to an old resource. Error messages are typed if the name or units have too many characters, if the % OFFSET is greater than 100, if the sum of the parts of any spread is not 100 or if more than six weeks are typed in for a spread (Appendix B). If seven spreads are included when the details of a resource are first typed in, after the seventh the program will type a message indicating that the resource record is full and will then return to the basic R state. The spread numbers for any spreads added as alterations to an already existing resource record should be sequential to those already in the record. If there are five spreads in the records and a new one is typed in with the number 7 it will be renumbered 6 by the program and a message will be typed to indicate this.

If PUNCH is typed while in the R state the program will punch a paper tape of the contents of the resource file in binary code. If there are no resources in the file an error message will be typed. To read a tape, produced in this way, back into the resource file it must be loaded into the tape reader and READ typed with the program in the R state. Anything already in the resource file will be overwritten. The tape is punched with a title (R) and if a tape with any other title has been put in the reader an error message will be typed. The tape is punched in the opposite direction to that in which it is read.

If a carriage return on its own is typed while the program is in the basic R state, it will return to the neutral state. The same rule applies to the M,P and O states.

Owing to a shortage of core store on the computer available the number of resources is restricted to five. An error message will be typed if the user tries to enter a sixth resource.

9. THE M STATE

The program responds to M, carriage return with a line feed and TOTAL PROG. ALLOWANCE £K followed by a value (the £ should be read as £). If one has already been typed in it will be this value otherwise it will be zero. In either case the user may then type a new value for the total program allowance followed by a carriage return. The new value is stored by the program and the previous value is lost. To keep the same value the user just types carriage return without a new value. The program responds to the carriage return with a line feed and returns to the neutral state. If the value typed in was not an integer number the program starts again as if the M state had just been entered.

10 THE P STATE

The program responds to P, carriage return with a line feed and then waits for a project number, PUNCH or READ, each followed by a carriage return. If a carriage return only is typed the program returns to the neutral state. Anything else typed in produces the response line feed followed by ?

If a project number, which is not in the project file, is typed the program types the left hand part of FIG. 2, line by line (e.g. PROG. ALL), and the user types in the "value" for each line followed by carriage return. As for the resources the program checks that only integers are typed where the value should be an integer and that the title does not contain too many characters. It also checks that the spread numbers given for each resource are not higher than the number

of spreads available for that resource. Each resource allocation is checked to see that it is not greater than 32767 (a limit set by the size of the computer word) and the program allowance is checked to see that it is not greater than 99999. If the value typed in for any resource allocation is zero the spread number for that allocation must be zero too.

When the user types a project number which is in the file the details are shown on the display screen (FIG. 3.) Alterations to the project details are made using the light-pen and the typewriter.

The possible course of action using the light-pen are:

1) Identify (see 6.1) one of the names of the displayed project details apart from PROJECT or SPREAD, e.g. PROD WEEKS, and type in the new value of that field. If the user wishes to change the spread number associated with a particular resource usage he must first identify the word SPREAD in the project details and then the resource name before typing the new spread number. When a name has been identified it goes dim so that the user may check which one he has identified.

2) Identify a resource name in the list to the left of the histograms and then a week number under the histograms. This produces a typed list of the projects using the SET LIMIT or more of the resource in that week (see FIG.4). The resource name goes dim when it is identified.

3) Identify which ever of SPREAD or NON-SPREAD is showing to alter the mode of loading of the histograms (see 6.6)

Either of the first two sequences may be terminated when incomplete and the display returned to the ready state by identifying ERROR. If an invalid identification is made (i.e. one not in one of the above sequences) an error message is typed.

To obtain a paper tape of the contents of the project file in alphabetic (ASCII) code, the user types PUNCH in the P state. The format of the contents of a tape for two projects in the file is shown in FIG. 5. The lines are separated by carriage return, line feed pairs and the project records are separated by lines containing *. The tape starts with a line containing the title P and a blank line and ends with a line containing $. A tape such as this is read in by the user typing READ in the P state. If this is done with a tape without the title P on the first line an error message is typed. Error messages are also typed if invalid data is found on the tape.

A tape in alphabetic code is used for the projects so that a tape can be produced on a teletype other than that on the computer to save computer time.

Owing to limitations of the equipment being used there is room for only 110 projects in the project file. An error message will be typed if the user tries to enter more than 110.

11. THE O STATE

The program responds to C, carriage return with a line-feed. The user may then type in the BBC-1 code number of a production department to obtain a Production Schedule of all projects (both BBC-1 and BBC-2) being produced by that department. The code numbers for the production departments are given in Appendix C and a sample Production Schedule in FIG. 6.

If the user types in a resource name a Servicing Schedule for that servicing department is produced. The schedules for Design, Costume and Make-up all have the same format. The three types of Servicing Schedule are shown in FIG. 7.

A carriage return on its own returns the program to the neutral state.

If anything other than the messages described above is typed the program responds with a line feed and ?.

12. PRAGMATICS

This program, in considering the thirteen weeks, 37 - 49, is different from a full scale system which would display histograms for a section of a large data base containing data for the weeks preceding and following the quarter displayed. Because resource allocations are spread over a period of up to five weeks before the production week, part of the resource loading on weeks 45 to 49 would be due to programs being produced after week 49. Since these programs are not included in this pilot model the histograms would tail off towards the end of the quarter if they were loaded in the normal straight-forward way. To overcome this difficulty and produce a closer correspondence with a full scale system the resource allocations, of programs early in the quarter, which would fall in weeks 32 to 36 are loaded on weeks 45 to 49. This idea of "knock-back" is used when a paper tape of projects is read in and the histograms built up, and whenever the mode is changed from SPREAD to NON-SPREAD or vice-versa. It is not used when a project is added or altered via the typewriter in order to make the scheduling manipulations more realistic. In this latter case any resource allocations falling outside the quarter being planned are ignored and any allocations loaded on the

histograms by the "knock-back" effect are not changed. The routine which types details of resource usage for one week ignores "knock-back" loadings in weeks 45 to 49.

13. ACKNOWLEDGEMENTS

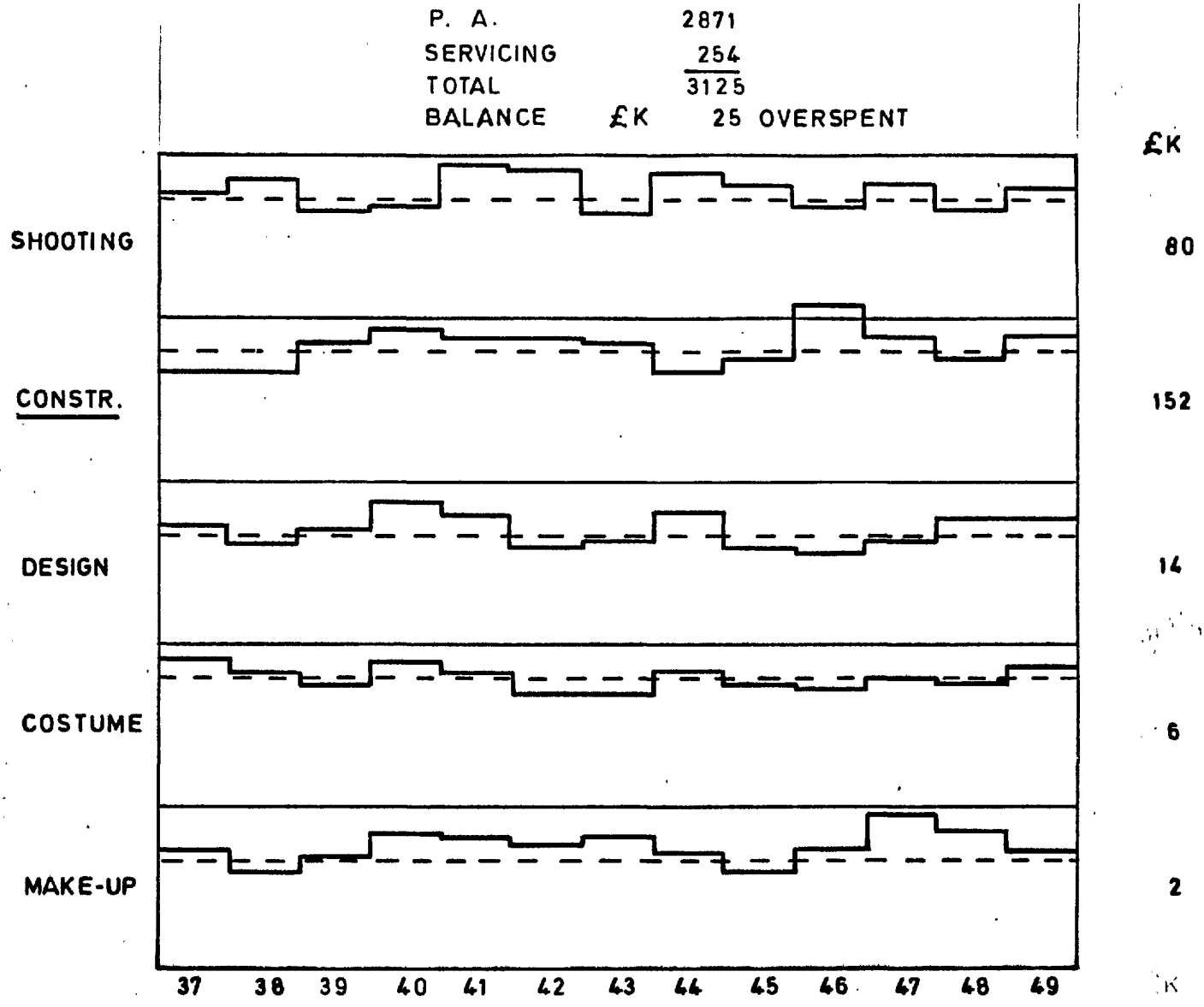
This specification is based on an original idea by P.L.Cloot and was developed with considerable help from D.M.V.Jones, C.W. Lashmar and A. Dobson of the B.B.C. Television Service. The work has been supported by a Science Research Council grant to study the effect of computers on management, and the equipment used is provided in part by the Ministry of Technology.

```
DESIGN
  UNITS    = DY
INT. CAP.  = 180
TOT. CAP.  = 220
SET LIMIT  = 20
COST RATE  = 15 $
% OFFSET   = 60
SPREAD  1  = 0,0,10,20,70,0
SPREAD  2  = 0,0,0,70,30,0
SPREAD  3  = 50,20,0,30,0,0
```

FIG. 1 : RESOURCE DESCRIPTION

```
4812
TITLE       HORIZON
PROG. ALL.  8000
PROD WEEKS  41  44  47
SHOOTING    5
SPREAD      3
CONSTR.     200
SPREAD      3
DESIGN      5
SPREAD      2
COSTUME     0
SPREAD      0
MAKE-UP     20
SPREAD      4
```

FIG. 2 : PROJECT DESCRIPTION



PROJECT : 1248
TITLE : HORIZON
PROG. ALL. : 8000
PROD WEEKS : 41 44 47

		SPREAD	ERROR SPREAD
SHOOTING	5 DY	3	
CONSTR.	200 HR	3	
DESIGN	5 DY	2	
COSTUME	0 HR	0	
MAKE-UP	20 HR	4	

(NB. THE MONEY FIGURES IN THIS DIAGRAM ARE FICTITIOUS)

FIGURE. 3 THE DISPLAY

OVERLOAD FACTORS : SHOOTING WEEK 43

SET LIMIT = 4 DY

AMOUNT	PROJECT	TITLE	PROD WEEK
4	01/42	WEDNESDAY PLAY	44
4	01/42	WEDNESDAY PLAY	45
5	41/31	THEATRE 625	44

FIG. 4 : PROJECTS USING THE SET LIMIT OR MORE IN ONE WEEK

```
P

0142
WEDNESDAY PLAY
8000
44 45 46
8
1
1000
3
35
2
150
4
120
6
*
4812
HORIZON
8000
41 44 47
5
3
200
3
5
2
0
0
20
4
*
$
```

FIG. 5 : CONTENTS OF PROJECT TAPE

PRODUCTION SCHEDULE : DRAMA PLAYS

PROJECT NUMBER	TITLE	$PA	PROD WEEK	SHOOT DY	CON HRS	DES DY	COS HRS	M/U HRS
01/03	WEDNESDAY PLAY	8000	39 47 49	5	1200	30	210	96
			42	5	1200	30	210	96
01/53	BOY MEETS GIRL	5000	41 45	3	850	20	150	60
			48	3	850	20	150	60
41/01	30 MINUTE THEATRE	2000	37 39 41 43 45 47 49	0	350	12	80	25
			38 40 42 44 46 48	0	350	12	80	25
41/31	THEATRE 625	8000	39 47	8	1400	40	230	120
			44					

FIG. 6 : PRODUCTION SCHEDULE

SERVICING SCHEDULE : SHOOTING

START WEEK	TITLE	PROJECT	SHOOTING ALLOC	SHOOTING WEEK	PROD WEEK
35	SOFTLY SOFTLY	03/05	3	35	37
36	WEDNESDAY PLAY	01/03	2	36	39
			2	37	
			1	38	

SERVICING SCHEDULE : CONSTR.

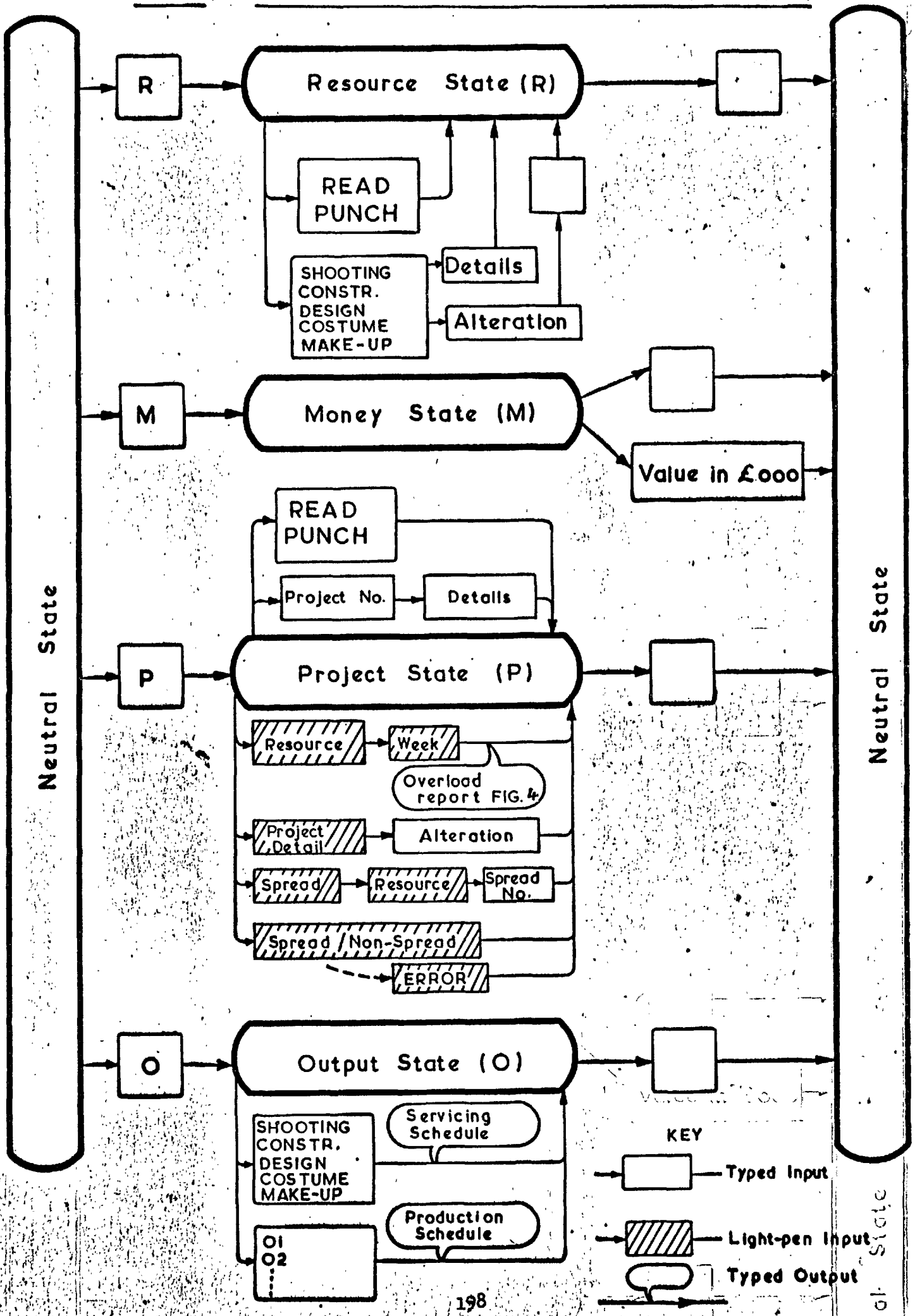
START WEEK	TITLE	PROJECT	SHOOTING ALLOC	SHOOTING WEEK	PROD ALLOC	PROD WEEK
36	WEDNESDAY PLAY	01/03	300	36	900	39
37	SOFTLY SOFTLY	03/05			800	37

SERVICING SCHEDULE : DESIGN

START WEEK	TITLE	PROJECT	ALLOC	SPREAD	SHOOTING ALLOC	SHOOTING WEEK	PROD WEEK
33	SOFTLY SOFTLY	03/05	20	4	3	35	37
34	WEDNESDAY PLAY	01/03	25	6	2	36	39
					2	37	
					1	38	

FIG. 7 : THE THREE TYPES OF SERVICING SCHEDULE

FIG. 8 STATE DIAGRAM FOR COMPUTER SYSTEM



APPENDIX A: SUMMARY OF OPERATOR INSTRUCTIONS

1. Typewriter Operations

Carriage return completes typewriter input message. Response is line feed.

Type in	Program Action	See FIG.
R	Go to R State	
PUNCH	Punch binary tape of resource file	
READ	Read " " " " " produced as above	
SHOOTING	First time request resource details one by one. Subsequent times type details in resource file.	1
CONSTR.	" " " "	
DESIGN	" " " "	
COSTUME	" " " "	
MAKE-UP	" " " "	
Any line from FIG. 1 (except resource name) with new value	Alter contents of resource file	
Nothing after alteration	Return to R state	
Nothing in R state	Return to neutral state	
M	Go to M state. Type TOTAL PROG. ALLOWANCE = ØK (value)	
Value	Update total P.A. Return to neutral state	
P	Go to P state	
READ	Read alphabetic tape of project file	5
PUNCH	Punch " " " " "	
Project No	If in project file, display details on CRT (see also light-pen operations)	3
	If not request details one by one	2
Nothing	Return to neutral state	
O	Go to O state	
Code No. of Prodn. Dept.	Type Production Schedule	6
Name of resource	Type Servicing Schedule	7
Nothing	Return to neutral state	

2. Light-pen Operations

The operations are carried out with the program in the P state.
Operator action results in identified item going dim.
Program returns to P state after each action.

Items Identified	Program Action	See FIG.
Resource, Week	Type details of projects using set limit and above	4
Project detail apart from Project no.	Await new value for detail from typewriter. Update display when new value accepted.	
SPREAD in project details, resource in project details	Wait for new spread number from typewriter. Update display when new number accepted.	
ERROR	Return display to ready state.	
SPREAD or NON-SPREAD	Alter allocation mode and reallocate all projects. Update display	

APPENDIX B: LIST OF ERROR MESSAGES

ACCEPTED AS 'N'	-	Spreads are numbered consecutively in the order in which they are typed in.
EOP	-	end of spreads - only 7 spreads are allowed per resource.
FLX	-	field length exceeded - too many characters typed in.
GTH	-	greater than a hundred - % OFFSET cannot be greater than 100%.
IPA	-	invalid programme allowance found on tape.
IPN	-	invalid project number found on tape.
IPS	-	incorrect pen sequence - display items identified in wrong order.
IPW	-	invalid production week found on tape
IRA	-	invalid resource allocation found on tape
ISN	-	invalid spread number found on tape
ITT	-	" title " " "
IWN	-	invalid week number - only production weeks 37 - 49 inclusive are accepted
NDR	-	numeric data required - character other than a digit found where an integer is expected.
NHP	-	not a hundred percent - sum of numbers in a spread should be 100(%)
NIN	-	none in - no resource or projects in file when output is requested.
NMR	-	no more room - the file or record into which you are trying to enter data is full
NRA	-	non-zero resource allocation - a zero spread number with a non-zero resource allocation is verboten.

NTL	-	number too large - a number is too large to fit into its place in a record even though it has a permissible number of digits
S/£	-	shillings or pounds (£) - COST RATE must be expressed in shillings or pounds
SNI	-	spread not in - a spread number, which is greater than the number of spreads available for that resource, has been used.
TMW	-	too many weeks - spreads cannot be more than six weeks long
WRT	-	wrong tape - tape being read does not have the expected title.

APPENDIX C: PRODUCTION DEPARTMENT CODE NUMBERS

BBC.1		BBC.2
01	DRAMA PLAYS	41
02	SERIALS	42
03	SERIES	43
04	LE COMEDY	44
05	VARIETY	45
06	FEATURES ARTS	46
07	GENERAL	47
08	SCIENCE	48
09	O.B. EVENTS	49
10	SPORT	50
11	MUSIC	51
12	DOCUMENTARIES	52
13	CURRENT AFFAIRS	53
14	CHILDRENS PROGRAMMES	54
15	RELIGION	55
16	PRESENTATION	56
17	SCHOOLS	57
18	FURTHER EDUCATION	58
19	CONTINGENCIES	59
20	RESERVE	60

APPENDIX B

The Questionnaire

This Appendix contains the questionnaire used in the survey of users and potential users of TMIS (see chapter 7).

From: Director of Programmes, Television

Room No. & Building: 6086 Television Centre Extn: 2945/2014 June 1970

Subject: TELEVISION COMPUTER PROJECT

To:

As you know, for the last four years, there has been a Television Computer Project. The aim of this project has been very simple. It has been to try to help the Television Service ensure that it is making the best use of programme money. I believe that it can help towards this end by producing quicker and better information than can be obtained by any other means, and indeed, undertaking planning calculations which simply could not be achieved without a machine.

But, of course, while the aim of the project is relatively simple, its achievement is not easy. It would be difficult in any organisation, and even more so in a fast-moving operation like Television. Many of the systems are coming into use now, and others will follow. The systems are not yet perfect, but everyone is working very hard to improve them. Simply because of this, we have to know how, and if, the system is being used, what is wrong with it and how it can be improved to be of greater use. It is, after all, the servant and not the master.

Many people have worked to create this system. Amongst them are the holders of the Television bursaries at Imperial College. They have also devised a questionnaire: its aim is to get a cross-section of Television staff's opinions about computers, and their usefulness in the Television context.

We need this information. Of course, you do not have to fill the questionnaire in if you do not wish to, but if you could find time it would be helpful for the reasons I have stated. Your answers will be treated confidentially. There will be no identified individuals, since the results will be published in terms of averages. To try to make it easier, possible answers to many of the questions have been provided so that you can just tick or mark your answer. It should take about 10-15 minutes to complete.

I hope you will feel you can help by filling in the questionnaire. A stamped addressed envelope is enclosed for its return.

David Attenborough

SRY (David Attenborough)

SECTION 1

This section is concerned with the use of computers in the Television Service and how this affects you.

1) Do you have any dealings with the computer, directly or indirectly?

Yes ☐ No ☐ Go to question 7

What you supply to the Computer

2) Would you please tell us about any information you supply to the computer. How many documents (actual sheets of paper) do you fill in to be sent to the computer, and how often do you provide information for a document to be sent to the computer, but do not actually fill it in yourself? In order to be explicit, we have classified the documents you may fill in and the information you may provide into two types, as indicated in (a) and (b) below. Please do not include any document or information provided under both (a) and (b).

None ☐ Go to question 3

(a) Documents filled in on a regular weekly basis:-

..... per week on average

Information provided on a regular weekly basis:-

..... times per week on average

(b) Documents filled in for a particular programme, at one or more times depending on the state of the programme:-

..... per programme on average

Information provided about a particular programme, at one or more times depending on the state of the programme:-

..... times per programme on average

If you fill in any documents or provide any information of type (b), please would you indicate how many programmes you deal with on average per year:-

..... per year

Whdt you get from the Computer

3) Would you please tell us now about any information you receive from the computer. Please tick just one of the columns for each printout which you receive personally or which you refer to but do not receive personally.

	Distributed to me personally	Refer to this printout, but not distributed to me
Strand Operating Plan/Statement		
Dept.Operating Plan/Statement (Progs).		
P.B.E./General Enquiry Printout		
Others (please specify)		
.....		
.....		
.....		
.....		
.....		

4) On average, how often do you refer to any computer printout in your work?

More than 3 times a day	☐
About 2-3 times a day	☐
About once a day	☐
About 2-3 times a week	☐
About once a week	☐
Less often than once a week	☐
Never	☐
Could'nt say	☐

5) How long is it since the first occasion on which you saw a computer printout from the Television Management Information System?

More than 18 months	☐
About 12 to 18 months	☐
About 6 - 10 months	☐
About 2 - 4 months	☐
1 month or less	☐
Have never seen one	☐
Don't remember	☐

How the Computer has affected your job.

6) We would like to find out how the computer has affected your job.

If you have changed jobs recently so that it is not possible for you to compare your job before and after the introduction of the computer, please tick the box below and go to question 9.

Have changed jobs recently ☐

On the whole, how has the computer affected the work you were doing before its introduction? Would you say it has been -

- A great help ☐
- A slight help ☐
- No effect ☐
- A help in some aspects, a hindrance in others. ☐
- A slight hindrance ☐
- A great hindrance ☐
- Don't know ☐

7) As a result of the introduction of the computer do you have to do any work that you did not have to do before?

Yes ☐ No ☐ Go to question 9

8) How do you regard the new work caused by the introduction of the computer? Would you say it is

- A great waste of time ☐
- A slight waste of time ☐
- Some a waste of time, some useful ☐
- Slightly useful ☐
- Very useful indeed ☐
- Don't know ☐

9) Has the computer made your job more or less interesting?

- Much duller ☐
- A little duller ☐
- No effect ☐
- A little more interesting ☐
- Much more interesting ☐
- Don't know/Can't say ☐

How the Changes have been explained to you

10) What do you think of the explanatory information you have received about the new management procedures (total costing, cost recovery, etc)?

Would you say it was

- ☐ Very informative. Told me all I needed to know.
- ☐ Quite informative. Covered most points, but not all.
- ☐ Mixed. Missed as much as it covered.
- ☐ Uninformative. Covered some points but missed most.
- ☐ Very uninformative. Told me almost nothing of what I needed to know.
- ☐ Have received none
- ☐ Don't know.

11) Have you been to one of the McKinsey "presentations" where one of their team described their proposals?

- Yes ☐
- No ☐
- Can't remember ☐

12) Have you been to one of the Computer Project Team's "Involvement Meetings" where the computer proposals were described?

- Yes ☐
- No ☐
- Can't remember ☐

13) How many times has any member of the Computer Project Team discussed the computer system with you?

- 0 ☐
- 1 - 2 ☐
- 3 - 5 ☐
- 6 - 10 ☐
- more than 10 ☐
- Can't remember ☐

14) Did you go to one of the demonstrations at Imperial College of a computer with a visual display?

- Yes ☐
- No ☐
- Can't remember ☐

15) What do you think of the explanatory information you have received about the computer system (meaning and use of printouts, input documents,etc)? Would you say it was

- [ ] Very informative. Told me all I needed to know.
- [ ] Quite informative. Covered most points, but not all.
- [ ] Mixed. Missed as much as it covered.
- [ ] Uninformative. Covered some points but missed most.
- [ ] Very uninformative. Told me almost nothing of what I needed to know.
- [ ] Have received none
- [ ] Don't know.

16) Do you have any suggestions for ways in which the communication of new management procedures and computer usage might be improved? If so, please give them.

None [ ]

.....

.....

.....

.....

How computers will affect Television

17) What effect do you think the use of computers will have on the centralisation of authority in the Television Service as a whole? Will the authority to make decisions be more concentrated in a few people or will the authority to make decisions be more widely spread throughout the Service?

- [ ] Very much more centralised
- [ ] Slightly more centralised
- [ ] Little or no effect
- [ ] Slightly less centralised
- [ ] Very much less centralised
- [ ] Don't know/Can't say

18) If you think that there will be a change in decision making authority, please say from whom and to whom, in general, the authority will be transferred.

.....

19) What effect do you think the use of computers will have on the freedom of your own department to make decisions?

- Very much more freedom ☐
- Slightly more freedom ☐
- Little or no change ☐
- Slightly less freedom ☐
- Very much less freedom ☐
- Don't know/Can't say ☐

20) What overall effect do you think the use of computers will have on the Television Service?

- Extremely beneficial ☐
- Slightly beneficial ☐
- No effect ☐
- Slightly adverse ☐
- Extremely adverse ☐
- Mixed effects ☐
- Don't know/Can't say ☐

21) Please give your reasons for your answer to question 20.

SECTION 2

Your other experiences with Computers

The aim of this section of the questionnaire is to obtain a general background of your experiences with computers.

22) Outside work, do you receive any bills, bank statements, etc. produced by computer?

Yes ☐
No ☐ } Go to question 5
Don't know ☐

23) Overall, how is the use of a computer affecting the services you get from banks, shops, Government departments, etc.

Very much improved services ☐
Slightly improved services ☐
No change ☐
Slightly worse services ☐
Very much worse services ☐
Varies/Depends ☐
Don't know ☐

24) Have you ever had to complain about an incorrect bill, bank statement, or other such document produced by a computer?

Yes ☐
No ☐
Can't remember ☐

25) Have you had any experience of working with computers before the Television Management Information System?

Yes ☐
No ☐ —— Go to question 29

26) Where did you obtain this experience of computers?

With the BBC ☐
Elsewhere ☐
Both ☐

27) What was the duration of this experience?

- 3 months or less ☐
- About 6 - 9 months ☐
- About 1 - 1½ years ☐
- About 2 - 3 years ☐
- More than 3 years ☐
- Can't remember ☐

28) What were your responsibilities with respect to the computer and what was your reaction to this work with a computer?

.....

.....

.....

.....

29) What do you think will be the overall effect on society of the use of computers?

- Extremely beneficial ☐
- Slightly beneficial ☐
- No effect ☐
- Slightly adverse ☐
- Extremely adverse ☐
- Mixed effects ☐
- Don't know/Can't say ☐

30) How has your experience, if any, of the use of computers in the Television Service changed your opinion of computers? Is your opinion now

- Very much less favourable ☐
- Slightly less favourable ☐
- Little or unchanged ☐
- Slightly more favourable ☐
- Very much more favourable ☐
- Don't know/Can't say ☐

SECTION 3

Personal Details

The information given in this section will be used to classify and compare the responses and not to identify individuals.

31) How long have you worked for the BBC?.....

32) What is your job?.....

33) Grade.....

34) Department.....

35) What previous jobs, outside the BBC, have you had, if any?

None ☐

.....

.....

.....

.....

36) What formal qualifications do you have?

Higher degree (M.A.,M.Phil.,etc.) ☐

Degree ☐

HND ☐

HNC ☐

Other degree level (please specify).....

A Level/ONC ☐

O Level ☐

Other (please specify).....

None ☐

37) Please list any professional organizations of which you are a member

None ☐

.....

.....

.....

.....

38) Finally, is there anything you feel we ought to know about the effects of computers that has not been covered in this questionnaire?

APPENDIX C

Tabulation of Responses to the Questionnaire

1) Do you have any dealings with the computer, directly or indirectly?

	Yes	No	No answer
Number	180	87	1
Percentage	67	32	

2) To standardise the responses to this question, they were converted to the number of documents filled in per year and the number of times information was provided for the computer system per year.

Documents filled in per year	Number	Percentage
0	165	62
1 to 99	63	24
100 to 999	27	10
1000 and above	13	5

Times information provided per year	Number	Percentage
0	182	68
1 to 99	44	16
100 to 999	33	12
1000 and above	9	3

Number of documents filled in plus number of times information supplied per year	Number	Percentage
0	135	50
1 to 99	58	22
100 to 999	56	21
1000 and above	19	7

3) Some of the TMIS printouts are produced in sets of related printouts. Thus in a few of the cases below the number of printouts is not clearly defined. This is mainly true for those receiving several printouts. The vast majority (of those who received any printouts) received one or two of the printouts quoted in the questionnaire.

Number of Printouts received personally	Number	Percentage
0	180	67
1	63	24
2	10	4
3	6	2
4 to 7	9	3

Number of printouts referred to but not personally received	Number	Percentage
0	205	76
1	47	18
2	9	3
3	7	3

4)

Frequency of reference to any computer printout	Number	Percentage
More than 3 times a day	6	2
About 2 - 3 times a day	3	1
About once a day	1	
About 2 - 3 times a week	12	4
About once a week	43	16
Less often than once a week	63	24
Never	47	18
Could'nt say	3	1
No answer	90	34

Of those who gave no answer to questions 4 and 5, 87 were directed past them by question 1.

5)

Length of time since TMIS printout first seen	Number	Percentage
More than 18 months	8	3
About 12 to 18 months	23	9
About 6 - 10 months	42	16
About 2 - 4 months	27	10
1 month or less	29	11
Have never seen one	41	15
Don't remember	9	3
No answer	89	33

6) 11 people (4%) had changed their jobs recently.

Effect of computer on work done before its introduction	Number	Percentage
A great help	10	4
A slight help	25	9
No effect	20	7
A help in some aspects, a hindrance in others	80	30
A slight hindrance	27	10
A great hindrance	9	3
Don't know	2	1
No answer	95	35

Of those who gave no answer to this question, 84 were directed past it by question 1, because of an error in the questionnaire.

7)

New work caused by the introduction of the computer	Number	Percentage
Yes	145	54
No	111	41
No answer	12	4

8)

Opinion of new work caused by the introduction of the computer	Number	Percentage
A great waste of time	13	5
A slight waste of time	20	7
Some a waste of time, some useful	50	19
Slightly useful	41	15
Very useful indeed	16	6
Don't know	3	1
No answer	125	47

9)

Effect of the computer on interest of job	Number	Percentage
Much duller	5	2
A little duller	19	7
No effect	174	65
A little more interesting	33	12
Much more interesting	14	5
Don't know/Can't say	14	5
No answer	9	3

10)

Opinion of explanatory information about new management procedures	Number	Percentage
Very informative	27	10
Quite informative	126	47
Mixed	63	24
Uninformative	6	2
Very uninformative	3	1
Have received none	32	12
Don't know	8	3
No answer	3	1

11)

Attendance at a McKinsey presentation	Number	Percentage
Yes	166	62
No	100	37
Can't remember	2	1

12)

Attendance at a Computer Project Team "Involvement Meeting"	Number	Percentage
Yes	41	15
No	225	84
Can't remember	1	1
No answer	1	

13)

Number of times computer system discussed with member of Project Team	Number	Percentage
0	172	64
1 - 2	48	18
3 - 5	18	7
6 - 10	7	3
More than 10	22	8
Can't remember	1	

14)

Attendance at Imperial College demonstration	Number	Percentage
Yes	19	7
No	248	93
Can't remember	1	

15)

Opinion of explanatory information about computer system	Number	Percentage
Very informative	7	3
Quite informative	50	19
Mixed	31	12
Uninformative	8	3
Very uninformative	4	1
Have received none	158	59
Don't know	6	2
No answer	4	1

16) Summary of Suggestions for Communication of new procedures

112 out of the 268 questionnaires analysed contained suggestions. Those which occurred more than once are listed below in order of frequency of occurrence with their frequency.

18 - General unspecific request, e.g., more information, wider distribution of existing "papers".

14 - Lectures, seminars, teach-ins.

11 - A single comprehensive document or handbook (rather than assorted memos).

11 - More involvement of users, particularly in early design stages.

9 - More user oriented examples and explanation, i.e., how the system affects the user personally.

8 - Short courses (anything from one to three days or even weekends suggested).

8 - Use better/simpler English. Don't use computer or administrative jargon or provide a glossary.

7 - A newsletter or circular (more oomprehensive and more widely circulated than the current one).

6 - More personal contact/informal meetings.

4 - More use of diagrams, flow-charts, etc.

4 - Provide proof or figures for benefits gained from system.

4 - Make a video tape or film about the use of computers in the BBC.

3 - Make sure the system designers and communicators understand the users' problems.

3 - Wider availability of printouts.

3 - More succinct descriptions.

2 - All information to be distributed from a single source.

2 - More on the input of information to the system.

2 - More explanation of printouts.

2 - Better communication about other departments' procedures.

2 - Direct communication by Heads of Departments at regular meetings.

17)

Effect of computer use on decision making authority	Number	Percentage
Very much more centralised	53	20
Slightly more centralised	54	20
Little or no effect	58	22
Slightly less centralised	22	8
Very much less centralised	26	10
Don't know/Can't say	51	19
No answer	4	1

18) The categories for responses to this open-ended question, on the transfer of decision-making authority, were developed from the responses received.

	Decision-making authority transferred	Number	Percentage
1	To line managers from senior managers or department heads and to department heads from Controllers (hierarchical decentralisation).	18	7
2	To heads of departments/Controllers from line managers/producers (hierarchical centralisation)	17	6
3	To producer/production department/line manager from Programme Planning/ administrative staff (functional decentralisation)	14	5
4	To Planning/finance/administrative staff from production staff/line managers (functional centralisation)	9	3
5	To producers/production departments/line managers	12	4
6	To Planning/finance department	4	1
7	To Controllers/heads of departments/ senior management	11	4
8	To those with access to/controlling the computer	2	1
9	To production departments from servicing departments	2	1
0	No change	9	3
+	Miscellaneous (e.g. level or department stated without saying from or to)	27	10
	No answer	143	53

19)

Effect of computer use on freedom of respondent's department	Number	Percentage
Very much more freedom	22	8
Slightly more freedom	34	13
Little or not change	115	43
Slightly less freedom	39	15
Very much less freeom	24	9
Don't know/Can't say	29	11
No answer	5	2

20)

Overall effect of computer use on the Television Service	Number	Percentage
Extremely veneficial	59	22
Slightly beneficial	86	32
No effect	8	3
Slightly adverse	20	7
Extremely adverse	8	3
Mixed effects	41	15
Don't know/Can't say	41	15
No answer	5	2

21) Reasons given for beliefs about the overall effect of the use of computers on the Television Service, with the number of times they were given.

Good effects

58 - Better/faster/more accurate information available

35 - Cost saving/improved cost control/improved cost consciousness

27 - Improved resource usage/awareness of resource usage

24 - Improved decision making

15 - Better forward planning

10 - Reduction in clerical/routine work, leaving more time for creative work

6 - Centralisation of information/decision-making

4 - Greater flexibility

Neutral or qualified good effects

33 - Depends on how they are used

18 - Computers not suitable for creative/artistic work

8 - Bad data currently going in to the system

7 - Good for administration/finance/ Programme Planning

5 - Needs correct data

Bad effects

21 - Too much attention paid to costs/computer system, resulting in lower programme quality or less time spent on programmes

21 - Inflexibility of system (particularly the difficulty of making changes to data in the system)

19 - Extra time spent on input or extra staff needed to provide input to TMIS

16 - Incorrect/unrealistic data on printouts

8 - Greater standarisation of programmes

7 - Expertise needed to deal with computer (and not available)

6 - Detailed data needed for TMIS before it can be given

5 - Computer is a bad way of dealing with a shortage of money. The money available should be spent on programmes.

Miscellaneous

12 - Too soon to say/don't know enough to say

3 - Faith

22)

Receipt of computer-produced bills, bank statements, etc.	Number	Percentage
Yes	259	97
No	4	1
Don't know	4	1

23)

Effect of computer use on bank services, etc.	Number	Percentage
Very much improved services	17	6
Slightly improved services	43	16
No change	70	26
Slightly worse services	78	29
Very much worse services	26	10
Varies/Depends	21	8
Don't know	1	
No answer	9	3

24)

Complaint about incorrect computer-produced document	Number	Percentage
Yes	145	54
No	108	40
Can't remember	6	2
No answer	9	3

25)

Previous experience of computers	Number	Percentage
Yes	34	13
No	233	87
No answer	1	

26)

Location of previous experience	Number	Percentage
With the BBC	15	6
Elsewhere	10	4
Both	9	3
No answer	234	87

27)

Duration of previous experience	Number	Percentage
3 months or less	12	4
About 6 - 9 months	10	4
About 1 - 1½ years	3	1
About 2 - 3 years	2	1
More than 3 years	3	1
Can't remember	2	1
No answer	236	88

29)

Overall effect on society of computer use	Number	Percentage
Extremely beneficial	64	24
Slightly beneficial	76	28
No effect	3	1
Slightly adverse	23	9
Extremely adverse	8	3
Mixed effects	67	25
Don't know/Can't say	19	7
No answer	8	3

30)

Effect of computer use in Television on respondent's opinion of computers	Number	Percentage
Very much less favourable	10	4
Slightly less favourable	28	10
Little or unchanged	167	62
Slightly more favourable	23	9
Very much more favourable	11	4
Don't know/Can't say	21	8
No answer	8	3