DISTRIBUTED DATA PROCESSING AND ORGANISATIONAL DECISION MAKING - MODERATORS, CONSEQUENCES & OPPORTUNITIES

Dissertation Submitted for the degree of M Litt

by

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to

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SYNOPSIS

Applications of distributed data processing systems are examined to determine what impact this technology has on management decision making. The research also looks at the problems these systems bring for users, how they affect relationships between users and data processing staff and what skills users need to acquire to make the best use of the technology.

A conceptual model is derived and empirical data to test it is obtained through two case studies on companies which have implemented distributed systems. Research shows that because the technology is under end user control, information systems better tailored to managerial need have resulted and system output tends to be used more directly in decision making by middle and top management than is the case for other computer based information systems. Moderating influences on systems application include the nature of the relationship between users and data processing staff, user computer expertise, model building skills and the extent of management support given to users.

The study concludes that greater emphasis on middle manager training is required by organisations planning to use distributed systems. This emphasises needs to include training in computer knowledge and model building skills and there is also a need to foster suitable linkages between data processing departments and end users. The potential for aiding decision making, particularly in less structured decisions is high, but this can best happen when users and data processing staff combine their expertise.

Further research is needed to determine the extent of model building skills in distributed system users and what factors inhibit the use of models by end users. Research is also required to ascertain whether distributed data processing has any industry specific managerial implications.

CHAPTER ONE

SOME IMPLICATIONS OF DISTRIBUTED DATA PROCESSING ON AN ORGANISATION

Introduction

This dissertation will concentrate on how distributed data processing systems impact on management decision making. It will look at the particular properties these systems have which provide new opportunities for managers and it will also explore what special skills and knowledge managers need to use the technology and what, if any, organisational structural changes and new relationships need to take place to exploit the technology. A secondary, but important area of study will be the attitude of specialist data processing management to distributed systems, since potentially at least these systems present a new organisational situation for data processing managers. It is the study's intention to examine this to determine what opportunities and problems distributed systems present to professional data processing management.

This chapter will however, take a more general look at distributed data processing by describing what it is and why it is used, and then go on to discuss some organisational implications which could result from the use of the technology. Finally, the chapter will pose some questions for possible research which will lead into chapter two where the research focus will be narrowed down to form the basis for the dissertation.

The Concept of Distributed Data Processing

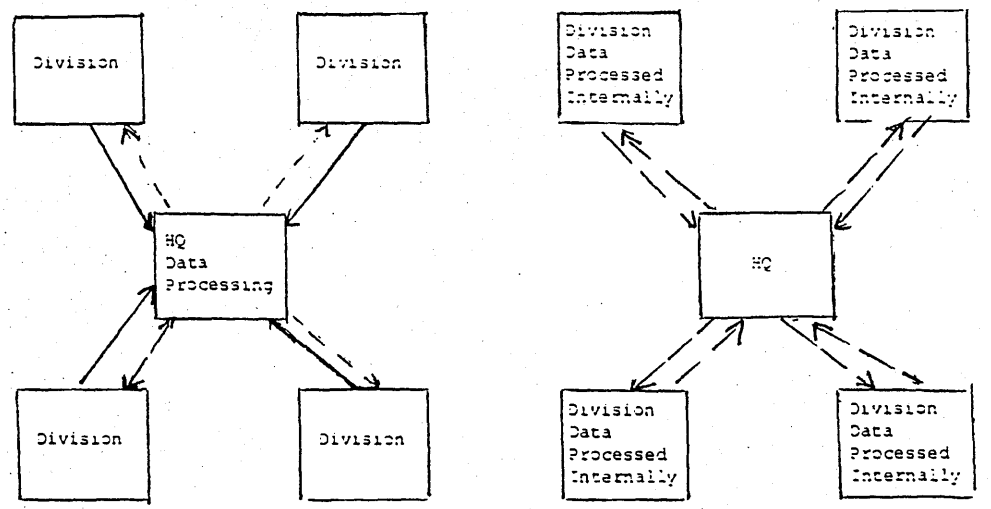
In the business world everywhere we look we can see a proliferation of computers and we are constantly reminded that we live in an information age. The very low cost of computers has meant that most organisations can now afford them and many people at work are finding that they must interface with computers whether they want to or not. At managerial level we are seeing and reading that apparently computers can greatly aid the manager in his work and help him with decision-making, whether routine or otherwise.

Advances in technology have meant that very sophisticated and powerful computing systems can now, at fairly low cost, be available for a manager who thinks he needs one. Since the 1960's a large number of studies have been carried out on the impact of computers on organisations, for example Whisler's (1970) study on the effect of computers on structure, management roles, work organisation etc. The bulk of these studies have seen computing as a homogeneous mass of technology and it was only with the advent of word processing that specific type of systems have been the centre of study on the organisational effects. These word processing studies thus recognised that the special properties of the new systems may have effects different to those observed or predicted by workers studying computer systems in general.

One type of system that has appeared since the late 1970's is that of distributed data processing (DDP). Special advantages have been claimed for this configuration as will be discussed later and it does appear, on a first look, to offer opportunities not previously available from other types of system.

Until recently an organisation had basically two choices available when structuring its management information system which Murdick and Ross (1971) define as a communication process in which information is recorded, stored and retrieved for decisions on planning, operating and controlling. It could opt for a fully centralized system where all data from the various divisions, branches or departments would be sent to the headquarters for processing to become management information used for planning and control: sometimes part of this information would be sent back to the originator of the data for use. All control of the processing of the data would be centralized however, as would most of the decision making. If computers were used then the various departments or divisions would simply use a computer terminal to send data to headquarters for processing.

Alternatively the organisation could choose to decentralize all the processing of data into information. The only information which would be sent to headquarters would be summaries which top managers would use mainly for longer term planning and control purposes. In effect this gave a large measure of autonomy to the, often geographically remote, departments or divisions and very little, if any, communications would exist between each of the decentralized computers. We can represent these two states of information processing as follows:-



Occasional flow of information — — — —

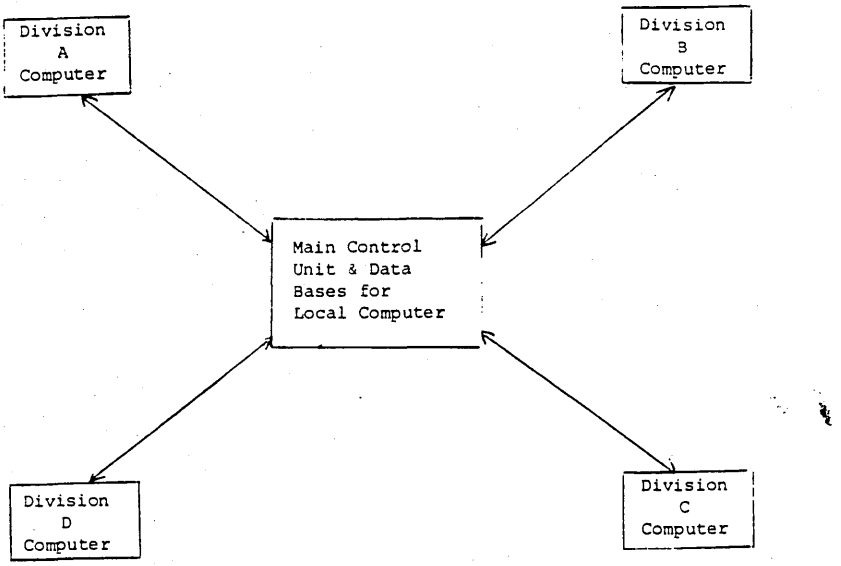
permanent flow

If computers were used the software required by each separate unit would be often tailor made and all files required locally would be generated and held there. They would be under the control of each autonomous unit, unlike the fully centralized case where all software design would be controlled by the centre and most files would be held centrally.

In the past few years the availability of small, low cost, yet powerful computers has tended to be a force for decentralization of information systems. Now however the new technology of DDP has emerged which offers the opportunity to combine the advantages of centralized information systems yet at the same time provides the flexibility of decentralized systems. Because DDP consists of many forms and is, as yet, not fully developed, there is no universally accepted definition. O'Brien (1979) calls it "a decentralization of data processing made possible by a network of computers dispersed throughout the organisation". Martin (1981a, p22) states "the term distributed processing is used to describe systems with multiple processors" while Longley and Shain (1982, p98) define the term as "...the processing of jobs at a number of geographically separated locations". Data processing tasks are done by data communication networks of various computers spread over a wide geographical area rather than relying on one large central computer. Vanacek et al (1980) describe it as "existing on a continuum between fully centralized and fully decentralized processing". The DDP system has some form of data sharing and overall system control. The majority of data collection and processing is handled by a local computer but there is some data sharing between all <u>distributed</u> computers and the central computer. Thus the overall system is usually held together by a central control processor but most of the work is done by the localised or distributed computer.

There are three main forms of DDP, "star", "loop" and "hierachical" shown below:

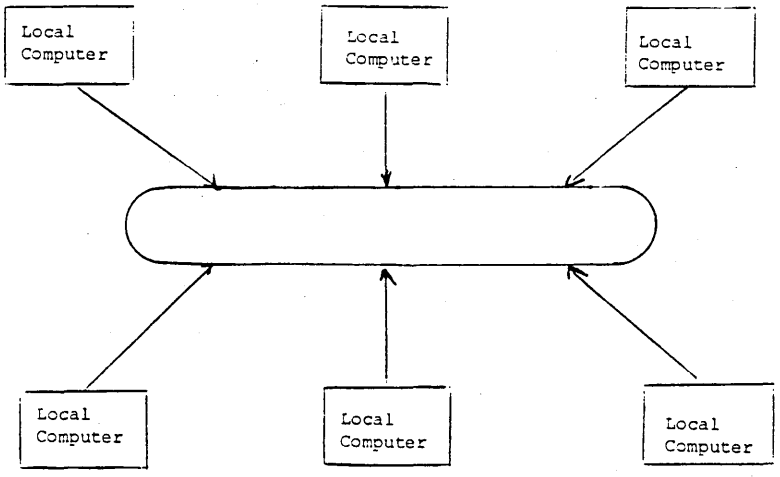
Star System



A B C D etc are local computers with local data bases.

In this case there is a main control computer and the local processing computers are not linked to each other directly but only through the main unit. This also acts to manage the overall system if required and can replicate the local data bases. There is a master data file with local files being updated occassionally as necessary.

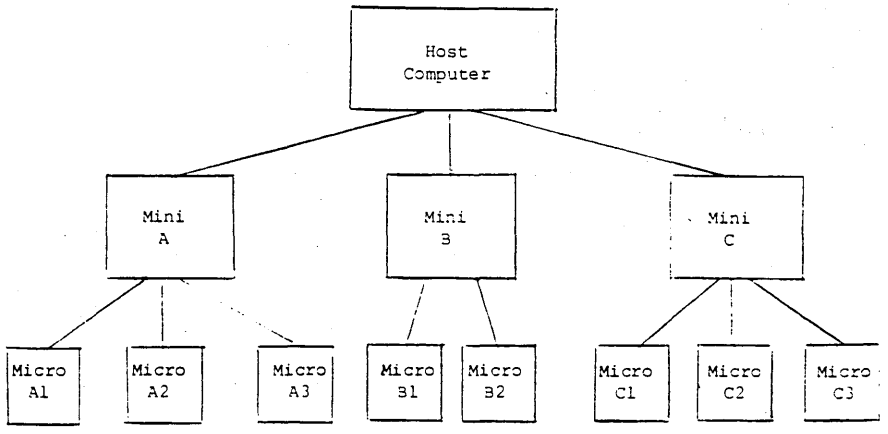
Loop



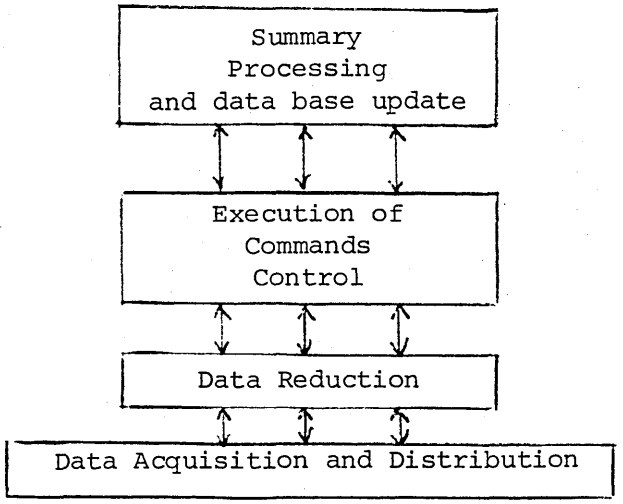
A loop system consists of a high speed uni-directional channel which is arranged as a closed loop or ring. Mini or microcomputers or peripherals can be attached. In this form any computer can send a message to any other on the loop by entering a message on to the ring. The message will then travel round the ring till it reaches the computer (or node) to which it is addressed. The local computers share system resources. This type of system is more widely known as a local area network and commercially available systems are sold as Ethernet, Wangnet, Cambridge Data Ring etc.

The hierarchical configuration consists of a tree strucure of mini or microcomputers and in general the capability of the processor increases as the top of the hierarchy is reached.

Hierarchy



Often the lowest level processors are highly specialised performing well defined tasks and sending data collected to the next level of storing. Most low level computers provide a quick response to events, eg in process control, and transmit results to the next highest level. The following diagram gives an example of task allocation for this kind of system. (From Weitzmann, 1980, p82)



Advantages of Distributed Data Processing

Despite the fact that computing has changed dramatically over the past twenty five years, DDP is likely to be more permanent than many other computing developments. It is a major fourth generation development and as Donaldson (1979) states, it places "computer power where the people and the problems are ". It does this by allowing the users to provide their own programming and operations functions while at the same time having some form of overall systems management. For example central staff can have authority to implement software applications that they require and they can provide advice and design application packages of use to all users thus ensuring overall systems compatability. Files used by one user can be made available to all users, thus DDP combines the best of both concepts of centralised and decentralised control. Also Statland (1980) writes that "the more the daily information needs of the individual users are unique, the greater the likelihood that the data processing tasks can be deployed profitably on to distributed minicomputers".

Some other advantages mentioned by authors are:-

1. It allows the organisation to change hardware incrementally, i.e. there is no need for major upgrading of equipment just because one or two users have reached the limit of their equipment. (Vanacek, 1980)

2. The system has in-built redundancy (in the engineering sense that is some parts are not always needed) ie if one local computer fails it will not close down the entire system as would failure of a centalized computer configuration. (Vanacek, 1980)

3. There is better computer efficiency, ie the central facility is worked harder by linking with many other computers. (Donaldson 1979)

4. The reduction in cost of hardware is tending to encourage the use of DDP. According to Donaldson (1979) the cost trends are strongly in favour of the following:

   (a) personal and very small computers

   (b) local stand alone computers

   This is mainly because the users do not need to have specialised computer acommodation like air conditioning. Trends are against central computers run in "batch mode" (where data is accumulated and processed periodically as opposed to "real time" processing where data is processed immediately) and remote job entry to central computers.

5. It allows local managers more direct control of computer resources to take charge of their own information processing functions

(Vanacek et al). It does so, yet at the same time, prevents the proliferation of decentralised stand alone computers and information systems which are not compatible with each other or with the organisation's objectives and plans.

6. Distributed systems can be developed quicker since they are mainly concerned with the immediate needs of a particular user instead of the complex requirements of a diverse set of users. This of course assumes the DDP system is developed incrementally which may not always be desirable.

A summary comparing DDP with other computing configurations is shown in the following table.

Comparison Factor	DDP	Centralised computing	Decentralised computing
Local Processing need fully met	Yes	Doubtful	Doubtful
Full Local Control over Computer	Yes	No	Yes
Tailor Made software for local needs	Yes	Doubtful	Yes
Full central involvement in MIS	Yes	Yes	No
Planned hardware integration	Yes	Yes	No
Ability to share computing resources	Yes	No	No
DP Compatability with Organisation Requirements	Yes	Yes	Doubtful
Links with other computing facilities in company	Yes	Possibly	No

Some Examples of DDP Users

The range of potential users of DDP is very wide but are often organisations which have locations on several or even many sites

geographically separated. This would include banks, hotel chains, travel agent groups, retail chains, wholesale companies etc. Also Buchanan and Linowes (1980) point out that the "motivation to distribute computer resources will be felt most keenly in highly diversified conglomerates but will be less important to single product companies that are organised by function".

DDP is particularly useful for inventory control or sales and marketing information systems. It can also be used by companies who have manufacturing plants at several locations. Each local production information system could be scheduled by the local DDP system yet each days figures could be relayed to any other plant which, for example, uses as part of its production process the output of any other plant. Thus each location's production scheduling and planning will be fully up to date with respect to available parts from other plants.

Typical information processing activities for say a company with a manufacturing plant and two divisional offices each remote from the corporate headquarters could be as follows. The production plant would use a mini or micro-computer to prepare production schedules and inventory control information. This computer also supplies, to the divisional offices, information on product availability by means of an on-line enquiry system entered through microcomputers located in the divisional office. Also on a daily basis the divisional offices send stock replenishment orders to the manufacturing plant. The divisional office computers handle local customer sales information and accounting information. Customer payments are remitted directly to headquarters. Order entry is performed at the two divisional sales offices and, after delivery invoices are prepared locally but the preparation of monthly

statements is done at the headquarters office. Accounts receivable activity is also performed at head office.

Other typical applications would be in say a single location whose data bases holding accounting or personnel data on a large (mainframe) computer could be accessed by functional management in finance or personnel. Financial staff could extract data on bills or payments, stock evaluation etc and use it to enter details on say a financial cash flow model. The personnel managers may want to call up data on precise up-to-date staffing levels in each department which is then used in manpower budgeting calculations performed by personnel staff for later compilation on to quarterly report.

In retailing, where often profit margins are very low, DDP could allow central buying departments to have up-to-the-minute sales information thus allowing them to take immediate action on re-stocking good selling lines without having to request regular reports from each outlet. This control could be made more easily if point of sale terminals were used. Daily profit analysis would be possible with results being available both to local management and to headquarters. With a low profit margin business this could be crucially important for control purpose.

Examples of companies which currently use distributed systems include the following:

Christian Salvasen

British Leyland

Scottish Bus Group

Ferranti

I B M (UK)

John Menzies

The Implications for Organisations which Use DDP

Virtually all published work on DDP systems and their effects on a company are concerned only with their advantages. No author has, as far as is known, written about the problems of DDP. Equally no written work is available which documents in depth the wide range of opportunities presented by DDP. This chapter will now try to identify as many as possible of the problems and opportunities.

DDP is not just another computer marketed by the big computer companies but has fundamental differences from previous systems and will present opportunities which can be grasped or not depending on how perceptive each user is to these opportunities. As Kantrow (1980) states "A critical link between technology and strategy exists; the only real choice is whether managers want to see it".

Thus it is important to try and identify, first of all the opportunities, then how well they are realised by management and at the same time what are the problems raised by DDP and how well they are resolved by users.

The remainder of this chapter will try to examine the problems and ask some questions which need answers not found in present publications. It will look at the following topics:- management information system implications, management roles, organisational structural implications, data processing staff roles, company resources and strategy and decision aspects.

Firstly let us look at the implications for the management information system. Several writers believe that management information systems needs top management support as well as user involvement in design and

implementation. This has been well documented by Kanter (1972) among others. Thus since DDP should mean a major redesign of the management information system this may in fact not happen. Yet as Ligon (1978) has pointed out "To management, the change of information systems has become a vital and critical ingredient for successful business operations". Therefore any important influence on the management information system brings with it potential problems of lack of involvement of all interested groups. To gain the best possible advantage of DDP the management information system must be designed to enhance the opportunities. Also the management information system must be designed to fit the organisational structure as failure to do this will suboptimise the organisation's performance (Ein Dor and Segev, 1978). DDP means that much information will be processed and will remain at local level yet headquarters must obtain enough information to make decisions (daily if necessary) which enhance organisational performance. Thus careful management information system design will be required to separate what is required locally from what is needed centrally. Many DDP users will require to use standard software packages sold by the computer manufacturers and how far these suit any organisation will be a potential problem as DDP is of course applicable to many types of companies (see earlier).

Next there are management problems which need consideration.

Management capability will be challenged by DDP for three reasons:

(1) The enchanced processing capability and information available at local sites in the organisation will be a strong pressure for local management autonomy. Most firms would usually encourage this to

some extent since central control could still be exercised when required via the management information system. However, if information equals knowledge equals power then DDP could help shift real power away from the centre, presenting a challenge to both local and central management.

(2) Decentralized information will place greater emphasis on local management's ability to use it, thus placing greater responsibility on the local manager. This clearly has implications for the quality of managers below top level. Thus DDP may raise questions of management style in respect of attitudes to computers, computer knowledge and adjustment to changed (increased) workload. Both Statland (1980) and Donaldson (1979) have already suggested problems in these respect.

DDP will place more information locally and since information is essential both for making and controlling decisions it will be interesting to see in reality how much DDP can improve local management's decision making.

This point was made in a different context by McCosh and Scott Morton (1978) who, when discussing the development of information systems towards "decision support systems" (DSS), claimed that improvements in technology, in particular remote access to computing power and a better understanding of decision making processes, had implications for systems design. Decision Support Systems are a combination of computing power, a manager with a problem to solve or semistructured decision to take and a model which reflects the problem situation.

(3) A third aspect of the problems of management is what new skills and knowledge will DDP systems demand of managers as users? Will it be necessary for all users to have programming skills and to have in-depth knowledge of computer hardware and software? Will the concept of decision support systems develop naturally from a manager using his own local computing power and if it does what skills in say modelling or systems design will the manager require?

There are organisational structure implications which also must be considered. D S Davies (in Forester, 1981 p334) discusses some general consequences for employment concerning the introduction of microelectronics. His paper ends with some questions which, though posed generally, are in some cases relevant to DDP. For example how can attractiveness and quality of jobs be improved and not damaged by any new technology? How an organisation structures the work organisation round the new DDP system will affect the quality of the jobs of those who use the equipment and those affected indirectly by way of changed work routines. As Davies (1976) says "job designs exclusively tailored to one component of the system, namely technology tends to result in less than optimal performance". Also many writers eg Child (1970) have stated that organisations have a much wider choice than is often realised when designing the social system round a new technology. Others, however, have in part challenged just how wide this choice really is in reality eg Rose (1975) is quoted as saying "the notion that choice of organisation is possible, given a specific technology and the need to show a profit is ...somewhat deceptive".

Does therefore DDP offer real choice in work organisation or is the company placed in a position where the choice is forced upon it by the constraints imposed by the systems analyst's design of the system?

The connection between technology and such organisational parameters as type of staff employed, span of control, number of levels of authority, specialisation, human relations aspects etc has been well challenged by Woodward (1980). Does DDP make any difference to some of these factors since there is some evidence (Donaldson 1979, p38) that DDP may involve new support service groups and a need for better management of clerical staff?

Martin (1981b, p24) has pointed out that DDP is so flexible that it "can be designed to conform to the existing organisational structure" yet at the same time, for effective use of DDP, many organisations have changed their structure to take advantage of the new technology by decentralizing the functional management processes yet centralizing the strategic management processes. Does this however mean that the decentralized management remains outwith the strategy-making function or does DDP offer a golden opportunity for them to participate in and shape the strategic thinking of the organisation? Martin does not offer a view on this but he does emphasize (1981b, p32) that DDP "networks are a new technology offering new opportunities to management if understood".

There are potential problems too in respect of <u>data processing staff roles</u> in a distributed processing environment. If a large proportion of the company's computing power is located in functional departments like production, personnel, finance etc and used by the functional staff in these departments then what will become of the traditional, centralised data processing function whose job it was to design and operate the company's computing systems? One problem could be that functional users of distributed systems may learn so much about computers that they will not be dependent on help or advice from the company's computing

specialists. Decisions about future computer purchases or systems development may be taken by non-specialist functional managers and thus control over data processing passes from the computer specialists working in data processing departments to managers in production, marketing, personnel etc. This point has been raised by Martin (1981b, pp73-83) but how far it is happening in reality is not clear and little other work has been published on this aspect.

If any less of control is experienced by data processing departments what problems does this raise over the career paths of computing professionals and what possible implications might it have for the type of education and training given to computer staff? It is not common for data processing staff to move out into functional departments for career progression but perhaps DDP may bring a change in this respect.

There are also resource implications which need to be considered. The careful introduction of new computing technology would be expected to enhance the use of any company's resources of staff, money, materials etc, and when intelligently introduced computers have been able to improve productivity of these resources in many cases. It would be worth investigating, however, just how much better DDP is at improving resource usage if an organisation already (pre DDP) made wide use of computers. In other words can DDP make a further quantitative leap in resource productivity? Careful analysis may be required to determine this, because although staff costs may go up, eg increased data processing staff, the ratio of output/staff or output per pound sterling invested may rise, thus productivity has really increased.

Information is also a resource potentially of use by the organisation. In order to make a given amount of information (or potential information ie data) more productive, it has to be able to raise output somewhere in the organisation eg increase sales, reduce wastage etc or else help to make better use of other resource inputs eg reduce labour or material costs/unit. It can be put to better use by being processed quicker or restructured into a form not previously available then used to improve control or decision making. DDP clearly has the capability to speed up information flow but does it automatically lead to improved information provision from already available data or does more data need to be generated to allow better information - in other words does DDP increase the productivity of the company's data or not?

Finally let us look at some strategy and decision aspects. Anthony (1965, p16) defines strategic planning as the process of deciding on objectives, on changes in these objectives, on the resources used to attain these objectives and on the policies that are to govern the acquisition use and disposition of these resources. Taylor and Sparkes (1977, p7) make these aspects more specific by noting that strategic planning includes... "appraising the enterprises resources... analysing trends in the commercial environment... and assessing alternative paths open to the business."

Freeman (1974) writes that "Successful attempts at (technological) innovation were distinguished frequently from failure by greater attention to the education of users... to market forecasting and selling ....and to the understanding of user requirements". The need for managers to appreciate the technological dimension in their company's strategy is emphasised further by Kantrow (q.v.) who sees it imperative

"to provide managers with needed guidance in their formulation of a technological strategy for their companies".

DDP is capable of having an impact on a company if used correctly. As Martin (1981b, p25) points out the use of DDP strategically must be preceded by the organisation asking how the technology could change the corporate logistics or market. The answer then feeds into the data processing strategy, leading in turn to the development of applications. How then could DDP affect company strategy?

As already noted earlier it offers an excellent opportunity to improve stock control applications and purchasing policies. If used wisely it could provide an opportunity via improved inventory control to enhance profit margins. In high volume markets even an increase of even fractions of a per cent may mean, in absolute cash terms, relatively large sums of money. Thus a firm could, via DDP, offer price advantages over its competitors allowing it to increase market share or make better use of existing resources. This advantage is possible but whether it takes place or not depends on management seeing the opportunity.

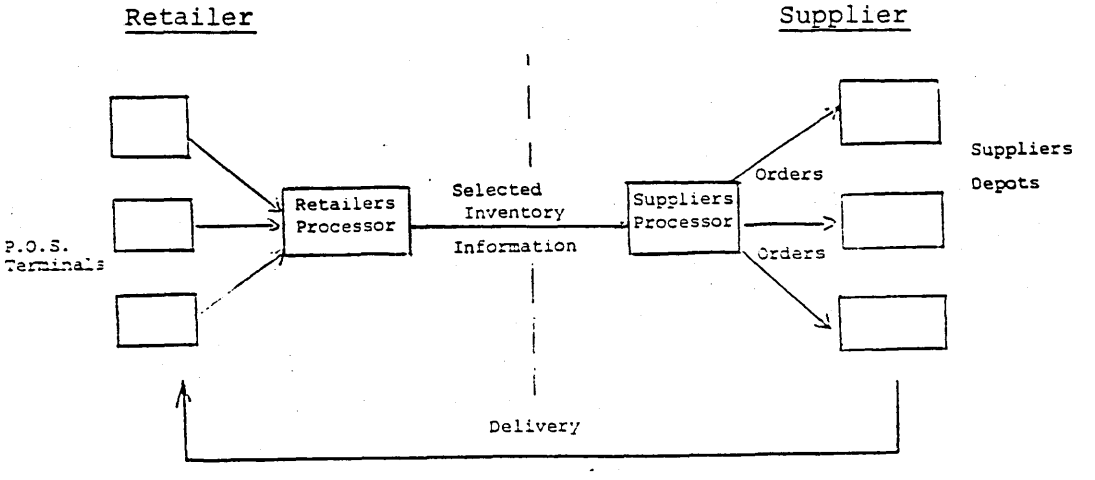
Better information processing could also permit faster order processing which in the medium term should be able to improve company performance. It should allow generally a faster work throughput since jobs can only be processed as fast as the accompanying information allows.

Production processes upstream and downstream from each other are not always sited together, eg car engine and body manufacturers are sometimes geographically separated. Since information flow is one of the major integrating forces between parts of organisations DDP should

be able to improve integration between company sub units. Good information links should permit a wider choice of locations for company sub units. If the location needs to be near the demand for services eg banks and shops, then problems of transfer of information from the control headquarters will be alleviated by the use of DDP networks if used properly. Marketing information will be able to be handled locally without recourse to centralized processing capabilities.

Organisations will have the potential to have direct links with other organisations which are for example major customers or suppliers, by using DDP networks to transmit market information between them. It would be possible to link say a major retail group directly with a supplier via the point of sale terminals, thus allowing the supplier to control the delivery of stocks to each retail outlet without waiting for orders to be processed by the retailer's own offices.

The concept is shown diagramatically below.



Of course organisational politics would be a major obstacle to this taking place since managers of one company may feel they are having to surrender some control over decision making and therefore power, to another company because of computer systems linking the two companies.

To return to data processing strategy, as Martin (1981b, p149) writes "the objective of the (DDP) strategy should be to establish a framework within which distributed processing can grow rapidly ... with high productivity of application development, and without the pitfalls". He explains that his strategy would be conerned with six main items.

the setting of standards

architecture selection

hardware and software selection

usage decisions

data design

applications development

So important does he consider data processing strategy to be, that he believes (p195) that "Data Processing no longer has a minor influence on a corporation: it has become its heartbeat and data communications the arteries".

Clearly this means that top management must be responsible for designing data processing strategy but how far it actually is involved in the case of the introduction of DDP would be interesting to study. In particular this would apply if the company already has a computing ethos which may lead top managers to "leave it all to the technologists" thus probably failing to see the opportunity which DDP could give on a strategic level.

Strategy and DDP technology therefore has two perspectives. One is the question of how far company data processing strategy recognises the possible impact DDP systems could have on management information provision within the organisation. Secondly, to what extent is DDP able

to be used to help strategic decision makers make better or at least more informed decisions?

This chapter has reviewed DDP in the context of organisational impact with a view to posing some as yet unanswered questions, a summary list of which is now shown below.

Some Questions for Further Consideration

1. What involvement do local functional managers have in designing the distributed systems that are implemented in their departments?

2. What is the user manager's attitude to the new DDP systems which he is expected to use?

3. At what management level are DDP systems actually used ie junior, middle or top management?

4. How much real management power is decentralized via the technology?

5. What steps do organisations take to improve the computer knowledge and other necessary skills of management and other users of DDP?

6. How much does DDP contribute to letter local management decision making and what level of decision is it capable of helping?

7. What are the training implications of DDP on an organisation's staff?

8. What kind of choices do organistions have for the design of jobs centred round DDP systems?

9. What effect does DDP have on company structure or can DDP be made to work effectively within present organisational structures?

10. What challenges does DDP pose to company data processing staff in terms of roles and potential loss of control?

11. Does DDP have any implications for data processing staff education and training?

12. Does DDP offer opportunities for different career progression for data processing staff?

13. Can DDP raise the productivity of organisational resources?

14. To what extent do organisations use DDP to give a strategic advantage over competitors? In the broader sense do organisations fully appreciate the strategic opportunities provided by DDP?

Many of the above questions will be developed further in the next chapters via a review of the literature and construction of a theoretical model for the basis of the research.

CHAPTER TWO LITERATURE REVIEW

Management Attitudes and Expectations

Chapter one raised many issues on the impact of computing including the effect on management roles, but since the manager's role is partly self determined by his attitudes to his situation it is necessary to consider what are management attitudes to computing technology and how important are they in determining the level of use of computers by managers. In other words can the attitudes affect use so markedly that 'good technology' is not used properly.

Attitudes are likely to be shaped by a variety of factors, but much of the recent research has concentrated on less senior management attitudes. However, some workers have identified general management resistance to new technology Swords-Isherwood & Sencker (1980) looked at qualifications and attitudes of UK and German managers to see if they correlated with attitudes to new technology. They concluded that lack of investment in numerical controlled tools resulted in management reluctance to accept increased responsibility and that German management is better educated for technical change.

Since one important element of this dissertation is that management attitudes to computer systems(DDP in this case) have consequences for organisational performance it is necessary to consider what it is that affects management attitudes to computer systems. (note most research focusses on MIS which will have to be interpreted as equivalent to computer systems).

Ginzberg (1981) shows that there is a strong relationship between user expectation of management information system performance and user satisfaction,ie an unrealistic expectation leads to less satisfaction with the systems when using it later. He identifies three areas as crucial

a) management support of development effort

b) user involvement in development

c) the implementation process itself

He also concludes that the areas of expectation which determine user response are - system goals, problem importance, system impacts on organisation, how it is used and the criteria used to evaluate the system. Thus, management support and involvement, and the goals and impacts of the system will be crucial in determining management attitudes.

Robey (1979) develops an expectancy model which shows a strong positive relationship between user attitudes and the actual use of the management information system similar to the Porter and Lawler expectancy model (1968). Robey concludes that it is essential to involve users in design effort to focus on performance and rewards in management information sytems.

E Burton Swanson (1982) in his review paper concludes also that attitudes to information systems are related to system use but that the usage relevant components of user attitudes are not well understood and more research is needed. Even if research only identifies some measures to be used in future work then he would regard this as a useful step forward.

This "cri de couer" for further effort is repeated by Zmud (1979) who focusses on individual management differences. He concludes that they are important and ends by calling for further research on the relationships between management information system success and the personal characteristics of users. Little is known about the characteristics of users with negative attitudes to information systems. Zmud does not define what type of characteristics he means but level of education, age and computer knowledge could be important ones. He also states that usage is a key factor in measuring attitudes to information systems.

Lucas (1978) when considering implementation of computer based systems suggests that management support is related to user attitudes. Thus if management provides rewards to subordinates for participating in the computer based information system then attitudes should be favourable. He also proposes that higher levels of use of the system should be related to favourable attitudes. Both of his propositions seem to be supported by his results but he suggests further research is needed to identify what system characteristics are associated with attitudes.

Schewe (1976) when exploring behavioural aspects of the information system user concludes that if the behavioural problems of users are not reckoned with its true potential will not be realised.

Guthrie (1973) in a study of middle managers attitudes and management information systems, which gave inconclusive results, nevertheless was able to identify that middle management's environment needed particular attention.

It is thus apparent from the current literature that user management expectationsare important in determining user attitudes and therefore system use. While certain aspects like management support and user involvement have been identified as important,more work needs to be done on the behavioural aspect of information system users. With the rapid spread of new,ie distributed systems,a wider range of management levels than before are now becoming users; in particular senior managers are more involved in actual usage. Thus the behavioural aspects of management users at different management levels need to be taken into account.

Need for Control

Virtually all textbooks on management have a section on control and the managers need for control. Koontz, O'Donnel & Weihrich (1980) stated that it is "the function of every manager from president to supervisor". They outline the classic theory of control through feedback of information leading to corrective action first developed by Weiner (1948). They thengo on to discuss the notion of feed-forward control (pp 728-734) mechanisms. These attempt to eliminate the time lag caused by feedback controls to provide a control system that gives managers the opportunity to take corrective action before problems occur.

Stoner (1982) again defines control in feedback terms and then suggests (pp 594-595) that the need for control is caused by factors like changing environments, complexity, the fallibility of organis-ation members and the need for delegation of authority. He then discusses (pp 604-606) the characteristics good control systems have,ie accuracy, timelieness, objectivity, easy to understand, focussed on strategic control points, realistic, etc.

J F den Hertog (1978) discusses the role of information and control systems in relation to organisations dealing with uncertainty. He points out that one way they do this is to extend and refine control systems, ie managers want to know more, know it faster and know it better.

Robert Anthony in his classic text (1965) stresses the overlap between planning and control found in most publications on the subject and he then proposes a framework that minimizes overlap - strategic planning, management control and operational control. This framework is valuable in deepening understanding of the control mechanisms at work in organisations as a prelude to examining the usefulness and applicability of computer based information systems used by managers at all levels in their attempts to control their organisations.

Microtechnology and its Effect on Management

Since microtechnology is a development of computer technology it is worth beginning by examining the views of some of the early authors on the effects of computers on organisations.

One of the seminal texts on this subject was by Mumford and Ward (1968) who examined the impact of computers on line management and pointed out that the middle and top managerial levels would be considerably affected by the widespread use of computers. In chapter ten they claimed that many middle management functions would be taken over by computer based systems and this would lead to middle management losing its role of routine decision making. There would be an increased capacity to centralise decision making and information would go straight from the computer to the managing director who would be even better placed to wield control over the

business. They believed that top managers would have more relevant facts but would have a greater need to solve ill-structured problems. However, the use of computers to run simulation models would allow these managers to better understand decision variables.

At the top of the firm there would be a group of general managers responsible for the integration of units and the need for this type of manager will increase. However, Mumford and Ward noted that middle managers were liable to resist computers if there seemed to be a threat to work interest and status. Yet although top managers would gain most from computer developments they were, at that time, very slow in appreciating the full implications of the information technology. Proposals were made regarding the need to develop managers to meet the demands of the computer age. Middle managers would still require to plan for innovation and personnel matters while top managers would need considerable knowledge of organisation theory, since they will need to create awareness of the probable impact of information technology on the structure of business organisations.

Writing a little later Rosemary Stewart (1971) considered the effects of computers on procedures, planning and control, and long term planning policy. Procedures would be automated leading to fewer clerical posts but problems over recruitment and training would occur. At the same time middle managers would have better support via computer systems. There would be more time available at middle manager level for planning and control and corrective action could be taken sooner. Managers concerned with long term policy would have the opportunity to be more quantitative, there would be a greater ability to review policies and more managers could contribute to policy making, thus there would be more

interdependence between managers.

However, two common effects were noted. Firstly, the effects on management's job were small and secondly managers were more frequently stimulated into thiking more about policies since computers enforced a discipline in thinking about goals.

The main organisational effect she noted was the creation of new departments to service the computer and therefore new types of jobs were introduced. Two other factors mentioned were that computers could increase the importance of service departments and may also increase centralisation and change the levels at which decisions are made. Thus power balances between departments may be distributed.

A more recent article by Michael Earl (1978) which considered the organisational effects of microelectronics also mentioned the devolutionary trends created by microtechnology but pointed out, that while information processing and organisational design are interrelated one need not determine the other. The new technology would allow new organisational forms to take shape but would likely offer challenges to existing power balances. He hinted that managerial prerogative may be challenged by office workers and shop floor staff who, if given the chance to process information traditionally handled by others, may themselves be well placed to offer alternative courses of action to solve problems.

Barron and Curnow (1979) in their work which examined the societal impact of microelectronics did not dwell very much on the organisational impact but they did expect to see a radical impact caused by office automation. This will, they believed, reduce the number of managers required and thereby the number of

secretaries. This would improve managerial productivity and thus the efficiency of the company. They point that the main sector of employment under threat from microtechnology was the administrative force(p153).

A recently published work by Buchanan and Boddy (1983) examined the impact of several types of microtechnology on organisations. Their study drew attention to the relatively unsatisfactory state of current theory and had, as one of the main objectives, the furthering of understanding of the relationship between the choices made on how technology was used and the role of management.

Among their main conclusions were that decisions to use technology stemmed from expectations of better performance and workflow control; and computer technology did largely lead to improved control. However, the management emphasis placed on consistency, predictability and reliability in work processes were not necessarily the main factors to be considered when designing the technology/people system at work. They pointed out technology often led to new support groups and that structural changes often introduced new management hierarchies and positions while at the same time the functions of management at lower levels may be eroded. Buchanan and Boddy like others before them, notably Twiss (1980), emphasised the crucial role of "promoters" but very importantly these promoters could be at any management level and not just the most senior.

They concluded that technological consequences were not predictable from the forms of technology used but depended mainly on management objectives and assumptions.

Management Skills in Computing and Model Building

Until recently, it was not necessary for managers to attain skills in computing ; the data processing staff provided all the necessary expertise ,and data manipulation was done by junior clerical staff. Computers were used for the processing of large volumes of routine data which eventually was summarised into management reports. As computers became applicable to higher level problem simulation organisations recruited specialists who had expertise in management science and computing,eg operation research specialists or management analysts who analysed problems (often using computers) to present answers for later use by management at higher levels. How far computer based solutions ever really contributed to aiding management decisions is questioned by Mintzberg (1973) who wrote

"there may be few problem areas for which effective models can as yet be built".

Since models are not often "accurate enough and flexible enough to adapt to new information as easily as the manager..."
The problem Mintzberg believes is that there as yet "no science in managerial work" and "almost none of the managers' work is explicitly programmed".

Managers work patterns, he believes, encourage them to prefer verbal information channels. Traditional (but computerised) information systems provide largely historical but aggregated information whereas managers seeks current, trigger information.Managers thus design their own information system by establishing contacts and special communication channels within their organisations.(p70). However, Mintzberg criticises this situation as not being in the

interests of management. Verbal channels are incomplete and managers lack time to develop to the full the information system they need. Instead he proposes (p149-150) that analysts, who have the time available and the knowledge of system design, could by careful attention to what management actually does, design information systems that could tap available resources so providing a relevant management information system.

The kind of working relationship between analyst and manager proposed by Mintzberg, which would recognise powerrelationships and politics in the organisation as well as non-economic goals and the perception of managers, seems however to be too seldom found in practice. Bentley (1981) in his study of sixty one managers in a large UK company from director downwards, found in general that "management's needs had not been considered in detail and that this had led to information systems which were not fully effective."(p61)

Bentley and to some extent Mintzberg's proposals are nothing new since as long ago as 1968 Ackoff had criticised some of the excesses of computer based information systems. Among his comments was that designers too often left managers ignorant of knowledge of the information system they used. As a result managers were incompetent in questioning the system. He called for greater cooperation between analysts and managers and participation by managers in the design process. Unwillingness to devote their time to do this would, he claimed, lead to systems which would "abuse" the managers.

Some recent examples have appeared in the literature of very senior management using and programming computers to produce their own personal information system. Rockhart and Treacey (1980) demonstrate how some American companies are experimenting with systems

which allow top executives to not only retrieve reports but carry out data analyses and model building on their own executive information systems. For this to be achieved however, the users had to invest much of their own time in obtaining the data and learning what the computer can do. They also require some training and assistance with computer languages achieved via executive information system "coaches",ie staff who have expertise in data processing but who are not heavily involved in day-to-day operations. The advantages of the executive information system are given as

a) they offer top executives analytical power to aid deeper company understanding.
b) they can be structured to meet the needs of individual managers.
c) they can start small and grow as needed.

A similar theme is reported by Whiteside (1983) who outlines various studies in which top executives use their own desktop computers to good advantage. Again the use of systems support staff is essential as consultants and coaches. The main reason for slower adoption in the UK is the status aspect of using a keyboard and he predicts that in Britain the use of computers among executives will not happen "for the next ten years".

The themes discussed above are developed by Wagner (1982) who outlines the idea of decision support systems in the office. His main point is that increasingly decision support systems will pervade top management practice but to do so requires "participation of organisation members of all ranks who have a stake in the issue, and open honest communication among participants". A practical

method of implementing the above ideas is suggested by Gremillion and Pyburn (1983) who propose that analysts develop "quick and dirty" systems in response to user needs. These systems are then modified jointly by analyst and manager user as they are used.

Strategic Opportunities for Organisations

According to Anthony (qv) management at the strategic level largely consists of strategic planning, and other authors eg Stoner (1982, p647) have noted that the type of information used at this level is "external", "future oriented","low in accuracy" and "quite old", while King (1977, p 18) sees strategic planning information as "broad and aggregated". Anthony (qv) and other authors eg Cushing (1978 p278) suggests that models can "clarify managements planning requirements". Anthony himself pointed out (p59) that models "may suggest the need for a strategic decision" and "the model is a tool for analysis of the probable consequences of alternative strategic decisions". Higgins and Finn (1976) in their review paper noted computer based model usage appeared to be restricted to middle management and doubted if corporate models would be used by senior managers in the near future (though the position in the UK seemed to be more optimistic).

A different perspective has been taken by Tricker (1982) who takes as a basic theme the strategic significance of information systems. He quotes examples of how computers had major impacts on companies' strategies in marketing, production, manpower, finance, acquisition and even overall strategy. He states that "information systems have moved beyond providing support to the rest of the enterprise; increasingly they are its core". (p19)

These ideas were echoed in a Booz Allen & Hamilton inc. publication (1983). F G Rogers,the vice-president of marketing of IBM writes "to be truly competitive, we all need to understand how technology can be utilised to support business objectives". H.Poppel of Booz Allen discusses what he calls an "information technology strategy" and one of the key steps he advocates is to reach agreement on how it should impact the firms competitive position. Also new information technologies will give planners the "flexibility to tune information technologies to the strategic requirements of the business".

There is thus a growing awareness of the strategic opportunities new computing technology can provide and DDP can, as discussed earlier in chapter one, open up opportunities to management. These opportunities should come via information systems that are tailor-made for each user,butsaying this should happen is no guarantee that it will occur. Therefore examples of the strategic significance of DDP to organisations need to be obtained along with an examination of what special atttributes cause this and what if any impediments are apparent in organisations when exploiting the potential of DDP.

The Data Processing Department's Role in a Distributed Processing Environment

Harold Lorin (1981) discusses three reasons why many DDP systems fail to achieve anticipated potential. They are organisational, planning and implementation failures. Part of the organisational problem is failing to understand the between relationship data processing staff and the business units, and he recognises that failure to define properly the responsibilities each has will cause

conflict. It is important not to overestimate the abilities of users to carry out certain key data processing tasks since they may not have the necessary skills, and eventually the system fails to operate to plan. This problem was also discussed by Rockart & Flannery (1983) who found there was a growing number of functional support personnel who were competent programmers and who supported other users. These support staff were important to other functional staff and tended to decentralise control over systems development. The authors recommended that organisations needed to recognise three key aspects to encourage end users:

1) there should be an end user strategy
2) end users need to be supported via the organisational structure and educational programmes.
3) each organisation will need to define its own control procedures for end users.

Thus both papers noted above indicate that effective use of DDP systems would only happen if organisational structures are changed to suit the needs of the information system. This, however, is not in accord with the earlier work of Robey (1979) who concluded that there is no technological determinism regarding structural changes, but instead what changes do occur are because of management objectives and political strategies. So the later work of Rockart & Flannery would indicate that structures may well be determined by new computer systems.

What however is likely to be the role of data processing staff in a distributed environment? An attitude survey by Chenney and Dickson (1982) concluded that the success of new computer

based systems was more dependent on the management skills of the management information system department than the system's technical sophistication. It was more important to worry more about user interaction that took place than about how up-to-date was the hardware. Sizer (1982) even believes that the trend to DDP systems is an undesirable one and that data processing staff will spend more and more time maintaining the operating system and less on applications development, and to contain "hidden" cost growth central control must be maintained to some degree. James Martin (1981b) lists that among the pitfalls of DDP are loss of data processing management control and even loss of control of the management information system function. Hessinger (1981) cited a case where a DDP system actually decreased data processing effectiveness because of the wrongful placing of responsibility for data processing in areas that were not prepared for it. He concludes that data management is the key for organisational success and to achieve this the correct management structure is required along with data processing controls and standards imposed on all computer users.

Johnson (1981) also drew attention to the need to manage data usage differently when DDP is implemented. However, he makes it clear that the best way for this to happen is to change the role of the central staff to a more coordinating one which ensures harmonisation of systems and support of users.

It is clear therefore that reserchers are noticing a change in role for central data processing staff. The impact this may have on data processing career paths was one of the topics examined in a paper by Kaiser (1983) who surveyed thirty six firms over a four year

period. Two important findings were that firstly there was little evidence of formal career paths for data processing staff and it seemed that the interaction between developments in technology and organisation structures were difficult to anticipate,and this made it hard to plan a formal career path which might constrain staff developments. Secondly, the survey found that some systems staff had migrated to user areas and that crossover between functional areas and systems departments will be the "way of the future". It is even suggested that this infiltration could put the Information Systems Director in charge of the information resource.

What is obvious is that very little attention is being paid to the changing nature of the data processing department when an organisation uses DDP. Bearing in mind the potential loss of control that could affect the data processing department and the potential career implications there is a need to include data processing staff roles in any consideration of the impact of DDP on organisations.

Decision Making

Much of the literature on decision making has a strong quantitative orientation but this section will not take this perspective; instead decision making will be considered from an organisational viewpoint. Even within this framework there are several themes each adding a little to understanding on the decision making process, so it is first necessary to consider the classical thinking before we can attempt to build on it.

Herbert Simon (1960) treated "decision making as synonomous with managing" (p 1) and identified three principal phases "finding occasions for making a decision (intelligence activity); finding possible courses of action (design activity); and choosing among courses of action (choice)." (P 1). He distinguishes two types of decision as existing at opposite ends of a continuum, "programmed decisions" which are repetitive and routine with definite procedures worked out for handling them and "non programmed decisions" which he saw as "novel, unstructured and consequential". Each type of decision needed different techniques for dealing with them. Programmed decisions would be made using data processing techniques and operations research models, while non programmed decisions would require the use of heuristic problem solving techniques. More traditional methods like standard procedures and rules of thumb would belong to the past and be superceded by the modern techniques, although he was quite clear that organisational structure "itself a partial specification of decision making programs" (p 10) would remain hierarchial since "hierarchy is the adaptive form of finite intelligence to assume in the face of complexity"(p 43).

He is also clear that special provision must be made for non-programmed decision making since "programmed activity tends to drive out non-programmed activity." (p 13). His central hypothesis is that problem solving could be done by organising the simple information processes "into orderly, complex sequences" able to respond to the tasks and the clues that are "extracted from the environment as the sequence unfolds" (p 26). He is certain that computers can "describe and simulate human thinking". Thus Simon's framework is useful to our thinking on two counts. Firstly, it identifies types of decisions which are made in all kinds of organisations and secondly

he sees the use of computers are being able to be applied to both extreme types. His non-programmed decision type is likely to apply largely at the strategic and managerial planning levels described by Anthony (qv).

Later in a third edition of his book "Administration Behaviour" (1976) Simon dealt specifically with the relationship information processing and decision making would have on organisation design. The growth in information to be processed would lead to a splitting of decision making functions into fairly independent groups (or systems) each to be designed to have minimal concern for interaction with the others (p 293). Thus, he is saying that a focus on the decision making components of organisations could give different structures than the conventional departmental groupings usually found. This section of his book is concerned with information technology effects so he is outlining how computers could affect organisation structures eg "processing capacity must be allocated to specific decision tasks" and "the scarce resource is processing capacity to attend to information"; also "the richness of the information environment and the scarcity of attention have many consequences for organisational design" (p 294). Although distributed processing was not around when Simon wrote these words it is easy to see that DDP systems could fit neatly into his scheme of ideas. Organisational subsystems would have their own processing capability to handle large volumes of information, filtering out the key information thus allowing "attention" by the decision makers. This is in contrast to the attempts to design large scale, integrated information systems which failed because they were too complex and did not properly clarify data to allow it to be used in the decision making process.

Simon proposed three rules of thumb for an information system - small output to conserve attention, passive and active indexes and analytic models built in to solve problems (p 303).

Simon's work was used extensively by M S Scott Morton (1971) when describing computer based systems for decision making. Simon's three phases of intelligence, design and choice were each sub-divided further into (1) generation of input data, (2) data manipulation and (3) selection for the following phase; these sub-divisions applied to both programmed and non-programmed decisions. Scott Morton discussed five components which were required for a management decision system, (1) the manager and the problem area, (2) the terminal, (3) the computer, (4) software and (5) the data base necessary for the decision. The computer based system would be used to subdivide the phases described by Simon and if properly designed provide management with "powerful support in his decision process" (p 139). For the software to be of value it must allow managers to "be able to solve problems the way they like to work and in a context with which they are familiar." (p 140). Morton emphasised the need to have the systems analyst and the manager working actively together since this would lead to systems partly designed by the users, ie managers, and that would support complex unstructured decision making which previously was not well suppported by information. He ends (p 153) by stating that "Such involvement is absolutely necessary to provide the perspective and analysis for an effective management decision system (MDS). The MDS area cannot be left to computer people... It must involve line managers as active members of the team. When this occurs the payoff can be substantial."

Cyert and March (1963) in their classic work illustrate how the concept of a single,universal organisational goal is untenable. They examine the process of setting objectives,and the resulting bargaining produces a "quasi resolution of conflict" with respect to goals. Their decision process is not focussed on computer technology but instead is concerned with feedback, organisational control of its environment (uncertainty avoidance), searching for solutions to problems (problemistic search) and finally the proposition that organisations can adapt their goals and procedures for reacting with the environment. The conceptual linking of feedback, search and adaptation in a continuous loop was the basis of later decision process models.

One of these later models was Harrison's (1975) who, in his discussion on decision making, is again not concerned with computing but does make some general points worth noting. Decision making begins with the setting of objectives (p 23) then it follows a search, evaluation, choice and implementation stage; the whole process is iterative involving constant re-setting of objectives. It is also seen as inter-disciplinary involving individual and group behaviour, values, probability, models and even environmental influences (p 41). Thus the disciplines of mathematics, sociology, psychology, philosophy, law, political science, etc come together in the decision making process. His omission of the place of computer technology and information systems is strange but his theme is important as he sees decision making essentially as "integrative", "interdisciplinary", "interlocking" and "inter-relational". Harrison does also concede that "new (computer) technology changes the very process of decision making..." He is also aware that "Technology is an immediate determinant of

individual and group job design..."

Impact of Computers on Decision Making

All of the authors discussed have either stated explicitly or assumed that information is a necessary input to the decision process. Computers obviously affect the information used by managers, yet McCosh and Scott-Morton (1978) state that "the impact of computers in the way top managers make decisions has been minimal". (p 15) They suggest this is partly because management support is not a technical problem, which is probably true, but it may also be because, until the arrival of DDP systems, information handling was a stage removed (physically and organisationally) from most managers. Perhaps for these reasons no well-known decision process models have included the role of computing but this is no longer sensible now that management has become, in some organisations, the direct user of the technology. As Blumenthal (1978) quotes, DDP capabilities "will be at management's finger tips for decison making and development of decision making models" and "DDP could increase managerial productivity by 10-25%".

Two other factors related indirectly to each other and directly to the influence of computers on decision making must be considered. Firstly, the work of McCosh and Scott-Morton (qv) on decision support systems (DSS) describes how the amalgam of the manager and computers combined with models can have a considerable impact on decisions which they class as semi-structured, ie decisions where one or more of Simon's phases of intelligence, design and choice

are not fully structured. Decision Support Systems are particularly valuable for decision making at the management control and strategic planning levels and the authors claim that computers, as part of Decision Support Systems, will have an important effect on management decision making. Peter Keen (1980) emphasises that Decision Support Systems must be built from the managers perspective and believes that the decision application drives the technology. Computers therefore provide opportunities for managers to help them in their own jobs on their own terms. He discusses the technological advances that have made Decision Support Systems possible, stressing the importance of "implementers" who use their computer knowledge to work with managers in clarifying the decision process, and concludes that through Decision Support Systems - "managers can make effective use of computers in their own decision making" (p 43). In a not unrelated vein Tricker (1982) shows how computerised information systems are now having a considerable strategic impact on organisations of all kinds. Information systems now have major implications for organisation structures and how management operates and he writes (p 7) "the key issues are operational no longer; they are strategic".

As an aside, but still relevant, a recent "Fortune survey on DDP was outlined by Scannell (1981). It discussed the reasons why organisations had chosen to use DDP systems and top of the list were the desire to retain corporate control and the need to access information or software from a central site. Thus DDP systems were apparently able to improve or at least maintain management control in the organisation.

Gaps in Present Knowledge

From this survey it seems that although there is a wealth of research material available on the impact of computer systems on organisations there are certain gaps which are apparent. Firstly, very little published work concentrates specifically on DDP systems but instead talksgenerally about "computer systems". DDP is sufficiently different in character to warrant consideration of what specific impact it has. Since DDP systems are much more in user hands than former types of computer applications more attention needs to be given to the user characteristics required to ensure successful use of DDP, eg what educational and expertise components of attitudes are important and what role, if any, do "promoters" play? Are users more involved, or even forced to take a greater part, in information systems design which in turn may lead to management information systems which are better tailored to management requirements? What forms of organisational and systems support staff groups are needed to smooth implementation of DDP into end user locations?

Some attention is also needed on the impact of DDP systems on management decisions. For example, what level of decision making is affected and are there any implications on strategic level decision making?

Finally the nature of the impact on data processing departments needs examining. Do organisations reappraise their data processing strategy; how does data processing management retain control over computing; what is the role of data processing; what structural changes are necessary in data processing departments and does DDP offer new career paths for data processing staff?

CHAPTER THREE

Development of Conceptual Theoretical Model and Research Methodology

The recent arrival of DDP technology has, probably more than other computing development, the capability to influence directly managerial decision making. Its flexibility allows local users to design their own systems which can use locally generated data and be linked to large, central data bases. Local users can decide for themselves their priorities for systems design and data processing. While the above statements are true they are, of course, a gross oversimplification of the reality of organisational life. As shown earlier, many constraining factors tend to moderate the potential of any computing technology. For example lack of management support is often blamed for poorly used systems, unfavourable attitudes by management, unrealistic expectations of system performance and poor understanding of computer capabilities have all been mentioned earlier as reasons for computing technology not fulfilling its potential to improve information systems.

The central figure in systems realising their potential is, of course,the manager who is expected to use the output of the system. He has to somehow use the output from the technology to make decisions which help him reach his objectives. As already noted these objectives do not usually fulfill the managers ideals but instead are often chosen to minimise organisational conflict. The constraints of time, cost and organisational politics have acted to moderate objectives to a level where they

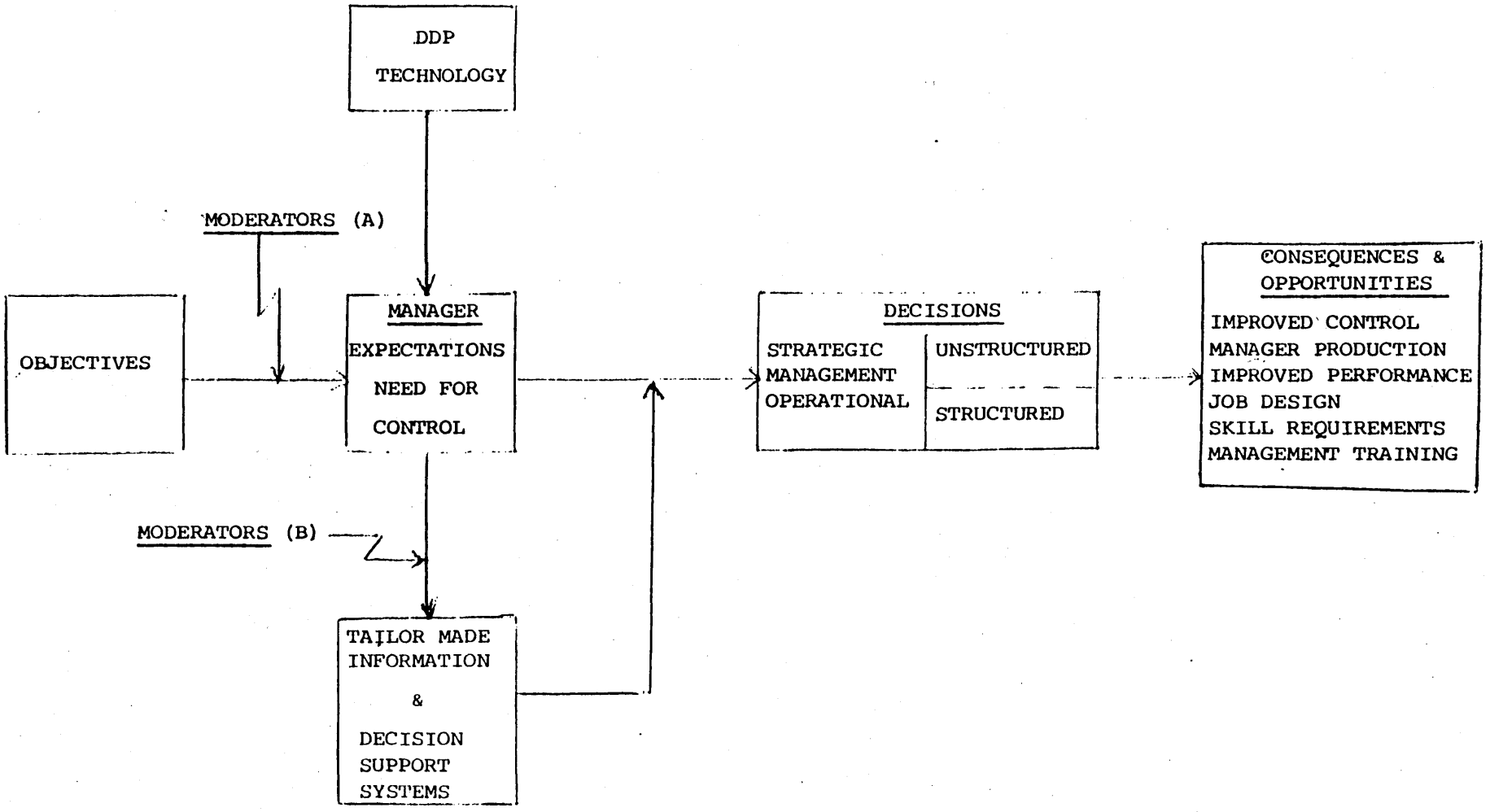
are acceptable. However, authors like McCosh and Scott-Morton and Tricker have claimed that computers, suitably combined in many cases with models, are beginning to influence decision making particularly at the higher strategic and managerial control levels. The poorly structured type of decisions at all three of Anthony's levels are now being affected by the use of computing technology. The model shown in Fig 3.1 is therefore proposed as a means of linking many of the points raised earlier in this chapter. It is intended to conceptualise how managerial decision making is influenced by DDP technology and how some of the classical works on decision making can be merged with more recent views on the affect of computing on decision making.

Discussion of the Model

The manager as the central interest has the opportunity to merge DDP technology with his objectives. But as stated before his objectives are formed to quasi resolve conflicting pressures of time, cost, organisational politics etc. Thus these act as moderators as the manager takes in his objectives. The manager has an overriding need to control his department, division or whole organisation and he can use the technology to help him obtain systems which act as a decision aid to attain the necessary control. Thus he has expectations regarding what the DDP technology may do for him.

DDP systems are controlled by the user who can either design his own systems by himself, have them designed for him by data processing professionals or more likely design them jointly with computing staff. Thus more than with earlier computing technology the manager is able to have systems tailor made to his needs. Systems to be useful for the unstructured and higher

DECISION MAKING PROCESS



MODERATORS (A)

TIME
COST
ORGANISATIONAL POLITICS

MODERATORS (B)

MANAGEMENT SUPPORT
MANAGEMENT COMPUTER SKILLS
MANAGEMENT MODEL BUILDING SKILLS

level decision making, almost certainly will require models so the model building skills of the manager are likely to be very important in determining how well tailored the decision support system is. Thus model building skills are one of the moderators which may act as a barrier to really useful systems. Similarly the manager's computer skills are important in making full use of the technology's potential. Lack of skill will act to prevent good understanding and exploitation of the DDP technology. Two other moderators are important. Strong support by senior management is essential for obtaining maximum benefit since time and resources need to be commited to developing systems and without high level management support this will not happen. The other factor is the reaction of data processing professional staff. Statland (1980) has noted that DDP systems could pose a threat to central data processing staff since local users may learn to self program their computers and design their own system. However, choice of hardware, problems of equipment compatability and access to central data bases will require the expertise of professional computing staff so the local DDP user will need the help of this group to design, start up and maintain the system even although the day-to-day use is largely the manager's affair. For these reasons the organisation's computing staff attitudes to DDP are very important since an uncooperative attitude would certainly mean an inadequately designed local system. Thus data processing staff attitudes may also act as a moderator to well designed systems.

Decisions clearly lead to consequences but also to opportunities. DDP systems should aid managerial control and improve the manager's productivity and usually well made decisions should

improve organisational performance. The manager's job will change in respect of his using and designing computer systems for decision support. Probably a greater knowledge of computers will be required and instead of a manager leaving keyboard operations to more junior staff he will require to use the computer himself for data entry and for analysis. This will have training and educational implications.

Two things should be noted regarding the model proposed. Firstly, the moderators between the manager and tailor made system could act in such a way that their influence becomes so strong that really useful systems do not happen. In fact it is likely that all four moderators must act together to allow the design of good systems. If any one of them is absent or acting in the negative direction then good systems may not result. The second thing of note is that well designed and used decision support systems will allow more careful analysis of the manager's decision problem. More options will be able to be explored through the use of models and it may be likely that the moderators of time and cost become less influential in deciding what management objectives are chosen.

The viability of the model needs to be tested empirically by studies in organisations using DDP systems and the remainder of this chapter discusses the research methodology used to gather the data.

Methodology

The empirical data for the research was gathered from two case studies written by the author. The first and larger case was conducted within the company Scottish & Newcastle Breweries plc. The two departments included in the data gathering were the Group Personnel Department and the Computer Services Department with the former department providing the bulk of the interviewees. The second, and much smaller case, was done within Wm Grant & Sons, the privately owned whisky company.

Information gathering consisted of interviewing managers at various levels up to and including director. In Scottish & Newcastle a total of fourteen managers were interviewed in the Group Personnel Department and four in the Computer Services Department. Although a full list is given in the case study in Chapter Four it is relevant to note that the range of interviewees included the Personnel Services Director, the Remuneration and Information Manager, the Training and Personnel Development Managers, two Remuneration Analysts, a Salaries clerk etc as well as in Computer Services two Systems Managers, Data Manager and another Computer Services Manager. Interviews lasted at least one hour in every case and many interviews were up to two hours in duration. In several cases, notably the Remuneration and Information Manager, the Personnel Development Manager, Personnel Officer (Admin) and the Personnel Information Officer more than one interview was held and in fact the Personnel Information Officer acted as a liaison person arranging many of the interviews and often making himself available at fairly short notice to help the author in

fact gathering.

While each interviewee was not asked the same questions the range of questions the Personnel Managers were asked did remain approximately the same for each one. Clearly any manager's job was different from most others and questions had to take this into account but in general the topics covered by the questions included the following:-

job objectives and role, type of decisions taken or advice proferred including frequency of routine and non routine decisions, use made of computer system, involvement in system design, future computer applications which would help in job, level of computer knowledge and highest educational level of interviewee?

The Financial Director of William Grant was asked broadly similar questions and he was willing to talk openly about how the computer system had affected the company and the benefit it would bring and perhaps had already brought.

The computer professionals in both companies were asked different questions as follows:

job role, involvement with DDP systems, benefits and problems DDP can bring to the company generally and to data processing staff in particular, the effect of DDP on your job, the controls necessary for DDP systems, is DDP a threat or an opportunity, examples of subordinates moving out of data processing into other company functional posts?

Interviews were recorded by note taking and a statement of points raised at each interview was typed and sent to each manager who was asked to check, and if necessary amend, the typed statement. A summary report was also prepared from the Scottish & Newcastle interviews and this was sent to the company for comments at the same time as the interview statements. In the William Grant example the case study was written up in full and the two managers involved were invited to correct any errors of fact. They did this by inviting the author to a discussion where they commented on the case study and made suggestions which were incorporated into the final version.

Further data was gathered from internal company reports produced within Scottish & Newcastle and also from the company's Annual Report for 1983 issued to shareholders. Some of the internal reports were prepared by a firm of management consultants who wrote the feasibility and later follow up reports on the computer based Personnel Information System dated November 1975, August 1976 and December 1976. A later internal report was written by members of the Group Personnel Department in 1977 and was titled "Personnel Information Functional Specialist Report."

These reports were particularly useful since they identified the problems of the personnel information system before computerisation and they also identified what benefits could be expected from a computer based system specifying the type of computer output which would be available.

Reasons for Use of Case Study Method

Case studies are not of course the only way to gather data for research purposes. Other techniques which could be used singly include questionnaires and other survey methods. Surveys are investigations which provide hard data gleaned from very structured lists of questions which normally offer a choice from a list of pre-determined questions. This can be useful under certain conditions but is not subtle enough nor comprehensive enough for many purposes.

A case study need not preclude the use of any technique. For example, a case could be built up using a mixture of interviews, questionnaires, observations etc and this is a part of its appeal as a research tool. Other data sources like company reports can also be incorporated where necessary. This mixture of techniques also allows data to be both quantitative and qualitative. Often a case is gathered from material over a significant time span and changes can frequently be taken into account and used to develop theoretical concepts. One good example of this was the work of Andrew Pettigrew (1973) whose book is a large case study of organisational change over time concerning the application of computers. The mixture of data collection methods used and the ability to test and confirm research ideas (often as they develop during the data gathering) allows connections between facts, opinions or assumptions to be much easier made than would be possible using say survey methods only. The major attraction of a case study is that is gives a "rich picture" of a situation and can provide a variety of ideas for theoretical development.

Problems and Disadvantages of Case Studies

Undoubtedly the writing of a case study is a time consuming activity. Considerable time needs to be spent arranging and conducting interviews then writing up the interview discussions. Most participants need to be seen more than once and reports need to be read and discussed with interested individuals. All of this takes quite a time. Thus compared to a survey a case is expensive in research time resources.

However, the main problem is that any case study is inevitably "one off". It thus needs great care if one is to draw lessons from the particular and then apply it to the general situation. It does of course depend on at what point the research worker starts to gather data. A different picture will be obtained if an organisation starts at say a point where efficiency is high then finds it perhaps difficult to justify certain changes on economic grounds than would a similar organisation starting from a lower efficiency base. Any research conclusions need therefore to take account of where the organisation started from when introducing change.

To build up a case means that the research worker will be "around" the organisation quite a lot and may almost inevitably seem to want a considerable portion of the participants' time. Not all will be willing to agree to this so organisations may all too quickly grow weary of the research worker and cooperation may dwindle. Cooperation at a high level is essential anyway for a case to be written and this will not always be given (though it may be promised).

A real problem can arise over the dynamic nature of research work and the original terms of reference the researcher agreed with the host organisation. It is very likely that as data for the case is being gathered the research worker will uncover aspects not previously considered when the host organisation agreed to cooperate with a stated set of terms of reference. While it would be sensible to renegotiate the terms of reference this may be a delicate matter and the investigator will therefore need to be careful not to "tread on anyone's toes" and also to be very careful when exploring delicate issues which have arisen during the investigation.

Of course, the very capacity to take account of the changing situation is also a strength of the case study method of data gathering and this has already been mentioned. However, problems still can arise if the researcher tries to extend the terms of reference without proper consultation with the host.

CHAPTER FOUR CASE STUDY

SCOTTISH & NEWCASTLE BREWERS - GROUP PERSONNEL DEPARTMENT

The Company

Structure

Scottish & Newcastle Brewers plc is one of Scotland's largest companies the main product being the brewing and distribution of beers and lagers. There are three main production sites at Edinburgh (2), Newcastle (1) and Manchester (1). The organisational and principal activities of the Group at June 30th 1984 are as follows:-

Scottish & Newcastle Breweries plc

The principal Company, Scottish & Newcastle Breweries plc, owns the breweries, maltings, warehouses and other properties which relate to the production of beer and wines and spirits, and owns licensed and other properties and fittings which relate to the Group's hotels, managed public houses and tenancies. The Company sells its beers under the brand names McEwan's, William Younger's and Newcastle and is active in promoting the sale of Harp Lager.

The Company is incorporated in Great Britain and registered in Scotland, as are all its subsidiaries except where stated otherwise. The principal country of operation is that of incorporation.

The following wholly-owned non-trading subsidiary companies have been appointed by the Company as its agents.

Table I Scottish & Newcastle Breweries Subsidiaries

Subsidiary	Main Business Line
Scottish & Newcastle Beer Production Ltd	Operation of 4 Breweries in Edinburgh (2), Newcastle and Manchester.
Scottish Brewers Ltd	Wholesaling and Distribution of Beer Products in Scotland and Ireland, operation of managed pubs in Scotland.
Scottish & Newcastle Breweries (Ireland) Ltd	Wholesaling and Distribution of all Beers in Ireland.
The Newcastle Breweries Ltd	Wholesaling Distribution of Beer Products and operation of public houses in N.E. England.
McEwan Younger Ltd	As Newcastle Brewers but in Cumbria, N.W. England, Yorkshire and N. Wales
William Younger Ltd	As Newcastle but in S.England and Wales.
Scottish & Newcastle Breweries (Sales) Ltd	Sales to National Accounts
Scottish & Newcastle Breweries (Services) Ltd	Provision of certain central functions.
Thistle Hotels Ltd	Control of Company's hotels.
Canongate Technology Ltd	Exploitation of Company Property Rights and Technology.
Waverley Group Ltd	Wine and Spirits Home and Overseas. Beer Sales Overseas.

The company in 1983 had 21,968 employees embracing a very wide range of occupations from research scientist to brewers draymen and barmaids. Staff are scattered over a very large number of sites in the UK which include breweries, warehouses, bars, hotels, restaurants etc.

Some Company Facts

The following table gives an indication of some relevant labour statistics for the year ending May 1st 1983.

Table II Basic Labour Statistics for 1982/83

Employee Group	Numbers at 1.5.83	% Members of Trade Unions
Production Warehousing and Distribution	2998	99
Vehicle Mechanics and other Craftsmen	515	100
Hotels and licensed House Staff and Managers	13800	13 - 69 (range)
Clerical, Administrative and Technical Staff	2034	80
Management, Sales and other Employees	2621	11
Total Employees	21968	38

All figures are taken from the Annual Report and Accounts 1983. Some relevant financial figures from the same report are given below -

Table III Financial Data (Historical Cost Basis)

Item	1983 £M	1982 £M
Group Turnover	641.8	620.5
Profit Before Taxation	41.1	32.2
Retained Profit	13.2	6.2

This case study was conducted largely in the Group Personnel Department with some work being done in the Company's Computer Services Department, both located in Edinburgh, which is the site of the Company's headquarters.

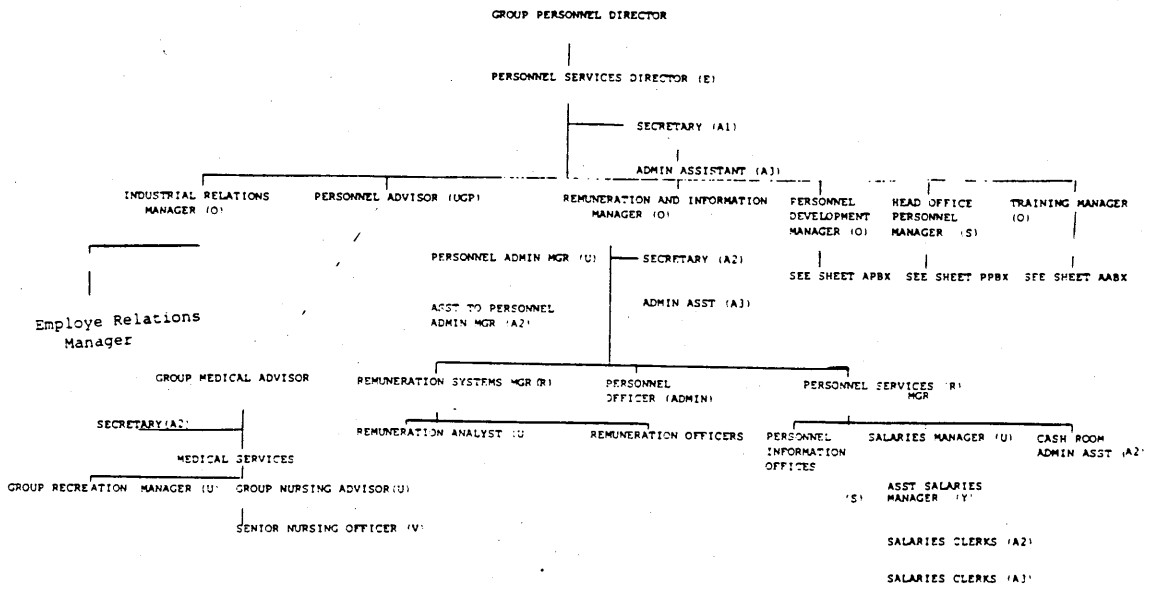
Group Personnel Department

Structure

Group Personnel administers all the company's personnel affairs and has a staff of twenty four managers plus assistants and secretarial staff ranging from personnel services director to clerical assistant.

The department's structure at January 1983 was as shown in Fig I below.

Fig I Structure of Group Personnel Department



For the purposes of this case study the Group Personnel Department will hereafter be referred to as the personnel department.

Management Objectives and Functions in the Personnel Department

The responsibilities, objectives and decision areas of the departments and sections of the personnel department which were included in the case study are outlined in the following table.

TABLE IV - Responsibilities, Objectives and Decision Areas

Manager/Department/Section	Responsibilities	Objectives and Decision Areas
Remuneration and Information Manager	Company personnel information system. Preparation of proposals for remuneration changes.	To ensure information and recommendations are available for personnel services director.
Remuneration Systems	Auditing & Monitoring Wage Bill. Job Gradings	Wage Drift Control
Personnel Information Officers	Overhaul existing administrative system, develop computer based system	To assist in the design and implementation of computer based information systems
Personnel Officer (Administration)	Develop Wang system	Scheduling and design of Wang based systems
Salaries	Administration of Salaries and pension scheme	Meet relevant time schedules. Decisions on payment of sick pay
Training	Develop and implement courses for employees. Provide training data and maintenance of training course records. Preparation of training budgets	Constantly improve the planning of training. Investigate benefits of more functional training. Courses Training budget
Personnel Development	Senior management recruitment, graduate recruitment. Management development and appraisal, administration of relocation of managers.	Assistance with management and graduate selection
Employee & Industrial Relations	Employee Relations Policy Making. Consultation with management and unions. personnel managers on industrial relations problems	Brief personnel managers on impact of employment legislation. Maintain an update Group Policy Manual.

The 1983 Annual Report shows that labour turnover for the year was 14%. Time lost through strikes and stoppages was 552 man days, a reduction of 2342 from the previous year. During the year 17,124 man days were spent on off-the-job training. The company recruits about 24 new graduates a year and about 1200 job applications are processed through the Personnel Development Section.

Note on Methodology

Data gathering consisted of interviewing staff in the Group Personnel Department and the company's Computer Services Department as well as extracting data from certain company reports prepared by a team of management consultants and Group Personnel Staff.

The holders of the following posts in personnel were interviewed :
Personnel Services Director, Remuneration & Information Manager, Training Manager, Personnel Development Manager, Assistant Training Manager, Remuneration Systems Manager, two Remuneration Analysts, Salaries Manager, one Salaries Clerk, Employee Relations Assistant Manager, Personnel Officer (Admin), a Personnel Information Officer and the Personnel Administration Manager.

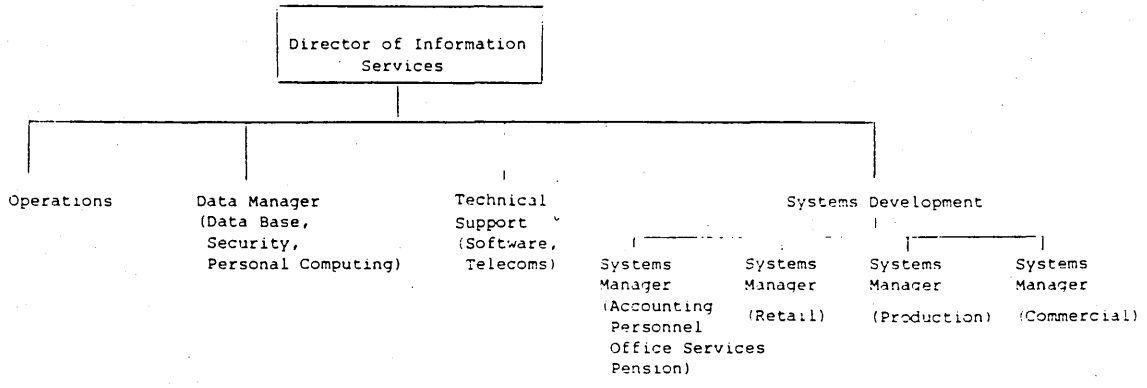
A request was made to interview some of the clerical and secretarial support staff but this was refused since it was claimed that the author would not learn much from staff who were still themselves learning to develop the system. Similarly permission was not given to interview support staff in the

Personnel Development Section because they were under considerable work pressure and the Industrial Relations Manager was unavailable for interview though no reason was given.

In Computer Services the following post holders were interviewed :- Systems Manager responsible for production, distribution and personnel systems, Data Manager responsible for data base administration, Computer Services Manager responsible for computer operations and T.P. network and Systems Manager responsible for Waverley Printners,

The structure of the Computer Services Unit is as shown below -

COMPUTER SERVICES UNIT STRUCTURE (APRIL 1983)



The Distributed Processing Information System in Group Personnel

Historical Development

The company has a long standing tradition of using computers and has two major computing sites at Edinburgh and Newcastle. Each one has a large IBM Mainframe and data entered from anywhere in the group is processed on one of these machines. Some three hundred terminals throughout the group are linked to the IBM computers; terminals are used for data entry and enquiry and several are located in the personnel offices.

In 1975 the company commissioned a team of management consultants from Binder, Hamlyn and Fry to examine the possibility of implementing a computerised personnel information system (PIS). The consultants' first report (1) identified problems faced by the company in terms of the following :-

1. New policies of management structure
2. Long range strategic planning
3. Greater emphasis on management freedom and at the same time a need to ensure consistency of approach to group long term objectives.

Ref: (1) November 1975 - Information Requirements on Personnel Resources

Therefore a personnel information decision system was required which would communicate policy decisions and plans, contribute to decision making and monitor all aspects of management performance and resource utilization. Problems were also highlighted over identification of training needs and appraisal techniques, manpower planning, assessing the effects of changes in recruitment policy, promotion systems, salary structure and policy changes resulting from legislation.

Two other reports by the consultants (2) and (3) identified output requirements under various headings eg staff records, management reports, manpower planning, exception and enquiry reports, statutory requirements, data extracts for wages modelling.

Benefits would be apparent in the following areas:- personnel administration, manpower budgets, career development, industrial relations, planning and policy making.

The consultants recommended a computer based PIS and estimated the capital cost in 1976/77 at £143,500 including development and testing, and the operating costs were estimated at £81,600 per annum which was a projected average cost per employee of £2.70 per annum. If only 0.1 per cent of the total wage bill is saved by a better staff utilization then £100,000 per annum would be saved.

Refs (2) August 1976 - Personnel Information - Management Needs

(3) December 1976 - Personnel Information Operational Requirements

Personnel Information System

A later report (4) prepared by Scottish & Newcastle staff in 1977 stated that the computer system objectives were:-

a) maintain common central source of accurate information about the company's employees.

b) interface with the existing computerised payment system thus allowing only one output source on all employee data.

c) provision of regular analysis and exception reports.

d) provision of effective reports comparing current with budget situation.

e) to provide a base upon which the personnel department can obtain rapid response to enquiries.

f) provision of a library of general enquiries accessible via VDU by operating personnel managers.

g) maintain security of access.

h) provision of up-to-date personnel record cards for each employee.

i) all of the above to be provided without major alterations to existing salaries and wages systems.

The PIS was implemented during the late 1970's.

Ref: (4) Personnel Information Functional Specialist Report, 1977

The Distributed System Development and Implementation

By the early 1980's the personnel department has perceived a need for some data processing capacity of its own (as opposed to VDUs) to aid administration and, through a link to the IBM and the PIS, provide certain useful opportunities.

After a feasibility study, personnel management in conjunction with the Computer Services Department decided to install a Wang OIS 140 Word Processor with four terminals and three printers. The equipment was chosen to provide word processing facilities and also computing power comparable to a mini computer. Wang equipment was not usually compatible with the IBM computers but both companies were persuaded to help make a link between the Wang and the mainframe. The link meant that data could be extracted from the company's personnel data base on the IBM but no data could be entered to the IBM directly from the Wang but only via the IBM terminals. This system would capitalise on technology developments by improving office systems processing, bringing together the office and information processing. The equipment was installed in late 1981.

The feasibility study and implementation of the system were done by the Office Systems Department, part of the company's Computer Services Department but the system is managed by the Remuneration and Information Manager in the personnel department. This Manager worked for eight years in the company's Data Processing Department and his extensive knowledge of computing was a key factor in implementing the system. His enthusiasm was a major component

and he helped bridge the knowledge gap between data processing staff and the non computer-literate group personnel staff.

The decision to install the Wang was the eventual responsibility of the Personnel Services Director but much of the analysis of personnel needs and the necessary liaison with the computer services department was the responsibility of the Remuneration and Information Manager.

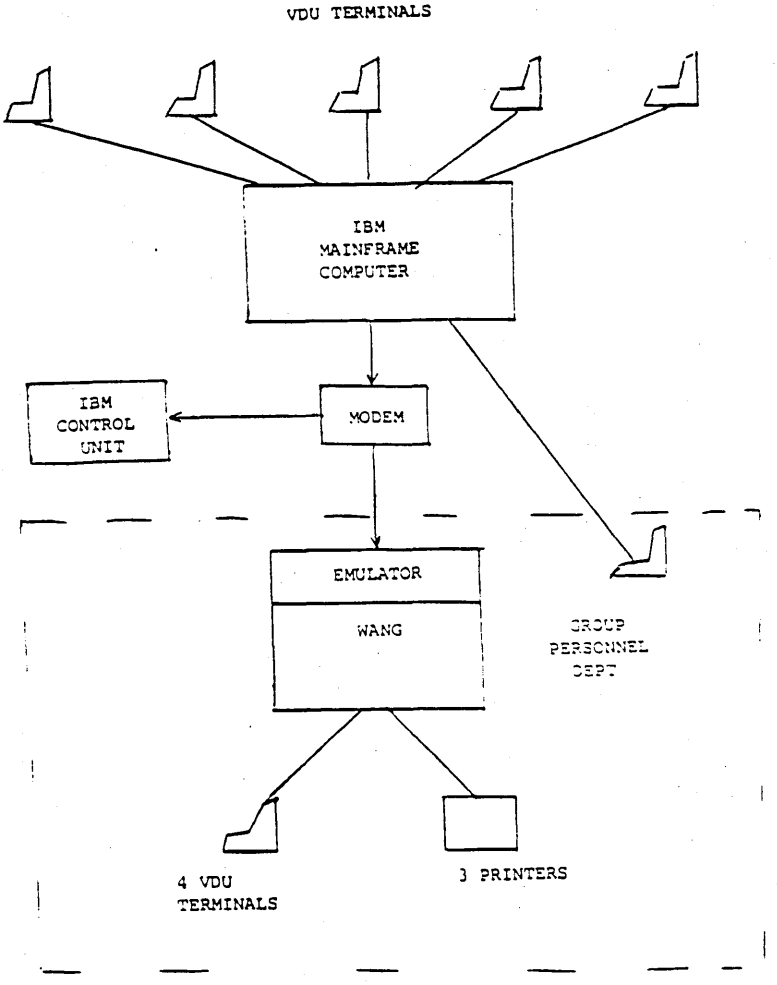
Data Processing Staff Involvement

As stated earlier the feasibility study was done by the Office Services Section of the Computer Services Department which had the necessary expertise on word processing. The Computer Services Department staff encouraged the exploitation of the Wang as a computer, ie not just a word processor, they also wrote the hardware specification and set up the facility to transfer data from the IBM to the Wang. Computer Services recognised this would be especially useful when Personnel wanted to extract data from the PIS for wage negotiations, since the IBM could not always be guaranteed to be available to Personnel enquiries. However, the PIS can only be updated through centrally controlled programs. Although further systems development, including program writing, was done by personnel staff, the help given by Computer Services staff was important in getting the Wang system started.

System Outline

An outline diagram of the system is shown below:-

FIGURE II - OUTLINE OF SYSTEM HARDWARE SPECIFICATION



The Wang has the following features:

Word processing

Information storage retrieval and filing

GLOSSARY feature - a simple high level programming facility

BASIC programming facility

IBM link

Four terminals and three printers

The four terminals and three printers are located as follows:

Director's Secretary - terminal and printer

Personnel Development- " "

Remuneration - " "

Training - terminal

Decisions on location were made on the basis of need. Remuneration was heavily involved as a guinea pig and Personnel Development had a pressing need to meet deadlines due to the demands of graduate recruitment and company appraisal schemes. The Director's Secretary had considerable prestige and "power" over other secretaries and because of her influence it was considered she should be given a terminal.

The system can be classed as distributed since it fulfills two of the key requirements for distributed processing 1) there are at least two linked computers (the IBM holding the PIS data base to which the Wang is connected and the Wang), 2) offers independent facilities for computer processing and storage of data generated locally.

System Objectives

The objectives for the Wang system were :-

a) to improve office system processing

b) to provide local control over the analyses of certain types of data required by managers.

c) to reduce dependency on the central data processing department in respect of computing facilities.

d) to allow the design and operation of wages models as a planning requirement for wage negotiations.

e) to improve office efficiency.

f) to make use of developments in computer technology.

It is worth drawing attention to important reasons why the system was bought. The Wang would bring computer processing power into the personnel office and through local control tackle the problem of "remoteness of the computer" which seemed to worry some staff. It was also under the control of personnel management. This avoided the need to wait for various analyses to be done by computer services staff, thus management reports could be prepared by personnel staff and greater control could be exercised over confidential data.

The Wang could, of course, only be used for wage modelling through its linkage to the personnel data base held on the IBM machine which had details of staff numbers, grades, earnings, wage structures etc.

System Applications

The uses made by the various departments are shown in Table V below. This is followed by a discussion on how these applications affected management operations and decision making.

TABLE V - Outline of Present Uses of Wang as a Computer (April 1983)

Department	Type of Use
Industrial & Employees Relations	Word Processing only
Personnel Administration Manager	Preparation of Manpower Budgets
Remunerations Systems	Word Processing only - Plans made for use in job evaluation grading
Salaries	Administration of car allowance expense data (P11D forms) Administration of Sickness records
Personnel Development	Analysis of management trainee applications output for management data reports (quarterly) Standardise data test results for management trainee selection tests Production of reports on company bridging loans for management relocation
Training	Word Processing only
Remuneration & Information Dept	Wage Modelling

The Wang can call up any data held by the Personnel Information System and, through the use of specially written programs, data held on the base can be manipulated for analysis purposes. Analyses can only be done via these special programs which could only be written after the analytical objectives had been specified by managers in the personnel department. Programs are written by three staff members of the personnel department who have been trained in BASIC programming (self-learning packages) and in the special enquiry language (GIS) which gives access to the personnel data base. Any member of personnel who wants a program written places a request with one of these three staff who writes the program in consultation with the requesting manager. The manager is then expected to use the results of the program himself whenever he wishes.

Achievement of System Objectives

Information Processing and Data Analysis

Of the fourteen managerial staff who were interviewed nine of them mentioned that management information was much more accurate than before. This was stressed in connection with the calculations for the planning of wage negotiations where, because of the large size of the company wage bill (£106m in 1982/83) even small percentage errors in calculations or inconsistent personnel records could lead to significant errors in cash terms. Errors had appeared in the past and important advantages were gained by a combination of the PIS database and the wages models in terms of accurate costing.

The system also gave better looking printed output of wage illustrations for presentation to the trade union officials, an

example of which is shown in Appendix 1, and budget reports and the standard letters used by other sections were much better presented. The improved presentation of printed output was mentioned spontaneously by both the Personnel Services Director and the Personnel Development Manager who commmented that departmental "credibility" and "image" had been enhanced by using Wang output.

Salary administration was easier because the P11D Inland Revenue forms, 1500 of which were processed each year by the Wang, were now dealt with quicker to the extent that the Salaries Manager had saved one staff member. Data required monthly for staff sickness record administration was also processed faster and had saved about two hours work each week and eliminated much of the tedium of this activity. About twelve hundred graduate applicants were received each year by Personnel Development and this department's administration of recruitment and also bridging loan reports were now quicker using the Wang.

The Personnel Administration Manager commented on the improved ability to obtain accurate data on manning levels and other certain types of analytical data eg age analysis, union membership etc. Reports based on such data were required on both an ad hoc and a regular basis for use at management meetings and the enhanced quality of reports was frequently mentioned.

The Employee and Industrial and Relations Department have entered the Group Personnel Policy Manual on a Wang file. This document requires updating on a regular basis and this task is now much easier and quicker than it used to be when all updating was typed up conventionally.

Thus the objectives of improved office systems processing and improved office efficiency have largely been met.

The following list summarises the achievement of these objectives.

Management Information now more accurate.

Easier salary administration.

Faster processing of graduate applications and bridging loan reports.

Easier updating of Group Personnel Policy Manual.

Local Control over Data Analysis

Two factors were relevant here; the ability to have system outputs which matched precisely the managers' needs and which could be run whenever personnel wanted without having to wait on central data processing facilities becoming available, and also the need to maintain security and confidentiality of data. All of the applications for which programs were written (see Table V) required special design and the ability of the personnel department to have immediate access to processing power was thought to be essential. Security of data was clearly crucial for the Career Development Review file held by Personnel Development, for budget reports and wages modelling.

Again, as with office systems processing and efficiency objectives significant achievements had been made. These ranged from the ability to obtain budget reports and other analyses precisely in the required form to the Personnel Development Department's facility to score by computer the results from the hundred or so personality profiles obtained from tests on graduate applicants

prior to the selection procedure stage. In every case the important thing was the instant access to computer power plus the use of specially tailored programs and files. Thus the distributed system had fulfilled a real need in terms of management decision making capacity through its ability to allow user managers the opportunity to design systems precisely meeting their requirements for information.

In some ways, however, the system was not used to improve decision making capacity. Some managers in both Training and Remuneration Systems were able to identify useful areas where applications would be of considerable benefit. For example, Training Needs Analysis and other data on training were either not done at all, because of the effort required, or were done manually and therefore slower. Information on who had been on, say a course in "Training for Negotiating Skills" was simply too difficult to obtain quickly by manual analysis so was not done at all. The Assistant Training Manager was certain that "the potential of the PIS has not been properly tapped." The belief that computers should not dominate managements' judgement was held by the Training Manager. This view was so firmly held that it seemed the main reason why the Wang was not fully utilised by Training. Other reasons which were mentioned were lack of management knowledge and difficulty of access to equipment.

Remuneration Systems had identified applications which would be of use to this department. They included statistical data analysis and files of competitors wage data. In the audit of wages a program could be written which would further analyze IBM output. This analysis is done manually at present but is very time

consuming, and as a result too little time is available "to analyse data which they already get". Audits done within the past year on only a "small part" of the company's wage bill showed that a £½m could be saved each year. Suggested reasons why the programs were not at that time written was partly lack of computer knowledge and partly a matter of not pressing hard enough.

Summary of Achievements

Budget reports and other analyses now in required form.
Instant access to own computer power.
Tailor made information systems.

Objectives not achieved

No application developed for Training.
Applications identified for Remuneration System but not as yet designed.

Computer Access and Management Use

A very significant factor in the use of wages models was the immediate access to the personnel department's own computer. For the models to be useable during negotiations, or even for no delays to occur in the planning stage, instant access to a computer was essential. The local processing power of the distributed system was a key factor in the use of models and so too was the fact that personnel staff designed and ran the models thus giving full understanding of their constraints and usefulness.

In the same way immediate access was also clearly very important to the Personnel Development Department both to create their own career development review files and to design programs to analyse

data on recruitment.

Objectives Achieved

Immediate access to "own" computer.

Design and Operation of Wages Models

As stated earlier the consultants who had reported output requirements for a computer based Personnel Information System had, among others, identified a need for the Information System to provide data extracts for wages modelling (1). Modelling of certain aspects of the company's wage bill was established on the IBM machines some years before the Wang installation but the personnel department recognised that improvements were required both to the models themselves and to personnel management's access to a computer on which to run the models as required. Thus the Wang installation was seen as an excellent opportunity to make these improvements.

The refinement and program writing of the models took place between December 1981 and the summer of 1982 and a total of twelve models were constructed for certain manual pay grades. The models operated by extracting certain data on numbers of employees in certain grades and their earnings from the PIS data base via the Wang. These extracts were then entered into the models held on Wang files. As part of the planning for wage negotiations, changes would be made for example to basic pay, certain allowances, bonus etc, to see what the total effect would be on that part of the wage bill. The computer gave the opportunity to examine a

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Ref: (1) See reports mentioned earlier (August & December 1976)

wide range of possibilities and the Personnel Services Director emphasised that before the Wang system was installed only two or three options used to be examined whereas now a large range of options was explored before and even during negotiations. The Director also stated that he could now "switch course in a couple of hours" during negotiations and at the same time have greater confidence in the accuracy and the cost of the decisions. The ability to "play your own tunes" whenever necessary was also emphasised by the Remuneration Systems Manager in respect of planning for wage negotiations.

The distributed system therefore offered two key advantages not previously available -

a) immediate and constant access to computing power by personnel staff.

b) improved facilities for wages model design.

These two opportunities directly fed into decision making at the very highest level and were capable of influencing strategic level decision-making.

In late summer of 1982 the company negotiators, led by the Personnel Services Director, concluded a much heralded three year agreement with the trade unions representing the manual grades. This agreement was a complex package which included not just changes to wage rate rates but other service conditions, like superannuation, holidays etc as well. Now the wage models were designed largely by a Group Personnel Manager who had learnt by self-teaching, to write programs only from December 1981. Also the models were only designed to cover agreements for changes taking place over one year. Yet while they were used during the

planning stage which took place for several months before the three year agreement was concluded, they were unable to be used directly to calculate the effects of this agreement because of the combination of model constraints and the complexity of the agreement. The manager who programmed the model admitted that due to her limited (at that time) programming experience and in the way the negotiations quickly changed it was not possible to rebuild the models in time.

The objective therefore of designing and operating wage models while achieved in principle was not fully achieved in time for the 1982 agreement. However, it was not a problem of the technology but the constraints of computing and model building expertise allied to a complex agreement.

Nevertheless the company did recognise that computer based models could be of significant value in aiding decision-making at the highest level and the Personnel Development Manager has identified manpower modelling as being potentially useful in the future.

Objectives Achieved

Personnel staff refined and programmed wages models.
Larger number of wage options able to be explored compared to previous system.

Objectives not Achieved

Wages models not useable for wage changes over more than one year.

Reduced Dependence on Central Data Processing Department

As stated earlier a member of the company's central data processing department (the Computer Services Unit) carried out the feasibility study and helped with the early stage of implementation for about the first three months. The Computer Services Unit had

an Office Systems Department which had expertise on word processing.

This assistance with feasibility and implementation was to a great extent the only involvement the Computer Services Unit had with the Wang system. The Personnel Officer (Admin) reporting to the Remuneration and Information Manager is responsible for scheduling the program writing for systems applications and she and two Personnel Information Officers in Personnel Services have written all the applications programs. Thus programs were specially tailored by personnel staff to fit exactly the needs of the personnel managers. It was emphasised by one of the Personnel Information Officers that it is vital for the end user to get what he wants regarding programs. It was too easy for the user to specify a "Concorde and get a Sopwith Camel instead" because of the inevitable misunderstandings between users and professional systems designers.

Objectives Achieved

Central Data Processing involvement mainly with feasibility and implementation only.

Personnel Officer (Admin) schedules systems development and writes programs along with the two Personnel Information Officers.

Specially tailored programs prepared for personnel uses.

Make Use of Developments in Technology

It was pointed out by the Remuneration and Information Manager that the Wang system was installed to capitalise on technology developments. It would for example, prepare "one-off" standard letters for graduate and management recruitment much quicker and easier than before, and it greatly aided management report preparation by avoiding the need to retype computer print out sheets. Very importantly, it also was programmed to prepare packs of printed details for trades unions negotiators who much prefer the more understandable form of the presentations.

Developments in the technology have made it easier to cope with changing work patterns and also allow much better control over security and confidentiality of personnel data.

The facility of the Wang linked to the IBM stored personnel data base allowed the data base processing power of a large computer yet at the same time meant full control by personnel department staff over office processing, information analysis, modelling, program writing etc. The Wang being smaller and aimed at a different type of user than a mainframe was much easier to use by the non computer-expert personnel staff and was completely controlled by personnel management.

Thus the objective of making use of technological developments was partly achieved, certainly in terms of word processing. However, because the Wang was not fully compatible with IBM equipment the link was only one way ie from the IBM to the Wang. Data to be entered to the IBM computer had to be done using an IBM linked VDU and this caused limitations in system development. For example,

the Group Personnel Policy Manual is held on Wang file which means it can be fairly easily updated by personnel staff. A possible development is to link the Wang two way to the IBM, so that the Policy Manual can be called up directly from the Wang by the operating personnel managers. Thus they would always have access to a completely up-to-date policy document. Now the link is only from IBM to the Wang (ie unidirectional) as already noted so a problem over technology development is affecting further development. How much of a hindrance this is was shown by an example that it took over two days to type originals, collate and send out three hundred sets of the Group Policy Manual amendment sheets. Since the manual needs fairly regular updating a two way link IBM to Wang would save much effort and time.

A summary of the objectives achieved is shown in Table VI below, while Table VII is a summary of those objectives which were not fully met at the time of the data collection.

Summary of Achievement of Objectives

The following table summarises the foregoing section.

Table VI Achievement of Objectives and Comments

Objectives	Measure	Target	Achievement	Comments
Improve Office Efficiency	Staffing Levels	Reduce	2 clerical posts reduced in Personnel Dev. & Training	Largely met
Improve Office System Processing	Better & Faster Data Analysis. More accurate data.	Extensive use of W.P. Selection & Appraisal System on Wang GPPM on Wang	Letters and Reports prepared by W.P. now faster and more accurate.	GPPM link only one way.
Control over Data Analysis	Run Systems as Required. Tailor made systems Data Security			PIS data keyed to Wang
Design & Operation of Wages Models	Design Models to schedule Run as required	Build models in time for wage negotiations in Summer 1982	Achieved but models not able to cope with 3 year agreement	Models too simple No use of software package
Reduced dependency on Computer Services Unit	Design & Run Systems as required. Tailor made systems	Operate & develop Wang independent of DP Dept	Some delay to systems development	Problems over computer expertise. No packages used.
Use Developments in Computing Technology	WP Link to PIS Mini Computer Facilities.	Link IBM to Wang Use Wang as Computer & WP	One way only Several systems developed	One way link holding up developments No packages used

Table VII Summary of Objectives not Achieved

Main Objective	Sub Objective not Achieved	Comment
Improve Office System Processing	GPPM link only one way	Main objective largely met.
Control over Data Analysis	Remuneration Analysis Training Needs Analysis	Application in both cases identified but not implemented
Design and operation of Wages Models	Models not Applicable to 3 year Wage Agreement	Complexity of Agreement and Lack of Time to Develop models Inhibited use of current models.
Reduce Dependence on Computer Services Unit	Possible faster systems development	
Use Developments in Computing Technology	Two way linkage to IBM mainframe	Under investigation

Factors Influencing Implementation and Use of System

To Management Support and Involvement

This was a crucial factor. The most important person by far in driving the implementation of the system was the Remuneration and Information Manager. His computer experience gained during eight years in the Computer Services Unit was, by his own admission, essential to "set it up". He knew the "tricks" to cut through the jargon of computer professionals and especially important was his relationship with the computer department. His knowledge prevented the computer professionals from "putting in their interpretation" of what was required. He was able to bridge the gap between the computer and the personnel staff and his enthusiasm was a major factor. His role was emphasised by the Personnel Administration Manager, the Personnel Officer (Admin) and the Personnel Information Officer who all commented that adoption of the technology was very much influenced by his enthusiasm and drive.

The Personnel Services Director was also an influence but in a different way. A group consisting of the Remuneration and Information Manager, Personnel Services Manager, Personnel Officer (Admin) and one of the Personnel Information Officers saw the need for the system and persuaded the Director to push the company to invest in the Wang. Once the Director had been persuaded of the need he became committed to the project and gave it his full backing and the decision to implement was his.

The reverse situation provided further evidence of the importance of top management support. In one section where virtually no systems had been developed, Training, it was clear that the head of this section was not wholly committed to the idea of computerised information provision. The Training Manager believed that computer data on personnel could never take account of the "grey areas" regarding for example, data on staff appraisal, and for this reason he was not completely convinced that the Wang system was of much use.

Organisational politics seemed to be playing a part in the implementation process but no opportunity was allowed to pursue this aspect. For this reason it will not be discussed further but it was certainly present.

It is thus clear that top manager influence was vital. It is doubtful if, for example, the link to the IBM would have been made at all without the Remuneration and Information Manager's knowledge that by overcoming some hurdles it could be done. Everyone in personnel saw him as the driving force. He did not believe that his level of computer knowledge was perhaps essential but he did admit that implementation would not have been as good without his computer knowledge.

Computer Literacy and Skills

As discussed under the objectives of Local Control over Data Analysis, certain important applications had not as yet been implemented. While partly this was a matter of not being able to do everything at once it seemed also partly because the level of computer expertise was not equally good throughout the personnel department. In fact several managers when asked stated that their knowledge and understanding of computers was poor, and self estimates of computer expertise included such phrases as "limited", "fairly slight" and "primitive". Of the thirteen managers interviewed, which excluded the Personnel Director, four had good or very good knowledge of computers as Table VIII below shows.

Table VIII

Summary of Computer Expertise of Interviewees

Department	Number of Managers with Computer Knowledge of the following levels		
	Low	Medium	Good or Very Good
Remuneration & Information	4	2	3
Personnel Development	-	-	1
Training	2	-	-
Employee & Industrial Relations	1	-	-
TOTALS	7	2	4

It is noteworthy that two departments where no applications had been implemented were Training and Employee and Industrial Relations where computing expertise was low. In both the Personnel Development and Remuneration and Information Departments applications development had proceeded but even here the important objective of design and operation of wages models had met with only partial success.

Meeting the objectives of reduced dependency on the computer services unit in whole or in part, may have been at the expense of being not fully aware of other developments taking place in computing, which might have been of value. In particular the use of commercial software packages for modelling could very likely have shortened the time taken to design wage models and certain packages may have been sophisticated enough to have been used to calculate the effect of the three year agreement. Packages like MULTIPLAN are widely available for both mainframe and microcomputers.

The locus of computer skills rested on the Personnel Officer (Admin) and two Remuneration Officers (one of whom was off long term sick during the interviews) and the Remuneration & Information Manager. Only the last manager had any professional experience of computing before the Wang was installed, the others had to teach themselves by self instruction packages. This was mainly

for the purpose of acquiring an expertise in BASIC programming so that programs could be written for the applications identified within personnel.

It does seem that the overall level of computer expertise was not high enough to ensure rapid systems implementation. Virtual independence from Computer Services staff was too ambitious an objective without a considerable effort being made to upgrade the computer skills and knowledge of nearly all management staff in Group Personnel.

The computer knowledge required by managers would need to include the following:-

basic hardware familiarity and keyboard skills.

problems of programming.

key differences between mainframe and mini/micro computers.

an awareness of the limitations and strengths of computers.

an outline awareness of the availability of certain commercial software packages.

Note that it is probably <u>not</u> essential to be an expert in BASIC or other high level language.
This aspect of computer literacy will be taken up later in the dissertation.

The essence of distributed systems is that the "user (manager) is king" but this can only be possible if the user is knowledgeable enough to be "king of the computer" or else data processing involvement and commitment is high enough to work hand in glove with users to design tailor made systems.

Model Building Skills

It has been noted already that one of the objectives was to design and run wages models. Group Personnel had, since the late 1970's, recognised the potential that wage model outputs could offer to top management in the negotiations with trade unions. The Personnel Services Director had emphasised how much greater was his power vis-a-vis trade unions during negotiations because of the ability to explore, using wages models, a wider range of options than was possible without computer based models. He would also have greater confidence in the accuracy of the cost of any decisions he took.

For computers to be useful directly to management they must be capable of feeding into the decision making process of senior managers ie systems must not only process operational data and produce information used at the operational level of management. Models are one important (and widely available) means of influencing decision making, particularly at the very top ie strategic decision level.

Now of course this kind of model use is not confined to distributed computer systems. Any suitable computer whether stand alone or linked could be used to run models. However, in the case of the company's Wang system what was particularly useful was the ability

to link with the PIS data base held on the mainframe. This database contained accurate up-to-date figures on numbers of staff by grade, wages and other relevant information. What was also important was the fact that the Wang could be used any time by personnel staff to refine, run and re-run models without any need to queue for mainframe computer time. Thus effective use of models requires at least the capability to run them when required with no delays and distributed systems do offer this. They also provide the capability to call up extracts from large data bases and then to "play your own tunes" using the models and the data extracted. Effective model use also requires the skill to build models which do express, albeit in a simplified way, a version of reality relevant to management's needs. The wages models used by the company were capable of expressing reality for a one year wage change but when the offer under discussion became more complex the models were not able to cope, and because the negotiating situation changed rapidly there was not time to design new models. Thus whether the models had much influence on management decisions was not clear though everyone stressed they had helped the planning of wage negotiations.

Whether the models could have been redesigned quickly enough to be useful was not certain since no details were given of the model structure nor of the final wages and conditions agreements made between the company and unions. What does seem likely though, since programs had to be written for the models, was that the use of a suitable modelling package like VISICALC or MULTIPLAN would have made it easier and quicker to take account of changes.

For reasons discussed above distributed systems can therefore offer the opportunity for computers to influence strategic decisions via models but only if management has sufficient skills in modelling.

Data Processing Management Attitudes

Clearly the help given by the company's data processing staff was crucial in developing the system to the stage where personnel staff could take over and immediately start to design applications for their own use. Interviews with senior data processing managers showed that attitudes to the growth of distributed systems in the company were not negative but the positive side required qualifying. All senior data processing managers agreed that distributed systems were here to stay, but due to the company's already heavy investment in present systems that were non-distributed, the spread of distributed systems would probably be slow.

Several benefits to the data processing department were identified as DDP systems became more widespread. They may reduce the volume of transactions through the main computers as data would stay locally where required, and the central computer would receive each days transactions overnight or at some other less busy time. User developed systems may be implemented sooner since the user will not require to "queue up" waiting on the central staff resources. Also some local processing power may provide a contingency reserve in the event of mainframe breakdown and finally local manager's responsiveness and ability to "do their own thing" was to be welcomed if it improved company performance.

One major problem anticipated by all four data processing managers was that since users would lack the professional experience of data processing staff there would be less attention paid to the proper documentation of user designed systems and lower standards of documentation could result. User departments may come to depend too much on one individual who, if he left, would perhaps then force the data processing department to solve problems which, perhaps by their urgency would disrupt the central data processing management plans for dealing with problems in an orderly fashion. In any event data processing staff would need a working knowledge of what local data meant even when the local user had full responsibility for systems design and use.

Local users would, it was thought, need to have greater competence in computing and appreciation of user requirements and would require training in structured analysis. Also they would require skills in data manipulation languages and software packages. One data processing manager felt that distributed systems would require to be "idiot proof". Data security standards would require to be implemented by local users and security controls measures built in to all locally designed systems.

As well as rigorous standards of documentation data processing managers would want professional standards to be applied in testing and copying of programs. Problems of planning for computer capacity may occur if users were not "controlled" and in general there would be a need to take an overall view of computing to take account of strategy, accountability and user knowledge.

Obviously from the interviews with senior data processing managers their attitudes were very positively in favour of DDP since it would reduce queues for system development and would therefore allow more rapid exploitation of computing. What was interesting was that these managers could identify what users would require by way of computer knowledge, ie training in analysis and programming and knowledge of software packages. To a great extent this training was not given to virtually any personnel manager. Also the data processing department did foresee its role would need to be much more supportive and be ready to offer advice to users. That this did not happen to personnel users was at least partly because of the objective to reduce dependence on data processing staff, as discussed earlier. Data processing staff involvement ended after a three month implementation. It is hard to be sure that this slowed down later development but it does seem likely that if professional data processing staff had been involved for a much longer time, systems would have been developed quicker and more attention paid to user education. Any argument that users would not get "tailor made systems" was countered by the point made by one data processing manager that this was really a problem of users themselves not being clear about what they wanted. The extent to which useful systems can be designed and implemented quickly when there is a good close working relationship between data processing professional and management user will be demonstrated in the second case study described later.

As well as problems for users there would nevertheless be benefits. There would be more rapid exploitations of computing within the company. The belief that systems analysts do not develop "tailor

made" systems was often due to the users not really being clear what are their requirements. User mistakes would often remain confidential to the user and because line staff were felt to be more sympathetic to user needs and failings,it was thought likely that user managers would prefer to learn programming than convert programmers to line managers.

Role of data processing staff in a distributed environment - The four managers saw a definite role change likely if the company moved towards distributed systems. All four felt that more advice would be required from them and their staff and the use of a "help desk" would grow in importance to the company. Although there might be fewer programmers employed at the centre (and this was not thought to be at all certain) the larger numbers of support staff forback up advice would probably mean that the net staffing position in the data processing department would be the same as at present. Data processing management's role would become more demanding and technically more supportive. This point was emphasised by all four managers. Another point mentioned was that the "cost charging" philosophy may require changing as more programmers would be working out of the centre with local users.

Threat or Opportunity - Not one of the four managers interviewed would actively oppose DDP systems. One manager considered that DDP systems could possibly reduce the backlog of demand from local managers for new systems, leaving the centre more time to develop big, company wide systems. Another comment was made that the centre should develop the company management information system and operating system and local users develop their own decision support systems tailored to their needs.

In no case was DDP seen as a threat by the data processing managers. It could only present a threat if central control was sacrificed. All managers saw DDP as an opportunity to develop the central staff role as advisors to the growing number of locally based users. Far from being a threat this type of role change would, it was felt, increase further the central data processing staff's credibility within the company.

In summary then there were four factors which seemed to influence the full implementation of the system

The factors identified were:

Top Management support and involvement

A certain level of computer literacy and skills

Model building skills

Data processing management attitudes

As mentioned earlier a fifth factor was that of organisational politics, but this aspect could not be pursued sufficiently far to reach any firm conclusions on it.

The Effect of the Distributed System on Management Decisions

Table IV has already outlined the objectives and decision areas of each of the department or managers interviewed. The extent to which the Wang system was able to help meet these will now be discussed.

a) Remuneration and Information Manager - The DDP system was able to help considerably in the preparation of "packs" of documents for union negotiators. Everyone commented how these were a great improvement on manually prepared statements. Also the preparation of manpower budgets which was a responsibility personnel had for the entire company was greatly eased and made more accurate and up to date using the Wang. Budget reports which are updated each quarter are now done so much easier using the Wang. The Manager's ability to deal quicker with problems has been strengthened by the use of the Wang system.
The conclusion is that the Wang has been of real value in aiding this manager's decision areas.

b) Remuneration Systems - At the time of interviewing no Wang applications other than word processing were in use so it obviously could not directly affect the objective of wage drift control or auditing of wages.

c) Salaries - The Wang processed P11D forms and staff sickness files much quicker than manual processing. It therefore did help with the objectives of meeting relevant time deadlines for salary administration.

d) Training - No applications had been implemented at the time of interviewing so no effect on decision making was possible.

e) Personnel Development - Wang systems were used for graduate recruitment, management appraisal and budgeting. The Career Development Review files were used to identify promotable managers and the scoring of aptitude and personality test data by Wang was stated to have provided a mechanism for making better decisions in a shorter time. Analyses of the Graduate Recruitment File had been used to try to identify "best" universities for recruitment of graduate trainees.

f) Employee and Industrial Relations Department - The only application of the Wang was for word processing, for example of the policy manual which is held on Wang file and is relatively easily updated but is not able to influence decision making.

g) Personnel Services Director - The results of wage modelling done on the Wang were intended to be used by the Director in decisions over wage negotiations. The extent to which it did has already been discussed but its results were certainly used by the Director at some stage in the negotiations.

The following table briefly outlines the types of decision areas or objectives influenced by the Wang.

Table IX Decision Areas and DDP Influences

Decision Level	Examples of DDP Influence
Operational	Forms processing by Salaries Dept
Middle or Management Control	Graduate Recruitment CDR file on managers Budget reports
Strategic	Wages Models

Management Expectations and Need for Control

The provision of information was seen by several key individuals as a vital factor in helping managers control their decision areas. For example the Director had recognised that some time ago personnel information needs were not being fully satisfied and the Personnel Information System was implemented to improve matters. The Wang was then a development of the Personnel Information System. Typical of comments made regarding information and its importance were:-

"Greater command of information than the trade unions have is management's main power during negotiations."

"Personnel information needs were not being full satisfied and this led to the Personnel Information System implementation."

"Information was needed to ensure staffing figures were accurate for management meetings."

"Information on staffing was low."

"The Wang has allowed more comprehensive information on individuals."

"Information is the servant of the payside."

Another important aspect mentioned by several managers was the importance of accuracy of information used. This was especially emphasised regarding calculations for wage negotiations and the models were an attempt to overcome this problem. Comments made included:-

"Accuracy is very important."

"Greater accuracy is possible."

"The Wang has helped by its speed of response and its ability to provide accurate information."

"Greater confidence in the accuracy of the cost of any decision taken."

"The main impact of the system has been to greatly increase the accuracy of the input information to the decision process."

Along with accuracy, speed of response was also seen as a key management requirement. The Director in particular mentioned this. Comments made by several managers included:-

"The Wang has helped by its speed of response."

"Saves time when filling vacancies."

The Wang system also allowed work pressures to be eased as the quotations below indicate:-

"With increased demands on the department it could not have coped without the Wang or more staff. More staff would have been

politically unacceptable."

"The ability to meet deadlines accurately via the Wang has reduced the pressure on typists."

"The use of the Wang greatly eased pressure of work."

"Time is saved and the scoring of test data is better."

Another important control need satisfied was that of providing various analyses and also maintaining security of data.

"To get under control various analyses which thus avoided needing to queue to be served by central dp department."

"The Wang system was designed to give control from the start over matters like confidential personnel data."

A final aspect worth pointing out was that the Wang enhanced departmental credibility with the outside world.

"The overall result is that ..... division credibility has risen with trade unions and ..... within the company....."

"The department image is better with word processing."

Thus managers needed and expected

a) more information.

b) more accurate information.

c) the ability to respond to outside influences.

d) to ease work pressure yet still maintain or improve the level of service.

e) control over analyses.

f) if possible an enhancement of departmental credibility and image.

The Wang, as a development of the Personnel Information System was intended to meet these needs. To a very large extent it did so. Thus it was able to contribute to the attainment of management objectives for each of the decision areas over which personnel has responsibility.

Changes to Organisational Structure

The organisational structure before the Wang arrived already included two Personnel Information Officers and a VDU operator/ Admin Assistant. When the Wang was installed all three individuals were given time to learn BASIC programming and the VDU operator/Admin Assistant was promoted to become Personnel Officer (Admin), reporting directly to the Remuneration and Information Officer. This officer was also given the main responsibility for applications development and scheduling of systems. Thus all personnel managers requests or needs for programs were handled and written by the three staff designated for this purpose.

The major advantage of this arrangement was that systems design was completely under control of personnel management and not dependent on central computer services staff, who would inevitably be less able to respond instantly to all requests. As well as the response factor the three programmers were all personnel staff who therefore had an excellent understanding of, and sympathy for, the exact information needs of other personnel managers.

The disadvantages, however, were also important. The three staff were not computer professionals by background and had therefore to learn programming. This must have slowed down applications implementation. Also because only three programmers were available

(and one of them was ill for a good part of 1982) not all requests could be dealt with simultaneously. Thus some queuing had to take place and this again would slow down applications development.

However, any disadvantages that this arrangement incurred was regarded as less of a problem than not having full control over systems development which would have happened if central computer services staff had been used to develop applications. What is also clear is that the systems that were developed were "tailored made" and therefore fitted exactly to management needs. This advantage may be hard to gain if fairly remote computer professionals, working largely from central services were responsible for applications development.

CONCLUSIONS

Achievements

1. DDP was able to give full control over computing power by user management.
2. DDP does allow precise systems tailoring for operational and management control decisions.

Problems

3. Nearly everyone could identify useful applications but only a few managers had actually used the facilities available.
4. Managerial computer literacy was not very high and this seemed to have affected the rate of applications development.

Impact on Management Decision Making

5. The opportunity to use the combination of locally designed wages models and local computing facilities during wage negotiations was not realised because the models were not designed to deal with the complex three year agreement which was made and could not be redesigned quickly enough to respond to the changing situation during negotiations.
6. Full control over computing power by user management did not, however, guarantee that the system would be used to help decision making and solve problems.
7. Where systems application was implemented it showed that DDP could be a very useful decision making support.
8. For top level strategic decisions precise information systems tailoring is very difficult to achieve.

Impact on Staff

8. The DDP system led to management creating a functional support group to design systems and be responsible for systems implementation.

9. This support group was able to allow virtual independence from professional data processing staff after the initial implementation.

10. Top management support for the system was vital in ensuring implementation. In particular one very senior manager's enthusiasm and drive pushed through the linking of the Wang with the IBM and generally his enthusiasm for the system influenced others to embrace new applications.

Data Processing Staff Attitudes

11. Central Computer Services management were in favour of DDP systems spreading throughout the company. Computer managers were willing to cooperate in designing and implementing systems but would insist on certain professional standards being met over documentation, user skills and controls.

12. If distributed systems spread within the company, Computer Services Management anticipated the need for greater user support with the creation of user support groups.

13. No Computer Services Manager thought DDP would be a threat to professional data processing staff. Instead they considered that the role change caused through the need for more user support would enhance further the Computer Services Unit's credibility within the company.

CHAPTER FIVE CASE STUDY

William Grant & Sons Ltd Distillers

This study is much smaller in scale than the Scottish & Newcastle one, partly because the company is smaller but mainly it only involves one highly focussed application of distributed processing. It does, however, contribute to understanding more about certain aspects already discussed in the large case study.

The Company

William Grant & Sons Ltd is one of the few privately owned Scotch Whisky Distillers in the UK.

The first Grant whisky was produced in 1887 at the Glenfiddich Distillery, Dufftown. Glenfiddich Malt Whisky is a brand leader today and as a result of its contribution to Exports, was presented with the Queen's Award to Industry in 1974.

A second malt distillery was built nearby at Balvenie in 1894. The firm became a private limited company in 1903 and from that time on, expanded its sales and marketing operations throughout the world.

An associate company, William Grant & Sons (Standfast) Limited, in cooperation with three of the large brewing companies, is responsible for the United Kingdom market.

The major proportion of production is for export to the Company's sales outlets in 186 countries. In recent years, overall sales have gone from £10m to over £66m and the Company has an excellent

record in a growth industry vital to the nation's exports.

In 1960, the Company opened a Bottling Plant, Bonded Warehouse and Distribution Centre in Paisley. In 1963, the Company built a large new grain distillery at Girvan, Ayrshire.

The Company contributes over 10 per cent of the total production of Scotch Whisky and employs 700 people in the UK. It is big enough to offer the challenges and problems that professional management expect, yet small enough to recognise the individual contributions of its management personnel.

SOURCE: Company Information Sheet, 1980. (updated)

The Staff Involved and Their Responsibilities and Functions

For this study only two company managers were involved, the Financial Director and the Data Processing Manager, and their major responsibilities and decision areas are as follows:

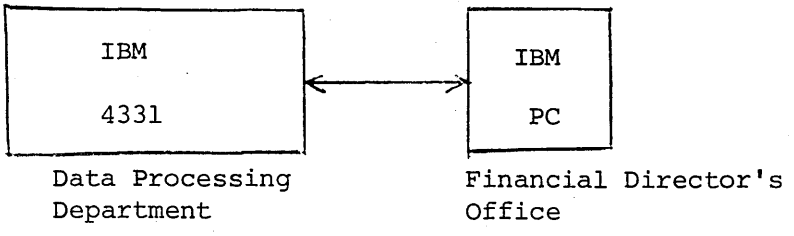
Table I Manager Responsibilities and Objectives

Manager	Responsibilities	Objectives and Decisive Areas
Financial Director	Accounting Department Whisky Stock Department Data Processing Department	1. Wise Capital Spending. 2. Whisky Stock Investment. Decision every 6 months. 3. To have efficient departments and to make each the best in the industry.
Data Processing	Data Processing Department System Development and Operation	1. To manage the Data Processing Department. 2. To recommend to the Board the Data Processing requirements for the company.

The Distributed Processing System

The Company owns an IBM 4331 mainframe computer which is used to process the usual company data on accounting, sales, production etc. In September 1983 they bought an IBM Personal Computer (a micro-computer) which is compatible with the 4331 and can therefore be linked with it. The microcomputer was installed in the Financial Director's office to run a company financial model. System outline is thus very simple as the following diagram shows.

Figure I - System Outline



The system is used to operate a company financial model which produces figures for cash flow and profit. It is run as required and when it is seen to be important. The model has 240 rows by 40 columns and typical inputs are - company budget figures,eg wages, production costs, advertising costs, fuel costs, costs related to sales (bottles etc), budgeted sales calculations, revenue etc. Input data will be partly derived from the various mainframe files,eg sales figures, and partly entered directly via the microcomputer,eg advertising and promotion costs, new and revised budget figures etc. Projections are made and "what if" questions can be explored to predict the effect of for example, changes in sales. Sales are seasonal and the model can check

what, if any, borrowing would be needed if expected sales figures are not achieved. In this way potential cash flow problems can be anticipated. The model is divided into different segments and each can be examined separately.

The program for the model is a commercial spreadsheet software package (Peachpak) bought from MSA, a software house which produces a range of IBM software. The system is thus truly distributed since there are two computers linked together each with its own processing power, software and files, and one of them uses data from the other computer.

System Objectives Although the main objective was to run the company's financial plan an important second objective was to allow the company to run the financial model using its own computer. Before the microcomputer was bought the company model was run on a bureau computer but this had proved unsatisfactory. Problems had arisen over instant access to a computer and because of the critical importance of the model to the company, the need to run the financial plan when it suited William Grant, led to the introduction of the microcomputer. Although no figures were given it was stated that in any event it was "easily cost justified."

Further system developments are planned for whisky stocks modelling and since it is portable it is planned to use it at other company centres and the Chairman is very interested in using it to run models during Board meetings.

Management Expectations and Need for Control

Control By the nature of the whisky industry cashflow is perhaps the most important control problem. The Financial Director had

explained that up to about 1974 the industry had grown at about 9 per cent per annum but since then growth rates had fallen to about 4 per cent and were still declining. This meant that stock projections had become much more difficult and since whisky required to be stored for years between distilling and retailing, large quantities of money were tied up on stock holding. Incorrect estimates of stock to be held can be very costly as although "selling stocks can be very profitable, buying stock rarely is."

Another key factor is the nature of the company itself. William Grant is a private, independent company. The Data Processing Manager pointed out that, as the company is a family business, the option of issuing shares to raise cash is not really available. The Financial Director also spontaneously emphasised that the Company must "keep control of cash as it is a family company." The Board thus lays great stress on controlling cash flow.

Thus the use of a financial model is necessary to help calculate when cash will be needed. Nowadays for quick, accurate modelling computers are regarded as essential. However, although the Company had been using a bureau computer for financial modelling this had presented problems over access, and since the Financial Director needed the model's results when it suited him and not the bureau, the requirement for control over computer processing led to the introduction of the microcomputer linked to the 4331. The Company based model gave quicker answers to questions and allowed changes to be made easily and quickly so that the potential effects could be determined.

Thus the distributed system was able to offer advantages of a strategic control nature.

a) The model results greatly aided cash flow control.

b) Cash flow control is instrumental in maintaining company independence and even survival.

c) The processing of data by the model was now fully under the control of the Financial Director.

Expectations The main expectations the Financial Director had regarding computers was to aid company planning by providing quicker answers to questions. He saw it as being "important to get beyond using computers to do routine tasks" and allow computers to "help solve problems". Also computer systems, like the microcomputer linked to other computers, would, he believed, help "strengthen cooperation with other company groups who have to deal with other common outfits, for example Customs and Excise".

In terms of the effect on people, systems will be designed which constrain every user in company locations to use the same systems. Everyone in the company had to be more aware of the computer's potential since a better system "should place less strain on people." At the same time modelling applications could help teach people the "feel" for what figures mean.

Achievements of Objectives

a) Run the Company's Financial Plan - Clearly this objective was met in full as the model had been run for several months by the time the author interviewed the Managers (November 1983).

b) Achieve Immediate Access by Management to Computer Processing - In the same way this objective had been fully met by the company

transferring the model runs from a bureau computer to its own microcomputer. This allowed instant model processing and "control of our data" so that results were available when required by the Financial Director.

Effect of the Distributed System on Financial Director's Decisions

The Financial Director stated that his two key decision areas were whisky stock investments which were made about every six months, and decisions on cash flow control which were made about every four weeks. The importance of cash flow control has already been shown earlier in terms of its ability to affect company independence and survival, so clearly decisions in this area were of the highest importance. Whisky stock investment decisions had, since 1974, proved to be quite tricky because of the variable growth rates of the industry since 1974 and this meant that projections regarding stock holding had become more difficult. Stock decisions are clearly important in an industry where the product takes 4, 8 or 12 years to mature. However, stock can be sold to raise cash and selling stock is profitable where buying rarely is. Also the relationship between what stock is sold and what was made could present big problems over cash flow.

Now the model for cash flow projection was not new as it had been run on a bureau computer for some years previously. What was new was the microcomputer linked to the mainframe and the use of a software package with a model designed using it. This gave advantages over the bureau system of instant access, lower running costs and the ability to run as many projections as desired without going through an intermediary (ie the bureau). Since the model is broken down into market segments each segment can be examined

separately it is now much easier to project the outcome by "playing around with sales projections".

The importance of the model was shown by the fact that its results were used directly by the Financial Director. His statement that "... cash projections are so important it is necessary to make use of a financial model to help calculate when cash will be needed", is a good indication of the place the model had in influencing decisions. Another measure of how important the model and the microcomputer based system were was the time given over to its design by the Financial Director. Although this point is discussed later in the next section it is important to note that the Financial Director spent several days each week for some weeks to design the model used on the micro-computer. He would not have done this if it had not been important to him.

Thus the distributed system of microcomputer, mainframe, software package and model were in combination used for cash flow modelling, the results of which fed in directly to the Financial Director's decision making. The system was clearly focussed on to financial decision making of strategic importance to the company.

In summary, the system was a key decision aid for the Financial Director when decisions on cash flow control were made. This decision area is of strategic significance for the company and therefore the DDP system was contributing to strategic decision making processes in this example.

Factors Influencing Implementation and Use of the System

Top Management Support The Financial Director regarded the use of the model as of paramount importance in helping him achieve his objective of wise capital spending and also in helping him make the correct decision on whisky stock investment. His commitment to the operation of the microcomputer was such that he worked with the Data Processing Manager two or two and a half days each week for several weeks in order to design the company model. The Director designed the model relationships and the Data Processing Manager helped translate these into computer codings etc. The Director's close involvement with the design and implementation was obvious and his need for running the model under his control was the driving force behind the introduction of the microcomputer - 4331 system.

Computer Skills The Financial Director had stated that his computer knowledge was "reasonable - but I would not claim to be an expert". He was largely self taught regarding computing, much of it since January 1983. Two things are noteworthy. Firstly, although he had some knowledge he was making an effort to learn more because he considered it important to continue designing models for whisky stocks etc. He was intending after his holiday to "allocate a portion of time each week to become thoroughly familiar with the system." Secondly, he had spent some substantial time working closely with the Data Processing Manager to design the model (see above). This allocation of the Director's time was a measure of how important he felt it to be to increase his computer knowledge.

Thus, although the director's level of computer skills was not

expert it was sufficient to allow him to contribute meaningfully to the design and operation of the model.

Model Building Skills The cash flow model was designed by the Financial Director firstly on a manual basis then it was computerised. Computerisation of the model was in fact not a major difficulty largely because commercially packaged software of the spreadsheet type was used. No attempt was made to write a unique programme which would have, in any event, taken longer. Clearly good model building skills were available but these were enhanced by the use of a modelling software package. The Director emphasised how important it was to "understand relationships within the model", and to be able to interpret the model results. For example, he instanced that a model may show a given level of profit to be possible in the future but a full understanding of the model may indicate that this profit level could only be achieved at the expense of new investment in bottling capacity or warehousing.

It was clear through comments like these and the fact that company models were well established on a bureau computer that good model building skills were available.

Data Processing Management Attitudes The Data Processing Manager had been very fully involved in helping to evaluate and choose the microcomputer based system including the software. He had also translated the Director's model into a form suitable for entry to the microcomputer, and had designed the base of data held on the mainframe which was used as the input data.

He saw several advantages in the type of distributed system used by William Grant & Sons. For example he thought the use of the microcomputer hardware would grow and with it the ability "to bring down data to model". This could help keep data accurate and up-to-date. He considered microcomputers would be suitable for use by end users who were less skilled (in computing)and data management than data processing staff. He believed it was the right thing to give the users the tools to use themselves but at the same time data must continue to be "managed centrally".

He did, however, recognise that changes would be necessary if distributed systems became more widely used. These were in the areas of user skills, control required and the role of data processing staff.

With regard to user skills, these will need to become more analytical to allow understanding of data relationships. However, "very little computing skills" as such will be required because most systems will be menu driven or use spreadsheet packages. Users will require nevertheless to recognise that they must put in effort to get value from their computer; they must define relationships and data. Some data processing help will still be needed with self-learning,along with some formal training of users. The users must realise that "control of accuracy of data is vital" to avoid wrong decisions being taken due to incorrect output caused by wrong input data.

The important aspects of controls werecontrol of input data integrity, and data processing staff must be involved in this to set up standards and monitor their application. This is especially important if models proliferate.

He foresaw the role of data processing as consisting of several aspects:- ensuring integrity and accuracy of data, advising on hardware and software used, initial training of users and an ongoing commitment to monitor and control how systems are used. The role of data processing must change and there is "no need for conflict if we welcome change".

The Relationship between the Data Processing Manager and the Financial Director

It was clear that the design of the model meant considerable cooperation between the Director and the Data Processing Manager. They had worked closely 2 - 3 days each week for several weeks to achieve an end result. The Director had made every attempt to understand more about computing and the Data Processing Manager had been happy to have a good working relationship with the Director. Both men had together evaluated the hardware and software. What was obviously important was that the computer based information system had not been chosen and implemented by either data processing management or the Director but that both had worked together to give the company a system that was successful. Each had a skill to offer, the Director his understanding of the model's relationships and the Data Processing Manager his knowledge of computing; by combining them a useable system was obtained in a short time which was able to make a significant contribution to decisions of a strategic nature to the company. Certainly, the Data Processing Manager did, as stated earlier, report to the Financial Director and this must have made it easier to obtain cooperation. Nevertheless, the Data Processing Manager was fully aware of the importance of the company model and used his expertise to choose a system which

maximised the model's usefulness. This example of good relationships between data processing and user management working to use distributed systems to the organisation's benefit, seems to illustrate that to make full use of distributed systems user management and data processing management cannot operate in isolation but if they join forces excellent results can be obtained and the technology is not sub-optimised.

Thus the factors which affected implementation and use of the system were:-

Top management support.

A reasonable level of computer literacy by the Finance Director.

Good model building skills available to the Financial Director, coupled with a good understanding of the relationships that determine cash flow projections.

Conclusions

1. The objectives of running the company financial plan and achieving independence from a computer bureau were met using the combination of financial model, IBM computer linked to an IBM mainframe and a commercially available software package.

2. The DDP system was able fairly quickly to contribute meaningfully to decisions on company cash flow control which is a vital factor in profitability and company independence and survival.

3. The model building skills of the Financial Director and his understanding of the key relationships in the cash flow projections as well as his active involvement in systems implementation were essential factors in the success of the system.

4. The Data Processing Manager's attitude to the spread of distributed data processing within the company is highly positive. However, he believes users would need to become more skilled in understanding data relationships but would not necessrily require high level computer skills. The data processing department would also require to be involved in controlling and monitoring the integrity of data particularly if modelling increased in use.

5. Of paramount importance was the way in which the Finacial Director and the Data Processing Manager worked in close cooperation to evaluate, choose, design and implement the system.

CHAPTER SIX

ANALYSIS AND DISCUSSION

The empirical data was gathered to test then check the model validity as any model is only of value if it can be shown to hold up in practice. This analysis will then take each stage of the model in turn and see what the data has to say then look at the whole model checking for corrections required, changes, additions, wrong assumptions, different outputs, different feedback loops etc.

The value of any model is that it can be used to predict outcomes given a set of input data. It is sensible therefore to begin with a brief comment on distributed data processing technology which then feeds in to the model.

DDP Technology

The concept of organisation members having their own computing power is evidently growing in importance as shown by the large number of publications appearing to this effect. In recent years it has become easy to link micros and mini-computers to mainframe computers. Whereas before computing was purely for the specialist, now this has become less and less the case; witness the growth of personal computers, micro computers, office automation, network systems etc. The concept of linked computers is offering advantages of large storage capacity and ease of use and the management opportunity to design own programs and use software chosen by the management user. For example, Scottish & Newcastle had examples of programs written specially for wage modelling, manpower budgeting, career development review, appraisals, graduate recruitment etc, and William Grant's had a specially written program for financial modelling. Thus the academic literature does reflect the situation in organisations as witnessed by the two case studies.

It is important to note that the new computer configurations are being used at middle management level much more than at operational or routine levels in organisations. Thus DDP systems appear to be offering a way of meeting a need which computers in the past were unable to do. The technology was seen by all users in Scottish & Newcastle and Grants as providing information which was needed by managers. In some cases this information was simply provided better than it has been before the technology was introduced. It was perhaps provided quicker or more accurately or simply more information was provided, for example, budget analysis, wages modelling, financial modelling etc. In other cases the technology was able to offer new information opportunities not previously available to management, eg career development review, graduate recruitment etc.

The really crucial property the technology offered was instant access - freedom to "play your own tunes", a chance to be free from data processing staff control, which meant for some managers the elimination of queues for programs to be written, and the opportunity to learn as you go, ie the chance to make your mistakes then correct them in your own time.

Thus DDP was seen by all users as being of immediate use to process information at management's own pace and in their own office space. It was therefore easier simply to turn round and use it and it would thus be more likely that managers would regard it as part of their armoury of tools.

Indeed so important was the instant access offered that in Scottish & Newcastle's case it was one of the objectives set by top management, ie

one of the reasons for obtaining the technology at all. This aspect was also a key objective of William Grant's system.

An interesting point to note is that in neither company's case did the staff see DDP as a thing by itself. In both cases, at the preliminary interview stage with the author, the managers asked "what do you mean by DDP". The concept of the name DDP was really not perceived by anyone. All they were interested in was that it was their own computer under their own control. Conversely, the data processing staff, although they saw the potential problems regarding the spread of DDP throughout the company and therefore the need for formal control and standards to be introduced, had really not actually done very much about this. Thus, to a large extent the technology was being pushed by non data processing staff, ie functional managers. A problem of course is that if the technology is under functional management control, how does data processing management build in standards and controls?

Objectives

Two basic types of objectives were apparent, (a) objectives regarding the computer systems and (b) objectives which the managers had in respect of doing their job (where the computer was at least on the surface irrelevant).

Examples of type (a) were:

1. improve office efficiency
2. allow freedom from data processing staff
3. give instant access to the computer and run programs as required
4. freedom from use of a bureau computer

and examples of type (b) were

1. design and run wages model or financial model
2. meet deadlines in respect of provision of information
3. improve departmental credibility etc.

Objectives also seemed to divide up into classes where one was to make management's job easier, for example, improve efficiency of a department and give more elbow room to management like instant access, no dependency on the data processing department; and secondly, objectives which enhanced decision making capacity, like the use of modelling; improved analysis etc. It is worth noting that the objectives for the computer system seemed to be for the most part completely interlocked with general management objectives to the extent that they in fact become really management objectives instead of computer objectives. In terms of moderators (A), in the model the computer could have helped to overcome some of the cost and time elements which according to Cyert and March (q v) lead to non maximising of objectives. For example Scottish & Newcastle remuneration analysis department had targets in terms of wage monitoring which could only be partially met because of time constraints. Computer applications had been identified but not yet implemented which would have, it was claimed, partially eased the work load and would have contributed to actual cash savings. It was not clear why the applications had not been developed but reasons given included, waiting on programs being written, lack of time by managers to help identify program specification and even "anti-computer attitudes".

What was obvious was that most of the managers had a clear idea of their job objectives and what their implications were in terms of how to achieve them. In most cases, this created the need for controls eg the

cash flow control of William Grant Financial Director, the need for accuracy in the wage modelling of Scottish & Newcastle, the need for up-to-date figures on manpower budgets, the need to speed up the processing of appraisal/personality test scoring in management development and graduate recruitment. The following table shows a set of objectives by department and the control mechanisms employed to meet these objectives.

Manager/Department	Objectives	Control Mechanism
Financial Director (Wm Grant)	Cash flow control	Financial Model
Management Development	Recruitment of senior managers and graduates; management development and appraisal; administration of costs on relocation of managers	CDR file on Wang. Scoring of test data
Remuneration & Information Manager	Preparation of proposal for wage and salary movements	Personnel Information System Wages Models

Not all managers saw that the computer could help meet their objectives by aiding their decision making process. Some others did however, see the opportunity to combine computer technology with their information needs to try to give information systems dedicated to their functional specialisms.

Need for Control and Expectations

That management saw the computer as helping in this area was clearly the case. The various quotations offered are examples of this -

"Information was needed to ensure staffing figures were accurate for management meetings".

"Greater accuracy is possible"

"Time is saved and the scoring of test data is better".

"Cash projections are so important it is necessary to make use of a financial model..."

"You can play your own tunes" (using the DDP system)

The financial model used by William Grant was a key element in cash flow control in fact perhaps a matter of life or death for the company's independence. As already stated the model was already in use on a bureau machine, and the DDP system simply added the freedom to run the model at any time, and also to refine the model. The wage model used by Scottish & Newcastle was improved on the Wang system and taken to the stage where it was used at the planning stage for the company wage negotiations. The model's main use was to give top management (directors) more information regarding the costs of proposals and some chance to explore the wider range of opportunities available at the negotiations stage. In several other cases the systems provided improved control, for example management analysis reports, greater accuracy of output, faster processing of data.

Information and Decision Support Systems

It is made clear in the literature that a major property of DDP is that it will give the user freedom to design his own system to fit exactly his own needs. The cases provided evidence that this certainly happened for example the financial modelling by William Grant's Director, the manpower budgetting and Career Development Review file in management development at Scottish & Newcastle.

In the latter case programs had been specially written for each application and in the William Grant case the models were designed solely to meet the needs of the Financial Director and cash flow

control. Some applications were more successful than others, in the sense that they were used when required and did actually contribute directly to control and decision making. In the cases where the manager was closely involved in the design of the system, either by assisting with program writing or working closely with the data processing specialist, good well-used systems generally developed.

The theoretical model differentiates between management information systems and decision support systems. The latter involve a model as well as a computer and a manager; and the combination of the technology and the model allows the manager to explore a range of options. The management information system is, by contrast, a computer based data processing system using inputs which probably are not handled by the manager who requires the information, and is certainly not capable of being interrogated to ask for the results of varying input figures.

Management Support

Whether or not a useful system was developed depended on several important factors. The easiest to identify was management support which Twiss (1980) and Buchanan and Boddy (1983) had also noticed. In Scottish & Newcastle's case the Remuneration and Information Manager who earlier in his career had been a data processing specialist, was a key figure in driving the systems implementation. The Management Development Manager was also clearly committed to the use of the technology in his own department and again in this department good useable systems developed fairly quickly.

On several occasions, staff pointed out that the enthusiasm of the Remuneration and Information Manager was a vital factor. He clearly

believed in using the computer generally to aid information provision but in particular the Wang system was one he had personally helped select with a view to achieving certain objectives. Other members of the department, for example the Remuneration Officer and the Personnel Assistant (Admin) had also been involved in preparing the case to present to the Depute Director of Personnel. Thus several people took an active interest in the success of the system.

In William Grant the Financial Director personally became very involved in the system developemnt.

In this example the use of a financial model was essential for cash flow control and the DDP system was bought initially only for using the model. As the case showed, the Financial Director was heavily involved in the implementation and use of the system from its very beginning.

Management Computer Skills

Where the manager had some knowledge of computing and what computers could do, a system was introduced and used by that manager or department as is outlined in the following table.

Table : Management Computer Knowledge and System Used

Department/Manager	Computer Knowledge before Wang	System in Use
Salaries	1 Officer Good	P11D Processing, Staff Sickness Lists
Management Development Manager	Adequate/Good	CDR, Personality Profile Scoring
Manpower Budgeting	Limited (but becoming better)	Manpower Budget
Training	Poor	No system in use
Remuneration	Limited	No system in use
Employee & Industrial Relations	Low	No system in use
Wm Grant Financial Director	Adequate	Financial Model

The table therefore indicates that sections or departmental managers with at least some computer knowledge did have systems in use and more or less the reverse was also apparent. With the exception of those managers whose main role it was to write application programs for the personnel department, no other Scottish & Newcastle manager interviewed could program, at least with any degree of expertise required to write useful applications. It seems that the term "computer skill" does not need to mean high level of skill but instead what is required as a minimum is an understanding of what computers can do and how they could be of help to the manager in providing information. Of course, commercially produced software packages are one way of getting the computer to work for a user quite quickly, if a suitable package is available. For many of the applications required in Scottish & Newcastle personnel department no suitable package would be easily or at all obtainable except perhaps in manpower budgeting. The other area where

packages may have been available and fairly easily applied was a general modelling package for example VISICALC, MULTIPLAN etc. These packages are very versatile, useable for a wide range of model types, fairly easily learnt and suitable for many types of computer hardware. The extent to which management knew of these packages was not clear but the data processing department would have had knowledge of them. It is even possible that the company staff was too mainframe orientated and not enough consideration therefore was given to the use of micro-type application packages. The decision to do without professional data processing staff after the initial implementation phase may have unwittingly cut off the personnel department staff responsible for systems design from knowledge that could have helped speed up implementation of applications. It must be remembered that the officers responsible for program writing in group personnel had themselves to learn BASIC by self-instruction while the Wang was being implemented. This is a praiseworthy objective but could not have helped for fast implementation. Learning about programming is not all there is to know about applying computers even if the learner is enthusiastic. We can contrast this by examining what happened in William Grant where the Financial Director worked closely with the Data Processing Manager and both contributed to system design each in his own way. A modelling package was used which drasticaly reduced the time to implement a useable system.

It seems apparent that DDP systems need a certain level of computer expertise by the manager user to aid fast implementation, but that does not necessarily mean the ability to write programs. What is required is to recognise the best combination of hardware, program writing and use of commercial packages which can aid fast implementation of systems.

Either a specialist data processing professional would be needed who would be likely to know this combination or a manager user would need to make special effort and take the time to acquire the necessary knowledge (and keep it up to date).

Management Model Building Skills

This skill was available in Grant's Financial Director and was put to good use in building the cash flow model used. Financial Managers are used to the concept of models and it is also part of the education given for high level financial qualifications. Thus attempting to build a financial model for cash flow may not have been an over-ambitious task for the Financial Director, who in any event was proud of his ability to understand relationships in a model.

In Scottish & Newcastle's case wage model building was done by the Personnel Officer (Admin) who had a post graduate qualification in management studies which included operations research as a subject. The models were designed for a one year change in pay situation. As stated earlier, this model was used to plan for the wage negotiations but was not able to calculate the affect of the three-year package because of the complexity of the offer combined with a model which was designed for a simple situation, and the model could not be changed quickly enough to be useable.

Did this show that models are really only suitable in certain straightforward situations as Mintzberg said, or does it also mean that it is the model builders who lack the skills to build really effective models? Often model builders are specialist operations research staff who themselves are not functional managers and have to take time to

learn about the problem which will be the subject of the model. In Scottish & Newcastle's case the model builder was a Personnel Officer who would have understood personnel management but did not have in-depth specialist experience of model building. Even an experienced operation research specialist would have had a very difficult task to re-design models quickly enough to be useful during the development of negotiations which culminated in the three year agreement. Thus if an organisation seriously wishes to use computer based models it has to ensure that modelling skills are available to cope with a dynamic situation when models are to be applied.

The stark evidence of the two cases was that the Grant's Financial Director had modelling skills which provided the company with a useable (and well used) cash flow model. Scottish & Newcastle wanted to use wage models but in a dynamic situation found the models inadequate. How far this was lack of modelling expertise or lack of computer skills was not clear but the idea of "Executive Information System coaches", working within the Scottish & Newcastle Group Personnel may have helped (see ref Rockart and Flannery 1983).

What is certain is that if we see the combination of model, computer and manager as a Decision Support System made to aid the manager's need for control in meeting objectives, then management model building skills will be needed to design a part of the Decision Support system. Thus the extent of manager modelling expertise will control to an important extent the capability to achieve useable tailor made Decision Support and Information Systems. Manager model building skills is therefore a moderator which does fit the theoretical model examined in this thesis.

Data Processing Staff Attitudes

The cases contain no evidence of unfavourable data processing attitudes. Again, however a contrast between the two appeared in a different way. In William Grant's case the Data Processing Manager worked closely with the Financial Director to design a system which was quickly implemented and which contributed to the Financial Director's decisions on cash flow. In Scottish & Newcastle's personnel department the Office Administration computer specialists only helped with the initial implementation phase and thereafter the personnel's own staff were trained to write programs and did all subsequent system development. They were however not experienced computer professionals. It was personnel's decision not to ask for any further data processing assistance and not reluctance on the part of the central data processing services to allocate resources (although part of this decision was a recognition that central data processing was under considerable pressure).

As the cases illustrated what was relevant was not simply data processing attitudes but the extent to which data processing staff worked in close relationship with the user/manager. The realisation that, in order to design good DDP systems, both specialists must work in harmony as a team, obvious though it seems, is not by any means universally found in organisations.

In neither case studied was there any evidence of enough attention being paid to what Rockart & Flannery call end user strategy on an overall organisational basis. In Grant's case the Data Processing Manager was able to identify what user controls and education would be required for DDP systems but he had not yet implemented these changes, even though

DDP had already been introduced in a small way. In Scottish & Newcastle's case the data processing managers also talked of what should be done not what had been done. However, the Rockart & Flannery plea for support of end users through the organisation's structure had been met by Scottish & Newcastle training specialist support staff in the personnel department to write programs and develop systems. Although the support group was created it is important to note it was a management decision to create one and not essential because the technology determined it. Also Cheney & Dickson (1982) point out that user interaction with management information system staff is important and this was borne out by the success of the William Grant system.

The Scottish & Newcastle data processing managers saw a definite need to change the role of data processing staff in a distributed environment, ie more help desks, support and generally the need for data processing to be more willing to support users.

Thus both cases show that data procesing management is well aware of what is required in terms of control procedures, support personnel and procedures, but had only begun actually to implement some of the ideas.

Little evidence was apparent in terms of how DDP would affect careers in data processing. The Remuneration and Information Manager in Scottish & Newcastle had formerly been a computer profesional but his move to personnel had been made well before any distributed system was in use and not because of the special need for computing staff operating in functional areas. However, the Personnel Director had recognised the opportunity to use this manager's expertise and, as discussed earlier, this was a key area in getting the system going. No data processing

manager was able to identify any movement of computing staff out to functional management posts where the move was because of computing expertise being deliberately sited inside a function. Yet, as the Grant's case showed, good close working relationships between data processing and management to develop systems can pay off very handsomely.

Thus the cases show that organisation's data processing staff seemed to be slow to insist on the standards they know to be required for end user maximisation of distributed data processing. It also shows that failure by data processing managers to guarantee the resources will lead to functional support groups set up with data processing responsibilities which will bring computing expertise into functional management, independent of central data processing services. It also shows that where managers and computer staff work together in a close relationship working towards a common objective then good systems can be developed quite quickly.

While it is easy to say that organisations need to define clearly the strategy for end user computing and the support and control procedures necessary it does need a special effort. Data processing management does recognise that DDP is here to stay, but so far has only tentatively grasped the nettle of insisting on certain key essentials. It is no use waiting till DDP is used in a big way then trying to influence users. Data processing management must, from the first use of DDP, insist on certain training programs not just to teach people how to get the most out of DDP but to educate users for the pitfalls of poor control standards, documentation etc. Data processing departments must make special effort to go to the end user and offer to join in a partnership

to develop systems. Also the users must be taught to see that do-it-yourself is laudable but has its limitation. Where a do-it-yourself system is impacting on functional performance and not just the efficiency of one section or manager, then do-it-yourself may not be the best way to go. By this education of end users data processing management may stand a better chance of keeping control.

The structures of data processing departments also need examining. The Scottish & Newcastle case showed a structure which had sections responsible for functional areas. Two options could be considered. A special department or section within data processing for DDP systems which would take the responsibility for all DDP in all functional specialisms. This may mean potential communications problems however with other data processing staff also responsible for the same functional areas but not for Distributed Procesing Applicaitons. It may therefore be better to recognise DDP's importance and form DDP group advisers within the same section of data processing responsible for respective functions. In fact, it is probably better not to form a separate DDP department within data processing but to recognise that all organisational functions will use distributed processing; therefore support and co-operation from data processing services will be part of the normal role.

Distributed processing can offer it seems more than ever before, the chance for a career path out of data processing services. Since the relationship between user and data processing is crucial it may be easier to foster the necessary relationship if data processing staff work in functional areas and become like the Remuneration and Information Manager in Scottish & Newcastle "functional (personnel) professionals".

Functional careers for data processing are not common mainly because their expertise is in a fairly narrow area. However, if functional manager skills normally would include those of communicating knowledge gained from training and experience then if computer knowlege is now essential to improve management performance, it is as easy for the data processing professional who has the motivation to learn the functional skills as it is for the functional manager to learn computer skills.

Decision Making and Distributed Data Processing

It is Mintzberg's view that computers contribute very little to management decisions because of the nature of managerial work and also the fact that computer based information systems produce historical outputs. Later writers like Rockart & Flannery (1983) as well as Wagner (1982) indicate that at least for modelling applications used by very senior managers, some evidence is available that computers do impact on decision making. What is the evidence from the two case studies with regard to distributed Data Processing Systems?

The effect on decision making really appeared to separate into two types. One where the effect was direct and where faster or better decision making was possible and the second where the effect was 'softer' perhaps less obviously beneficial, but was nevertheless present. The direct effects were threefold - earlier warning of the need for action, better decision making and thirdly a greater speed of response, each of which is discussed below.

An example of how the system could give earlier warning of the need for action was the use of a cash flow model by William Grant's Financial Director. As discussed earlier the importance to him of the system's

output was such that he spent an appreciable portion of his time helping to design and implement the system. Only one decision level was being affected - that identified by Anthony (1965) as strategic planning. By the nature of these decisions Simon (1960) would regard them as largely unstructured and the director did point out that the model did allow him to obtain advance warning that he may have to consider borrowing or selling stock if sales projections indicated the possibility of growth in demand. It was not just a question of selling more products but other factors like bottling capacity could become a constraint in the future. In a similar way the Scottish & Newcastle wages models had contributed greatly to the pre-planning of wage negotiations, although discussed earlier when a decision point was reached the models were not used. However, it is certain that more options than in the past had been explored at the planning stage and here again a process of trying to "firm up" an unstructured decision (ie what increase in pay may be acceptable to the company) was helped by the DDP system. In both examples the system was able to provide what Mintzberg called "trigger information" and therefore a computer system was now meeting the real needs of the managers.

Examples of better decision making were provided by Scottish & Newcastle Management Development applications. The results from the scoring of raw data from aptitute tests were now available before selection meetings and this gave the manager information which meant he was better prepared to make recruitment decisions. The system generally provided comprehensive data on every applicant and along with the improved administration made possible by the computer, it was claimed that time was saved in filling vacancies. The system was also being used on a trial basis to analyse recruitment information to identify which

universities were 'best' at providing a source of graduate management trainees. This had allowed recruitment effort to be focussed on fewer universities thus concentraing effort which should lead to improved results. In another more subtle way the access to local computer processing power had given improved facilities for model design. Models were thus produced in both William Grant and Scottish & Newcastle which were better than those used previously and this contributed to better decision making.

The system's ability to improve managers' speed of response in decision taking was quoted by the Personnel Administration Manager and the Personnel Director. Much of the manpower budgeting work which used to be done manually was now done much quicker by computer. The system now produced reports for issue to personnel and other managers on such things as trade union membership, labour turnover, budget versus actual labour figures etc. These reports were now more up-to-date and were prepared much quicker and it was claimed this allowed faster decision making.

The "hard" effects on decision making were also accompanied by more subtle but still important "softer" implications. For example many managers including the Personnel Director, stressed the greater accuracy the system outputs gave compared with before. This was particularly mentioned in respect of the wages models and the manpower budgeting analysis. In turn, this raised management confidence as was instanced by one manager's statement that he now had "greater confidence in the accuracy and cost of any decision taken". The system was designed to give better looking printed output for presentation to groups like trade union negotiators and senior managers in departments other than

personnel and this, together with the improved accuracy and response speeds, had enhanced departmental credibility. Generally, also the system had eased work pressures and had meant the need for more staff was removed. At many stages of the data gathering it was pointed out by personnel managers that reports and analysis were now in the form required by users, that is the system outputs were designed precisely to need. This improved information provision was important particularly to the Personnel Director who stated that the "greater command of information... is management's main power during negotiations". The system also gave greater control over data security which was important for confidential personnel data. Finally, another aspect which was important was that each DDP system studied had, in different ways, changed the relationship between the company's professional computer staff and the manager/user of the distributed system. In Scottish & Newcastle's case the system was implemented partly to reduce dependence on the central computer services and thus a partial severing of those links was the result. In the William Grant situation the system had the reverse effect of involving a closer working relationship between the model builder (the Financial Director) and the Data Processing Manager.

Thus to summarise and bring together the points discussed in this section the effect that DDP systems had on decision making were as follows:

Direct Effects	-	Earlier warning of the need for action.
		Give management the opportunity to respond faster.
Soft Implications	-	Information now more accurate.
		Greater confidence on decisions taken.
		Enhanced departmental credibility.

Easing of work pressure.

Information now tailored precisely to need.

Changed relationships between managers and data processing departments.

Thus the evidence indicates that DDP systems are impacting on decisions both at the very top ie strategic level and also at the middle management control level. The use of models to explore possible outcomes of future action is of course the same as the feedforward control concept discussed by Koontz and others(1980). The use of models is not new but DDP is now offering the combination of local computer, locally developed programs (eg models or the programs to score test data) and the ability to tap large data sources via the use of data bases, for example the personnel data base or company financial data base. It is therefore very likely that Distributed Systems are particularly open to this type of useful exploitation. As discussed earlier the key factor seems to be the instant access by the manager/user to allow time to develop the model (or any other program) precisely to the manager's needs and also to explore options when it suits the manager.

Support Groups

The Scottish & Newcastle case evidenced a support group embedded within the Group Personnel Department. This backs up the claim by Rockart and Flannery (q.v.) that functional support groups were growing in number and were important to other functional staff. Scottish & Newcastle trained its own group personnel staff to learn programming and these staff made up the functional support groups. This worked but perhaps not as well as attaching computing professionals permanently to the

Group Personnel Department. However, support groups are clearly necessary if DDP is to flourish. Problems will however, arise if the support groups is not fully committed to the funcitonal specialism eg personnel etc. What was important to Scottish & Newcastle Group Personnel Management was control over computer programming, scheduling etc. So functional management control over support groups seems an objective that data processing management may have to accept unless they can guarantee central data processing help whenever required by functions.

Comparison of Industry Environments and How DDP Suits Them

The case studies concerned two firms which though both concerned with the alcoholic drink were in reality about firms representing industries with substantial differences and it may be useful to assess the strengths and weaknesses of DDP systems in the two different contexts. The beer company has a very large number of employees with a wide occupation range and strong trades union membership. Its product is made in large volume mainly for the UK, has a fairly short life cycle, sales can be affected by the weather and the product has to be distributed to thousands of outlets. Key decision areas include staffing problems often involving trades union pressures, the need to maintain good staff relations to avoid disruption to product distribution and an ability to respond to sales demands relatively quickly.

The whisky industry involves fairly low volumes of product with a long life cycle, large quantities of expensive stocks stored for years, very important export markets to many countries and a small workforce relative to the capital employed. Key decision areas are in stock

levels, cash planning and the need to operate in a wide range of markets across a wide political spectrum.

The two companies therefore have very different information needs. The beer company will need reliable information on manning levels, wages, bonuses etc. Precedents will be important and there is a requirement for information on past staffing practices and probably also clearly defined rules to ensure consistent management practice. Decisions may be "structured" as much as possible as a management aid. There will therefore be an important need for a large data base to feed into the decision process. Conversely because key decisions in the whisky industry will often concern marketing aspects involving product demand in a large number of countries, many decisions will be fairly uncertain and only partly "structured". The product demand is subject to political forces like quota restrictions and high taxes which are often changed abruptly. Information uncertainty will be a fact of life and it is relevant to note that the cash flow model used by William Grant's was based on sales projection and "what if" questions.

Nevertheless in both these different industry situations DDP systems proved to be of considerable value. It was able to help personnel managers tap into a large database yet allow local computer availability for management use. Also in the case of the whisky company financial model and the beer company wage model, it allowed functional managers to do modelling applications independent of the central computing services in each company. DDP in the companies studies offered flexibility yet the chance to be part of much more powerful computing system. Any "weaknesses" of DP were less obvious but in the beer company the large personnel database required a continuing professional data processing

expertise to maintain data integrity. For DDP systems to be useful in less structurd decisions it is essential that the decision taker or at least the system user has good corporate modelling skills. Thus the system "weaknesses" can only be identified if we consider the manager/user and the data processing departments as part of the system.

This area of discussion cannot be taken to a proper conclusion without further investigation into a wider range of companies in different industries, but further research would be useful to identify the applicability of DDP systems across the industrial spectrum.

CHAPTER SEVEN

OPPORTUNITIES, CONSEQUENCES AND CONCLUSIONS

Opportunities

The immediate one that presents itself is the real likelihood for the first time that the manager will use the computer to help him in his decisions as opposed simply to providing him with historical data which may be of very limited use to him. By having his own computing power more or less permanently available, the manager can, if he has certain skills, design his own information or decision support system which, much more than in the past, comes close to what he wants and needs. As shown in the text earlier, this can be rapidly exploited under varying conditions of management skills to aid decision making often at the highest level through the use of models. At a middle management level the main advantage is tailor made data processing systems which can be used to attend to the managers key problem areas and which, because the computer is on tap at any time, produce the right output which is available when needed and not when the decision point has passed. Thus the managerial need which Mintzberg (1973) calls "analyses of current trigger information" is being more nearly met than under former computerised information systems. And as Mintzberg also notes, since managers design their own information systems by setting up contacts and special communication channels, the same manager can now use Distributed Data Processing systems to help design his own information system, but this time a computer based one (at least in part).

Secondly, the use of models designed by the manager and run on the local computer but drawing on a data base held on another computer, is giving the chance to improve control over his functional area. The best

examples of this were Wm Grant's Financial Director's use of the cash flow model and the Scottish & Newcastle's Management Development Manager using the computer to score raw test data before personnel selection meetings. It seems highly likely that managers generally will seize the opportunity to design their own informaiton system so that they can exercise better control over the outcome than they were able to in the past. Having a better information system still cannot guarantee to improve decision making. Nevertheless the possibility of increased use of feedforward mechanisms like models will reduce or even eliminate the need to rely on historical data being the only computer based information input to management decisions. All the managers interviewed firmly believed that control over their area of responsibilities had improved using the new systems and it seem this will be an important feature of the relationship between DDP and managerial work.

Blumenthal (q.v) believed that DDP would increase managerial productivity and evidence both direct and indirect on this can be seen in the cases. At the lower operational level the Scottish & Newcastle Salaries Section did claim an increase in productivity by reducing processing time for certain routine clerical tasks. Similarly in another section the preparation of manpower budgets is now done in one to two days compared to two to three weeks. These are fairly straight forward direct increases in productivity. Less directly, but probably more valuable is the effect on higher levels of management. For example, the use of computer based models to examine possible outcomes does allow the manager to arrive fairly quickly at a set of outcomes he is prepared to accept and can plan for. Or it can prepare him for outcomes which he may not have foreseen or would have meant (if they had come to pass) urgent action to rescue a crisis, which is often wasteful

of resources. Now it could be said that any computer based model will help in this way, but while this is true it has already been argued that Distributed Processing systems combined with models offer a unique tool to help managers. Thus for this reason the cases do validate the claim that DDP raises managerial productivity.

But if DDP, as a specific type of information technology, is to have a real impact on organisations, it must offer advantages to those who take the decisions on the business objectives ie the strategic decision takers. We must therefore look for the strategic opportunities of distributed systems. In the literature review it was noted that three aspects were highlighted under this topic. Firstly, the use of models to clarify managements planning requirements, secondly, the point that information systems had now become the core of the enterprise, and thirdly that to be strategically significant, information systems should support business objectives and impact the firms competitive position. What examples could be found of DDP systems having strategic significance, what special system attributes could cause this and what impediments could perhaps act against companies wanting to use DDP in a strategically useful way?

That both systems were used in modelling applications by user/managers, was the clearest evidence that distributed processing was of strategic significance. Important points to note were that although computers have been used for some time to model business applications, in the two cases studied it was not operations research staff but decision takers eg the Financial Director, who were responsible for building the models and testing them. It was of some significance that in the Wm Grant case, the financial model was the first application designed for the

system. Two other points of importance were that in order to build models, the managers would of necessity, need to have a full understanding of the relationships within the models and how they affected the models output and therefore described company performance; and secondly that the Scottish & Newcastle wage model gave top management more opportunity to be better informed than the trade unions so offering strategic advantage to management negotiators.

The importance of information was shown by the very fact that the personnel department was able to win its case for the Wang system as a development of the Personnel Information System. The application for analysis of universities, aptitude test scoring, manpower budgets and wage modelling were providing information which greatly improved top managements command of information over staffing and wages, and several managers saw better information provision as vital in helping them control their decision areas.

The distributed systems studied did also support company objectives and impact on competitive position. The cash flow model of Wm Grant's was, as shown earlier, used to help ensure ultimate company independence. The wages models were used to pre-plan company wage negotiations and were used to examine the total effect of possible wage changes. The analysis of universities application was designed to aid graduate management recruitment, an important responsibility of the Management Development Department.

The distributed system studied did therefore match the points highlighted in the literature review, ie they were used for modelling applications by managers, information systems were of core significance

to the personnel department and thirdly the technology was used to support business objectives and impact the competitive position of the firms.

Three special attributes of DDP give it strategic significance. Firstly it allows managers to design their own applications which exactly fit their needs, secondly that having a computer based in a functional department obviously allows immediate access to processing power which, in turn, probably encourages greater use of the system and thirdly as mentioned above, decision makers using their own local computers are themselves designing corporate models which feed into the decision process. While all these points have been discussed already it is important to re-emphasise how critical they are.

The second aspect of organisational strategy which is connected with DDP is that of the organisation recognising that to embrace the DDP technology and minimise user problems, the data processing strategy needs to be reviewed. This review would require to take account of four aspects which affect the organisations ability to maximise the value of DDP; they are controls, user skills, data processing staff role and the job of the data processing manager. Controls will need to be exercised over documentation of locally developed systems and over the integrity of the locally used data if it is entered into a data base used by other company staff. Who is accountable for local data and who will be responsible for data security, will need to be decided. Users will require certain computer skills in hardware and software selection as well as training in structured systems analysis. Perhaps they should also be made responsible for development of their own decision support systems. Both data processing management and staff will require to re-

examine their roles with management spending more time on planning computing stragegy and future capacity, and staff being more involved in advising and training users. The number of programming staff employed at the centre will also need re-consideration.

While it is true that many of these aspects are of a tactical or operational level, taken as a whole they would represent a quite different emphasis by the data processing department towards the rest of the organisation and this change of emphasis would be capable of both supporting organisational objectives and impacting the firm's competitive position. It would represent an information technology strategy for the organisation which could be tuned to the strategic requirements of the business (see H Poppel, 1983) if users were more able to build computer models in areas like marketing, financial and manpower strategy.

For reasons discussed therefore, DDP technolgy can offer strategic advantage to those who use it. Firstly it is capable of directly helping strategic decision makers and secondly, it can make data processing management have a greater involvement in helping manager/users improve their information provision thus helping managers to identify new and important uses for computing in decision making.

As the Grant's case demonstrated the development of some systems is best done through close co-operation of data processing professionals and managerial staff. It does seem that DDP does offer more than centralised systems do, the chance for both to work together and develop systems. It would assume that both want to do this but as was shown in the case, if management can identify clearly what it wants and then

offers full commitment to develop a computer system to act as a management tool, systems development then is constrained largely by data processing expertise. As the interviews with the Data Processing Managers showed, data processing departments are willing to work with users but often it is the user who wants to "do his own thing" without professional help. Distributed Processing, because it is used by non-data processing staff, provides an opportunity for both professionals to co-operate thus enhancing the performance of each group. This provides the opportunity for better working relationships to develop between data processing staff and manager/users of the new systems.

As a follow on from that and because functional managers increasingly will require to use locally sited computers, having a certain level of expertise in computing will very quickly become essential for most or all managers. This requirement opens the door to easing the transfer of computing professionals into non-computing functional areas where their expertise will be of real value to say personnel, finance, marketing etc. As Kaiser (1983) had noted, even though there had been some "crossover" of data processing staff, little evidence of their career planning was apparent. Distributed Processing should provide the spur for organisations to move computing staff into non-computing roles as a career choice open to those who wish to use their computer skills in a different role. They may also learn to become functional professionals like the Scottish & Newcastle Remuneration and Information Manager who, though formerly a data processing specialist, now regarded himself as a "personnel professional".

Consequences ·

The easiest to identify was the need for managers in organisations which use Distributed Processing situated in non data processing functional departments to acquire both computing skills and in some cases, modelling skills. While this seems obvious and has been predicted for a long time, it was evident from the cases that management training was not given to those who would interact with the system. Using support groups to develop systems should not absolve organisations from raising the knowledge of all those who will use computers and who will make requests for systems. As pressures on organisations increase both from competition and internally from demands and expectations made by groups like trade unions and shareholders, the task of management will become harder and managers will be expected to respond quicker than ever before. Computer systems can be immensely helpful but only if they are tailored to the precise needs of the manager user. To do this they need the manager's professional expertise at the design stage coupled with data processing expertise. A knowledge of computer programming is not so crucial as a knowledge of how computers systems function, what are their limitations, what they can do, what possible "shortcuts" could be used and how long it takes to develop systems and what commitment is required by the manager. Most of these points are not common knowledge to managers and in fact some evidence was found of computers not being used properly because it would leave little or no room for management judgement. Thus to get the maximum from the combination of computer and management user, the user must raise his level of knowledge.

The following is a suggested list of important topics on computing which should be included in a training programme for manager/users of distributed systems.

Hardware Knowledge	-	operating requirements of mainframe systems
	-	microcomputers, processing capacity and limitations
	-	problems of protocol when linking computers
Software Knowledge	-	software needs of mainframe computers
	-	range of commercial software packages available for both mainframe and microcomputers
	-	particular knowledge of spreadsheet, data base and word processing software
Programming Knowledge	-	outline only of BASIC, COBOL, PASCAL, FORTRAN as appropriate
	-	appreciation of query languages
Systems Analysis	-	outline of methodology
	-	concept of feasibility study
	-	project control, estimating, scheduling
Prototyping	-	basic concept
	-	applicability, advantages and limitations
Keyboard Skills	-	familiarity with terminal and micro-keyboards and acquiring basic typing speed
Documentation and Control Standards	-	sound appreciation of need for program and procedure documentation. Outline knowledge of data security standards and security controls

The proper time to acquire this type of knowledge is obviously before systems are implemented although keyboard skills could be learnt on the actual system hardware before changeover to the new system. Clearly the above can only be covered in a carefully designed training programme lasting several weeks, with plenty of hands-on experience so that trainees become familiar with the systems and break down any psychological barriers which may be present. Organisations must accept that acquisition of computer systems must go hand in hand with thorough

user training so that both the computer and the manager/user can achieve maximum performance via computer systems.

Because Distributed Processing is the first type of computer system to be used by functional managers, their expectations have been quite high and systems have been expected to contribute to higher level decision making by, for example, the use of models. For the first time the need for this kind of skill may be required in functions other than in finance or production. Thus model building skills need to become an integral part of general management training as much as does the need for computer knowledge.

As a converse of the need to take account of the opportunities DDP offers for career pathways for data processing staff, general management need to accept that a computing professional can contribute immediately to functional management. This can be done by helping them to design computer systems tailored to management's immediate need. No longer must the systems analyst be seen as a staff specialist with little understanding of functional management. We now live in what is accepted as an information age; functional management will, to an important extent, be manipulating and generating information. The computer expert is well placed to do this once he has committed himself to a function like, for example, personnel.

At the same time organisations may choose to implant support groups with data processing expertise into functional departments. This was noted by Rockart & Flannery (qv) and had been implemented by Scottish & Newcastle in the Group Personnel Department. The big advantage of Scottish & Newcastle's method was that the computer support staff were

actually personnel specialists who had obtained computer expertise, thus they were fully in tune with personnel needs and committed to them. They were also managed by the Group Personnel Department Senior Managers and on top of these advantages had acquired certain computer skills. In terms of their being available at all times to Group Personnel staff this was a very successful structural change. The lesson seems to be that support groups are a good idea if they are fully under the control of senior functional managers and if their loyalties are towards that function.

Refinement of Model

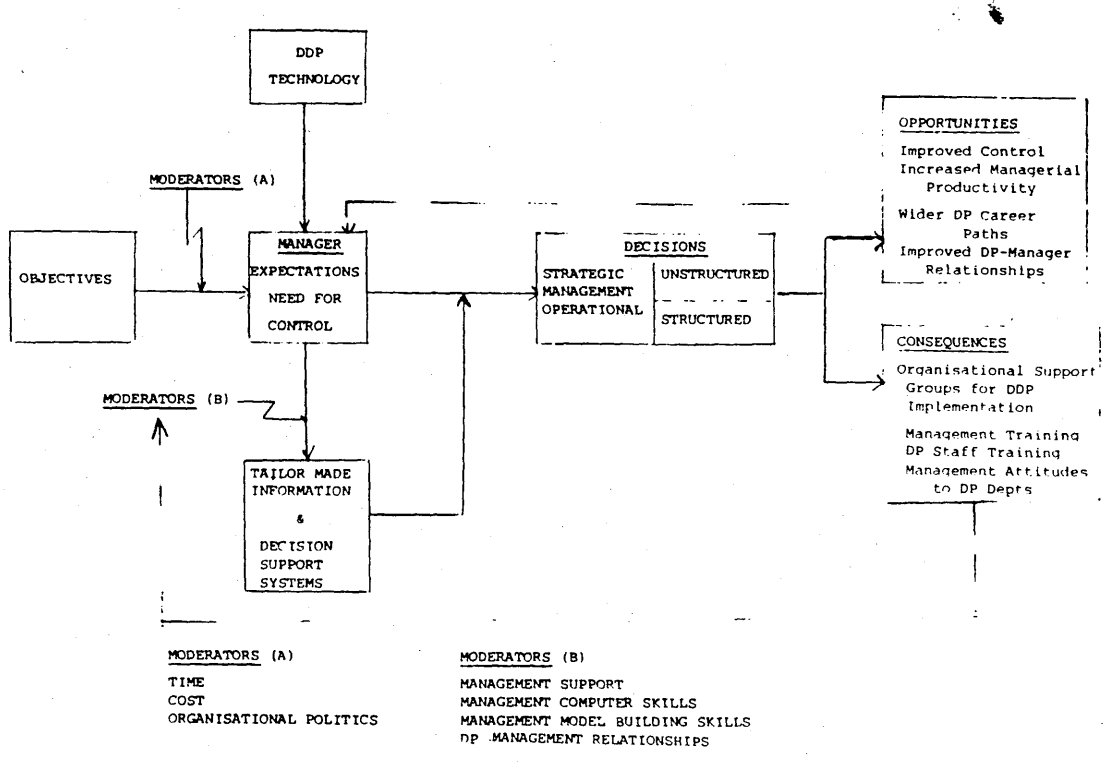
The model as developed in the theoretical section, while largely still valid, does need some refinement. In particular this would apply to the Moderators (B), to the end block Consequences and Opportunities and to feedback loops.

Under moderators (B), data processing staff attitudes were not, in practice, found to be a controlling factor. No evidence was obtained anywhere of negative data processing staff attitudes; instead they wanted to keep and support users wherever possible, provided professional standards were implemented by user/designers. What was critical was the relationship between the manager/user and the computing professional. Thus the data processing staff attitudes should be taken off the list of moderators and replaced by data processing user relationship.

The final block really needs to be split in two, Consequences as one, and Opportunities as the other. The first should contain sub headings for example management training (ie attainment of basic computer

literacy and modelling skills), data processing staff training, willingness of management to accept computing staff into functional management, creation of support groups etc. Under opportunities should go improved control mechanisms, higher managerial productivity, data processing career pathways, the chance for closer relationships between data processing and management. Feedback loops will be necessary leading back into the body of the diagram and the model would thus appear as follows.

DISTRIBUTED DATA PROCESSING AND THE DECISION MAKING PROCESS (REFINED MODEL)



Implications for Management

This dissertation has attempted to show that to make effective use of DDP at strategic and tactical levels it is important for the manager to have a certain expertise in computing and corporate model building. Earlier in this chapter a list of topics for inclusion in a training progamme on computer knowledge was proposed for all staff required to use DDP systems directly or indirectly. This is the first clear general implication for management.

The second implication concerns modelling skills. Both modelling applications illustrated were of the forecasting kind as opposed to the analytical optimisation approach relying on exact data and precise mathematical rules to generate an optimum solution. The forecasting technique is very powerful and subjects complex problem areas to scientific analysis, is flexible and model complexity (realism) is limited only by the designer's imagination. It has been pointed out earlier that to build models of this type it is necessary to understand the relationships between the key variables and to have a good understanding of what the figures used actually mean. It involves three stages, conceptualisation, construction and validation. During the first stage the manager must examine the problem in depth to extract relationships, define objectives and model parameters and the output expected. This is the key stage and can ony be done if the decision maker makes considerable effort to tease out the essential nature of the problem which rests on the decision makers ability to think constructively in an abstract fashion. This is a skill often not well developed in many managers.

Mintzberg (1973) pointed out that there may be only a few problem areas where effective models can be built as yet and he suggested this is caused by models not being accurate or flexible enough to adapt as easily as the manager. However, in recent years this seems to have changed with the advent of Decision Support Systems (DSS) since Keen (1980) reports that these systems now are important to managers in America and that the managers "have picked up the concept of Decision Support Systems and used their own creativity and the resources provided by the organisations", and he notes that "in the past three years, practitioners have responded to it (DSS)." Similarly Thierauf (1982, p67) states that the use of appropriate models is an essential requirement of a successful decision support system and indicates (p206) that their use is growing. In the two case studies in this dissertation, the use of models was however not at an advanced stage and this needs further consideration. Higgins and Opdebeeck (1984) had pointed out the relatively low level of use of models by UK marketing specialists in spite of the growth of use of microcomputers in British industry. They suggested that this was partly due to differences in perception of managerial education requirements between academics and management practitioners. Fletcher (1983) has also noted that in respect of marketing models the UK manager is behind his USA counterpart and he believes this is because the average UK manager is "qualitative rather than quantitative and has an inherent distrust of computers". Thus the spread of DDP and its use by middle and top managers would seem to require a different, more quantitative outlook by UK management. It seems likely that this may happen as part of the diffusion of micro computers into all company areas but this does not absolve UK managers from taking a more analytical and quantitative approach to solving

problems. Modelling as a subject is often only an optional area in UK business degree courses and one has to ask if this is a tenable situation now that computer applications are being developed on a distributed philosophy. Thus another implication for managers is that skills in conceptual and abstract thinking need to be well developed. This would be the same type of skills required for structured systems analysis where the analyst has to build a conceptual model of the physical system and also a conceptual model of the data system. Training in structured analysis for DDP users was one requirement foreseen by data processing management. Traditionally organisations have tended to concentrate conceptual skills in Operations Research or Systems Analysis Departments but this may need to be reviewed if DDP systems are to become commonplace.

The importance of the linkage and relationships between data processing staff and manager users of DDP systems has also been discussed earlier (p148). Because functional managers need professional data processing help in a DDP environment, there is an implication here for the organisation to redefine the links and relationships between users and data processing staff. Several choices are available, for example data processing staff could form functional support groups and be seconded to user groups which would need to have considerable authority to decide applications scheduling priorities. Another option would be that some functional staff could be trained by data processing and these functional staff would be totally responsible for all applications development but maintain close links with data processing for knowledge updating etc. Yet another alternative is for secretarial staff to become the data processing support for managers. This of course would need a better educated and trained secretarial staff than most companies

employ at present. This last option however, is not so unlikely as activities like modelling could be done largely by the manager and the secretary left to enter and manipulate data on the computer. Secretaries with these skills are available, eg the Diploma in Graduate Secretaries qualification.

In summary therefore the implications would appear to be:

- managerial expertise in computing
- managerial expertise in model building which in turn relies on a higher level of conceptual and abstract thinking
- managers need to be more quantitatively oriented
- redefining of the linkages and relationships between data processing and DDP users.

Further research however is needed to look closer at what level of modelling skills is present in management in the UK and to determine why, unlike in the USA, British managers seem to be slow in adopting the Decision Support System concept. Modelling is not widely used in the UK by functional managers but the reasons are not obvious and it would be a fruitful topic for research to extend the work begun in this dissertation. Similarly, much more investigation is needed to uncover the potential for linkages between managers and data processing staff.

Summary of Conclusions

DDP and Management Users

1. Distributed Data Processing is being used by managers mainly at the middle but in some cases at the upper strategic level.

2. The key property of Distributed Data Processing is instant access by users compared to centralised systems and also the fact that systems design is under the scheduling and control of local management which can then achieve tailor made systems under a time scale which suits the local manager.

3. The use of the technology is being pushed by management users not data processing staff.

4. Distributed Data Processing is capable of giving tailor made information and decision support systems by a combination of management involvement in design and data processing expertise. Thus for the first time managers are able to design their own computer based MIS to complement the verbal information systems traditionally used.

5. Top management commitment is essential.

6. Where management had some understanding of computers, systems were introduced more quickly and put to more immediate use.

7. Programming skills are not required at middle management levels but a familiarity with computer systems generally is.

8. Functional management education and training programmes need to stress the importance of broad computer literacy and the skill of model building to maximise the potential of DDP systems.

9. DDP is directly contributing to increased managerial productivity.

Decisions and Control

10. DDP system output are capable of aiding decision making at the middle and strategic level. At the strategic level this is through the use of models designed by manager users. At middle level DDP can provide tailor made information provision at the correct time to be used by managers.

11. For Distributed Data Processing computer systems to be useful at strategic management level good corporate modelling skills are required.

12. DDP systems using models provide the opportunity to incorporate feedforward and other control mechanisms into managerial practice.

Organisational Structural

13. Functional support groups created by management users to advise on and design DDP systems may grow in importance and will tend to allow functions to be largely independent of data processing departments, except where interfacing to a large data base is required.

14. Functional management will want full control over these support groups.

15. Data processing departmental structures need to take account of DDP technology and the users' needs.

Data Processing Management and DDP systems

16. No evidence was found of negative attitudes to Distributed Processing by Data Processing Managers. However, they see a clear need for certain standards being applied to locally designed systems.

17. Data processing management needs to prepare an end user strategy when distributed processing is being implemented.

18. Where a good working relationship exists between manager user and data processing staff, good systems can be introduced quickly and contribute immediately to decision making. DDP is a catalyst to help both groups develop fruitful working relationships in order to design information systems of direct value to management.

19. DDP could offer career path alternatives for data processing professionals to move into functional management roles where their data processing expertise can be used on DDP systems design. Data processing staff training programmes need to take account of this.

DDP and Future Research

20. Further research is needed to determine how much use UK managers make of corporate models and what barriers exist which inhibit the manager's use of models.

21. More work needs to be done on what, if any, industry specific characteristics there are which either encourage or discourage the implication of DDP systems.

T&GWU NEGOTIATIONS 1982

DATE: 10000000

The Company proposes the following improvements to terms and conditions of employment:

		PRESENT	INCREASE	FUTURE
1. BASIC	MA	73.08	6.92	80.00
	M1	76.10	5.90	82.00
	M2	78.62	5.38	84.00
	M3	81.15	4.85	86.00
	M4	83.67	4.33	88.00
2. SHIFT ALLOWANCE				
MORNING & BACKSHIFT		27.00	3.00	30.00
NIGHTSHIFT		36.00	2.00	38.00
3. FIXED AWARD				
DAY		12.00	0.00	12.00
SHIFT		10.00	0.00	10.00
4. FIXED SUPPLEMENT		4.00	0.00	4.00
5. FLEXIBILITY		12.00	1.00	13.00
6. BONUS		1.26	0.00	1.26
7. MEAL ALLOWANCE		0.76	0.04	0.80
8. OVERNIGHT SUBSISTENCE		10.33	0.57	10.90

* Example only, rates not necessarily correct.

Job Title _____

Date of Birth _____ Location _____ Years Service in Present Job _____

Salary _____ Job Holder's Manager _____

PERSONAL SKILLS PROFILE

Skill	Present Ability
Man management	
Decision making	
Communicating	
Planning	
Innovating	
Data analysis	
Problem solving	
Coordination	

Job Title _____

Date of Birth _____ Location _____ Years Service in Present Job _____

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PERSONAL SKILLS PROFILE

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