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COMPUTER BASED INFORMATION SYSTEM

FOR BANK OF SUDAN

ADOPTING MODERN DESIGN

AND

EVALUATION TECHNIQUES

by

Zeinab Ahmed El-Tahir, B.Sc. (Econ)

Thesis submitted for the Degree of
Master of Philosophy

at the University of Durham

June, 1978.

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ABSTRACT

Introduction of computer based systems is slow in developing countries. Financial and social cost of the non-availability of information or manual information processing tends to be higher than the cost of an EDP system.

This thesis is an investigation in the Bank of Sudan - a Central Bank in a developing country - to study the feasibility of introducing a computer based system.

Also it is an adoption of the modern ETHICS and BASYC techniques in the design and evaluation of these systems.

ETHICS is concerned with the design of man-machine system allowing for equal consideration for its technical and social variables. BASYC provides the multi-dimensional framework to assess the benefit of the changed system for the several groups of people who will be influenced by that change.

While in other banks saving by replacement of clerical staff may be the main objective of introducing computer based systems, in a Central Bank the important objective is the improvement of the information necessary for control and planning.

The ETHICS and BASYC techniques are applied to design and evaluate a computer based information system for export trade - a cluster of related activities within the foreign exchange operation. An integrated computer based management information system was the best of two viable solutions. It was a good demonstration of the design of socio-technical systems allowing for technical and social requirements. Besides its contribution to staff and user satisfaction because of the availability of information for control and planning, the predicted payoff in financial terms is far more than the cost of the system.

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CHAPTER 1.

INTRODUCTION

Planning for change in the existing information systems of an organization that involves the utilization of computer technology as an integral part of these systems is one of the complicated processes that have faced many organizations (McFarlan, Nolan & Norton (1973), Mumford and Ward (1968)) and much has been written about the problem. This planning process covers a number of distinct but interdependent topics (Hawgood & Land (1976)). The efficient planning for this process requires the co-operation of several disciplines, including economics, accountancy, operational research, computer and social or behavioural sciences.

In developed and developing countries many organizations have experienced partial failure in their change to computer based management information systems. Almost the degree of failure differed from one organization to another typical situation, involved heavy financial costs that exceeded the estimated budget, poor functioning of the system due to creation of social problems, dissatisfaction of users because their requirements had not been adequately considered, etc., (Dearden (1972), Dickson and Powers (1973), Mumford (1971), McFarlan, Nolan and Norton (1973), Mumford, Land and Hawgood (1978), Hawgood (1977)). These problems are attributable to several factors but in many cases it was the consequences of an over-concentration or complete reliance on one discipline or one group of people to develop systems and of the ignorance of other groups about these disciplines (Diebold (1969), McKinney (1968), Reichenback and Tasso (1968), Mumford and Ward (1968)).

Planners for this kind of change face two important questions :-

(i) What approach to follow so as to create systems which are acceptable according to the objectives of the organization and contribute more towards them ?

(ii) How to assess this contribution for decision making ?

The first question is concerned with system development and the other is related to the evaluation technique and criteria for decision making. System development and evaluation are interdependent subjects and complementary to each other. While system development is directed to the creation of systems to achieve organizational objectives, evaluation is concerned with the measurement of the contribution of these systems towards the objectives. For system development, planners think in terms of what to do and how to do it, i.e. what resources to be utilized, and how to utilize them to achieve objectives. For evaluation purposes, one thinks in terms of costs to be incurred, benefits to be realized and how to relate them for decision making. Evaluation is necessary to reduce the risk of resources misallocation, and to increase the certainty of decision making. For resources allocation and evaluation, system development evolves through the following stages :-

- (i) Analysis
- (ii) Design
- (iii) Specification
- (iv) Implementation
- (v) Operation and Maintenance

Informatics is a recent phenomenon in Sudan. The introduction of computer technology as an integral part of information systems started during the late sixties. Up to the mid-seventies there were only five small computer centres. If the development of computer based information systems is allowed to evolve through the phases through which it evolved in developed countries (Nolan (1973)), several decades will be required before they reach the enter phases of the Nolan Model. This is likely to enlarge the gap between developed and developing countries, as there is rapid progress and further discoveries in developed countries, while developing countries are lagging behind. Due to this fact, it was relevant to search the literature on the subject of design and evaluation in developed countries to select the appropriate techniques to be

adopted by an organisation in a developing country.

In developed (Mumford and Ward (1968) , Diebold (1969)), and developing countries (author's contact) the implementation of a computer based management information system is considered a design of a technical system to be carried out by computer specialists. The social and technical problem of providing manual information has sometimes led to developing countries attempting planning without information (author's contact). At the same time the risk of introducing computer technology in developed countries, about which developing countries are aware, is not encouraging them to consider computer information processing seriously (author's contact). This resulted in direct and indirect costs for these countries. The cost paid by them, due to maldistribution of their limited resources because of the nonavailability of information for planning and control, may be more than the cost of computer based management information systems.

In order to validate this argument and to prove that the computer as an integral part of an information system can contribute positively towards objectives of organizations in developing countries, the author of this thesis examined several approaches to system development to select the relevant one for the case under consideration (Blumenthal (1969), McFarlan, Nolan and Norton(1973), Anthony and Dearden (1976), Mumford (1971), Mumford, Mercer, Mills and Weir(1972), Weir (1974), Hedberg and Mumford (1974), Waters (1974), Waters (1977), Emery(1969), Sanders (1970), Sharpe (1969), Mumford, Land and Hawgood (1978), Forrester (1961), Weil (1971, etc)).

The theoretical work on this subject involved a framework for system development in general and an approach to system analysis and design in particular.

A computer based management information system is a socio-technical system in which there is interaction between man and machine or man and the technical aspects of his job. Several approaches had been developed to cater

for this relationship (Acoff (1969), Vaill (1969), Herzberg (1969), Paul (1969), Smith (1968), Davis (1966), Tuggle (1969), Mumford (1971), Mumford, Mercer, Mills and Weir (1972), Weir (1974), Mumford, Land and Hawgood (1978)). The ETHICS "Effective Technical and Human Implementation of Computer Systems" is one of these techniques to system designs (Mumford (1971), Mumford (1974), Mumford, Mercer, Mills and Weir (1972)). This technique will be applied to design a computer based management information system for the Export trade which is a cluster of related activities within the foreign Exchange operation and Reserve system of the Bank of Sudan ; the Central Bank of the Democratic Republic of Sudan.

The ETHICS technique involves the following steps (Mumford (1971):-

- (i) Definition of social and technical objectives of proposed change.
- (ii) Identification of possibility, needs and constraints in technical and social solutions.
- (iii) Merging of technical and social solutions.
- (iv) Establishing the viability of a particular socio-technical solution.

The ETHICS technique explicitly allows equally for the technical and social factors of organization. It leads to the selection of a system in which these factors are compatible with each other. Although the solution arrived at is the best in the term of the two factors merged together, it is not the best if each factor is taken separately (Mumford (1971)). As the solution arrived at is meant to achieve objectives and will be subjected to economic analysis, this itself will allow the social and technical factors of organization to interact with its other factors as well.

The application of the ETHICS technique in the Design process is very much dependent on the analysis stage of the existing system (Mumford, Mercer, Mills and Weir (1972)). The output of this stage are the objectives to be achieved, the constraints that hamper the acceptance of one solution or another

and the resources to be utilized. In many applications definition of objectives is left to computer specialists (Diebold (1969), McFarlan, Nolan and Norton (1973), Waters (1977)), but they are not the people who use the system to cater for its requirements and this creates problems and dissatisfaction amongst users. To avoid such problems, it will be necessary to participate the users in analysis and then design of their own system (Mumford (1974), Mumford (1976), Mumford, Land and Hawgood (1978), Hawgood and Mumford (1971)).

There are significant difficulties in the definition of social objectives. Social objectives are derived from the diagnosis of the pre-change situation in terms of the degree of fit between organization and employee needs, in terms of employee attitudes to change in general and to proposed change in particular ; in terms of employee rigidity/flexibility and employee ability to influence change events (Mumford, Mercer, Mills and Weir (1972)). The difficulties are due to the failure to analyse the social system. Considerable effort has gone into means to overcome them (Mumford, (1974)). Social analysis is based on a definition of job satisfaction. Job satisfaction is defined as the achievement of a good fit between what people want from work, i.e. their job needs, expectation and aspiration and what they experience in work, the demand of work situation in which they find themselves (Mumford (1974)). This definition permits the measurement of job satisfaction, for one can measure the fit between what people want and what they receive. Accordingly, it becomes necessary to identify the factors that create job satisfaction so as to measure this fit before the change to arrive at objectives and after the change to assess the contribution of the change towards the objectives (Mumford, Mercer, Mills and Weir (1972), Weir (1974)).

The evaluation of computer based management information systems is one of the complicated subjects that attracted the attention of many people specialized in different disciplines such as economics, accountancy, operational research, social and computer sciences, to contribute in its solution.

The computer based management information system is an investment project for which significant resources of the organization will be devoted. Beside the direct cash in and out, the introduction of computer technology in organizations influences the indirect financial resources through its influence on aspects of information and the consequences of this on decision making, control and planning functions (Emery (1973), Davis (1974), Marschak (1971)). Also, it influenced the services organizations offer to their customers (Land (1975) , , Land (1975 (a), Diebold (1969), Hawgood and Land (1975), Hawgood and Land (1976) etc), the working conditions of the staff (Weir (1974), Mumford(1974), the potential activities to the public (Laver (1974)) and the image of organization, hence the image of management (Hawgood and Land (1976), Atkinson (1974)). In order to evaluate such projects for decision making, the author examined the known evaluation techniques and criteria developed for this and other purposes (Merret and Sykes (1966), Hooper (1966), Bierman and Smidt (1966), Quirim (1967), Horne (1968), Hill (1966), Emery (1971), Emery (1973), Marschak (1971), Sharpe (1969), Hill (1966), Gardiner and Edwards (197), Hawgood and Land (1975), Hawgood and Land (1976), Land (1975), Weir (1974), Beyer (1969), Schwartz (1969), Patrick (1965), Stout (1966), Hawgood (1977), Mumford, Land and Hawgood (1978), Turvey (1969), Kendall (1969), etc.). The BASYC technique "Benefit Assessment for System Change" (Hawgood and Land (1976), Hawgood (1974), Land (1975), Mumford, Land and Hawgood (1978) is one of the approaches to multi-attribute, multi-criteria decision making. This approach makes explicit allowances for the groups of people or interest who will be affected by an investment in computer based management information systems as a part of the evaluation process. Hence, this approach will be applied to evaluate a computer based management information system for the Export trade system within the Bank of Sudan.

The BASYC technique is a multi-attribute utility analysis (Mumford, Land and Hawgood (1978)). It is a decision support technique in two senses (Hawgood and Land, (1976)) .

(i) It is intended to help the management of organizations to decide whether to make a change of systems or policies and which of several alternatives to adopt.

(ii) It is also intended to support their decision by ensuring that it is realistic and acceptable to the people affected.

The BASYC approach allows explicitly for goals and objectives of people who will be affected by the change of system or policy throughout the life cycle of the changed system. The evaluation process based on it considers the investigation and initial planning right on through design and implementation to the management and monitoring of operational system (Hawgood and Land (1976)).

One of the shortcomings of the financial techniques in the evaluation process is the reduction of the benefits of the changed system to financial unit. Some would claim this as an advantage and techniques had been developed to do it for investment projects in general (Hertz (1964), Hertz (1968), Emery (1973), Prest and Turvey (1965) etc.), but staff and customers own benefits are not financial and it is not rewarding to reduce them to monetary value. At the same time, technical approaches in evaluation process try to measure the efficiency of the computer system without relating it to the objectives of the organization. Neither of them will help us to state the contribution of computer based management information system towards the social well-being of the organization. The BASYC approach differs from them. It is based on the assessment of benefits of the groups of people who will be affected by the given project whether customers, users, staff owners, or managers and public at large. It will help us to state the contribution of the project towards the social, financial, technical, managerial and organizational objectives of the organization without trying to reduce them to monetary values. The BASYC approach is humanistic in that it seeks benefits to all the groups of people affected, adaptive in that it reacts to changing circumstances for

these people , and participative in that it is operated by some of the same people (Hawgood and Land (1976), Hawgood (1977)). It provides a formal structure for the co-ordination of subjective and objective factors influencing decision about change of systems (Hawgood (1977)). Potential benefits of alternative systems are assessed in terms of their likely contributions to the attainment of a number of detailed and measurable goals, defined participatively within the broad aims of the organization by representatives of the various groups of people who might be affected by the change of systems such as staff, customers, owners, managers (Hawgood (1977)).

The evaluation process based on the BASYC technique, involves the following stages (Hawgood and Land (1976)):-

- A. (i) Identification and classification of the possible beneficiaries from a change to the systems. The BASYC technique identified five groups of people to whom a change in systems presents an opportunity or a threat and these are :
- (a) Those with financial interest such as shareholders or taxpayers.
 - (b) Employees of organizations whose jobs will be influenced by the change of systems with job satisfaction objectives.
 - (c) The users of the system with service objectives.
 - (d) Top management with organizational objectives.
 - (e) The personal subject of information - in the case of information systems - with privacy and confidentiality objectives.

The BASYC approach classified people according to the nature of their benefits and by so doing it reduces the number of groups to allow for in the evaluation process. Here, it differs from cost/benefit analysis approach that stresses the classification of people to sectors into which the economy can be directed (Turvey (1969)), which is too difficult to perform.

- (ii) Exploration of the opportunities provided by the new system in terms of specific measurable targets.

(iii) Provision of a set of weights for each target where the weights are given by the various individuals or groups who will be involved by the change.

- B. Assess how different designs of systems or alternative strategies might contribute to the achievement of targets.
- C. Subject the outcome to a sensitivity analysis.

The study can be a one or multi-phase study depending on the results arrived at, at each step, their sensitivities to weights and measures used and their acceptance by decision makers to proceed further or their demand to investigate to find other alternatives (Hawgood and Land (1976), Hawgood (1977)).

The BASYC approach may be used to aid decision at every stage of system life cycle from initial feasibility study through design and implementation to operation and maintenance until removed from services (Hawgood and Land (1976)). The same structure of the feasibility study recurs iteratively with individual steps requiring different amounts of effort in different cycles, in a progression guided by the successive results of earlier cycles which indicate sensitive parameters or areas requiring further study (Hawgood (1977)).

The BASYC approach can be applied in public or private organizations which are making profit or offering services.

APPLICATION

The Bank of Sudan, the study case under consideration, is the central Bank of the Democratic Republic of Sudan. Central Banking in Sudan is a recent concept. Up to now the Bank is laying the foundation to implement its function as stated in its acts of rules.

In developed and developing countries these Banks have stated objectives to be achieved. In order to approach the subject of informatics in these Banks, the author consulted the literature on central banking in general. This was necessary to study the environment in which these banks work (De Koch (1954),

Brinner (1959), Siemienski (1957), Brown (1968), Basu (1967), Hoss (1972), Cobbald (1962), Fleetwood (1964)). The practice of central banks to computerize their information system is also included. This covered the Bank of England, a central bank in a developing country and the central Bank of Iraq - a bank in a developing country. The Bank of England started its computerization program in the early sixties. Its main objective was saving costs by the replacement of clerical staff. The Stock department was the first to be computerized. Towards the end of the sixties, the Bank started to investigate the possibility of a computer based management information system for the other functional areas including foreign exchange, note issue, account systems, payroll and personnel management. The introduction of computers in other banks and the need to improve information were the main stimulating factors for change in the Bank of England, but when they approached the evaluation question these features were assumed to be intangible benefits. A 10% rate of return which was the only tangible benefit to them was necessary to justify the installation of computer technology. The Management Service Department, which is entrusted with the function, is staffed with people specialized in economics, accountancy, behavioural sciences, computer technology, and sciences and operational research. A consultant had been appointed to supervise the job. Although they make allowances for technical, social and financial factors when they computerize a given task or functional area, still the criterion for selection is financial and the evaluation process is left to the accounts department to do.

In the central Bank of Iraq the change to computer based management information system started in the early seventies. Technology is considered to be the only means to speed the development programs. As a result they introduce systems wherever they feel they can make use of them. Their attitude to computer technology is no different. There are several investigating teams - most of their members are specialized in computer sciences - to study the possibility of computer systems, but in technical terms. Financial justification is the least

to be considered while social factors are ignored completely. They had committed themselves to the purchase and installation of the hardware before working out their solutions to system alternatives or evaluation of the job.

In the case of the Bank of Sudan, there are several stimulating factors for the introduction of computer technology as an integral part of information systems. Within the Foreign Exchange operation and Reserve systems, there is an urgent need for information to support the planning, control and decision making functions of operating staff, line managers, and top managers. Apart from the book-keeping job which is necessary to control payment and receipt in foreign currencies, it is difficult to say what information processing for control and planning functions exist for operating staff and middle managers. The distribution of resources under the control of this functional area is based on the principle first-in first to be served. Although the resources are very limited - foreign exchange currencies - the control system and planning function related to them are based on personal judgement without the support of information and hence add to their cost due to misallocation. Manual information processing, if to be considered, is characterized by social problems, dissatisfaction of clerks, and technical problems, delay, inaccuracy, etc. If accepted as a solution, then management has to face up to social and technical problems. The management of the Bank has chosen the easiest way, i.e. do without information. Apart from the financial cost due to resources misallocation, the non-availability of information resulted in a social problem, namely frustration amongst middle managers. The introduction of computer technology as an integral part of the information system of this functional area is necessary to avoid the social and technical problems likely to be created by manual information processing, to produce information to support the planning and control functions of middle managers and operating staff and hence reduce the frustration among them and to reduce the cost of resource misallocation.

The accounts system of the Bank is the only system where manual and

mechanized data processing is employed. The members of staff within this system are dissatisfied and this is reflected by their demand to move to other functional areas of the Bank. The presence of job dissatisfaction and absence of satisfaction validates the argument that manual information processing is not accepted by clerks in general. Also, the business transactions have increased to a size which further expansion of the system cannot cope with. There is an urgent need to change to computer accounts systems to create satisfaction among members of staff and accommodate the increase in transaction numbers. The payroll and personnel management information system of the Bank is neither efficient or effective. Apart from the financial transactions which are generated by the system for accounts purposes, it is difficult for members of staff to receive timely information related to their salaries, leave, loans, etc. Personal information about members of staff are scattered in general and personal files. Also, the system which is based on manual information processing is costly in terms of clerks. From the literature surveyed, the introduction of computer technology within such functional areas is likely to reduce the cost and provide information for control and managerial planning.

It is too difficult to say that computerization of one of these systems is urgently needed rather than the other. Each one of them is characterized by its own problem in which solution the computer processing may contribute.

In order to validate this argument, the author of this thesis surveyed the functional areas of the Bank twice. The first survey was based on departmental level and the second on departments within the functional area so as to divide them to clusters of related activities for development of future systems (Davis (1974), McFarlan, Nolan & Norton (1973), Blumenthal (1969), Anthony & Dearden (1976) etc.). From the start the author faced two different questions, (a) am I trying to develop and evaluate a computer-based management information system for the whole of the Bank or (b) am I trying to show how the system should be developed and evaluated.

On functional bases, it is possible to group the information systems of the Bank of Sudan under the following main system :-

- (i) Foreign Exchange Operation and Reserve System
- (ii) Account System
- (iii) Payroll and Personnel Management System

Each one of these systems has components of sub-systems and each sub-system was developed to handle certain tasks and achieve stated objectives. Each one of them has its own problems and requirements. It is very difficult to integrate the functional areas for the development and evaluation of a computer based management information system for the whole of the Bank. Also, too much work and considerable numbers of years are required to develop and evaluate computer based management information systems for the sub-system within functional areas. The process will be repeated for each sub-system. This thesis is not a place for it. The main objective of the thesis is to show how the system is to be developed and evaluated. The selection of a sub-system is more relevant for the achievement of this objective.

In a developing country like Sudan, resources, financial and human, are very limited. To receive the greatest benefit from limited resources, it is essential that information systems be developed in areas that are critical to the success of the organization (McFarlan, Nolan & Norton (1973)). The non-availability of information processing for control and planning characterized the Foreign Exchange operation and Reserve System of the Bank. The availability of computer processed information should help in the reduction of the cost of foreign exchange currencies which is the result of the planning based on personal judgement.

Export trade systems is a cluster of related activities within the Foreign Exchange operation and Reserve System. It involves technical problems, non-availability of information, social problems, frustration among line managers and senior staff and financial problems, increasing cost of foreign exchange currencies. A computer-based management information system for export trade

will affect several groups of people including exporters, applicants for foreign exchange currencies, employees within the users departments, senior managers and decision makers of the Bank. It should play an important role in developing the social infra-structure especially in that it should raise the level of understanding the discipline in systems (Hawgood and Land (1976)), and should help the people, especially the managers and politicians who are concerned about foreign exchange currencies problems to be EDP oriented. The change of this system is a typical example to design a computer based management information system for unstructured sort of jobs. More important, the change of the system is a good example to solve the paradox of the limited resources and their inefficient utilization due to the non-availability of information for planning, control and decision making functions.

System development and evaluation for export trade started by system analysis. System analysis covered technical, social, economic and organizational factors of this system within the context of the Foreign Exchange operation and Reserve System. The importance of this is to reflect the interaction of Export Trade system with the other system of this functional area. Also, to study the environment under which export trade system is operating.

Social analysis is based on a questionnaire, the statements of which involve the factors necessary for job satisfaction, attitudes of employees to change in general and the proposed change in particular, their rigidity/flexibility and their ability to influence the changed events.

Four months were spent in the survey of the Bank's functional areas and another three months to study export trade systems within the Foreign Exchange functional area. Two full-time members of staff, the author is one of them, were involved in the job supported by members of staff within users departments. The results of social analysis were shown to some of the members of staff, line and senior managers, for comments and views. Based on social, technical, economic and organizational factors, the author supported by the head of sections

of export trade system prepared alternative designs for the system.

The results of this work are reflected in Chapters 4, 5, 6 and 7. Chapter 4 is the survey of the Bank to reflect the stimulating factors for change in the existing information system. Chapter 5 is the analysis of export trade within the foreign exchange system. Chapter 6 involves the alternative system designs for export trade. Chapter 7 is the evaluation process of the viable alternative solutions.

CHAPTER 2

APPROACH TO COMPUTER BASED MANAGEMENT INFORMATION SYSTEM

DEVELOPMENT

2.1 INTRODUCTION

Any organization, public or private, commercial or administration develops information systems in order to collect data from their business transaction and external sources that influence their business activities, so as to process them, originate and update files, retrieve, display and produce information for control, planning and decision making functions of operating staff, managers and decision makers (Davis (1974), Kenneron (1970), Emery (1969), McFarlan, Nolan & Norton (1973), Anthony and Dearden (1976), Blumenthal (1969)).

Stimulated by the technical value system that advises the maximum possible use of technology so as to be wealthy and comfortable, the introduction of computer technology as an integral part of information system in organizations was meant to increase information processing efficiency by replacing the clerks and calculating machines (Davis (1974), Nolan (1973), Sanders (1970)). The clerks who were the major factor of production of these systems resisted their introduction as they threatened their job security (Mumford and Banks (1967)). The problem was further extended by the traditional approach of planning for technical innovation that this is an engineering responsibility of technical specialists (Mumford & Ward (1968), Mumford (1971), Diebold (1969), Reichenback & Tasso (1968), Hooper (1966)). They concentrated their attention on the technical aspects of the computer based information system and ignored human factors, simply because they do not know individuals' needs when they design systems and are unable to consider them in their process

(Weir (1974)). Once the system was programmed and put in operation these social factors showed themselves in different ways. They resulted in heavy cost, endless problems (Mumford, Mercer, Mills and Weir (1972)), and even the failure of the system as it happened in the first attempt to computerize the account system of the Bank of Sudan in 1969. This state of affairs supported the humanistic value system which tells organizations to beware of technology for it is a mirage which will lead them to disaster rather than success. Somewhere in between these value systems is another which says technology is essentially neutral ; whether it produces gains or losses depends entirely on the decisions that are taken on how it shall be used (Hedberg & Mumford (1974), Laver (1974)). Computers and information technology represent a powerful resource for improvement at all levels of society (Davis (1974), Laver (1974), but for this improvement to come about alternative ways of using the technology must be identified and choice made in terms of human psychological needs (Hedberg & Mumford (1974), Mumford (1974, Mumford (1975)).

A definition of a computer based management information system, as the term is generally understood, is an integrated man-machine system for providing information to support planning, control and decision making functions in an organization (Blumenthal (1969), Emery (1969), Davis (1974), Anthony and Dearden (1976)). Thus defined, it would include a large portion of the total organization (Emery (1969)). The organization itself is a socio-technical multivariate system (Acoff (1969), Hedberg & Mumford (1974)) characterized by four interacting factors and these are (i) structure, (ii) technology, (iii) people, and (iv) tasks (Hedberg & Mumford (1974), Leavitt (1964)). A major change, especially that one which involves the introduction of computer technology as an integral part of information systems will influence not only the technology but also the work role of individuals, the nature and performance

of their task and the structure which is designed to keep the organization components together. On planning the development of such systems, planners should realize that they are developing a socio-technical system that influences the four factors which define the total organization (Hedberg and Mumford (1974)). While they need an approach to cater for the social and technical factors when they develop the system, at the same time they have to work with an organizational model to accommodate it and relate to what they are trying to achieve.

For system development and resource allocation and evaluation, it is more relevant to visualize the system under consideration as having a life cycle (Land (1970), Waters (1974), Blumenthal (1969), Laden & Gildersleeve (1963), Charman (1971), McFarlan, Nolan & Norton (1973), Morris (1971)). Several approaches have been developed to phase system life cycles. The most relevant approach to phase system life cycles is to follow the established control method of operating a plan, implement and obtain feedback loop (Waters (1974)). The plan involves the definition of objectives to be achieved which is the output of the analysis stage, then how they will be achieved through system design. Implementation and then operation provides the feedback to assess the system performance against its planned performance. System development evolves through the following main iterative stages

(Morris (1971)):-

- (i) Analysis and definition of objectives that the system should achieve.
- (ii) Design of system to achieve objectives.
- (iii) Implementation of systems.
- (iv) Operation and Maintenance of the system.

From the literature surveyed (Anthony (1965), Blumenthal (1969), Mumford (1971), McFarlan, Nolan & Norton (1973)), it is difficult to know

whether writers are addressing the question of system development or design. Most of the approaches surveyed stressed on information processing and flow in technical terms related to the requirement of decision makers, managers and operating staff (Anthony (1965), Blumenthal (1969), McFarlan Nolan, Norton (1973)). The ETHICS (Mumford (1971), Mumford (1974)) is the only approach that makes explicit and equal consideration for technical and social factors on the design process of these systems. The ETHICS approach is of great use in the selection of an alternative system design. The bases on which the ETHICS is founded can be applied to plan for the other development stages (Mumford, Mercer, Mills and Weir (1972, Mumford and Ward (1968)). Although the other design approaches are developed to cater for one problem or another, still they should be consulted in the detailed design procedures. Most of them are complementary to each other (McFarlan, Nolan & Norton (1973)).

This chapter is a detailed procedure for the system development. Beside the stages through which system development will evolve, the chapter includes as well the stimulating factors for change and prerequisite for system development planning process. The provision for these principles should reduce the risk of change and increase the certainty. The question is not only to develop systems but to show how to manage its planning process as well.

2.2 STIMULATING FACTORS FOR CHANGE

The life cycle of a computer based information processing system is initiated at a point in time. This point will be decided when the organization faces problems that hinders its information system to achieve its objective. The functioning of these information systems is subjected to internal and external factors, social, technical, financial, organizational or political (Morris (1973),

Land (1970), Mumford (1969)). The coincidence of several factors presses the organization to effect change in their information systems but their interactions make it difficult to identify the stimulating factors for it and the objectives to be achieved by the change. The stimulating factors for change can be derived from the functioning of the information systems related to its objectives. These objectives are related to the total objectives of the organization. Economically the organization must be able to secure a return on the capital being invested by a given time, ensure long term financial savings through increased efficiency of operations. The capital being invested in the system and the pay-off resulting from it should be related to the economical objectives of the organization. When the cost of operation increases due to inflation, high recruitment and training cost because of staff turnover, high maintenance cost of existing mechanised equipment as they are old and obsolete, increasing cost due to many stockouts or much capital tied up in stocks, increasing cost of uneconomic purchasing of new materials, etc. the organization is stimulated to change its information system to attain its economical objectives.

Socially the organization must ensure the maintenance of high morale among the staff. When the staff turnover increases, absenteeism rate rises, and efficiency declines, the management will question the working conditions and job-satisfaction among the employees. The stimulating factors for the change should be the creation of job-satisfaction and elimination of the dissatisfaction especially if the information processing system is the main factor for it.

Related to clients and customers, the organization attempts to offer a level of service to increase their satisfaction either by reducing the cost per unit, improving the services at the same cost or increasing the satisfaction with less relative increase in cost. The information system plays an important role in consumer satisfaction. The computing processing will reduce the processing time per transaction and hence reduce the time cost of the consumers. The computer will bring the branches information system under one centre. The consumer need not travel to his own branch to get the required services as any

branch will do. This is another reduction in his cost especially in banks. The computer processing will enable the organization to offer more services within the announced time for it, due to which the customers need not wait longer in a queue to be served. When the sales records decline and the consumer numbers shrink, the organization should investigate its service level especially if its product market is growing. The stimulating factors for change should be the consumer satisfaction through the improvement of services.

The organization has many objectives. It attempts to change its information system when a major re-structuring is necessary to enable it to absorb or create the skill to meet its obligations, when a new activity or additional branches are introduced, when the need for accurate, timely and precise information for management are required, if there is illegal system operating, if the management are not in a position to evaluate alternative courses of action by using modern techniques such as simulation and linear programming, if the internal communications within it are inefficient, if the competitive organizations introduced the technology, if the organization with whom it trades uses computers for activities in which both organizations share, if the information for decision making is inadequate or late, if the processing cycle is too long because of the many control points that delay the functioning of departments, if the existing system involves inaccurate files, wrong calculations or inadequate checking leading to wrong results, if the organization is unable to acquire some factors of production such as management, white collar staff and accommodation, if there is high cost due to departmental and control costs etc. These taken together will be the stimulating factors for change as far as the organizational functioning is concerned, but the objectives of the change is to focus on maintaining the fit between technological requirements and the structure of the organizations and ensuring that the latter is changed to conform with the logic of the new system.

Sometimes the organization attempts to change its information system

to serve the community on whose behalf it was established, to process, access and utilise its information to distribute fairly its resources especially in public enterprises such as hospitals, local councils, etc., but in doing so the organization will be confronted with its objectives towards the total community especially the redundancy in clerical staff if many of them would be saved. In such cases the ethical objectives will have two sides, the side of the individual and the side of the community at large, (Mumford & Banks (1968)). Management should be able to choose which side is most appropriate for consideration when a system is to be changed.

Most of the stimulating factors for change listed above apply to a large number of situations and applications (Morris (1971)). Before the decision to develop systems is to be made, organizations should be surveyed generally to report the nature of the problems in financial, technical, social, and organizational terms. This report should be done by the management of the departments supported by their staff. A committee to be appointed by the decision makers is to study these reports. If the problems are real, hinder the organization from the achievement of its objectives or violate its existence, then the decision makers supported by early findings are to decide on the nature of action to be taken.

2.3 FRAMEWORK FOR SYSTEM DEVELOPMENT

The ETHICS approach explicitly makes equal consideration for social and technical factors in system design. This will be the base for system development to be considered in this section. The section provides detailed procedure for the main stages through which system development evolves and these are :

- (i) System analysis and definition of objectives
- (ii) System design
- (iii) System implementation
- (iv) System operation and maintenance.

2.3.1 System Analysis and Definition of Objectives

Based on the ETHICS approach to system development, the analysis stage involves :

(1) The diagnosis of the human problems and factors, i.e. social analysis within the user departments and EDP centres.

(2) Detailed studies of the operational activities within the organization to be computerized or to be influenced by computer processing, the structure and technology of the organization, i.e. system analysis.

The facts to be revealed by these studies will be the basis for planning strategies and for socio-technical system design. The studies should be undertaken by the user departments supported by personnel managers or social scientists in the social analysis and supported by computer specialists and economists in investigating the system, (Mumford - (1969)). The purpose of the studies is to learn enough about system equipment, personnel, operating conditions and demands on it to establish the objectives of the change in terms of the information to be input to, maintained within and output from the system and how this information is to be processed. Further, to test alternative designs of the system against the objectives and this involves the consideration of possible solutions and the detailed analysis of these in terms of the economic, technical, organizational and social objectives and constraints. The word analysis is restricted to fact-finding, to statement of objectives and to examining systems to learn how they work ; such analysis is applicable to existing or proposed systems.

2.3.1.1 Social Analysis

The development of an information system in which computer technology is involved must move towards the kind of organization which is in balance because its four characters, i.e. people, technology, structure and tasks, fit together and inter-relate effectively. This can be achieved only if there is

equal consideration of the social and technical systems of the organization when planning for the change. This section will be devoted to the analysis of the social system.

Any employee when he agrees to join an organization is concerned about the factors that create satisfaction to him. The development of a new or greatly changed information system is likely to influence the job satisfaction through the factors that create or reduce it. Accordingly, computer based information processing systems ought to be developed so as to improve the job satisfaction if it is low and maintain it if it is high. In order to achieve this objective, the planning team must be supported by a method in their social approach to measure this job satisfaction. The method to be used is based on the proposition that effective and systematic planning for a computer based system change requires a diagnosis of the pre-change situation in terms of the degree of fit between organizational and employee needs ; in terms of employee attitudes to change in general and to the proposed change in particular; in terms of employee rigidity/flexibility and employee ability to influence change events (Mumford, Mercer, Mills & Weir (1972)). The diagnostic procedure which analyses the social system is based on a definition of job satisfaction. Job satisfaction is defined as the achievement of a good fit between what people want from work - their job needs, expectations and aspiration - and what they experience in work - the demands of work situation in which they find themselves (Mumford (1974)). This definition permits the measurement of job satisfaction for one can measure the fit between what people want and what they receive. Accordingly, it is necessary to identify the factors that create job satisfaction so as to measure this fit. These components are collected from the different schools of thought related to thinking on what aspects of work create job satisfaction. They come under five main variables assumed to be implicit contract between the employee and the organization, (Mumford (1972)), and these are :

(i) Knowledge contract.

This is the extent to which the individual or groups feels that their skills and knowledge are adequately used in the work situation and are being developed further. There will be a good fit on this variable when the organization is able to obtain staff with the level of skills and knowledge which it ideally requires and when the employee who has these skills believes that he is being adequately financially rewarded for using them, that he is being assisted to develop his skills, and that his work environment is satisfactory ; a bad fit if the employees believe that their skills and knowledge are being under-utilised or restricted in development.

(ii) Psychological contract.

The organization seeks motivated employees who will, if required, place its interests before their own. In return for doing this the employees seek an employer who will meet their needs for recognition, achievement, responsibility, advancement and work interest. The measurement is to find which of these motivators are important to the group of employees and if there is a good fit on how the employees want their psychological needs to be met and the extent to which these are being met in the work situation.

(iii) Efficiency/Reward contract.

The organization seeks employees who will meet its productivity and quality standards and who will accept its administrative procedures and control. In return for doing this, the employee requires these procedures and controls to be arranged in such a way that he retains a degree of personal control over his activities. The important variables are the adequacy of the pay packet and non-financial controls such as supervisory and work controls.

(iv) Ethical contract or social value fit.

Every employee brings to work a powerful personal value system and he wishes to work for an employer who supports or at least does not contravene these values. Also the organizations have powerful value systems. Some of them place

a great deal of importance on performance and rate personal qualities much lower. Others value highly employees who are successful as human beings as well as workers. Organizations seek employees who match their ideologies and cultures. In turn, employees seek employers who hold similar sets of values to their own. A good fit will result if both match.

(v) Task contract.

The structure of tasks in an organization is usually closely related to its technology and to the nature of its products or services which it is producing. Some tasks will lead to simple routine work and others to work which is complex and challenging. The organizations seeks employees who will work within the constraints imposed by its technology and task structure. The employee seeks a work situation where he is provided with the level of variety and opportunity to use discretion which meets his needs. The variable components are to measure the fit between what he is required to do and his own need for interesting, varied and responsible work.

These contracts are broken further into sub-variables. In order to measure the fit between job needs and job requirements, whether it is a good or bad one and whether the group to be investigated has a high or low level of satisfaction, a questionnaire should be presented to those individuals to complete it by themselves. For each sub-variable within the contract area there are two statements, the first states the actual work experience and the second states the aspiration, expectation or needs. The employee is asked to agree, partially agree or disagree. Matching answers for the two statements mean satisfaction. In order to find the areas with job satisfaction problems, the answers for the sub-variables of the given contract are grouped in three categories, i.e. (i) variables with high percentage, i.e. over 70%, (ii) variables within the middle range, i.e. between 70% and 30%, and (iii) variables with low percentage, i.e. less than 30%. The interest is concentrated on the high percentage variables to maintain them and the low percentage variables to improve

them when a computer based information processing system is being considered. From the several analyses on job satisfaction questionnaires done by the Manchester Business School Computer and Work Design Research Unit, they get curves with peak and tails. The grouping of variables, according to them in this way, is for simplicity and their acceptability by management. Also, the final recommendations are not sensitive to them. The questionnaire should also be supported by discussion with the user groups. The investigating team must show the result of the questionnaire to the users, especially the managers, who are to help by enlightening the team on the causes behind them. Not all problems can be corrected through the design of the system, but most of them can be eliminated.

The assessment of employees' attitudes to the proposed change can be obtained by using another questionnaire to be answered by the employees. The answers will be categorised into groups having negative, neutral or positive attitudes. The flexibility or rigidity of the individual and his work group is established by ascertaining their previous experience of major change. Attitude scales are also used to establish whether individuals like change and variety or whether they prefer the security of stability (Mumford, Mercer, Mills and Weir (1972)). Measures of perceived power and influence are more difficult to establish. Reliable indications come from examining the group's past behaviour and from rating the degree of militancy of the Union to which the employees belong.

Measures of fit, perception of the proposed change, flexibility/rigidity and perceived power enable group profiles to be constructed and these can assist the formulation of planning strategy (Mumford, Mercer, Mills & Weir - (1972)). The planning strategy for the social factors includes education, information, participation, compensation, negotiation and command. All or some of them will be employed for the organization. The use of any one of them depends on the pre-change diagnosis and group profile. These findings will also be the

basis for the socio-technical system design.

2.3.1.2 Feasibility Study and System Analysis

The social analysis was concerned with the human problems, needs and objectives to be considered in the design process of the system. In order to identify the problem and define objectives other than the social, the organization at the same time should undertake a feasibility study and system analysis. The social and system analysis should be simultaneous.

The feasibility study and system analysis is a detailed investigation into an area of business activity, the purpose of which is to establish the appropriateness of a computer assisted solution to the underlying problems. It is not only to put the existing system of work on the computer but to demonstrate that an economically viable system can be produced with the aid of a computer (Mumford and Ward (1968)). The existing system has to be studied in the most minute detail in order to determine these objectives and analyse the processing procedures. Processing procedures involve input data, facts in files, output reports, manual efforts, working place structure of the functional area, etc., (Gregory and Van Horne (1963), Waters (1974))). Raw data originate on documents or other suitable media as events occur - business transactions with outsiders, transfers between departments and operations within a department. Event data are processed against files to update existing records and to introduce the new ones into files. System output ranges from brief answers in reply to specific questions, through listings of raw data with little or no processing to highly condensed summaries and periodic analyses of files (Gregory & Van Horn (1963)). An understanding and appraisal of existing systems coupled with some clear thinking are necessary for selecting a design approach and designing a new data flow system.

The system analysis involves the following steps:

(i) Request for the study, then selection of a team to undertake it and obtain terms of reference for it. Introduction of the teams and the techniques

at their disposal which may be applied during the study to the respective members of staff whose operational activities will be involved in the study.

(ii) Study of procedure manuals, rule books and other system documents (Land (1970)). Obtain a copy of the organization charter - in the absence of such a charter, draw one up and agree the lines of communication and responsibility. Obtain an outline of the functions of the section/office from the supervisors/managers in charge.

(iii) Obtain facts by interviewing people whether members of staff, users of the system or decision makers, and observe the activities about the events - their type, volume and timing - that lead to the organization of documents, maintenance of files, issue of reports, processing steps done at each point in the work cycle and flow of documents between working points (Gregory and Van Horn (1963)).

(iv) Collect sample copies of filled-in documents, file papers and reports with facts on activity - smallest, average and largest number - during each period and the number of lines and characters of data per line to indicate the volume of activity.

(v) Study processing operations to learn the how and why of every document that each person receives or issues, what processing steps he performs, the nature of the files he keeps or uses and the content of any reports he prepares. The volume and nature of the job, the speed of throughput required, the extent and frequency of access to files carried are determining factors for the machine to be selected (Waters (1974)).

(vi) Use questionnaires whenever required to validate and measure the source of the facts being collected.

(vii) Organize the facts obtained into flow charts, flow lists or other suitable form to trace the path of data from origin through each stage of communication and processing into files and out of files to reports. The facts being collected should be compared with the manual of procedures to find the

additional acquired procedures so as to know why they happened to provide for them if necessary.

(viii) Further interviews with the users to validate the facts being collected.

(ix) Systems specification.

From the facts being collected, the information processing requirements will be derived and partitioned. These will be documented to yield an outline computer system specification. The partitioned information processing requirements can be divided into five main sections (Waters (1974) and these are (i) data dictionary, (ii) input messages, (iii) output messages, (iv) data base, and (v) computing processes, (Waters (1974))

(x) Based on these specifications it is possible now to propose the computer-assisted solution. Careful balance of the different components must be made in order to demonstrate that the solution is viable. The team is in a position to do some estimates of the probable cost of a computer capable of doing the job (Mumford and Ward (1968)). This will involve the investigation of the technology, the manufacturers' support which includes the software that supplements the hardware, and so on.

Based on the volume of the business transactions, the input and output of the system, and the processing procedures required, the planning team is in a position to estimate the size of the hardware required, the random access devices, the input-output channels, multi-access facilities hardware and multiply-and-divide features. These investigations and estimations must be done by highly skilled technical people. The organization is looking for a system not only a machine. Accordingly the investigation should involve the reliability of the computer manufacturer which can be obtained from the experience of other organizations if possible. Another factor that comes with the hardware is the support of the manufacturer. This support is reflected by how much emphasis is placed on research and development, the ability of the manufacturer to help in the implementation and

maintenance of the system. Another important factor that complements the hardware is the software supplied by the manufacturer.

The software refers to all programs which can be used on a particular computer to make the best use of it (Chander, Graham & Williamson - (1974)). There are two categories of software : (1) Basic software and (2) Application software (Smythe (1971/72)). Basic software is mostly prepared by the manufacturers.

Application software includes sets of programs designed mostly by the EDP staff of the organization to solve particular application or problems of the functional areas within it.

On the selection of the machine, the investigating team must consider the basic software to be offered by the manufacturer, that some of these basic software programs do not occupy the largest portion of the memory etc., (Smythe (1971/72)). If the required skill to do the investigation is not available within the organization, then it becomes necessary to seek the help of a consultant (Mumford and Ward (1968)).

The desirability of the manufacturer to cater for future expansion and growth of the system is also important. The question is not to put the present system into a computer based system. More important is the management demand to put more complex jobs on to the EDP system. Accordingly, the planning team should ensure that the manufacturers are offering a machine capable of future expansion and increasing demand of the managers and operating staff. The importance of this is to safeguard against the problem of program rewriting due to change to larger versions of the computer family that results from expansion.

The structure of the organization is one of the important variables to be investigated if a computer assisted solution is suggested. Computer processing results in the centralisation of the information processing to serve the requirements of the organization. The organization with several branches is likely to function as far as the information is concerned as one branch, especially in banks,

insurance companies, distributing firms, etc. The sections with data processing activities are likely to be eliminated, while the planning sections may be enlarged. In investigating the structure it is necessary to consider the opportunity the introduction of a new information processing technology provides for it and the impetus it gives for forcing changed structure. Some of the structuring problems and opportunities are revealed by the social analysis.

Staffing of the EDP centre is one of the main problems of the organizations which are introducing computer technology for the first time. This problem is severe in developing countries more than developed countries because EDP is a new field to them. Like other technological discoveries, they are far behind. The estimated cost of the resources to provide for it will be very high, especially the preparation of the human factor necessary. Computer staff is always likely to be one of the scarcest resources. Organization must ensure the availability of these staff if it is to switch to EDP. This can be done by including technical training programmes for programmers and systems analysts in its educational provision, thus ensuring that it has the facilities to produce its own skilled staff. It can do it by seeing that salaries and conditions for work are such that they meet the expectations of people in these skilled jobs. It can do it by providing a career ladder into management for their most able EDP staff (Hawgood and Mumford (1971)).

Besides the economic feasibility, the system must be technically feasible. Technical feasibility tends to be concerned with finding computer based solutions to solve the underlying problem and cater for future expansion. The social and system analysis will be incorporated to ensure that the solution is :

- (i) efficient
- (ii) implementable
- (iii) can be successfully operated
- (iv) can be successfully maintained
- (v) sufficiently flexible to meet changing conditions

- (vi) reliable by giving guaranteed service to the user
- (vii) provide timely and accurate information
- (viii) compatible with other systems so that all systems form an organized integrated total system
- (ix) portable, i.e. the hardware/software is liable to change, which may arise due to new discoveries
- (x) acceptable
- (xi) economical and meets the other objectives.

The analysis results in a comprehensive description of the existing system and statement of requirements translated into information processing requirements in terms of the information to be input and maintained within and output from the system and how this information is to be processed.

Given a definition of information processing requirements and a definition of resources, the next stage is to design a system in human and technical terms that satisfies the required objectives of the system, whether social, technical, organizational or economic.

2.3.2 System Design

System design is the creative act of devising or inventing a partially or completely new scheme for processing data and management information systems to meet the requirements, objectives and constraints set out in the analysis stage.

Several approaches and models have been developed to aid designers in their job (Anthony (1965), Blumenthal (1969), Forrester (1961), Mumford (1971), Waters (1974), Anthony & Dearden (1976). While each one is directed at a different level of detail and hence a different design objective, still they conceptually interrelate (McFarlan, Nolan & Norton (1973)).

Computer based management information system is a socio-technical system. In designing such systems, designers have to work with a model that makes allowances for its social and technical factors. The ETHICS approach on which application the thesis focuses is one of the approaches that makes explicit allowances and equal

consideration for the social and technical factors of the system. Although the framework for system design is based on this ETHICS approach, still the other approaches are employed to help in the detailed design process.

The ETHICS uses technical and social means to achieve the social and technical objectives. The importance of this approach is that it should lead to better functioning systems as both the human and technical needs are equally catered for. The method consist of the following steps (Mumford (1971)):

(a) Possibilities, needs and constraints

On the basis of the job-satisfaction diagnosis, the user managers will set out social objectives. Supported by social scientists, they work out the social alternatives. At the same time the computer specialist will work out the technical objectives and the alternatives to achieve them.

(b) Merging of technical and social solutions

The two teams together are to rank the available technical and social solutions in two columns in order of their closeness to the solutions giving the greatest improvement (best solution). They have to eliminate any which do not improve at all on the present situation. Then they are to indicate which technical and social solutions are compatible with each other, put these together and rank in order of their closeness to the best technical and social solution. Eliminate incompatible solutions.

(c) Establishing the viability of a particular socio-technical solution.

The system designer, supported by the financial managers, have to estimate the technical resources required to implement the socio-technical solutions remaining on the list, then they rank them in order of reliability, ease of availability, etc. Also they have to work out the cost of these resources and estimate the benefits of using a particular resource. Then they check that the technical part of all viable socio-technical solutions meets the primary technical objectives which must be attained (Mumford (1971)).

The O & M personnel supported by the financial managers are to estimate

the social resources required to implement the socio-technical solutions on the list, i.e. experts, knowledge and facilities. They are to rank them in order of their availability and to work out the cost of these resources and estimate the benefits of using a particular resource or facility. They rank them in terms of this cost evaluation and check that the social part of all available socio-technical solutions meets the primary objectives which must be achieved (Mumford (1971)).

The system designers are to rank the available socio-technical solution in three columns, i.e. (i) availability of required resources, (ii) cost/benefit of each, and (iii) closeness to best solutions.

The last step in this method is the choice of the best solution which comes top in the closeness to best solution column and it will merely be necessary to check that the required resources are available and that the cost/benefit evaluation does not rule this particular solution out.

The ETHICS approach stresses heavily on social factors. It provides methods to analyse it (Mumford, Mercer, Mills and Weir (1972)) and procedures to allow for it in the design process (Mumford (1971), Mumford (1974)). Apart from its demand to state technical possibilities, needs and constraints, the ETHICS approach as such (Mumford (1971)), did not provide methods to analyse or detailed procedures to allow for technical variables. The technique can be applied to arrive at alternative frameworks for socio-technical system design. Also, it is of great help in designing the social system. When it comes to technical analysis and design, planners have to consult the literature written on the subject.

Cost/benefit evaluation is suggested to establish the viability of a particular socio-technical solution. Because the cost/benefit analysis reduces the benefit of change to monetary value, it has been rejected as an evaluation technique for this case in which there are multi-objective and multi-criteria decision making (Hawgood (1977)). At this design stage it is more relevant for

the designers to think in terms of resources available, resources required and how to utilize them to achieve objectives. Evaluation procedures are to be done on other bases and at later stages. Lots of work has been done to solve the problem of evaluation incorporating the ETHICS approach as design and evaluation techniques (Hawgood and Land (1976), Mumford, Land and Hawgood (1978)). The ETHICS approach partitioned the system into human and technical systems, then merged them to arrive at socio-technical solutions. A computer based management information system is a component of a sub-system. On discussing the detailed design process, this will be related to the following sub-systems (Land (1970)).

- (1) Computer sub-system
- (2) Human sub-system
- (3) Interface sub-system
- (4) Other supporting sub-systems

2.3.2.1 Design of Computer Sub-system

The computer sub-system is the computer programs and data files to support the total system. The design process is concerned with designing

- (1) Files
- (2) Programs

on computer hardware furnished with computer software so as to meet the design objectives at minimum costs (Waters (1974), Blumenthal (1969), McFarlan, Nolan and Norton (1973)).

2.3.2.1.1 Design of Files

Files were developed in relation to narrowly defined applications. As application broadened, the same files might be used for more than one function. This development is now leading to the concept of a single data bank for an organization serving the needs of a broad series of application described as a management information system (Blumenthal (1969), Anthony (1965), McFarlan, Nolan and Norton (1973)). There are two characteristics of the files (Land (1970))

(i) The logical file:-

A complete description of data elements in the file to be provided by the designer. The description must show rather for input and output details for each data element in the file and the relationships between the elements. In addition the designer has to specify the degree of security to be attached to each element.

(ii) The physical arrangement of the file within the computer system:-

The physical arrangement of the file is determined by the programme in the light of the particular characteristics of the file media available and the requirements of the job with regard to speed of access, frequency of use and other constraints and varied objectives such as security recovery from breakdown, flexibility and portability (Land (1970), Waters (1974)).

The description of the logical file must provide the programmer with the information to design physical file.

In the design of files, the designer has to consider the following (Waters (1974)):-

- (i) The information content of master files
- (ii) The sequence of each logical file
- (iii) The access method, i.e. to choose the addressing method whereby the records of a file can be located and accessed.
- (iv) Formats of master files

2.3.2.1.2 Programming Procedures

Programming is the process in which the system specification which defines the functions performed by each computer operation or suite is converted into suites of programs. The programs to be developed will serve the computer and other supporting sub-systems such as cut/over, stand-by and recovery systems to be discussed later. The personnel required for this job are professional programmers. They can be selected from the intelligent clerks of the organization. The input

for this stage is the specification of the information processing requirements of step (ix), Section 2.3.1.2 and the set of files developed in Section 2.3.2.1.1.

Although the writing of the programs is a part of the implementation stage that follows, still the procedures for programming are a part of the design process.

The programming process can be broken down into a number of separate stages (Land (1970)). First: In order to influence a sort of control on the programmer's performance, a program will be separated into independent but linked modules. The leader of the programming team will design the program to meet the following objectives :

(a) The requirements of the job, i.e. the job has to handle a certain volume of transactions in a specified time, subject to some consideration of reliability in meeting the targets.

(b) Reliability of the job: e.g. the job may have certain permitted levels of degradation in the case of computer breakdown.

(c) Maintainability: The programs have to be planned in such a way that they can be maintained by someone other than the original programmers.

(d) Flexibility: Programs should be devised in such a way that changes in requirements can be accommodated with a minimum of reprogramming.

(e) Robustness: The property of a program to meet unexpected combinations of transactions without causing failure or error.

(f) Using the minimum of computer facilities in the context of other objectives.

The program design is incorporated in a series of program specifications and module specifications which lay out the strategy for the individual programmer to follow.

Second: The program modules will be coded into computer instructions.

Thirdly: The codes modules will be checked first by another programmer

for logical and accuracy errors. Then it is converted into computer readable form and provided with the kind of data it would have to operate on as part of the working system. In order to test the functioning of the programs, simple data, then complex and added data, abnormal or invalid data, will be used. The separate modules will be combined for tests to see if they will link together properly. Further tests and corrections may be required for the whole programs that make up the program suite.

Hundreds of computer hours and many calendar months will be spent in the writing and testing of the programs so as to perform as specified (Land (1970)). Further testing of programs using a sample of real data will be required. Only when this test is completed can the program be considered ready for the implementation stage.

2.3.2.2 The Human Sub-system

It includes the manual procedures to capture the input data, their conversion into computer readable forms, the methods to feed the machine with these data, the ways to get the output and dispatch it to the users, the procedures for dealing with the resulting output, etc. Although some of them are man/machine procedures, this section is concerned with the human requirements and clerical procedures to be involved.

In designing for the human systems, the following factors should be built into their related jobs (Mumford (1971)):

(i) Responsible autonomy: The employee must be provided with a degree of control over his work . There must be an area of decision taking within his job that he can call his own.

(ii) There must be a reasonable degree of mental rather than physical difficulty in the job.

(iii) Task identify: There is to be a quality of significance in work which enables the individual to feel that his work is meaningful, that people at least round him understand and respect what he is doing, that he is contributing

in the end result.

(iv) Reasonable variation of tasks within the job: The work content per transaction must neither be too much nor too little. Too much may demand a high level of attention and effort, and too little may lead to boredom and fatigue. A reasonable degree of variation that allows the employee to take a rest from a high level of concentration if the job is to be interesting.

(v) Optimum length of cycle: Too short means too much finishing and starting, too long a cycle makes it difficult to build up a rhythm of work.

(vi) Some scope for setting standards of quantity and quality of production and suitable feedback of knowledge and results.

(vii) The job must be designed so as to enable the individual to be responsible for the factors that come under his controls, not outside him. There must be a boundary to tasks.

(viii) The employee must be able to acquire more knowledge from his work, at least to know what he is doing and what ends to achieve.

(ix) The job must lead to future opportunities.

The end product of this process are the clerical procedure manuals to be merged with the computer system so as to implement them together.

2.3.2.3 Interface System

This is the design process that brings the computer and human systems together and the creation of the organizational structure to contain and interact with them. Sometimes the change required may be small, but as applications become complex and take over functions across departmental boundaries the amount of change increases, due to which most of the functions in the system and the environment are changed. New sections with new roles may be developed, others with data processing activities may be eliminated, the location of authority and responsibility can also change, new social groups are likely to emerge, additional skill may be required, new processing procedures may be demanded.

It is less difficult to adapt technical solutions to the environment in

which they will operate than to adapt the human system to the technical system. While computer design can be amended and changed, human nature is too difficult to adapt easily to change. Accordingly, for this interface system design there must be several controlled experiments using alternative techniques if the human and environmental factors are to adapt to technical change with less risk and cost.

While technical efficiency, especially under large scale productions, means more automated activities, i.e. more work on the computer, there may be redundancy in clerical staff and the organization will be faced with the question of using them. If it cannot use them, then they have to get rid of them, but if it cannot use them and cannot get rid of them, then it will have a motivation problem (Herzberg (1968)). The decision related to the size of job to go for EDP is very dependent on the job satisfaction among the users and the efficient utilisation of the technology. This has to be resolved by this interface system before the implementation process is started.

2.3.2.4 Other Supporting Systems

The previous three systems are designed for the normal operation of the total system. There are other systems to be designed so as to smooth the change process from the present to the new or modified system, and this is the cut/over system. These are used only at the implementation stage. Their life will be terminated when the total system is on the normal level of operation (Land (1970)).

Also, there is the system that replaces the new or modified system if it fails for one reason or another. It is referred to as the stand-by or back-up system. In a computer based information system the stand-by system is very necessary, especially if the business activities are very dependent on the computer. The stand-by arrangements may be another smaller computer, external computer centre or manual procedures, or a combination of all. Sometimes the stand-by system may be a version of the computer and manual systems to which the organization can switch without too much trouble or problem to the users, operating staff and

decision makers. The important design objective of the stand-by system is to replace the normal system without much difficulty to the parties concerned at the least possible cost.

The third supporting system to be designed is the recovery system. It is that system to be designed so as to enable the stand-by system to hand over its function to the normal system. If the stand-by system is a duplication of facilities, the recovery system may be simple. It will be complex only if the stand-by system comprises different procedures from the normal system.

It is clear that these supporting systems involve human and computer systems and the interface between them and their environments. In designing for them, the designers must also consider the design objectives of the previous system such as flexibility, reliability, implementability, economy and job-satisfaction requirements.

The end result of the design process is the detailed set of files and programming procedures to be passed to the programmers to write the required programs necessary for the implementation, and the manual of clerical procedures ready for implementation..

2.3.3 System Implementation

The implementation stage involves the bringing together of the various separate sub-systems into a whole working system. It includes file creation, documentation and staff training for the human system, flowcharting, programming and debugging, etc. for the computer system, and changeover procedures of pilot and parallel running (Waters (1974)), finishing finally with live running (Stubbs & McManigall (1973)).

The planning of the implementation phase is concerned with the installation of the computer system and working with the minimum of stress anxiety and conflict for everyone concerned (Mumford (1967)). It requires very careful scheduling and tight but flexible control mainly to reduce the cost and risk which

may arise from the social factors. In fact the staff of the department which is to go on the computer are the most sensitive group at this stage. Most of the troubles can be avoided if the system has been designed to fit with their needs and requirements, which are grasped from the analysis stage. However, it is difficult to convince employees of the excellence of new methods of work which they have not yet tried, and it must be recognised that even the most perfectly designed system may be resisted by staff during the implementation stage of the system (Mumford (1969)).

The EDP staff are the most eager to complete this implementation process. Any delay in the delivery of the technology or the preparation of the site may result in poor morale among them and hence may influence their efficiencies. The management must ensure that the manufacturer is delivering the equipment in time.

The most important variable at this stage is the availability of skilled staff within the EDP centre, whether programmers, analysts, machine or punch operators, and the creation of the required skill within the user department to prepare the source of the input data and utilise the resulting output of the system. This can be done by continuous training at this stage for both the EDP and user department staff.

Besides the writing of the required programs for the implementation stage, the method to prepare the data to feed the machine so as to produce the required output is very important. The computer is a machine, the results from it are no more accurate than the data it receives. Accordingly, the machine readable data must be tested for accuracy before they are processed to produce the required information or the creation of the files.

At the implementation stage the planning strategies which are suggested to reduce the resistance of employees to the change will be in more practice. While some of them were started during the previous stage such as communication, consultation and involvement, more stress on them is necessary at this stage as the plans will be realistic.

Before the normal operations of the system and at this implementation stage, the new or modified system must be tested under the fully operational conditions as the final step to ensure that the system meets its basic objectives. There are several ways to do this test (Land (1970)) and these are. :

(a) Parallel Runnings

Where the outputs of the new system resemble the outputs of the system being replaced, though the inputs and procedures for arriving at the outputs may be very different from the previous method, then the method of testing is parallel running.

On parallel running the two systems, old and new, are both operated and the outputs of the two are compared. Any differences between the results of the two systems have to be analysed and explained, and if necessary changes have to be made in the new system.

Under ideal circumstances, parallel running would be carried out, (i) until all possible variations the system has to cater for have in fact occurred, or (ii) until there are no further differences between the old and new systems. In general, parallel running will continue until the management is satisfied that (i) the new system is operable, and (ii) differences can be successfully explained.

(b) Pilot Running

When the output from the old and new systems are not directly comparable, the new system may have to be introduced on a pilot basis. The procedures would normally be to select for operational running with the new system a small sample of the items in the system. The sample should be sufficiently small for the output of the new system to be checked very carefully by repeating or simulating the procedure by alternative means. The pilot sample can then be treated as the first phase of a planned take-over operation. Once the pilot phase has been accepted, subsequent phases will tend to take over larger proportions of the work load. In pilot running the new and old systems will both be in operation until all phases of changeover have been completed.

(c) Direct Changeover

There are some systems which are to be changed directly because the basic procedures of the old and new systems are incompatible, the costs of running the two systems are prohibitive or the new system can only operate as a complete system.

Whichever method is employed it is important to test normal operational conditions, not only the normal system but also the other supporting systems.

Depending on the volume of work to go for the computer and the amount of change required, the implementation process can be phased in a number of ways (Land (1970)), and these are :

- (i) Phasing by function
- (ii) Phasing by location, for example in a banking system the implementation can be by branch
- (iii) Phasing by physical attribute, for example, in a production control application the implementation can be done for one range of products and followed by other ranges.

The time taken for bringing the new system into full operational use may be considerable. The costs of the transition can be high, not only in performing the various tasks of the implementation phase but also in the comparatively inefficient final checking of the new system. A great deal of effort may have to be spent in timing it (Land (1970)).

2.3.4 System Operation and Maintenance

The development of a computer-based change which follows the established control method of operating a Plan, Implement and obtain Feedback loop to assess the system's operational performance against its planned performance does not end with live running. There must be periodic assessment of the system based on statistics during the system's operation. There must be an application Review that takes the statement of Requirements and Outline systems specification and

audits the expected benefits and savings against those which have actually occurred and proposes further action. As part of the operation process there will be continuous maintenance (a) of the system and this involves additional programs, more system and program documentation and file maintenance, (b) of site which includes buildings, plant and machines. There will be continuous provision for accident and breakdown which includes stand-by facilities, file protection and insurance.

During the operation, there must be control procedures to ensure high standards of work performance. This can be done by the ETHICS monitoring procedures. The procedure requires the development of historical reasons for labour turnover, voluntary and involuntary absenteeism, overtime, grievances and productivity (Mumford, Mercer, Mills and Weir (1972)). If there is a movement away from these norms during the change process, then this must be regarded as an indication that all is not well and steps must be taken to identify the sources of trouble so as to cater for them.

Although it is difficult to measure and to know what would have been the result in a particular situation, still the incorporation of the results of the experience gained throughout the system change process into codes of practice will be of great value for planning and implementing future changes. Also the evaluation of the system for remedial action is necessary.

As far as the human factor is concerned, the evaluation procedures will measure the resulting fit between the organization and the employees and the employees' perception of the new system. The questionnaire used in the social analysis stage will be applied.

It must be stressed that continuous thought must be given to system improvement.

The ideal will never be achieved but the organization must work for the best.

2.4 DEVELOPMENT PRE-REQUISITE PRINCIPLES

Beside the approach to system development which had been covered in the previous section, there are many planning factors that reduced the relative success of the introduction of computer technology as an integral part of the information system. These factors include the lack of top management support (McKinsey (1968)), the objectives to be achieved (Land (1970)), lack of knowledge of application area, a long development time of the system (Boot (1973) , Hawgood and Mumford (1971)), poor documentation of design (Gregory and Van Horne (1963)), reliance on manufacturers in the development process as it happened in the Bank of Sudan, etc. There are a number of valid ways to provide for these factors so as to reduce the risk of the change process.

(i) Involvement of senior managers in the development process:

It is the function of the managers to decide on the type of change and its degree in their organization. They are responsible for planning, control, staffing, decision making and management of their respective organizations. Computers introduction calls for these functions and hence the hand of senior management. Managers must first acquire knowledge about the influence of computer technology within organizations, whether positive or negative. They must be in a position to approve the objectives to be achieved in technical, social, financial or organizational terms, (Waters (1977), Hawgood and Land (1976), Hawgood and Mumford (1971)). They are to appoint the required skill to the development and evaluation processes and make decisions about whether and how to proceed beyond one stage to the next (Hawgood and Land (1976)).

(ii) Objectives to be achieved :

A change in the information system in which computer technology will be involved means social, technical, economical and organizational change (Land (1976), Sanders (1970)). As the organization has explicit but sometimes implicit objectives related to the factors which will be affected by the introduction of the technology, it is more relevant to relate the objectives of

the change to the organizations objectives (Land (1975)). This is necessary to avoid the narrow technical approach in system development (Mumford (1969) , Mumford, Mercer, Mills and Weir (1972)) and the short-sighted financial return in the evaluation process (Hawgood and Land (1976)).

(iii) The people to undertake the development process :

The contribution of the users departments in the several stages through which system development will evolve is very essential. Each stage of system development requires special skills, knowledge and experience. While system analysts are necessary to advise the user department on the technical side of it, social or behavioural scientists help them to diagnosis the social and organizational factors (Mumford (1969)). The Personnel department which is responsible for the social and technical requirements of organizations should be there to create the consultation and communication media (Hawgood and Mumford (1971)). The Accounts or Financial Department is to set the financial objectives, estimate financial cost and control the payments according to the plans. It is the responsibility of the Market Research department to state objectives of consumers and to set means to meet them. Also, presences of consumers in the evaluation process is important (Hawgood and Land (1976)). The decision on 'go'/'not go'/'postpone' should be made by top managers of the organization. The user manager advised by computer specialists and social or behavioural scientists is to work out the alternative system design in technical and social factors respectively. The human system should be passed to the O & M personnel to produce the clerical procedure manual and the computer system goes to the programmers to develop program suites (Stubbs and McManigall (1973)). The users departments, computer staff and the Personnel department must work together in the implementation process.

It is advisable to appoint consultants to help in the statement of objectives, their definition in information requirements, in designing the system and investigating the technology (Pefferers (1966), Mumford and Ward (1968)). The management should define the length of his period and the activities in which he

is to advise. They must be sure that the consultant has passed his knowledge to the respective members of the teams. Consultants should be used to augment company effort, not supplant it.

Some organizations depended on equipment suppliers to study them and develop systems (Sanders (1970), Reichenback and Tasso (1968)). This proved to be disastrous because the equipment supplier is interested in selling his own equipment and he is not in a position to know the requirements of organizations. Also, he is unwilling to evaluate other suppliers offers (Smythe (1971/72)). In fact the implementation and operation of systems will be taken by organizations staff, so if the design is done by someone other than them, they will find it too difficult to implement or understand its operation and hence the inefficiency of systems. Equipment suppliers should only be there if their offer is accepted (Mumford and Ward (1968)).

(iv) Timing and phasing of project :

Long development time resulted in systems that failed to meet requirements. It has been stated that by the time a system becomes operational, the users requirements, as originally specified, may well have changed (Boot (1973)). Efficient planning can take up to five years (McFarlan, Nolan & Norton (1973), Hawgood and Land (1976)), but for some systems more than that period is necessary until the system is in full operation. To overcome the difficulties which may arise due to changes in situation and technology through the years, it is advisable to apply more resources especially skilled people and/or split the complex system into a number of less complex sub-systems (Land (1970), Hawgood and Mumford (1971)). Several months are required for either the analysis or design stages (Blumenthal (1969), McFarlan, Nolan & Norton (1973)), but years will be spent in the implementation stage because of the programming effort (Land (1970), Waters (1974)). The operation stage is very dependent on the implementation design (Mumford and Ward (1968)). The time and cost scales for each stage must be

compared with the plan so as to control them and revise for stages that follow. On planning for systems, it is important to decide the length of time for each stage and to check that these estimates are likely to be reasonably accurate (Hawgood and Mumford (1971)). The inability to achieve stage work within the planned time has its effects on the morale of both the EDP staff and users department.

(v) Change to computer based systems should include the procedure and operations that are likely to be computerized in the short and long run. In many organizations systems development included the operational activities of the sponsoring departments or a functional area where there are urgent problems to be solved (Peffer (1966)), but this approach is likely to create bottleneck problems. In order to avoid it some writers suggested a departmental approach (Spencer (1964)). At the same time they admitted that this will cost in terms of equipment and planning effort, but it will include major and minor departments, and sections. Others suggested functional approaches to system development (Tagg (1969)). They argue for it on the basis that it separates the activities of the organization into meaningful basic functions such as material planning, production control, etc. For the case under consideration, i.e. Bank of Sudan, it is more relevant to approach system analysis through departments within the main functional areas. Selection of clusters of related activities within the functional area is the best for system design. Here, there is the advantage of creating a common data base to serve the functional activities of several departments or section being established to achieve stated objectives of the Bank.

(vi) Information to be computerized :

There are three information systems that make the total information system of the organization (Davis (1974)) and these are (a) formal (b) informal, and (c) private systems. Information for these systems flows from inside and outside the organization, i.e. internal and external information (Anthony and Dearden (1976)). Part of it is systematic and the other is non-systematic (Anthony and

Dearden (1976)).

The formal information system is the public structural system operated by the organization and available to anyone who is authorized to obtain the information or the services of the organization, e.g. export trade statistics and records that include commodities exported, countries to which they are exported, values, etc. The existence of this system is explicitly recognized and defined as part of the total system (Emery (1969)). The informal system is an unstructural system but public in the sense that it serves all persons in the organization who might happen to connect with it (Davis (1974)), such as the quantities of the same commodities exported by other countries. This information fills in the information crevices overlooked by the formal system and this serves the extremely important role of an information backstop. This is particularly true in the case of higher level decision making where information requirements are very difficult to anticipate (Emery (1969)). The private system is based upon the person who occupies the position. They operate in a non-structural way and most of the information is collected by personal effort from internal or external sources (Davis (1974)) such as markets for new commodities which can be produced by the country recorded by a manager in a private notebook for future discussion or uses. Attempts to develop a system to encompass all the requirements of the three systems will result in large, costly and unwieldy systems (Davis (1974), Emery (1969), Anthony and Dearden (1976)). Accordingly, the information to be computerized by the system to be developed is the formal structured and the portion of the informal and private systems which include all information processing of a programmed nature.

(vii) For control purposes, the achievement of each stage should be compared with the estimated budget and the relevant plans. This should help if for any reason there is deviation to find why and to state its magnitude so as to provide for it (Hawgood and Mumford (1971)).

(viii) Creation of the organization environment for the proposed change :

This includes the education of staff within EDP centre, managers, employees of users departments and the personnel, users of the system, communication, and consultation with the relevant parties involved by the change (Hawgood and Mumford (1971)). Before organization used to prepare the projects and suddenly the EDP staff announce that the project will be implemented (Peffer (1966)) due to which many social and technical problems result. This is a typical case when systems are developed by an equipment supplier or external consultant alone. The inability to create the organization environment for the proposed change contributed in the failure of the first attempt to computerize the accounts system of the Bank of Sudan.

(ix) Involve user community in the development process and these are line managers and operating staff whose jobs will be influenced by the change. If the staff are not involved in the development process especially analysis and design of system, they may find it difficult to apply the new system. Their presence during the development process will stimulate them to make accurate approaches to system capabilities, cost reduction, etc. The accurate view of computer adaptation can be gained only by involving the staff in conducting and presenting the required studies and supporting development process (Mumford (1969), Mumford and Ward (1968))

(x) Revise objectives, parameters and targets as made necessary by external or internal changes and monitor the required system modifications (Hawgood and Mumford (1971), McFarlan, Nolan and Norton (1973)). This is important especially for organizations working under dynamic situations.

(xi) Incorporate the results of experience gained through system change processes into codes of practice for use in planning and implementing future changes (Hawgood and Mumford (1971)).

Every organization that wants to change its information or other systems

will find it necessary to cater for all or most of these elements in the development process.

2.5 CONCLUSIONS

Planning for technical innovation is one of the most difficult jobs to be undertaken by the organization. The difficulty is attributed to the fact that it involves technical, economic, organizational and human relation factors. The shortcomings of the previous approach that resulted in many costs and many problems are attributable to the concentration on technical and economic factors and complete ignorance of the social variables which are a main component of any man-machine system. This was due to the fact that the planners to do the job are either economists or technical people. They are competent in the areas of their own specialized knowledge but are not prepared to range further afield.

With the introduction of computer technology within the information systems of the organization the resulting situation was further worsened. This is due to the fact that the information system of the organization involves a big portion of the total organization. Any change in this information system, especially the one that involves computer technology, will influence the components of the organization. As a solution to this problem the planning process to introduce computer technology is to involve the social, technical, organizational and economic factors of the organization as all of them will be subjected to change.

Another planning defect resulted from the tendency to regard planning as a single process to be carried out by a single group of people. The accurate approach to the planning process for computer based information systems is to split it into (Mumford (1969)) :-

(i) strategic planning : setting out the firm's data processing objectives and deciding on the most appropriate ways of attaining these, which is a long-term activity.

(ii) system planning : to work out the most appropriate methods for using both the potential of the computer and the skills and resources of the department which is to be computerized.

(iii) tactical planning : the policies and tactics necessary to ensure a relatively stress-free changeover and to maintain employees' morale and create their enthusiasm.

Strategic planning is strongly influenced by economic and technical variables, tactical planning is influenced by sociology and psychology, and system planning is influenced by technical and social factors. Accordingly, each planning process must be handled by the required expert teams that involve personnel and user departments, social scientists, economists and computer experts, based on the planning stage to be done.

In order to follow the established control method of operating a plan, implement and obtain feedback, the development process was phased into :

1. System definition
2. System design
3. System implementation
4. System maintenance

The definition and design stages yield the plan of what is to be achieved and how it will be achieved respectively ; the maintenance stage includes monitoring, which provides the feedback to assess the system's operational performance against its planned performance.

The general approach to these stages is based on the ETHICS method in which the human and technical factors are equally analysed, to result in technical and social objectives to be achieved, then a system to meet the technical and social objectives was developed. A compatible solution in both terms for which the required resources are available and economically viable was selected. The required programs for this solution and the required resources for its implementation were further considered.

The proposition is that if these steps are followed, the required experts to do them are prepared, and the control procedures to ensure high standards of work performance are provided, then the organization will end with a better functioning information system that contributes to its profitability, survival and development.

CHAPTER 3

EVALUATION OF A COMPUTER BASED MANAGEMENT INFORMATION SYSTEM

3.1 INTRODUCTION

The introduction of the computer technology as an integral part of the organization's information system is an investment project for which a significant proportion of the organization resources will be devoted. It results in financial, social, technical and organizational gains and losses for the organization (Sanders (1970), Land (1970), Hawgood (1974)). The evaluation process for this investment is concerned with the measurement of efficiency and effectiveness. A measure of efficiency can be developed that relates costs to some standard, i.e. to a number that expresses what costs should be incurred for the amount of measured output (Anthony and Dearden (1976)). Effectiveness is the relationship between a responsibility center's output and its objective (Anthony and Dearden (1976)). It is concerned with making use of the output so as to meet the goals of the organization (Land (1974)). A measure of effectiveness then is the extent to which the use of the output, in this case the information system, makes a contribution to the achievement of these goals. The more these outputs contribute to the objectives, the more effective is the system. Efficient systems are those which produce whatever they produce with the lowest consumption of resources; but if what they produce is an inadequate contribution to the organization goals, they are ineffective (Anthony and Dearden (1976)). The decision to go for a computer based management information system should be based on the contribution of these systems towards the objective of the organization or its worth to the organization (Land (1975), McFarlan, Nolan & Norton (1973), U.S.Navy Bureau of Personnel).

In profit-making enterprises the only objective conventionally recognized in making a capital investment project is to attempt to maximize the value of the

firm to its current shareholders (Benishay (1961)). Several methods and criteria had been developed to support the decision making function related to the selection of an investment project to achieve that financial goal such as discount cash flow, net present value, internal rate of return, payback period, etc. (Merret and Sykes (1966), Burman and Smidt (1966), Quirim (1967), Horne (1968), Bronwich (1970), etc). One factor common to these methods is that they evolved round the cash in and out associated with the project. The same approach had been followed in the decision to go or not to go for computer based management information system (Dorey (1971)), but the adoption of financial techniques and criteria based on direct cash in and out are not sufficient to state the contribution of these systems even towards this financial goal. These systems resulted in indirect payoff as well. Considerable work had been done to point out and calculate this indirect payoff, (Stout (1966), Schwartz (1969), Hill (1966), Emery (1969), Diebold (1969), Emery (1971), Ardron (1971), Emery (1973), Marschak (1971), Kalman (1974)). The application of the cost benefit analysis characterized some of this recent work (Emery (1971), Emery (1973), Glans (1968), Joslen (1968) etc).

In the present time even in commercial organizations there is increasing demands to consider the well being of staff and customers as well as that of owners or shareholders if organizations are to survive and develop (Hawgood and Land (1976)).

In making a decision about an action or an investment project in business organizations, an individual or manager respectively has in mind the selection of the action or project that maximizes total satisfaction or total utility as economists put it. From the application of the known evaluation technique and criteria such as discount methods or cost benefit analysis, this utility is equated with money. The highest the financial return the more is the utility. Accordingly, monetary values are assigned for the resulting effects of action or project added together to give the total worth of that project. Such an approach might work if there were market prices for the direct and indirect effects of the given project

but this is not true in real life. Staff, customers, managers and citizens own benefits are not financial in that narrow sense. It is not rewarding or relevant to reduce them to financial terms.

The evaluation of a computer based management information system involves the measurement of the different directions of benefits that represents the multiple objectives of the organization towards owners, customers, staff managers and citizens (Land (1975), Hawgood (1974)). The evaluator should work with a multi-attribute technique to support the multi-criteria decision function related to such project.

The BASYC technique "Benefit Assessment for System Change" developed by the ABACON ("Automation Benefit Appraisal Consultants") in conjunction with the Manchester Business School Computer and Work Design Unit, is one form of multi-attribute utility analysis (Hawgood (1977), Mumford, Land and Hawgood (1978)). The fundamental principle of the BASYC approach is to identify the groups of people likely to be affected in different ways by a change of system or policy, in this case it is the computer based management information system, which is being considered, and to carry along explicit numerical evaluations of possible benefits of alternative policies or systems in terms of their likely contributions to the attainment of a number of detailed and measurable goals related to these groups defined within the broad aims of the organization (Hawgood, Land, Mumford and Weir (1975), Hawgood (1977), Land (1975)). The BASYC approach sees the benefits of change as five categories of benefits to the groups of people with and without change at a time in the future. It provides the multi-dimensional framework allowing benefits to all groups to be considered on the same footing (Hawgood and Land (1976)).

The BASYC approach is a technique relevant to the measurement of the effectiveness of a computer based management information system towards the objectives of the organization. It focuses attention on conflicting interests and identifies the groups of people according to their own benefits. This is

omitted from the conventional cost/benefit analysis except to the extent that a valuation may be placed on other groups interests including customers, staff, etc. Also, it helps in integrating the technical and human system design in an attempt to ensure both increased cost effectiveness and improved job satisfaction in the changed system.

Beside the BASYC approach, this chapter considered the effects of introducing computer technology as an integral part of organizations information systems and the elements of cost, the provision for which should contribute to the efficiency of the system.

3.2 INFLUENCE OF INTRODUCING COMPUTER TECHNOLOGY

The influences of introducing computer technology involves its positive and negative effects on organization.

The Computer is one of the technological innovations that influenced the information processing systems in commercial and administrative organizations. It results in financial, social, technical and organizational costs and gains. It is essentially neutral, whether it produces gains or losses, depends entirely on the decisions that are taken on how it shall be used (Hedberg & Mumford (1974)). Like other investment projects that involve capital expenditure, it demands large sums of money to develop it. While some of the funds will be paid to provide computer function, others will be paid to plan its development and a third group to reduce the risk associated with it.

On the side of benefit there is the direct financial saving due to replacement of clerical activities, accommodation and other equipment. The most important contribution towards financial objectives of organization is their indirect payoff due to availability of timely, relevant accurate information and the consequences of the information on control and planning functions of the different operating levels of organization. The realization of this indirect payoff is comparatively recent (Hooper (1966), Hill (1966), Diebold (1969),

Emery (1971), Emery (1973) etc).

Computer processing is tackling the less structured, more abstract and important problems of decision making. It helps managers in their planning function by providing them with accurate, complete and timely information which (a) causes faster awareness of problems and opportunities- computer can quickly signal out of control conditions requiring action when actual performance deviates from plan, (b) it enables them to devote more time to planning by freeing their time of clerical and data gathering tasks and permit them to concentrate more attention on analytical and intellectual matters, (c) permits them to give consideration to more complex relationships, to consider more of the internal and external variables which may have bearing on the alternatives confronting them, and (d) assists in decision implementation. Computer utilization can certainly improve the effectiveness of managerial planning, but, and this is very important, it does not make decisions. Rather it follows programmer's decisions made earlier by managers and implemented by EDP staff (Sanders (1970)).

Computer processing influences the control function of managers in several ways (Sanders (1970), Davis (1974)). Unlike planning, control looks at the past and the present. It follows up the planning and consists of (a) proper control requires predetermined goals to be established by planners - the setting up of realistic standards requires quality information ; (b) measuring actual performance - timely and accurate performance information is essential to control ; (c) comparison of actual performance with standards - computers can provide such information to managers on an exception basis only when performance variations are outside certain limits ; and (d) taking appropriate control action.

Leaving them with staff supervision and planning role, computers enhanced the managers with planning responsibilities and strengthened their control role. Managers who are left with staffing functions only will be subjected to tighter control and reduced freedom of action as they have transferred part of their managerial jobs to the computer (Mumford & Ward (1968)). If not compensated

this will be a disbenefit to them and may result in social costs to the organization.

Computer processing influenced employees of organization through their job structure and hence their job satisfaction. Although it creates the interesting jobs of programming and machine operation for intelligent clerks, at the same time it creates the routine and boring job of punch operators (Mumford and Banks (1967)). Computer based systems are notorious for their frequent unreliable standards in data handling or data preparation. They are by and large production line operations. The serried rows of punch girls at their machines could never ever, even if encouraged, summon up much interest or enthusiasm for their dreadful task. In many organizations, especially banks and insurance companies, the calculating machine operators are trained to take over the job of punching and verification. Calculating machines provide the operators with a job in which there is variation, contact with other people, a reasonable degree of mental challenge besides identity and autonomy, but as in the case of the Bank of Sudan, the continuation in this type of job for more than ten years results in serious illness to the operators. Comparing calculating and punching machines there are benefits and disbenefits depending on how they are designed and used.

The employees of the user departments will also be influenced by computer processing. The computer as a mechanical clerk can handle large masses of repetitive and complex work. Computers are an essential alternative to unwieldy and time-consuming clerical processes (Atkinson - (1974)). By so doing they remove some of the drudgery from many clerical jobs and hence join in creating interesting jobs for these employees due to which staff turnover may decline and efficiency should increase. This is a benefit to both staff and the organization.

Computer acquisition is likely to create organizational restructuring. By pooling information processing in one centre to serve the entire departments and branches of the organization, some sections may be closed and others would be enlarged. This in itself may result in saving of operating costs, of enhancement

of some departments and tightening of others.

The availability of information in one centre and its retrieval by several users within the organization may help it to distribute fairly its resources and services to satisfy the people who demand them and preserve the rights of those who are likely to ask for them, for example take the case of government storage of personal information in its computer files (Laver (1974)). Those with the most detailed records will be, as now, those who most frequently interact with the state, in particular those who need and use its social services. They will therefore tend to be the weaker and the poorer members of society, and they are also the most passive in politics and the least likely to kick up a row. There is therefore bound to be a considerable unevenness in what the state knows about the personal affairs of individuals, and equality of revelation is no more likely in a data bank society than it is today. One must now however forget the positive side ; the rules and status that govern the many kinds of benefit available from central and local authorities are too numerous and too complex for most of the people to comprehend, and some are no doubt receiving less than they should. Data bank records plus computer evaluation of each applicant's circumstances could help to ensure that all those in need receive their full entitlement ; and for this to be established quite unemotionally by an impersonal machine may make it seem less like receiving embarrassing charity from the interviewing official. Equality of treatment is a major merit of automatic processing (Laver (1974)). This can also be a disadvantage if the availability of information threatens the privacy right of the individuals to whom the information stored in the system refers (Land (1975)).

Computer usage has its impact on top management and the organization. It enables them to control middle management, rather than to allow the middle managers to control them. This of course supports the commanding position of senior management. The communication under the EDP allows the information to go straight from the computer centre to a top manager who is now able to wield a much tighter control over the business and his subordinates than was ever possible (Mumford and

Banks (1967)). Also the terminals and their interactive use for accessing and manipulating a number of models which have been built as important, indeed essential, aids to management and decision taking (Atkinson (1974)).

Computer processing influences the competitive position of the organization through its consequences on the utility function of the customers. It influences the time factor of the customers waiting for the services. It enables the organization to offer additional services, especially in banks. It increases the reliability of offering the services, e.g. the distributing organization, etc. By so doing it increases the consumer satisfaction, a thing which may invite him to demand more and to be a regular customer. If the system does not work properly both the organization and its customers will disbenefit.

The resulting payoff due to change in the information system is attributable to the characteristics of the information system subjected to this change. Among the most important are (a) the specific content of information outputs, (b) selectivity with which information is provided, (c) time lags associated with the information, (d) accuracy of outputs, (e) reliability, (f) generality, and (g) flexibility and its impact on decision making and operational activities of the organization. The benefit due to these characteristics comes in the form of better decisions that ultimately lead to reduced costs, increased revenues (Gregory, Van Horne (1963), Emery (1971)) satisfied employees with increased efficiency, reduced rejection and turnover and satisfied customers with more demand and increased sale.

On evaluating a computer based information processing system the criteria to be employed is to measure the cost to develop the system, the impact of improved information on the financial cost and revenues and on consumer satisfaction, the way to process this information on the job-satisfaction of the employees and the impact of the improved information and the way to process it on the image of the organization and decision makers. The evaluation is not a matter of listing factors such as improved services or accurate information. It is a difficult job to assign values and estimate costs of improved information systems. Despite these

practical difficulties there are various ways to achieve a measurable balance between the value of improved information and the cost of doing it (Emery (1973)). In assessing the influence of introducing computer technology those who evaluate it must consider the financial, social, technical and organizational consequences on organization as all of these will be achieved by change to computer based management information system.

The BASYC technique is the only one that explicitly provides means to assess the influence of introducing computer technology on financial, social, technical and organizational objectives of organization.

3.3. THE BASYC APPROACH

The approach is a combination of the ETHICS method "Effective Technical and Human Implementation of Computer Systems" devised by the Manchester Business School Computer and Work Design Research Unit (refer to Section 2.3.3 for detailed steps of the ETHICS method) and the Abacon approach "Automation Benefit Appraisal Consultants" to computer benefit forecasting (Hawgood, Land, Mumford & Weir (1974)).

The BASYC approach is a decision support technique in two senses (Hawgood and Land (1976)). On the one hand it is intended to help the responsible manager to decide whether to make a change and which of the several alternatives to adopt ; on the other it is intended to support his decision by ensuring that it is realistic and acceptable to the people affected as they will have been considered (and some will have participated) right through the planning process. It is flexible to cope with the inevitable differences between situations in different places and different times even within one organization. It is human in that it seeks benefits to all the people affected by the change, adaptive in that it reacts to changing circumstances for these people, and participative in that it is operated by some of the same people (Hawgood and Land (1976)).

The evaluation process based on the BASYC techniques involves the

following three main phases (Hawgood and Land (1976)):-

- (i) Identification of these groups of people who might benefit (or lose) from a new or changed system and the goals relevant to them ;
- (ii) Exploration of the opportunities provided by any proposed new system in terms of specific measurable targets ;
- (iii) Scoring of change proposals in comparison with existing policy then subject the result to sensitivity analysis.

Phase I Identification and Classification of Beneficiaries and Goals :

The BASYC approach identifies five groups of people to whom a change in systems or policy presents an opportunity (or a threat) and these are :

(a) Those with financial interest in the organization. They provide the funds to be invested or share the profit to be distributed or both. In commercial organizations they are the owners, whether proprietors, partners or shareholders. In most of the public organizations they are the taxpayers. The benefit to them is reflected by the change in the net income to be distributed to them as shareholders or remaining after collection of their contribution as taxpayers. In accepting an investment project they are hoping for an increased income and/or decreased expenditure. This direction of benefit is seldom forgotten and frequently is the only one considered at all (Hawgood and Mumford (1972), Land (1975), Hawgood and Land (1976)).

(b) The employees within the organization. They are the employees of the EDP centre who will directly be influenced by the change and the employees within the user departments who originate the data or utilise the information system they are hoping for increased job satisfaction, i.e. a change in the fit between their need, aspiration and expectation and their actual work experience in the organization (Mumford (1972)).

(c) The users of the system whose behaviour or mode of action determine the load on the system and its mode of operation. Although there are several

measures of the service to be offered to them, the most important and very much influenced by a change in the information system is the amount of their time allotted to the use of the system. Accordingly, the benefit to them can often be measured by the change in a time factor.

(d) The personal subjects. There are two directions of benefit that refer to two groups, (i) the individual with privacy right of personal information stored in the system about him. The benefit to him is the change in the probability of beneficial situation that concerns him. It differs from one application to another, (ii) the public at large. The benefit to them is the fair distribution of the resources of the organization and preservation of the rights of those who might ask for them.

(e) The decision makers and the organization. The benefit to them is not personal as in the other four groups. They are concerned with the image of the organization to be enhanced by the required change, the expansion of the business activities, adaptability to changing conditions, etc. Their goal is to keep the organization's policies and system flexible to cope with the rapid changes experienced in economic conditions, technological innovation, competitive pressure (Hawgood and Land (1976)). Refer to Table 3.3.1 for more grouping under the situation of different organizations.

There is the possibility that these groups within a given organization may overlap but the important thing to be considered is that the direction of their benefits must be measured in different ways ; though in particular cases one may be able to define a rate of exchange between the categories, this will not be transferable to other situations, so the five categories must always be calculated and presented separately (Hawgood and Land (1976)).

The goals of the organization can be considered in terms of the goals of each set of beneficiaries. To provide measurable targets for an information system the general goals for each group of beneficiaries can be broken down into sub-goals until measurable aspects for which values can be assigned are derived

Table 3.3.1.

Grouping of human factors who will be influenced by computer-based system in some business enterprises and organisations.
(Sources - Hawgood 1974)

CATEGORY APPLICATION	PERSONAL SUBJECTS & PUBLIC	INDEPENDENT USEAS	EMPLOYEES	FINANCIAL BENE-(MALE-) FICIARIES	DECISION MAKERS
Social security	Applicants	Department	Branch Staff	Applicants (Taxpayers)	Politicians Officials
Bank	Account holders	Account users	Bank clerks Branch managers	Shareholders Savers Borrowers	Directors General managers
Hospital	Patients	Doctors	Nurses Clerks	(Taxpayers)	Consultants Members of Board
Mail order	Agents	Departments Agents	Clerks	Shareholders	Directors Managers
Public Library	Borrowers	Readers	Assistant librarians	Ratepayers	Librarian Councillors
Gas Board	Customers	Department managers	Staff of G.B.	Customers	Managers
Credit agency	Applicants Debtors	Retailers	Agency staff	Borrowers Shareholders	Agency managers
University research	Survey respondents	Reseachers	Computing staff	(Taxpayers)	Committees
University admin.	Students Staff	Administrators	Clerks	(Taxpayers)	Committees
Criminal records	Criminals Suspects	Police	Police Clerks	(Taxpayers)	Politicians
Airline reservations	Passengers	Travel agents	Airline Staff	Shareholders	Managers Directors
Inland Revenue	Taxpayers	Department managers	Branch staff	(Taxpayers)	Politicians Officials

(Land (1975), Hawgood and Land (1976)). For example, the goal of the Bank of Sudan of providing a system of control of export trade can be broken down into specific goals related to:

(i) Effectiveness : the control procedure must uplift the collected proceeds to the level of the value of shipped commodities.

(ii) Reliability : the system must generate information about the expected proceeds for planning within a month from the date of shipment.

(iii) Flexibility : the system must be flexible in that it must not result in reduction in the level of export trade.

(iv) Economy : the benefit of the change must offset the cost of the new or modified system.

Each group has sub-goals within the main goal. The goal(s) of one or more groups may be more important than the others. As the direction of the benefits of the five groups are different, it becomes necessary to arrive at some kind of value for each goal. This can be done by giving each goal a weight in relation to all other goals (Hawgood and Land (1976)). For example, it may be possible for decision makers or senior managers to determine how much value they assign to goals related to the users as against goals related to financial beneficiaries, or against goals related to improvement in planning and control function or against goals related to improvement in job-satisfaction, and so on. As there is the possibility of the assignment of different weights to the different goals, it is necessary to ask different groups to make their assessment of the relative importance of the different goals. If there is a wide divergence between goal values, it may be necessary to take steps to resolve a potential conflict (Hawgood and Land (1976)). If the proposed change provides a benefit -for one group and results in loss for another group, it may be necessary to provide the losing group with some compensation (Hawgood and Land (1976)). For example, the control procedure of the export trade example may result in disbenefit to the exporters as they will be subjected to tight control but it may result in benefit to the organization through the

increased collection of proceeds. In such case the exporters must be compensated by an advisory role to compensate them for the loss.

Phase II

The next phase is to assess how different designs of system might contribute to the achievement of the targets. It is best to reduce the number of alternative designs to four or five and taking the existing system as the reference system for scoring the alternatives (Hawgood and Land (1976)). It is essential to make both optimistic and pessimistic estimates of everything. The estimation process can be divided into two questions (1) what would this measure be if the new strategy were in operation now with today's prices and environment ? and (2) how would likely future trends affect this measure ? The resulting outputs are the forecast differences in measure values and costs between each change strategy and the no-change strategy at some future date.

Phase III Final Phase

In the last phase each change strategy will be scored accordingly to its contribution to each target. Some of these alternatives may contribute a great deal to the achievement of some targets but do badly with respect to others. For example, an on-line system may result in heavy operation costs compared with the manual system, but it will produce timely information to enhance the control function. As the targets are not of equal importance, by multiplying the scores of each design by the weight attached to each target and adding the products for each group, it is easy to arrive at the design which over all the targets can be agreed to contribute the greatest total benefit to the organization (Hawgood and Land (1976)).

Finally, the outcome should be subjected to a sensitivity analysis to test, for example, whether a small change in the relative weights assigned to targets would affect the choice of design or whether changes in the assumption about the relative performance of the different designs would affect the result. Where small changes make critical differences it is best to test the weights and measures used

(Hawgood and Land (1976)).

To summarize, the BASYC approach includes the following steps

(Hawgood and Land (1976)) :-

(1) Initiation of study, formation of investigating team, definition of problem boundary and time scale for the study and for policy change.

(2) Identification of interest groups and sub-groups who will be influenced by this change of system or policy.

(3) Definition of the main organizational objectives into goals to be related to interest groups.

(4) Estimation of current measures and the required targets by end of the planning horizon.

(5) Work out the relative importance of these goals to the respective groups of people to short-list them. This can be done by assigning percentage weights for goals.

These steps of the feasibility study will yield the first stage in the evaluation process, i.e. identification of those who might benefit (or lose) from a new or changed system.

(6) Specification of alternative system design in technical and social terms so as to arrive at socio-technical system design.

(7) Forecasting of the measures with these alternative systems designs or strategies. This will include optimistic and pessimistic values for each goal under each alternative strategy.

Steps (6) and (7) is the second stage in the evaluation process.

(8) Estimation of total benefits of alternative strategies. Each alternative strategy is scored for each goal. The score will be multiplied by the percentage weight assigned to that goal by the interest group. This will give the utility contribution of a given alternative strategy to that goal for each interest group. The utility contribution of an alternative strategy will be

summed over all the goals of each interest group to arrive at the total contribution of that alternative strategy for a given interest group. There will be optimistic and pessimistic utility contributions or total benefits for each interest group.

(9) Subject the results to sensitivity analysis, then present to decision making. This is the last step of the feasibility study and the last stage in the evaluation process.

This study can be a one or multi-cycle study depending on the results arrived at at each step, their sensitivities to weights and measures used, and their acceptance by decision makers to proceed further, or their demand to investigate to find other alternatives.

3.4 MEASUREMENT OF BENEFITS

The BASYC technique identified five groups of people with different goals, the contribution of the changed system towards these goals will state the groups own benefits.

Objectives of organization and goals of the groups of people who will be influenced by change of system or policies differ from one organization to the other. Even in the same organization there are several systems and the goals of the groups related to each system might differ from one system to the other depending on the business interest and operational activities of the system. For example, in the Bank of Sudan the personal subject group to whose members information of foreign exchange operation refers are exporters and importers. Some of these deal in export and import trade together. Introduction of control measures to check performance of exporters will be a disbenefit to these exporters. At the same time the resulting increase in foreign exchange currencies due to control measures will be a benefit to them as importers.

Organization should be able to identify its main objectives and to relate them to the interest groups of people to arrive at their goals so as to state the

elements of benefits to be assessed.

This section is concerned about general approaches to assess individual benefits. While some of them can be applied in different organizations such as job-satisfaction and financial benefits, others might be in certain situations.

3.4.1 Financial Benefit

The financial benefit of computer based management information system change is the differential net income resulting from the changed system to be collected by proprietors, to be distributed to partners or shareholders or remaining after the collection of their contribution as taxpayers. It can also be saved cost to be invested in other projects on behalf of taxpayers as in the case of the Bank of Sudan.

Many organizations estimated the direct cash in and out to arrive at financial benefits of computer based management information system change. Some of them did it in order to show that computer operation is no more expensive than equivalent manual or mechanised systems (Hooper (1966)). Others did it in order to be sure that there would be an adequate return on the fund being invested (Diebold (1969)).

In order to arrive at the financial benefit of computer based management information system change, the evaluator should identify the cost variables to pay for as well as those cost variables to be saved of the alternative systems. The cost variables to pay or to save of each alternative system are to be compared with the present system to arrive at differential cost of each one of them. The following are some of the cost elements likely to be incurred or saved by change to computer based system :

- (a) Equipment at computer centre.
- (b) Accommodation at computer centre.
- (c) Staff at computer centre.
- (d) Stationery at computer centre.
- (e) Equipment at data preparation centre.

- (f) Staff at data preparation centre.
- (g) Accommodation at data preparation centre.
- (h) Stationery at data preparation centre.
- (i) Staff at user departments.
- (j) Equipment at user departments.
- (k) Accommodation at user departments.
- (l) Stationery at user departments.
- (m) Power consumption.
- (n) Education programming.
- (o) Payments for staff to plan the development of the system.
- (p) Consultants to advise.
- (q) Payments for staff to implement and operate the system.
- (r) Maintenance of equipment, buildings and software.
- (s) Cost of implementation and operation.
- (t) Others.

These elements of cost influence the income of organization and they are disbenefit in financial terms. They will be assessed for individual and cumulative years, then adjusted for inflation.

The difficulties in assessing financial benefit of computer based management information system change arise from the indirect payoff. The indirect payoff is the resulting influence of the available information with new aspects such as accuracy, reliability and relevancy on control and planning function of the different operating levels of organization, on consumer satisfaction and on the personal subject of information.

Information has value if it is used to further the goals of organization. There are three requirements in a piece of information to which value can be assigned (Emery (1971)) and these are :

- (i) The information has to have a surprise content in the sense that it has to tell something that one did not already know.

(ii) In the face of new information that has some surprise one has to take an action that he would not have taken otherwise.

(iii) The action that the new information leads to has to provide a higher payoff than one would have got otherwise.

The incidence probability of the information having surprise content or the new information leading to different decision has to be decided. To measure the surprise content one needs to know what he knows now provided by the present system and what he will know if the system is changed so as to compare them. In order to assess the value of the information one has to know how the new information leads to a change in decision (Emery (1971)). For example, in the Bank of Sudan they depend on export proceeds to finance import and other obligations in foreign exchange currencies. The deficit is financed by loans, sometimes on short-term basis at higher rate of interest or on long term basis at lower interest rate. Availability of information of foreign trade will help managers to estimate future trends for export and import. On this information they can estimate the expected deficit. If the information is available at an earlier time, they can possibly go for long-term loans, but if it is not available then they will face difficulties that press on them to go for short-term loans and hence pay higher interest rates. The value of the information availability is the difference in interest to be paid for short and long-term loans to finance the deficit. The financial benefit of processing this information is the difference between the cost of processing information and the resulting difference in interest to be paid for loans.

For this kind of evaluation it is relevant to apply sensitivity analysis. In order to perform it, organization should be able to formalise their decision function (Emery (1971)).

In assessing the financial benefit, costs and income will be estimated separately. While the differential cost will be the cash out depending on whether it is positive or negative, at the same time the indirect payoff will be the income of the changed system depending as well on whether it is positive or negative.

3.4.2 Service Benefit

The second benefit to be assessed is the service. The customers or the users of any system are hoping for improved services in terms of time or improved services in terms of value and confidence. The utility approach to the theory of individual consumer's demand will be employed to evaluate it. In economic theory the consumer will continue to consume more units of a commodity up to the point where his marginal utility is equal to his marginal cost. If a consumer demands more units this means that still he is getting additional satisfaction more than additional cost. The theory goes further to state that the more units the consumer demands, the less will be the increase in his total utility. In other words, the marginal utility of the last unit is less than the marginal utility of earlier units. This is the law of the diminishing marginal utility. The concern here is to measure this surplus utility because it is the indicator of increased benefit due to improved services. Increase in this surplus can be achieved in two ways :-

(i) Decrease in cost per unit associated with increase in demand, i.e. decrease in time in which the service is offered to the user. This can be represented by a movement along the demand curve shown by Figure 3.4.2.1.

(ii) Improved quality of services, especially accuracy and reliability, given a constant cost per unit. This is represented by a shift in the demand curve away from the origin - "superior commodity law" - Figure 3.4.2.2.

The surplus benefit (differential service benefit)

$$= \text{Demand} \times \frac{(\text{demand change at constant cost (Figure 3.4.2.2.)})}{(\text{demand change per unit cost change (Figure 3.4.2.1.)})}$$

There is an underlying assumption that the demand responds to change in price per unit of commodity or a change in marginal utility per unit of money's worth of a commodity.

In some situations this assumption does not hold because demand is constant

due to other factors. In such a case the differential service benefit is the change in total processing time which =

change in processing time/unit x number of transactions.

This applies where the user is a departmental manager and the benefit to him is expressed by an efficiency in handling the operations of the department. This benefit can be a financial return if the resulting decrease in total processing time is met by a decrease in clerical staff. Also, it can be a service benefit if the differential time is utilised to offer other services.

Under other conditions the benefit is attributed to reduction in rejected services because of a change in accuracy level. Rejected services require additional processing time from the different operating levels in the department that provides the service.

The differential benefit under such case

= processing time per unit of rejected transactions

x change in number of rejected services

One must be careful to disentangle the increase in demand because of time factor and increase in demand because of reduced confidence. For example, an account holder who comes to the counter to ask about the accuracy of his statement is demanding a service, but if this statement is accurate he would not have come to the counter, and hence the difference. The service dimension can be broken into several sub-goals to which a value can be assigned. The aspects of service that can be influenced by system change are :

(i) Reduction in time in which the service is demanded and supplied.

This includes the travelling time to where the service is to be supplied, waiting time until the user is attended to and the time in which the service is offered. The increase or decrease in these three times due to system change can possibly be estimated as well as the decrease or increase in the number of transactions associated with them respectively, (Land (1975)).

(ii) The second aspect is the improvement in confidence. Confidence should be increased with increased accuracy, which can be measured in terms of mistakes or a given limit within which the mistakes are not acceptable. Here one needs to identify the type of mistakes that can be avoided by the system change and the reduction in user visits to investigate these mistakes, or a reduction in returned services because of these mistakes. Confidence should also increase because of increased reliability. Reliability is expressed by the ability of the system to offer these services when advertised. This can be measured by the change in the probability of the system in offering its services ; for example, before the system change one of the shops advertised that they would deliver any commodity being ordered by a customer on the same day. A lady who tried them ten times was successful in six. Hence the probability that the shop should meet its obligation in time is $3/5$. After system change it increased to $4/5$. The increase in demand because of increased probability of delivery is an organizational benefit but the increased reliability is the service benefit.

(iii) The third aspect is the varieties of services to be offered because of a change in the system. In the past an account holder of a commercial bank can only cash money through the counter at a specified time. Now the cash terminals located in different branches make it convenient to the user to cash a specified amount of money whenever he requires. The increase in demand due to these varieties is an indicator of the increased benefit in this respect. Also the possibility that the centralised account system should enable an account holder to cash his money from any branch is another service benefit because he need not travel to his actual branch and incur transport and time cost.

The differential benefits to the user (and hence by definition to the organization) can best be obtained after observing changes in computer usage behaviour following changes in time-costs to the user or in service-levels provided (Hawgood, Mumford (1972)).

Movement along Demand Curve due to change in Price

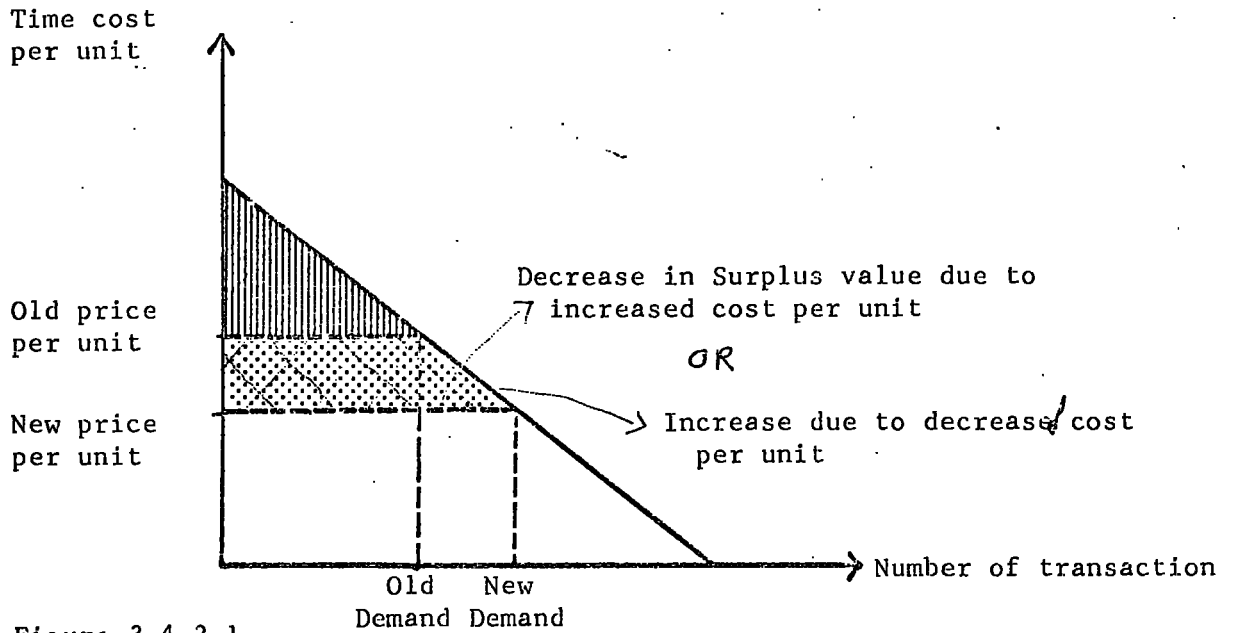


Figure 3.4.2.1.

Shift in demand curve due to Improved Quality

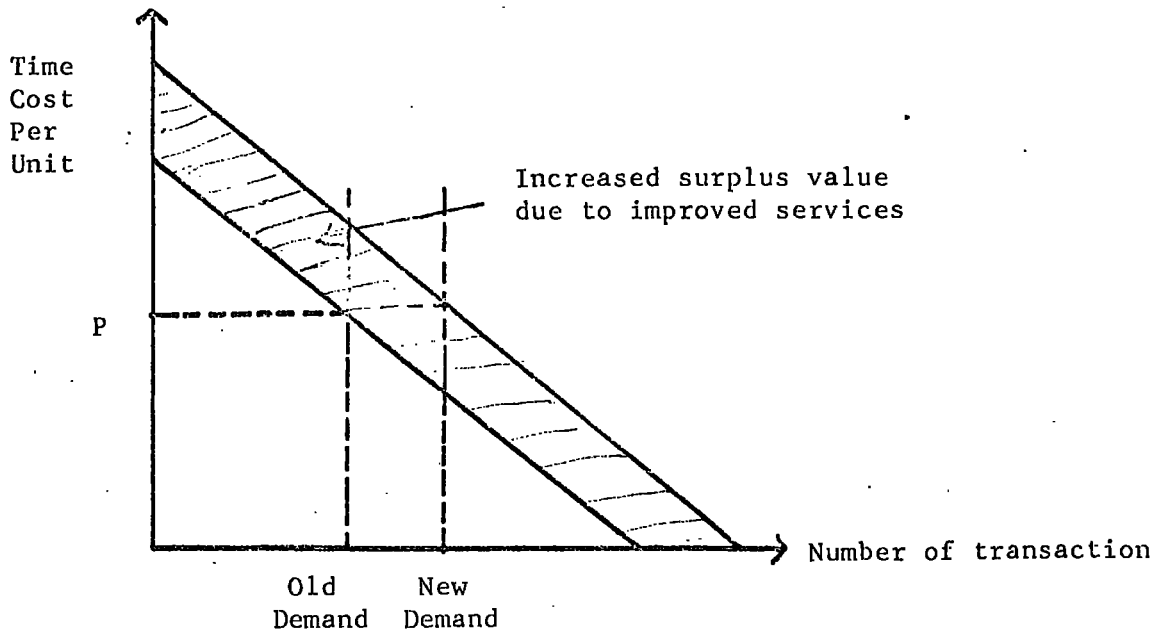


Figure 3.4.2.2.

3.4.3 Job Satisfaction Benefit

The method of social analysis of Section 2.3.1.1 that involved questionnaire about job satisfaction variables will be used to measure the level of satisfaction before change of system then after the change to assess the contribution of the changed system towards staff own objectives. The measurement process which is based on the definition of job satisfaction as five contracts breaks these contracts into main categories. The categories are broken further into variables and for each variable there is a pair of statements on which the member of staff whose job is likely to be influenced by change of system is asked to agree, partially agree or disagree. The first statement concerns the employee's actual work experience, and the second statement concerns the employee's own preference. Matching answers to both statements indicate an employee's job satisfaction related to that variable. The number of variables under one contract area with over 70% level of satisfaction may be divided by the number of variables under the same area with less than 30%. The result is a crude measure of the job satisfaction among the employees within the contract area. There will be five such measures which are to be calculated before and after the change so as to assess the influence of the change on the degree of the fit in the five contracts (Hawgood (1972)). For example, under the knowledge contract there are twelve variables. In two of them the level of satisfaction was over 70%, and in three it was less than 30%. In calculating the score for this contract it is $2/3$. The ratios of good to bad fit are not actually divided out, but simply used to determine whether one fit is expected to get better or worse. The higher the score the better the fit.

Sometimes the score is very high, for example 5:1. Still the variables with less than 30% level of satisfaction create problems and job dissatisfaction. In such a case it is relevant to consider the percentage of staff to be satisfied if that variable is to be changed. The change for that variable will be the social cost or benefit of the changed system.

3.4.4 The Personal Subject Benefit

The benefit and the beneficiaries are to be derived from the applying organization and the situation under which the system operates. There is no common measure as in the three preceding groups because the information to be stored about them differs from one organization to the other. Also the objectives of the organization towards the public is dependent on the nature of its business activities, but in each organization there are two directions of this benefit, (i) the direction of the public at large which is concerned with the ability of the organization to meet their potential rights expressed in the general objectives of the organization, and (ii) the direction of the individual about whom the information in the system is stored concerned with the availability of this information to cater for their active demand and their confidentiality to preserve their privacy rights.

The organization stores information about individuals in order to ease its communications with them and cater for their needs within its rules and statutes so as to preserve equality of treatment. Sometimes individual subject of information receives more than his requirement. By so doing he deprives the potential or indirect rights of others and this will ultimately result in conflict between individual and the public. In an attempt to measure this direction of benefit, organization should identify the factors that are likely to result in positive or negative benefits to the individual personal subject related to its information system. For each factor a pair of statements, one to state the fact and the other to reflect preference and aspiration, is to be prepared in a form of questionnaire. This questionnaire is to be presented to a number of individuals within this group. They will be asked to agree, partially agree or disagree with the respective statements of the questionnaire. Matching answers to both statements indicate satisfaction. The variables with high percentage rates, over 70%, will be the goals to be maintained for this group. The variables with low percentage rates, i.e. less than 30%, will be the goals to be improved for the group.

The procedures of the BASYC technique to estimate the contribution of the alternative systems towards these goals will be applied to arrive at a group's own benefit.

3.4.5 Organizational and Decision Makers Benefit

This benefit is in a slightly different position from the other categories of benefit because neither the senior managers nor decision makers will benefit personally from system change except that their image will be enhanced if organization is able to achieve its objectives.

Besides the goals of the other groups of people, managers or decision makers are the only responsible individuals for flexibility of organization, its progress and expansion. It is their job to prepare the required resources to enable organization to adapt successfully in the short and long run. It is their job to select projects that ensure fair contribution to the different groups of people rather than one of them.

In considering change of information system, their goals are to keep organization policies and systems flexible to cope with rapid change in economic conditions, technological innovation, competitive pressures and social environment. Although the BASYC approach provides for the assessment of their benefit, still their decision function related to selection of alternative strategy will measure organization benefit. Also, the constraints that they impose on the planners will reflect their attitudes towards organization profitability.

3.5 IDENTIFICATION OF COSTS

Computer information processing is a production function. Financial, social, technical and managerial costs will be incurred to develop and operate a system that contributes more to the objectives of the organization. The BASYC approach is the selected technique in this thesis to assess the contribution of the system towards the objective of the organization. This section will deal with

the elements of cost to be considered in the development and operation of a computer based management information system. Each cost will be incurred to produce a level of production or satisfaction tangible or intangible. For each element of cost it is necessary if possible to consider what is required, the alternative means to achieve it and its cost. This is required to increase the efficiency of the system to be developed.

Cost will be incurred to plan the system that involves analysis and design then to implement and operate it (Morris (1971)). For cost identification, it is more relevant to relate the elements of cost to the main phases through which system development will evolve and these are :

- (1) System analysis
- (2) System design
- (3) System implementation
- (4) System operation and maintenance

This approach should contribute to the efficient utilization of the organizations resources.

3.5.1 System Analysis Cost Variables

This stage of planning is to set EDP objectives for the organization as a whole, assess and create resources and evaluate alternative means of achieving objectives through computer assisted solutions. The cost variables will be incurred in :

- (a) Education programmes

There are four groups of people to be educated if a change in the information system is to be considered, and these are (i) the top managers to enable them to arrive at a sound computer policy, (ii) the EDP group ;besides their technical background that could enable them to cater for the data processing requirements of the functional areas of organization, they must acquire knowledge about the influence of computer processing on human factors. This is necessary

to ensure the development of systems to meet the social and technical requirements of the organization and reduce the risk due to these variables, (iii) the line managers and the staff of the user departments. Their education is to create analytical skills so that they can re-think their function and adopt new methods using EDP for handling the problems their department has been set up to solve and enable their staff to handle the introduction of the system, and (iv) the personnel department ; because they are responsible for the staffing demand of the other departments and the social problems within the organization, they must be able to estimate the influence of the change on manpower, on the structure of departments and organization and on responsibilities of the management. In some organizations the personnel departments communicate between the departments and the top management. Effective planning for a computer based system stresses the importance of fast, accurate and continual communication ; the personnel department has to recognise this fact. Because of the social problems which are likely to develop due to the change, the personnel department must be there to lead the consultation programmes to settle them.

(b) Resources required to meet plans

Planning involves the estimation of resources required to meet the plans and establishing how these resources can be obtained and secured. The staff of the EDP centre is one of the scarcest resources associated with change in a computer based system. The extent of this is aggravated in the situation of developing rather than developed countries. The cost in such cases will be incurred to set up facilities to provide the required job in a context that secures their availability in the short and long term. This can be done through (a) technical training programmes for programmers and systems analysts to produce the skill required, (b) the salaries and conditions of work are such that they meet the expectations of people in these skilled jobs, (c) provide a career ladder into management for the most able EDP staff (Hawgood and Mumford (1971)).

3.5.2 System Design Cost Variables

This involves the working out of the most appropriate methods for using both the potential of the computer and skills and resources of the departments which are to be computerised. The objective of this stage is the early foundations of a system based on technical as well as social factors. Besides the focusing to maximise the potentialities of the computer technology, the employees' potentials as a production factor must also be considered (Mumford (1969)).

The main cost variables within this planning stage will be incurred for :

Work problem solution

Before an organization proceeds to implement or operate a system, it must be able to estimate its cost and benefit with a reasonable degree of accuracy and the feasibility to do it subjected to social, technical and financial justification. The expenses to be paid to recruit or train skilled personnel to study and analyse the systems of the organization, the salaries and other expenses of the personnel while they are conducting the study, the fees of consultants who advise the organization in its EDP alternatives, the indirect cost due to interruption of employees being involved by the study are the typical costs to be incurred by an organization to work its problem solution.

There are some provisions to be made in order to reduce the risk associated with this planning stage. The first one of them is the timing and phasing of the project. There must be a realistically estimated length of time for the completion of the several stages. Over-optimistic deadlines will result in social cost due to the drop in morale of both the EDP group and the user department which is likely if the time allowed is exceeded. The fact that the introduction of a computer within the information system of the organization saves staff of the user department and calls for new skill among the EDP group, must be handled in a practical way so as to reduce the risk of the change. If there is need for new skill, the planning team must state the quantity and quality and relate the

time for training them to the time of implementation. Instead of recruiting new employees to staff the EDP centre, an organization can make use of its intelligent clerks and other members of staff by attaching them to the EDP centre if some of them will be made redundant due to the change.

The structure of the organization is likely to be influenced by the change. The expansion and contraction in planning and data processing departments respectively may lead to a reduction or an increase in the number of supervisors required within organization. If not compensated, there will be social cost to be incurred by organization. The provision for such factors is to reduce the risk associated with the change.

In planning for the technology, organizations assess the direct cost of the hardware, input/output channels, random and multi-access devices, etc. Although the decision function is based on the least cost to do the work efficiently, here the direct cost is not the total cost, and sometimes the smallest direct cost turned out to be the most expensive overall. In order to reduce the financial and technical cost due to the selection of the technology, organization must be prepared to incur cost in order to recruit personnel and pay for a consultant to advise on the type of the several options available to them. In investigating the technology the organization must investigate a system before a machine. Besides the hardware, the investigation must involve the software and the services to be offered by the manufacturer in the future, the reliability of the manufacturer to deliver the machine in time, etc. The assessment includes the cost to do it and the ways to reduce the risk associated with it.

3.5.3 System Implementation Cost Variables

Implementation should be planned in order to install a computer system and work with a minimum of stress, anxiety and conflict for everyone concerned (Mumford (1969)). The costs to be assessed at this stage include :

(a) the final system analysis and the development of a socio-technical solution to meet social and technical objectives of the organization, subjected

to financial justification. Besides the salaries and expenses of the personnel while doing the process, there are several costs to be estimated as well as means to reduce the cost. Their consequences are likely to be aggravated by the implementation stage. The most important one of them is the diagnosis and prediction of the social variables of the organization. The employees of the user departments are potentially the most hostile and resistant to the change. Even if the system is "perfectly" designed in the technical sense, it may be resisted by them during the implementation phase. Although the diagnosis and prediction take time to do and result in cost due to the salaries and expenses of personnel and the expenses of the method to do it, this cost is likely to be more than offset by the avoided risk due to this social factor.

The programming stage is part of the implementation process. Direct cost will be incurred to pay for the programmers, the computer time to test the programs, the operating staff to prepare the data and run the machine, payments to other senior staff of the EDP centre, consultants, etc. There are several design objectives to be considered by the programmers so as to reduce the risk of this stage. These objectives are related to (Land (1970)) (a) the requirements of the job - the job has to handle a certain volume of transactions in a specified time, subject to some considerations of reliability in meeting time targets ; (b) the reliability of the job - the job may have certain permitted levels of degradation in the case of computer breakdown ; (c) maintainability - in general programs have to be planned in such a way that they can be maintained by someone other than the original programmer, which requires clear, uncomplicated programs and good documentation ; (d) flexibility - programs should be devised in such a way that changes in requirements can be accommodated with a minimum of re-programming (the more dynamic the organization using the programs, the more important it is to make programs flexible) ; (e) robustness - the property of a program to meet unexpected combinations of transactions without causing a failure or error ; (f) using the minimum of computer facilities in the context

of the other objectives.

Control is an important factor to reduce the cost of the programming stage. Although operations personnel can easily be controlled, the difficulty arises with programmers and systems analysts. This is due to the nature of their work, which involves quality and quantity. Quantity control can be established as so many statements per day or per week, but this is no real guide if the statements are poor and result in poor machine efficiency. In order to control them, this is to be done within their own specialism and by using the different levels of supervision to monitor both quality and quantity within the limits set by project targets (Ardron (1971)). Another way to reduce the cost of programming is to program for the several sub-systems that make the total operations of the given system, namely the normal computer system, the cut/over, the backup and the recovery systems, rather than to program when the need arises (Land (1970)).

(b) System Introduction

In assessing the cost of implementing a system, organization includes the cost of the new system. Practically there is often a period in which the new and old systems will be running in parallel. This cost must be assessed as well. Not only that, there is the cost due to morale of the employees. If the system is poorly planned for the human factor, their turnover may increase and efficiency may decline. This cost will be assessed from the historical performance of the employees towards any change. Also, it must not be forgotten that the introduction of the change will disrupt the organization. The disruption may delay the services of the organization and hence its customers. Such cost should be assessed and provided for.

(c) Manpower

The cost of the manpower to implement the system includes the operating cost of the EDP group and the employees of the user department being involved by the implementation stage. The assessment must provide for indirect or other

incremental cost to be incurred if there is turnover among the EDP group. To maintain the level required, cost will be incurred for further training for both EDP and user department staff. Temporary staff may be needed in order to implement the system ; such cost should be estimated. The fact that the EDP is a new field, the members of staff of the EDP centre may be attracted by external organizations. In such case organization has to revise their wage and salary schemes in order to make them fit with new skill and status level. Otherwise the direct cost will be incurred to replace them or indirect cost will result from the education program to prepare the skill required.

(d) Provision and installation of hardware and software

While in the system planning stage the cost is incurred to investigate the technology and its supporting programs, at this stage, cost of the selected system will be incurred to provide for it. Besides the direct cost to be paid to the manufacturer, there is the cost of housing the system and indirect cost if the delivery is not on time or the site is not complete. This cost may run into several thousands, especially if temporary staff and consultants are there to help with it.

(e) The structure

The designed structure of the organization will be realised during this stage. Although in the system planning stage the cost has been incurred to do it and to reduce the risk associated with it, too much managerial work has to be involved especially if the change is significant. The line managers will mostly be influenced by it. The cost will be incurred if there is no compensation for them. Besides the direct payment to the managers to do the exercise, the indirect cost should be estimated.

(f) Education, communication and consultation continue throughout the implementation and operation stages. Good communication and consultation with staff at all levels can act as an excellent feedback mechanism which draws management's attention to areas where problems are being encountered.

3.5.4 System Operation and Maintenance Cost Variables

System operation is the continuation process of implementation. The operation stage is very dependent on the previous stages but cost will be incurred in :

(a) System maintenance : this involves additional programmers, revision of files created by others, and their maintenance. For an organization operating under an ever changing environment, the maintenance of programs and files will cost too much. A necessary condition to reduce this cost is that the users and staff must be economically minded. They must be aware of the efforts to be done by the EDP staff in order to change the programs and files. At the same time such organization must maintain the EDP group so as to avoid the resulting cost if they are overloaded and dissatisfied.

(b) Site maintenance : although the plant and machines maintenance is provided for under the cost of the technology, still organization may need an engineer to be on the site to maintain them whenever required. -Such cost is normally transferred to the manufacturer, but here there is the risk that the manufacturer may not be prompt in his service.

(c) Stand-by facilities and backing system : to reduce the risk of accident and breakdown, the organization incurs cost to back its system. This can be done by using an external centre, or a small machine to do the urgent jobs, etc. Another cost will be incurred to protect the files which are likely to be damaged. Sometimes the payment will be made in order to duplicate them but sometimes there are other means to protect them.

(d) Insurance : in order to guard the funds being invested in their system, the organization incurs cost to insure them against fire and other unforeseen natural accidents.

(e) Improvement: operation does not mean the end of the job. There must be continuous improvement and this will result in additions and reductions. All these are paid for and their cost has to be assessed as well.

3.6 CONCLUSION

A change in the information system of the organization in which computer technology is involved is a long term investment project for which resources of manpower, financial and organizational, will be devoted. Conceptually, there is no new problem in determining its cost but practically there are difficulties to assess them because of the very significant joint costs, especially in its early stages of development, the several indirect cost factors to plan, implement and operate it, and the provision for many variables to reduce the risk associated with it.

Computer processing results in primary and secondary influences. It influences the financial resources of the organization through the funds to be paid to develop it, the resulting saving in clerical staff and the gain due to the new attributes of the information to be produced by it. It results in restructuring of the organization due to which the location of authority and responsibility is subjected to change as well. The new manual procedures required for its operation, its demand for skilled staff and saving in clerks with bookkeeping jobs, the change in sections or departments, etc. all together have consequences on the job satisfaction among the employees.

One of the main factors that encourages the organization to make use of the computer technology is to sharpen their effectiveness in competitive markets. Computer processing enables the organization to serve its customers quicker and to offer them additional services. These influence the consumer satisfaction on one level and the organization's competitive position on the other.

The capability of the computer to produce timely accurate information supports the planning and control function of the organization due to which its image should enhance and its flexibility to adapt better to change should improve.

One of the main contributions of computer processing is that it enables the organizations, especially the public ones, to distribute fairly their

resources and preserve the rights of those who might ask for them.

In the attempt to evaluate this type of investment some organizations started the planning process by providing for the cost variable to be conclusive in decisions about the computer based management information system. This resulted in a situation whereby the time it was clear that the net benefits were too small to justify the change, so much of the cost had been incurred and it became more sensible to proceed than to stop (Morris (1971)). To avoid such a situation one should first answer the question, "is it worthwhile to change to computer based management information systems ? " The BASYC approach is one of the multi-attribute utility analysis technique selected in this thesis to answer this question. The provision or estimation of cost to develop and operate the system came after. In order to increase the efficient utilization of the organization's resources to be devoted for the EDP, this chapter as well considered the elements of cost to be estimated for the development and operation of the system. Elements of cost are phased according to the main stages through which system development evolves and these are (1) system analysis, (2) design, (3) implementation, and (4) operation and maintenance. Each stage involves financial, social, technical and managerial cost factors. Some of them are necessary for the action to be done, others to reduce the risk of change and others to increase benefit. The importance of this phasing is that on the result of each stage the manager should be able to decide whether to proceed to the next stage or not. In general cases, organizations have not considered most of the cost variables necessary for development or operation because they were not recognised, not measurable and the suitable method of costing was not available, etc. (Morris (1971)). According to the author, this might be one of the factors that pressed on organizations to use the known evaluation techniques such as discount methods or payback period to measure the worth of the computer based management information system.

The BASYC technique provided means to quantify intangibles on measurable

units but one may argue that it ends up quantifying them on a utility scale where meaning might not be acceptable by decision makers. The final ranking of the alternatives is not the only result to be presented to the decision makers. Goals, alternatives, measures, weights, scores and utility contributions are included as well. For those who want to work with quantities, quantities are there. The important thing is not the quantity. The value of the goal, the score to be assigned to the alternative system in the achievement of the goals, and the total satisfaction to be gained, are the important factors to be considered and these need not be monetary values.

Those who will be affected by the change of policies or systems in which evaluation of the BASYC technique will be used, should understand the decision rules and processes. This will increase the cost of the evaluation process. Managers who are keen to participate their staff, and the customers in the change process should be ready to pay for it. The benefit should result in the short and long term.

With the BASYC, each strategy will have its own aggregate utility upon which it is judged (Hawgood and Land (1976), Hawgood (1977), Land (1975), Mumford, Land and Hawgood (1978)), The aggregation rule assumes value independence (Gardiner and Edwards (1975)), i.e. when scoring a criterion, the analyst ought not to think about the scores being assigned to the alternative strategy towards the achievement of other goals and this is what we have in the BASYC.

The BASYC stresses on the provision of goals with measurable attributes. This must aid subjective appraisal of the effectiveness of the alternative systems or policies.

It has been stated that the multi-attribute-utility approach can easily be adapted to cases in which there are minimum or maximum acceptable values on a given dimension of values by simply excluding alternatives that lead to outcomes that transgress these limits (Gardiner and Edwards (1975)). With BASYC the case is different. It is based on the contribution of the alternative system or policy

towards the goals of each group. This contribution might be positive or negative and the alternatives are ranked according to this contribution. There is no question of minimum or maximum acceptable values but there are alternatives that contribute more or less towards the goals of the groups. Accordingly it could be applied easily in any evaluation process.

Research is going ahead to apply fuzzy models in the BASYC approach. Unfortunately it is too late to apply it in this thesis.

CHAPTER 4

OBJECTIVES AND FUNCTIONS OF CENTRAL BANKING STIMULATING

FACTORS FOR CHANGE

4.1 INTRODUCTION

In any organization, whether public or private, there are explicit and implicit objectives to be achieved if the organization is to survive and develop. The functioning of the organization to achieve the objectives is subjected to internal and external economic, social, technical, organizational and political factors. For one reason or another the organization faces problems that hinder it from attaining its objectives. The coincidence of several factors press it to effect a change in its systems but the interaction of the many factors make it difficult to identify them to state objectives to be achieved if a change is to be considered.

The information system of the organization is one of its main system. The availability of the computer technology is one of the factors that stimulated many organizations to change their information system so as to introduce the technology as an integral part of them. Within organizations the introduction of the computer technology started in payroll, accounting and bookkeeping systems (Nolan (1974)), but this led to systems that stress data-processing efficiency at the expense of organization effectiveness (McFarlan, Nolan & Norton (1973)). Financial and human resources especially in developing countries constraint many organization to implement a computer based information system for the whole organization, at one go. While it will be necessary to develop a master plan for developing a computer based system, at the same time it is more relevant to implement it by system or even sub-system, but here there will be the problem of the system to start with. Setting of priorities which provides the foundation for the long-range system plan should be based on an intensive analysis of the organizations overall business activities. Priority in information system develop-

ment should be given to the areas that are critical to the organizations long-term success (McFarlan, Nolan & Norton (1973)).

This chapter is meant to point out the critical areas of the Bank of Sudan in which information system computer information processing is required.

4.2 BACKGROUND OF THE BANK OF SUDAN

After political independence in 1956 there was a strong feeling among the Sudanese to have their financial and monetary independence as well. Up to that date the Sudanese banking and monetary systems were tied to the Egyptians. The currencies circulating before 1956 were Egyptian bank notes and Egyptian and British coins. The National Bank of Egypt, Khartoum Branch, had been conducting some of the central banking function by being a banker of the Government and lender of last resort to the commercial banks. The banking institutions were in the hands of expatriates and all of them were branches of foreign banks (Economic Survey, 1958). Business enterprises were concentrated in foreign trade activities as the commercial banks only supported it. Financial profit was the only objectives of these Banks. They were reluctant to finance agriculture and industrial activities on which the development of the country is dependent. Their geographical distribution was unbalanced as they were mainly located in Khartoum, the capital of Sudan, and Port Sudan, the main port of the country. The absence of effective control over them, particularly the size and purpose of their advances, resulted in rapid expansion in these advances during the fifties for purposes other than industry and agriculture (Economic Survey, 1958).

There was a series of moves to create economic and financial institutions to aid the further development of the country's resources. This was only feasible by the establishment of financial institutions to control the banking system, to encourage, supplement and direct it to support the financing of the development projects of the country (Brimmer, 1959)). The Ministry of Finance and Economics used to practice these responsibilities, but it was unable to effect the control

required as it lacked the tools of the central bank. It was the administrator of the foreign reserve of the country as well.

Another major step was the currency reform. In 1956 a Currency Board was established to which was assigned the replacement of Egyptian bank notes and Egyptian and British coins by Sudanese national currency, (Siemienski (1957)). It began in late 1956 and completed the currency exchange in April 1958 (Sudan Currency Board Report, 1957). Like other Currency Boards it was limited in its operation and was unable to control the credit system. It operated almost as an automatic mechanism and created a link between money supply and the balance of payments (Fleetwood (1964), Basu, (1967)). With an increase in export earnings, the currency in circulation and deposits in banks increase as the earnings will be collected by the commercial banks who in turn will deposit them with the Currency Boards to get the equivalent in Sudanese currency. An export boom was followed by an import boom and a demand for bank advances as well as foreign currencies to finance import trade. A slump in exports might lead to a slowing down of domestic activities through its effects on bank advances and currency circulating. In such cases the Currency Boards were unable to influence the credit condition (Fleetwood (1964)). A central bank has discretionary power to increase or decrease money supply without linking them to the foreign reserves of the country.

These and other positive reasons made it essential to establish a central bank in Sudan.

"The importance of a central bank may be attributed to the growing realization that under modern conditions of banking and commerce it is a great advantage to any country irrespective of its economic development to have a centralized cash reserve vested in one bank which has the support of the state and is subject to some form of its supervision and participation." (De-Kock, (1954)).

By February 1960 the Bank of Sudan - the central bank of Sudan - was established. It took over the assets and liabilities of the National Bank of Egypt, Khartoum Branch, and the Currency Board.

4.3 MANAGEMENT AND ORGANIZATIONAL STRUCTURE OF THE BANK

The Bank of Sudan is a public corporation whose capital is entirely state-owned (Bank of Sudan Act, Section (7)) but has financial autonomy and judicial personality ; it enjoys a monopolistic position.

The organizational structure of the Bank of Sudan has been considerably influenced by the Bank of England tradition in the administrative set-up. It is headed by a Governor, Deputy Governor and seven members of the Board of Directors, among whose members the Governor and his deputy, responsible for monetary and credit policy of the country, four of the other five members are appointed by the Council of Ministers and the fifth is appointed by the Minister of Finance and National Economics to represent him on the Board (Bank of Sudan Act, Section 13(a)). The composition of the Board of Directors is particularly significant in determining the extent to which the Bank of Sudan can be in a formal sense independent of the Government and hence able to resist inflationary pressures in the Government sector (Brown (1968)).

At the executive level, there are three General Managers supported by ten deputy General Managers, under whom come eight Assistant General Managers and eighteen Managers of the Bank's separate departments besides eight Branch Managers and one Manager of the Institute of Banks (Bank of Sudan Annual Budget (1975 and 1976)).

Up to 1967 there was one General Manager and one Deputy General Manager. To cope with the expansion in the economic activities within the country that influenced the internal functioning of the bank on one side and the commercial banking on the other side, it became necessary to appoint another Deputy General Manager to whom the responsibilities other than the internal ones were transferred.

Before the nationalization of the commercial banks and their conversion into limited companies to be owned by the Bank of Sudan in 1970 there were eleven departments located in the head office and ten branches distributed throughout the country to handle limited functions on behalf of the head office. After that

date another four departments were established, the branches were reduced to eight and some of the departments were enlarged by converting their sections into departments to be administered and supervised by Assistant General Managers.

Due to the need for specialized administrative skill to handle the further expansion in the business and banking activities, the diversification of the economy of the country, the increase in export and import trade, expansion in industrial and agricultural activities, the increase of the foreign investment in the Sudan, the increasing requirement to get foreign currencies to finance the development plans, besides the associated requirement for national currency and the increasing dependency of the Government sector on the central bank, the other two General Managers and the eight Deputy General Managers were recruited. These movements resulted in the organizational structure reflected by Fig. 4.3.1.

The Bank of Sudan is a line-staff organization based on an assignment of roles while maintaining a hierarchy of line authority^{*}; it allows not for functional supervision but for functionalized staff departments working through a line supervision. The Departmental Managers and their staff jointly retain the complete responsibilities for end results.

4.4 OBJECTIVES AND FUNCTIONS OF CENTRAL BANKING

Central banking is an entirely separate branch of banking as distinct from the function and operation of commercial banks, specialized banks or savings banks. Central banks developed their code of rules and practice which can be described as the art of central banking (De-Kock, (1954)).

Before the twentieth century there was not a clearly defined concept of central banking. The traditional concept of central banking as embodied in the structure and practices of old established banks - for example the Bank of England - has passed through different stages of evolution, in the course of which their function and responsibilities underwent a transformation that had not been envisaged

* For type of organization see Woodward, Industrial Organization Theory and Practice (London, Oxford Press, 1965).

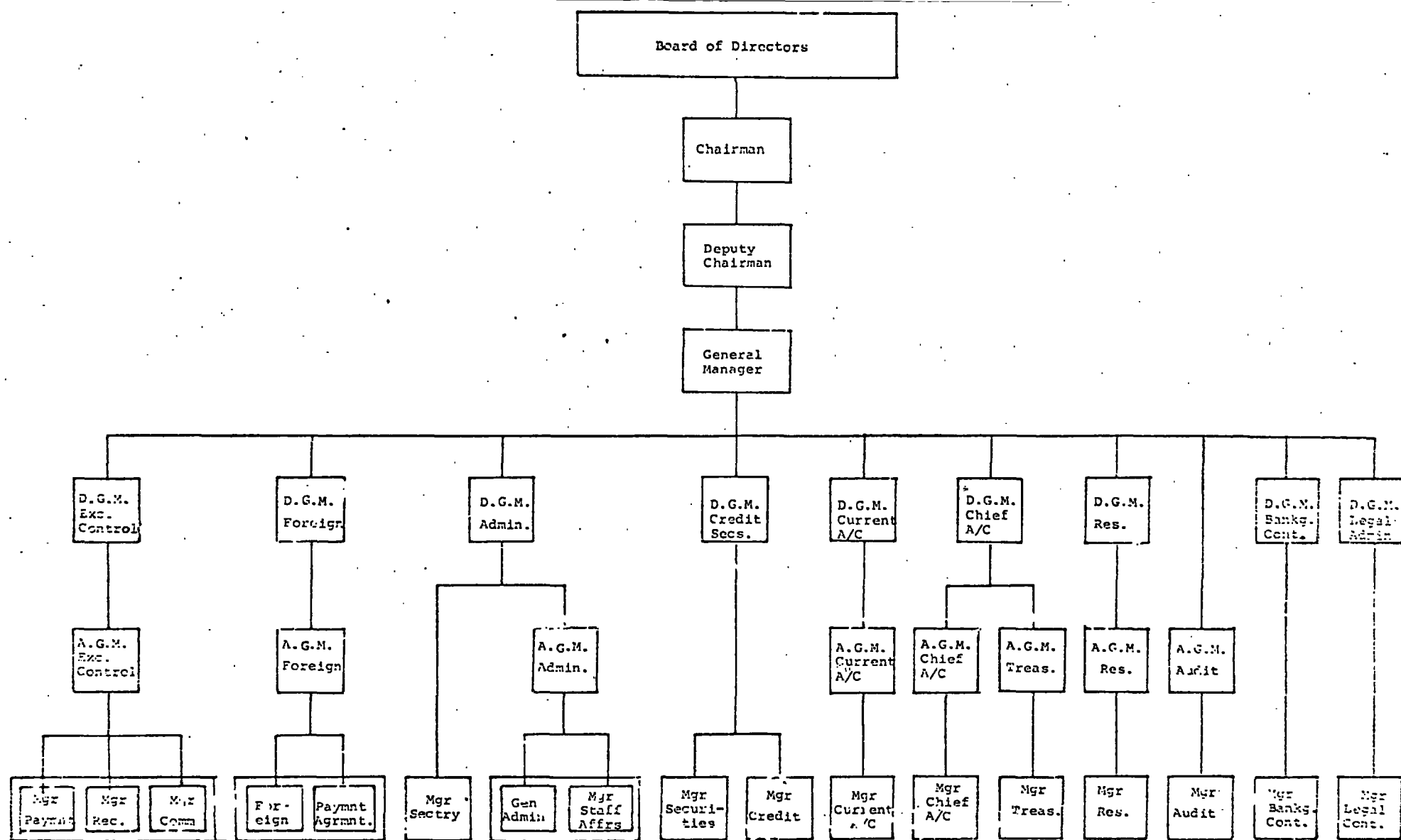


Figure 4.3.1. Organisational Structure of Bank of Sudan

in their legislation (Basu (1967)).

The scope of the objectives of central banking has been considerably broadened in the statutes of the central banks established after the great depression of the thirties and World War II. There was stress on the relations of the central banks with the Government, the public and financial community, the role of the monetary reserves and monetary control as well as the attitude towards economic development of the respective country (Cobbald (1962)).

The legislation of these banks specified general monetary and economic aims and at the same time listed other functions, namely

- (i) Regulation of issue of notes and coins
- (ii) Assistance in the development and maintenance of a sound monetary credit and banking system.
- (iii) Preservation of the external stability of the national currency and maintenance of external reserves to safeguard the international value of the currency.
- (iv) Banker and financial adviser to the Government.

Most of the banks in developed and developing countries show a tendency in practice to conform to or work to almost identical patterns in respect of the listed functions (Hoss (1972)). The difference in practice is a matter of degree and kind governed by the stage of economic development of the country ; its volume and variety of material resources ; the make-up of the country's banking and credit structure ; the nature of its international financial relationship ; its capital and money market (De-Kock (1954)).

4.4.1 Stated Objectives and Functions of the Bank of Sudan

The objective of the Bank of Sudan, a central bank of a developing country, stressed the importance of promoting economic development : "The principal objects shall be to regulate the issue of notes and coins, to assist in the development and maintenance of a sound monetary, credit and banking system in Sudan with a view to

the orderly and balanced economic development of the country and the external stability of the currency and to serve as Bankers and financial advisers to the Government" (Act of Bank of Sudan, Section (5)).

The achievement of these objectives entailed with it a list of functions to be done by the Bank of Sudan, and these include :

- (i) Issue of legal currency and provision of the market with adequate supply of money.
- (ii) Pooling of the country's foreign exchange reserves and maintenance of its level.
- (iii) To be Banker to the Government and collaborate with the Treasury in the financial policy with the specific view of protecting the value of the currency.
- (iv) Supervision of the banking system to influence the credit situation, with the view to maintain monetary stability and adapt credit systems to the economy's needs.
- (v) Promote and mobilize domestic savings.
- (vi) Maintain equilibrium in the balance of payments and stability of exchange rate.
- (vii) To encourage the development of an efficient money and capital market.
- (viii) To further the orderly and balanced economic development of the country.
- (ix) To diminish inter-regional social imbalance in the country.

These functions are stated in the Act of the Bank of Sudan which stated other functions not to be taken by it, besides their legality and limitations. The manual of the Bank of Sudan described in detail the operations to be undertaken by the employees to put these functions into practice. These include the collection of transactions, the channel through which they are transmitted, the

process to be undertaken at the several points of this channel, the extent of the responsibility of the employees at these points, the information to be generated, etc. During the years of its operation the Bank of Sudan acquired more techniques to increase its efficiency to make its function more effective to meet the demands of its clients and preserve their rights within the Act.

4.4.2 Social Objectives of Bank of Sudan

While the manual of the Bank of Sudan defines the operations and tasks of employees to put the objectives into practice, the qualifications and skill required to do them, the manner and attitude in handling them, the internal records of the Bank of Sudan and the terms of service reflect what the Bank offers to these employees in doing their jobs.

Secondary school leavers and university graduates are recruited for service in the Bank of Sudan after written and oral examinations to select them, the former for clerical jobs and the latter for executive posts. University graduates are enlightened on the nature of the business of the Bank then attached to the several departments of the Bank. After two years' service all of them will be in permanent service. They are mobilised within the departments and the branches of the Bank, which allows them the chance to know more. The employees are promoted according to their performance, length of service, behaviour and educational qualifications.

The payment system is on monthly basis to be increased annually on recommendation of the Managers and/or promotion. For future financial security the employees are asked to join the provident fund scheme which will be converted to pensions in the coming few years. The other financial support includes housing allowances, transport, loans to build houses and buy cars, medical treatment charges etc. There is a bonus paid to the employees at the beginning of the financial year.

Employees are sent regularly on educational and training courses to acquire more knowledge to help them to do their job efficiently. There is a banking institute to teach the employees of the banking system banking and monetary affairs.

It is managed and sponsored by the Bank of Sudan.

Most of the jobs in the Bank of Sudan are identified as including variety, responsible autonomy, some degree of challenge and varying cycle length. The jobs of an accountancy nature are less interesting due to the many varieties per transaction or the large number of transactions per head. The statistical jobs are even worse because of the limited variety and too much finishing and starting.

Generally the clerks of the bank disliked the pressure to which they are subjected. There is stress on quantity and quality and demand for reports for decision making without the provision for them.

Inside the bank the job-satisfaction varies within and outside the departments, but compared with other public entities, the Bank of Sudan is one of the most attractive careers to potential recruits of high quality. The Bank is in a professional service and problem solving role looking for staff with an appreciation of professional ethics and with a good all-round problem solving ability.

The Bank of Sudan does not serve individuals directly. Apart from the collection of cheques drawn by units to individuals, all of its transactions are either through the commercial banks or through the government units and public entities, the authorised representatives of the people. The rights of the public at large is preserved through the services to be offered to the banking system and public sectors.

4.5 OPERATIONAL ACTIVITIES OF BANK OF SUDAN

On functional bases, the operational activities of the Bank of Sudan come under the following :

- (i) Foreign exchange operations and reserves.
- (ii) Banking and agency services for the central government units, public entities and boards.
- (iii) Banking services, control, supervision and support of the commercial banks.

(iv) Payroll and personnel activities of the employees of the bank.

4.5.1 Foreign Exchange Operations and Reserve

The services under this functional area are offered to individuals through commercial banks and to government units and public entities. They include :

(a) Approval of visible and invisible payments and receipts :

These include import and export trade, payments for private loans, travelling purposes, insurance, commission, foreign investment in Sudan and its profit, etc. "Bank of Sudan carries out as agents such functions and duties relating to control of foreign exchange transactions as may be authorised by the law" (Act of Bank of Sudan, Section (38)).

(b) Payments and receipts of foreign currencies based on the approved forms in (a), besides the receipts and payments of foreign loans and their related obligations on its behalf and on behalf of the central government and public entities.

(c) Availability of foreign exchange currencies to settle foreign exchange transactions.

(d) Audit of the operations in (b) against the approved forms of (a) above.

(e) Control of the level of foreign exchange currencies in the hands of the commercial banks.

It is the responsibility of the central bank to see that the foreign reserve of the country is adequate for the requirements of the country. There are four categories of reserve adequacy and these are (I.M.F. Staff Paper (1953)):

(i) Enough to enable a country in bad years by resort to restriction to maintain its external debt payments and to purchase the goods and services necessary to avoid hardship to its population or dislocation to its economy and the possible emergence of an

exchange crisis, i.e. to permit a reasonable distribution over time of the payments which it can afford to make over an entire cycle.

- (ii) Enough to maintain currency convertibility barring a severe depression but with occasional necessity to resort to trade and exchange restrictions for balance of payments purposes.
- (iii) Enough to maintain currency convertibility barring a severe depression but without the necessity for occasional resort to trade and exchange restrictions.
- (iv) Enough to maintain currency convertibility even through severe depression, without either the necessity for occasional resort to trade and exchange restrictions or the necessity for resorting to domestic deflationary policies for the purpose of restraining imports.

There are determining factors for this adequacy level. The central bank must be able to acquire information about them, and these are :

- (a) The normal seasonal variations in the country's imports and exports and in the service items in its balance of payments.
- (b) The extent to which the volume of its imports and exports is subject to extraordinary variations because of natural or other factors such as crop failures, political or economic changes elsewhere, etc.
- (c) The variability in the prices of its imports and in the prices of and demand for its exports.
- (d) The extent to which the country is dependent on imported raw materials, equipment and essential foodstuffs to avoid dislocation of its economy or undue hardships to its population.
- (e) The size of its inventories of export goods and their components and of import goods and their products, and the extent to which these

inventories could be compressed without hardship in the event of pressure on the country's reserves position.

(f) The extent to which the country may expect adverse changes in its reserves position to be offset by equilibrating movements of short-term credit.

(g) The prospect that the supply of reserves can be supplemented by grants-in-aid or long-term loans from other countries or financial institutions.

There are also social and psychological factors that affect the level of reserves, namely the confidence of the people in the country's situation. The less the confidence in a country's situation the more is the desire to stockpile beyond ordinary requirements, the more stress on the level of adequacy at a given time (I.M.F. Staff Paper (1953)).

This functional area involves the operational activities of:

- (a) The three departments of the exchange control which are :
the Receipt, the Payments and the Commercial departments.
The three of them approve foreign exchange transactions.
- (b) The Foreign and Documentary Credit and Payment Agreement departments
They pay in foreign currencies on behalf of the central government, public entities and boards, and collect any foreign currencies that accrue to them. They are responsible for the level of foreign reserves and availability of foreign currencies.
- (c) The Audit department Foreign Exchange section. It controls the Payments and collections in foreign currencies other than export effected by the commercial banks. Also, they follow weekly the level of foreign currencies in the hands of these commercial banks.

The present manual system of this functional area failed to provide

information for control and planning, for decision making and operating staff. The system is unable to cater for the factors that influence its functioning, or the factors that influence the foreign reserves of the country, although data elements for this information are available inside the bank. It has been a subject for criticism by many people of different classes due to the difficulties they face to get imported commodities or transfer foreign currencies for other purposes.

The policies of the bank concerning the import trade are dictated by the Ministry of Finance and National Economics (MFNE). The MFNE is responsible for the availability of imported commodities inside the country and the Bank of Sudan is responsible for the payments for these commodities. The MFNE estimates the amounts based on the need of the people, while the bank pays according to the availability of the foreign currencies. The MFNE approves the import licences and the Bank frank them. Without this action of the bank, the importers cannot pay. Up to the early seventies the bank used to keep the import licences if there were difficulties in foreign currencies. It only franked them when there were possibilities for payments. Due to pressure from the MFNE the bank began to frank the licences even if there were difficulties of foreign currencies. When the importers approach the commercial banks to pay on their behalf they refuse because they are short of foreign currencies. Sometimes they accept to pay on a specified date. When they apply to the Bank of Sudan to supply them with foreign currencies, the bank either rejects their application or suspend them, due to which they pay interest on delayed payments. This creates discrimination among the importers as the commercial banks accept to pay on behalf of some but not others. It helps in creating black-market for essential commodities. Importers apply for import licences for specified quantities of a commodity. When they get it, they import part of it to sell at higher prices - restricting supply and increasing demand.

The non-availability of foreign currencies, the pressure of the MFNE, the attitude of the commercial banks and importers, the demand for foreign currencies for other purposes all together press on this functional area to change its system to acquire information to help the planners to do something. Import trade represents over seventy-five percent of foreign exchange payments. In the next few years Sudan will start to pay the instalments of several loans being borrowed during the early seventies. This, as well, will influence the foreign reserves of the country.

The position is more aggravated by export trade, the methods applied to control the collection of export proceeds, and the difficulties of acquiring information about export proceeds to help in planning for demand for loans and their payments. Export trade increased due to diversification in agricultural production and the international demands for them. The restriction of import trade and other payments and absence of effective control stimulated the exporters to reserve part of their export proceeds in international financial institutions. The need to import commodities without transferring foreign currencies to pay for them encouraged the barter trade between Sudan and other countries. Before the seventies this method of trade was allowed for commodities which are not demanded internationally. In those days it went further and included the commodities that can be sold for foreign convertible currencies. Most exporters became importers and vice versa. This makes it more difficult to fulfil the other obligation to be paid from the export proceeds, namely foreign loans for development processes.

The inability to produce information for planning, the absence of effective control procedures or link between the department that approves the payment and receipts and the department that effects the transfer in foreign currencies are the main problems of this operational activity.

The Exchange Control Receipt department is concerned with the approval of export trade and control of proceeds, the Payment department approves payments on

predefined rules, the Foreign department pays according to the approved forms from the available foreign currencies. When the latter faces shortages, then the problem arises and the search in international markets for loans is the only way out of this problem. There is no co-operation or communication between these departments.

In the last few years the demand for loans is at an increasing rate. Associated with it is an increasing interest to be paid. The Bank of Sudan is a central bank of a developing country in its early stages of development. It is very dependent on international governments and institutions to support it with foreign currencies to meet its obligations. If the confidence of these governments is disturbed because of the inability of the Bank of Sudan to meet its obligations, this will create difficulties, namely dislocation of the economy and undue hardship to the population. It becomes the responsibility of the decision makers to estimate how much to demand, when and how to repay it. They cannot do it if they have no information to support their planning role.

The stimulating factors for change in the information systems of this functional area are the following :

A. Management Control

- (i) Management control system is not receiving information to support its control function related to export and import trade.
- (ii) Management is not in a position to evaluate alternative courses of action because information is not available.

Even if it is available, the mathematical and statistical techniques are not applied in the planning process.
- (iii) The illegality of many operations, especially the attitudes of importers and the commercial banks and the exporters with the collection of proceeds.
- (iv) The absence of interdepartmental links and communication, which are needed for planning and control.

- (v) The increase in business transactions and the activities of the bank without a significant change in the information systems to cater for it.

B. Cost of Operation

- (i) The main cost of these operations is the increase in the interest to be paid to get loans to finance the obligations. The public sector units developed the habit of approaching international financial institutions to supply them with foreign currencies. By law these units pay their obligation in foreign currencies through the Bank of Sudan. On the specified dates of payment they just send to the bank departments to effect it, provided that they have not notified the bank before. These amount to millions, which is difficult for a central bank of a developing country to have whenever required. Accordingly the bank seeks loans from international markets. It accepts the offers within certain limits, which are normally higher than the prevailing rate of interest, and hence the cost. Also the approval of payment transactions without relating them to the available resources of foreign currencies has its implications.
- (ii) The increasing demands for reports by decision makers make it necessary for the department, sometimes the sections, to appoint one of the staff to prepare them. This is associated with an increase in operating costs and duplication of efforts.

Within the coming ten years the Bank of Sudan will start to pay loans and their obligations being borrowed during the early seventies. The implication of this will be a reduction in the level of import trade and further restriction on payments for other purposes. Either the Sudanese accept severe cuts in the imports of less essential commodities so as to enable the central bank to pay for

the import of industrial equipment and raw materials, or they will face stagnation in the economic activities, especially the ones that depend on imported commodities.

The Bank of Sudan and the MFNE cannot do this by just asking the people to accept it. It must be supported by information and plans to state the obligations in foreign currencies, the commodities to be imported, their values and seasonalities, the export trade, its directions, the media of payments and stress the importance of collection of proceeds. There must be policies to be followed by exporters and importers. There must be co-operation between the MFNE and the Bank of Sudan. There must be links between the approving authorities and the ones that effect the payments. This can only be achieved by an information system that furnishes the bank and the MFNE with the required information.

4.5.2 Banking and Agency Services for the Central Government Units, Semi-Government Units, Public Entities and Boards.

In being a banker to the government units, public entities and boards, the responsibilities of the Bank of Sudan range from the stage of keeping their accounts payment and collection of their money, lending and credit facilities, to their availability of foreign currencies to settle their obligation or collection of foreign currencies on their behalf.

Listed below are the operational activities within this functional area and their legislative basis :

- (i) Banking accounts: The Bank of Sudan accepts the cash deposits of these units, cheques or drafts, and undertakes the collection of the cheques and drafts drawn on other banks ; it supplies them with the cash required for salaries and wages and other cash disbursements, and also debits their accounts with the amounts of cheques or vouchers drawn by them on it and presented for payment by other customers. It transfers funds for the government from

one account to another or from one centre to others

(Bank of Sudan Act, Sections (52-53)).

- (ii) Loans and advances: It grants them with temporary advances to help them to finance their projects (Sections (57 and 57A)).
- (iii) Agency services to the government: It regulates the issue and management of government loans publicly issued in the Sudan. It took over the services connected with the distribution of its securities, etc.
- (iv) Foreign exchange operations: The Bank of Sudan provides these units and pays and collects on their behalf foreign exchange currencies required for their external debt services and purchases of goods and other disbursements abroad. It buys any surplus foreign exchange currencies which may accrue to them from foreign loans and from other sources.

The central bank operates as the government's banker not only because it is more convenient and economical to the government, but also because of the intimate connection between public finance and monetary affairs (De Kock (1954)). The state is in every country the largest receiver of revenue and has in most countries become the biggest borrower. Its expenditure has come to play an increasingly important part in the economic life of the nation. The central bank on the other hand is charged with the duty and responsibility of controlling and adjusting credit in the national economic interest and carrying out the monetary policies adopted by the government. As the manifold financial activities of the state can in certain circumstances disturb the credit policy of the central bank, the centralisation of government banking operations in the central bank at least gives the latter a better opportunity of judging the general financial situation at any time, giving the appropriate advice to the government, and taking necessary remedial measures.

Since the late sixties and the early seventies there is an increasing reliance of the central government and public entities on the Bank of Sudan for accommodation. In 1966 their borrowing from the Bank of Sudan was LS16 millions, by 1971 it amounted to LS101 millions, and reached the level of LS300 millions by 1975. Associated with it is an increase in the number of cheques and drafts of these units and the number of accounts as well, due to increased numbers of Ministries and other public entities. Owing to the magnitude of the public sector's financial operations, the keeping of the public sector banking accounts entails an enormous amount of clerical work and expense. The operational activities within this functional area are shared between several departments. While the Current department approves payments and collects funds by the settlement of accounts through cheques and drafts, the Treasury department pays and collects in cash and regulates the issue of notes and coins ; the Credit department arranges for loans to the public sector other than central government after consultation with the Current department and takes the sole responsibility of lending to the commercial banks. The Security department arranges for borrowing facilities to the government from the commercial banking system and financial institutions through the sale of securities ; the Foreign and Documentary Credit and Payment Agreement departments take the responsibility of payments and collections in foreign exchange currencies. The resulting transactions of these departments are pooled in the Chief Account department to post them in ledger cards, statements of accounts, and the different monetary reports of the Bank of Sudan.

In the ten years since 1966 the number of financial and account transactions increased by 106% from 13,727 during 1966 to 28,232 in 1975. Despite this massive increase, there was little or no change in the manual and mechanised account systems of the Bank of Sudan. The work content and control procedures increased as well. This state of affairs resulted in a high level of pressures on clerical staff of the Current and the Chief Account departments.

Facing an increasing number of transactions, delay in arrival of financial

transactions due to length of processing cycle and control points, many processes per transaction, pressure of management to finish the business by the end of working hours, old machines in the case of the Chief Account department and loose-leaf ledgers of the Current department, the employees of these two departments are dissatisfied. These factors reduced the attraction of these two departments as a career to potential recruits of high quality.

4.5.2.1 Stimulating Factors for Change

The main factor in this functional area is the morale of staff due to the following:

- (i) The increase in the number of transactions without an increase in the number of staff.
- (ii) The stress to finish the work in spite of the added control procedures within the limited number of hours during the day.
- (iii) The demand for higher accuracy level and speedy processing provided old machines and equipment and increasing rate in business transactions.

Operating Cost

- (i) The maintenance cost of old machines.
- (ii) The cost of operators waiting for limited number of machines during the working hours.
- (iii) The overtime cost of the operators when they are kept to finish the work after the working hours.
- (iv) The cost because of duplication of many processing procedures which are meant for higher accuracy level and control.

Others

The need for feasible systems to contain the rise in the number of transactions without pressure on staff.

4.5.3 Banking Services, Supervision and Control of Banks

The operational activities of this functional area involves the policies of the Bank of Sudan towards the commercial and specialised banks and financial institutions. The central bank is a banker of these banks. It offers them similar banking facilities to those that they themselves render to their own customers. These include the following :

- (i) Custodian of their cash reserves: These banks and institutions keep their cash except till money requirements with the Bank of Sudan. They draw currency from it and pay in surplus as it accumulates. They accept fully and unequivocally this position of the central bank on condition that the central bank is not to compete with them in their commercial activities. The centralised cash reserve is used as a measure of control over the banking system. There is a provision of minimum reserve to be kept by the commercial banks in the Bank of Sudan. The Bank of Sudan is empowered by act to make changes in the minimum balances of the commercial banks with it and hence the control of the amount of facilities allowed to them (Bank of Sudan Act Section (44)).
- (ii) Lending policies and credit facilities : The Bank of Sudan grants to these banks loans, advances and overdrafts against the collateral of exchange or promissory notes drawn or issued for commercial, industrial or agricultural purposes and the warehouse warrants or any other documents securing sole possession of goods issued in respect of staple commodities or other goods duly insured (Act Section (41)).

The significance of this function lies in the fact that it increases the elasticity and liquidity of the entire credit structure. It provides the commercial and specialised banks

and other credit institutions with additional or alternative means for the conversion of certain of their earning assets into cash when their cash reserves are adversely affected.

It allows the Bank of Sudan not only to retain but to extend control of the internal credit system, thereby re-enforcing the instruments of monetary control (Fleetwood (1964)).

The Bank of Sudan charges different rates for such facilities, depending on the nature of documents to be discounted or pledged (Bank of Sudan Act Section (42)). The application of multiple and discounting rates is to help the Bank of Sudan to allocate credit among different sectors rather than use it as a weapon for controlling the volume of credit (Basu, (1967)): Also to direct the credit facilities to serve the requirement of development processes.

The intention behind discount by the central bank was that no sound and genuine business transaction should be restricted or abandoned merely on account of shortage of bank cash. Since the sixties and up to the seventies the Bank of Sudan policies restricted banks' advances to finance import trade. This was to ensure the availability of these funds to finance export trade, industrial and agricultural projects. During this period most importers directed their business to export trade and other business activities. They applied for loans to finance the less restricted activities ; when they got them, they utilised them to finance import trade. Other businessmen went further by utilising these loans to buy houses. Another group of businessmen developed the habit of approaching several commercial banks to finance one project. This attitude resulted in delayed payments and the failure to pay.

To restrict the use of credit, and control its level, the Bank of Sudan asked the commercial banks to submit for approval any advances to their clients that exceeded certain limit. This policy has its consequences on the business level of the Credit department. The commercial banks concentrated their branches in few towns. This resulted in social imbalances. While some groups of people have several banks to bank with, others - especially rural populations - travel hundreds of miles to get such services. Others hoard their savings because there are no banks to deposit them with. This influenced the size of currency circulating and deprived the banking system of the use of such funds. It is one of the functions of the central bank to mobilise the savings and encourage it to help in development processes by directing the commercial banks to establish branches in rural areas.

The other banking facilities offered to the commercial banks are included within the banking system of the Bank of Sudan that comes under the scope of the Accounting departments of the Bank of Sudan stated in Section 4.5.2. above.

4.5.3.1 Stimulating Factors for Change

Besides the stimulating factors for change that come under 4.5.2.1., the Bank of Sudan needs to know about the level of the advances to be offered to the commercial banks and the advances of the commercial banks to their clients, the indebtedness of businessmen from the banking system cumulatively, and the purpose of these advances. Already the Bank of Sudan has acquired the required information but not yet processed because of manual sorting and processing.

This information as well will help in planning the distribution of credit facilities between rural and urban populations. This is the main social role of the Bank of Sudan towards the population of the country related to credit facilities.

4.5.4 Personnel and Payroll System of the Bank of Sudan

Under this functional area comes the social objectives of the Bank of Sudan stated in Section 4.4.3. The operational activities include :

- (a) The staff of the Bank of Sudan's several departments and branches
- (b) The payroll that involves salaries and wages and other financial allowances and needs.
- (c) The operating costs of the Bank of Sudan.

The operating cost due to clerical activities involved in these operations and the inability of manual processing to cater for the rights of the employees are the main objectives to be considered by any system change.

The managerial policies of the Bank of Sudan penalise the work of these departments due to the concentration of decision making related to staff in the hands of senior management. This managerial attitude developed as a result of the inefficiency of the department in handling its functions, especially the personnel side of it. The department has no say in the mobility of staff, neither their recruitment, and hence its weakness.

Computer processing may change the efficiency but it cannot be said that it will influence the management policies.

In most business organizations, computer processing comes to be known through this functional area. Figure 4.5.1 is the network of the present information system of the Bank of Sudan.

4.6 CONCLUSIONS

Taking the functional areas of the Bank of Sudan together, the stimulating factors for change in the information system are the following :

- (i) The weakness of the accounting system to contain the increase in business transactions without an immediate addition in number of staff, offices to accommodate them and new machines to replace the old ones.

During 1973 the Chief Account department was subjected to study due to delay in posting the transactions in the statement of accounts and production of monetary reports.

The study revealed the following:

(a) While in the last five years of the sixties the rate of increase in number of transactions was approximately 23%, during the first three years of the seventies it was about 41%.

(b) While the machine operator was allowed 46 seconds to process a transaction, now only 23 seconds are allowed to process the same transaction.

(c) The machines are old, some of them expired their working life and are still in operation.

(d) No addition was made to the number of machine operators since the sixties.

These are the other findings:

(e) The absence of motivating factors. The machine operators continue to operate the machines until they leave the bank. They are not allowed to compete for other clerical jobs in the bank.

(f) There is discrimination against them. The clerks of the bank and machine operators are secondary school leavers. The former are promoted due to which their salaries increase. For the machine operators there is a maximum which is less than the maximum of other clerical activities ; once they reach it, they will not expect any future increase in their salaries. About 80% of them reached that level several years ago.

(g) The work with the machine for more than ten years resulted in serious illness to the machine operators. The doctor of the bank

advised the management to rotate the machine operators to save their health.

Besides the increase in business transactions, the unhealthy working conditions and job dissatisfaction work to reduce the efficiency of the machine operators and posting staff.

- (ii) The presence of job dissatisfaction and absence of job satisfaction within the clerks of the Accounting departments, namely the Current and Chief Account, the absence of job satisfaction within the coders of the Research department. For the former it is due to the number of transactions, the many processes per transaction, and managerial demand for efficiency and accuracy. For the coders it is due to repetition of the action hundred times per day and the future of coding jobs within the bank.
- (iii) The need for relevant and timely information to support the control role of the staff within the Foreign Exchange departments and production of reports to help in planning and decision making that involves foreign exchange currencies and adequacy of foreign reserves.

The solution to these problems is believed to lie in the application of electronic processing to serve the several functional areas of the Bank of Sudan.

CHAPTER 5

APPLICATION OF THE APPROACH TO SYSTEM ANALYSIS

5.1 INTRODUCTION

The approach to system and social analysis of Section 2.3.1 will be applied in this chapter to analyse the Export Trade system of the Bank of Sudan.

This process involves:

- (i) Detailed studies of the mode of operation of the existing system to be computerized or affected by computer information processing.
- (ii) Diagnosis of the human problems, i.e. social analysis within the user departments.

This study is initiated by the author who is a member of the EDP section of the Bank. The section was established in 1969 to computerize the account system of the Bank. The attempt failed in the first few days. The non-availability of skill to plan the development of the computer based system or evaluate it as well as the approaches followed by the planners in these two processes might have been the main factors for the failure.

There is an increasing demand for information among senior staff and managers to support their control and planning functions. The management of the Bank is still considering the introduction of computer information processing as a solution. They are in favour of a project to be a base for future plans. They do not want to start with a project that involves the purchase of a computer technology as they have in mind the failure of the first attempt.

Having these problems in mind and supported by the literature written and research done in developed countries about the development and evaluation of computer based management information systems, the author initiated the study.

A top-down approach was followed in this analysis process. The discussion started first with top managers, followed by middle managers, then operating staff.

From the discussion with top managers it was possible to define boundaries of the system to be changed. The export trade information system is not only the information system of the Receipt department that approves export contracts and controls the collection of proceeds. Information about quantities and values of exported commodities, commodities and proceeds collected is processed by Foreign trade and balance of payments sections of the Research department respectively. Information about values of approved contracts, expected and actual utilization of contracts, collected and outstanding values of exported commodities is necessary for decision making process of the Foreign departments of the Bank. This information is required by the managers of the foreign exchange operation and reserve system and the top managers of the Bank. The change will directly affect the Receipt department and the coding section of the Research department. Accordingly, the detailed social and system analysis is confined to these two units.

The availability of processed information will influence the planning and control functions of the foreign exchange system top management. Their demands for information will be considered in the analysis and design processes of the export trade system and the influence of the available information will be considered on the evaluation process.

Beside the acts and manual of procedures of the Bank, procedures within departments, formal or informal, that evolved through the years, the method of fact finding included interviews of staff and managers, observation of procedures, collection of transaction samples operated on or produced by staff, generated reports for internal use, reports demanded by other departments, top managers or external organizations, and questionnaires whenever required. While studying

the sections, the members of staff and managers are asked to state the services to be offered by them and to whom the level at which they are offered, the difficulties that hinder them from achieving their own or the Bank's objectives, the volume of business transactions in normal and exceptional days, the resources they utilize, the actions they make and decisions they undertake.

After the discussions with the top managers of the Bank, the author asked for a meeting with the operating staff of the Receipt department. In the presence of their managers, the author stated to them the objectives of the study. The knowledge of staff members about computer information processing was limited to data processing. As a step in this analysis process, the author as well explained in detail the implication and capabilities of the technology in the field of management information systems. This included its consequences on clerical procedures, the influence of information availability on planning and control functions, the change in the structure of the organization that might result due to centralization of information processing to serve several operating levels providing several sources of elementary data, its influences on job requirements and satisfaction stressing the meaning of satisfaction, the costs likely to be incurred and benefits to materialize, etc. Also, the author explained to them the ETHICS and BASYC techniques in the design and evaluation respectively and why she selected these two techniques. This stage was finalized by a visit to one of the external EDP centres to see the technology, the way it operates to process data and produce information, the preparation of the data to feed it, etc. The stage was concluded by asking them to cooperate with the study team by supplying them with the required information. Disturbances of their daily business activities was kept to the minimum possible.

System analysis and design should be carried out by the members of staff within users departments supported by consultants specialized in economic, computer and social or behavioural sciences. This is necessary for the consideration of the economic, technical, social and organizational objectives, needs and

constraints in the design process (Land (1970), Mumford and Ward (1968), Mumford (1969)). In the case of the Bank of Sudan, the author was a consultant, analyst and observer, because the study was meant for her research.

The Export Trade system is a cluster of related activities within the foreign exchange operation and Reserve system of the Bank of Sudan. The analysis of the characteristics of the decision making process within the export trade system in the light of the demands which it places on the information system should be related to the foreign exchange system. This is necessary for the total system approach (Forrester (1961)). A general survey of the foreign exchange system reflects the environment under which export trade systems operate. This is necessary for the evaluation process based on the BASYC approach (Weir, Land and Hawgood (1975)).

5.2 BACKGROUND OF THE FOREIGN EXCHANGE OPERATION AND RESERVE SYSTEM

Sudan is a primary producing country. Its national currency is inconvertible. It depends on the export of agricultural produce to generate foreign exchange currencies. It is the object of the Bank of Sudan to see that these currencies are adequate to enable the country to effect commercial and financial transactions without difficulties, i.e. to maintain its external debt payments and to purchase goods and services necessary to avoid hardship to the population or dislocation to the economy. When the proceeds fall short of demand the concerned management in the Bank of Sudan or the politicians responsible for the economy of the country resort to foreign governments and international financial institutions for aid and loans to finance the deficit. In the last ten years the proceeds had never satisfied the minimum requirements despite the fact that there is restrictions on import and payments for service items of the balance of payments. The ever reliance on foreign loans resulted in their accumulation from one year to the other. Table 5.2.1 shows the receipts, payments and outstanding foreign debts.

TABLE 5.2.1:

Receipts, Payments and Outstanding Debts (LS million)

1966 1967 1968 1969 1970 1971 1972 1973 1974 1975

Total Receipts	84.6	90.7	62.9	106.4	116.8	127.0	133.1	174.3	161.8	183.0
Receipts from Export	74.0	77.7	87.9	92.4	101.8	110.8	116.3	158.1	139.0	147.9
Invisible Transactions	10.6	13.0	15.0	14.0	15.0	16.2	16.8	16.2	22.8	35.1
Total Payments	105.9	110.7	125.7	122.3	140.7	146.1	171.3	193.6	298.6	388.0
Payment for Imports	82.2	83.4	96.6	89.8	104.6	114.6	122.2	128.1	207.0	286.0
Invisible Payments	21.8	24.9	24.8	27.2	27.4	26.9	32.7	38.2	57.8	63.9
Loan Payments	1.9	2.4	4.3	5.3	8.7	14.6	16.4	27.3	33.8	38.1
Outstanding Official Loans	62.2	74.1	93.2	109.3	110.0	101.1	119.2	119.1	254.3	371.7

Sources: Bank of Sudan Annual Reports 1966 - 1975.

The implementation of the five year development plan which started in 1970 resulted in further drainage of the foreign reserves of the country. It was greater than could be accommodated by the available resources. On considering the 15%-20% ratio of debt servicing to export proceeds which indicates the sole limits of credit worthiness, in Sudan it is over the upper limit, 28% for 1975.

During these years there is change in social life reflected by variation in people's tastes and habits. It is associated with an increased demand for manufactured imported commodities and demand for foreign exchange currencies for holidays, education and medication in other countries. They increased the demand and competition for the available and expected foreign exchange currencies. Faced

with increasing demand and difficulties to get foreign exchange currencies, it was necessary for the monetary authority to introduce policies to encourage export trade and impose restrictions on the disbursement of these currencies. But most of the policies have been directed to the solution of urgent problems of short-term duration. For example, in the early seventies they allowed import for nil values, i.e. without exchange of foreign currencies. At the same time there are several snags in the export system. The businessmen know about them. It was very possible for exporters to make use of their foreign exchange proceeds or part of them to import on nil values. Although the policy released part of the pressure on foreign exchange directly, it resulted in a decline in the receipts from exports. The table below shows the receipt and value of exported commodities in the last ten years.

TABLE 5.2.2:

Value of Exports and Receipts (LS million)

1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 :

Value of Export	69.8	75.7	85.1	86.2	103.9	114.4	124.4	152.2	122.0	152.4
Receipt	74.0	77.7	87.9	92.4	101.8	110.8	116.3	158.2	137.4	147.9

Besides the pressure due to the scarcity of foreign exchange currencies, the non-availability of information for control and unawareness to apply modern mathematical techniques in planning or policy making resulted in maldistribution of these resources, hence more pressure on the expected foreign exchange currencies from export trade.

It is possible to solve some of these problems and reduce the pressure by processing information to support planning and control functions, but manual processing is never interesting, especially for the young impatient generation. At the same time control or planning without information, because of the limitation

of resources is frustrating for ambitious graduates who acquired education in the application of modern mathematical and statistical techniques in problem solving. It is the responsibility of managers in the Civil Service to provide them with jobs to satisfy their requirements and aspirations if they are to keep and attract them to their job. The introduction of computer information processing is one of the possibilities.

The foreign exchange operations and reserve system is an integration of the following sub-systems :-

- (i) Approval of export trade and control of collection of proceeds.
- (ii) Franking of import trade, approval of its payments and assessment of performance against approved forms for control.
- (iii) Approval of payments and receipts in foreign exchange currencies for invisible transactions, i.e. service items of balance of payments, and assessment of performance against approved forms for control.
- (iv) Payments and receipts in foreign exchange currencies on behalf of the public sector for transactions approved in (i)-(iii) above and others which are not subjected to approval such as foreign loans of the public sector.
- (v) Payments and receipts for approved transactions that come under payment agreement trade.

The system is responsible for policy making, planning and control functions related to the disbursement and collection of foreign exchange transactions, the value of which is round about LS 550 millions. There is no stress on information processing to support these functions. In the account system which is responsible for disbursements and collection of assets and liabilities, the value of which is round about LS 450 millions, there is a demand and provision for 100% accurate, and timely information. For example, the ratio of clerks to process information

to executive staff is 2:1 in the account system and 5:7 in the exchange system.

The functioning of the foreign exchange operations and reserve system is mainly concerned with the foreign exchange reserve of the country, its availability and book-keeping. With the exception of its book-keeping system and few reports to be produced as a by-product of this job, there is no structured sort of information network to be directly computerised. Most of the units under the system produce transaction documents that contain an action to be taken by other units or action taken to be assessed for control. For example, the receipt department approves the contracts and export licences. Based on these licences the commercial banks issue sets of export forms to authorise the exporters to ship the commodity. Based on a copy of these forms to be sent by the commercial banks to state that a given quantity is to be exported, the receipt department will make the required follow-up to control the proceeds collection that materialise. The commercial department franks import licences, the payment department approves the payments, the foreign departments pay on behalf of the public sector and the commercial banks on behalf of the private sector, and the audit department assesses the performance against approved forms based on these transaction documents. The information elements of these transactions as well as the action being taken refer to the factors that influence the foreign reserve of the country and its components. The information as such is not related to each other for planning or control function and there is no techniques to process them to serve these functions. Although the foreign exchange currencies available are limited, still the non-availability of information for planning and control functions resulted in inefficient utilisation of these limited resources. A change of this system is a typical exercise to modify information systems so as to create an efficient and effective control and planning system.

Although the systems have a basic objective to be achieved, there is no communication or interaction between them through processed information to

coordinate their planning and control function. The various information flows are unconnected and only at the very top, i.e. the level of decision making of the Bank, is a sort of overall picture available. Being processed for operational control, the information does not meet the requirements of decision making. In most of the cases, policies and decisions are based on intuition only. It can hardly be said that there is any planning based on information. This resulted in dissatisfaction to the groups of people who are involved for one reason or another in the functioning of this system. Through a computer based change it is possible to integrate the information flows and process them for planning so as to cater for the interest of the relevant groups.

In developing countries the non-availability of information for planning and control resulted in inefficient utilisation of their limited resources. At the same time the significant development cost of computer based management information systems to produce timely and accurate information is not encouraging them to make use of computer technology in administrative or business organisations. People in general are not technical oriented. Computer based information processing function is very slow. For example, in Sudan the first computer had been installed in 1967. By 1976 there are only five small computer centres whose main function is limited to clerical activities mostly arithmetical operations and calculations.

5.3 THE EXPORT TRADE SYSTEM

Although the Receipts department is fully responsible for the approval of export trade and control of proceeds collection in foreign exchange currencies, still the Research department processes the resulting information to produce export trade statistics and receipts for balance of payments reports. These reports are the basis for planning and policy making by top managers and decision makers of the Bank. It is more relevant to survey the export trade system than just the Receipt department.

The export trade information system is a cluster of the following related activities :-

(a) Approval of export contracts and licences by the receipt department.

(b) Follow-up of the collection of proceeds and its auditing for control, based on a set of export forms to be drafted by the commercial banks on behalf of exporters, also by the receipt department.

(c) Processing of data to produce export trade and receipts reports for foreign trade statistics and balance of payments to be analysed by the research department.

(d) Utilisation of information about expected proceeds by the foreign department in planning for the payment of obligations in foreign exchange currencies and policy making related to the control of the disbursements of these currencies as well as the export trade system.

Apart from (d) there are twenty two members of staff involved directly in control and information processing under the export trade system. Ten of them are executive staff who are concerned about the approval and implementation of policies of export trade. The other twelve are clerks including the coders of the research department.

Export trade transactions are originated by the approval of export contracts to be submitted to the Receipt department through the commercial banks of the exporters. The approval is based on the nature of commodity, the terms of payment, the quantity and the price per unit, hence the total value, the country to which the commodity will be exported, the period within which the commodity will be shipped, the validity of the contract, the insurance, the commission and other related conditions. The approval authorises the exporter to ship the commodity within a certain period after which either the contract is to be renewed or is invalid. In order to ship the commodity, the exporter has to present export forms to the customs station to be drafted by one of the national

commercial banks. The commercial bank prepares original and four copies of the export form, gives the original plus two copies to the exporter, sends one to the Receipts department and reserves one copy for its own use. These export forms reflect the information of the contract, but whether the whole or part of the quantity depends on the terms of contract. On the back of the copies the customs station states the quantity being shipped, the date of shipment and the destination. They return the original copies of the form to the commercial bank, send one copy to the Research department of the Bank of Sudan to generate export trade statistics, and reserve the other copy. When the commercial bank collects the value it states the amount being collected on the back of the original copy and sends it to the Receipts department. The Receipts department compares the amount being collected against the value of the shipped commodity. Also it compares the information on this original copy with the information on the copy being sent previously by the commercial bank. If the values are equal, then the Receipts department files the original and returns the copy to the commercial bank, otherwise they will question the commercial bank for justification. These procedures are shown by Figure 5.3.1.

There are several clerical activities involved in this job. These are:

- (i) Collection and registration of contracts when they are submitted for provisional approval. The registration is in provided books sorted by the name of the commercial banks.
- (ii) Recording of management remarks beside each contract in the same registration book, then despatch of the contracts to exporters through the commercial banks.
- (iii) Registration of the daily approved contracts in a book to reflect to the management the daily performance of the department. This is a duplication of (i) and (ii) above.
- (iv) Collection of export licences and contracts for final approval.

- (v) Registration of contracts and export licences when finally approved in the registration books of (i) and (ii) above.
- (vi) Copying of the information of the contracts and export licences when finally approved for future follow-up and control in a book.
- (vii) Filing of the original copy of contracts and a copy of the export licences.
- (viii) Filing of the letters attached to the contracts in a separate file.
- (ix) Despatch of the contracts and export licences to exporters through commercial banks.
- (x) Collection of export form copies from commercial bank branches, comparing them with export licence copies and filing them sorted by number in the name of these branches of commercial banks.
- (xi) Collection of the original copies of the export form, and their comparison with the copies being collected in (xi) above. Unfiling the copies and filing the original in their places.
- (xii) Preparation of requested reports to satisfy the demands of decision makers about the value of approved contracts or contracts of a specified commodity.
- (xiii) Collection of export forms to be sent to the Research department of the Bank, capturing their information elements to punch them in cards to be processed in an off-line system to produce export trade statistics and receipts for balance of payments.

Accumulation of contracts and export forms through the years is a major problem for manual control and informaton processing. The trade cycle that starts from the date of contract approval up to collection of proceeds takes a minimum of four months. The annual average of approved contracts is round about 12 thousand likely to be renewed several times. Export forms rise to 20 thousand annually. It is too difficult to integrate the information elements of contracts

and their related export forms for control and planning functions. They refer to the contract when there is dispute between the exporters and the staff. The control function is not fully implemented because the information required, although available, is not processed. The receipt department allows three months for the utilisation of contract and 45 days starting from the date of shipment for the collection of proceeds. At present they are not applying the 45 days target because they have no access to the transaction documents that state the date of shipment (refer to Figure 5.3.2. for the present network of export trade information system). These documents, i.e. export form copy 2 (E/F copy 2) are collected by the research department to process information for export trade statistics. There is no communication through information between the two departments. If processed to meet the requirements of the research and the receipt departments the latter will be in a position to know what contracts have been utilised, what proceeds to be collected and when. Under the present system the control function is based on the export form copy 4 (E/F copy 4) that arrives from branches of commercial banks to state that a given contract is expected to be utilised, and export form copy 1 (E/F copy 1) that reflects the proceeds collected. Every branch of commercial banks has the right to issue these export forms. Some of them send them in time, i.e. during the day or week of issue. Others send them when they accumulate after a month or more. Others do not send them. Being collected by the receipt department in a given sequence, manually it is easy to spot out if there is a set being issued but its copy, i.e. copy 4, has not been submitted. But whether the branches send these copies or not, there is no information to tell hence the snag in the system. Accordingly the information system is to be changed and modified to close such gaps.

The policies and decision functions of the management of the Bank of Sudan related to the regulation of export trade, plans for the payments of obligation in foreign exchange currencies are very dependent on the performance and information

of the export trade system. Most of this information is crude, not related, incomplete and not timely. In order to improve decision making, besides the skill, there must be better information, better decision models or decision procedures. The required change is to do the following :

(a) There must be information to relate approved contracts and the set of export forms relevant. This is necessary for control and reflection of performance of export trade for policy and decision making.

(b) The receipt department must be provided with information to apply the 45 days' target for proceeds collection. Further they must be able to tell about the capability and reliability of exporters in utilisation of the contracts and collection of proceeds. This is important for the foreign department and the management of the Bank. For example, if the exporters export say 80% of the quantities approved in the contracts and collect 90% of the value of shipped commodities, then it may be possible to estimate how much is expected from export trade. Also, if 60% of approved contracts are utilised within three months and 80% of their values are collected within two months, then it may be possible to tell about the performance of trade. Based on this information, the management of the Bank can decide how much to allot for payments of import trade, and service items of the balance of payments, how much to borrow and when, hence it is possible to reduce the cost of foreign debts.

(c) The commercial banks are responsible for the collection of foreign exchange currencies that materialise from export forms drafted by them. Also they initiate the control procedures when they send copy 4 of export form. It is the responsibility of the receipt department to initiate the control procedure. Instead of sending export form copy 2 to the research department, it is to be sent to the receipt department by customs station. In processing the information elements of these copies, by the

sequence of their number within branches of commercial banks the receipt department will be able to tell which set has been issued and by whom. Based on the relevant information, the receipt department will communicate directly through information with these branches for notification rather than depending on them to send the transaction documents, i.e. copy 4, whenever they want to, hence the receipt department will be in a position to initiate the control procedures.

(d) There must be information about each exporter to state his ability in utilising approved contracts and reliability in collecting proceeds. This information will be the basis for future cooperation with them. For example, if there is quota for a given commodity to be distributed to the exporters, the approval of contracts under this quota will be allotted to capable and reliable exporters more than others.

(e) The new modified system is likely to result in tight control for exporters in certain aspects. It has to make up for this by creating new benefits in others. Under the present system there are many clerical routines involved. For example, after the registration of the contract in the Bank of Sudan, the exporter submits an export licence to be approved first by the MFNE then later by the Bank of Sudan. For one reason or another the export licence is likely to be rejected. The procedure may take several weeks. It is possible to eliminate some of these clerical routines as a compensation for exporters. Further, it is possible to provide them with an advisory role about prices, markets and commodities to be exported.

(f) The required change will create the new task of data capture for processing and utilization of processed information in the control function of operating staff. If information is to be processed manually, it will be time-consuming and create social problems. Then comes the question of

data capture. The coders of the Research department undertake the clerical activity (xiii) above and it is mainly coding. This job, according to them, is never interesting and the clerks are not satisfied with it because there is no possibility to learn or acquire more knowledge. If they are asked to do more coding, this will increase the problem. If another coding section is to be established to capture information elements for control, there will be more staff with job satisfaction problems and duplication of effort and hence more financial cost. If the clerks of the Receipt department are asked to do their own coding, they are in immediate need of expansion. Accordingly, the information system to be designed is to maintain and increase if possible job satisfaction among the staff of the Receipt department and improve it among the coders of the Research department. The required information network of the export system is reflected by

Figure 5.3.3.

Electronic data processing should enable the respective system to create data-bases from which it can process information about exporters and their commercial banks. It will help in eliminating the clerical activities (iii) registration of daily performances (iv) copying of information of contracts (x) comparison of copies of export forms, (xi) comparison of original forms with the copy of the same set and (xii) preparation of reports to meet the demands of decision makers.

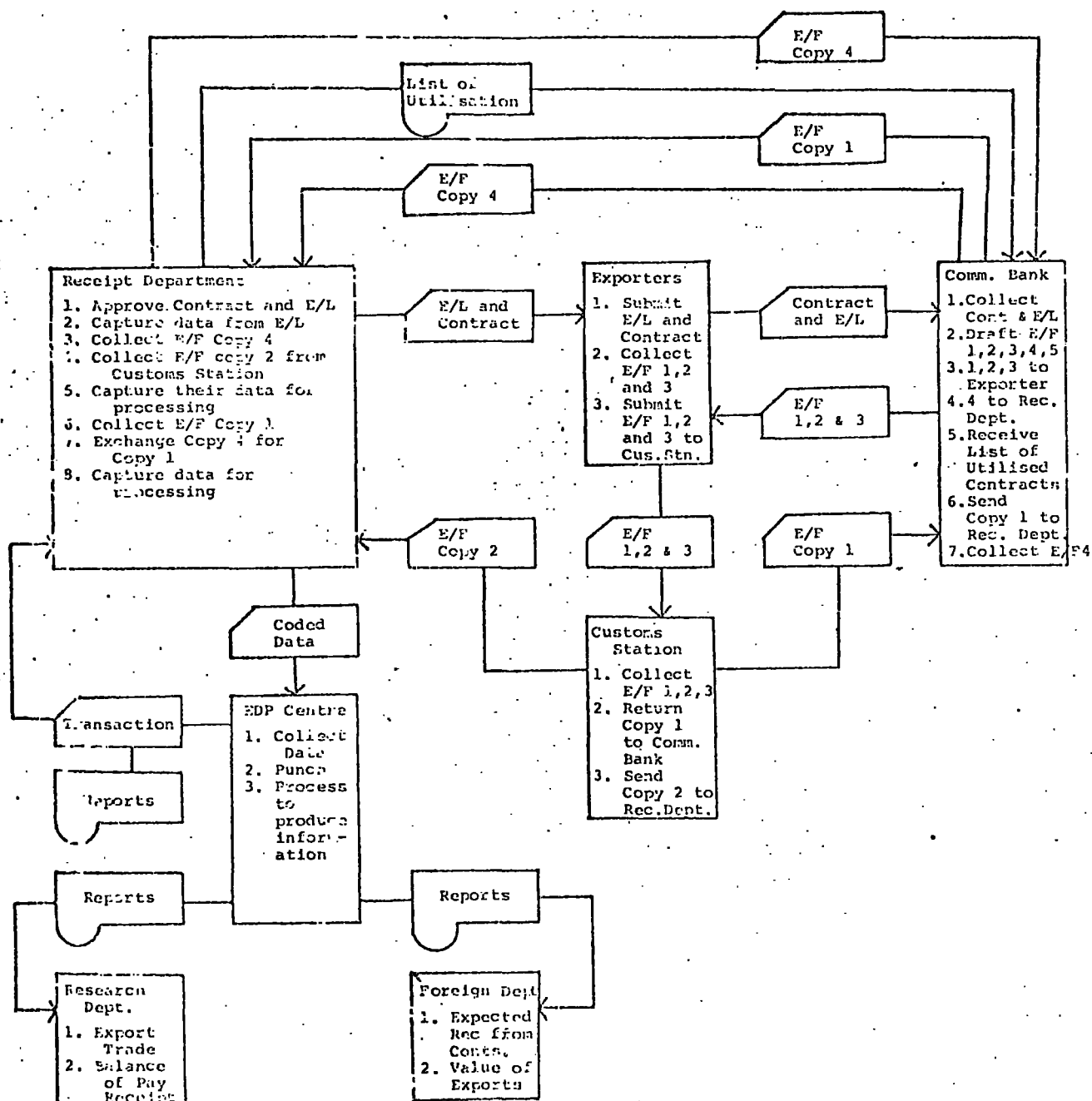


Figure 5.3.3 Alternative Network of the Export Trade Information System

5.4 SOCIAL ANALYSIS

The social analysis is necessary to find the variables that create satisfaction or dissatisfaction to members of staff to maintain or improve them respectively through systems design. While some of the variables reflect where the present policies seem to be working well and conditions are felt to be suitable, others show where some of these policies are not accepted by staff and working conditions are not healthy for them. The variables will also be incorporated in the evaluation process based on the BASYC approach to assess the contribution of the alternative systems towards the social factor or objectives of the Bank.

The detailed social analysis is based on a questionnaire about job satisfaction variables, attitude of members of staff towards change in general and change to computer information processing in particular. The author studied the questionnaire designed by Manchester Business School Computer and Work Design Research Unit (Weir (1974)). The variables under each contract area could be applied to this case of the Bank of Sudan. While some of the statements for several variables could be applied as well, others should be modified to suit the case. After modification, the questionnaire was translated into Arabic then presented to the staff members of the Receipt department and the coders of the Research department. Eighteen completed answers were returned which represented 82% response rate. (Appendix A is the questionnaire used in this analysis).

There are some factors that have their consequences on the fit between a member of staff's needs, expectations and aspirations against his actual job experience. These include age, sex, marital status, education, qualifications, status in the Bank and length of service. Questions about these were included as part of the questionnaire..

The policy of the Bank of Sudan in recruiting staff is to accept University graduates with degrees and school leavers who completed secondary school education

but sometimes intermediate school with certificate. Education level reflects qualification. Several attempts had been done to change the system of the Bank, to increase the efficiency and effectiveness. Manipulation of the structure through change of sections within departments or the establishment of new departments were the only means to achieve the objectives. Although there were more possibilities for promotion, hence status and financial rewards, still the employees especially in executive posts are not happy. This is reflected by the increasing rate of turnover among them. The author interviewed some of those who left the Bank to join other organizations, inside or outside the country. Some of them stated their dissatisfaction as the result of management style in allowing them to plan or control based on modern techniques. It has been stated by some of them that while there is increasing demands for the resources of the Bank, the resources are too limited to satisfy them so they need research, information to simulate their alternative courses of action. On the other hand, the decision of the senior management, which is based on their intuition, is one of the factors that supplant the effort of these employees. There is ever changing policies and decisions especially in foreign trade systems. While the change is necessary to cope with the variation in external and internal factors, still it had not been supported by the required information. This resulted in pressure on the staff and increasing criticism of the functioning of the Bank.

In Sudan there is an accepted assumption that public entities - the Bank of Sudan is one of them - are overstaffed, while the laws of the Civil Service do not allow management to get rid of their unwanted staff. The author does not accept this assumption because the investigation reflected facts to refute it.

Apart from the transactions that state action to be implemented by another unit or action taken by that unit, the entities assumed to be overstaffed process no information whatsoever to reflect their performance for control or planning. It is true that there are many clerks and executive staff who spend most of

their working hours idle. If information processing for control, planning and decision making is included as part of the clerical activities and if the executive staff are asked to plan and control based on the information, there will be an immediate need for additional staff to do the job. The management do not ask clerks to process information because of its social problems. Their decision and policy making are based on personal judgement only. In between the management and the clerks there are the executive staff who are responsible for the implementation of policy and decisions of top management as well as operational control and planning. Operational control and planning, unlike policy and decision making, require current information to reflect the performance. The non-availability of information is a source of dissatisfaction to those members of staff. The resources under the disposal of the members of staff are limited and there is increasing competition among the purposes to be satisfied by them. Faced with limited resources and non-availability of information to work out their alternative courses of action, these members of staff work on the principle of first in, first to be served. Once the resources are utilised, they stay idle waiting for additional resources to be distributed, but if there is information to support their distribution function, the number of staff will not be sufficient for the job. There is increasing frustration among them because there is pressure from different sources. The turnover among them in particular is increasing. For example, during the first five years of the seventies about forty of them left the Bank to join organizations in other countries. Instead of investigating the reasons for their turnover, the politicians had chosen the easiest alternative for them, i.e. introduction of new laws to stop emigration of educated people to other countries. The laws will not solve the frustration problem. The cost of inefficiency due to dissatisfaction might be higher for the organization. EDP should help in the solution of the frustration problem due to the availability of information. At the same time, information

processing based on a computer system might not result in negative consequences on clerks' satisfaction. It should contribute to it. Any change in the system or structure of the Bank without change in its information system is doomed to failure.

There was not too much significant variation in the results. Tables 5.1 and 5.2 are summaries of the variables that create satisfaction to more than 70% and less than 30% for members of staff respectively.

TABLE 5.4.1

Variables satisfactory to more than 70%

Variable Number	Variable Name	% satisfied
1	Variety of work task	82
2	Variety of documents and equipment	74
4	Variety in work space	77
9	Contact with colleagues	82
14	Errors to be picked up quickly	75
19	Visibility of work results	79
23	Quality standards	86
25	Feedback on errors	71
29	Skill required	71
38	Utilisation of abilities and training	75
48	Probability of regular pay rise	98
50	Manager's willingness to help with problems	72
61	Sense of achievement	73
69	Work interest	76
75	Responsibility for own efforts	93
77	Change of promotion	73
81	Being good employer	73
96	Bank as employer compared with outside firms	71
98	Team spirit in office	70
99	Co-operation in group	74

TABLE 5.4.2 :

Variables satisfactory to less than 30%

Variable Number	Variable Name	% satisfied
8	Freedom to work independently	25
28	Feedback on success	29
57	Management dealing with people	27
67	Suggestions about work	24
87	Emphasis on length of service in promotion	29
88	Emphasis on performance in promotion	27
89	Information about management decisions	29
92	Consultation about change	27
93	Significance of contribution to work of Bank	18

5.4.1 Detailed Analysis of the Results

Detailed analysis of the results is based on the main categories within the five contracts that define job satisfaction as well as the variables that reflect staff attitude towards change in general and change to the computer system in particular.

5.4.1.1 Task Contract

Task contract includes the following main categories :

- (i) Amount of variety which staff feel they have in their job.
- (ii) The extent to which they have autonomy in the way they do their job.
- (iii) The amount of contact they have with colleagues and customers.
- (iv) The amount of discretion they are allowed to exercise.
- (v) The degree to which they can clearly identify their own jobs.
- (vi) The quantity and quality targets they have to achieve.
- (vii) The amount and kind of information they get back about their performance.

The group of questions under task contract are concerned with the actual work done by the staff within the Export Trade System.

The task of six out of eighteen members of staff who returned the questionnaire is information processing. The work of the other members of staff is approval of action to be taken by another unit, statement of action being taken, or comparison of action against approved documents. Calculating machines are provided for data processing. There is an off-line system to process information to produce foreign trade and balance of payments statistics for the Research department.

Freedom to work independently and feedback on success are the only variables that create satisfaction to less than 30% of members of staff within these categories of task contract. Eight variables are sources of satisfaction to over 70%. Freedom from quality target scored the highest level, i.e. 86%. The satisfaction level for thought required to solve problems was marginal, i.e. 31%. 60% of staff are asking for less. The reliance on personal judgement due to non-availability of information and the negative consequences of many actions being taken by them is a factor that made them to ask for less.

Generally there is a high level of satisfaction. But if manual information processing is included as part of the tasks within this system, the author is expecting a low level of satisfaction. The presence of job dissatisfaction among the staff of the account system whose jobs are mainly based on manual book-keeping procedures and their demands to move to units within the foreign exchange operation and reserve system is an evidence to support the author's expectation.

The variables under task contract are sensitive to change of system in which technological innovation such as computer is involved. As there is a high level of satisfaction within this contract area, too much effort should

be devoted to design system alternatives in social terms to preserve and increase if possible this level of satisfaction.

The present system is acceptable because it does not include manual information processing. Manual information processing will not be accepted by executive staff or clerks in general. During the early seventies there was dispute between EDP centre and the account system of the Bank due to which the EDP centre refused to process information for the Research department. The managers of the Research department thought of manual processing as an alternative solution. On the third day the clerks who were asked to do it refused to proceed further. It was proof for the management of the Bank not to consider manual information processing any further. Besides its technical capabilities, computer processing is necessary to avoid social problems.

5.4.1.2 Knowledge Contract

The main categories under this contract include the following :

- (i) knowledge level
- (ii) opportunities for training
- (iii) use of potential

The percentage of satisfaction among these variables ranged from 33% up to 75%. The satisfaction level among executive staff from the use of potential variables was lower than the total. The executive staff feel that they are unable to apply their educational background although the training that they acquired in the Bank is fully utilised. They think that this will not help to contribute to the solution of the problems of the country in general and those of the Bank of Sudan in particular. They are acquainted with modern techniques and their application in planning and control, but the non-availability of processed information is not helping them to contribute positively to the objects of the Bank.

5.4.1.3 Efficiency Contract

This contract includes the following categories :

- (i) Policy and administration
- (ii) Payment policies
- (iii) Supervision
- (iv) Working conditions
- (v) Relationships

The dealing of managers with people is the only variable within these categories that creates satisfaction to less than 30%. At the same time the willingness of managers to help with problems scored a high level, i.e. 72%. This reflects one of the aspects of the social life in Sudan. Any individual who asks for the services of public entities has the feeling that he is the only person with problems to be solved. Instead of following business routine, they go directly to the managers. Those who contact the managers are friends or relatives of members of staff and through them these individuals know their way to the managers. The managers who refuse to discriminate among individuals are assumed not to deal well with people by their staff.

Probability of regular pay rises scored the highest level in the entire questionnaire, i.e. 98%. Staff in general depend on their monthly salaries for their living. There is no savings scheme or social security system to support them other than their salaries. Although it is accepted by staff, still it has its consequences on the Bank. Pay rises include competent and others. As far as everyone receives regular pay rises, whether he increased his efficiency or not, then no one should be keen to make research to contribute to the objects of the Bank. This is one of the snags in this pay system. While some of the staff are working full days because of the business demand, at the same time there are some who are idle for most of the day. Regular pay rises are one of the factors that reduce the efficiency in public sector entities. As people put

too much weight on their salaries it is possible to discriminate them by ability, knowledge and experience so as to increase the efficiency in a developing country such as Sudan. There is general satisfaction from this contract area.

5.4.1.4 Psychological Contract

The main categories in this contract are :

- (i) Achievement
- (ii) Recognition
- (iii) Interesting work
- (iv) Responsibility
- (v) Advancement

Apart from management's willingness to accept ideas (that scored a low level of satisfaction, less than 30%), the other variables are sources of satisfaction to a high proportion of staff. Six of them were above 70%. The provision and acceptance of the variables within these categories under the psychological contract creates the feeling among managers to work their own policies without stating explicitly their acceptance to ideas put forward by the staff. Managers in general are willing to accept ideas if they are supported by studies to validate them. The staff put forward these ideas but they are not keen to investigate their suitability or not due to which the managers behave according to their sense, in the back of their minds they have these staff ideas. Scope to try out new ideas scored a reasonable level of satisfaction, i.e. 42%. While there are 72% who are asking for more willingness of management to accept their ideas, there are 51% who are asking for less scope to try out new ideas.

Being a central bank recognised by internal and external organizations which has its influences on the main business activities inside the country contributes to this high level of satisfaction within this psychological contract.

5.4.1.5 Ethical Contract

This contract includes the following main categories :

- (i) Image of the organization, i.e. image of the Bank
- (ii) Bank job requirements
- (iii) Personal provision
- (iv) Organizational identification
- (v) Work atmosphere

There is significant variation in the level of satisfaction within the variables of this contract. While four variables scored less than 30%, at the same time there are another four that scored over 70%. Feeling that work makes little contribution is the lowest in the entire questionnaire, i.e. only 18%. Job design is based on fragmentation of activities so as to ease their handling, i.e. job specialisation. The work of several individuals complete an operation but work of one individual compared to the total is not significant. On surveying the units, heads of sections used to say that they are contributing to the object of the Bank by doing these activities. The junior members of staff whose jobs are fragmented state the opposite. This is one of the factors that stimulated the author to investigate work design of these members of staff more deeply. It is one of the variables to be considered in job design within the alternative social options to be considered later on.

Emphasis on length of service and performance on promotion scored low levels of satisfaction, less than 30%. These can be changed by policies, not systems. However, it is possible to increase the level of satisfaction for information from top management and consultation about changes by change of system and policies together as the level of satisfaction from these variables scored less than 30%. The managers do not mean to exclude staff when they change policies and introduce new plans. Most of their actions are based on urgency due to the dynamic environment in which the Bank operates.

The variables under work atmosphere in general scored about average levels of satisfaction. This is attributable to the social feeling among Sudanese in general. They are very co-operative with each other and they are friendly.

In general the staff showed a high level of satisfaction with their jobs and their working conditions within this functional area. Detailed information about levels of satisfaction is given by Figure 5.4.3(a) to (3).

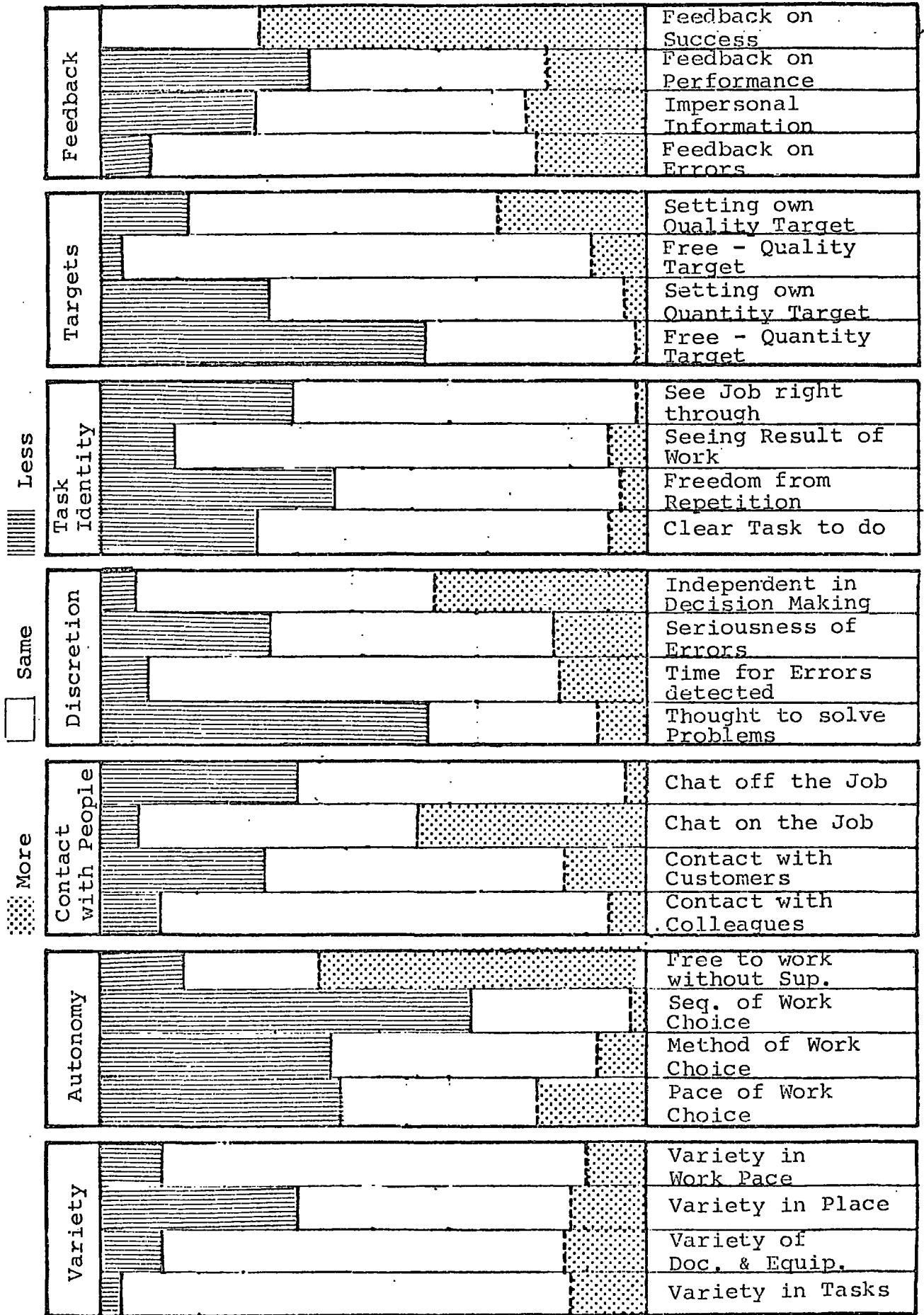
5.4.1.6 Attitudes Towards Change

The following tables show the attitude of staff to change in general and change to computer in particular.

TABLE 5.4.3 :

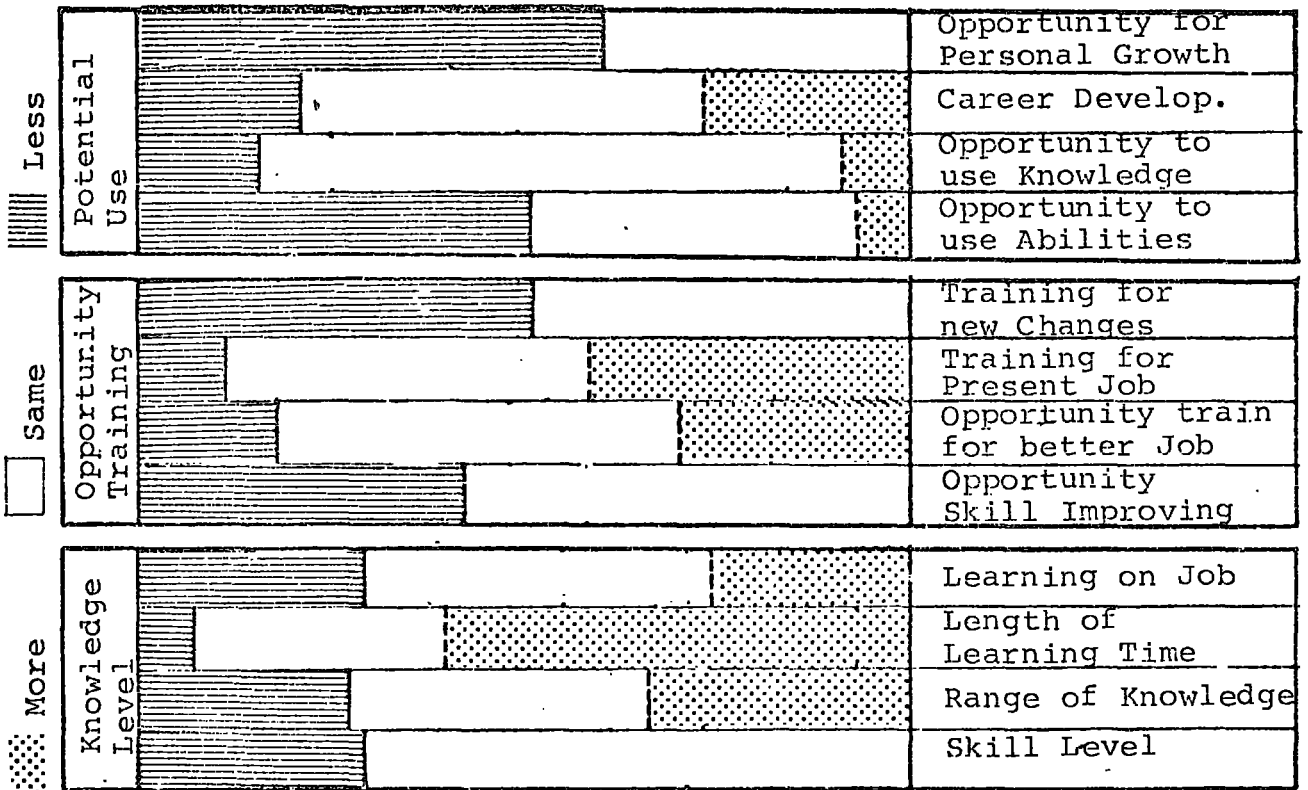
Attitude Towards Change

Variable Name	Agree	Partial agree	Disagree
Acceptance of job done the same way	84	7	9
Unacceptance of routine life	89	2	9
Chaos due to change	31	33	36
Movement to job to improve prospects	91	9	0



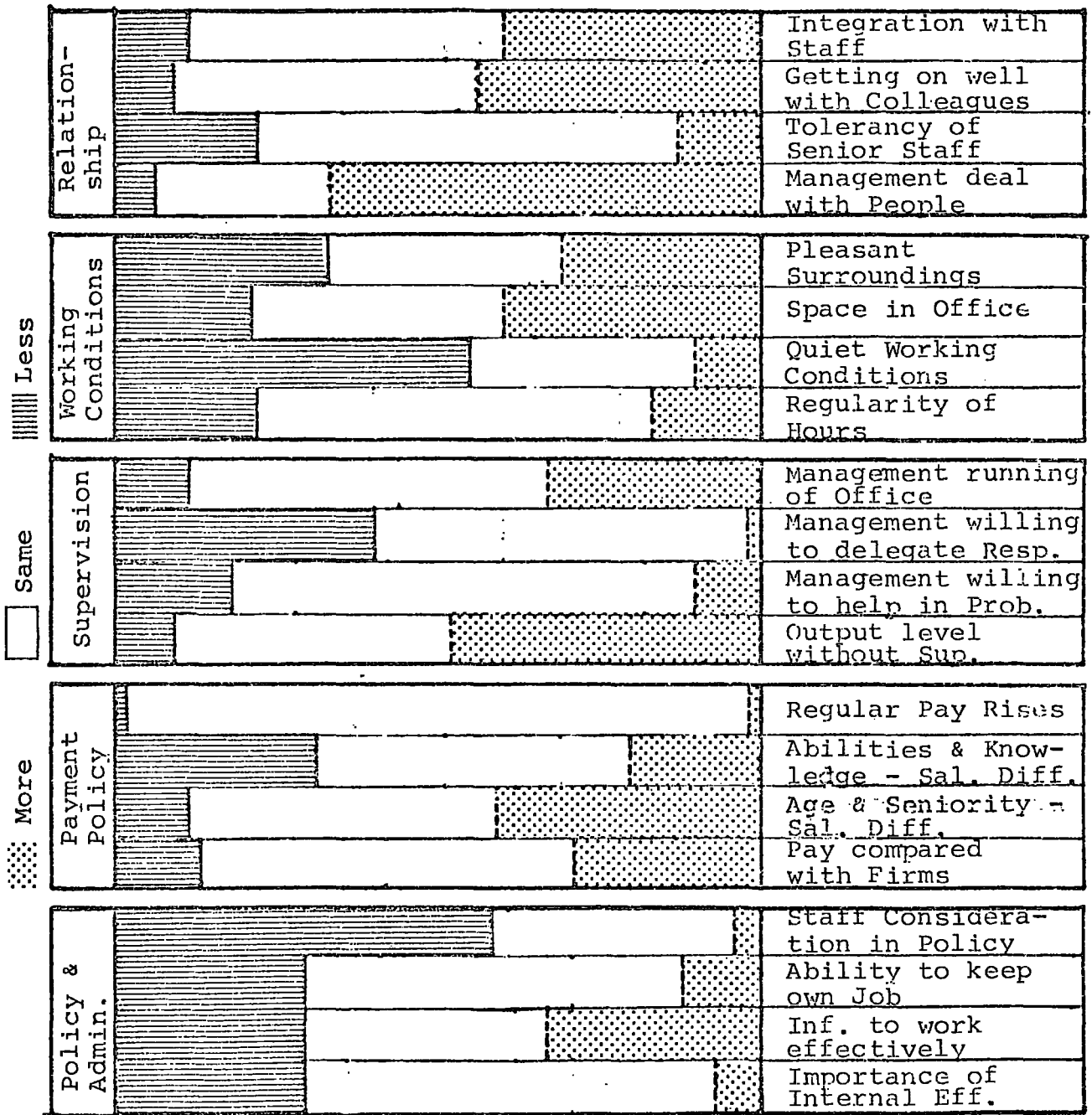
Total 100%

Figure 5.4.3a Task Contract: Percentage of those who would like less, same, or more



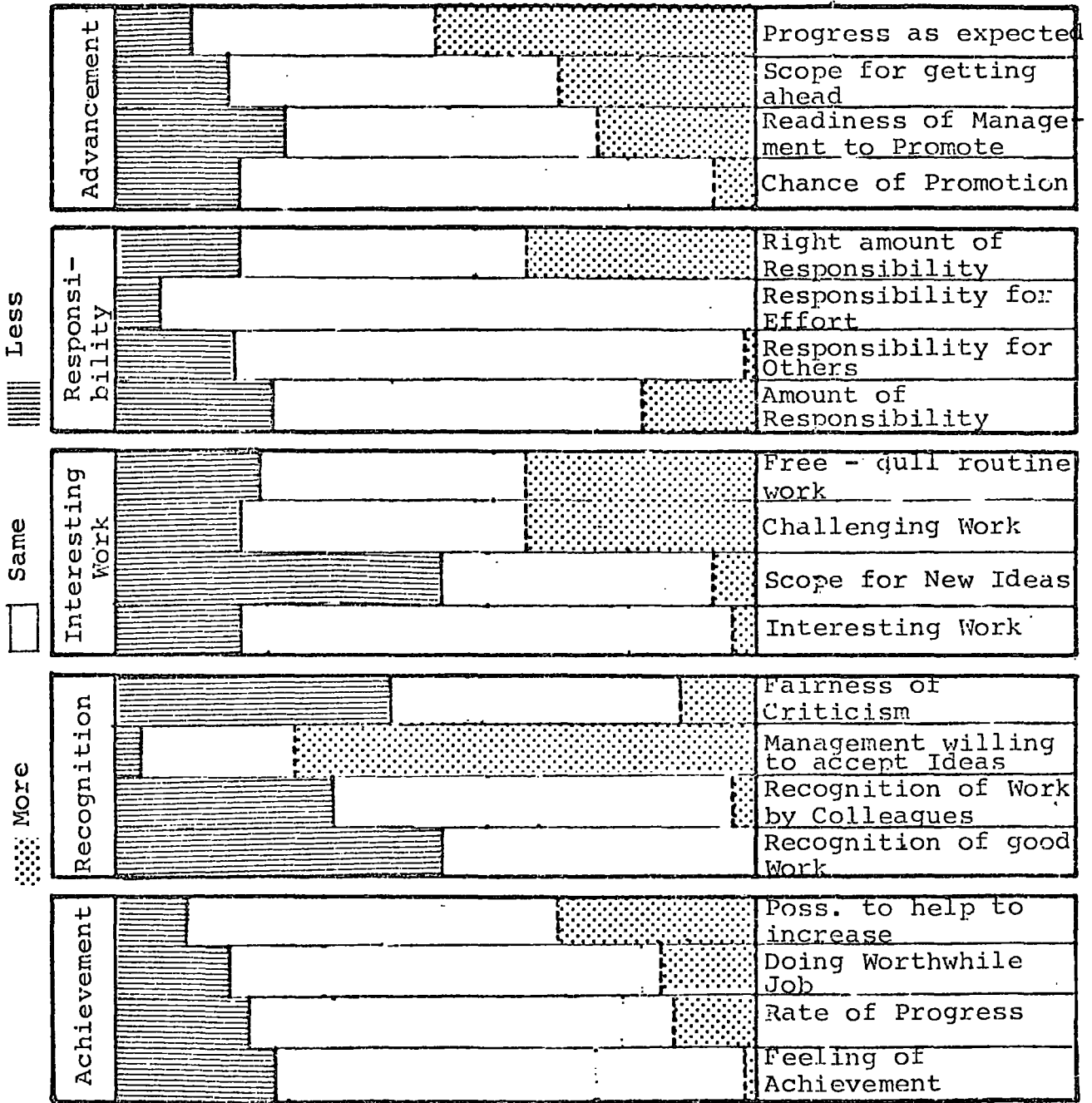
Total 100%

Figure 5.4.3b Knowledge Contract: Percentage of those who would like less, same, or more



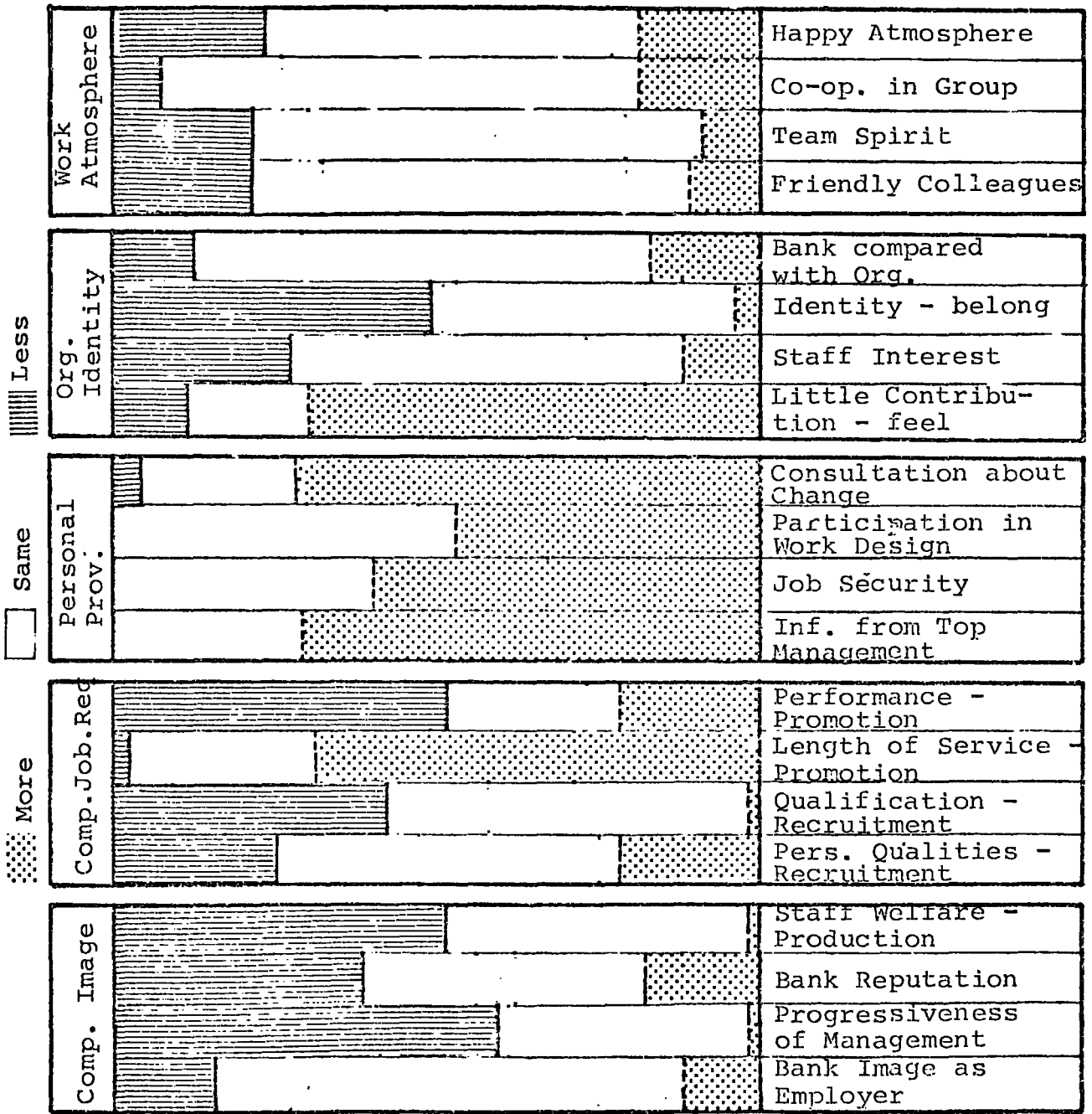
Total 100%

Figure 5.4.3c Efficiency Contract: Percentage of those who would like less, same, or more



Total 100%

Figure 5.4.3d Psychological Contract: Percentage of those who would like to do less, same or more



Total 100%

Figure 5.4.3e Ethical Contract: Percentage of those who would like less, same, or more

TABLE 5.4.4 :

Attitude Towards Change to Computer

Variable Name	Agree	Partial agree	Disagree
Complexity of computers	47	44	9
Domination of computers	27	55	18
Reduction of personal contact by computers	16	53	31
Reduction of jobs availability due to computers	7	33	60
Monotonous and uninteresting work due to computers	18	47	36
People won't matter any more with computers	20	42	38
Ease and efficiency in work due to computers	47	40	13
Availability and accuracy of information due to computers	53	44	2

A very high proportion of staff, 84%, want jobs to be done the same way, 89% do not want life to go on in the same way from year to year, and 91% would not mind moving to jobs to improve their prospects. There was significant answers for the resulting chaos due to change. One third of the staff agreed, another third partially agreed, and the last third disagreed. In general the group of staff surveyed is flexible and used to change.

On the list of variables that reflect staff attitudes towards change to computer, there is a general tendency for partial agreement. The average for partial agreement is round about 45% for all of the variables and it ranged from 33% to 55%. Change to computer system is a new concept for most of the staff and they are not sure of its consequences on the rest of the variables

being included. Those who know about it acquired their knowledge from the present EDP section of the Bank or through their postgraduate studies in industrial countries. About 60% disagree on the reduction of jobs due to the introduction of computers. At the same time 53% do not deny the influence of computer processing on the availability and accuracy of information. Only 2% disagree on this variable. 47% agree on the ease and efficiency of work due to computer operation. In general there is neutral perception of the proposed change to computer function and positive for some of the variables.

The resulting percentages on job satisfaction variables, attitudes towards change and change to computer system help in the construction of staff profiles. It was clear that there is a good fit on the majority of variables, the staff are flexible and would not mind change but with neutral perceptions of the proposed change on some of the variables and positive perception for others. These profiles will be the basis for the formulation of planning strategy. As far as there is neutral perception for changes, the most important factor to be considered in changing their attitudes and behaviour towards change to computer operation is to educate them about its influence on their tasks, on the structure of the organization, on the technology and people. Although their participation is very important in the several development stages, still this cannot be done without their education. Already information from top management and acceptance of staff ideas scored low levels of satisfaction, i.e. less than 30%. These members of staff do not mind moving to jobs to improve their prospects and they do not like life to go on the same way. The introduction of computer technology will change life and it is possible to create posts for intelligent clerks and other members of staff, especially those with planning and control functions. Information about change leads to greater facility and confidence of staff to cope with it. Education, participation and information are the important factors to be considered in

the case of the foreign exchange operation and reserve system. Command and negotiation will be necessary within the foreign departments one of the systems within the foreign exchange.

5.5 CONCLUSION

The export trade information system includes the information system of the Receipt department, foreign trade section and export sub-section and balance of payment section - Receipt sub-section of the Research department. The decision making process that involves strategic planning and management and operational control involves the top management of the Bank, senior managers of the foreign exchange operation and Reserve system, line managers of the Receipt department, operating staff of the Receipt department and the coders of the Research department. The non-availability of information processing within the Receipt department has its influence on operational and management control of the department. The absence of co-ordination and communication through processed information between the Foreign and Receipt departments may be one of the factors that decreases the efficiency of management control measure of the former. The coder section of the Research department processes the information of export trade for top management of the Bank - no allowance is made for management and operational control of the Receipt department. Technically, computer information processing is necessary for export trade system to integrate the information elements and create files to meet the requirements of the several operating levels within sections, departments and sub-sections.

The export trade is the main source of foreign exchange currencies. When these currencies are short of demand, the Bank of Sudan resort to foreign loans of short-term duration and hence pay interest. Timely information that reflects the performance of the trade should help in the planning process for

the disbursement of the available exchange currencies and hence contribute in the reduction of the cost of the foreign loans in the future. The financial objective of the change to computer information processing is to enhance the planning and control function of the foreign exchange operation and Reserve system so as to reduce the cost of foreign loans.

The fact that the information elements of the several documents that complete the trade cycle are not related to each other creates snags in the control measures of the Receipt department. This is one of the factors that decrease the reliability of the exporters and hence the damage of the economy of the country. While privacy rights of the exporters will be allowed for in system design, still control measures based on related information are necessary to check exporters performances. The integration of information elements is one of the capabilities of computer information processing. Manually, it costs in terms of funds and time.

Although the social analysis reflected a reasonable degree of job satisfaction among members of staff who will be affected by the change, still the interview of the coders of the Research department reflected their dissatisfaction from their present coding job. The coders process the export trade information for the top managers of the Bank. The Receipt department is in need for information by transaction for management and operational control. By merging the coders with the staff of the Receipt department, it would be possible to reduce the cost of operation which is likely to result if an information processing section is to be established for the Receipt department while the coders are to continue to do the same job for the top managers. This has the advantage of avoiding the duplication of sub-systems. Further, their merging should create job satisfaction among them. Instead of having a group with high job satisfaction and another with low or dissatisfaction, it would be possible to have one group with reasonable levels of satisfaction.

The policies of the decision makers of the Bank, which are not based on related or timely information, is a subject of criticism of people such as applicants for foreign exchange currencies or consumers of imported commodities, etc. The organizational objective of the change is the enhancement of the image of the Bank through planning and decision making processes.

CHAPTER 6

DESIGN OF COMPUTER BASED MANAGEMENT INFORMATION SYSTEM

6.1 INTRODUCTION

This chapter is an application of the design approach of Section 2.3.2 to design a computer based management information system for the Export Trade System of the Bank of Sudan.

The design approach is based on the principles of the ETHICS method. This method has been developed to solve the design problems of socio-technical systems (Mumford, (1971)). It makes equal consideration for the technical and social factors of the system in the design process (Mumford (1971), Mumford, (1974)). The design process in this chapter involves two main parts :

- (i) Arrival at socio-technical solutions. This involves setting of technical and social possibilities, needs and constraints, merging of technical and social solutions to select compatible solutions and eliminate incompatible ones, then ranking for selection.
- (ii) Detailed design procedures for a computer based management information system. This involves the design of (a) computer sub-system, (b) human sub-system, (c) interface sub-system and (d) other supporting sub-systems.

The ETHICS method provided detailed procedures to design the social system, (Mumford (1971), Mumford, Mercer, Mills and Weir (1972)). Apart from the framework for the technical system design, the ETHICS had not provided detailed procedures to do it. The literature on technical system design is a rich one. Detailed models and procedures have been developed for this purpose, (Waters (1974), Waters (1977), Blumenthal (1969), Sharp (1969), Land (1970), McFarlan, Nolan and Norton (1973), Weil (1971), Forrester (1961) etc.). Some of this work concentrated on information input related to decision making

process (Forrester (1961), Weil (1971)) and hence the design of a total system, others tackled the problems of computer sub-systems and provided detailed procedures for system architecture that includes input, output, files and programming procedures (Waters, (1974), Blumenthal (1969), Land (1970), McFarlan, Nolan & Norton (1973)). They discussed the question of data bases and the creation of files. These approaches will be employed in the detailed design process of the Export Trade Information System.

The ETHICS provided an outline to design the interface sub-system. The interface sub-system is mainly concerned with the adaptation of the information system to the structure of the organization. Designers need to run several controlled experiments using alternative techniques to arrive at acceptable interface sub-systems (Land, (1970)). For the Export Trade Information System, the interface sub-system is mainly concerned with the removal of the coders of the Research Department to the Receipt Department and the side effects of this action on the former department.

The above sub-systems are concerned with the normal operation of the information system. There are other supporting sub-systems, including the system to smooth the change process from the present to the new modified system. For the Export Trade Information System the cut-over sub-system is concerned with the establishment of the master files. The manual system is capable of replacing the new system in case of failure.

6.2 PLANNING STRATEGIES

It has been found that the system design is influenced by the perception that the design team has of needs of those affected by it, (Hedberg and Mumford, (1974)). The users of the system are the largest group of people to be affected by the change of the system. They support the implementation and operation of systems to be designed in the way they see themselves, i.e. according to their needs and requirements. This can be achieved by their participation in the

design process. Based on the social and system analysis of Chapter 5, the author supported by the heads of the sections within the Export Trade System, prepared outlines for alternative solutions in technical and social terms. These are shown in Section 6.3. In the presence of the manager of the Receipt department and the author who acted as a consultant, members from the staff of the system examined these solutions. Some of them expressed their dissatisfaction of the new coding job as they are not acquainted with it. In the present situation they copy the actual elements of information and the coders of the Research department code them for punching. This problem is likely to be overcome through the days.

The main objective is to design a total management information flow based on an integrated data processing system. The Export Trade System is one of the systems within the Foreign Exchange. The analysis of the decision making process reflected that the systems within the functional area are operating to achieve one basic objective, namely the adequacy of the foreign reserve of the country and its efficient distribution. Each system is functioning without relating its business activities that include planning and control to the other system. Communication through processed information is almost nil. The various information flows are unconnected and only at the very top of the Bank, i.e. the level of decision making is an overall picture available. In order to achieve this planning strategy, the author analysed the decision making process. This was discussed with the top management of the Bank. As far as the export trade system is concerned, they want to know the value of approved contracts, utilized contracts, collected and outstanding proceeds whenever required. This is necessary to estimate the availability of foreign exchange currencies so as to regulate the payments for imports, invisible transactions of the balance of payments and the debts of the country. The demands of the top managers for information of export trade will be considered in the design of files, output and programming procedures. Information by transaction is

necessary for operational control. The information of the transactions identified by given attributes, such as value of exported cotton to the U.K., will be accumulated for managerial tasks. A grand total will be accumulated for top managers. The characteristics of the information required by each one of the three levels that represent the decision making process of the organization (Anthony and Dearden (1976)) are quite different from the other (McFarlan, Nolan & Norton (1973)). As far as the internal information of the organization is concerned, the difference to the author is a matter of degree in terms of aggregation, frequency of use, accuracy and time horizon. It is not difficult to create data bases from this internal information to meet the demands of the three levels.

The degree of the sophistication of the users and personnel departments in the implication of the EDP is very important, especially if the organization is providing the function for the first time (Mumford (1969)). Although computer processing started in the Bank of Sudan during the late sixties, it has been limited within the research department. For those who knew anything about it, their knowledge was acquired through personal contact and limited to its technical capabilities. In order to raise the degree of sophistication among the employees of the Bank so as to create the skill required for its implementation and operation, there must be educational programmes. This can be done by introducing courses in informatics to be taught in the Institute for Banking which is sponsored by the Bank of Sudan for the employees of the banking system. The courses should be social and technical but not hardware oriented. One thing to bear in mind is that the computer should be considered an instrument, a tool, a means to be used in fulfilling purposes, but not an end in itself. These courses should be attended by the managers and employees of the Bank.

One of the major obstacles of developing countries when introducing computer technology is the lack of the manpower resource to staff their EDP centres. In the last few years universities in Sudan introduced computing

courses in their educational programmes. This is likely to reduce the short supply of system analysts and programmers in general. The Bank of Sudan has to make use of its clerks who are likely to be saved due to change as programmers. It could be achieved by educating and training them for the job. It is relevant and useful to select at least ten members of staff and train them inside the Bank for six months by an expert in programming. They could make use of the computer centres. They could be grouped in teams to write applications programmes for their training and future use. Technical education, especially for system engineers, could be acquired by sending at least two employees to industrial countries for the required education. This should be cheaper than educating them inside the country. Also there is the advantage that they can see more about the technology and its development as the present centres in Sudan are limited in size and variety.

The functioning of the present EDP centre in the Bank of Sudan has been restricted because the centre is locked in the research department. The other departments consider any computerisational effort is meant to meet the requirements of the research department. They do not feel that the EDP centre can serve any users. The removal of this feeling is very necessary to gain the support of the users. It can be there only by establishing an EDP centre separate from the research department. The centre must be staffed with experts in operational research, behavioural science, accountancy and computing. The objective is not to computerise the information system only, but to help the operating staff, managers and decision makers by providing them with processed information, simulation models, statistical techniques to support their planning and to evaluate their alternative courses of action as well as to increase the effectiveness of their control and planning functions. It is a question of informatics in the broad sense, rather than just 'data processing'.

The urgent need for computer information processing in developing countries is there in every aspect of life, but they are constrained by the

non-availability of financial and human resources to develop the system and operate them. Educational programs are costly in terms of funds and time. Management in several organizations are not keen to invest in educational programs, but they are in need for computer information processing. According to the experience of the author in Sudan, it might be more relevant to specify a fund in the annual budget for computer information processing and the planners should decide the project in which the fund is to be invested, especially in public organizations such as the Bank of Sudan. The operating cost of the project developed in the previous year should be included in the operational cost of the other systems of the organization while the new fund is to be invested in a new project. For the success of this approach, it will be necessary to develop a master plan for developing a computer based management information system for the whole organization.

In Sudan the laws of civil service do not allow organizations to get rid of their saved staff. Decision makers and managers support labour intensive more than capital intensive projects. Any computer based information system in which the objective is reduction in cost by saving staff might not be accepted by them as this will lead them to social and political problems. Accordingly it is more wise to plan in such a way that the staff 'saved' should be absorbed by the organization.

6.3 COMPUTER BASED MANAGEMENT INFORMATION SYSTEM FOR THE EXPORT TRADE

This involves :

1. Arrival at socio-technical solutions based on the ETHICS approach.
2. Detailed design procedures for a computer based management information system.

6.3.1 Socio-Technical Solutions for the Export Trade
Information System

The steps of the ETHICS method will be followed in this sub-section to arrive at socio-technical solutions for the Export Trade Information System.

6.3.1.1 Possibilities, needs and constraints

6.3.1.1.1 Technical Possibilities

At this stage of design, designers supported by their technical knowledge and the available technology, provide technical solutions, i.e. the solutions providing the greatest technical improvement irrespective of costs and constraints (Mumford (1971)). Accordingly, the following are the possible technical solutions :-

(1) Real time on-line system:

Under this system the information elements of contracts or export licences, the export forms that arrive from commercial banks and customs stations will be recorded by use of an entry device such as a typewriter or CRT to be located in the offices of the receipt department. These devices will be connected directly to the computer. The information will be edited and processed when received. There will be an immediate access to centrally updated information. There is the possibility of immediate correction of information by the person doing the input.

(2) On-line system:

The transactions are recorded by the use of an entry device such as a typewriter or CRT. The information elements are accumulated on transaction files to be processed at subsequent times. The processed information will be held centrally on magnetic tape. There will be an immediate access to information through the use of terminals located in the receipt department. The information will not be completely up-to-date. The direct entry through typewriter or CRT has the advantage over the tape or punched card if suggested in that most of the editing may be performed while the transaction is being

recorded. Many types of errors can be identified and reported back to the entry device for immediate correction. This might seem expensive for the Bank of Sudan compared with punched cards because the Bank has its own punching machine which will be in operation for several years.

(3) Off-line system:

Input will be through punched cards to be produced by the EDP centre. Information will be held centrally on magnetic tape because of the availability of punching machines. There will be a master file to reflect the performance of approved contracts, a master file holding information about each exporter and a master file holding information about commercial banks. The information elements will be accumulated in transaction files to update the master files periodically. The transaction files, after sorting, will be listed weekly and/or monthly for editing and after that they will be processed to update the master files.

(4) Off-line manual system:

This is a modification of the present off-line system of the research department and the manual system of the receipt department. The clerks of the research department will include the number of the export forms in the information element of the export trade statistics. The information will be processed first to produce the export trade statistics, then second to produce a listing of export forms within the commercial bank branches. The clerks of the receipt department will relate this listed information to the forms being sent by the commercial banks first to calculate the expected proceeds to be collected by each one of them, and second to see that the collected proceeds are equal to the value of the exported commodity.

Option 1 is the best followed by 2, then 3, and option 4 will improve on the present situation technically.

6.3.1.2 Social possibilities

In order to increase the efficient utilisation of the resources through

planning and the effectiveness of the control procedure there will be the new task of Data capturing for processing and utilisation of processed information in the control function of operating staff. Already there is the coder section of the research department to prepare the information elements and the punch operators of the EDP section who convert them into computer readable form. The coding job by itself is never interesting due to which the clerks of the research department are not satisfied with it. It has been stated that the executive staff and the clerks of the receipt department are satisfied with their job but information processing for control is a source of dissatisfaction to them. The feasible social goal is to maintain the job satisfaction and increase it if possible among the staff of the receipt department and improve it among the clerks of the research department.

The following are the possible options:

(A) The coders of the research department will continue to prepare the input data of export trade and the collected proceeds but they will add the information elements, namely the export form number, so as to produce printed reports to be used by the staff of the receipt department in their control function. The clerks of the receipt department will continue their present job but add the new control procedures based on the new information and the advisory role to exporters.

(B) The coders of the research department will continue to prepare the input data for export trade statistics and balance of payments, i.e. collected proceeds. The clerks of the receipt department will prepare the input transactions for processing, apply the new control procedure and advisory role.

(C) The coders of the research department will be merged with the staff of the receipt department. Preparation of input data and the utilisation of the processed information for control will be part of the job to be undertaken by them together. It is possible to specify a team within the merged group

to undertake the responsibility of preparing the input data.

(D) The preparation of input data will be the responsibility of the clerks of the research department. The staff of the receipt department will only be responsible for the retrieval of the information and its utilisation in the control function and advisory role.

From the coders' viewpoint, option (C) is the only one that improves on their present situation as there is the possibility of variable tasks, future promotion and increased knowledge. Option (D) is the best for the staff of the receipt department.

6.3.1.1.3 Technical constraints

In the present time the Bank of Sudan has no computer of its own to implement the technical solutions one and two. The available computer centres nearby are too small in size to allow sharing based on an on-line system. If the Bank is to install a computer for this function, whatever the size, the cost in terms of funds will be expensive for an organization in a developing country. The Bank of Sudan pays LS 33 per hour for an external computer centre. If a mini computer is to be considered, the Bank has to buy it because the leading manufacturers, especially IBM, is no longer renting machines for organizations in Sudan. The cost, just to buy it, would have been over forty thousand Sudanese pounds. It has to be paid in the first year of implementation. These prices had been quoted earlier, but with the new micro computers it might be possible to get less expensive technology for the job if the need for on-line operation is there.

6.3.1.1.4 Social constraints

Option (D), which is the best for the staff of the receipt department, is the worst for the clerks of the research department because they will do

more data preparation. Option (A) is also not acceptable to them as it will not improve their present situation. It will result in more work but less than (D). Option (B) will not be accepted by the clerks of the receipt department as they have many variables in their tasks. New procedures besides the input preparation are likely to reduce their job satisfaction more than to be compensated by the satisfaction they gain from the availability of information for control. At the same time, it will not improve the satisfaction of the coders.

6.3.1.2 Feasible Socio-Technical Solutions

Although there are four technical and four social options, there are still technical and social constraints that make some of them unfeasible. In order to arrive at a feasible solution, the options in either terms will be merged together. Table 6.3.1.1 shows the possible combination of these options.

TABLE 6.3.1.1 :

Combinations of Social and Technical Options

Special option Technical option	A	B	C	D
Real time on-line (1)	1 by A * -*	1 by B * ^	1 by C *	1 by D * >>>
On-line (2)	2 by A * -*	2 by B * ^	2 by C *	2 by D * >>>
Off-line (3)	3 by A * -*	3 by B ^	3 by C ↑	3 by D >>>
Manual and Off-line(4)	4 by A * -*	4 by B ^	4 by C ↑	4 by D >>>

* Technically infeasible

-* Socially is not acceptable by the coders

^ Socially is not acceptable by the staff of the Receipt department.

>>> Socially will not improve the working conditions of coders

↑ Compatible solutions

The application of the ETHICS technique in this design process is to help designers to arrive at alternative socio-technical solutions to achieve social and technical objectives. These alternatives will be subjected to evaluation procedures for decision making.

The question is not to explore the possibility of introducing computer technology as an integral part of the information system without consideration to the needs and constraints. More important is the design of feasible socio-technical solutions which will be accepted by the groups of people who will be influenced by the changed system. There are several factors that make technical solutions 1 and 2 not feasible for this case of the Bank of Sudan. The management of the Bank are very conservative in the purchase of computer technology for the account system to go on-line. From their discussions during the first attempt to computerize this system in 1969 it was clear that they will be willing to install a computer if the other systems will go for computer functions as well. Whatever the price, they would not accept the installation of a computer for export trade to go on-line. About four months are necessary for the full operation of a computer based management information system for export trade on an off-line system. A minimum of four years are required to plan for the other system of the Bank to go for computer operations and hence the decision to buy or not to buy a computer. Export trade system may go on-line if needed after five years. If a mini-computer is to be considered for export trade, computerization programs will go ahead and the problem of bottlenecks will develop due to which it will be essential to replace the mini-computer very soon. To buy a computer to allow for the other functional areas in the future will keep the technology idle for a long period and this is a waste of funds. To switch from manual systems to real-time on-line or to on-line systems is not so easy and it will not be successful in an organization without computing experience. For operational control, managerial planning, and decision making, the information processing on an off-line system for export trade will do according to the managers of the system. Based on technical and social need and constraints

real-time on-line and on-line system, options 1 and 2, should not be considered as feasible solutions for further studies.

Option 4 will improve on the present situation. It influences control functions of the receipt department. The department will be able to know the proceeds to be collected by each one of the commercial banks, but the collection is not likely to be timely because the 45 days target will not be applied.

According to these factors, the feasible solutions for export trade systems are 3 by C and 4 by C.

3 by C is a combination of an off-line system with the preparation of input data and the utilisation of processed information for control being undertaken by the clerks of the research department merged with the staff of the receipt department together.

4 by C is a combination of an off-line and manual system. Socially the same as the above.

On ranking these two solutions, it is clear that 3 by C is the best as it will meet the technical and social requirements. It is less expensive than on-line processing to start with in an organization in a developing country. There is the possibility of its being a base for developing the social infra-structure for future computerization based on an on-line system. It will be backed by the manual control system, due to which the risk and errors due to the non-orientation to EDP is likely to be reduced. Above all it will contribute greatly to control, planning and decision making.

Option 4 by C will meet the social requirements of the coders of the research department, but it will not contribute much to the control and planning function of the respective systems.

Instead of introducing computer functions, one may consider modification of information flow and manual processing as an alternative solution. Such experiments was done in 1971. The manager of the research department asked the coders to accumulate totals of export trade by country and commodity

then accumulate totals for receipt by country and commodity for one month manually. During that month there were three thousands export forms including copy 2 and copy 4. Six clerks were to do the job. One month was necessary to complete the job. Besides the errors, it was clear to the management that manual processing is costly and time consuming. Since that date the management decided to use one of the external computer centres to process information of foreign trade and the balance of payments. Also, the clerks stated that they will not do it again because it is boring.

6.3.2

Procedures for the Design of a Computer Based Management Information System for the Export Trade

From Section 6.3.1, two socio-technical solutions are considered to be feasible for application for export trade information system. 3 by C is the best of them. It involves the usage of computer function to process information for control and planning together. It is a good demonstration to designing computer based management information system, one of the themes of this thesis. The information system to be designed includes the formal structured system and the portion of the informal and private systems which include information processing of a programmed nature.

Computer based information processing system change involves the design of (1) computer sub-system

(2) human sub-system

(3) interface sub-system

(4) other supporting sub-systems.

6.3.2.1 Computer Sub-System Design

Any information system receives inputs of data and instructions, processes the data according to these instructions and outputs results (Davis (1974)). Sometimes information processing requests data or information that was collected

due to prior processing, due to which file storage is added to the model. In designing a computer sub-system each application will be related to (1) input, (2) output, (3) file and (4) processing.

The computer facilities available for processing export trade information include IBM 360/30 64 K, three disk drives, four tape drives, one paper tape reader, one read/punch machine, one line printer, one console typewriter and operating system DOS. Inside the Bank there are six punch and four verifying machines, 75 magnetic tapes and three disks.

6.3.2.1.1 Input Design

The information elements to create the database and files of export trade information can be captured from export licences and contracts, export forms that arrive from the commercial banks to reflect the expected utilization of contracts, export forms that arrive from the custom stations to state the quantities being shipped and the date of shipment and export forms that arrive from the commercial banks that reflect the actual proceeds collected. Organization of input data and the time to be taken to read them are the important factors to be considered in the input design process. The following are the main input data cards :-

- (1) Approved contracts cards
- (2) Expected utilization cards
- (3) Shipment cards
- (4) Receipt cards

The information elements of these cards will be processed to create transactions and master files necessary for control and planning functions of the system and the demand of other systems related to it.

6.3.2.1.2 Output Design

An initial design consideration is the organization of output results and the time taken to print them (Waters (1974)). Most of the output to be

produced for export trade systems is to be designed because it has not been produced before. The information to be produced has to be related to the task of operating staff, managers, and decision makers, as this is very important for planning and control function of the organization (Anthony (1965), McFarlan, Nolan & Norton (1973)). The demands of the other systems within the foreign exchange systems from export trade systems has to be considered because this is necessary for the total system approach (Forrester (1961)). The output reports to be produced include :-

- (i) Weekly listing of approved contracts
- (ii) Expected proceeds
- (iii) Expected utilization of contracts
- (iv) Value of exported commodities
- (v) Monthly export trade by country and commodity
- (vi) Receipts by Commercial Banks
- (vii) Performance of export trade
- (viii) Performance of Commercial Banks
- (ix) Performance of Exporters

While some of these reports are necessary for operational control such as weekly listing of approved contracts, expected proceeds, expected utilization and receipts by commercial banks, others are required by managers such as monthly export trade, value of exported commodities, performance of commercial banks, performance of exporters. Total values of approved contracts, exported commodities, receipts and performance of export trade, will be required by senior managers of foreign exchange systems and decision makers of the Bank.

6.3.2.1.3 Files Design

The design of master and transaction files of export trade systems is considered with respect to information content, sequence, access method, format and other technical and organizational conditions relevant.

For this off-line system there are three master and four transaction

files to be designed and these are :-

(1) Master files

- (a) Performance by contract file
- (b) Commercial Banks file
- (c) Exporters file

(2) Transaction files

- (a) Approved contracts
- (b) Expected utilization
- (c) Utilization of contracts
- (d) Receipt

It is possible to have two master files, namely the performance by contract and exporters file. This can be done only if the commercial banks through which the contracts and export licences are submitted for approval will be the same one to draft the sets of export forms relevant. The qualification for this, according to the staff of the receipt department, will take a long time because exporters have to understand system discipline which is not true in the present time.

6.3.2.1.4 Computer Programs

This stage is to decide the procedures to be considered in computer programs so as to meet data processing requirements. The computer programs necessary include data validation, sort/merge information contents of files then processing procedures which directly refer to or update files, edit and print output reports and messages. Sort/merge and print programs are normally provided by the manufacturer. The process programs vary from a simple one file in/one file out to a complex several files in/several files out. These programs will be considered with respect to the data processing requirements

subjected to hardware constraints.

For export trade information systems it will be necessary to update the three master files with the information elements of the transaction files. Other procedures will be required to process the information elements of files to produce the reports stated in the output section. Although the programming procedures will be directed to process information of routine nature still a provision for requested reports from information elements of these files has to be made. (Refer to Appendix 'B' for the detail design of this system).

6.3.2.2 Human Sub-System Design

This section is concerned with the detailed design procedures of human sub-system in which staff requirements are the determining factors in the type of clerical procedures to be done by them to meet computer processing requirements.

The socio-technical solution arrived at for the export trade information system which was based on the result of job-satisfaction survey, attitudes to change and computer change in particular involves merging of the coders of the Research department with the staff of the Receipt department to undertake the clerical procedures necessary for the functioning of the system. It was possible to identify the variables which are satisfactory or sources of dissatisfaction to a high proportion of staff. Through change of system and policies it may be appropriate to alter the present unsatisfactory working conditions to improve job satisfaction, but sometimes it is not possible to effect such change if the conditions giving rise to the problem are outside the control of the management. Accordingly the discussion will evolve through the variables of job-satisfaction that will be influenced by a change of system and policies. It is meant to maintain, increase or improve if possible the level of satisfaction.

The variables of the categories under task contract are the most to be influenced by the introduction of a computer function. The variables of the

variety category are a source of satisfaction to a very high proportion of staff within the range of 50% - 82%. The number of tasks to do and the documents and equipment to use will be improved for the coders but maintained for the staff of the Receipt department. About 50% of the staff were satisfied with the present opportunities to leave desk and 36% want less. By merging the coders with the clerks of the Receipt department then organise them in separate groups to handle complete related jobs, it is possible to reduce their walking around, hence increase their job satisfaction.

The choice open to the staff in the speed at which they work, the methods of work they use and the sequence in which they can do their various tasks are sources of dissatisfaction to 60%. 51% want less. Under EDP processing it may be necessary to determine speed so as to prepare the input data in a given sequence ready for punching and processing, due to which staff satisfaction is likely to increase.

The freedom to work independently is a source of dissatisfaction to 75% of the staff. 60% of them want more. It is possible to take action to improve the level of satisfaction, by grouping the clerks to undertake related clerical procedures to complete part of the job. For example, the group that collects contracts and export licences for approval will also be responsible for the preparation of their information elements for computer processing and the procedures to deal with "Weekly Approved Contracts", "Expected Proceeds", "Performance of Export Trade" and "Performance of Exporters" reports. Now they can have a degree of control over their work and there is an area of decision taking that they can call their own.

69% were not satisfied with the amount of thought they need to give to problems they encounter in their job. 60% of them want less. It was necessary to know why they wanted less because with the availability of information the management may ask for more problem solving. In the personal interviews with

some of the staff members it was clear that the physical effort to sort information and process it to arrive at a solution is one of the factors that make them ask for less problem solving. One of the advantages of computer processing is to release the clerks from the question of information processing. It is very predictable to increase the level of satisfaction, and those who are not satisfied will be asking for more.

Compared with the other three variables under identity, the amount of repetition in work scored less. The work in the Receipt department is not of a repetitive nature. 43% want less, among whom are the coders of the Research department. Being merged with the staff of the Receipt department there is change for them to be released from the repetition of the coding job that they used to do.

It is very promising to find that 86% of staff gain a great deal of satisfaction from doing high quality work. The importance of this variable is its consequences on the data preparation for the computer function. Only 38% are satisfied with the present target imposed on them and 60% want less of it. Like any business that involves members of the public, it is difficult to predict whether a change of system or policies will improve it or not.

While 71% are satisfied with the system of feedback on errors, unfortunately the feedback on success is a source of dissatisfaction to 71%. Only 29% are satisfied with the present situation. It is the responsibility of the management to arrange for it but computer processing is likely to help.

Under the present system the jobs are fragmented into small units. Every member or group of staff take little time to learn them. Only 33% are satisfied with it and a further 60% are asking for more. By grouping several related jobs in a unit, the staff may need longer time to learn it, hence gain satisfaction and increasing it for the use of skill by providing staff with information rather than leaving them to use personal judgement only.

One of the planning strategies necessary for the introduction of a computer function is the training system to be followed. In the Bank of Sudan the present system of training is based on getting it while you are doing the job for a very long period. A high proportion of staff (51%) want less of it. The interview with them reflected that they want systematic training to do related jobs rather than to be trained for a piece of a job. Already the provision for it is made under the planning strategies. Still the employees get a high level of satisfaction (80%) from the utilisation of their training, although they were not so happy about the training system. This can be maintained by systematic training to meet the requirements of computer processing within their own system.

There are factors which are unsatisfactory to a high proportion of staff but their change can be effected by changes of policies and systems other than information system. For example, the readiness of the management of the Bank to accept staff ideas, the promotion system which is based on length of service or ability alone, etc. However there are other variables which are sources of dissatisfaction but it is possible to provide for them through the planning strategies of system design. The important variables among this last category are the provision of enough information from top management about decisions and planning and the opportunities to make suggestions about changes. Both of these variables can be catered for by the participation of the members of staff in work design and hence improve the level of satisfaction.

6.3.2.2.1 Design of Clerical Procedures

The clerical procedures required include the following :

(i) Collection and registration of contracts when they are submitted for provisional approval under the name of the commercial banks through which they are submitted, their distribution to executive staff, back to registration of remarks, then despatch to exporters through commercial banks.

(ii) Collection of export licences and contracts for final approval, their investigation for validity and accuracy, their distribution for approval, back for registration of numbers, reservation of copies of contracts and licences, then despatch of other copies to exporters through commercial banks.

(iii) Coding of the information elements of contracts or licences in provided books to be accumulated for punching.

(iv) Filing of copy of the contract and licence in a manual file and the letter attached to them in a separate file for future reference.

(v) Collection of export form copy from commercial banks, checking their accuracy against the list of approved contracts, coding their information elements in provided book to be accumulated for the month for punching, then filing the forms in a manual file.

(vi) Collection of export form copy 2 that arrive from customs stations, coding of their information elements in a provided books to be accumulated for the month for punching.

(vii) Submission of books of coded information to the EDP centre to convert them into computer readable form.

(ix) Collection of output reports from EDP centre of the Bank.

(x) Procedures to deal with the produced reports : these are two procedures :-

(a) The contracts and export trade : this involves the approved contracts, performance of export trade, expected proceeds by commodity and performance of exporters reports. The approved contracts sorted by the serial number of the Receipt department must not include any break in the sequence. Any contract approved, three months passed and it has not been utilised is to be identified. Any contract being utilised and its receipt has not been collected must also be identified. Changes in

prices, markets, commodities, are also part of the responsibility of this section.

(b) The second section will be responsible for the performance of commercial banks, export trade statistics and balance of payments reports. Within each commercial bank it is their responsibility to see that for any export form copy 2 there is an equivalent copy 4. If copy 2 is received and two months passed while the collection copy has not been received, then the section must contact the exporters through the commercial bank. Any collected proceeds must be equal to the value of the exported commodity.

The most appropriate structuring of the section is to divide it into two groups. The first group will be responsible for the first four clerical procedures as well as the procedures to deal with the reports related to contracts. The second group will be responsible for clerical procedures (v-vii) and the reports related to performance of commercial banks. It is the responsibility of the senior clerk of the two sections to collect the books of coded information, their submission to the EDP centre, then collection of reports and their despatch to the two groups. These are the procedures which will be passed to the O & M personnel to produce the clerical procedures for export trade system of the Bank of Sudan.

6.3.2.3 Interface Sub-System Design

The interface sub-system is an amalgamation of computer and human sub-systems and the creation of an organizational structure to contain and interact with them.

The human and computer sub-systems have been designed to fit in with each other. Although the new system is not likely to result in a significant change of organizational structure, still there is the possibility of side

problems to be considered.

The coders of the Research department are part of two sections established to prepare foreign trade and balance of payments data to process them and produce reports to serve the function of the department. Export trade and receipt data are part of these reports. The new system will produce them more timely and accurately, but the removal of some of the coders to the Receipt department may not be accepted by the management of the Research department because of its consequences on the other remaining coders, especially if they faced the question of leave for any reason or another. The change of this system is not the only one to be considered. The import and payment to which the other coders will be attached will follow soon. The position of the other coders will be temporary. If there is significant deficiency in the number of coders, this can be catered for by clerks who will later join the EDP centre or by overtime systems.

In the Receipt department the space is small to accommodate three clerks but will do for one. Already it has been stated that the new system will save two of them. In order to avoid the question of staff redundancy, the saved clerks will be absorbed by the EDP centre which is not yet staffed.

6.3.2.4 Supporting Sub-System Design

This group includes the cut/over, standby and recovery sub-systems. Although the cut/over is necessary for implementation, standby and recovery for operations, still their design procedures are part of the system design.

These sub-systems involve humans and computer with their interface sub-systems. The cut/over sub-system is the most important under the case of export trade information system. The cut/over sub-system includes :

- (a) The establishment of three master files, and these are contracts, commercial banks and exporters files. Their information elements will be collected from the outstanding contracts and export forms. It may

be necessary to process the information data of export form copy 2, i.e. E/F copy 2 that arrived from the customs station in the last three months. They will show whether there is an export form set being issued and there is neither copy 4 nor copy 1.

(b) Adaptation to the suggested clerical procedures, especially the coding system and the utilisation of the output.

The reports to be produced and the files to be updated will provide the standby arrangement necessary for the system. This sub-system will be of significant importance if the breakdown of the computer centre lasted for several months, which is not very likely.

6.4 CONCLUSIONS

The design process was meant to demonstrate to the management of an organization in a developing country how to approach the design of their information system in which computer technology is involved.

Information technology especially in which computer usage will be involved is urgently needed in developing countries. These countries are suffering from lack of resources, especially technical skill and finance, but their planning which is not supported by information or skill resulted in inefficient utilisation of these limited resources. Their urgent need for information and the lack of skill may press them to accept information systems based purely on technical factors, but the research in developed countries reflected that such systems are costly in social and financial terms. In order to avoid the consequences of this technical approach, it was necessary to design systems which are in balance because there is equal consideration of its social and technical factors. The ETHICS method was the most relevant approach to this process. The only problem with it is that it is characterised by its demand for time and resources, especially human skill. These countries are anxious to operate systems, especially

those which involve technology, as urgently as possible to reap their results. Already they have done without informatics for hundreds of years and they spent thousands of pounds for technical advice. It is not impossible to be patient and to spend several thousands to develop systems so as to arrive at better results. It is the responsibility of the senior managers in the civil service and politicians to consider the importance of the technology design in such ways to adapt better to their social requirements.

The ETHICS approach has been applied to arrive first at a socio-technical solution for the information system of the export trade and the analysis based on it was employed to design the human sub-system, i.e. the clerical procedures to be taken by the clerks within the export trade system.

In the system designed there was consideration of an integrated data processing system to serve management information flow. It involves the production of reports for operational control and planning and the creation of data bases to be processed for policy making and decision functions.

It is the responsibility of the management who are in charge of the design process to see that the basic objectives of system design, which include social, technical and economic factors, are satisfied. After all, these are recommendations to be followed in the design of information system change, whether they are accepted or not it is the responsibility of the decision makers.

The hypothesis is that if this approach is accepted by the management of the Bank of Sudan, it will be on the same level as far as the informatics are concerned of the organization in developed countries. Its application resulted in significant success in many organizations in these countries. Its application in a developing country should help them to avoid the consequence of technical approaches from which developed countries are suffering.

CHAPTER 7

BASYC APPLICATION

EVALUATION OF COMPUTER BASED MANAGEMENT INFORMATION SYSTEM

7.1. INTRODUCTION

This chapter is an application of the BASYC approach to assess the benefits of a computer based management information system for the Export trade system of the Bank of Sudan.

The evaluation process based on the BASYC technique involves the main following phases:

- (a) Identification of the groups of people to whom the change of system might result in benefit or loss. This stage consists of these steps:
 - (1) Initiation of the study, formation of the investigating team, detailed statement of the problem, then the time scale for the study and for the policy changes to be studied.
 - (2) Identification and classification of interest groups.
 - (3) Definition of the Bank of Sudan's main objectives into measurable goals to be related to the interest groups and the units of measure for these goals.
 - (4) Estimation of current measures and the required targets.
 - (5) Relative importance of goals to the respective groups of people by assigning percentage weights to them to short list them.

These steps will be considered in Section 7.2.

(b) The second phase in the evaluation process is to estimate the opportunities provided by alternative strategies or policies. The main steps of this stage include the following:-

- (1) Specification of alternative system design.

(2) Forecasting the measures with the alternative strategies.

Section 6.3 was detailed coverage of the alternative system solutions for the export trade information system step (1) of this stage. Step (2) will be the subject of Section 7.3.

(c) The last phase in the evaluation process is to calculate the total benefits of the alternative strategies for each group of people then subject the results to sensitivity analysis. This stage will be the concern of Section 7.4.

Section 7.5 is the presentation of the results for decision making.

7.2 INTEREST GROUPS, GOALS, MEASURES AND WEIGHTS

The study is initiated by the author who is a member of the EDP section of the Bank of Sudan for her research work.

After the survey of the Bank's functional areas to derive the stimulating factors for change and the analysis of export trade system, the author asked for a meeting with the management of the Bank. In that meeting, the author explained the design and evaluation approaches based on the ETHICS and BASYC techniques respectively and the suitability of their applications. The steps to be followed in the application of the BASYC were included as well. The discussion involved the general objectives of the Bank and the contribution of the computer based management information system for export trade towards them in general. It was possible to identify the groups of people who will be affected by the change of this system and the direction of their benefits, positive or negative. The manager of the Receipt department was asked to manage the evaluation process as his department was the main functional area to be affected by the change. A meeting with members of staff of the Receipt department was arranged. Head of sections and representatives from the

Research department in the presence of the Receipt department's manager attended the meeting. They identified the main groups of the people in detail, their goals to be considered, units of measures for these goals and current measures. The alternative system design arrived at in Chapter 6 was discussed in a separate meeting. According to the advice of the top manager, the manager in charge of the study stated that the on-line alternatives are not to be considered now because the management of the Bank would not consider the purchase of a computer to start with. Also, export trade information system is not in need for on-line operation as weekly or even monthly information should do for operational control and managerial planning. On-line operation might be considered after the Bank develops a master plan for the information system to be computerized. A minimum of five years is estimated for the development of the plan. They agreed on a five year forecast horizon for export trade information system.

The author and four heads of sections agreed to proceed further with the evaluation process. Each one of them was asked to represent a group of beneficiaries and to assign weights to the goals related to that group.

In order to validate the weights assigned to the goals of exporters, the personal subject of information, the author interviewed fifteen managers of exporting firms including five nationalised firms from the list of exporters available in the Receipt department. Different measures were suggested including rejected contracts by international markets due to delay, but there is not relevant information for this measure.

The author and the heads of sections make forecasts of the effects of the alternative system designs on the measures for the goals over the five years period. In the presence of the manager they worked out target values for each goal. Optimistic and pessimistic forecasts were prepared for each goal. They compared the forecasts of the effects of the alternative system

designs on the measure with the target values. The author asked them to score these values in comparison with target values using a 21 point scale running from -10 to +10 (-10 complete failure, 0 performance of the present system and +10 complete success). The scores multiplied by the weights to arrive at the utility contributions for each goal for each group for each strategy. These added over all goals to give total optimistic and pessimistic utility for each strategy for each group. The strategies are ranked for each group according to their utility contribution.

The results of the evaluation process are shown in the sub-sections of this section.

7.2.1 Identification and Classification of Interest Groups

From the discussion with the head of sections, it was possible to identify the following groups of people who might be affected by the change of export trade information system :-

(i) Exporters

(ii) Commercial Banks

(iii) The management of the Receipt department who should gain if the changed system increased the effectiveness of the control procedures.

(iv) The management of the Research department who should gain if the new system resulted in timely and accurate information for export trade and balance of payments reports, due to which they may be able to analyse them for decision making.

(v) The senior managers of the Exchange Control and Foreign department who should get satisfaction if the changed system provides them with information to improve the efficient utilisation of foreign exchange currencies.

(vi) Applicants for foreign exchange currencies. They should gain if the system resulted in well defined policies to regulate export trade and the disbursement of foreign exchange currencies, due to which they can

look ahead and plan their affairs with confidence. They might lose if the change resulted in change of policies which might subject their business and plans to sudden stops and starts.

(vii) Taxpayers. They are concerned about the net increase that materialises from the change, due to utilisation of information in planning and control functions or cost reduction.

(viii) The decision makers of the Bank who will gain satisfaction if the new system enhanced the image of the Bank, increased its flexibility and contributes to its objectives.

(ix) Employees of the Receipt department who may lose if they are to process the information manually but will gain if the information is processed and they apply this in their control procedures.

(x) The coders of the Research department who will lose if they are to do more processing but will gain if the changed system provides them with tasks that involve variation.

After further discussion they agreed to classify these groups of people under the following categories of beneficiaries :

(A) The Personal subject. It is the group of people on whose behalf the system of export trade has been established. In this case they are the exporters and their commercial banks.

(B) The users of the system whose behaviour will determine the load on the system and its mode of operation. This group includes the line managers of the Receipt and Research departments and the senior managers of the Exchange control departments - the Receipt departments is one of them and the Foreign Exchange departments.

(C) The financial beneficiaries. They are the taxpayers and applicants for foreign exchange currencies. It was possible to put the applicant for foreign exchange currencies with the public at large, but in this case their goal is financial. It is related to the availability of foreign

exchange currencies to release them from the additional cost (interest) to be paid for delayed payments and stability of payment policies to secure their business from sudden stops and starts, hence the loss of their regular suppliers.

(D) The fourth group of beneficiaries are the senior management of the Bank and the Board of Directors, which includes the Governor and his deputy.

(E) The staff of the Bank within the export trade system. They are the employees of the Receipt department and the coders of the Research department.

7.2.2 Goals and Units of Measures

The main objective of the Bank of Sudan in undertaking the control responsibility of export trade, its regulation and provision of its services, is to see that the resulting overall profitability is more than the cost of the services and the environment.

The interpretation of this objective differs from one group of people concerned about export trade to the others depending on its or their own goals. The goal as such cannot be related to these groups of people to estimate the cost or assess the benefit resulting from the change of export trade information system. Accordingly, it should be broken into sub-goals with measurable properties to be related to the relevant groups classified under Section 7.2.1.

The personal subject in any organization are concerned about the availability and fair distribution of its resources to meet their active and potential demands on acceptable terms to them and to the organization.

In the case of the Bank of Sudan the personal subject are the exporters, their commercial banks and potential businessmen who might join the export market. The commercial banks submit the contracts and export licences for approval, draft the sets of export forms, and send copies to the Receipt department for control function and collect the receipt in foreign exchange currencies on behalf of exporters. At the same time they utilise part of the foreign exchange currencies to pay on behalf of applicants for these currencies and sell the remaining balances to the Bank of Sudan. These services are part of their banking activities. Exporters deal in this business as a source of income.

In order to arrive at goals and appropriate units of measure for them, the author interviewed fifteen managers of exporting firms on different occasions.

The control procedures are to ensure that the commodities to be exported are allowed for export and the receipt collected is equal to the value of the exported commodities. At the same time export trade policies are meant to encourage and expand it. The exporters and their commercial banks argued that the expansion of trade, hence the possibility to increase foreign exchange currencies, might not be feasible if there are too many clerical procedures or tight control systems that hinder their business activities. For the purpose of evaluating the change of export trade information system, the tightness of the control procedures is measured by the number of contracts likely to be rejected because the applicant has not fulfilled his outstanding obligation. The clerical procedures is measured by the number of transaction documents necessary for the completion of the export trade cycle to be submitted to the Bank of Sudan.

Present and potential exporters may need advice about the export system and information about commodities to be exported, their prices, international markets, and so on. This goal will be of importance if the exporters based on

the information can plan and expand their trade business. It is measured by the availability or frequency of circulation of these reports for their use.

For the members of staff who might be affected by the change of export trade information system, the goal special to them is their job satisfaction. Job satisfaction has been measured by the technique of Section 3.4.3 and the results are shown in Section 5.4. From the result of the survey it was easy to spot out the variables for which the level of satisfaction is to be improved, increased or maintained. These variables have been catered for in the design of the socio-technical solutions and the design of human sub-systems of Section 6.3.

It is possible to measure the benefit of the change using the same technique, but sometimes the score for a given contract is over 1, still the variables with less than 30% level of satisfaction create problems and job dissatisfaction. For example, the psychological contract scored 3/1. The opportunity to make suggestions about work is a source of problems, especially for university graduates. In such a case it is more relevant to consider the percentage of staff to be satisfied if that variable is to be changed. The proportion before and after will be the benefit or cost of the change. Further, it will be better to categorise the variables with high and low percentages of satisfaction into two groups. The high level of satisfaction will be the source of satisfaction and the low level will be the source of dissatisfaction. The decrease in percentage of satisfaction for the first group will be social cost and the increased percentage of satisfaction for the second group will be social benefit. For the staff there are the goals to maintain source of satisfaction and improve the sources of dissatisfaction.

The users of the export trade information system are line and senior managers of the Exchange Control and Foreign Exchange departments. According to them they are concerned about the effectiveness of the control system and the efficiency of the planning process related to the collection of foreign exchange

currencies that materialise from export and their disbursement. The availability of processed, relevant, timely, accessible and accurate information should increase the feasibility of these managerial jobs. Being a change of information system, its benefits to them should be measured by the influence of the new aspects of information on their control and planning functions.

Export trade is the major source of foreign exchange currencies. The planning process related to the disbursement of these currencies and the size of loans to be borrowed are partially dependent on the value of exported commodities and reliability of exporters to collect the proceeds in foreign exchange currencies when it is due. For example if they want to estimate the availability of foreign exchange currencies to meet import, service items of balance of payments and debt servicing, they consider the volume of local production to be exported, the value of export in previous years, and the receipts. Local production is out of their control. The variables they consider in their planning process are the capability of exporters to be measured by the value of exported commodities and their reliability in bringing the proceeds inside the country to be measured by the percentage of receipt to the value of exported commodities.

Managerial and operational control are dependent on current information that reflects the performance of exporters. For example, the export of certain commodities is subjected to quota system to protect local consumers. If there is no timely feedback on the volume approved for export, it is difficult to achieve this object. Also there are exporters who ship their commodities but for one reason or another they fail to bring the proceeds inside the country. Such exporters are considered to be blacklisted. If there is no information to identify them, it is difficult to control their behaviour. The feedback on performance is measured by the time necessary to get information, and update the files to produce routine and requested reports.

One of the objects of the change is to increase the effectiveness of the control system, but if the change resulted in contraction of export trade, then the image of the system and the management concerned about it will not be enhanced. Expansion of trade for this group of users is measured by the value of approved contracts and the number of exporters.

For the financial beneficiaries group that includes taxpayers and applicants for foreign exchange currencies, there are the goals of increased income, reduced cost and security of invested funds. The taxpayers are concerned about the net income to be transferred to the account of central government, their legal representative, to be invested on other projects on their behalf. Applicants for foreign exchange currencies are concerned about the efficient utilisation of these foreign currencies which might result in a reduction in foreign loans and hence interest paid for them in which they participate. For both of them the income goal is a lost income paid as interest to get foreign exchange currencies to finance deficit in the balance of payments. The Bank of Sudan subtracts this interest from its revenue to arrive at the net profit to be transferred to the account of central government. Applicants for foreign exchange currencies, especially importers, pay this interest if they delay the payments of their outstanding obligations to foreign suppliers. The difference in interest to be paid for foreign loans to finance the deficit is the lost income for financial beneficiaries. It is the unit of measure for the income goal.

In a developing country like Sudan, the taxpayers have no say in the funds to be invested in any project. The management and decision makers in the Civil Service and politicians have the final word. They are entrusted with the right of the taxpayers and security of their funds. Because of the limited financial resources to provide sophisticated computer systems, they ask for less expensive projects. Accordingly, the expensiveness of the project or changed system is measured by its cost, i.e. the funds to be invested.

Besides this and other goals of the interest groups, the top managers and decision makers have other goals. Being a change of information system, the decision makers and top managers of the Bank are expecting availability of data bases to meet their demands for reports. There are several reports to reflect the current performance of the trade but they are produced by request of the management. On measuring this goal it is more relevant to consider the availability of data bases to be held in the system to produce routine and requested reports. The measure is the percentage of required reports whether of routine or requested nature likely to be satisfied from the available data bases.

The image of the Bank and its decision makers should be enhanced if the real increase of export trade comes up to the expectation of the planners concerned about foreign reserves of the country. To the decision makers this goal is measured by the receipts from export trade.

The goals and their units of measure are given by Table 7.2.2.1.

7.2.3 Current Measures and Targets

The non-availability of information in accessible form is one of the problems that hinder the success of studies and planning in developing countries. Hundreds of man hours are necessary to process information to estimate current measures and 5-year targets for this study. It is worthwhile as it will lay down the foundations of planning based on empirical studies rather than depending solely on personal judgements.

Each goal is treated separately to estimate its current measures and targets.

(a) Clerical procedures

The clerical procedures are measured by the number of transaction documents needed to complete the trade cycle. The documents involved are (i) the contract, (ii) export licence, (iii) export form copy 4, (iv) export form copy 2, (v) export form copy 1, and (vi) export form copy 5. These documents are needed

Table 7.2.2.1.

GOALS AND UNITS OF MEASURE			
Group		Goal	Unit of Measure
A. Personal Subject Exporters	a	Clerical procedures Reduce	Transactions to complete trade cycle
	b	Tightness of control system Reduce	Value of rejected contracts for control
	c	Possibility of advices Increase	Frequency of report availability
B. Users Lins & Senior Managers	d	Capability of exporters Increase	Value of exports
	e	Reliability of exporters Improve	% of receipts to export value
	f	Feedback on performance	Time to acquire and process information
	g	Expansion of export business	Number of exporters
	h	Expansion of export trade	Value of approved contracts
C. Financial beneficiaries taxpayers and applicant	i	Income	Change in cost of foreign obligations
D. Top Managers & Decision Makers	j	Avoidance of expensive projects	Cost of the change
	k	Availability of information	% of reports satisfied
	l	Real increase of export trade	Receipts from export trade
E. Staff		Job satisfaction -	Percentage of staff satisfied
	m	Maintain sources of satisfaction: Variety in physical tasks Variety in tools and equipment Variety in work space Contact with colleagues Errors to be picked up quickly Visibility of work results Quality standards Feedback on errors Skill required Utilisation of abilities and training Probability of regular salary increases Level of supervision Sense of achievement Possibility of helping to increase business Work interest Responsibility for own effort Chance of promotion Being good employer Bank as employer compared with other firms Team spirit in office Cooperation in group	
	n	Improve sources of dissatisfaction: Increase freedom to work independently Increase feedback on success Improve management dealing with people Increase suggestions about work Decrease emphasis on length of service in promotion Increase emphasis on performance in promotion Increase information about management decisions Increase consultation about change Increase the significance of contribution to work of the Bank	

to know how much will be exported, how much has been exported so as to ensure that the quantities exported equal the quantities approved, then how much has been collected as a receipt to ensure that the proceeds are equal to the value of the exported commodities.

Export licence is a reflection of the information element of the contract. It should save exporters and staff time if both of them are submitted for approval together rather than separately. Also it helps the exporters to finalize their agreement with the relevant buyer before they approach the Bank of Sudan for approval. Instead of two clerical procedures, the approval of contract and export licence should be one procedure. Export form copy 4 states the quantity to be exported. It is sent to the Receipt department to ease its control based on manual inspection. Copy 2 reflects the quantity being shipped and the date of shipment. Copy 1 shows the proceeds collected and will be exchanged with copy 4 to release the commercial banks from the responsibility of collection. Copy 5 states the proceeds collected but its information elements are processed to produce reports for balance of payments. Copies 1 and 5 state the same fact but they are sent to different departments. Copy 4 reflects the action to be taken by copy 2. The contracts, export licence, export form copy 1 and copy 2 are the necessary transactions for the completion of the trade cycle, and these represent three clerical procedures instead of 6.

(b) Tightness of control procedures

Although there are many blacklisted exporters who had not collected the proceeds of their exported commodities, still there is no control measure to be applied to restrict them. In order to estimate how many contracts will be rejected if there is a control system, it is necessary to estimate the values of contracts utilised but their proceeds have not been brought inside the country. The contracts of exporters who come under this category should be rejected in the future.

The percentage of receipts to value of exports is 97% for 1975.

The 3% represents the contracts utilised but their proceeds had not been collected or brought inside the country. If the control system is applied, then the contracts of the exporters under this group should be rejected. 1975 figure will not be a base to estimate the future because in the last ten years the receipts were less than the value of exports in four out of ten. Whatever the case exporters prefer if there is no rejection so the expected five years target for them should be nil.

(c) Availability of advice

At the present time there is no information circulated by the Bank of Sudan to help the exporters in their search for commodities to be exported or markets that demand them. They acquire such information by their own efforts. Weekly updated information to enlighten them should be very much appreciated by them.

(d) Capability of exporters

This goal is measured by the value of exported commodities. The 1975 value, which is LS 153 millions, is the current measure. In order to estimate the 5-year target it is necessary to consider the historical performance of the trade. During the early seventies some of the main export firms have been nationalised and there have been changes of export policies. Accordingly, it is relevant to consider the trend during the seventies. The table below reflects the annual rate of increase during this period.

TABLE 7.2.3.1 :

Annual Rate of Increase in Export Value

1970	1971	1972	1973	1974	1975
21% *	11%	9%	28%	-19%	26%

* 1969 is a base for 1970

At this rate of increase the 5-year target should be round about LS 255 millions,

but there is an increasing diversification in agriculture production and large areas are developed for the purpose. Most of the produce are meant for export. Accordingly, the top managers are expecting a 15% annual rate of increase in export trade, i.e. LS 270 million target at least. The important factor to consider is the effect of the control measures on this goal not only the rate of increase.

(e) Reliability of exporters

It is measured by the percentage of receipts from export to the value of exported commodities. 1975, which is 97%, is the current measure. Before the seventies the annual average was round about 105%. During the seventies it declined to an average of 101%. In two out of six cases it was over the 100% (see the table below).

TABLE 7.2.3.2 :

Percentage of Receipts to Export Value

1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
106	103	105	107	98	98	94	104	114	97

The management appreciate if the sixties level is restored.

The expected 5-year target is 105%.

(f) Feedback on performance

The unit of measure for this goal is the time necessary to capture and process the information elements to produce reports to reflect the performance. Postal service is one of the factors that delay the feedback on performance and it will be there in any alternative to be considered by the Bank of Sudan because it does not come under the scope of its control. The presence of several clerical procedures and information processing are the other factors for delay.

Allowing for post and other factors, the management is expecting feedback on performance by mid and end of the month for this system. Under the present system the feedback of related information is not applicable because the information is not processed. The few reports produced by the coders of the Research department are several months behind.

(g) Expansion of export business

There are well established export firms and other exporters who deal in export trade but not regularly. The total number is about 500. On considering the expansion of export business, it is more relevant to estimate the number of the first group of exporters whose behaviour is an indication of the expansion of export business. Up to 1972 the number was 200, it increased to 240 in 1975. At this rate of increase the 5-year target will be round about 300.

(h) Expansion of export trade

The value of approved contracts is the measuring unit for this goal. In 1975 the value of approved contracts was about LS 180 millions. At 15% expected rate of increase, the 5-year target will be round about LS 315 millions.

(i) Income

This goal will be measured by the change in interest to be paid for foreign loans to finance the deficit in the balance of payments. The Government and the Bank of Sudan resort to foreign loans to finance development projects, provide temporary assistance to the balance of payments, to mitigate the effects of fluctuations in the country's receipt and disbursement of foreign exchange, but sometimes to help when there are temporary shortfalls in export proceeds arising from reasons outside the control of the country. Loans for development projects are planned and they are accepted at rates of interest that range from nil to 7%.

The other groups of loans are of short-term duration. They are not planned. The sudden payments obligations press on the Bank of Sudan to go for them. They are accepted at rates of interest that exceed the prevailing

international rate of interest by a further 2%. This rate ranges from 7% to 11%. This interest is the cost of inefficient planning related to the disbursement of foreign exchange currencies because it is paid to get foreign exchange currencies to finance obligations supposed to be financed by other receipts. In the last few years, the absolute interest paid for these loans is increasing annually. From LS 386 thousands in 1970, it jumped to round about LS 7 millions in 1975. The table below shows the interest paid annually in the last six years.

TABLE 7.2.3.3 :

Interest Paid (LS000)

1970	1971	1972	1973	1974	1975
386	887	1345	2299	3067	6844

At 84% rate of increase taking 1975 as a base, the Bank of Sudan is expecting to pay by the end of the 5-year period round about LS 30 millions, but the financial beneficiaries would prefer if this interest is eliminated or reduced to the minimum possible.

(j) Cost of change

Although the differential cost for each one of the alternative strategies will be estimated separately, still it is necessary to find from the management of the Bank how much they will allow for a change of system. They would not mind spending up to LS 6 thousands per year if the estimated benefit of the change will justify it. The 5-year target will be round about LS 30 thousands.

(k) Availability of information

About 20% of routine or requested reports are satisfied by the present system. Most of the routine reports for operational or managerial control and planning and policy making are produced as requested reports. Decision makers, senior and line managers and operating staff are hoping for at least 90% of

reports required by them to be satisfied from the data bases available.

(1) Real increase in export trade

The receipts from export trade is the unit of measure for this goal. The 1975 value, which is LS 148 million, is the current measure. Receipts from export trade is a function of the value of exported commodities and reliability of exporters. The management is expecting a 15% rate of increase in value of exports and the restoration of exporters' reliability to the late sixties average, which is 105%. Taken together, the 5-year target for receipts is round about LS 284 million.

(m and n) Job satisfaction goals

The average of the percentage values of satisfaction for the variables to be maintained and the variables to be improved will be calculated to be the current measures for each group. These averages are found to be 78% for the variables to be maintained and 27% for the variables to be improved. The least expected by the 5-year period is to improve or increase the average of the second group to over 40%, maintain or increase if possible the average for the first group.

The current measures and 5-year targets for the goals are given in Table 7.2.3.4.

While some of the goals are meant to measure the contributions of the strategies in solving the problems of the organization, others are necessary to measure the contribution of these strategies towards the main objects of the organization. For example, the reliability of exporters measured by percentage of receipts to value of export is one of the problems to be solved. It can only be solved by introducing control measures to check the behaviour of exporters. The control measures might result in negative influence on the expansion of export trade and hence the value of exported commodities, and the object of the Bank of Sudan in providing export services is to encourage its expansion.

Accordingly it was necessary to include goals to measure the expansion of export trade and utilisation of approved contracts, i.e. goals (h) and (d) respectively.

TABLE 7.2.3.4 :

Current Measures and 5-year Targets

Goal Measure	Current Measures	5-year Targets
a Number of documents per trade Cycle	6	3
b Value of Contracts rejected for Control (LS million)	0	0
c Frequency of Report Availability	-	Weekly
d Value of Exported Commodities (LS million)	153	270
e % of Receipts to Value of Export	97%	105%
f Time necessary to acquire and process Information	-	Twice per month
g Number of Exporters	240	300
h Value of approved Contracts (LS million)	180	315
i Cost of Foreign Obligations (LS million)	6.8	30
j Cost of Change (LS 000)	-	30
k Probability of Reports to be satisfied	20%	90%
l Receipts from Export Trade (LS million)	148	284
m % Average of Variables to be maintained	78%	78%
n % Average of Variables to be improved	27%	40%

7.2.4 Relative Importance of Goals

The goals are not of equal importance to the interest groups. While some of them are very important, others are less important or quite irrelevant. Further, it may not be possible to effect a change of system or policy to satisfy all of them. Also for the general welfare, it is not advisable to effect a change that deprives the right of any group. Accordingly it is necessary to arrive at some kind of value for each goal to specify its importance to the group or groups against other goals to be considered in the proposed change of system or policy. One way to do it is to assign percentage values, i.e. weights, to each goal. Sometimes it may be difficult for certain groups such as exporters or taxpayers to work with percentage measures. In such a case, the list of goals

had been presented to 15 exporters. They are asked to rank the goals in terms of "very important", "important", "not very important", or "irrelevant". The survey resulted in the percentages shown by the table below.

TABLE 7.2.4.1 :

Importance of Goals for Exporters

	V.Imp.	Imp.	Not V.Imp.	Not Rel.
a Clerical procedures	38	36	19	7
b Tightness of Control System	53	30	12	5
c Advices	30	25	31	14
d Capability of Exporters	8	6	46	40
e Reliability of Exporters	7	6	52	35
h Expansion of Export Trade	6	8	49	37
k Availability of Information	5	3	42	49
l Real Increase of Export	5	8	58	29

The percentage sum for very important and important for each goal divided by the total of the two categories is the base to assign percentage weights for these goals and their relative importance. The weights are shown by table 7.2.4.2.

The same procedures had been applied to arrive at weights of goals to be assigned by taxpayers and applicants for foreign exchange currencies. The head of section who represented that group selected a sample of fifty including applicants for foreign exchange currencies. It was necessary to validate the weights by asking the managers in charge of the availability and disbursement of foreign exchange currencies. The income goal measured by the change in the cost of foreign obligations was acceptable to them and it is the most relevant measure to this group of people, especially in these days because there are complaints about the additional cost to be incurred by applicants due to delayed

payments. According to the manager there are other goals which have significant influence on this income and these include real increase of export trade and to some extent avoidance of expensive projects because of their consequences on the profit to be transferred to the account of the central government.

For the other three groups of people the process was straight-forward. The list of goals had been presented to many of them. There was no significant difference in the weights being assigned. Averaging was necessary. The result of the weights for the groups are shown in Table 7.2.4.2. Now it is possible to identify the most important goals to shortlist them. Expansion of export business is the only goal to be dropped from the list. Expansion of export trade, capability and reliability of exporters are more important than the expansion of export business. The managers feel from their experience that there are many exporters in the market. Table 7.2.4.3 is the shortlist of goals.

7.3 OPPORTUNITIES PROVIDED BY ALTERNATIVE STRATEGIES

This is the second step in the evaluation process based on the BASYC approach. It involves the following:

- (1) Specification of alternative systems design (strategies)
- (2) Forecasting measures with alternative strategies

7.3.1 Alternative Strategies

This phase had been the subject of Section 6.3. Based on technical and social needs and subjected to availability of resources, social and technical constraints, two socio-technical solutions have been considered to be feasible for the change of export trade information system. These are :

- (a) An off-line manual system - strategy (1)

It processes part of the information elements to cater for partial control of operating staff, planning and policy making of senior managers and decision makers. The data elements will be captured then coded by the merged group

Table 7.2.4.2.

Name of Goal	<u>Relative Importance of Goals</u>				
	Exporters	Line & Senior managers	Tax-payers & appli- cants	Top managers & Decision makers	Staff
	A	B	C	D	E
a Clerical procedures	27				10
b Tightness of control system	30				
c Availability of advices	20				
d Capability of exporters	5	10	10	8	
e Reliability of exporters	5	12	10	10	
f Feedback on performance		15		10	10
g Expansion of export business		5			
h Expansion of export trade	5	10			
i Income		8	40	20	
j Avoidance of expensive projects			20	20	
k Availability of information	3	15		12	10
l Real increase of export trade	5	10	20	20	
m Maintain sources of satisfaction		7			30
n Improve sources of dissatisfaction		8			40
<u>TOTAL</u>	100	100	100	100	100

Table 7.2.4.3.

Shortlist of Goals

Goals	Interest Groups				
	Exporters	Line & Senior Managers	Tax-payers & appli- cants	Top Managers & Decision makers	Staff
	A	B	C	D	E
a Clerical procedures	27				10
b Tightness of control system	30				
c Possibility of advices	20				
d Capability of exporters	5	10	10	8	
e Reliability of exporters	5	14	10	10	
f Feedback on performance		15		10	10
h Expansion of export trade	5	13			
i Income		8	40	20	
j Avoidance of expensive projects			20	20	
k Availability of information	3	15		12	10
l Real increase of export trade	5	10	20	20	
m Maintain sources of satis.		7			30
n Improve sources of dissatis.		8			40
<u>Total</u>	100	100	100	100	100

of the coders of the Research department with the staff of the Receipt department. The merged group will utilise the processed information in their control procedures besides other clerical activities of the Receipt department.

(b) Off-line system - strategy (2)

Socially is the same, but technically will process information for control, planning and policy making of operating staff, line and senior managers and decision makers of the Bank. Data bases will be created to satisfy the production of routine, requested or special reports of the respective groups.

7.3.2 Forecasting Measures with Alternative Strategies

This phase is very crucial in the BASYC study. It involves

- (1) Estimation of contribution to goals from each alternative as of now.
- (2) Reworking of the contribution on the basis of future trends.

Future performance of any system is impossible to estimate with certainty. Planners depend on historical events to predict the future. Under the same factors historical performance might be favourable but sometimes unfavourable. Planners must not be solely optimistic or pessimistic in their estimations. They have to allow for favourable conditions (optimistic) and unfavourable (pessimistic) conditions to help the top managers to be aware of the future consequences in their decision process.

The performance of the changed system will be influenced by the interaction of its many variables on each other. On measuring the contribution of this change towards the goals of the interest group, it is necessary to consider the relation or interaction of the different variables due to that change taken together. For example, on measuring the influence of the changed system on the value of approved contracts, it will be necessary to consider the consequence of the tightness of the control procedures on the behaviour of exporters and the

availability of advices on the expansion of export trade. Whatever the case the forecast for future events under optimistic and pessimistic conditions will help to arrive at a decision about the suggested change of export trade information system.

It will be better to manipulate the measures to estimate their future trends and their influence on each other.

(a) Number of transactions

For strategy (1) and (2) approval of contracts and export licences will be one procedure. The difference will be in the number of export forms. For strategy (1) which is based on manual inspection, export copy 4 is necessary to identify the commercial banks that issued them, copy 2 to identify the contracts being utilised then export trade statistics and copy 1 to check the proceeds against the value of exported commodities then to process to produce the Balance of Payments report. The number of transactions is 4, but it may be 5 if the amalgamation of approval of contracts and export licences have been rejected by the concerned management. Under strategy (2) copy 2 and copy 1 are essential, but the management may ask to know about the exporters to whom contracts have been approved and export forms have been drafted, but they fail to export the commodity for one reason or another. In such case the number of transactions will be 3 but if the demand of the management is to be satisfied and the contracts and export licences will be two steps then the number will be 5. The measures by the end of the planning horizon are shown by the table below.

TABLE 7.3.2.1 :

Number of Transactions

Strategy Goal and Unit of Measure	Strategy 0		Strategy 1		Strategy 2	
	opt	pess	opt	pess	opt	pess
a Clerical procedures : number of documents per cycle	6	6	4	5	3	5

(b) Value of rejected contracts

The non-availability of related and processed information to reflect the historical performance of exporters hence the application of control procedures is one of the shortcomings of the present system. Strategy (1) which is a modification of the present system has the same disadvantage. Strategy (2) will enable the staff of the Receipt department to acquire information that reflects exporters' performance due to which they will be able to spot the reliability of exporters to apply this measure. The absence of control is a beneficial situation for some exporters especially those who export to secure sources of foreign exchange currencies to be deposited in banks abroad for their personal purposes. Most of the exporters under this group joined export business during the seventies. The deviation of proceeds collection from the late sixties' performance is attributable to their behaviour. It will be misleading to base future estimations on 1975 performance alone. It is more relevant to consider the performance in the last ten years. In six out of ten the collection of proceeds was over 100%, so rejection will be nil for six out of ten. In two cases it was 97%, in one it was 98%, and in another case it was 94%. On applying these probabilities to the expected value of approved contracts, the rejection will be LS 10 millions, but if the trend of the seventies continues, then the rejection will be about LS 15 millions for pessimistic conditions.

As the information will not be available under strategy (1) there will be no rejection of contracts and this measure will be nil.

(c) Frequency of reports

Weekly report to reflect prices, commodities and markets from the contracts approved during the week can be produced from the weekly contracts file of strategy (2). It is possible to update it manually from other weekly and monthly reports if the clerks have time to do it. Under optimistic conditions an updated report can be produced weekly. Otherwise it will be produced once per

month from the contracts file.

The present system generates this report when the management ask for it. It is not available for exporters to help them in their search for commodities and markets. Under strategy (1) it is possible to produce this report from the information elements of export trade statistics monthly, but it must be available for the exporters to compensate them for the partial control of this strategy. For optimistic and pessimistic conditions the report will be produced once per month by strategy (1).

Value of approved contracts (goal (b)), utilisation (goal (d)), receipts from exports (goal (i)), its ratio to export value (goal (e)) and speed of collection will be considered together. Economically they are influenced by similar factors. The direct influence of the change of the information system on one of them will have its indirect consequences on the others because of their interaction with each other.

Export trade is a function of agricultural production, international demands, prices and the need of the country for foreign exchange currencies. For evaluation purposes it is necessary to disentangle the influence of the changed system from other factors. Although some of the other factors have been considered in estimating the current measures and the 5-year targets, still it is necessary to state them under this section.

In the last five years, agricultural production has been expanding within 10-25% for several exported commodities and there is more diversification (Sudan Ministry of Agriculture, Food and National Resources - 1974) to meet international demands. The expected 15% average rate of increase is likely to be achieved. This should apply for the present or alternative strategies.

The issue to be considered under this section is the influence of the changed system, especially the application of control procedures on the performance of the export trade.

The availability of information to guide the exporters in their search for commodities to be exported and markets to buy them will contribute further in the achievement of the 15% rate of increase in value of approved and utilised contracts, but the objective of the Bank of Sudan in providing export services and undertaking the responsibility of its control is to see that the foreign exchange currencies that materialise from export trade is brought inside the country, so the expansion of the volume of export trade must be associated with increased collection of proceeds. The restriction on the disbursement of foreign exchange currencies for personal purposes besides the inefficient control procedures of the present system made the achievement of this objective infeasible. The availability of information to help the Receipt department to apply its control function is necessary, but the control procedures result in positive and negative consequences on the expansion of the trade, hence the foreign exchange currencies expected to materialise. The validity of this can be proved by figures.

It is possible to categorise the exporters into the following groups :

- (a) Exporters who mainly deal in export business as a source of income.
- (b) Exporters who joined the market to secure sources of foreign exchange currencies for their personal purposes.

Most of the exporters under the second group joined the market during the seventies. The decline in reliability reflected by the percentage of receipts to the value of exports during the seventies is attributable to their performance.

Under strategy (2) there is a file in the name of each exporter to reflect the approved contracts, utilisation, proceeds collection and outstanding obligations. Depending on his own objective, the exporter should think several times before he applies for the approval of new contract. This might result in well established competent and reliable export firms but at the same time it might

discourage those who want to export to generate foreign exchange currencies for personal purposes. Strategy (2) directly reduces the value of approved then utilised contracts because of rejection and indirectly through its consequences on exporters, especially the second group.

The information of these files should be the base of future co-operation between the exporters and the staff of the Receipt department. The need of exporters for staff support should encourage them to utilise the approved contracts in time and bring the proceeds inside the country as they used to do it during the sixties. On considering the percentage of utilisation to approval during this period, it was ranging from 87-92. Subtracting the value of rejected contracts from the expected value of approval, then applying the 92 and 87 rate of utilisation, it is possible to estimate the expected influence of the changed system on the value of exports. This is shown by Table 7.3.2.2. below.

TABLE 7.3.2.2 :

Value of Exports Under Strategy (2)

Rejection (LS million)	Approved Contracts (LS million)	Utilisation %	Value of Export (LS million)
Less Rejection LS 10 millions	305	High % 92	281
		Low % 87	265
More Rejection LS 15 millions	300	High % 92	276
		Low % 87	261

In two out of four, the value of exports will be above the expected 5-year target and in two out of four, below it. The first and the third quartiles will be for pessimistic and optimistic value of exports under strategy (2), i.e. LS 263 million and LS 279 million for the two conditions respectively.

Under strategy (1) there will be no rejection. The 85% to 90% rate of utilization of the seventies will apply for this strategy. Multiplying these

rates by the expected value of approval, then the expected value of export will be LS 268 millions and LS 284 millions for pessimistic and optimistic conditions respectively for strategy (1).

Strategy (2) will help the staff of the Receipt department to limit or eliminate some of the unreliable exporters. It is possible to restore the reliability to late sixties level, i.e. 105%. Otherwise they might be able to keep the average rate of the last ten years, which is 102%. The availability of timely information about utilisation will put them in a position to keep following the exporters when the collection date is due. In combining the expected value of exports under optimistic and pessimistic conditions and the reliability of exporters, it is possible to estimate the proceeds, i.e. receipts, from export trade for strategy (2). This process is shown by Table 7.3.2.3.

TABLE 7.3.2.3 :

Expected Receipts under Strategy (2)

Export Value (LS million)	Reliability %	Receipts (LS million)
opt 279	High 105	293
	Low 102	285
pess 263	High 105	276
	Low 102	268

The first and third quartiles will be for pessimistic and optimistic conditions respectively, i.e. LS 272 million and LS 289 million.

Strategy (1) will enable the staff of the Receipt department to influence partial control on exporters through their commercial banks. From the information elements of export form copy 2 which is sent by custom stations, they can identify the commercial banks that issued them and the expected date of collection. List of these forms including the date of collection will be sent to these commercial banks. The commercial banks will be asked to make the required follow-up of proceed collection. It is possible to restore the last ten years reliability if these commercial banks co-operate positively with the Receipt department, but the exporters will not be penalized, for example, by rejecting their contracts if they failed to bring the proceeds in foreign exchange currencies inside the country due to which the reliability trend of the seventies is likely to continue. The combination of export values, exporters reliability and hence the Receipt under strategy (1) is shown by Table 7.3.2.4 below.

TABLE 7.3.2.4 : Expected Receipt under Strategy (1)

Export Value (LS million)	Reliability %	Receipt (LS million)
opt 284	High 102	290
	Low 101	287
pess 268	High 102	273
	Low 101	271

The first and third quartiles will be for pessimistic and optimistic conditions respectively is LS 272 million and LS 289 millions. The receipts

for the two conditions under Strategy (1) are equal to the receipts for the same conditions under Strategy (2), but the value of exported commodities under strategy (1) is higher than under strategy (2) and it will score higher under the former. There is one thing to be considered in this case. The export of certain commodities has its negative significant influence on local consumption such as meat, oil, etc., and they are exported to get foreign exchange currencies to import important commodities. If their export continues to increase at that rate while the reliability is maintained within 101-102%, then there will be indirect loss as the country will pay foreign exchange currency to reimport them.

(c) Time necessary to acquire and process information

Postal services is one of the factors that delay the arrival of transactions and hence their availability to collect their information elements for processing. From two to ten days are necessary for the arrival of transactions from different places in the country. This delay will be there in any alternative because it cannot be controlled by the respective system or the Bank of Sudan.

On estimating the contribution of the alternative strategies to this goal, it will be related to the following factors :

- (i) Delay of information processing for control and planning resulting from the clerical procedures.
- (ii) Time necessary to process the information elements to produce the required reports.

Contracts, export licences, export forms copy 2, copy 4 and copy 1 are necessary for the control system of the Receipt department under Strategy (1). After exchanging copy 1 for copy 4, the commercial banks send copy 5 to the Research department to process its information elements to produce balance of payments reports. The commercial banks send these copies to the Research department once

per month. For example, the copies collected in the first week of the month by the commercial banks are sent to the Research department by the end of the month or the first week of the next month. Allowing one week to code their information elements then process them, the resulting delay in feedback on the performance will be round about 6 weeks, but it is possible to reduce this period by making use of export form copy 1. After the commercial banks exchange copy 1 for copy 4, the Receipt department is to send copy 1 to the Research department. The coding process will be daily. By the end of the month the coded information elements will be punched, then processed to produce the required reports for planning. Optimistically information processing will be once per month and pessimistically two further weeks later, i.e. round about 6 weeks. Still it is partial feedback on performance because it does not involve all of the transactions.

Under strategy (2) the feedback on performance will be monthly and will include the information of exports integrated. It is possible to have it twice per month but it will be associated with additional cost for processing this information. Optimistically the feedback will be twice per month but pessimistically once per month.

At this stage it is appropriate to consider the probability of reports to be satisfied from the available data bases - goal (k).

Strategy (1) will create data bases for value of exports and receipts. The information elements can be manipulated to generate reports to reflect export trade, receipts from export, collections made by the individual commercial banks and expected collections by them. There will be no information about exporters for control or planning other than the contracts, export licences or export forms. It is difficult to estimate the reliability of each exporter to control him. The information elements for control will not be related to each other. This strategy will not satisfy the requirements of operating staff as it will not process the transactions, produce reports or process enquiries. The only trans-

action to be processed for operation is export form copy 2 that reflects the utilisation, but the contracts, export licences, export forms copy 4 or copy 1 will not be involved. Line and senior managers will be able to know the total performance of the trade reflected by the value of exports and receipts. But they cannot estimate the variation from planned performance related to utilisation compared with approved values. They will not be able to know the reasons for deviation from performance.

Export trade and receipt reports should help the top management and decision makers to know the performance of the trade. But it is difficult to estimate future performance because the information of contracts or export licences is not included. The probability of reports to be satisfied immediately under strategy (1) would range within 30% to 35%.

Strategy (2) includes the creation of the data bases to satisfy the requirements of operating staff, line, senior and top managers, and decision makers. It involves the information elements of export trade from approval up to collection of proceeds. It reflects current and historical performance. It is expected to satisfy up to 90% likely to be less if conditions change.

(i) Change in cost of foreign obligations

The interest paid for foreign loans to finance current obligations is the unit of measure for the income goal. The annual obligations include imports, service items of balance of payments, principles and interest of outstanding foreign debts. Receipts from export trade and receipts from service items of balance of payments are the sources of foreign exchange currencies to finance these obligations. The deficit, if any, is financed by foreign loans. In (i) under Section 7.2.3 two types of foreign loans have been considered and these are short-term and long-term loans. Long-term loans are planned and they are borrowed to finance development projects but they are to be paid from the expected total receipts. Short-term loans are not planned. The Bank of Sudan

and the government resort to them to avoid hardship to the population or dislocation to the economy. Long-term loans are generally cheaper than short-term loans, but they need time to negotiate and ratify them with the respective donors. The urgency to meet sudden obligations presses on the Bank of Sudan and the government to go for short-term loans, hence paying higher interest. The higher interest to be paid to get these short-term loans to finance the deficit in current balance of payments is the cost of inefficient planning which is not supported by information but depends solely on personal judgement. In estimating the opportunities provided by alternative strategies for this goal it will be necessary to consider the following :

- (i) The influence of control procedures on receipts from export trade, i.e. goal (i), because it is the main source of foreign exchange currencies to finance the obligations.
- (ii) The consequences on the planning process of information availability related to export performance for the values in foreign exchange currencies to be allotted for individual items of obligation and hence the foreign loans to be borrowed to finance the deficit if any.

The influence of control procedures on receipts from export trade have been considered in a previous part of this section. For the two alternative strategies the receipts under optimistic and/or pessimistic conditions were equal, i.e. LS 289 million and LS 272 million respectively (refer to Tables 7.3.2.3 and 7.3.2.4.).

Receipts from service items of the balance of payments represent 15% of total receipts, but if the trend of 1974/75 continues due to increasing interest of Arab investors in Sudan, then the rate of increase will be 17%. 1975 receipts will be the base to estimate the 5-year target. The expected receipts other than export proceeds will be LS 61 million for pessimistic conditions and LS 65 million for optimistic conditions. This item will not be influenced by the changed system but it has to be considered in the planning process. Adding the receipts from

exports to receipts from other sources, the expected total receipts arrived at is shown by Table 7.3.2.5.

TABLE 7.3.2.5 :

Expected Total Receipts (LS millions)

Receipts - exports	Other receipts	Total receipts
289 opt	65 opt	354
	61 pess	350
272 pess	65 opt	337
	61 pess	333

Expected total receipts will be LS 352 millions for optimistic conditions and LS 335 millions for pessimistic conditions.

Payments for individual obligations is the other variable to be considered in the planning process. The change of export trade information system will influence payments through the availability of foreign exchange currencies to be allotted for these obligations. Payment for service items of balance of payments and outstanding loans is the responsibility of the Bank of Sudan. Although the Bank of Sudan pays for import trade, still the planning process for the volume of imported commodities has to be decided by MFNE. After allowing for other obligations, the Bank of Sudan has to advise MFNE to plan for import trade within the remaining balance of foreign exchange currencies. If the remaining balances do not suffice for the normal annual imports, then it will be the job of the Bank of Sudan to go for foreign loans to finance the deficit.

Payments for obligations other than imports are increasing within the range of 15%-17% annually. 1975 will be a base to estimate the 5-year target. The expected payments for obligations other than imports will be LS 179 millions for favourable conditions and LS 189 millions for unfavourable conditions. Subtracting these values from the expected total receipts, the remaining balance for import trade are shown by Table 7.3.2.6 below.

TABLE 7.3.2.6 :

Foreign Exchange Balances for Imports (LS millions)

Total Receipts	Other Payments	Balance for Imports
352 opt	179 opt	173
	189 pess	163
335 pess	179 opt	156
	189 pess	146

Under optimistic conditions balances of foreign exchange currencies for imports will be LS 168 millions and for pessimistic conditions will be LS 151 millions.

The outstanding foreign loans which are to be paid from the receipts are subjected to international agreements with the respective foreign governments and international financial institutions. About 80% of these outstanding loans had been borrowed during the seventies to finance development projects. The operations of several projects such as sugar and textile industries will start during the last five years of the seventies. The production of some of them

will be import substitute. Foreign exchange currencies will be saved because of import substitution. During 1975 Sudan paid LS 40 millions for sugar. It will be self-sufficient in that commodity by the end of 1977 and will export towards the end of the seventies (Sudan Five Years Plan - 1970/71, 1974/75). The production of the textiles industry, especially grey unbleached cotton will be more than local consumption due to which there will be a further saving of LS 10 millions paid in 1975 to import it. The expansion in agricultural production such as wheat, rice, etc. is expected to satisfy local markets. The foreign exchange currencies paid for them during 1975 was round about LS 10 millions. These added together, LS 60 millions in foreign exchange currencies, will be saved annually from import substitute. If there is any planning, the first thing to be considered is the utilisation of the saved foreign exchange currencies in the payments of outstanding foreign debts. It is very likely that the MFNE will argue that the receipts from exports have to pay for foreign debts and the saved foreign exchange currencies be utilised to release the restriction on import trade, but for proper planning, it will be necessary for any country to relate its obligations to its capability. The outstanding debts had been borrowed to finance development projects including import substitute industries. What will happen if MFNE insists on its argument ? Import trade is increasing at 10% annually. Imports during 1974/75 were exceptionally high compared with previous years. This was due to the heavy imports of machinery and equipment to speed the implementation of the remaining projects of the 5-year development plan. If 1974/75 are excluded then the annual rate of increase in import trade is 6%. Still MFNE will not accept their exclusion because there will be further development projects for which machinery and equipment are to be imported. Allowing for import substitution, imports for other commodities under favourable conditions will be LS 244 millions and under unfavourable conditions will be LS 340 millions. The differences between balances of foreign exchange currencies remaining for import and the expected value of imports will be the deficit in balance of

payments. This deficit is estimated by Table 7.3.2.7. below.

TABLE 7.3.2.7 :

Expected Deficit (LS millions)

Balances for Imports	Expected Imports	Deficit
168	294	-96
opt	opt	
	340	-172
opt	pess	
151	294	-143
	opt	
	340	-189
pess	pess	

Under any condition there will be a deficit in the balance of payments that ranges from LS 96 to LS 189 millions.

It has been stated that strategy (2) is associated with complete feedback on performance and will enable the Receipt department to implement fully its control procedures. So it is possible to know how much to be exported from import substitute production and how much has been exported. Accordingly it might be possible to achieve the LS 60 millions in saving due to import substitute. Strategy (1) feedback on partial performance and it will control the exporters through their commercial banks, i.e. partial control.

Export trade is expected to increase by 15%. At the same time there is no control policy to govern the behaviour of exporters under strategy (1). Although some commodities are produced to substitute imports so as to save foreign exchange currencies paid to import them, the lenire export policies might encourage exporters to trade in these commodities as well. In such case the

country might be obliged to re-import to satisfy local markets as export without control will reduce the availability of these commodities. Already there is an expected deficit in the balance of payments. The payments to re-import will increase this deficit. The cost of foreign exchange currencies to pay for the import of these commodities will be the loss due to increased value of export trade for strategy (1). If the 15% increase included the export of import substitutes, then the country will pay LS 45 millions to re-import them by the end of 5 years. The deficit in the balance of payments for strategy (1) will be within the range of LS 141 millions to LS 234 millions allowing for re-import.

The sources of foreign exchange currencies to finance the deficit are important in estimating the cost of foreign obligations. If the Bank of Sudan or the government goes for long-term loans, they will pay 5% interest rate, but if they go for short-term loans, they will pay 9% average rate of interest. The availability of information about the expected performance of exports - the main source of foreign exchange currencies - might stimulate them to consider long-term loans. At the same time they might have in mind further restrictions on import trade and reductions in import values as most of the machinery and equipment for development purposes had been imported. They might wait for their expectation to be realised and if not then they have to go for short-term loans..

Whatever the case, there is an expected deficit in the balance of payment to be financed. Already there is LS 79 millions undisbursed balance of foreign loans. Subtracting this balance from the expected deficit then applying the interest rate for short and long-term loans, the expected cost of foreign exchange currencies to finance the deficit for strategy (2) is shown by Table 7.3.2.8.

TABLE 7.3.2.8 :

Cost of Foreign Loans - Strategy (2)

Deficit (LS millions)	Interest Rate	Interest (LS millions)
17 opt	5% Low	.8
	9% High	1.5
110 pess	5% Low	5.5
	9% High	9.9

The Bank of Sudan is expected to pay LS 13 millions for balances of outstanding loans. Added to this, the minimum and maximum interest to be paid to finance the deficit during the 5-year period, then the Bank of Sudan is expected to pay within the range of LS 14 millions to LS 23 millions for strategy (2). Applying the same process for strategy (1), the expected interest to be paid ranges from LS 17 millions to LS 27 millions.

(j) Cost of Change

In estimating the cost of the alternatives, the concern is about the differences between cost for different strategies. The best way to arrive at the difference between cost is to start by identifying the cost factors which will be influenced or required for both or either of the strategies compared with the present system. These cost variables are identified in the Table 7.3.2.9.

TABLE 7.3.2.9 :

Cost Factors differing from Present System

Strategy (1)	Strategy (1)
Not required	a Staff at Computer Centre
Not required	b Staff at Data Preparation Centre
Staff at User Department	c Not required
No off-set	d Less staff to be saved
Computer time	e Computer time
Not required	f Equipment
No off-set	g Less maintenance of equipment
Stationery	h Stationery
Implementation cost	i Implementation cost
Development cost	j Development cost

During the 5-year period the cost variables will be subjected to change due to internal and external factors. The magnitude of the factors is not known, but the appropriate way is to make estimations for optimistic conditions (low cost) and pessimistic conditions (high cost). Some of the cost variables are provided in the first year of the project such as equipment, implementation and development costs. Others are annual. These others will be multiplied by 5 to arrive at their difference by the end of the period. The results of this process are shown in Table 7.3.2.10. The total extra cost will be adjusted to allow for inflation.

(m) and (n) Job Satisfaction Goals

The feasible socio-technical solutions for export trade information system, planning strategies being adopted or to be adopted in system change, outline of clerical procedures attached to them, the variables of job-satisfaction to be maintained or improved have been presented to the concerned members of staff. They are asked to agree, partially agree or disagree with the statements related

TABLE 7.3.2.10 :

5-year Total Extra Costs (LS 000)

Cost Factors	Improvement (1)		Off-line (2)	
	opt	pess	opt	pess
a Staff at Computer Centre	0	0	7.5	9.0
b Staff at Data Preparation Centre	0	0	12.5	15.0
c Staff at User Department	10	12	0	0
d Less staff to be saved	0	0	-7.5	-6
e Computer time	2	3	16.0	13.0
f Equipment	0	0	1.5	2.0
g Less maintenance cost	0	0	-9.0	-8.0
h Stationery	2.5	3.0	6.0	7.5
i Implementation cost	.1	.2	2.0	3.0
j Development cost	.2	.3	3.0	5.0
Total extra cost	14.8	18.5	26.0	38.5
Total extra costs adjusted for inflation	17.0	21.5	31.0	44

to each variable provided the assumption that the alternative strategies are in operation. The percentages of matching answers for the variables to be maintained and the variables to be improved under each strategy as well as the average of each group have been calculated.

In considering the percentage of satisfied members for each variable, it was clear that variety in physical tasks, tools and equipment declined but they were higher under strategy (2) than in strategy (1). The percentage for skill required, utilisation of abilities and training increased. Also they were higher for strategy (2) compared with strategy (1) and the present system. The other variables for this group changed within 1% to 3%. The average under strategy (1) for this group declined to 75% but increased to 79% for strategy (2). There is significant variations in the percentage of satisfied staff for the

variables to be improved. This is expected because some of the variables will be influenced by planning strategies as well as the operation of the alternative systems, others will not. For example, emphasis on length of service or on performance in promotion have not changed. Variables such as freedom to work independently, suggestions about work and consultation about change have increased to 52%, 48% and 64% respectively for strategy (2). They are in the same range for strategy (1). The other variables improved but slightly. The only variable that declined further to 25% on average was the management dealing with people. The staff think that rejection policy might discriminate between exporters and hence the further decline in the percentage of staff to be satisfied. The average percentage of variables to be improved is found to change to 48% for strategy (2) and 39% for strategy (1).

When the alternative strategies are in operation, the averages are likely to vary. Whatever the case they are likely to be within the ranges of, 70-75 and 35-40 for the variables to be maintained or increased under strategy (1) respectively and within the ranges of 75-80 and 45-50 for optimistic and pessimistic conditions of strategy (2) respectively.

TABLE 7.3.2.11:

Measures with Alternative Strategies

	Strategy (1)		Strategy (2)	
	Opt	Pess	Opt	Pess
a Number of transactions	4	5	3	5
b Rejected contracts (LS million)	-	-	10	15
c Frequency of Report Availability	Monthly	Monthly	Weekly	Weekly
d Value of Export (LS million)	284	268	279	263
e % of Receipts to Value of Export	102	101	105	102
f Time necessary to acquire and process information	Monthly	6 weeks	Twice per month	Monthly
h Value of approved Contracts (LS million)	315	315	305	300
i Cost of Foreign Obligations (LS million)	17	27	13	23
j Cost of Change (LS 000)	17	22	31	44
k Probability of Report satisfied	35%	30%	90	90
l Receipts from Exports (LS million)	289	272	289	272
m % Average of staff satisfied	75	70	80	75
n % Average of staff satisfied	40	35	50	45

7.4 TOTAL BENEFITS OF ALTERNATIVE STRATEGIES AND SENSITIVITY ANALYSIS

In designing systems it is possible to arrive at problem-directed and goal-directed strategies. In order to find the contribution of these strategies, it will be necessary to compare them with the present system and with target measures.

It might come to one's mind to subtract the measures of the alternative strategies for each goal from the targets to arrive at its contribution to that goal, but this cannot be done because the value to the people concerned does not vary proportionately to the measures.

Someone might consider that the presentation of the contribution of the alternative strategies to individual goals as they are is sufficient for decision makers, but this is not good enough for the following reasons (Hawgood and Land (1976)). The quantity of data is too much to be digestible. Decision makers need a summary of results to support their decision rather than lengthy calculations to arrive at that decision. Further, the value of going (say) half way to the stated target will be different for different types of goals. For example, the availability of updated information for managerial control by end or middle of the month rather than on an annual basis is worthwhile, but further speeding up, say up to the minute information, may not be required by them. In such a case it will be necessary to relate the contribution of the strategies to the expected target. One way to do it is to score each strategy in comparison with the present system on a scale running from -10 for complete failure to +10 for complete success with 0 representing the predicted performance of the present system (Hawgood and Land (1976)). The scoring will be for individual goals for optimistic and pessimistic conditions, each treated separately.

Then comes the question of summarising the contribution of the strategies for decision making. This will be done by the following :

(i) Multiply the weights for every shortlisted goal for each group of people by the optimistic or pessimistic score for each strategy for the same goal.

This will give the optimistic or pessimistic estimate of the contribution that strategy would make to that group of people. This is known as the "Utility Contribution" for that goal.

(ii) Add the "Utility Contribution" over all the goals for one group of people and one strategy to arrive at an optimistic or pessimistic estimate of the difference in total benefit to that group of people forecast with that strategy compared to that with the present system. The results of this process are shown in Table 7.4.1.

It has been stated that the decision makers would not mind investing several thousands of pounds annually in computer based management information system change if the benefits expected justify it. In developing countries the financial payoff is very important in their decision making because their financial resources are limited while there is increasing competition among the purposes to be satisfied. Besides the total benefits to be contributed by the alternative strategies for each group of people, it is relevant to retabulate the funds to be invested and the expected payoff of the strategies under optimistic and pessimistic conditions. This is shown by Table 7.4.2 below.

TABLE 7.4.2 :

Total Benefits to each Group of People

Total Benefits	Strategy	Strategy (1)		Strategy (2)	
		opt	pess	opt	pess
A To Exporters		309	222	219	32
B To Line and Senior Managers		325	188	570	348
C To Taxpayers and Applicants		270	70	430	160
D To Decision Makers		266	88	460	210
E To Staff		360	190	510	370
Funds to be invested (LS 000)		17	22	31	44
Payoff of change * (LS million)		13	3	17	7

* Payoff is the expected cost of foreign obligations less expected cost of these obligations under alternative strategies.

Name of Goal Unit of Measure		Percentage Weights					Measures		With alternative strategies				Scores				Utility Contribution (Weight x Scores)																
		Group A Group B Group C Group D Group E					Current Value 5-year Target		With alternative strategies				Scores				Strategy (1)					Strategy (2)											
									Strat.(1)		Strat.(2)		Strat(1)		Strat(2)		Group A	Group B	Group C	Group D	Group E	Group A	Group B	Group C	Group D	Group E							
		Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass	Opt	Pass				
Clerical procedures Number of transactions		27				10	6	3	4	3	3	3	3	6	3	133	81					30	30	162	81				90	30			
Tightness of control system Rejected contracts (LS million)		30					0	2	-	-	10	15	0	0	-6	-7	0	0					-180	-210									
Availability of advice Frequency of reports		20					0	Weekly	Monthly	Monthly	Weekly	Monthly	3	3	6	3	100	100					120	100									
Capability of Exporters Value of exports (LS million)		5	10	10	5		134	270	284	268	279	263	3	3	4	2	25	15	30	30	30	40	24		20	10	40	20	40	20	32	16	
Reliability of Exporters % of receipts to export value		5		10	10		97	105	102	101	105	102	3	1	9	4	15	5	42	14		30	10		45	20	126	56	90	40	90	40	
Feedback on performance Time to acquire and process inf.			15		10	10	0	Twice/month	Monthly	6 weeks	Twice/month	Monthly	4	3	7	3		60	45		40	30	40	30		105	75		70	50	70	50	
Expansion of export trade Value of approval (LS million)		5	15				180	315	315	315	305	300	0	0	-1	-2	0	0	0	0					-5	-10	-13	-26					
Income Cost of foreign oblig.(LS million)			8	40	20		7	30	17	27	13	20	5	2	7	4		40	16	200	80	100	40			36	32	260	140	140	60		
Avoid expensive projects Cost of change (LS\$000)				20	20		0	0	17	22	21	44	-4	-5	-5	-7			-50	-100	-60	-100					-100	-140	-100	-140			
Availability of information % of exports satisfied		3	15		12	10	20%	40%	35%	30%	90%	90%	3	2	9	7	9	6	45	30		36	24	30	20	27	21	135	105		105	54	70
Real increase of export trade Receipts from exports (LS million)		5	10	20	20		148	254	289	272	289	272	5	3	6	4	25	15	30	30	100	60	100	60		30	20	60	40	110	80	120	80
Maintain sources of satisfaction % average of staff satisfied			7			30	78%	78%	75%	70%	80%	75%	2	1	3	2		14	7			60	30		21	14				90	60		
Improve sources of dissatisfaction % average of staff satisfied			8			40	27%	40%	40	35%	50%	45%	3	2	5	4		24	16			120	80		40	37				110	160		
Total Weights		100	100	100	100	100					Total Benefits				Opt	309	222	325	168	270	70	266	88	300	190	219	32	342	160	400	210	310	370
											Pass																						

Table 7.4.1.

Utility Contribution of Alternative Strategies

Ranking order of the strategies according to their total benefits contributed to each group is shown by the table below :

TABLE 7.4.3 :

Ranking Order of Strategies

Opt			Pess	
1	2	A	1	2
2	1	B	2	1
2	1	C	2	1
2	1	D	2	1
2	1	E	2	1

Export trade information systems change is straightforward case. Whatever change in measures or weights to be considered, the results will not change.

From Table 7.4.3 it was clear that strategy (2) is ranked second for the group of exporters only under optimistic and pessimistic conditions. This result is expected because the exporters have been benefiting from absence of control. The control policy associated with strategy (2) as well as the availability of information to reflect their performance is meant to reduce the damage that they are causing to the economy of the country. One might argue that the weight assigned to this goal is too heavy. Even if it is reduced to 20% still strategy (2) will be their second choice. The control system is one of the goals necessary for the operation of the foreign exchange operation and reserve systems, but the non-availability of processed and related information creates difficulties in its implementation. Another one may suggest the elimination of this goal from the list to avoid the hostility of the exporters which is likely to result due to the implementation of control measures.

In considering the interest groups, three of them are civil servants and these are staff, line and senior managers and decision makers. Although the staff have their own job-satisfaction goals, still its presence should contribute

further to the objectives of the Bank and hence the resources under the disposal of the system. The other two groups are concerned with planning and control functions related to the availability and disbursement of foreign exchange currencies. The taxpayers and applicants are concerned about the cost that might be incurred due to ineffective control or inefficient planning. It can be said that the goals of these groups are centred round the protection of the economy of the country directly or indirectly. If control measures are not to be implemented, this means the foresaking of the benefits of these groups for the benefit of exporters. The importance of strategy (2) is in its control measures and availability of information to support this control function, planning and decision making. It is meant to increase the reliability of exporters to increase the receipts from export trade and feedback on performance to check the plan against actual results.

The management of the Bank might argue that the cost of an off-line system, i.e. the funds to be invested, is too expensive compared with an off-line manual system. This is true but there is one thing to be considered. If the information to be processed by strategy (2) is processed manually, then the cost of manual processing should be more expensive than this off-line system. The availability of the information under strategy (2) should reduce the cost of foreign obligations within the range of LS 17 million for optimistic conditions and LS 7 millions for pessimistic conditions. The same cost for strategy (1) will be within LS 13 and LS 3 millions for optimistic and pessimistic conditions. These costs are expenses to be subtracted from the revenue of the Bank of Sudan to arrive at the net profit to be transferred to the account of the central government. Even if the cost is increased further, still the benefit of available information should offset it.

Another thing to be considered is the informatic phenomenon in developing countries. Sooner or later the organizations in these countries will be

obliged to introduce computer technology and they have to lay down the foundations for a computer function within their information systems. These countries and hence their organizations are suffering from lack of resources. At the same time the needs for these resources are increasing and competing with each other. Several years ago personal judgement alone used to do in the distribution of these resources. In these days there is a change in social life and the people began to demand their rights. The planners can no longer depend solely on intuition in the distribution of these limited resources. So they need information to better solve the fundamental problems they are now facing, such as how to conduct national economy, optimisation of resources for the promotion of social and economic development. Manual processing is one of the factors that create job-dissatisfaction. At the same time, planning for limited resources without information is frustrating and hence the importance of the computer function.

Whatever change in weights or measures, still strategy (2) will rank first for the groups other than exporters because the difference in total benefits is far more than in strategy (1). Strategy (2) will do better under pessimistic conditions for groups B and E compared with optimistic conditions of strategy (1).

The application of the BASYC technique in the evaluation of export trade information system turned to be single phase study. The results will be presented for decision making.

7.5 PRESENTATION OF THE STUDY

Too much information will not be required by decision makers as it will be difficult to digest it. Too concise information will not help them in their decision function as some of the required information may not be available. Accordingly it will be necessary to make a balance.

Table 7.4.1 is very important for decision making as it includes the goals of the respective groups of people, units of measures for these goals,

the importance of these goals as percentage weights being assigned by them, current measures, 5-year targets, measures with alternative strategies, scores for these measures, utility contribution of each strategy to each goal and total benefit of each strategy to each group of people. Retabulation of total benefit to each group of people, the funds to be invested in each system and the expected payoff of the strategies, i.e. Table 7.4.2 is also important. As they might have no time to work out the importance of the strategies to each group of people, it was necessary to rank the orders of these strategies according to their utility contribution, i.e. total benefit to each group of people, Table 7.4.3.

Besides this information, decision makers will need additional information. The additional information includes :

(a) List of groups of people who will be influenced by change of export trade information system. These groups include :-

- (i) Exporters
- (ii) Their commercial banks
- (iii) Management of Receipt department
- (iv) Management of the Research department
- (v) Senior managers of Exchange control and Foreign Exchange depts.
- (vi) Applicants for foreign exchange currencies
- (vii) Taxpayers
- (viii) Decision makers of the Bank
- (ix) Staff of the Receipt department
- (x) Coders of the Research department

Due to the nature of their interest to be considered by the change of export trade information system and for evaluation purposes, it was possible to classify these groups under the following main groups of beneficiaries :-

- (A) Exporters and commercial banks : they are personal subject.
They are the group of people, to the members of which the

information held in the system will refer.

- (B) Management of the Receipt and Research departments and senior managers of Exchange Control and Foreign departments :
they are the users of the system whose behaviour will determine the load on it and its mode of operation.
- (C) The taxpayers and applicants for foreign exchange currencies :
they are the financial beneficiaries. They are concerned about the payoff, namely the cost of foreign obligations in which they share directly or indirectly.
- (D) The decision makers of the Bank : they are concerned with the image of the Bank related to export trade and foreign exchange operation and reserve systems.
- (E) The staff of the Receipt department and the coders of the Research department who are concerned about the influence of the change on their job satisfaction.

Table 7.4.1 included their goals and units of measure for these goals. Table 7.4.2.1 showed the expected total benefits contributed by each strategy for each group of them. Table 7.4.3.1 is a ranking order for these strategies according to their total benefits to them.

(b) Brief outline of alternative system designs to point out their characteristics and shortcomings.

In this case of export trade information system, they must know that for feasible social solutions the coders of the Research department are to be merged with the staff of the Receipt department. This is necessary to distribute the burden of data preparation among several members of staff rather than to put it on one group, namely the coders. Already there are job-satisfaction problems among coders, further coding will increase it and is likely to reduce their efficiency. Another coder section for the Receipt department will be associated with social problems, financial

cost due to salaries, and space to accommodate them. It will be duplication of effort and further delay in the flow of information.

Information processing for operational control is necessary. Its provision is one of the objectives of this change. For both of the strategies, besides export forms to be sent by commercial banks, it will be necessary to use export forms to be sent by customs stations in this control function. As this form shows the date of shipment, it is possible to implement the 45-days target in proceeds collection. Lists of these forms sorted by number under the names of commercial banks will be sent to them monthly to notify them of the date of collection. A copy of this list will be reserved by the Receipt department to compare the collection against the value of exported commodities. It is easier for them to work with one list rather than thousands of transactions.

Because of the information quantity to be processed, strategy (2) turned out to be more expensive than strategy (1), but if the same information will be processed manually, its financial cost will be more expensive besides the social problems due to manual processing and delay.

Strategy (2) is characterised by the creation of data bases to reflect the expected or resulting performance of export trade as well as each exporter's for operational and managerial control and planning. Both of the strategies will produce information for planning and decision making of top management of the Bank. The flow of information under the present and alternative system is to be presented to them as well.

7.6 CONCLUSION

Up to the mid-sixties, cost displacement of clerical staff was the only criterion to justify the introduction of computer technology in administrative or business organizations. The cost of staff to be saved, plus the cost of the offices that accommodated them and other equipment, if any, set against the funds

to be invested to provide a computer function, was the only means to measure the benefits of computer processing. If this criterion alone is applied to evaluate the export trade computer-based management information system under consideration, the project should be rejected on the spot. There is a LS 6 thousands expected saving against LS 35 thousands to provide an off-line operation (strategy (2)), but there will be an immediate need for two members of staff added to it, LS 20 thousands to provide for partial change of this system, i.e. strategy (1). Whatever cash flow criteria to be employed, this change will not be justified.

During the late sixties it had been realised by many concerned planners that this cost displacement criterion was no longer relevant to support decision functions about this type of investment. The techniques employed to assess the cost or benefit ignored several important variables from the evaluation process because these variables were not known, it was difficult to assign monetary values for them, there was no unit of measure for them, etc. This in itself contributed further in the rejection of these cash flow methods in the evaluation of this type of investment alone. At the same time there was an increasing demand for computer processing, and a significant proportion of the National income was allotted to them.

In considering the other objectives of introducing computer technology, they are directed to the improvement of information aspects such as availability of information in a given time, integration of information elements, speed of processing, etc. If one asks ; why do these organizations bother themselves about accuracy, reliability and timeliness of information ?, the answer to this question is the base to assess the financial worth of computer processing. On applying this criterion to evaluate the export trade information system, the payoff in financial terms is more than to be offset by the cost of operation. Someone might argue that as far as the income of an off-line system is more than to be

offset by the cost of operation, then the management of the Bank might change its mind to consider the on-line system and might ask for its design and evaluation as well, but the export trade information system is not in need for an on-line system as weekly or even monthly information is sufficient for operational and managerial control and planning. The payoff is a variable necessary for owners or financial beneficiaries. The on-line system might result in negative benefit for staff as they will be asked to feed the computer with the data and this is a new task for them. Already they stated their dissatisfaction with the new coding job ; accordingly they might not accept to feed the computer with information as well. The important thing to consider is the value of the system to the respective groups of people who will be affected by it, not only one group, i.e. the financial beneficiaries. The payoff is one of the variables to encourage management in developing countries to consider informatics seriously and take action to speed the introduction of computer technology in their respective organizations, but if it is the only criterion for decision making, then these countries should end up with the same problems of developed countries that applied financial measures for evaluation and technical consideration in the design process.

Apart from the explicit variables stated in the book of rules of the Bank such as salary, holidays, etc., members of staff might not be aware of what they are supposed to do for their employers, and what the employers are supposed to pay for it. The technique of measuring job satisfaction had been employed to find the variables to be maintained or improved in the design of the alternative system then further the contribution of these alternatives towards the goals. The adoption of such technique has the advantage for members of staff as well as the organization as it should put the employee in a position to question what rights he is to ask for and what he is supposed to do to get them.

The rights of the personal subject on whose behalf the system had been established - in this case they are the exporters - had never been a factor to be considered in a change of policy or system in Sudan. Organizations or systems

are established to serve or cater for the goals of specified groups of people, but once these systems are in operation no one bothers himself to find out whether these systems are achieving these objectives or not. This is a characteristic of public entities in general. Ignorance of people about their rights to ask for is a factor that makes the planners not to consider them when they change systems or policies. The exporters who could contact politicians or decision makers could possibly influence the decision function for their own personal benefits. The others can share if it is a beneficial situation but might lose if it is against them. There is discrimination among exporters contributing to the damage of export trade, hence the economy of the country.

One of the best features of the BASYC technique is its provision for the goals of this group of personal subject in changes of policy or system. In the case of export trade, the exporters will lose because they have been benefiting from the absence of control measures. In other cases whatever the goals of these groups, no planners consider them.

Information processing is urgently required in Sudan in every aspect of life. Computer based management information systems might seem to be expensive but manual processing should turn out to be more costly if the same information is to be processed and the cost of the non-availability of information should be higher than any expected cost of its processing.

SUMMARY

'Informatics is a factor of primary importance in the political, economic, social and cultural life of countries, and it influences the forms and habits of human society more deeply than any other development since the Industrial Revolution.' (IBI (1) - 1975). 'The countries which are becoming aware of the importance of informatics and are taking appropriate action thereto are those which will be the most advanced at the end of the twentieth century, whilst those which are neglecting and overlooking this phenomenon will be less developed in the year 2000, whatever their present level of development may be.' (IBI (2) - 1975).

The primary purpose of this thesis has been the development of computer based management information systems in an organization in a developing country, i.e. Bank of Sudan, adopting modern design and evaluation techniques being developed in developed countries.

Apart from book-keeping procedures and its resulting financial reports, it is too difficult to say that there is information processing for managerial or operational control or planning. The social cost of manual information processing (reflected by the dissatisfaction of the employees concerned with the accounting system) the heavy cost to be incurred to develop computer based management information systems as well as the risk associated with the introduction of computer technology in developed countries are some of the main factors that cause management in Sudan to neglect and overlook informatics or even information processing to support control and planning functions. The non-availability of information, beside the indirect cost to be incurred due to inefficient planning or ineffective control systems, resulted in social problems, namely frustration among the managers and executive staff with control and planning functions. In developed countries the introduction of the computer technology as an integral part of the information system evolved through several phases. The discovery of

the technology, as well as the factors that brought managerial awareness to improve their information processing, was the first phase, i.e. the phase of technical efficiency of the information processing system. Due to the cost of clerical staff which tended to inflate and the capabilities of the computer technology in replacing them, many organizations came to believe that they could save by introducing this technology. Cost displacement was accepted as a criterion to evaluate the worth of computer information processing. While cash in and out characterized the evaluation methods employed, at the same time technical factors dominated the design of the system. This could be called the 'save money' stage.

Towards the end of the sixties many organizations realized that they could support their planning and control function by introducing the computer technology in functional areas with these functions. Cost displacement was not sufficient to assess the worth of computer based systems for such functions. The fact that there are no market prices for the effects of the EDP on the aspects of information might be one of the factors that contributed to the rejection of cost displacement criterion. Still technical factors dominated the design process. For evaluation purposes, evaluators considered the aspects of information necessary for planning and control, i.e. the decision making process then what will happen in this decision making process if computer information processing is introduced to change the aspects of information. This stage is said to be the 'make money' stage.

During the late sixties through the seventies, social or behavioural scientists started to ask organizations to consider staff job satisfaction an objective to allow for in system design and they proved that this job satisfaction is very much influenced by computer information processing. At the same time other planners realized that EDP systems could enable organizations, in particular public entities, to distribute fairly their resources and preserve rights of those who might ask for them. The influence of computer processing on consumer or user

satisfaction was realized in the second phase but it was approached through its financial implication on the organization.

The multi-effects of introducing the computer technology as an integral part of the information system led to the adoption of multi-attribute utility analysis as a technique to measure the worth of the system for the organization. The BASYC approach is one of these techniques. The fact that the computer technology influenced the technical and social factors of the information system stimulated social or behavioural scientists to develop methods of design to allow for these two factors together rather than the technical factor alone. The ETHICS is one of the methods that makes explicit allowances for social and technical factors in system design.

The multi-attribute utility analysis and the consideration of social and technical factors in system evaluation and design respectively characterized the third phase of the introduction of computer technology ; perhaps we could call this the phase of 'all-round benefits'.

Within the Bank of Sudan information systems, there are different social, technical, financial and organizational problems in which solutions computer information processing could contribute. These problems differ from one system to the other.

Developed countries lost financially and socially due to systems being designed on technical bases. They realized that the introduction of the computer technology means social and technical change. At the same time many organizations could not assess the worth of the system towards the objectives of the organizations on financial bases only because of the different directions of benefits to be considered. The BASYC and the ETHICS are two approaches being developed and applied to contribute in the evaluation and design problems respectively. It was irrelevant to apply financial criteria or technical bases for evaluation and design respectively in an organization in a developing country with social, technical, financial and organizational problems as far as there

are techniques other than these to guide planners in design and evaluation problems.

The ETHICS approach was applied to design the export trade computer based management information system. Later, it was incorporated with the BASYC approach to evaluate the benefit of the system change. On the application of the ETHICS approach, it was possible to arrive at a socio-technical computer based management information system for export trade in which its social and technical factors are compatible with each other. While the technical factor, i.e. data processing requirements, were fully considered, at the same time it was possible to reduce the risk of change likely to result from social variables by allowing for staff satisfaction, structure of the organization and managerial demands for information.

For the design purpose, the author considered the decision making process related to export trade system. Detailed analysis covered the Receipt department and the coder section of the Research department, then the demand made by the decision making process on the information system of export trade. If a departmental approach were followed in this development process, the change would have been confined to the Receipt department that represented the major section of export trade information system. While the coders of the Research department were to do the job for the top managers of the Bank, the Receipt department would have to do it as well. Here, there would have to be duplication of the same job and more financial cost of operation. Also the job satisfaction problems of the coders would have not been considered. The total system approach followed in this thesis has the advantage of reducing the cost of operation, avoidance of effort duplication and contribution in the solution of social problems. If a technical approach were followed in the design process, it would have been necessary to establish a coding section in the Receipt department. The management of the Bank would have to face up to job satisfaction problems of two sections, i.e.

the coders of the Research department and the new coding section of the Receipt department. Alternatively, the coders of the Research department were to do more coding jobs due to which their problems would have to be increased. The socio-technical approach, based on the ETHICS method which is followed in this thesis, has the advantage of creating an information system in which there is a large number of staff members with reasonable degree of job satisfaction rather than two groups with a high and another with very low job satisfaction.

On the application of the BASYC technique to assess the benefit of the change, it was possible to assess the direction of benefits of exporters, members of staff, line and senior managers, taxpayers and applicants for foreign exchange currencies and decision makers of the Bank. In Sudan, public entities - the Bank of Sudan is one of them - are established to achieve stated objectives related to the groups of people who will be affected by change of policies or systems. Once the entities start their operation, nobody cares to investigate whether they are achieving these objectives or not. In this case of the export trade system, the application of the BASYC technique has the advantage of revealing to the decision makers the deficiencies of the present system. Unfortunately, in the case of the Export trade, the exporters, i.e. the personal subject of information, used to benefit from the presence of snags due to control measures. By so doing they prevented the country from acquiring the full values of the exported commodities. The taxpayers and the applicants for foreign exchange currencies, i.e., the financial beneficiaries, are paying for the inefficiency of the export trade system. Applying financial techniques based on direct cash in and out to evaluate the worth of a computer based management information system for export trade, it would have been difficult to pinpoint this indirect loss of the system. Also, evaluators would have pointed out the efficient system for decision making but efficiency without effectiveness is not the only question of the evaluation measures.

There are two ways in the application of the BASYC approach. The first

is to consider the goals of a group of people then to measure the contribution of the alternative system or strategies towards the goals. The other is to prepare a list of goals for all the groups together then to carry on measures for the groups together. This second version was applied in this thesis. While there are some goals confined to a given group, there are other goals being shared by several groups. This is a typical case in daily life.

The thesis proved that the introduction of computer information processing, if designed on socio-technical bases and evaluated according to their contribution to the objectives of the organization, should contribute positively. While the socio-technical approach based on the ETHICS solved social and technical problems, the evaluation based on the BASYC proved that the indirect payoff is more than the equivalent of the direct cost of operation.

In developing countries technical knowledge and orientation and financial resources are some of the factors that constrained the shift from manual information processing to sophisticated computer operation such as on-line. Accordingly, and for this case of the Bank of Sudan, it was more relevant to start with simple computer information processing, that is, the off-line system.

In developed countries - as seen in the Bank of England - organization tend to establish EDP centres well staffed and equipped with the different disciplines required for the development of the systems, their progress and survival. They allow for consultants to advise them, system analysts to investigate the requirements in present and future, social scientists to care for staff requirements, operational researchers to build models to help units in solving their problems and utilise the output, technical people to increase the efficiency of the computer, financial people to assess costs etc. At early stages it might be costly for an organization in a developing country like Bank of Sudan to allow for the different disciplines necessary for the EDP centre. Those who are in charge of the centre are expected to be everything. They have to acquire

knowledge about these requirements to do them themselves or to ask for them or the recruitment of the disciplines in the future.

Phasing of implementation of the changed system according to availability of resources is necessary in developing countries.

This phasing has to be applied in staffing procedures as well of the EDP centre. In the present there are four punch machine operators, two machine operators, one of them on a permanent basis and the other takes over when the former is away for one reason or another, and three members of staff who started as programmers then later acquired knowledge as systems analysts and designers. The author is one of them. The section is attached to the Research department of the Bank, the managers of which know nothing about the implication of computer technology other than its capabilities in processing information.

Within the other units of the Bank there are several members of staff whose educational background included statistics, mathematics and modern operation techniques such as simulation, linear programming etc. As they are acquainted with the function and operational activities of the Bank, they can contribute in building models within their specialisation to contribute in problem solution. The management of the Bank do not pay for staff if they provide additional jobs different from the daily routine within their units and this is one of the factors that made staff not to care for additional effort other than their assigned jobs. No-one bothers himself to make research to find facts or solve problems. The author suggests payment system for the Bank of Sudan to involve anyone that design model to solve problems. Beside the other factors that create satisfaction, staff care very much for their salaries and their increase, so the Bank can use it as one of the means to increase efficiency. This will help in the preparation of application programmes, the main part of the software. In the future and when the EDP centre expands, the models designers can be attached to the centre.

System Engineers are not required at this stage of computerization as the changed system to start with is based on an off-line system and an external centre

will be used to process information. In the coming phase which is expected to take place after five years, the Bank will have its own computer installation to provide for the systems which will go for on-line operation. In such a case it will add to the benefit of the Bank if it prepares system engineer to specialise in computer technology. Beside his work with the technology, he will contribute by technical advice in the type of the machine to be installed as well as its implementation and operation.

Personnel department is one of the agents required for efficient planning of change to computer system because it is the only department responsible for staff problems and social objectives of organization. The present personnel departments of the Bank of Sudan do not include social or behavioural scientists to care for staff requirements. Without the advice of these people it will be too difficult to develop an efficient system in which their social and technical variables are compatible with each other. Social problems will be created in the personnel departments if a section concerned about staff requirements to advise on the problems of the computer installation is to be established within the EDP centre. This section will be responsible for staff requirements whose jobs will be influenced by the EDP operation. It will not be able to consider the influence of the computer technology on the other social objectives of the Bank. It will be duplication of effort hence more cost. Already the non-provision for staff satisfaction other than payments is one of the shortcomings of the present personnel departments. As the introduction of computer will be associated with changes in several aspects of the Bank, it will be the right time to allow for change in these personnel departments by recruiting the skill required for modern personnel management. The provision for the many disciplines required for the development, progress and survival of the system will cost more than benefit in early stages. The Bank is to plan the ultimate but convert by degrees. From the survey of the Bank of Sudan, it was clear that it will be too early for the

management to appreciate an integrated computer based management information system to include the whole operational activities of the Bank at one time. Most of the managers consider the introduction of this technology as conversion of manual procedure to electronic operation. When they view it they have in the back of their minds a sort of structured job to be transferred to the computer. Informatics is a new phenomenon for them and the capabilities of the computer technology in processing information or as an integral part of information system will not be appreciated by them if material proof is not provided. Change of Export trade information system is a good example. Beside its being a sort of unstructured activity to be transferred to the computer, it reflected the implication of information availability on planning and control function and hence the indirect pay off of information processing. This will contribute to their acceptance to establish an EDP centre separate from any unit to serve the entire systems of the Bank. Further the implication of the variables that influence the income due to change is a factor to encourage them to provide for the disciplines required for the section. They must know that the EDP centre is not a team of punch and machine operators and programmers. It must be staffed with operational researchers, system analysts and designers and computer technologists. It must be advised by a personnel department that includes social or behavioural scientists to consider its implication on staff satisfaction as well as the structure of the Bank. In order to gain the acceptance and co-operation of the several departments it must not be locked in a given department as it is now. To be fair for its members the centre must be managed by a manager who knows about computer operation to contribute to its development, progress and administration and to communicate between the centre and the top managers rather than to allow others in between. The centre must be viewed as a service offering unit rather than a competing department struggling to deprive the others of their functions.

APPENDIX A

THE JOB SATISFACTION QUESTIONNAIRE

TASK CONTRACT

Variety

1. Variety in Work Tasks

- (A) My work consists of doing many different things ; there is a great deal of variety.

agree partly agree disagree not clear

- (B) I like to have a lot of different things to do in my work.

agree partly agree disagree not clear

2. Variety of Documents and Equipment

- (A) I use many different documents in my job.

agree partly agree disagree not clear

- (B) I enjoy doing work where I have to use different documents.

agree partly agree disagree not clear

3. Variety in Place of Work within Office

- (A) I spent my working day sitting at one place.

agree partly agree disagree not clear

- (B) I do not like to move from one place to the other in the office to do my job.

agree partly agree disagree not clear

4. Variety in Work Pace

- (A) Sometimes I am busy to finish the job while sometimes I am idle without any work to do.

agree partly agree disagree not clear

(B) I do not like to be so busy at a time and idle for another time.

agree partly agree disagree not clear

5. Autonomy - Choice of Pace of Work

(A) I have no control over the speed of the work.

agree partly agree disagree not clear

(B) I like to be able to work at my own speed.

agree partly agree disagree not clear

6. Choice of Methods of Work

(A) I do my job my own way.

agree partly agree disagree not clear

(B) I do not like to be told how to do my job.

agree partly agree disagree not clear

7. Sequence Choice

(A) There are stated stages through which my job is to be done.

agree partly agree disagree not clear

(B) I do not like a fixed sequence in which to do my job.

agree partly agree disagree not clear

8. Supervision

(A) There is too much supervision and I report actions to head
of section or manager

agree partly agree disagree not clear

(B) I do not like to work with supervision for every action.

agree partly agree disagree not clear

9. Contact with Colleagues

- (A) There is a great deal of contact with the other people in the department.

agree partly agree disagree not clear

- (B) I don't need to have much contact with the other people in the department.

agree partly agree disagree not clear

10. Contact with Customers

- (A) I spend most of my time dealing directly with applicants for foreign exchange operations.

agree partly agree disagree not clear

- (B) I do not like the direct contact with the applicants.

agree partly agree disagree not clear

11. Opportunity to Chat on the Job

- (A) There is time for private conversation with people in the section while working.

agree partly agree disagree not clear

- (B) I prefer a job where there is time for a chat now and then while we are working.

agree partly agree disagree not clear

12. Opportunity to Chat off the Job

- (A) I can get away from the job during working time for a chat with my colleagues.

agree partly agree disagree not clear

- (B) I like the sort of job where you can go off and have a chat if you want.

agree partly agree disagree not clear

17. Task Identity.

- (A) In my job I can see where each bit of work begins and ends.
agree partly agree disagree not clear
- (B) I prefer a job in which I can see a definite start and finish
to each bit of work.
agree partly agree disagree not clear

18. Freedom from Repetition.

- (A) I repeat one action several times a day.
agree partly agree disagree not clear
- (B) I do not like to do one action several times a day.
agree partly agree disagree not clear

19. Seeing some results from work.

- (A) I can see the results of my work.
agree partly agree disagree not clear
- (B) I like to be able to see something as a result of my work.
agree partly agree disagree not clear

20. Task Wholeness.

- (A) In my work I do not do the whole job; other people do parts of it.
agree partly agree disagree not clear
- (B) I like to do a job from beginning to end - not just a small
part of it.
agree partly agree disagree not clear

TARGETS

21. Freedom from quantity targets.

- (A) I know how much work I am expected to get through in a day.
agree partly agree disagree not clear

- (B) I like to be given a target - a certain amount of work
to be done in a day.

agree partly agree disagree not clear

22. Scope for setting own quantity targets.

- (A) I can divide my work and set myself a certain amount to do.

agree partly agree disagree not clear

- (B) I like to set my own targets when I do my work.

agree partly agree disagree not clear

23. Freedom from quality targets.

- (A) My work has to keep up a clearly defined quality standard.

agree partly agree disagree not clear

- (B) I enjoy a job where I am expected to do high quality work.

agree partly agree disagree not clear

24. Scope for setting own quality targets.

- (A) I am free to set quality standards of my own to aim for.

agree partly agree disagree not clear

- (B) I like to set my own quality standards and then work towards
them.

agree partly agree disagree not clear

Feedback.

25. Information back about error.

- (A) I know about any mistake that I do in my work.

agree partly agree disagree not clear

- (B) I find it frustrating to know about every mistake in my work.

agree partly agree disagree not clear

26. Impersonal information back about errors.

(A) The post inform me about my mistakes.

agree partly agree disagree not clear

(B) I would prefer to know about my mistake without being informed by the post.

agree partly agree disagree not clear

27. Information back on performance.

(A) I do not know how much I have done each day.

agree partly agree disagree not clear

(B) It is important to know how much work I am getting through.

agree partly agree disagree not clear

28. Information back about successes.

(A) I never hear about it if my work is alright.

agree partly agree disagree not clear

(B) I like to be told when my work is well done.

agree partly agree disagree not clear

KNOWLEDGE CONTRACT

Knowledge Level

29. Skill level.

(A) I do not need skill to do my job.

agree partly agree disagree not clear

(B) I enjoy doing a job which requires a sort of skill.

agree partly agree disagree not clear

30. Range of knowledge.

(A) I am required to know what I am doing.

agree partly agree disagree not clear

(B) I prefer if I can do more than what I am doing.

agree partly agree disagree not clear

31. Length of learning time.

(A) I do not need much time to learn this job.

agree partly agree disagree not clear

(B) I prefer a job that takes me longer to learn it,

agree partly agree disagree not clear

32. Learning on the job.

(A) In this job I learn a bit more every day.

agree partly agree disagree not clear

(B) I enjoy a job where I never stop finding out something new.

agree partly agree disagree not clear

Opportunities for Training.

33. Opportunities for improving skills.

(A) There is no chance to learn more or improve my skill from this job.

agree partly agree disagree not clear

(B) I find it frustrating not to improve my skill or learn more from my job.

agree partly agree disagree not clear

34. Opportunities of training for a better job.

(A) There is not adequate opportunity here to train for a better job.

agree partly agree disagree not clear

(B) It is frustrating not to have the chance of being trained for a better job.

agree partly agree disagree not clear

35. Adequacy of training for the present job.

(A) I feel I had the training I needed for the job I am now doing.

agree partly agree disagree not clear

(B) It is important to be trained for the job I am to do.

agree partly agree disagree not clear

36. Adequacy of training for new change.

(A) I adapt myself to changes while I am doing the job.

agree partly agree disagree not clear

(B) I would like training when there are changes in my department.

agree partly agree disagree not clear

Use of Potential

37. Opportunities to use abilities to the full.

(A) There is no chance to use my abilities in my present job.

agree partly agree disagree not clear

(B) I find it frustrating not to be able to use my abilities to the full.

agree partly agree disagree not clear

38. Opportunities to use knowledge gained through training.

(A) I feel that my training is not being fully used in this job.

agree partly agree disagree not clear

(B) I get frustrated as I am trained to do more and I am not using it.

agree partly agree disagree not clear

39. Encouragement of career development by managers.

(A) The management of the Bank is interested in developing people for better jobs.

agree partly agree disagree not clear

- (B) I do not like to work in an office where I have to do things which are really someone else's job.

agree partly agree disagree not clear

44. Consideration for staff in policy making.

- (A) Most of the managements policies seem to disregard the consequences for staff.

agree partly agree disagree not clear

- (B) The policies of the management should be decided with the welfare of the staff in mind.

agree partly agree disagree not clear

Payment Policy.

45. Payment compared with other firms.

- (A) The payment in the Bank compares well with other public entities for the jobs we do.

agree partly agree disagree not clear

- (B) It is important to feel you are being paid the same as people doing similar jobs in other public entities.

agree partly agree disagree not clear

46. Age and seniority for salary differences.

- (A) Payment is based on seniority only.

agree partly agree disagree not clear

- (B) Payment should not be based on the seniority only.

agree partly agree disagree not clear

47. Abilities and knowledge for salary differences.

- (A) The Bank is not paying me a fair salary for the abilities and knowledge I use in my job.

agree partly agree disagree not clear

Interesting Work.

69. Interesting Work.

(A) I find the work here very interesting.

agree partly agree disagree not clear

(B) I must have a job which is interesting or I get fed up.

agree partly agree disagree not clear

70. Scope to try out new ideas.

(A) There is little scope for me to try out my own ideas in this job.

agree partly agree disagree not clear

(B) I wish if I can to use my own ideas and initiative in my job.

agree partly agree disagree not clear

71. Challenging Work.

(A) I find my work is often too easy for me.

agree partly agree disagree not clear

(B) I enjoy the challenge of a demanding job.

agree partly agree disagree not clear

72. Freedom from dull, routine work.

(A) My job is frequently dull and monotonous.

agree partly agree disagree not clear

(B) I find it difficult to put up with routine work.

agree partly agree disagree not clear

Responsibility.

73. (A) I have a great deal of responsibility in my job.

agree partly agree disagree not clear

(B) I would rather not do a job which carried a lot of responsibility.

agree partly agree disagree not clear

74. Responsibility for others.

- (A) Responsibility for other people's work is an important part of my job.

agree partly agree disagree not clear

- (B) I prefer to get on quietly with my own work than have responsibility for the work of others.

agree partly agree disagree not clear

75. Responsibility for own efforts.

- (A) In this job I am not feeling responsible for my own efforts.

agree partly agree disagree not clear

- (B) To share responsibility for own efforts with others is frustrating.

agree partly agree disagree not clear

76. Feeling of having the right amount of responsibility.

- (A) I have been given more responsibility than I would like.

agree partly agree disagree not clear

- (B) It is frustrating to handle more responsibility than you have been given.

agree partly agree disagree not clear

Advancement.

77. Chance of promotion.

- (A) I have a good chance of promotion to a higher post.

agree partly agree disagree not clear

- (B) I am keen to get promotion.

agree partly agree disagree not clear

78. Readiness of management to promote.

(A) The management is ready to promote people to higher posts.
agree partly agree disagree not clear

(B) The management should promote good people.
agree partly agree disagree not clear

79. Scope for getting ahead in the Bank.

(A) There are scopes for getting ahead in the Bank.
agree partly agree disagree not clear

(B) It is important to get on and get to the top.
agree partly agree disagree not clear

80. Progress coming up to expectations.

(A) My progress is more than my expectation.
agree partly agree disagree not clear

(B) I feel happy as I could move to higher post.
agree partly agree disagree not clear

ETHICAL CONTRACT

The Bank Image.

81. Bank's image as a good employer.

(A) The Bank of Sudan is a good employer to work for.
agree partly agree disagree not clear

(B) Being a good employer is a source of security for the employee.
agree partly agree disagree not clear

82. Progressiveness of management.

(A) The Bank of Sudan is moving with the times.
agree partly agree disagree not clear

94. Priority given to staff interests.

(A) We are asked to put the Bank of Sudan's interests before our own.
agree partly agree disagree not clear

(B) Staff should consider their own interests as well as the Bank's
interests for the good of both.
agree partly agree disagree not clear

95. Identity - feeling of belonging.

(A) I am fitting in very well here.
agree partly agree disagree not clear

(B) It is frustrating if I am not fitting in well or belonging.
agree partly agree disagree not clear

96. The Bank of Sudan as an employer compared with outside firms.

(A) The Bank of Sudan compares well with other firms as a place
to work in, from what I know.
agree partly agree disagree not clear

(B) I would rather have a job in the Bank of Sudan than in most
outside firms I know about.
agree partly agree disagree not clear

Work Atmosphere.

97. Friendly colleagues.

(A) Colleagues are friendly in this department.
agree partly agree disagree not clear

(B) It is important to work in friendly atmospheres.
agree partly agree disagree not clear

98. Team spirit in the department.

(A) There is a good team spirit in my work group.

agree	partly agree	disagree	not clear

(B) I like to work as a part of a team.

agree	partly agree	disagree	not clear

99. Co-operation in group.

(A) We help each other in work.

agree	partly agree	disagree	not clear

(B) It is pleasant to work in a department where people help each other.

agree	partly agree	disagree	not clear

100. Happy atmosphere in the department.

(A) This department is a happy place to work.

agree	partly agree	disagree	not clear

(B) I cannot work properly in an unhappy atmosphere.

agree	partly agree	disagree	not clear

101. Computers seem to be complex.

agree	partly agree	disagree	not clear

102. Computer is likely to dominate the Bank if they are brought in.

agree	partly agree	disagree	not clear

103. Computers reduce personal contact.

agree	partly agree	disagree	not clear

104. Computers operations create unemployment when it comes in.

agree	partly agree	disagree	not clear

105. Computers cause a lot of monotonous and uninteresting work.

agree	partly agree	disagree	not clear

106. With computers taking over people would not matter any more.

agree	partly agree	disagree	not clear

107. Computers help people to do their work more easily and efficiently.

agree	partly agree	disagree	not clear

108. Computer improves the aspect of information such as accuracy
availability.

agree	partly agree	disagree	not clear

109. I like a job in which things are always done the same way.

agree	partly agree	disagree	not clear

110. I do not like it if life goes on in the same way from year to year.

agree	partly agree	disagree	not clear

111. Big changes in the Bank of Sudan cause chaos.

agree	partly agree	disagree	not clear

112. I do not mind moving jobs to improve my prospects.

agree	partly agree	disagree	not clear

APPENDIX B

DESIGN OF COMPUTER SUB-SYSTEM

B.1 Computer sub-system Design

Information system receives inputs of data and instructions, processes the data according to these instructions and outputs results. Sometimes information processing requests data that was collected due to prior processing, due to which file storage is added to its model. In designing a computer sub-system, each application will be related to (1) Input, (2) Output, (3) file, and (4) processing.

The computer facilities available for processing export trade information include IBM 360/30 64K, three disk drives, four tape drives, one paper tape reader, one read/punch machine, one line printer, one console typewriter and operating system DOS. Inside the Bank there are six punch and four verifying machines, 75 magnetic tapes and three disks.

B.1.1 Input Design

The information elements to create the database and files of export trade information system can be captured from export licences and contracts, export forms (copy 4) that arrive from the commercial banks to reflect the expected utilisation, export forms that arrive from the custom station to state the quantities shipped and date of shipment (copy 2) and export forms that reflect the actual collection of proceeds (copy 1). The important factors to be considered in the design process of input data is their organisation and the time taken to read them. The following are the main input data cards:

- (1) Approved contracts cards
- (2) Expected utilisation cards
- (3) Shipment cards
- (4) Receipt cards

Descriptions of these cards and their layout is given by Fig.B.1.1.1.

07314-2-12034110 TW35110

a) Commodity from 001-999
b) Country from 001-999
c) Groups of countries from 0-9
d) Unit of Measure: B=Bale
T=Ton
H=Head
P=Pound
O=Others
e) Unit of Currency: D=US Dollar
S=Sterling
W=W. German Mark
F=French Franc
Z=Switzerland Franc
L=Italian Lira
G=D. Gilder
f) Terms of Trade from 0-9
g) Media of Payments from 0-9
h) Media of Transport from 0-9
i) Term of Contract or Shipment:
Contract card T=Total
P=Partial
Export form cards from 0-9
j) Remarks from 0-9

Figure B.1.1.1 Description of Input Cards

Weekly there will be 250 approved contracts cards, about 1500 expected utilisation cards, shipment cards and receipt cards respectively monthly. Approximately there will be 7000-8000 cards monthly. The read time each run should not take more than 35 minutes including resubmission runs to correct rejected data.

B.1.2 Output design

An initial design consideration is the organisation of output results and the time taken to print them (Waters, 1974). Most of the output to be produced for export trade system is to be designed because it has not been produced before. The output reports to be produced include the following:

(i) Weekly listing of approved contracts sorted by the serial number of the receipt department. The weekly average of approved contracts is round about 250. The information elements of each contract will be listed on a separate line. There will be a line in between. The layout of the report is shown by Figure B.1.2.1. The number of pages is about 10 and the time necessary is not to exceed 1 minute.

DATE XX-XX-XX

PAGE XX

WEEKLY APPROVED CONTRACTS

B.O.F.#	EXP/L#	COUNTRY	COMMODITY	QUANTITY	UNIT	PRICE	UNIT	VALUE	LS.VALUE	T.O.F	P/MEDIA	REMARK
X OX	XXXXXX	1---1	COTTON	XXXXXX	BALE	XX	STER	XXXXXX	XXXXXX	PARTIAL	CIF	1ST APPROVAL
XXXXX	XXXXXX	1---1	GUM	XXXXX	TON	XXX	POLL	XXXXXX	XXXXXX	TOTAL	FOB	RENEWED

Figure B.1.2.1

(ii) Expected proceeds monthly from the approved contacts sorted by commodity to be exported. Monthly expected proceeds will be calculated from the information of the contracts sorted by commodity for the three months

to follow. The layout of the report is shown by Figure B.1.2.2. There are about 75 main commodities for export. The expected value of each commodity will be printed on a separate line. A line in between will be allowed. Values are rounded to the nearest Sudanese pound. At the end of the report there will be accumulated total values sort by main foreign exchange currencies. The number of pages is 3. The time necessary for printing must not exceed 15 seconds.

Date xx xx xx

Page xx

Estimated Proceeds for three Months

Commodity

Value per Month LS

1 - xxxxxxxxx

2 - xxxxxxxxx

3 - xxxxxxxxx

1 - xxxxxxxxx

3 - xxxxxxxxx

Total Values LS

1 - xxxxxxxxx

2 - xxxxxxxxx

3 - xxxxxxxxx

Values in foreign currencies

Dollars

1 - xxxxxxxxx

2 - xxxxxxxxx

3 - xxxxxxxxx

Sterling

W.G. Marks

Italian Lira

French Franc

Swiss Franc

Japanese Yen

Others

Figure B.1.2.2

The Integer before the values refers to the month, i.e. 1 for January, and 3 for March for example.

(iii) Expected utilisation of contracts, from the first copy of export forms to be received from the commercial banks monthly. It is a listing of these forms within the branches of the commercial banks. The monthly average is round about 1,500 forms. The information element of each form will be printed on a separate line. About 40 pages are necessary for the printing allowing for outstanding forms. The time required must not be more than seven minutes. The layout of the report is shown by Figure B.1.2.3.

DATE XX-XX-XX		PAGE XX						
EXPECTED UTILISATION OF CONTRACTS								
COMMERCIAL BANK BRANCH 1-----1								
EXP/F#	EXPIL#	COUNTRY	COMMODITY	QUANTITY	VALUE-UNIT	SHIPMENT	T OF C	REMARK
XXXXXXX	XXXXXXX	1-----1	1-----1	XXX YAX	XXXXXXXXX DOLL	1st SHIP	TOTAL	TOTAL
XXXXXXX	XXXXXXX	1-----1	1-----1	XXXXXXX	XXXXXXXXX W.G.M.	5th SHIP	PARTIAL	FINAL

Figure B.1.2.3

(iv) Expected proceeds based on export forms to be received from customs stations. It is a listing of these forms within the branches of the commercial banks. Besides the quantity being shipped, there will be the date of shipment and the expected date of collection. The monthly average is round about 1,500 forms. The information element of each form will be printed on a separate line, then accumulated totals for each Bank. A copy of the report will be sent to the relevant branch of the commercial bank. The layout of the form is shown by Figure B.1.2.4. About 26 pages may be required, doubled for the copy. The time necessary for printing must not exceed five minutes.

DATE XX-XXXX

PAGE XX

UTILISED CONTRACTS BASED ON CUSTOM RETURN

COMMERCIAL BANK BRANCH 1-----1

EXP/F	EXP/L	COMMODITY	QUANTITY	VALUE-UNIT	SHIP DATE	T OF C	COLL DATE	REMARK
XXXXXXX	XXXXXXX	1-----1	XXXXXXX	XXXXXXX F.F	XX-XX-XX	PARTIAL	XX-XX-XX	3rd SHIP
XXXXXX	XXXXXX	1-----1	XXVXXX	XXXXXXX TIER	XX-XX-XX	TOTAL	XX-XX-XX	SHIP LESS
BRANCH TOTAL LSXXXXXXX								

Figure B.1.2.4

(v) Monthly Export Trade. It is a report based on custom returns, i.e. export forms (copy 2). It will reflect the accumulated values of each commodity within country and another one to reflect the accumulated values of each country within commodity. There are about 158 countries to which Sudan exports trade and 75 commodities to be exported. Few countries demand most of these commodities, others few of them, and a third group only one commodity. The average number of commodities per country is about ten approximately. Accordingly the lines to be printed are round about 1750. The time to print them for each report should not exceed 10 minutes. The number of pages required for each is about 80 allowing a line in between and sub totals. There will also be accumulated reports for the quarters, half-year and end of year. The report's layout for the different period will be the same, it is shown by figures B.1.2.5(a) and B.1.2.5(b).

(vi) Receipts by Commercial Banks. This report reflects the collection made by each Branch within the commercial bank in respect of the export forms being issued by it. There will be accumulated totals for each branch, then the commercial banks, then for all of them. It will be produced monthly. The number of forms is round about 1500, the number of pages is about 26 and the time should not be more than five minutes. The design of the report is shown by Figure B.1.2.6 below.

DATE XX-XXXX

PAGE XX

EXPORT TRADE BY COUNTRY

COUNTRY	COMMODITY	QUANTITY-UNIT	%-VALUE	f-VALUE	LS-VALUE
UK	COTTON	1000-BALE		20000	16000
	GUM	500-TON		5000	3000
	SUB TOTAL			25000	19000
U S A	GUM	1000-TON	200000		80000
	SUB TOTAL		2000000		80000
T O T A L S			2000000	25000	99000

Figure B.1.2.5 (a)

DATE XX XXXX

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EXPORT TRADE BY COMMODITY

COMMODITY	COUNTRY	QUANTITY-UNIT	PAY AGREE	FREE CURR	LS-VALUE
COTTON	INDIA	10000-BALE	\$200000		40000
	UK	5000-BALE		f10000	8000
SUB TOTAL			\$200000	f10000	48000
T O T A L S					

Figure B.1.2.5 (b)

DATE XX-XXXX

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R E C E I P T S B Y C O M M E R C I A L B A N K S

COMMERCIAL BANK 1-----1
BRANCH NAME 1-----1

EXP/F	EXP/L	COMMODITY	QUANTITY SHIPPED	E/F COPY4 VALUE	RECEIPT FOREIGN	RECEIPT LS	REMARK
XXXXXX	XXXXXX	COTTON	XXXXBALE	XXXXXX	XXXXXX	XXXXXX	NO DIFF
XXXXXX	XXXXXX	COTTON	XXXXBALE	XXXXXX	XXXXXX	XXXXXX	DIFF-LIMIT
BRANCH TOTAL							
COMMERCIAL BANK TOTAL							
T O T A L S							

Figure B.1.2.6

(vii) Reports for Balance of Payments. These reports reflect the receipts by country within commodity and commodity within country monthly, quarterly, half annually and annually. They are very like the reports of export trade under (v). The only difference is that there will be no quantity or units of measure. The layout of the reports, the required pages and the time necessary for printing them will be the same.

(viii) Performance of Export Trade. This report will be produced monthly to reflect the approved contracts, the expected utilisation from the first copy of the export form, the export from the export form to be sent by the customs station and the receipt in respect of each contract from the second copy of the export form. It will also reflect the outstanding contracts which are partially or not utilised, utilised but no receipt is collected, invalid contracts etc. It will be an accumulation of contracts and performance starting from the first day of the year to be started with the outstanding contracts and performance of the last year. The layout of the report is shown by figure B.1.2.7. If it is assumed that the contract will be utilised within three months and the proceeds will be collected in two months, then the report will include the performance of the contracts for five months. It is likely to be more or less depending on the speed of utilisation and collection. The average for five months is round about

5,500. Each one will be printed on a separate line. About 95 pages will be required. The printing time should not exceed 15 minutes.

DATE XX-XXXX

PAGE XX

PERFORMANCE OF EXPORT TRADE											
EXP/L	EXP/F	COUNTRY	COMMODITY	QUANTITY	VALUE	SHIPPED	VALUE	RECEIPT	QUNT-BAL	REC-BAL	REMARKS
XXXXXX	XXXXXX	1-1	1-1	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	REC-SHIPMENT UTILISED OUTSTAND REC
XXXXXX	XXXXXX										

Figure B.1.2.7

(ix) Performance of Commercial Banks. The report will be produced to reflect the set of export forms being drafted by the commercial banks, the utilisation of outstanding forms and the collection of receipts of others. The layout of the report is shown by figure B.1.2.8. The number of lines to be printed is dependent on the number of sets to be issued and the forms being collected to state utilisation or collection of proceeds. Monthly average is round about 5000 forms including the three types. Information of a given set will be printed on a separate line. About 90 pages may be required. The printing time should not be more than 15 minutes.

DATE XX-XXXX

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PERFORMANCE OF COMMERCIAL BANKS

COMMERCIAL BANK 1-1

BRANCH OF COMMERCIAL BANK 1-1

EXP/F	EXP/L	COMMODITY	QUANTITY	VALUE	SHIPPED	VALUE	RECEIPT	REMARKS
XXXXXXX	XXXXXXX	1-1	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	REC=VALUE
XXXXXXX	XXXXXXX	1-1	XXXX	XXXXXX	XXXX	XXXX		REC NOT DUEL
XXXXXXX	XXXXXXX	1-1	XXXXXX	XXXXXX				NOT UTILISED

BRANCH OF COMMERCIAL BANK 1-1

Figure B.1.2.8

(x) Performance of Exporters. This report will be produced by mid and end of year to reflect the performance of exporters related to approved contracts, utilisation and collection of proceeds. The report will be enclosed in manual files sorted by name of exporters. It will include the historical and current contracts during the outstanding period. There are about 240 main exporters and about the same number minor exports. Some of them are specialists in one commodity while others in several. The average is round about five per exporter. Allowance will be made for 20 exporters to join the market annually. Accordingly, the estimated number of pages required is round about 39. The time to print the report should not be more than 7 minutes. The layout of the report is shown by figure B.1.2.9.

PERFORMANCE OF EXPORTERS									
EXPORTER	EXP/L	EXP/F	COMMODITY	QUANTITY	VALUE	UTILISED	RECEIPT	OUTSTANDING QUNT	RECEIPT
XXXXXX	XXXXXXXX	XXXXXXXX	1-----1	XXXXXX	XXXXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXX
		XXXXXXXX	1-----1			XXXXXX			XXXXX
		XXXXXXXX	1-----1					XXXXXX	XXXXX
	XXXXXXXX	XXXXXXXX	1-----1	XXXXXX	XXXXXX	XXXXXX	XXXXX		

Figure B.1.2.9

B.1.3 Files Design

The design of master and transaction files of the export trade system will be considered with respect to information content, sequence, access method format and other conditions to be stated where relevant.

Under the off-line system option (3) of section 6.3.1, three master and four transaction files have been suggested for the export trade system, and these are:

- (1) Performance of approved contracts file - contract file
- (2) Commercial Bank file
- (3) Exporters file
- (4) Transaction files which include (a) approved contracts,
(b) expected utilisation, (c) utilisation, and (d) receipt.

It is possible to have only one master file to hold information elements if the solution arrived at is an on-line system. The design of these files will be considered with respect to the possibility of an on-line system in the near future. Under the off-line system it is possible to have two files, namely the contract and exporters files, only if the commercial banks through which the contracts and export licences are submitted for approval will be the one to draft the sets of export forms relevant. The qualification for this requires that there is understanding of discipline in the system. In a developing country like Sudan several years are necessary for it but still there is provision.

Although these files include information elements related to each other, still it is necessary to have them in these separate files as they are identified by different identifiers to serve different purposes at different periods.

.B.1.3.1 Contracts Files

There will be outstanding and updated contracts files. Outstanding contracts file includes the information elements of newly approved contacts, outstanding contracts which are approved from previous months, but not utilised, and utilised but their proceeds have not yet been collected. The updated contracts file includes the same information elements and utilised contracts as well. The updated contracts file is a by-product of the outstanding contracts before the extraction of the outstanding contracts to be used for the coming month's processing. Both of them are

groups of fixed length records about 110 characters each. Their lengths are variable but estimated to be about 5,500 records each run. The outstanding contract file will be accessed monthly to update outstanding contracts, produce updated contract files and extract outstanding contracts for further processing. The updated contracts file will be accumulated for six months to update "Exporters" file, to be discussed later. The records of the outstanding contracts file are identified by the number of the export licence but the updated contract file by the number of the export licence within the name or code of the exporter, which may be their business licence number. The records are likely to be active monthly. Both of them are sequential because they will be processed in that sequence. They will be accessed by index. Their information elements are fixed in length to permit decimal or binary representation as most of them are numeric and there is not much variation in these values. They will be subjected to arithmetic operations due to which fixed length format will add to the speed of calculation.

B.1.3.2 Commercial Banks File

The file includes the information elements of the set of export forms to be drafted by branches of commercial banks. It will include the information of newly drafted export forms, drafted but their quantities have not been shipped, and shipped but their proceeds have not yet been collected. It is a group of fixed length records about 90 characters each. The length of the file is variable but estimated to be round about 5,000 records each run. The records are likely to be active each run. They are identified by the number of export form within the branch number. The sequence, access method and format of contracts file are applicable to this commercial banks file. The file will be updated monthly.

B.1.3.3 Exporters File

The file includes the information elements of approved contracts and

the performance related to them under the name of each exporter. It is an accumulation of records starting from the first day of the year but opened by outstanding contracts from the previous year. The records are identified by the business licence of the exporters. Although under the business licence they may be more than a contract still the length of record which is identified by the export licence number within the business licence number is fixed in length. The file will be updated once every six months from the contracts file. It is sequential to ease access by index. Its information elements will be printed in the sequence of business licence number to produce the "Performance of Exporters" report of figure 6.5.1.10. Because of calculations and arithmetic manipulation as well as the numeric values of its information elements, the file format will be of fixed length.

b.1.3.4 Transaction Files

There are four transaction files and these are:

- (a) New approved contracts file
- (b) Expected utilisation file
- (c) Export file
- (d) Receipt file

New approved contracts file includes the information elements of the approved contracts first during the week then accumulated for the month. It is a group of fixed length records about 75 characters each. For the weekly listing the records are identified by the serial number of the Receipt department and by the export licence number for the month. Its length is variable, estimated to be round about 1,100 records per month. The weekly approved contracts will be processed to produce "Weekly approved contracts" report of figure B.1.2.1 in that sequence. The monthly accumulated contracts will be sorted in the sequence of export licence to update contracts file which is stored in that sequence. Its information elements are fixed

in length to ease arithmetic operation and satisfy the requirements of the master files.

Expected utilisation file includes the information elements of export form (copy 4) that arrives from the commercial banks. Its records are fixed in length about 71 characters each and they are identified by card type, i.e. 2 in column 3 and the number of the export forms within the commercial banks. The file will be consolidated with the export and receipt files to form the main transaction file to be sorted first in the sequence of card type within the export form number within export licence number to update contracts file, then in the sequence of the forms within commercial bank branches to update commercial banks file.

Export file includes the information elements of export forms (copy 2) that arrive from customs stations. It is a group of fixed length records about 77 characters each. Its length is variable but estimated to be round about 1500 records. The file is random. It will be sorted first in the sequence of export forms within commercial banks number to produce "Utilised Contracts based on Custom Return" report of figure E.1.2.4, then in the sequence of commodities within countries to produce export trade by country and commodity of figures B.1.2.5(a) and (b). Later it will be consolidated with the utilisation and receipt files to update contract and commercial bank files. It will be accessed monthly. Its format is of fixed length to meet the requirements of the master files and to ease arithmetic operations and speed the calculation.

The receipt file is typical of the export file. The only difference is that the records are identified by card type in column 3 being 3 for the export records and 4 for receipt records. The file will be subjected to sort runs first to produce Receipt by Commercial Banks then to produce reports for Balance of Payments. It will be accessed and processed monthly. Further it will be aggregated with utilisation and export files to update contracts and commercial bank files.

B.1.4 Computer Programs

Having designed output reports, input sources, description and structure of files with data content, sequence, access methods and format, the next stage is to decide the procedures to be considered in computer programs so as to meet the data processing requirements. The computer programs necessary include data validation, sort/merge, information contents of files then processing procedures which directly refers to or update files, edit and print output reports and messages. Sort/merge and print programs are normally provided in the manufacturer's software. The process programs to be considered vary from the simple one file in/one file out to the complex several files in/several files out.

The process will involve the procedures to be contained in the following programs:

B.1.4.1 Data Validation Programs

The input data will be punched in cards by the punch operator of the EDP section of the Bank of Sudan.

There are four types of cards to be validated . The validation program is to do the following:

(a) Format check: the program is to check that numeric fields contain only digits 0 to 9 and these digits are not interspersed with blanks.

(b) There are four types of cards: contract cards are identified by (1) in column 3, expected utilisation by (2), shipment card by (3) and receipt card by (4). The program is to check that there is no card other than these.

(c) Countries, commodities, unit of measure, unit of currency, terms of trade, media of payment and transport are codes. The program is to check that for any coded item there is an equivalent name. Table of names and codes will be included.

(d) Every exporter is identified by his business licence and there is a manual file identified by this business licence and name. There will be a table with the present business licence to identify the new exporters so as to open manual files for them.

(e) For any set of export forms there must be an existing contract.

(f) There will be a serial number check for export form (copy 4) that arrives first from the commercial banks. This may be required to identify missing forms for control purposes based on manual inspection.

(g) The value of approved or shipped commodities is equal to the price times the quantity.

(h) End of month serial number less beginning of month serial number of the Receipt department stated on contracts or export licence must be equal to the number of contracts approved during the month. The logic of this program is shown by figure B.1.4.1.

B.1.4.2 Process Program

The process programs to be designed vary from a simple one file in/one file out to a complex several files in/several files out. They will be considered with respect to the data processing requirements but the hardware available will be a constraint.

According to the output of section B.1.2.1, the first report to be produce is the Weekly Approved Contracts. It is a simple one file in/one file out. After sorting (1) the weekly approved contracts in the sequence of the serial number of the Receipt department, the records will be printed (2). As some of the information elements are coded, it is necessary to have a description file with codes and names for printing purposes. The logic of the system is illustrated by figure B.1.4.2. These weekly records will be accumulated to form the Newly Approved Contracts file for the month.

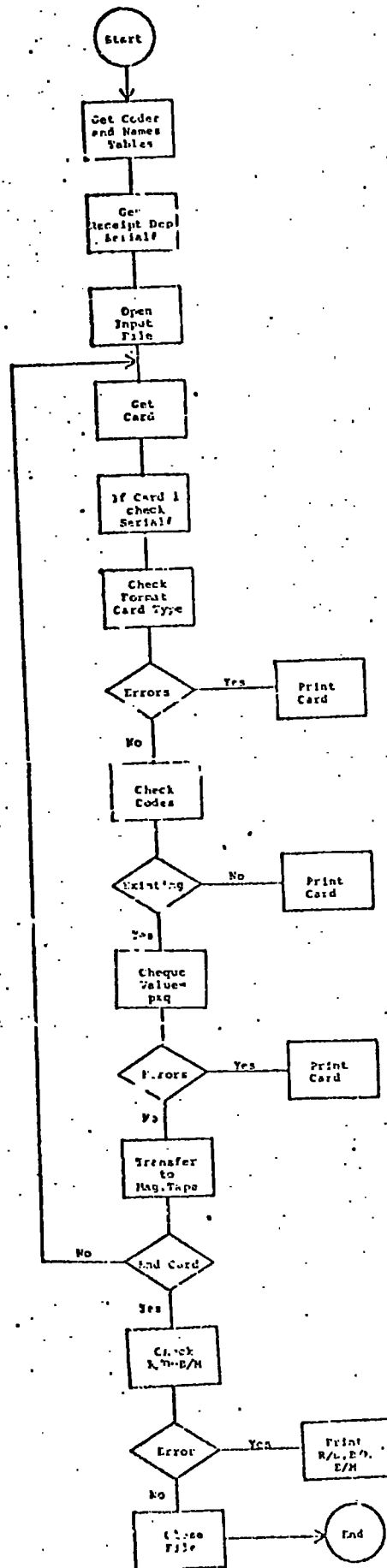


Figure B.1.4.1

Data Validation Program

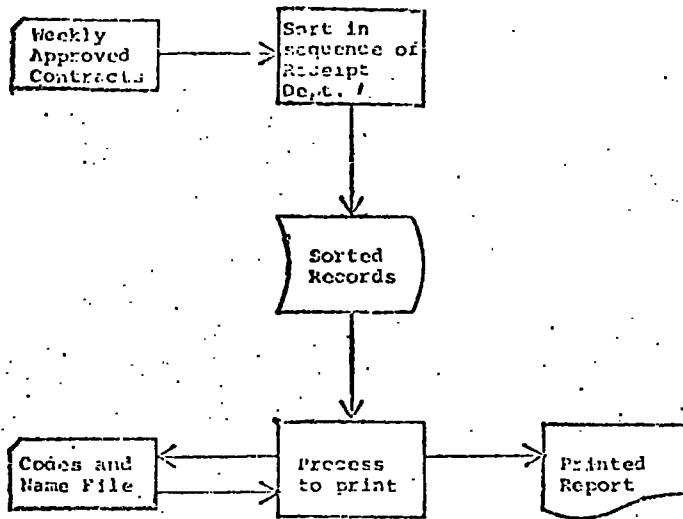


Figure B.1.4.2: Production of Weekly approved Contracts Reports

The "Utilised Contracts based on Customs Return", "Export Trade by Country" and "Export Trade by Commodity" reports are a simple multiple file system. The three of them are based on the information content of the monthly "Utilisation File". After data validation the records will be transferred to magnetic tape (A) (refer to figure B.1.4.3). They will be processed (1) to extract the information related to utilisation (B) and information related to export trade (C) statistics. Each group will be stored further in a disc. The utilisation data will be sorted (2) in the sequence of export form number within the commercial bank branches. Each record will be processed (3) to estimate the date of collection based on the date of shipment. The result sorted in that sequence will be printed (4) to produce two printed copies of Utilisation. One of the copies will be distributed to the commercial banks for notification. The information of export trade held in the second disc (C) will be sorted (5) in the sequence of exported commodities within country. The total value accumulated

for each commodity within the country (6) will be transferred to two separate discs (D,E) and magnetic tape (F). The content of the first disc (D) will be accumulated (7) according to that sequence to produce total values of exported commodities to each country. The result of the value of each commodity as well as the accumulated totals will be printed (8) to produce the "Export Trade by Country" report. The content of the second disc (E) being the value of each commodity exported to each country will be sorted (9) in the sequence of countries within commodity. The total value of each commodity exported to several countries will be accumulated (10). The sub-total and total will be printed (11) to produce "Export Trade by Commodity". The content of the magnetic tape (F) will be accumulated to produce "Export Trade by Country and Commodity" for the period starting from the first month of the year up to date. The logic of the system is shown by figure B.1.4.3.

The final production of the system is:

- (i) Printed Report X which is the "Utilised Contracts based on Customs Return" of figure B.1.2.4.
- (ii) Printed Report Y which is "Export Trade by Country" of figure B.1.2.5(a).
- (iii) Printed Report Z which is "Export Trade by Commodity" of figure B.1.2.5(b).
- (iv) Magnetic Tape (F) which is an accumulation of summary of export trade commodities within country to be processed to produce from the first date of the year up to date export trade statistics.

The logic of utilisation and export trade system can be applied to produce "Receipt by Commercial Bank" report of figure B.1.2.6 and the reports of Balance of Payments. These reports are based on the information contents of the receipt file for the month.

The next process is to update master files with the information elements of transaction files to process them to produce the required output reports and files.

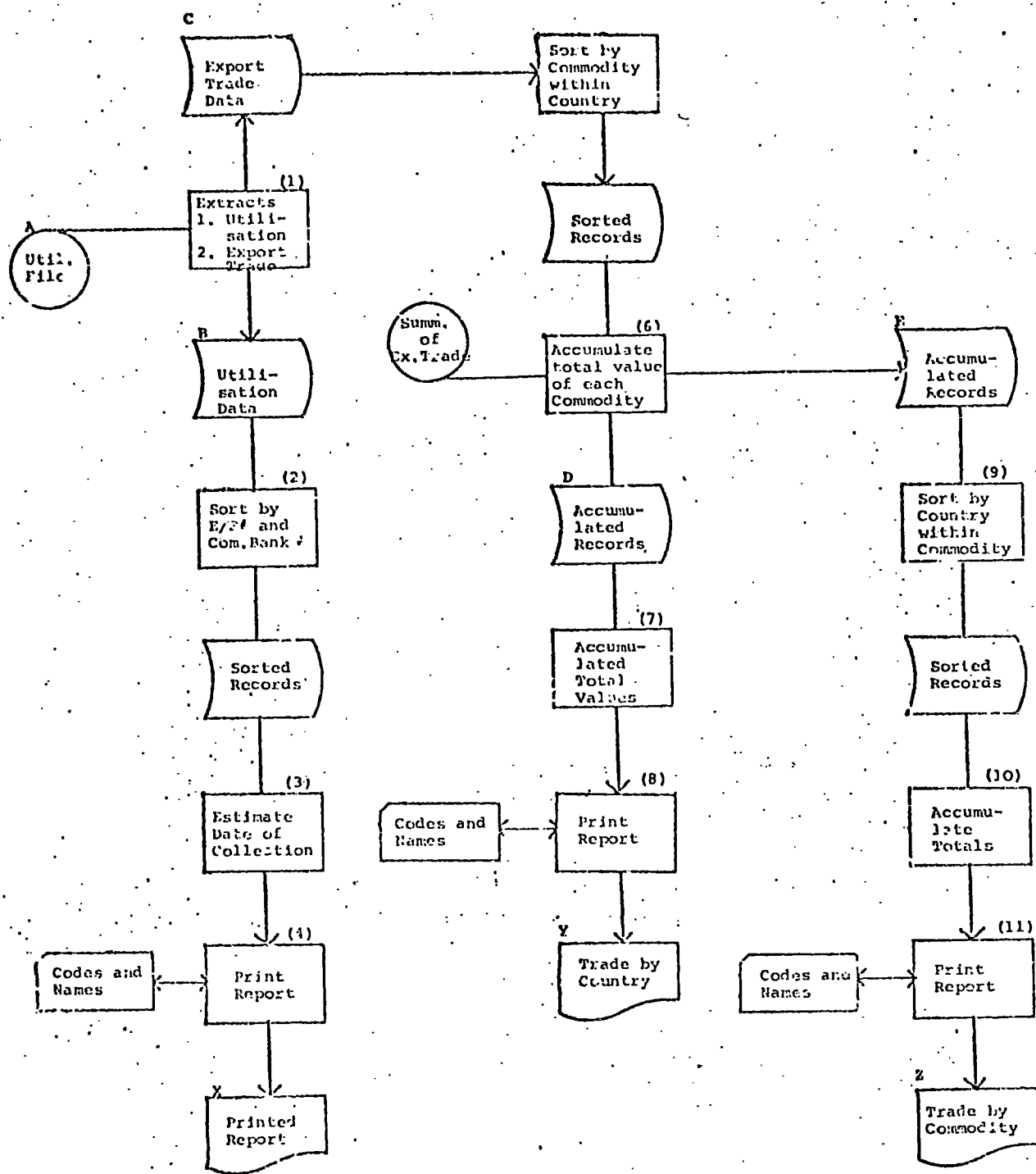


Figure B.1.4.3 Utilisation and Export Trade Systems

The contracts file will be updated first with the information elements of "Newly approved Contracts" file. The newly approved contracts file (A) in figure B.1.4.4 will be processed (1) to sort in the sequence of export licence which is the sequence of the contracts file. Then it will be processed (2) to update contracts file. At another stage the contracts file will be updated with information of expected utilisation, export and receipt files. These last three files will be consolidated in one transaction file (B). They will be processed at (3) to sort in the sequence of card type within export form within export licence number. The files will be processed (4) to update the contracts file. A copy of the updated contracts file will be transferred to a magnetic tape (C) to be accumulated for six months to update the exporters file. A working copy of the updated contracts file being stored in a disc (D) will be processed (5), to print "Performance of Export Trade" (6) report. The same working copy of the updated contracts file will be processed (7) to extract outstanding contracts. One copy of this outstanding contracts file will be stored in a magnetic tape (E) for next month's use. The other copy being a working copy stored in a disc (F) will be processed (8) to sort outstanding contracts in the sequence of commodities. The sorted records will be processed (9) to estimate outstanding proceeds. The estimated proceeds for each commodity will be processed (10) to print the "Estimated Proceeds for three months" report of figure B.1.2.2. A description table with codes and names of commodities is necessary for printing purposes. The logic of the system is illustrated by figure B.1.4.4.

The final products of the system are:

- (i) Printed report X which is "Performance of Export Trade" of figure B.1.2.7.
- (ii) Printed report Y which is "Estimated Proceeds for three months" of figure B.1.2.2.
- (iii) The same transaction file B to update the commercial banks file.

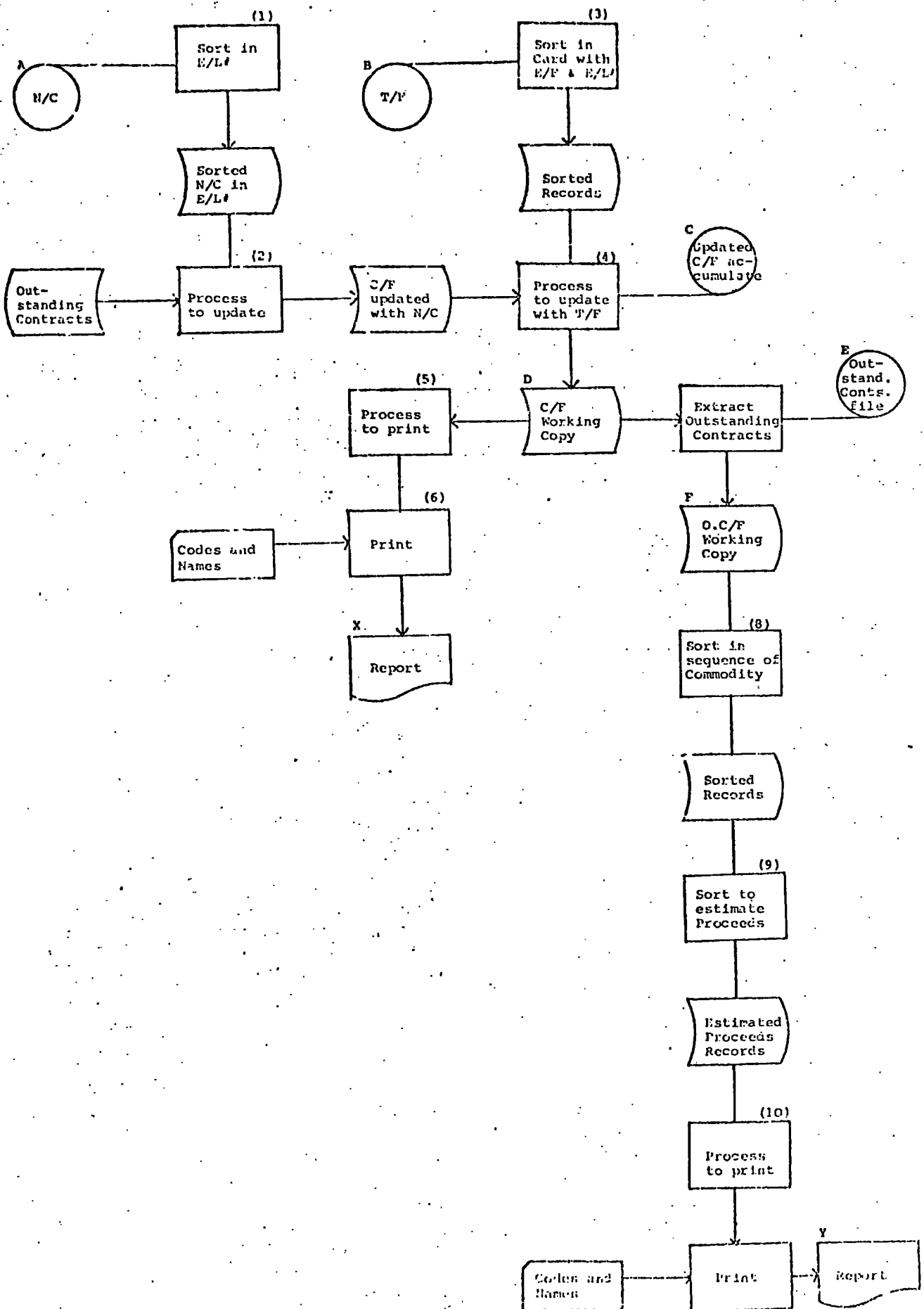


Figure B.1.4.4

Contracts File Updating - Estimation of Proceeds and Performance of Export Trade

- (iv) Accumulated updated contracts file to update exporters file once every six months.
- (v) Outstanding contracts file F to be used next month.

The commercial banks file will be updated monthly with the information of the consolidated transactions file B of figure B.1.4.4.

The transactions file (B) will be sorted (1) in the sequence of card type within export form number within branches of commercial banks, i.e. the sequence of the commercial banks file. The files will be processed (2) to update the master file. The updated commercial banks file being a working copy stored on a disc (C) will be processed (3) first to print "Performance of Commercial Banks" reports of figure B.1.2.8. The same working copy of the updated commercial banks file will be processed (4) to extract outstanding forms, i.e. forms being issued but not utilised, utilised but their receipts have not been collected. Outstanding forms will be stored on a magnetic tape (D) for next month's use. The same copy being a working copy stored on a disc (E) will be processed (5) to estimate expected utilisation, i.e. the information of export forms being issued but not utilised. The records will be processed (6) to print "Expected Utilisation of Contracts" reports of figure B.1.2.3.

The logic of the system is reflected by Figure B.1.4.5. The output of the system is:

- (i) Printed Report M which is "Performance of Commercial Banks".
- (ii) Printed Report N which is "Expected Utilisation".
- (iii) Magnetic tape D which is outstanding forms for next month's use.

The exporters file is the last master file to be updated once every six months from the accumulated updated contracts file (C) of figure B.1.4.4. The logic of this system is illustrated by figure B.1.4.6. The accumulated updated contracts file being stored on a magnetic tape, i.e. (C), will be

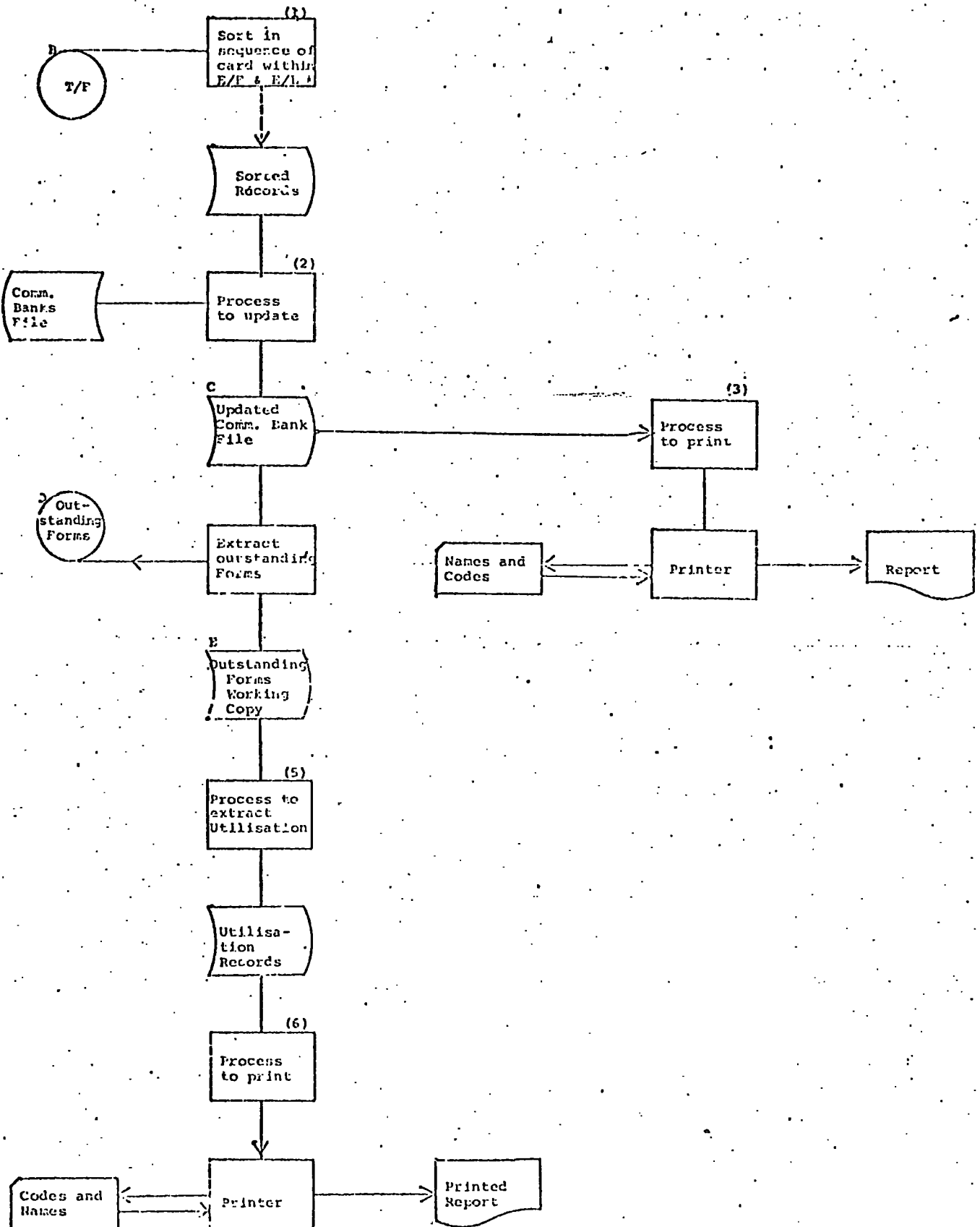


Figure B.1.4.5 Updating of Commercial Banks File and Production of Performance Reports

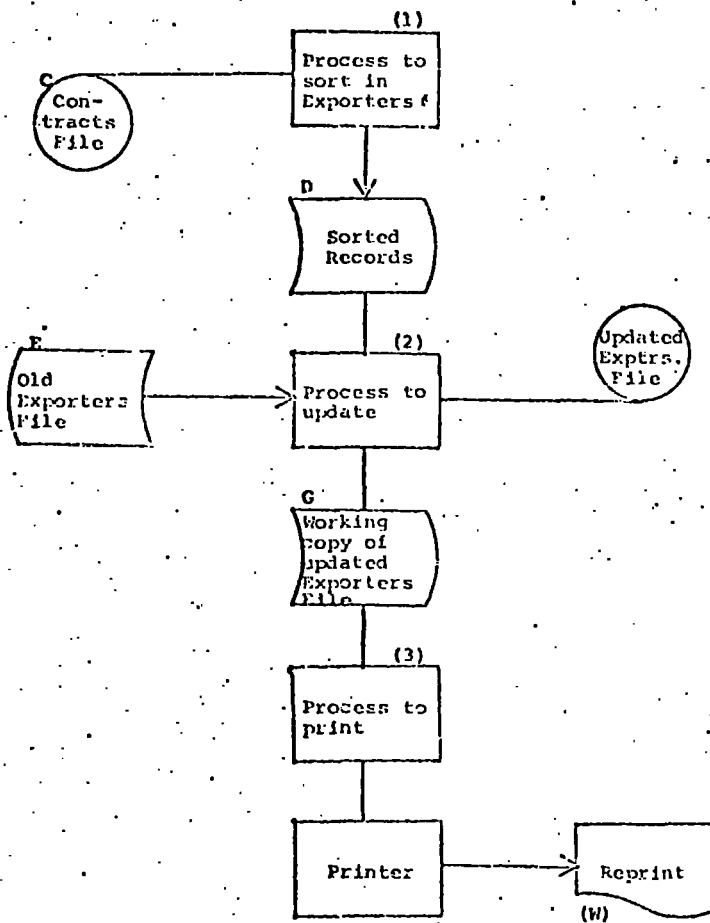


Figure B.1.4.6

Updating of Exporters File and Performance of Exporters

processed (1) to sort in the sequence of business licence or code of exporters. The business licence or code of exporters is one of the information elements of the records of the contracts file. There may be several records with this business licence number. The sorting will be in the sequence of export licence number within business licence number. The sorted records now available on a disc D will be processed to update the exporters file now being on disc (E). The update exporters file will be transferred to a magnetic tape (F) for the next month's use. A working copy of this file transferred to a disc (G) will be processed (3) to print "Performance of Exporters" report of figure B.1.2.9. This report will be filed in a manual file sorted in the name and business licence of exporters.

The final output of the system is this report (W) and updated exporters file stored on magnetic tape (F).

The output design involved reports of routine type to be produced periodically for operational control and management planning. There is the possibility of requested and special reports for managerial planning and decision making. The ones of a programmed nature are catered for by the design of files. The file design is based on the database concept to meet such requirements. Having created the database, it is possible to design computer procedures to retrieve them and produce the requested or special reports. At this stage it is difficult to predict what they are.

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