# CIFOR's Management Information System

Michael O. Ibach


CIFOR
CENTER FOR INTERNATIONAL FORESTRY RESEARCH

# CIFOR's Management Information System

## From Concept to Implementation

**Michael O. Ibach**

CIFOR
CENTER FOR INTERNATIONAL FORESTRY RESEARCH

Printed by SMT Grafika Desa Putera, Indonesia.

**ISBN 979-8764-28-5**

(cover photo by Christian Cossalter)

Center for International Forestry Research
Bogor, Indonesia

*Mailing address*: P.O. Box 6596 JKPWB, Jakarta 10065, Indonesia
*Tel*.: +62 (251) 622622; *Fax*: +62 (251) 622100
*E-mail*: cifor@cgiar.org
*Website*: http://www.cgiar.org/cifor

# Contents

## Chapter 2. System Design



## Chapter 3. Implementation and Maintenance

## Chapter 4. Conclusion



### Annexes

## List of Figures



## List of Tables

## List of Acronyms

| | |
|---|---|
| CD-ROM | Compact Disk - Read Only Memory |
| CGIAR | Consultative Group on International Agricultural Research |
| CIFOR | Center for International Forestry Research |
| CSF | Critical Success Factors |
| DSS | Decision Support System |
| EIS | Executive Information System |
| ESF | Entity Service Function |
| FAO | Food and Agriculture Organisation of the United Nations |
| IARC | International Agricultural Research Center |
| IBM | International Business Machines |
| IMS | Information Management System |
| INFORM | Information for Agricultural Research Managers |
| LAN | Local Area Network |
| MIS | Management Information System |
| MIS-PAG | Management Information System Project Advisory Group |
| MOU | Memorandum of Understanding |
| NARS | National Agricultural Research System |
| NGO | Non-Governmental Organisation |
| RDBMS | Relational Database Management System |
| SQL | Structured Query Language |
| TAC | Technical Advisory Committee |
| WWW | World Wide Web |

## Author's note

Michael O. Ibach was a former Director of Information Services at CIFOR in charge of the Information Services Group responsible for computer systems, information management, GIS and the library. He developed information strategies and tools to support research management systems, research networks, data exchange mechanisms and electronic publishing for use by CIFOR and its partner organisations. He also coordinated CIFOR's training activities in these areas. Specialising in Forest Botany, he obtained an MSc in Forestry from Freiburg University, Germany, and also holds an MSc in Business Economics from SHfB Technical University, Germany, with an emphasis on Information Management and Marketing.

This report was written as part of a study undertaken in 1996 on the concept and design of CIFOR's Management Information System (MIS), and was updated in 1998 to include a description of how the MIS was implemented.

# Introduction

This study describes the concept of a management information system (MIS) developed for the Center for International Forestry Research (CIFOR). The introduction describes MIS in general and similarities with related systems. It gives a definition of MIS and the institutional background. Chapter 1 is dedicated to the diagnosis and includes a description of the organisational structure, definition of MIS requirements, and procedure and results of an information needs and requirements survey.

The core of the study is the design of the MIS in Chapter 2. It is centred around outputs, inputs, processing, storage and personnel as key elements of the system. Chapter 3 deals with issues related to implementation and maintenance of the proposed system and describes key databases. Emphasis is given to personnel, soft- and hardware requirements, system architecture, training and procedural aspects. The study concludes with a discussion of project management requirements, critical success factors, monitoring and evaluation procedures, and the potential generalisation of the concept.

## The Importance of Management Information Systems

Information is a resource that gains increasing importance in many organisations. Every task on the operational or strategic level is somehow related to storage, processing or provision of information. Executives spend about 80 percent of their time on processing and communication of information (Davis and Ohlson 1985).

Efficient management tools can support the use of resource 'information'. Information management is facilitated through current developments such as the increasing user friendliness of computer systems, increasing access to data through new storage media and electronic communication networks, and increasing systems compatibility and integration (Wiggins 1994, Bergeron *et al.* 1990, Sethi *et al.* 1993). However, such technological improvements only provide the vehicle for driving on the so called 'information highway'. In addition, road networks and maps are necessary for orientation and special skills are required to manoeuvre the vehicle. Moreover, target destinations need to be clearly defined so that the optimal direction can be chosen.

The aim of this study was to identify such destinations and to provide solutions to reach them in the best possible way. In other words, a concept for a management information system is elaborated to support the objectives of the institution and the decision making process.

The characteristics of a research environment set specific requirements for a management information system. Research organisations require a particularly high degree of flexibility in managing new developments and innovations. They have to respond to an environment that changes in short cycles. An equally flexible infrastructure and information flow are essential to the success of managing change.

## Institutional Background

The Center for International Forestry Research is an international independent non-profit organisation with headquarters in Bogor, Indonesia. It began operation in February 1993 as a member institution of the Consultative Group on International Agricultural Research (CGIAR), Washington, USA.

CIFOR's mission is 'to contribute to the sustained well-being of people in developing countries, particularly in the tropics, through collaborative strategic and applied research and related activities in forest systems and forestry, and by promoting the transfer of appropriate new technologies and the adoption of new methods of social organisation, for national development' (CIFOR 1995).

The objectives of CIFOR are to:

- improve understanding of the relationships between forests and human well-being;
- devise and promote more sustainable, equitable and productive options for forest ecosystem management; and
- help national capacities for conducting research on forest-related policies and technologies.

The work of CIFOR has a global dimension that extends over all five continents with a focus on tropical lowlands in developing countries. Research is done in a collaborative mode in which it is anticipated that all activities involve a number of collaborating scientists from various institutions. Managing research therefore means managing people of a diverse geographical, cultural, professional and organisational background at different developmental levels.

Research is done on forest ecosystems and related economic and socio-cultural issues, which are characterised by highly complex and dynamic processes. These, in turn, make planning and management of individual research activities a difficult strategic task. It implies that research needs have to address issues within a wide range of disciplines, such as policy, social science, economics, biology, ecology and natural resource management.

CIFOR depends on funding from national and multi-national donor agencies. Unrestricted core funds are allocated through the CGIAR Technical Advisory Committee (TAC). In addition, donors make restricted core or complementary funds directly available for particular CGIAR member institutions or projects. Donor agencies obviously hold an important stake in CIFOR's activities. Their specific interests and requirements are different from those of CIFOR's collaborators and ultimate beneficiaries of research outputs. They had to be addressed appropriately and given special consideration in designing the structure and services of a MIS.

Since 1993, the number of research activities and consequently the number of staff in CIFOR have grown rapidly which makes it increasingly difficult for managers to maintain an overview of current and planned research. This study uses the terms 'manager', 'researcher' or 'scientist' for the same persons and a term is chosen in a specific context to highlight different functions in different situations.

Before, CIFOR had tried to meet management information requirements by monitoring research activities on a case-to-case basis. Inevitably such individual arrangements could not cope with the increasing amount of information required and generated. Thus CIFOR decided to develop a structure that would support planning, monitoring and evaluation of its activities in a comprehensive, efficient and cost-effective manner - the MIS.

## MIS Overview and Definitions

During the preparation of this study it became apparent that very different perspectives and definitions of MIS exist. In some cases there was even a lack of understanding of what a MIS is or can provide. It is therefore necessary to address different perceptions and definitions.

### Definition of MIS

A clear definition of a MIS is crucial to provide a common platform for the understanding of the concept. There are many terms synonymous with

MIS, such as executive information systems, management support systems and executive support systems but for the framework of this study, MIS is chosen as the term most commonly used for such systems (Parker and Case 1993, Mentzas 1994).

Although Stahlknecht (1993) does not provide a clear definition of a MIS, he defines information systems synonymous with MIS, since they are specifically established to provide information for decision making. This view might be appropriate for business organisations but in a scientific research environment it is questionable. Here, information systems exist that are not necessarily used for decision making but rather for problem finding and analysis, e.g. library information systems or geographic information systems. Gabler (1988) defines a MIS as a software system that provides management of an organisation with information for the preparation of strategic and tactical decisions. This definition focuses on data processing and computer support aspects related to the MIS. Davis and Ohlson (1985) have a similar focus. They see a MIS very comprehensively as 'an integrated, user-machine system for providing information to support operations, management, and decision-making functions in an organisation. The system utilises computer hardware and software; manual procedures; models for analysis, planning, control and decision making; and a database'.

Parker and Case (1993) give a very broad definition where a MIS is any system which supports organisational activities by providing staff with data and information. It includes four subsystems, transaction processing systems, management reporting systems, decision support systems and office information systems. Mentzas (1994) provides a very systematic approach to the terminology of computer-based information systems. Despite the fact that there is not a definition of a MIS, he describes its role as supporting primarily structured tasks for standard operations and information flows. Most authors who publish MIS-related work do not provide a clear definition of MIS and an enormous variety of different MIS perceptions can be observed.

Due to a lack of a common definition of a MIS, for the purpose of this study the following definition, based on the terminology of Davis and Ohlson (1985), is applied.

> *A Management Information System is a computer-based system that provides managers at all organisational levels with a minimum set of critical information for planning, operating, monitoring, evaluating and decision-making.*

A computer-based system provides users with hard- and software support to an extent that needs to be clearly defined. Nonetheless, it is understood that other, similar systems need not necessarily be computer-based. Serving managers introduces the human factor in this socio-technical relationship. Emphasis is given to the provision of a minimum set of critical information. In order to keep the system transparent and operational it should provide core information and avoid an overload of data. Management information is necessary for all stages of an activity cycle, including planning, operating, monitoring and evaluation and decision-making. Information is considered as data which are relevant to the problem, accurate and sufficiently actual. Otherwise, the term 'data' is applied.

There are some similarities and differences between MIS and these closely inter-related terms; decision support systems, information management systems and executive information systems.

## MIS versus Decision Support Systems

Some authors use the terms MIS and decision support systems (DSS) synonymously or refer to DSS when they mean MIS and vice versa (Pellow

and Wilson 1993, Gremillion and Pyburn 1985). This study regards DSS as a tool especially designed for decision making in a very specific technical or managerial area and, therefore, as a possible sub-category of MIS (Parker and Case 1993, Mentzas 1994). The difference is that the primary design focus of MIS goes beyond the scope of a DSS. A MIS is designed to serve a long array of standard decisions at different levels and for different purposes and therefore is less problem-specific than DSS.

## MIS versus Information Management Systems

The synonymous use of the terms MIS and Information Management Systems (IMS) can cause a lot of confusion. IMS provide tools to handle information with tool design, implementation and maintenance as the main objectives. In a simple format, this could be software for text processing or databases but it also can incorporate more complex elements such as electronic document storage and retrieval systems or electronic communication networks. In some cases, office automation systems or office information systems are used synonymously with IMS (Mentzas 1994, Parker and Case 1993, Gremillion and Pyburn 1985).

In contrast to IMS, the focus of MIS is the information content, i.e. how data and data structures relate to specific tasks or problems. Whereas an IMS meets its objectives by providing appropriate information infrastructure, a MIS is successful when it can supply adequate information at the right time in order to support decision making. Thus, any MIS requires an appropriate IMS in order to function.

## MIS versus Executive Information Systems

MIS and executive information systems (EIS) are very closely related in their function. They both provide information on structured processes and reporting tools in a specific organisational setting. A difference is in the clientele of these two systems. The term ‘executive’ commonly refers to senior management staff within an organisation; thus senior managers are the target group of an EIS. The target group of a MIS, in contrast, is wider and includes senior, middle and even lower management staff. Such a system serves various levels of decision making.

Chapter 1

# Diagnosis

This chapter analyses factors in CIFOR, including organisational structure and framework, that were critical to the development of the MIS concept. Information needs and requirements and existing information sources as well as future demands are examined.

## Structure of the Organisation

Describing the organisational structure proved a difficult task. In the early stage of its existence, CIFOR needed to adapt its initial structure to experiences gained and shifting priorities. This resulted in several reorganisations in the course of 1995, the last considered in this study being implemented on 15 January 1996. The following brief historical overview of the organisational evolution is provided to better understand management concerns and priorities which had a considerable impact on the course of this study. During the MIS implementation, the organisational structure continued to change but not in a substantial manner. Reference is made to such changes for better understanding.

CIFOR started with an organisational line management structure which consisted of five divisions and two administrative units. Four divisions were arranged according to different scientific subjects; the fifth division was responsible for research support and information services. In addition, there was a division for administration and finance and the office of the Director General. A divisional director headed each division. The first reorganisational measure was to subsume one Research Division into another due to an overlap of activities.

The next reorganisation in early 1995 transferred the line structure into a matrix structure, mainly in response to similar developments in the CGIAR. The four remaining divisions were renamed as scientific competence groups and constituted the horizontal dimension of the matrix. Vertically, the matrix was structured according to four research themes. Although agreed to by CIFOR's senior management, this structure was never really implemented. One main reason was a large degree of similarity between scientific competence groups and research themes.

Three months later, it was agreed that the three research divisions should be merged into two, basically to foster interaction among scientists from different disciplines working on similar projects. In addition, a new staff position, 'policy adviser' was created in the office of the Director General.

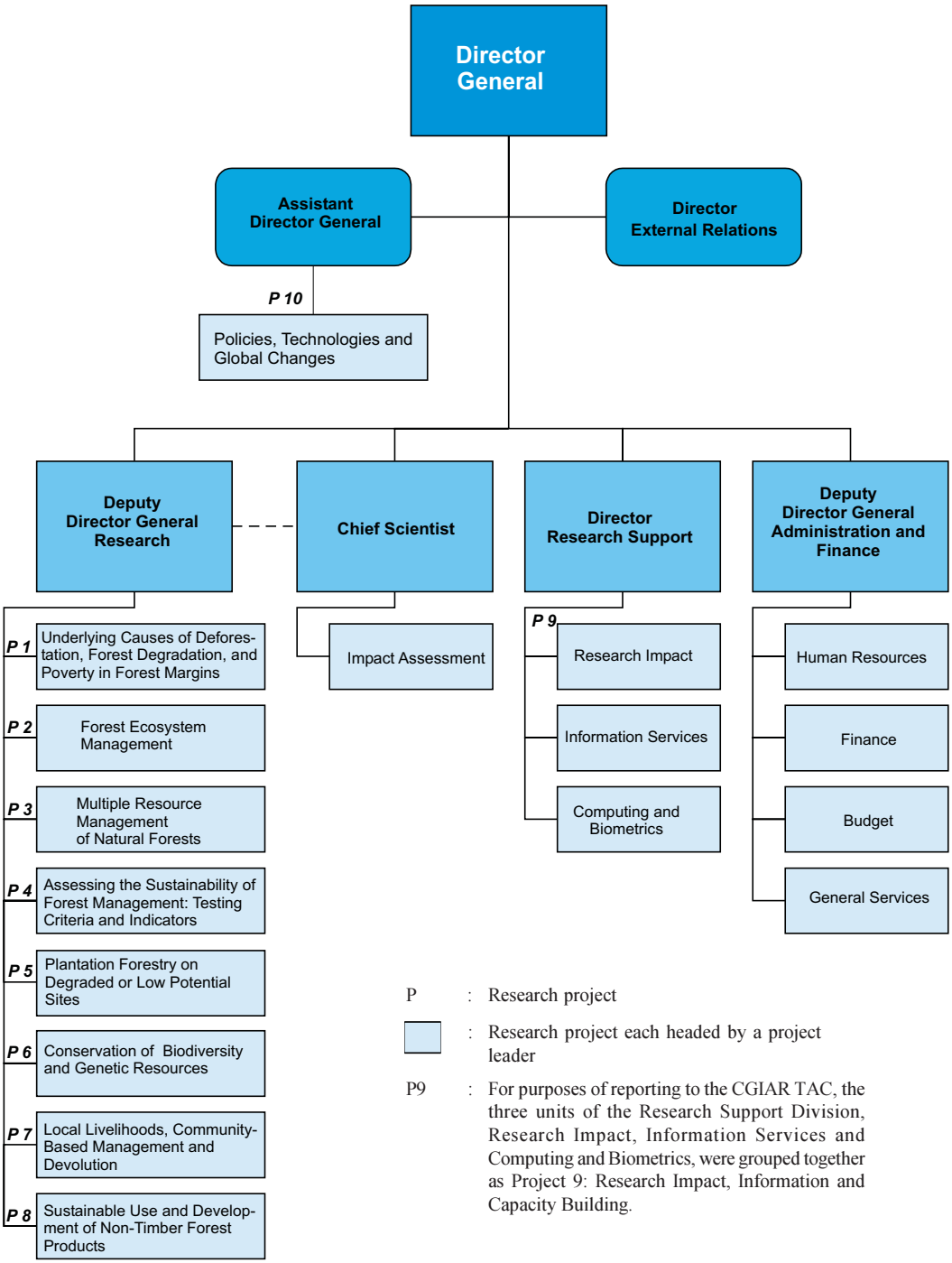
The last reorganisational measure considered in this study was started during an internally commissioned external review which recognised some problems in the existing structure (Anderson *et al*. 1995). As a result, a revised organisational structure was implemented at the end of 1995. It consisted of a research division, a research support division, an administration and finance division and some staff functions under the office of the Director General, (Fig.1).

## Definition of MIS Requirements

The principles and structure of the MIS have to reflect the organisation's overall objectives and strategies (Lederer and Mendelow 1993, Brancheau and Wetherbe 1987, Rowley 1995, Parker and Case 1993). CIFOR states in its strategic plan (1995), 'CIFOR is dedicated to achieving excellence in research - research that is undertaken efficiently and cost-effectively, .... '. Therefore:

> *The Management Information System has to provide managers at all organisational levels with an appropriate amount of information in order to pursue research most efficiently and cost-effectively.*

**Figure 1**. CIFOR Organisational Chart



Furthermore, CIFOR identified six key management areas in its pursuit of efficiency and effectiveness (CIFOR 1995):

- appropriate management structure;
- set of organisational values;
- procedures to assess research priorities and to review the quality and relevance of research proposals;
- professional management and administration of research and training;
- communication strategy that ensures that CIFOR and its research programmes and research outputs are widely known and understood; and
- monitoring and evaluation of research performance and research impact.

The objectives of the MIS correlate directly with these key management areas and can be defined as follows:

1. *To provide tools for research managers and administrators for professional coordination of inter-disciplinary and collaborative research activities and most effective fund allocation;*
2. *To ensure transparent documentation and reporting of planning and management procedures for research monitoring, evaluation and decision support;*
3. *To support focused communication of research activities and results to stakeholders;*
4. *To incorporate organisational values through system transparency, simplicity and flexibility and application of state of the art technologies.*

Figure 2 visualises the relationships of principles and objectives between the overall organisational level and the MIS.

At this stage of CIFOR's development, it was difficult to describe the decision-making process. Many decisions were just being formalised and ad-hoc arrangements were still dominating which resulted in difficulties linking the MIS concept to the decision-making process. However, it was expected that once the MIS was operational, it would have a considerable impact on the formalisation of the decision-making process.

A problem related to the lack of formal decision-making processes was the data content to be included in the MIS. It was little compared with the complexity of management issues and decisions that eventually occurred but there were two reasons for temporarily limiting the data content. First, to foster a 'learning' process to formalise decision-making where appropriate and secondly, to avoid a feeling of data overload at the beginning of the MIS implementation which was a staff concern.

## Assessment of Information Needs and Requirements

This section describes the background of the information needs and requirements survey that was conducted, its methodology and results.

### Importance of Information Needs and Requirements Assessment

The purpose of a MIS is to provide a service function, i.e. to serve 'clients' in meeting their demands. These demands can only be met if client demands are properly assessed and considered in the services. Thus, MIS services are determined by information needs and requirements (Qirui and Migxue 1993, Pellow and Wilson 1993, Davis and Ohlson 1985, Ackhoff 1967).

Why distinguish between needs and requirements? Information needs are understood as the critical set of data that serve to address a specific problem objectively. If the needs are met completely, the problem can be fully solved. Requirements for information are determined by individuals and include subjective preferences and views, which objectively may not be needed.

Ideally, information needs, requirements and availability are congruent fields that lead to an optimal treatment of the problem (Schmidt). In reality, these three components never match perfectly, thus making proper assessment of the situation more important, (Fig. 3).

**Figure 2.** Derivation of MIS Principles and Objectives from Organisational Structure

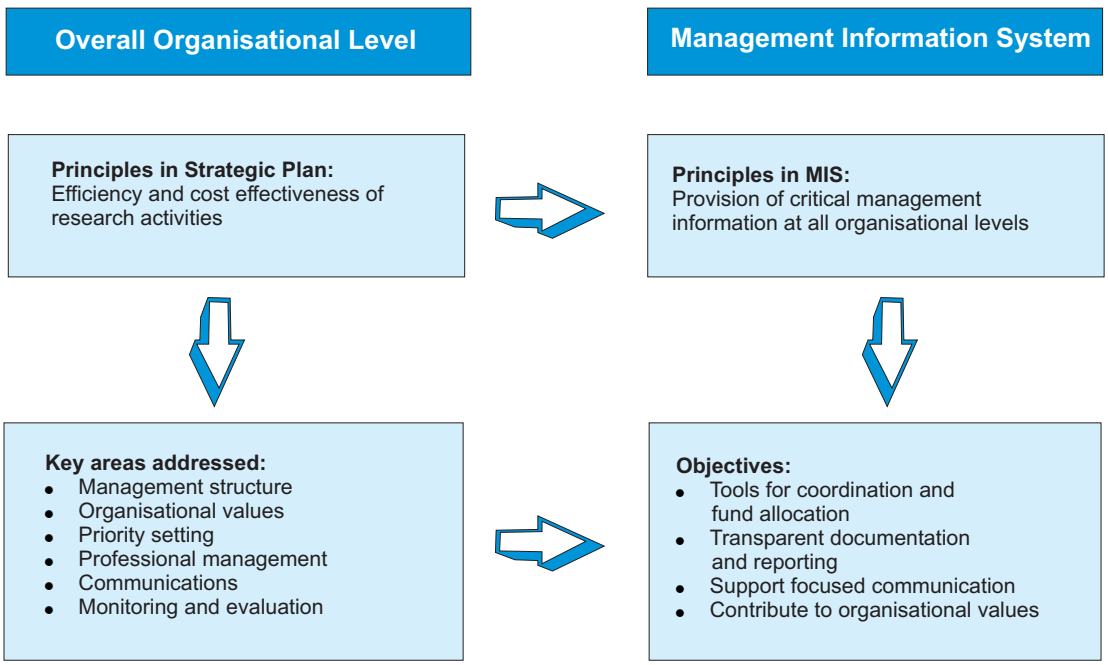
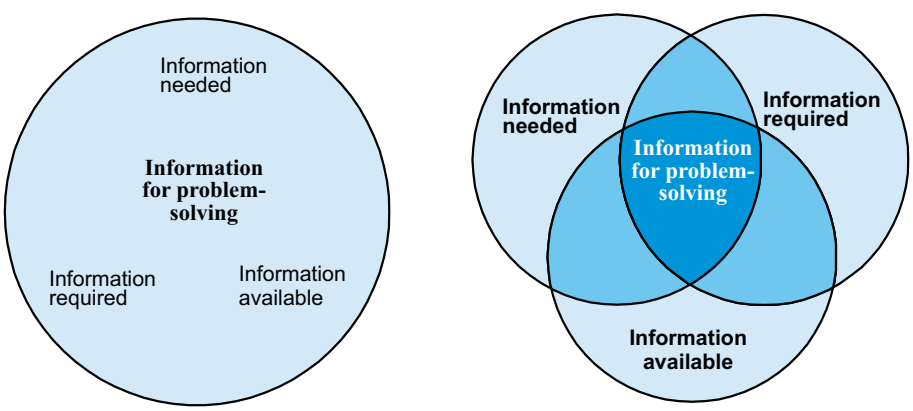



**Figure 3.** Information Needs, Requirements and Availability




(a) Ideal Situation

(b) Realistic Situation

There are some constraints on humans as specifiers of information requirements and these are caused by the nature of information processing, bias in data selection and use, and behaviour in problem-solving. Human information processing is dependent on memory capabilities to a great extent. Limitations, e.g. in short-term memory, may affect requirements that individuals consider important (Davis and Ohlson 1985).

Several factors may lead to a bias in specifications of information requirements: requirements may be adjusted to information currently available; recent requirements may be over emphasised compared to earlier requirements; and a value to unused data may be added 'just in case' it is needed. Another factor which may influence the description of requirements is the structure of models for problem-solving, together with individual preferences, skills and attitudes.

The consequences for MIS are apparent. Objective information needs and requirements must be identified and separated from individually biased requirements.

### Approach to Assess Information Needs and Requirements

A three-stage approach was applied for the assessment of information needs and requirements (Fig. 4). First, existing internal documents were examined in light of their relevance to the MIS. Documents included the CIFOR Draft Strategic Plan (CIFOR 1995), CIFOR Medium Term Plan (CIFOR 1993), relevant office memoranda and project related documents such as project briefs and reports.

An assessment chart was sent to all 22 professional staff. A sample chart is given in Annex 1. The main function of this tool was to assess needs and requirements on the level of separate institutional entities. Relationships of a particular division with other institutional and external entities had to be specified. The information provided in this chart was generally very good and the respondents appeared to be interested in the survey.

After evaluation of the charts, individual structured interviews were held with professional staff. The questions, (see Annex 2), were designed to provide indications for objective information needs as well as individual preferences. The interviews were very helpful in assessing the staff perception of the MIS and in separating needs and requirements. Respondents generally were very open and helpful.

## Results of the Assessment of Information Needs and Requirements

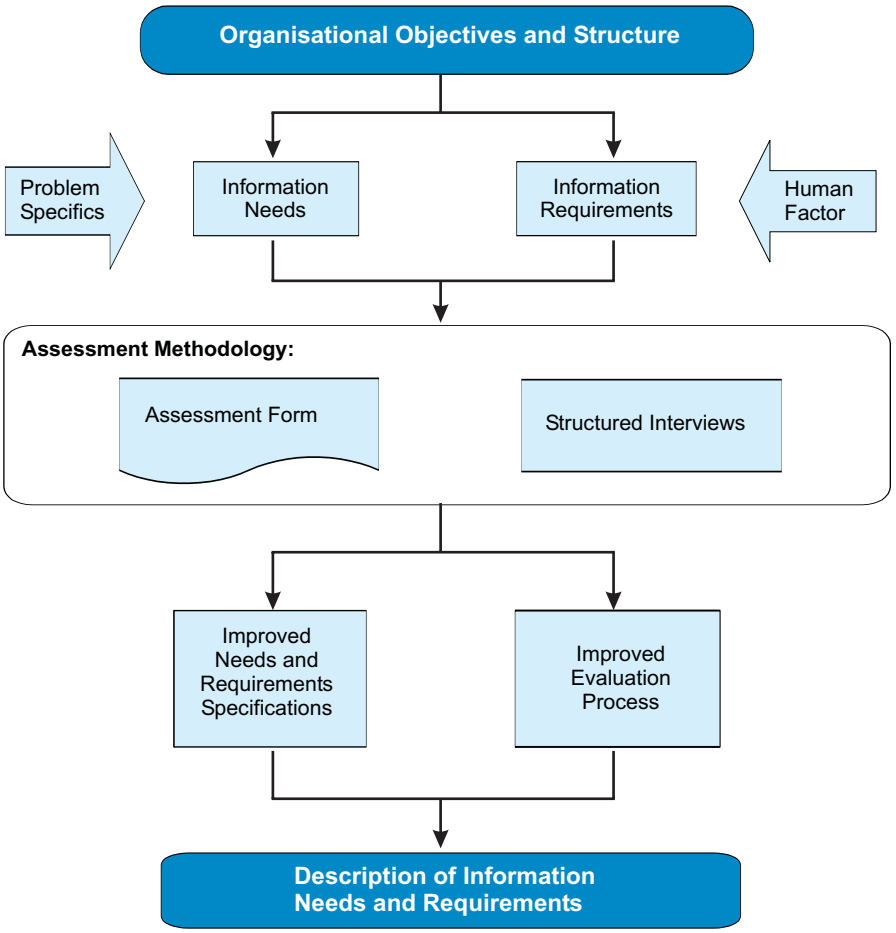
The description of the relationships and requirements between internal and external entities is based on the information provided in the assessment charts. Entities in the context of this survey are considered as one or multiple organisational units, groups of people or organisations with common characteristics that interact with one or several of CIFOR's organisational units. The following description of requirements and needs includes only items that were mentioned during the survey. They constitute core elements for the system design in Chapter 2.

### General Observations

A major task in this assessment was the distinction between information that is relevant to management and information which should not be included in a MIS. This was especially so in the description of relationships with the Research Support Division and Administration and Finance Division and should have been addressed more specifically in previous staff briefings on the MIS work.

It is crucial to precisely distinguish between information that needs to be delivered by the MIS and information provided by other information

**Figure 4.** Approach for Information Needs and Requirements Assessment




systems. This avoids the tendency to 'overload' the MIS with rather technical information and keeps it more simple and transparent (Ackhoff 1967). It is understood that information systems not included in the MIS can play a vital role and they may be linked to the MIS if appropriate. As a nomenclature convention for this study, information which was mentioned during the assessment and which should not be included in the MIS is referred to as 'technical information', required or provided through a specific 'entity service function' (ESF). An ESF is a service of a defined entity such as a division or a project which has no immediate relevance to the information and services provided by the MIS. Dealing with literature requests and supply of literature, for example, are considered ESF rather than functions the MIS should provide.

Another problem was the high degree of variance in the way respondents perceived information. However, since the survey included most senior professional staff in individual entities, a more concise and comprehensive image of information needs and requirements could be drawn.

Internally, main entities are the Research Division, Research Support Division, Administration and Finance Division, Office of the Director General and Management Group. In some cases, the Board of Trustees, Research Evaluation and CIFOR's travel agency were mentioned as other internal entities. Main external entities described were National Research Systems (NARS), International Research Centres (IARCs), donor agencies and the CGIAR. Other external bodies mentioned included media, International Union of Forestry Research Organisations (IUFRO), Non-Governmental Organisations (NGOs), TAC of the CGIAR, and United Nations Development Programme.

A major result of the survey was the allocation of all relevant information to five categories, namely projects, human resources, finance, facilities and procedures. All relevant survey data could be related to one of these categories.

**Projects**

Due to the re-organisational measures described on page 5, the term 'project' experienced a shift in its meaning. At the time the survey was conducted, a project was considered as a particular research or research support activity under any of the divisions. Under the subsequent organisational structure, the term attained a functional meaning, describing a functional entity under the Research Division, Research Support Division or the Assistant Director General respectively. Projects became administrative elements of a line structure. Thus, typical project management characteristics, such as project phases, milestones or project teams, could not be applied to CIFOR projects. In this study projects are considered as clearly identifiable sets of research activities with particular characteristics. A project is defined as a functional unit with a specific research focus and consisting of research tasks under the Research Division, Research Support Division or the Assistant Director General.

**Human Resources**

Human resources is the second information category identified. Information flows between the Research Division, Research Support Division and Administration and Finance Division, in particular the Human Resources Officer. The main interest of the Research Division and Research Support Division is in professional skills of human resources, which means efficient use of skills and capacities of human resources. The Administration and Finance Division's main concern is on the administrative side of human resources, such as salary and other benefits, training, leave and social conditions.

**Financial Resources**

Financial resources is another information category. As with human resources, there is a strong link between the Research Division/Research Support Division and the Administration and Finance Division. The latter maintains a budget and finance system which has to meet legal and organisational requirements. The main interest of the Research Division/Research Support Division is in budgets and expenditures related to cost centres' activities.

**Facilities**

The fourth information category includes facilities, mainly equipment and material. It should be pointed out that not all information about equipment needs to be considered in the MIS and that some of the related information is considered as ESF of the Administration and Finance Division. Facilities include not only information on equipment at CIFOR headquarters, but also in field projects or regional offices.

**Procedures**

Procedures is the last information category defined under the MIS. They include formalised structures that were established for the work process, such as

internal forms, memoranda of understanding for collaborative activities with partners, contract documents or interview procedures for applicants. The source of procedural information is mainly the Administration and Finance Division.

In the following sections, relationships and requirements for each major internal entity and the external entities mentioned are described in detail. Reference to individually mentioned entities is provided either under main entities or in descriptions of other entities.

## Internal Needs and Requirements

Internal information needs and requirements are described in the following sections based on information flow within and between separate entities described in the assessment. An analytical matrix of internal information needs is given in Table 1.

### *Research Division*

All of CIFOR's research should be conducted in an interdisciplinary manner. Thus there is a logical, intensive interaction between disciplines in different projects. Needs include access to information about planned, proposed and ongoing projects and project-related documents such as memoranda of understanding with collaborators or contracts with consultants or service providers. Scientists from various projects may also be involved in the review process of proposed projects. Idea generation and sharing is another element mentioned. On the output side there is a need for information on publications.

Needs for human resources information closely relate to projects. Information on research interests of staff is required and consequently information on human resources involved in various research projects. On the financial side, budgets need to be prepared and monitored. Similarly, information on shared facilities, which may include shared office space and equipment, laboratory equipment, literature, vehicles and field equipment, is requested. Procedures mentioned were memoranda of understanding with collaborators.

Literature exchange between scientists was mentioned under this category. This is a technical entity service function of the Research Support Division and should not be included in the MIS.

### *Research Division - Research Support Division*

The same information is required on joint projects as for Research Division interactions. Particular reference was given to some specific functional areas of the Research Support Division, namely capacity building and networking, geographic information systems and research impact assessment. Although these functions can be considered as ESF of the Research Support Division, they generally have more of a project than a support function character and thus should be mentioned in the specific context of project-related information requirements. Another requirement referred to articles and books published in various projects.

Nevertheless, most needs and requirements are ESF that have to be provided by the Research Support Division to the Research Division. They include requests for and supply of literature through the library services, management of documents and archives, statistical services, services for the production of visual aids, access to and maintenance of shared databases and computer and communications support. This extensive list of information requests and supplies is not considered part of the MIS. Potential links between MIS and ESF are discussed in Chapter 2.

### *Research Division/Research Support Division - Administration and Finance Division*

The Administration and Finance Division requires information on planned and ongoing projects to maintain an appropriate cost centre structure.

**Table 1.** Analytical Matrix of Internal Information Needs and Requirements

| | Projects | Human Resources | Finance | Facilities | Procedures |
|---|---|---|---|---|---|
| **Within Research Division (RD)** | • Planned<br>• Proposed<br>• Ongoing<br>• Reviews and ideas<br>• Joint publications | • Research interests of staff<br>• Staff assignments | • Project budgets | • Shared facilities | • Memoranda of understanding |
| **RD - Research Support Division (RSD)** | • Planned<br>• Proposed<br>• Ongoing<br>• Reviews and ideas<br>• Joint publications<br>• Published articles and books | | • Joint project budgets | • Shared facilities | • Memoranda of understanding for joint projects |
| **RD/RSD - Administration and Finance Division (AFD)** | • Planned<br>• Proposed<br>• Ongoing | • Daily time allocation to projects<br>• Leave management<br>• Personnel information | • Project budgets<br>• Accounts<br>• Expenditures<br>• Sources of funding<br>• Fund transfers<br>• Expense claims | • Space allocations<br>• Equipment requests | • Memoranda of understanding<br>• Forms |
| **RD/RSD - Office of Director General (DG) and Management Group (MG)** | • Status and progress reports<br>• Research proposals<br>• Trip reports | • Performance reports | | | |
| **AFD - Office of DG and MG** | | • Performance reports<br>• Recruitment requests<br>• Requests to issue contracts | • Project budgets<br>• Contracts | | • Contract matters<br>• General policies establishment |

Memoranda of understanding between the Research Division/Research Support Division and their partners need to be accessible to the Administration and Finance Division as well as contracts with consultants or other collaborators. In relation to human resources, the Administration and Finance Division requires daily time allocation to projects from individual professional staff members. Application and management of leave is another area where information is circulated between these two entities. Senior managers need to have access to personnel information on staff.

Most information requests between these entities are related to financial matters. Researchers need

information on project budgets, accounts, expenditures and sources of funding. Fund transfer information is another common area. Given the high amount of staff travel, travel and other expense claims were considered an important information category.

Information on facilities needs to be circulated widely, including office space allocation, office and field equipment. Frequent information requirements occur in the area of procedures. A set of forms is maintained by the Administration and Finance Division that is used by researchers in the areas of travel planning and authorisation, expense claims and purchase. Formats for memoranda of understanding or contracts with consultants and service providers are maintained by the Administration and Finance Division for researchers to use in their operations.

An important ESF of the Administration and Finance Division is the circulation and processing of information on residency and diplomatic clearance, research permits and other aspects related to working and living in Indonesia.

### *Research Division/Research Support Division - Office of the Director General and Management Group*

On the project level, managers have to provide status and progress reports to the Divisional Director, Management Group or Director General. These are produced irregularly on a needs basis. Formal reporting structures and procedures were lacking. CIFOR's Chief Scientist leads the review and formal approval of research proposals prepared by researchers.

CIFOR's global mandate requires scientists to travel extensively to projects, meetings and partner organisations. Scientists are required to submit reports for each of their business trips. These reports are circulated among professional staff and, in particular, allow senior management to keep track of external activities and contacts. There is no format required for trip reports and there is a considerable variance in structure, content and length. Since the beginning of 1996, each scientist is required to prepare an annual travel plan.

On the human resources side, the main flow of information consists of performance reports. At the end of each year, a performance appraisal for each staff member is conducted. Information flows from the staff member to supervisors and finally to the Director General. At each level, comments are added to the appraisal. From the Office of the Director General the appraisal is sent back to the staff member for final comments. Results of the appraisal determine promotional measures and, if applicable, disciplinary measures too. The final appraisal documents are filed in the Human Resources Office.

There were no information requirements on budgets and facilities between those entities. Inputs from the Research Division into strategic planning exercises were identified. Many scientists fulfil tasks for the office of the Director General which go beyond their research activities. These include activities such as the organisation of, or attendance at, meetings with visitors or replies to general correspondence. There is a considerable flow of information under such ESF, mainly from the Research Division to the Office of the Director General.

### *Administration and Finance Division - Office of the Director General and Management Group*

The survey results indicated that no project-related information is circulated between these two entities. Human resources information is concerned with recruitment requests and requests to issue contracts as well as performance appraisals. Most data that flow between these two units relate to budget and financial issues and include requests for and information on budgets, contractual matters,

financial and budget reports. No immediate information exchange was indicated about facilities. Procedural information is concerned with contract matters and established general policies.

## External Needs and Requirements

The following section describes the most important information requirements between CIFOR and external entities. Since these requirements are similar to those of most internal entities, they are described for CIFOR as a whole and not for each internal entity. Where necessary, reference is made to requirements or specifics of an individual entity. An analytical matrix of external information needs and requirements is given in Table 2.

### *Research/Research Support Divisions - External Entities*

One of the most important information flows addressed was between the Research Division/ Research Support Division and NARS. The term NARS is used within the CGIAR to describe national collaborating organisations such as universities, national research centres or NGOs. Most of the requirements relate to projects and include information on research and training activities, both at CIFOR and NARS. For joint activities, progress reports are circulated and information about the research capacity of NARS is gathered. On the human resources side, biodata on collaborating scientists are requested.

**Table 2.** Analytical Matrix of External Information Needs and Requirements

| | Research and Research Support Division | Administration and Finance Division | Office of Director General |
|---|---|---|---|
| **National Research Systems** | • Research data<br>• Research information<br>• Progress reports<br>• Training information<br>• Research capacity<br>• Collaborator biodata | • Contracts<br>• Memoranda of Understanding | • Project ideas and proposals |
| **International Agricultural Research Centers** | • Research data<br>• Research information<br>• Progress reports<br>• Training information<br>• Research capacity | • Exchange of experience and ideas | |
| **CGIAR** | • Data on system-wide initiatives<br>• Formal requests and procedures | • Exchange of experience and ideas<br>• Annual programme of work and budget<br>• Financial statements<br>• Procedural guidelines | |
| **Donors** | • Interest and priority assessments<br>• Project proposals<br>• Project reports<br>• Project budget data | • Annual funding requests<br>• Audited financial statements<br>• Financial project reports<br>• Payment requests<br>• Acknowledgement letters<br>• Contracts | • Project information |
| **Media** | | | • Activity information |

Information flow on financial matters and facilities is an exception and was not mentioned in the survey responses. Some of the facility information could come under the research capacity data described for projects.

Other information flows mentioned which were considered ESF rather than MIS-related include the provision of scientific and managerial advice and the exchange of publications and research data.

Many items described for relationships with NARS were mentioned also for IARCs. Only project-related information requests were described and include research data on collaborative activities. A category specific to the CGIAR is system-wide research initiatives that involve several or all member institutes of the CGIAR, for example the CGIAR's Inter-Center Working Group on Genetic Resources. Information requests specific to these initiatives were mentioned in the survey and focused mainly on technical data. Specifically, formal requests and procedural instructions are received from the CGIAR secretariat for consideration. ESF similar to those for NARS were mentioned.

Donors are another important external entity. Project information includes the assessment of donor interests and priorities in order to identify funding opportunities. In the very early stages, project proposals may circulate among the Research Division and Research Support Division and donors. Donors that fund CIFOR projects receive project reports. In addition to project information, budget-related information is requested. Provision of publications to donors is an ESF of the Research Support Division.

### *Administration and Finance Division - External Entities*

With NARS, information is exchanged about contractual agreements and includes project, human resources, financial and procedural data. Requirements in relation to IARCs include exchange of ideas and experience. More intensive requests exist with donor agencies. Although project-related, they have financial content such as annual funding requests, audited financial statements, financial project reports, payment requests and acknowledgement letters. Procedural information relates to contract specifications and donor-specific requirements.

Requirements with the CGIAR include annual funding requests and financial statements as well as the exchange of guidelines.

### *Office of the Director General - External Entities*

Project ideas and proposals are exchanged with NARS and IARCs. Project information is also circulated among donors. The media are another external entity with specific information requirements.

Chapter 2

# System Design

This chapter describes the design of the MIS. It is based on the analysis of the diagnostic data and in particular the information needs assessment, the experience of the author and relevant literature. There are several advantages of designing a modular system: the system can be designed in a transparent way; it allows a prototype for testing the core elements of the system to be rapidly developed; and flexibility for modification and extension to adjust the system for future demands is maintained. The importance of a modular concept is emphasised by the organisational characteristics outlined in Chapter 1.

The methodology is similar to the approach Parker and Case (1993) described. They identified six components of system development: output, input, processing, storage, procedures and personnel. There was a need for a more focused system since some of the categories used by the authors are closely related to each other. In some cases they are self-evident and need not be described or repeated.

The logical structure of the MIS is based on the five information categories: projects, human resources, financial resources, facilities, rules and procedures.The following sections describe outputs, inputs, processing, storage and personnel for each.

## Outputs

The outputs are the core element of the system since they have to meet users' requirements and thus determine success or failure of the system. The logic of how output needs are generated can be illustrated with the help of a slide rule model mentioned by Mertens and Griese (1993). The user can query the system by combining information categories at different levels (Fig.5).

The main feature of this system is to provide information about a combination of data from different information categories and at different levels of detail. In the example mentioned above, the specific information request is to view annual travel expenditures for team leaders of all projects, including the travel authorisations that were issued. This simple example illustrates the underlying concept of the system. In the following sections, for each information category individual output elements are described. Examples for elements of a project are project title or project staff. Each element of an information category is described by attributes, output form and output timeliness. Attributes of project staff, for example, are names and titles. The form describes whether data are quantitative or non-quantitative and in textual or graphic form. Timeliness categorises data according to their output intervals. The two types that are differentiated are periodic outputs at defined intervals and outputs upon demand. In addition, information is provided if data are considered time-critical.

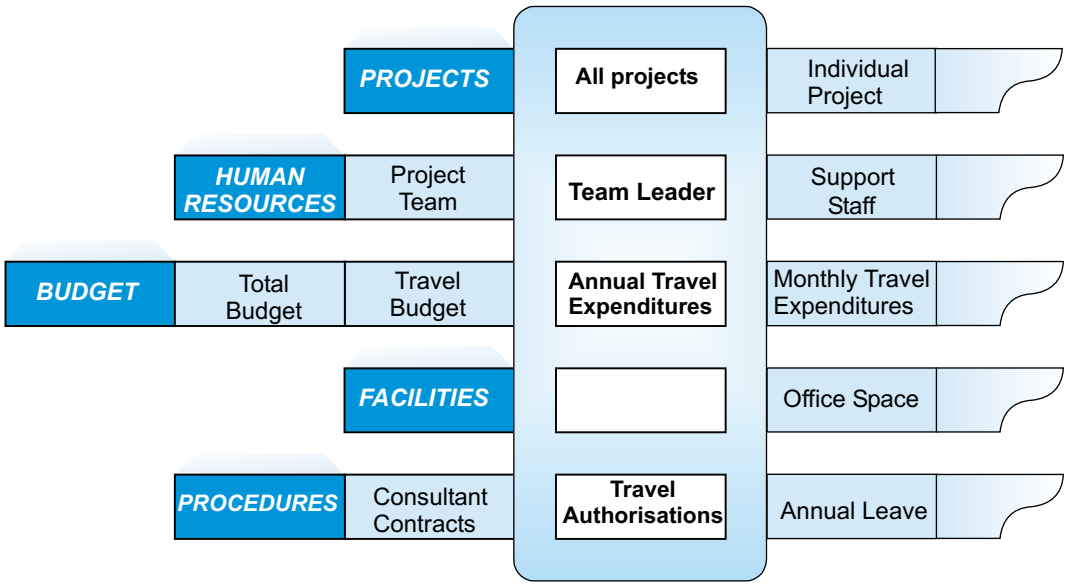
### Project Outputs

The system had to provide comprehensive information on the projects described above.

#### Project Level

A project is an information category consisting of one to several tasks. The relationship between a project and tasks can be described with the help of entity-relationship-models. Three relationships are distinguished, *1:1*, *1:n,* and *m:n.* A *1:1* relationship for projects and tasks would mean that one project can have only one task and vice versa. A *m:n* relationship, in contrast, would indicate that several

**Figure 5.** Output Slide Rule Model




tasks could occur under several projects. In the current situation the relationship between projects and tasks is *1:n*, which means that one project can accommodate several tasks but one task can be related to one project only. Figure 6 provides more details about project-entity-relations. A project is characterised by its elements, project title, project code, project status, project staff, tasks, time frame, budget, expenditures, location(s), collaborator(s) and a project description.

The project titles (see Figure 1) give a first impression of the subject project relationship. Title information is in non-quantitative text form and is not time critical. Project codes follow a multi-digit structure provided by the Administration and Finance Division. The first digit describes the division, the second and third digits the project. Projects are relatively free in the allocation of the last three digits. They are considered as text and are not time-critical. The project status provides information about the current phase of the project and includes the attributes proposed, implemented and completed. The form of status information is textual and non-quantitative. It may be requested periodically and upon demand and is not time-critical. Human resources involved in a project can be characterised according to three different groups. For each project, a project team leader is appointed. The role of the team leader is mainly coordination and facilitation with a limited amount of administrative tasks (Dykstra 1996). The team leader, together with the leaders of the Research Division, coordinates project tasks and budgets. The second human resources group is the project personnel. Project personnel are scientific staff working in a particular project and vary in number from one to six. The project-scientific-staff-relationship is *m:n* which means that one scientific staff member can be involved in several projects. The third project human resources group is the support staff. One support staff member can be assigned to multiple projects. Information attributes of project staff are their full name, job title and project title. The output form for human resources is textual. It is regarded as non-quantitative and not time-critical. Outputs are mainly required upon demand.

The time frame of a project describes its start and eventual end dates, duration, assignment of project staff time to the project as well as deadlines. Since some projects consist of several tasks, mechanisms are necessary for validation and comparison of time-related data between the task and the project levels. The output form of time-related information can include text and graphics. It is quantitative and time-critical data. Planned and actual time frames need to be comparable. Budget information has to include sources of funding and project budgets broken down by personnel, travel and equipment budgets. Three categories, personnel, travel and equipment, are sufficient for expenditures. Financial information is mainly quantitative but can include textual explanatory notes, e.g. the description of the purpose of a particular expenditure. It has to be presentable in text and graphical form and is time-critical. Inquiries about budget and expenditure status may occur both periodically and upon demand.

Information about project locations can be aggregated from task locations and has to be available at the country level. In addition, regional information has to be aggregated. The system has to have sufficient flexibility to use different regional classification schemes, for example agro-ecological zones defined by TAC, CIFOR's eco-regions (CIFOR 1995), eco-floristic zones or simply geographic regions. Geographical information is available in text and graphical form including a map projection facility. It is neither quantitative nor time-critical. Identical to the task level, requests about project locations are mainly upon demand. Collaborators have to be identifiable as individuals as well as by institution. Names and countries are the minimum set of information required and a link to contact address information is a desirable feature. Data on collaborators are used in textual form and are neither quantitative nor time-critical. They are usually queried upon demand.

The project description is textual information that should describe background, problem, objectives, strategies, methodology, outputs and current status of a project. It should also provide information about facilities used or required and relate to processes and procedures. This output factor is not time-critical and non-quantitative. Upon demand the current status of a project, as well as complete project descriptions, might be requested. In addition, periodic reports are generated. Table 3 summarises the output element-

**Table 3.** Output Element-Factor-Relationship for Projects

| Element | Factors | | | | | | |
|---|---|---|---|---|---|---|---|
| | Attributes | Form[1] | | | Timeliness[2] | | |
| | | Qua | Text | Gra | Per | Dem | Crit |
| Title | | | ✓ | | | | |
| Code | Multi-digit Financial Code | | ✓ | | | | |
| Project Staff | Staff No., Family Name, First Name(s), Job Title, Project Title | | ✓ | | ✓ | ✓ | |
| Project Status | Proposed, Implemented, Completed | | ✓ | | | ✓ | |
| Tasks | Title, Code | | ✓ | | | ✓ | |
| Description | Background, Objectives, Strategies, Methodology, Outputs, Current Status | | ✓ | | ✓ | ✓ | ✓ |
| Location | Country, Region | | ✓ | ✓ | | ✓ | |
| Time Frame | Start, End, Duration, Milestones/ Deadlines, Staff assignments | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Expenditures | Personnel, Equipment, Travel | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Budget | Personnel, Equipment, Travel, Funding Sources | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Collaborators | Family Name, First Name(s), Institute, Country | | ✓ | | | ✓ | |

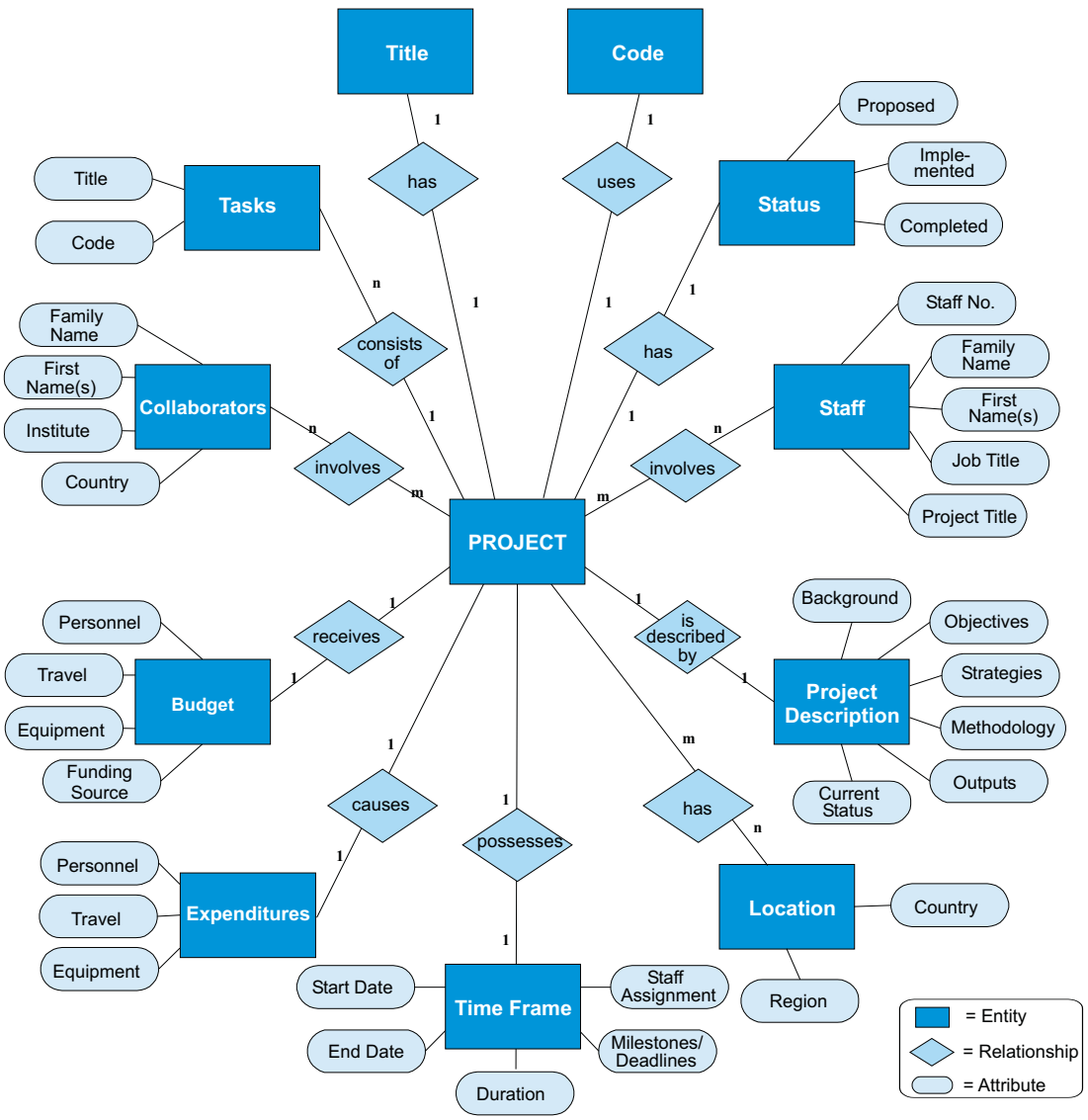
[1] *Form*: Qua=Quantitative Data, Text=Text Form, Gra=Graphical Form
[2] *Timeliness*: Per=Periodical, Dem=Upon Demand, Crit=Time Critical

factor-relationship at the project level. The relationships between these entities are presented in Figure 6.

### Task Level

The smallest unit within a particular project is a task. Elements of a task are task title, task code status, task manager, time frame, budget, expenditures, location, collaborators as well as a task description. The task title provides a first impression of the research (type). The project leader assigns task codes according to the multi-digit scheme developed by the Administration and Finance Division. Information about the current phase of the task is contained in the status element and

**Figure 6.** Project Output Entity-Relationship-Model



includes the attributes proposed, implemented and completed. The form of status information is textual and non-quantitative. It may be requested periodically and upon demand and is not time-critical. Task managers are responsible for the execution and management of their tasks and the assigned task budget (Dykstra 1996). Information about task managers includes full name and job title. The output form for task manager information is textual. Information about task managers is non-quantitative, not time-critical and is mainly requested upon demand. The time frame of a task has to include its start and end, its planned duration, the amount of staff time for the task manager as well as other staff involved and deadlines. This information is quantitative and by nature time-critical. A facility to compare planned and actual time-frames has to be provided on a periodic basis as well as upon demand. The output form is mainly textual but graphical features, such as bar charts, are required. The minimum set of budget information is data on various cost centres, such as personnel, travel, equipment and sources of funding, with an option to add other categories. Similarly, elements of expenditures include personnel, travel and equipment data. The form of this type of information is quantitative and accessible in text or graphical mode. It is also time-critical and comparisons between calculated budget and actual expenditures are required. Financial data are queried periodically and upon demand.

The location of tasks had to be described at the country level. CIFOR headquarters are considered a separate location. Aggregation into regions is unnecessary. This information is neither time-critical nor quantitative. The output form is textual and provided upon demand. Data about individuals and organisations involved in a task provide necessary information about collaborators. In addition to names, it could include address information, at least of the country where the organisation or individual is based. The form of collaborator information is non-quantitative and textual. It is not time-critical and provided upon demand. The task description provides all relevant information not captured in the categories above. This includes the background of the task, objectives, strategies, methodology, outputs and current task status. This information is time-critical and its output form is textual and non-quantitative. Periodic reports and reports upon demand have to be generated.

The main users of task-related information are task managers and, to a lesser extent, project managers. Table 4 provides a summarised overview

**Table 4**. Output Element-Factor-Relationship for Tasks

| Element | Factors | | | | | | |
|---|---|---|---|---|---|---|---|
| | Attributes | Form[1] | | | Timeliness[2] | | |
| | | Qua | Text | Gra | Per | Dem | Crit |
| Title | | | ✓ | | | | |
| Code | Multi-digit Financial Code | ✓ | | | | | |
| Status | Proposed, Implemented, Completed | | ✓ | | ✓ | ✓ | |
| Task Manager | Family Name, First Name(s), Job Title, Staff No. | | ✓ | | | ✓ | |
| Description | Background, Objectives, Strategies, Methodology, Outputs, Current Status | | ✓ | | ✓ | ✓ | ✓ |
| Location | Country | | ✓ | | | ✓ | |
| Time Frame | Start, End, Duration, Milestones/ Deadlines, Staff Assignments | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Expenditures | Personnel, Equipment, Travel | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Budget | Personnel, Equipment, Travel, Funding Sources | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Collaborators | Family Name, First Name(s), Institute, Country | | ✓ | | | ✓ | |

[1] *Form*: Qua=Quantitative Data, Text=Text Form, Gra=Graphical Form
[2] *Timeliness*: Per=Periodical, Dem=Upon Demand, Crit=Time Critical

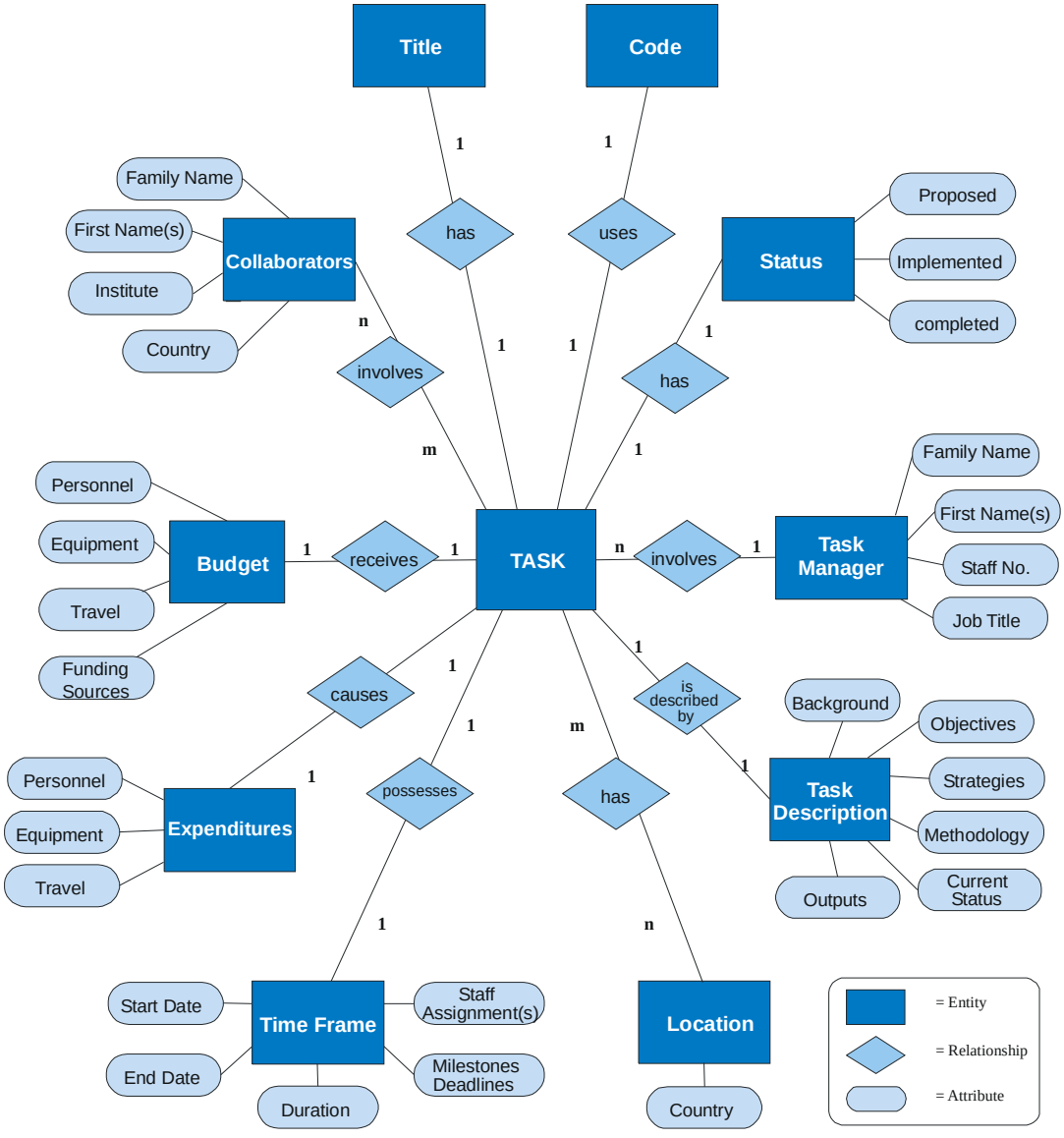
on the outputs at the task level and relationships among the various entities are presented in Figure 7.

## Human Resources Outputs

This section describes outputs of the MIS that relate to human resources. It is understood that these outputs take into account only MIS-relevant data and that human resources data requirements exist beyond the scope of the MIS.

According to the existing flows of information, human resources data are closely related to project information. One element in this category is basic

**Figure 7.** Task Output Entity-Relationship-Model



staff biodata which includes the attributes family name, first name, nationality, staff number, job title, staff category, research interests and entry date. The output form for this information is textual and graphical. Graphical outputs can include charts about nationality, age structure or gender distribution. Periodical reports are required, e.g. for the annual report, although reports upon demand are also required. Biodata information is not time-critical.

Another element is project involvement. There is a need to know which staff member is involved in which projects and tasks. Attributes are staff number, project codes and titles, task codes and titles. Project involvement information is textual, non-quantitative and can be provided upon demand as well as in the course of periodic project or task reports. Project involvement is not time-critical. Staff time management is a further element under the human resources category. For purposes of cost allocation, daily time records are maintained for projects and tasks. This element also includes leave management of staff. Attributes are staff number, projects and tasks, relative time allocation, and leave. The output form is textual and quantitative. Outputs are provided periodically and are by nature time-critical. The performance appraisal system is regarded as another information element. The system outputs follow the process described on page 14 and include the attributes staff number, self-appraisal, supervisor appraisal, appraisal of the Director General and measures resulting from the appraisal. This information is textual and non-quantitative. Reports are generated annually and are time-critical to the extent that the performance appraisal has to be completed by a certain deadline.

Another output element in the human resources category relates to vacancies and recruitment. There is a need to announce vacancies and to make the recruitment process transparent. Attributes include project number, vacancies, and eventual, short-listed candidates as well as information about the staff members involved in the recruitment process. This information is textual and non-quantitative and reports are requested upon demand. The information is time-critical since deadlines are set for applications, starting dates, and so forth.

Besides information about CIFOR staff, the MIS has to include collaborators and consultants involved in joint research activities. Collaborator attributes are family name, first name, job title, institute, country, project(s) or task(s) involved and reference documents such as memoranda of understanding or contracts. The output form is textual and graphical to the extent that charts showing collaborators by region or country are requested. The information is not quantitative and not time-critical and requests are answered upon demand. A similar set of attributes is required for consultants and consists of family name, first name, job title, company or institute, country, project(s) or task(s) involved and reference documents. As for collaborators, consultant information is not quantitative and not time-critical and requests are upon demand. Table 5 provides a summary of MIS output with regard to human resources. Figure 8 provides a graphical overview of the entity-relationships for human resource outputs.

## Financial Outputs

It is important to understand that financial outputs of the MIS, as for all other categories, take into account only relevant parts of a wider data set that might be maintained in other ESF.

Budget information was the most frequently mentioned element in the information survey. Budget attributes are project/task code, personnel budget, travel budget and equipment budget. Budgets by unit need to be displayed, e.g. the number of flights in the travel budget or the personnel cost for a particular staff member. Another attribute is source of funding which is important if projects or tasks receive funds from

**Table 5.** Output Element-Factor Relationship for Human Resources

| Element | Factors | | | | | | |
|---|---|---|---|---|---|---|---|
| | Attributes | Form[1] | | | Timeliness[2] | | |
| | | Qua | Text | Gra | Per | Dem | Crit |
| Basic Staff Data | Family Name, First Name(s), Nationality, Staff No., Job Title, Staff Category, Research Interests, Entry Date. | | ✓ | ✓ | ✓ | ✓ | |
| Project involvement | Staff No., Project No. and Title, Task No. and Title | | ✓ | | ✓ | ✓ | |
| Time management | Staff No., Project No., Task No., Relative Time Allocation, Leave | ✓ | ✓ | | ✓ | | ✓ |
| Performance appraisal | Staff No., Self-Appraisal, Supervisor Appraisal, DG Appraisal, Results | | ✓ | | ✓ | | ✓ |
| Recruitment | Project/Task Code, Vacancies, Names of Short-listed Candidates, Staff Involved | | ✓ | | | ✓ | ✓ |
| Collaborators | Family Name, First Name(s), Job Title, Institute, Country, Projects & Tasks Involved, Reference Documents | | ✓ | ✓ | | ✓ | |
| Consultants | Family Name, First Name(s), Job Title, Institute, Country, Projects & Tasks Involved, Reference Documents | | ✓ | ✓ | | ✓ | |

[1] *Form:* Qua=Quantitative Data, Text=Text Form, Gra=Graphical Form
[2] *Timeliness:* Per=Periodical, Dem=Upon Demand, Crit=Time Critical

complementary sources. The output form for budget information is quantitative and textual, but graphical display is also requested. Although no formal procedures are established, it is expected that periodic budget reports will be generated, in particular for comparison with expenditure information. A facility to produce outputs on demand also has to be considered. Budget information is time-critical, since payments and income are related to dates.

The next element in the finance category is expenditures. The attribute set of expenditures is similar to budgets and consists of project/task code, personnel expenditure, travel expenditure and equipment expenditure. These attributes must show totals and be accessible at the level of units. If expenditures for flights occur, for example, the required information might be the cost, transfer data and flight details, such as destination, dates and traveller. Personnel expenditures have to include information about collaborators and consultants. The output form for budget expenditure data is quantitative and textual and may require graphical options. As far as timeliness is concerned, the time-critical outputs will have to be generated periodically and upon demand.

In summary, for each of the described attributes, information is requested about amounts, date and descriptors. The financial output requirements from the MIS are summarised in Table 6. Figure 9 provides a graphical overview of the entity-relationships for financial resource outputs.

## Facility Outputs

Facility outputs have lower priority than the categories described previously but there are several reasons why they should be treated separately. In the near future it is likely that more activities will take place in the field and laboratories. Both activity types are usually equipment intensive. In field projects for example, equipment can include instruments for measurements, cars or office material. Laboratory facilities may include very specialised equipment for which data need to be kept in the MIS. Eventually high investments for equipment, requirements for specialised knowledge to operate and service the equipment and specific

**Figure 8.** Human Resources Outputs Entity-Relationship-Model

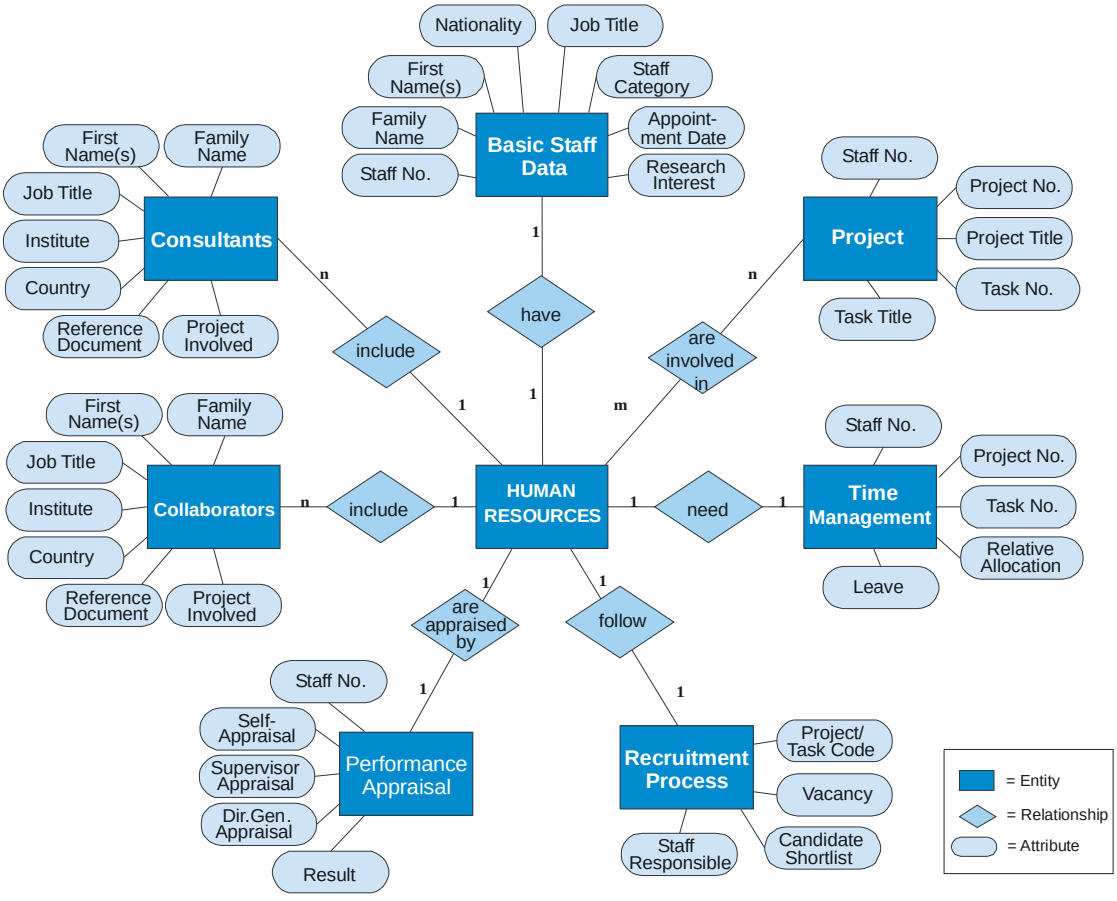
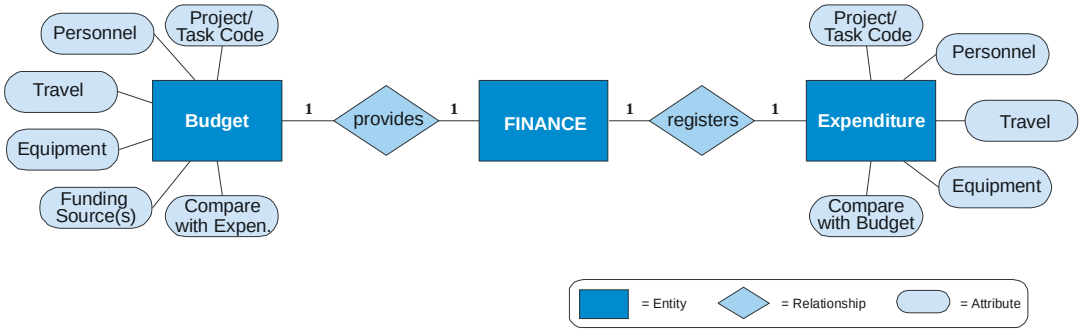



**Table 6.** Output Element-Factor Relationship for Financial Resources

| Element | Factors | | | | | | |
|---|---|---|---|---|---|---|---|
| | Attributes | Form[1] | | | Timeliness[2] | | |
| | | Qua | Text | Gra | Per | Dem | Crit |
| Budget | Project/Task Code, Personnel, Travel, Equipment, Funding Source, Budget-Expenditure Comparison | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Expenditures | Project/Task Code, Personnel, Travel, Equipment, Expenditure-Budget Comparison | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

[1] *Form:* Qua=Quantitative Data, Text=Text Form, Gra=Graphical Form
[2] *Timeliness:* Per=Periodical, Dem=Upon Demand, Crit=Time Critical

**Figure 9.** Financial Resource Output Entity-Relationship-Model




reporting requirements from donors justify the aggregation of this information into a separate category.

It is understood that the Administration and Finance Division has an important administrative ESF related to procurement, maintenance and registration of equipment. Thus, the MIS must provide data only, where justification is given and research or support staff are directly involved in the use of such equipment. In some cases the differentiation between ESF and MIS might be obvious, but in other instances decisions will be required on an ad-hoc basis. Links from the MIS to other information systems can support such decisions or even make them redundant.

Currently, in this category it is sufficient to include only an equipment element with the attributes inventory number, project/task number, and description. Financial attributes are excluded since, if necessary, they can be included in the finance category. As new demands emerge, this category can be expanded by further elements.

## Procedure Outputs

Procedures have an important cross-sectional role since all outputs in the four categories described above are embedded in a wide variety of procedures, protocols and regulations. Although CIFOR, as an open dynamic organisational system, has to maintain a high degree of flexibility in its operations, procedures are vital for some organisational functions.

Output elements of procedures identified in the course of the investigation are Memoranda of Understanding with partner institutions and a variety of forms. A screening of the shared resources available revealed more procedural elements exist.

MOU have high importance since they provide CIFOR's extensive collaborative activities with a necessary operational and legal framework. Attributes of MOU are: name and address of the cooperating institutions, purpose of the agreement, general points, institutional characteristics, general conditions, content of collaborative activities, specific contributions of all partners involved and general arrangements. Output forms for MOU are textual and non-quantitative and may be requested upon demand. They have a time-critical nature since they need to be established prior to the start of collaborative activities. Contract templates for consultants are another important procedural element. Contract attributes are: name of the consultant, subject, duration of contract, start date, end date, name(s) of personnel providing consulting services, task or project code, supervision, daily fee, maximum number of days fee will be paid, duty post and departure location of consultant. Contracts are mainly textual, non-quantitative outputs that are

time-critical and provided upon demand. Quantitative data are provided for fees, maximum number of days fee will be paid, duration, start and end dates.

Several forms with a high relevance to cross-organisational operations need to be mentioned. Travel authorisations are requested prior to each duty travel. They have to be approved by the immediate supervisor of the travelling staff member. Attributes of travel authorisations are: name of the person travelling, cost code allocation, type of travel, destinations, departure dates, arrival dates, purpose of travel, class of air travel, estimated airfare, estimated expenses, advance requested, date advance needed, signature of traveller, authorisation signature, amount of advance issued, numbers of travellers cheques, responsible finance officer and date advance was issued. Outputs are provided in text format and include quantitative aspects such as advance payment request, estimated airfare or duration of trip. They are time-critical and requested upon demand. Requisition orders are related to facility requirements and have the attributes: quantity, item description, cost estimate, actual cost, date ordered, date required, back order date, date delivered, task or project code, names of persons requiring, acknowledging, approving and receiving. They contain both, quantitative and non-quantitative data, are time-critical and have to be provided upon demand.

The elements described are summarised in Table 7 and an entity-relationship model for procedures is provided in Figure 10.

There are many other forms which are maintained, but their scope is more narrowly focused on individual organisational aspects, for example, a standard format for letters and facsimile, which is an ESF of the Office of the Director General and Administration and Finance Division.

**Table 7.** Output Element-Factor Relationship for Procedures

| Element | Factors | | | | | | |
|---|---|---|---|---|---|---|---|
| | Attributes | Form[1] | | | Timeliness[2] | | |
| | | Qua | Text | Gra | Per | Dem | Crit |
| MOU | Name/address of Cooperating Institutions, Purpose, General Points, Institutional Characteristics, General Conditions, Content, Specific Contributions, General Arrangements | | ✓ | | | ✓ | ✓ |
| Contracts | Name of Consultant, Subject, Duration of Contract, Start Date, End Date, Name(s) of Consulting Personnel, Project/Task Code, Supervision, Daily Fee, Maximum Number of Paid Days, Duty Post, Departure Location | ✓ | ✓ | | | ✓ | ✓ |
| Travel Authorisation | Name, Cost Code, Type of Travel, Destinations, Departure and Arrival Dates, Purpose of Travel, Class of Air Travel, Estimated Airfare, Estimated Expenses, Advance Requested, Date Advance Needed, Signature of Traveller, Authorisation Signature, Amount of Advance Issued, Numbers of Travellers Cheques, Responsible Finance Officer, Date Advance Issued | ✓ | ✓ | | | ✓ | ✓ |
| Requisition Order | Quantity, Item Description, Cost Estimate, Actual Cost, Date Ordered, Date Required, Back Order Date, Date Delivered, Project/Task Code, Names of Persons Requiring, Acknowledging, Approving and Receiving | ✓ | ✓ | | | ✓ | ✓ |

[1] *Form:* Qua=Quantitative Data, Text=Text Form, Gra=Graphical Form
[2] *Timeliness:* Per=Periodical, Dem=Upon Demand, Crit=Time Critical

**Figure 10.** Procedure Output Entity-Relationship-Model

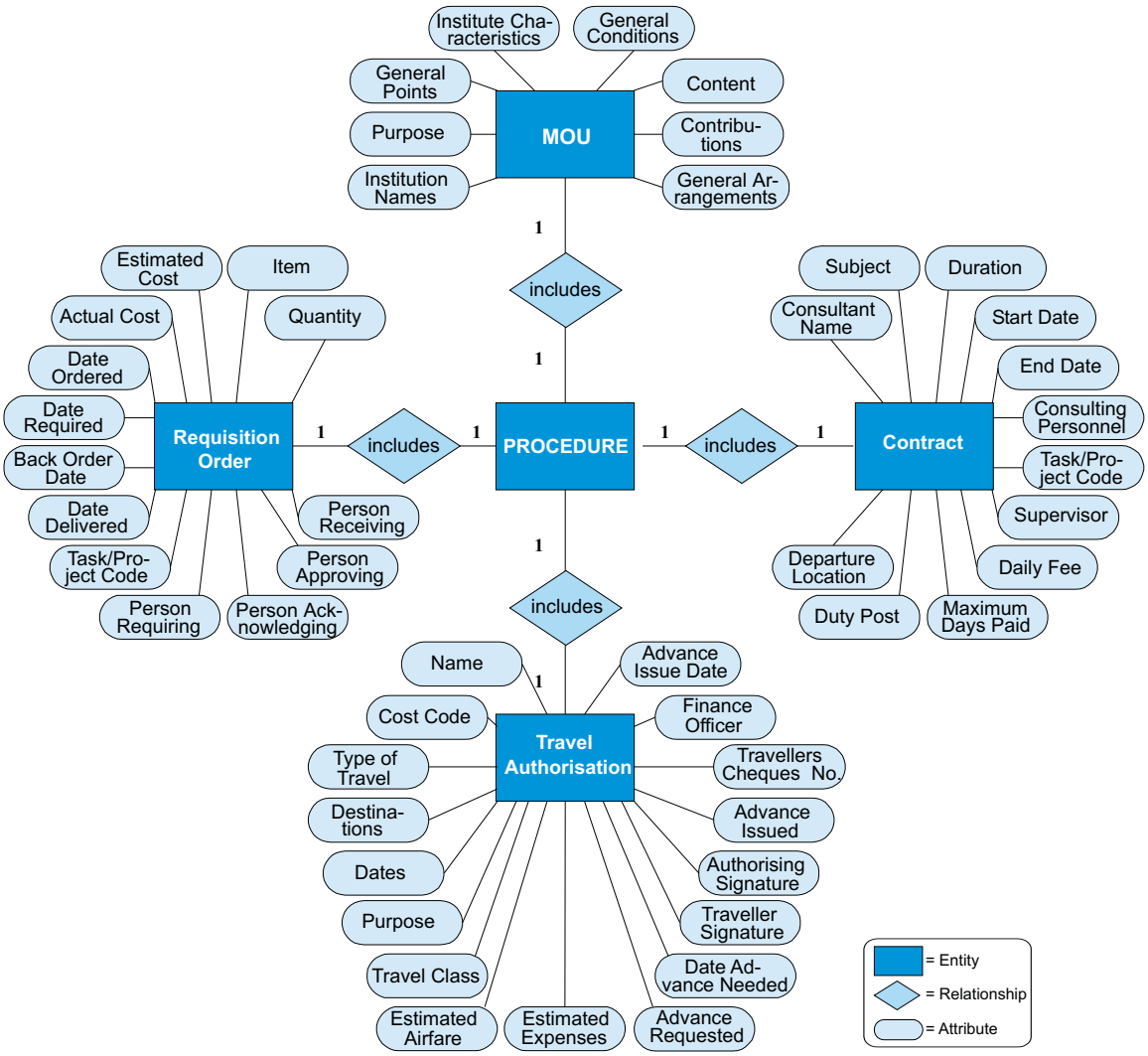
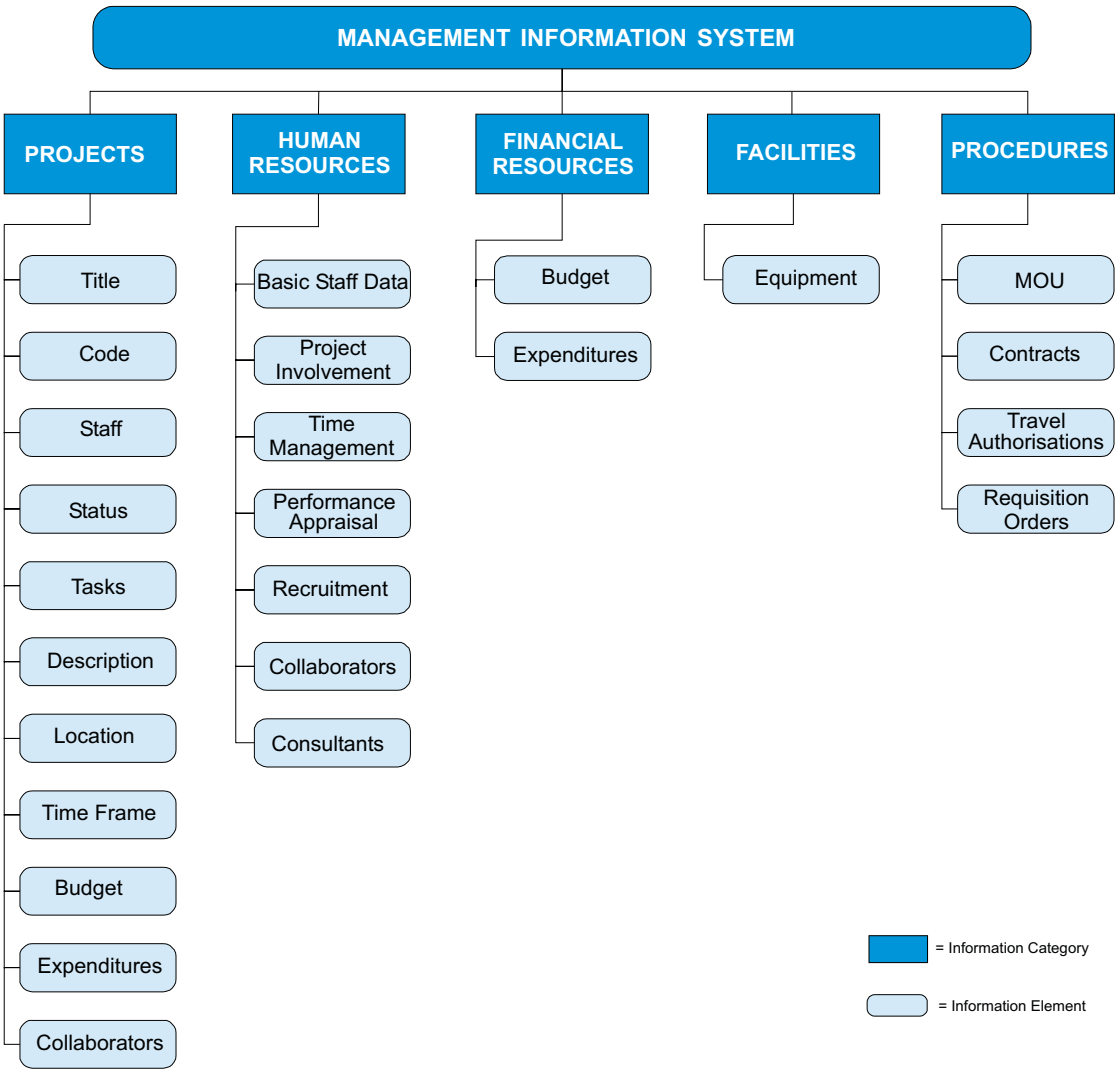



Figure 11 provides an overview of the MIS output elements for the five information categories: projects, human resources, financial resources, facilities and procedures.

## Inputs

Following the description of outputs, Parker and Case (1993) use a similar structure for inputs specifying input content, timeliness, media, format, and volume. The underlying concept for this study differs from their approach as their structure was developed for totally new systems, where none of the required inputs existed. However, in this case, some input sources existed already and needed to be integrated into the MIS to avoid data redundancy and inconsistency.

**Figure 11.** MIS Output Elements




The input specification starts with a brief overview of existing information sources which can provide inputs, at least partially, required by the MIS to produce the outputs described on page 17 This overview is followed by input specifications for each of the output elements. An output-input table provides, at the beginning of each section, a first overview of outputs and related input contents, input formats, timeliness and sources. The formats described for data inputs are in textual, numerical or date form. Aspects of timeliness indicate whether inputs are time-critical and made in a centralised or decentralised mode. Input sources indicate if input data exist in suitable formats, if they are partially available and suitable or if no source exists.

## Existing Relevant Data Sources

Some databases and information systems are in use by various entities in CIFOR, namely, the Financial Information System, Human Resource Database, Inventory Register, Alumni Database, Address Database and Project Sheets.

### *Financial Information System*

The Administration and Finance Division implemented a computerised financial information system, based on SunAccount, a standard, off-the-shelf application software. Information is stored in 43 different fields (see Annex 3). The financial information system is one of the most important data sources for the MIS. A brief description of some financial information system key elements is given but more details had to be considered in the course of the MIS implementation. Transactions are categorised into approximately 50 different accounts in the *accnt_code* field. This field can be used for analyses of various cost centres. The system allows specification of ten different codes for analysis purposes but only five codes are used currently of which the so called 'T1' code is the most important. It is a multi-digit cost centre code for each task and project. In the *descriptn* field, descriptive transactions text is entered.

The accounting system includes a module capable of generating structured query language (SQL) files. SQL, developed by IBM, was designed as a query language for databases (Hansen 1992). In the current version, it includes options for data definition, manipulation and control (Stahlknecht 1993) and can be used by most standard database management systems. The underlying language for Microsoft Access, for example, is SQL, which means that files can be directly exported from the financial information system into Microsoft Access in SQL format.

### *Human Resources Database*

A comprehensive database on human resources is not maintained. There are several spreadsheets covering the following areas: Leave; Personnel information including fields for name, education, age, salary, starting date, end of contract, housing allowance, insurance coverage, highest qualification attained, home country, nationality, gender; Incoming curricula vitae; Contracts including fields for end of probation period, end of contract, extension of contracts and application for visa; and Gender programme. Performance appraisal data, job descriptions, work plans and data on project and task involvement are filed manually in printed format.

### *Inventory Register*

An inventory register is kept by an administrative assistant in the Administration and Finance Division. It is available in electronic format as a spreadsheet in Microsoft Excel. Fields in the register include item number, description, brand/type, cost, date of purchasing, name of vendor, division where items are used and their physical location.

### *Alumni Database*

When CIFOR started its collaborative research activities a need emerged to document support provided to collaborators. As a result, the Research Support Division developed and maintains a database of CIFOR alumni. CIFOR alumni are collaborators that CIFOR actively supports, e.g. to attend meetings or prepare documents related to collaborative research. The Alumni Database was designed in Microsoft Access RDBMS and includes fields for names, position, institute and home address, type of involvement with CIFOR, research area of alumni, and dates on reception and updating of curricula vitae. Currently it contains 110 records.

### *Address Database*

The Research Support Division is responsible for the provision of a centralised Address Database. It is mainly used for sending publications to various stakeholders. The database, also using Microsoft Access, consists of the following fields: family and first name(s), position, department, institute, address, status, country, region, phone, fax, telex, e-mail, entry and update dates, date of reconfirmation, language of newsletter, eligibility to receive annual report and CIFOR occasional papers. 3,700 records are currently included in the database.

### *Project Sheets*

Project sheets were introduced in August/ September 1995 as a first attempt to provide project- or task-related information. Each task manager is responsible for the production of a task description that usually does not exceed one page of text. The documents are produced in Microsoft Word as simple text references. They follow a common structure, providing information on the activity with which the task is associated, title, file location and guide, budget code, name of task manager and contact person, nature of task manager's input, location, task summary, expected output, partnerships, duration, current status, funding, budget, budget spent, and date of updating. A sample project sheet is at Annex 4.

There are some problems associated with the project sheets in that they were hurriedly produced for the Internally Commissioned External Review in September 1995 resulting in insufficient consideration being given to medium-term organisational demands for project and task information. Scientists produced them to 'satisfy' potential needs of the review team rather than as a real tool to be used for various emerging demands. Several re-organisations took place after the project sheets were produced but they have not been amended accordingly and so do not reflect the current situation. Since they were established as text, it is difficult to draw upon specific elements of the description. Despite these problems, project sheets are important because they are the first attempt to provide comprehensive project or task information in a structured way.

## Project Inputs

Project inputs are summarised in Table 8. Input content for project titles is a textual description of the project, usually one or two lines. This is considered the official project title and has to serve as a reference for all project quotations. A single, centralised, input source should be maintained. At present, the titles exist in the financial information system. They are in other sources too, but these are considered less consistent, and therefore unsuitable as a reference source. The same applies for the project code which was developed by the individual projects or divisions. The financial information system is a central reference source for all project and task codes. The code is in numeric format and consisted of six digits. The first digit is used for the division, the second and third for the project number and the last three are allocated to individual tasks according to the discretion of the divisional leaders. These codes have since been revised. Input of codes is time-critical since budget and financial data, for example, can only be entered with a code.

The full name of project staff needs to be entered into the system, in separate fields for family and first names. These inputs are textual and should be entered decentralised at the source of origin, i.e. by the project leader. So far, no formal sources on project staff exist although the information can be retrieved in several documents (Dykstra 1996). Job title describes the position that a staff member has and is specified in job descriptions. It is textual and inputs are made centrally by the Human Resources Officer. The human resources database includes fields for job title (see page 30). The project title is text entered by project leaders and describes the

**Table 8.** Output-Input-Table for Projects

| **Outputs** *Element* Attribute | **Input Content** | **Factors**[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Format** | | | **Timeliness** | | | **Source** | | |
| | | **T** | **N** | **D** | **T** | **C** | **D** | **E** | **P** | **N** |
| *Title* | Official project title | ✓ | | | | ✓ | | ✓ | | |
| *Code* | Multi-digit project code | | ✓ | | ✓ | ✓ | | ✓ | | |
| *Project Staff* | | | | | | | | | | |
| Name | Family and first name(s) of all project staff | | ✓ | | | | ✓ | | | ✓ |
| Job Title | Position as specified in job descriptions | ✓ | | | | ✓ | | ✓ | | |
| Project Title | Function of staff in particular project | ✓ | | | | | ✓ | | | ✓ |
| *Project Status* | Indicator if project is planned, implemented or completed | ✓ | | | ✓ | | ✓ | | | ✓ |
| *Tasks* | | | | | | | | | | |
| Title | Titles of all tasks related to project | ✓ | | | | ✓ | | ✓ | | |
| Code | Multi-digit task code | | ✓ | | ✓ | ✓ | | ✓ | | |
| *Description* | Description of project problem and framework, objectives, strategies, methodology, outputs and current project phase | ✓ | | | ✓ | | ✓ | | ✓ | |
| *Location* | | | | | | | | | | |
| Country | Country name | ✓ | | | | | ✓ | | ✓ | |
| Geographical Region | Name of region | ✓ | | | | ✓ | | | ✓ | |
| CIFOR Eco-Region | Name of the eco-region | ✓ | | | | ✓ | | | | ✓ |
| TAC Zones | Name of TAC zone | ✓ | | | | ✓ | | | | ✓ |
| Eco-Floristic Zones | Name of eco-floristic zone | ✓ | | | | ✓ | | | | ✓ |
| *Time Frame* | | | | | | | | | | |
| Start & End | Dates of start/end of project | | | ✓ | ✓ | | ✓ | | ✓ | |
| Duration | Length of project in months | | ✓ | | | | ✓ | | ✓ | |
| Milestones/Deadlines | Important dates | | | ✓ | ✓ | | ✓ | | | ✓ |
| Staff Allocation | Months of project staff time | | ✓ | | | | ✓ | ✓ | | |
| *Budget* | Figures and description of personnel budget | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| Funding Sources | List of complementary donors to the project | ✓ | | | | ✓ | | | ✓ | |
| *Expenditures* | Figures and description of expenditures related to personnel, equipment and travel | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| *Collaborators* | | | | | | | | | | |
| Name(s) | Full name of each collaborator | ✓ | | | | | ✓ | | ✓ | |
| Institute | Institute(s) of collaborator(s) | ✓ | | | | | ✓ | | ✓ | |
| Country | Location of institute(s) | ✓ | | | | | ✓ | | ✓ | |

[1] *Format:* T=text, N=numeric, D=date; *Timeliness:* T=time-critical, C=centralised input, D=decentralised input; *Source:* E=existing data, P=partially existing data, N=data do not exist yet

function of each project member. At least three categories need to be entered, project leader, project scientific staff and project support staff. A source for such information is Dykstra (1996) although it might not be considered a formal reference point. Task inputs at the project level include task title and code, their input specifications being the same as the project title and code.

The description of projects is a key reference element in the MIS and needs to be inputted as textual information in a format which follows the output specifications. The text has to describe the problem, background, objectives, strategies, methodology, outputs and the current phase of the project. Inputs should be concise and are time-critical to the extent that a project description has to be prepared before any activity can be started. The preparation should be done at the project level. Partial inputs are available in the project sheets described on page 31. In the medium and long term, special consideration should be given to electronic links to other related information sources, such as project progress reports or even correspondence. Project location inputs follow the text format and it is suggested that country inputs are decentralised, whereas regional inputs are provided centrally. Inputs might benefit from a process in which regions are added automatically through a centralised system after manual country inputs. Country and geo-region information exist partially under the address database, where a master relational database is maintained for countries and geographical regions. Input sources for other regional classifications do not exist.

Time inputs are another key element in the system, since they are a managerial tool that can have a tremendous impact on efficiency and effectiveness of activities. Time-related inputs are difficult to maintain and update, and there is a risk of outdated information. Start and end dates and duration are usually specified for a proposed project and inputs may be decentralised. Inputs exist partially in project sheets. Infinite projects also have to be considered in relation to end dates and duration. Inputs on milestones and deadlines are more difficult to specify as they are by nature time-critical and currently there is no structured data source to provide such data. The last time-related inputs concern the relative time allocation of project staff. Staff will need to enter numeric data on the time spent on a single project. Internationally recruited staff were requested to maintain time-sheets on a daily basis. It should be noted that the management is looking for more efficient and convenient systems of staff time management which ultimately might have to be integrated into the MIS.

Budget inputs consist of numeric data on personnel, travel and equipment. These figures have to be entered for each unit. For example, budgets for each project staff member might be requested for each trip for a particular project. Managers also require a text description giving the details of each item. Budget information is time-critical simply because money needs to be available before activities can begin. Inputs have to be made centrally for reasons of data consistency and security. The financial information system (see page 30) is the input source for most, or even all, of the required budget outputs. In addition, details of funding sources are required, particularly for complementary funded projects. Related inputs in text format should be made centrally but these are not yet available in a structured system. Expenditure input requirements are similar to budget inputs. It is important that project managers have a description of each expenditure item to better understand transactions. Again, the centrally inputted financial information system is an important source. Finally, decentralised inputs about collaborators are required. Textual information on names, institutes and countries already partially exists in the Alumni database and the Address database, (see page 30-31). The MIS needs to link these systems with inputs on collaborators.

## Human Resources Inputs

The data inputs on human resources are summarised in Table 9. Basic staff data require inputs that relate to the formal agreement between

**Table 9.** Output-Input-Table for Human Resources

| Outputs *Element* Attribute | Input Content | Factors[1] Format | | | Timeliness | | | Source | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | T | N | D | T | C | D | E | P | N |
| ***Basic Staff Data*** | | | | | | | | | | |
| Name | Family and first name(s) of all staff | ✓ | | | | ✓ | | ✓ | | |
| Nationality | Nationality of staff | ✓ | | | | ✓ | | ✓ | | |
| Staff No. | Number for each staff | | ✓ | | | ✓ | | | | ✓ |
| Job Title | Position as specified in job descriptions | ✓ | | | | ✓ | | ✓ | | |
| Staff Category | Hierarchical position of staff | ✓ | | | | ✓ | | ✓ | | |
| Research Interests | Description of main professional interest and experience | ✓ | | | | ✓ | | | | ✓ |
| Entry Date | Start date of assignment with CIFOR | | | ✓ | ✓ | ✓ | | | | ✓ |
| ***Project Involvement*** | | | | | | | | | | |
| Project Title | Titles of projects | ✓ | | | | ✓ | | ✓ | | |
| Project Code | Multi-digit project code | | ✓ | | | ✓ | | ✓ | | |
| Task Title | Titles of tasks | ✓ | | | | ✓ | | ✓ | | |
| Task Code | Multi-digit task codes | | ✓ | | | ✓ | | ✓ | | |
| Time Management | | | | | | | | | | |
| Project/Task Code | Multi-digit project or task code | | ✓ | | | ✓ | | ✓ | | |
| Relative Time Allocation | Percentage of daily work time spent on a particular task/project | | ✓ | | ✓ | | ✓ | ✓ | | |
| Leave | Days and dates of leave | | ✓ | ✓ | ✓ | ✓ | | ✓ | | |
| ***Performance Appraisal*** | Self-appraisal, Supervisor appraisal DG appraisal and results | ✓ | | | ✓ | ✓ | | | ✓ | |
| ***Recruitment*** | | | | | | | | | | |
| Project/Task Code | Multi-digit project task code | | ✓ | | | ✓ | | ✓ | | |
| Vacancies | List of vacant positions | ✓ | | | ✓ | | ✓ | | ✓ | |
| Shortlist | List of shortlisted candidates (names) | ✓ | | | ✓ | ✓ | | | ✓ | |
| Recruitment Committee | Names of members of recruitment committee | ✓ | | | ✓ | ✓ | | | | ✓ |
| ***Collaborators and Consultants*** | | | | | | | | | | |
| Name(s) | Full name of each collaborator/ consultant | ✓ | | | | | ✓ | | ✓ | |
| Job Title | Position at home institute | ✓ | | | | | ✓ | | ✓ | |
| Institute | Institute(s) of collaborator/consultant | ✓ | | | | | ✓ | | ✓ | |
| Country | Location of institute(s) | ✓ | | | | | ✓ | | ✓ | |
| Project/Task Involved | Project/task code(s) | | ✓ | | | | ✓ | ✓ | | |
| Reference Document | MOU or contract | ✓ | | | ✓ | ✓ | ✓ | | ✓ | |

[1] *Format*: T=text, N=numeric, D=date; *Timeliness*: T=time-critical, C=centralised input, D=decentralised input; *Source*: E=existing data, P=partially existing data, N=data do not exist yet

CIFOR and its employees. The full name, nationality, job title, and staff category have to be entered centrally as text using the human resources database as the source. A staff number is a numeric, centralised input used as a key identifier in several database systems. Formal input sources for staff number do not exist. Research interests are textual information giving the professional interests and experience of a particular staff member. This information has to be entered centrally to maintain common formats and standards but there are no existing data sources. The final inputs under this

element are starting dates and duration of the assignment. These numeric inputs are provided centrally and can be retrieved from the employment letters. Outputs about staff project involvement require inputs about projects and tasks the individuals are working on. These inputs are titles in text format and codes in numeric format and are provided centrally in the existing financial information system.

Time management aspects are described through the numeric project and task codes which can be retrieved centrally through the financial information system. In addition, monthly time-sheet records enable inputs on an individual's relative time allocation to each of these projects and tasks. Time allocation is by its nature time-critical as are inputs about leave given as numeric data for the duration and dates of an absence. These data are provided centrally by the Human Resources Office and exist partially in the current paper-based leave application procedure.

Performance appraisals (as described on page 14) are a further element in the human resources category. Performance appraisals inputs are textual and originate from a self-appraisal by the staff member, and appraisals by a supervisor and the Director General. They are time-critical as they are provided annually at a given time. Partial inputs can be retrieved through the current process although it is not entirely in electronic format.

Recruitment inputs need a reference to the project or task. Inputs about vacancies are entered by the task or project manager as a text description which is time-critical because application deadlines have to be met. Inputs are partially available through systems such as existing vacancy announcements on CIFOR's internet homepage (www.cgiar.org/cifor), printed media or informal communications networks (CIFOR). During the recruitment process the Human Resources Office needs to input textual and time-critical information on a shortlist of suitable candidates. Although no system has been established, there were situations where relevant inputs were provided in appropriate format.

The last elements in this category are collaborators and consultants which can be described jointly. Inputs about collaborators' and consultants' names, job titles and institutes have to be provided in text format in a decentralised manner by task and project leaders. In part these inputs are already provided in the project sheets but they lack a common structure. Numeric codes are required for the projects and tasks in which the collaborators and consultants are involved. This information exists in a few cases but inputs for the MIS require an improved structure. A reference document is issued for each involvement and can be a MOU or contract. Such inputs are textual and time-critical since they specify dates and duration of services or collaboration. Both centralised and decentralised entry mode applies. The Human Resources Office has a central role in the provision of inputs into this category. Input sources partially exist in paper format or text processing files.

## Financial Inputs

This section describes the inputs that need to be provided into the financial category. Table 10 summarises output-input relations and requirements. All input sources exist in some electronic format in the financial information system and are time-critical since activities depend heavily on fund availability. The input of budget and expenditure codes are in the numerical format described earlier. For each budget or expenditure item for personnel, travel and equipment, the amount of money has to be specified as well as a text description of expenditure purpose. Expenditure inputs may, in addition, include dates

**Table 10.** Output-Input-Table for Financial Resources

| Outputs | Factors[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Element* | Input Content | Format | | | Timeliness | | | Source | | |
| Attribute | | T | N | D | T | C | D | E | P | N |
| ***Budget*** | | | | | | | | | | |
| Project/Task Code | Multi-digit code | | ✓ | | ✓ | ✓ | | ✓ | | |
| Personnel | Figure and description of personnel budget | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| Travel | Figure and description of travel budget | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| Equipment | Figure and description of equipment budget | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| Funding Source | Description of funding donor agencies | ✓ | ✓ | | | ✓ | | | | ✓ |
| Comparison | Budget and expenditure figures | | ✓ | | ✓ | | ✓ | | | ✓ |
| ***Expenditures*** | | | | | | | | | | |
| Project/Task Code | Multi-digit code | | ✓ | | ✓ | ✓ | | ✓ | | |
| Personnel | Figure and description of personnel expenditure | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| Travel | Figure and description of travel expenditure | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| Equipment | Figure and description of equipment expenditure | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| Comparison | Expenditure and budget figures | | ✓ | | ✓ | | ✓ | | | ✓ |

[1] *Format:* T=text, N=numeric, D=date; *Timeliness:* T=time-critical, C=centralised input, D=decentralised input; *Source:* E=existing data, P=partially existing data, N=data do not exist yet

and details about transactions to allow them to be traced. Budgets require textual and centralised inputs about the funding source, which is particularly important for activities funded from complementary sources. The comparison feature requires numeric inputs directly by the end-users.

## Facility Inputs

Equipment is the only element in this category and Table 11 presents its input requirements.

The inventory number is a nine digit numeric code assigned centrally in the Administration and

**Table 11.** Output-Input-Table for Facilities

| Outputs | Factors[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Element* | Input Content | Format | | | Timeliness | | | Source | | |
| Attribute | | T | N | D | T | C | D | E | P | N |
| ***Equipment*** | | | | | | | | | | |
| Inventory Number | Multi-digit item no. | | ✓ | | | ✓ | | ✓ | | |
| Project/Task Code | Multi-digit code | | ✓ | | | ✓ | | ✓ | | |
| Description | Item description | ✓ | | | | ✓ | | ✓ | | |

[1] *Format:* T=text, N=numeric, D=date; *Timeliness:* T=time-critical, C=centralised input, D=decentralised input; *Source:* E=existing data, P=partially existing data, N=data do not exist yet

Finance Division and for which a potential input source is the inventory register (see page. 30). The multi-digit project and task code input characteristics were described above and textual description inputs give specific information.

## Procedure Inputs

The last category is procedures for which relevant input data are aggregated in Table 12.

### MOU

MOU are time-critical since they are usually a necessary precursor to starting collaborative research activities. Names and addresses of collaborating institutions are decentralised textual description and may be retrieved from the address and alumni databases. Textual information has to be provided to specify the purpose of the agreement, general points of the agreement and institutional characteristics with reference to the concerned division. These decentralised data are not time-critical and they cannot be retrieved from existing sources since they have to be generated for a very specific purpose. General and specific conditions of collaboration are further textual inputs which are time-critical since they specify the collaborative activities. These decentralised data need to be developed on a case-by-case basis. Under specific contributions, text and numerical data are given on the services provided by each collaborator. This time-critical, decentralised information is provided on a case-by-case basis. General arrangements include text, numerical and time-related data on formal aspects of the MOU, such as the duration and duty station, and are generated as required. They are time-critical and are, as all other MOU inputs, decentralised.

### Contracts

Contractual agreements start with the specification of the name and address of the consultant or consulting firm to be contracted. This decentralised textual information is time-critical. Data may partially exist in informally maintained consultant rosters. The subject text specifies the Terms or Reference that apply to the contract and duration is numerical data on the number of days the services are required. These attributes, together with start and end dates, names of consulting personnel and their duty station and departure locations in text format are time-critical and decentralised as required. The numeric multi-digit task or project code serves as a time-critical reference, provided centrally and for which sources exist in the financial information system. The name of the person supervising the services is text entered decentralised upon demand. Daily fee and maximum number of days paid are numeric data which are time-critical, and provided centrally as required after consultation with task or project leaders.

### Travel

Most travel authorisation data are entered upon demand by the person travelling. The full name of the person travelling is entered as text and is time critical. The cost code is the multi-digit task or project code and is entered as numeric data. It is time-critical and can be retrieved from the financial information system. It is possible to use more than one code to allocate costs to different tasks or projects. Type of travel and destination are entered as text. These data and travel dates, entered in date format, are time-critical. The purpose and class of travel are specified as text. Numeric data are entered for estimated air fare, estimated expenses and travel advance requested and are all time-critical. The date the advance is needed is by nature time-critical. Signatures are entered as text by the person travelling and the person authorising the trip and are both time-critical. The Administration and Finance Division provides some inputs centrally including the amount of advance that was issued as numeric data, the numbers of travellers cheques and

**Table 12.** Output-Input-Table for Procedures

| **Outputs** | **Factors**[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Element* | **Input Content** | **Format** | | | **Timeliness** | | | **Source** | | |
| Attribute | | **T** | **N** | **D** | **T** | **C** | **D** | **E** | **P** | **N** |
| ***MOU*** | | | | | | | | | | |
| Cooperating Institutes | Name(s) and address(es) of cooperating organisation(s) | ✓ | | | ✓ | | ✓ | | ✓ | |
| Purpose | Subject of the MOU | ✓ | | | | | ✓ | | | ✓ |
| General Points | Agreement for collaboration | ✓ | | | | | ✓ | | | ✓ |
| Institutional Characteristics | Description of organisations | ✓ | | | | | ✓ | | | ✓ |
| General Conditions | Broad areas of collaborative activities | ✓ | | | ✓ | | ✓ | | | ✓ |
| Content | Specific collaborative activities | ✓ | | | ✓ | | ✓ | | | ✓ |
| Specific Contributions | Contributions by organisation | ✓ | ✓ | | ✓ | | ✓ | | | ✓ |
| General Arrangements | Duration and other formal aspects | ✓ | ✓ | ✓ | ✓ | | ✓ | | | ✓ |
| ***Contract*** | | | | | | | | | | |
| Consultant Name | Family and first name or company name | ✓ | | | ✓ | | ✓ | | ✓ | |
| Subject | Terms of reference | ✓ | | | ✓ | | ✓ | | | ✓ |
| Duration of Contract | Number of days | | ✓ | | ✓ | | ✓ | | | ✓ |
| Start Date | Date of start | | | ✓ | ✓ | | ✓ | | | ✓ |
| End Date | Date of end | | | ✓ | ✓ | | ✓ | | | ✓ |
| Consulting Personnel | Name(s) of consulting personnel to provide the services | ✓ | | | ✓ | | ✓ | | | ✓ |
| Task/Project Code | Multi-digit task or project code | | ✓ | | ✓ | ✓ | | ✓ | | |
| Supervision | Name of supervisor in CIFOR | ✓ | | | | | ✓ | | | ✓ |
| Daily Fee | Amount to be paid per day | | ✓ | | ✓ | ✓ | | | | ✓ |
| Maximum Days Paid | Maximum number of days per month services are paid | | ✓ | | ✓ | ✓ | | | | ✓ |
| Duty Post | Location where services are provided | ✓ | | | ✓ | | ✓ | | | ✓ |
| Departure Location | Departure location of consulting personnel | ✓ | | | ✓ | | ✓ | | | ✓ |
| ***Travel Authorisation*** | | | | | | | | | | |
| Name | Full name of travelling person | ✓ | | | ✓ | | ✓ | | ✓ | |
| Cost Code | Multi-digit task or project code(s) | | ✓ | | ✓ | | ✓ | ✓ | | |
| Type of Travel | Duty, home leave, education or spouse travel | ✓ | | | | | ✓ | | | ✓ |
| Destinations | Names of all locations of destinations | ✓ | | | ✓ | | ✓ | | | ✓ |
| Departure and Arrival Dates | Travel dates for each location | | | ✓ | ✓ | | ✓ | | | ✓ |
| Purpose of Travel | Description of purpose for each destination | ✓ | | | | | ✓ | | | ✓ |
| Class of Air Travel | Excursion, economy or business class | ✓ | | | | | ✓ | | | ✓ |
| Estimated Air Fare | Cost estimate | | ✓ | | ✓ | | ✓ | | | ✓ |
| Estimated Expenses | Cost estimate | | ✓ | | ✓ | | ✓ | | | ✓ |
| Advance Requested | Amount of advance payment | | ✓ | | ✓ | | ✓ | | | ✓ |
| Date Advance Needed | Date | | | ✓ | ✓ | | ✓ | | | ✓ |
| Signature of Traveller | Signature of traveller | ✓ | | | ✓ | | ✓ | | | ✓ |
| Authorisation Signature | Signature of authorising staff | ✓ | | | ✓ | | ✓ | | | ✓ |
| Amount of Advance Issued | Amount issued in the finance department | | ✓ | | | ✓ | | | | ✓ |

**Table 12.** (continued) Output-Input-Table for Procedures

| **Outputs** *Element* Attribute | **Factors**[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Input Content** | **Format** | | | **Timeliness** | | | **Source** | | |
| | | **T** | **N** | **D** | **T** | **C** | **D** | **E** | **P** | **N** |
| Numbers of Travellers Cheques | Serial numbers of travellers cheques | ✓ | | | | ✓ | | | | ✓ |
| Responsible Finance Officer | Full name or person in charge | ✓ | | | | ✓ | | | ✓ | |
| Date Advance Issued | Date | | | ✓ | ✓ | ✓ | | | | ✓ |
| *Requisition Order* | | | | | | | | | | |
| Quantity | Quantity of item requested | | ✓ | | ✓ | | ✓ | | | ✓ |
| Item Description | Description of item requested | ✓ | | | ✓ | | ✓ | | | ✓ |
| Cost Estimate | Estimated cost for item | | ✓ | | ✓ | | ✓ | | | ✓ |
| Actual Cost | Cost actually paid after procurement | | ✓ | | ✓ | ✓ | | | | ✓ |
| Date Ordered | Order date | | | ✓ | ✓ | | ✓ | | | ✓ |
| Date Required | Date when item is required | | | ✓ | ✓ | | ✓ | | | ✓ |
| Back Order Date | Date when item was ordered back | | | ✓ | ✓ | | ✓ | | | ✓ |
| Date Delivered | Date when item was delivered | | | ✓ | ✓ | ✓ | | | | ✓ |
| Task/Project Code | Multi-digit task or project code | | ✓ | | ✓ | ✓ | | ✓ | | |
| Requiring Person | Name and signature of requesting person | ✓ | | | ✓ | | ✓ | | | ✓ |
| Acknowledging Person | Name and signature of acknowledging person | ✓ | | | ✓ | | ✓ | | | ✓ |
| Approving Person | Name and signature of approving person | ✓ | | | ✓ | | ✓ | | | ✓ |
| Receiving Person | Name and signature of person who received item | ✓ | | | ✓ | | ✓ | | | ✓ |

[1] *Format:* T=text, N=numeric, D=date; *Timeliness:* T=time-critical, C=centralised input, D=decentralised input; *Source:* E=existing data, P=partially existing data, N=data do not exist yet

name of the finance officer in charge as text data, and the date the advance was issued in date format. The date is time-critical information. Data on the finance officer in charge can be partially retrieved through the financial information system.

### Requisition Orders

Data on requisition orders are all provided upon demand according to the specifics of the order. Time-critical aspects are in all listed attributes. Quantities are numerical data which are provided decentralised. A string of text describes the item and is entered decentralised. Cost estimates are numerical data, provided decentralised by the requesting person. Actual procurement cost is similar and provided centrally by administrative staff. Dates are time-related data on when items are ordered, required, back ordered and delivered. Only delivery dates are provided centrally. The numerical multi-digit project or task code is a reference provided centrally and retrieved from the financial information system. Names and signatures are text data and provided decentralised by persons requiring, acknowledging, approving and receiving items.

## Processing

This section discusses basic processing considerations, software, user interface, and system links.

## Basic Processing Considerations

MIS components, desired outputs and necessary inputs were described in the previous sections. The central issue in processing is to integrate all components logically and physically in an efficient and cost-effective way.

The logical process can be illustrated with the help of the slide rule model as described for system outputs on page 17. It allows users to query combinations of different information categories at different levels of aggregation and has to permit combinations of different aggregation levels in one category as well. Examples of eventual processing functions are:

*Query 1: All project staff of projects no. 3 and 5 who are involved in activities in Southeast Asia.*
Based on the user specifications the location element under projects is identified and combined with staff names for project codes number 3 and 5. Processing requirements may include an interactive component that asks the user to provide more detailed specifications, such as if project title and code should be provided, if countries should be provided for the region, or if all or only selected attributes of the staff element are requested.

*Query 2: Comparison of travel budget and expenditures of a staff member over the past six months.*
Processing demands for this query might include the presention of the result both in graphical format as a bar chart and as a table.

*Query 3: Descriptions of projects in which a specific collaborating institution is involved.*
A list of projects will have to be generated and descriptions selected. An interesting feature that could be provided would be to open on-line progress reports of the selected projects.

*Query 4: Payments to consultants and collaborators for task no. 103 137 for the past four months.*
A list of transactions will have to be generated as a table.

These four queries indicate the basic processing capability requirements of the system. Query 2 assumes that identical printing and on-screen display options are available for all features of the system. Report formats for both output options have to be defined. Pre-defined output options make the system easier to use but there is also loss of flexibility, particularly for users with advanced computing skills. It is the MIS manager's task to monitor output requirements and adjust the process accordingly. The system has to be capable of handling several levels of aggregation and to combine these levels within, as well as across information categories. In queries 1 and 3, processing takes place at the project category, element and attribute levels. It describes a situation in which all processed data are included in the project category. The different levels of aggregation are a key capability of the MIS since it has to respond to users from various organisational levels with different interests.

System access is recorded in a log file to help track problems, identify usage patterns and relate to security issues. Security capabilities are necessary for confidential data, such as parts of the financial data and staff appraisals. The examples of queries 2 and 4 include financial data which need special protection. A multi-level password system, either for individual users or for user groups, is necessary. Moreover a mechanism for encryption might be considered.

Inputs into the system need processing mechanisms for validation and duplication. A data validation capability allows only certain entries in particular fields, e.g. the task or project code in query 4 must have only a set number of numeric digits. Duplication checking is particularly important where the same information is held in different places. Inconsistency of address data is a common problem that can be resolved by duplication checks.

Nayar (1993) defines information integrity as succeeding in the provision of accurate, complete

and timely information. His approach to distinguish information integrity on three different levels is incorporated in the MIS. First, file level integrity is achieved through proper use of files, for example the access to the right file to process a certain job or the creation of a file necessary for further processing. Secondly, process level integrity needs to be achieved because although the error risk at that level is not usually very high, the effects can be disastrous. Calculation errors that lead to wrong results are an example of a lack of process integrity that might be hard to recognise. Finally, data level integrity has to be guaranteed to avoid wrong results. Data errors are usually hard to identify and proper validation mechanisms are crucial in keeping integrity problems to a minimum.

## Software

The most fundamental software decision is whether to use standard off-the-shelf applications or to develop individual software. This was not an issue for the CIFOR MIS, since management had decided to use a standard application from the beginning of the system development.

The advantages of a standard application are :

- lower cost;
- faster system implementation;
- less risk of failure or problems;
- application software developers adapt more quickly to information technology changes; and
- resources more easily available for maintenance and adaptation.

The possible problems of a standard application are:

- failure to meet exactly system or user requirements; and
- difficulties in integrating the application into an existing computer-based environment which could lead to major hardware and software change.

At the stage of concept development no recommendation was given for a particular software package. Chapter 3 makes more specific reference to the software selection process.

## User Interface

The user interface is one of the critical-success factors of the MIS because besides data and processing aspects, it determines how the user can interact with the system (see page 57).

Many MIS users possess only basic computer skills and moreover have little time to learn how to use the MIS. This has a tremendous influence on the design of the user interface. A Microsoft Windows-based graphical user interface is best since all users already have experience with such systems and thus have a basic operational knowledge. The system should guide the user through the application in a way parallel to the formulation of problems. The information needs and requirements assessment provides the necessary guidelines for the logic, and the query examples on page 40 give a brief impression of user demands.

There are two basic user design options. One is a menu driven user interface where the user is guided through the different menu levels until the final query elements are combined. This requires a highly structured interface design that takes into account any combination of required elements. A more flexible approach is the query-by-forms option where the user enters specifications in an empty form (Belkin *et al.* 1991). The form structure follows the information output structure described on page 17. To make such a system more user-friendly, pull-down menus or pop-up windows can give the choice of entry data for a specific form field.

The main functions of the graphical user interface are:

- query or command formulation;
- visualisation of the query results ;
- personalisation of views for individual purposes; and
- information exchange between other systems and users.

### System Links and Integration

The underlying concept of the MIS is a modular system which highly integrates with the existing computer-based infrastructure and data sources.

CIFOR's computer system is based on a local area network (LAN) with a bus topology and a PC server. The server was configured to a client/server architecture using Microsoft Windows NT software. Users were linked to the LAN through Novell Netware. Peripherals integrated in the LAN include decentralised laser printers, an A1-size colour plotter and two colour laser printers. Through the LAN users have access to basic applications such as text processing, spreadsheet, graphics and database programmes, to electronic communications via electronic mail and to the Internet for a select number of users for test purposes. A graphical overview of the network configuration is in Annex 5.

The MIS has to be physically integrated into the network topology and Figure 12 provides an overview of the logical infrastructure. Links have to be made to existing databases and information systems (see page 30) that contain data needed as inputs to the MIS. One consideration was that, it might have been easier in some cases to modify or extend some existing systems to provide accurate inputs. Another, where modification or extension was not possible or desired, was to establish new systems to store necessary MIS data. Depending on the software selected, these systems could be maintained either within the MIS shell or as separate databases with the necessary links into the MIS. Both existing and newly created data sources are considered 'primary links'.

As the system will develop dynamically, it may grow to provide more features than currently anticipated. Such links are called 'secondary links' since they will be considered only in future phases of the MIS development. Secondary links can include systems like the library database, geographic information system, decision support and expert systems, electronic management of documents, public relations material for corporate purposes, or data that relate to residential clearance needs. The modular MIS concept will allow secondary links to be integrated upon demand.

## Storage

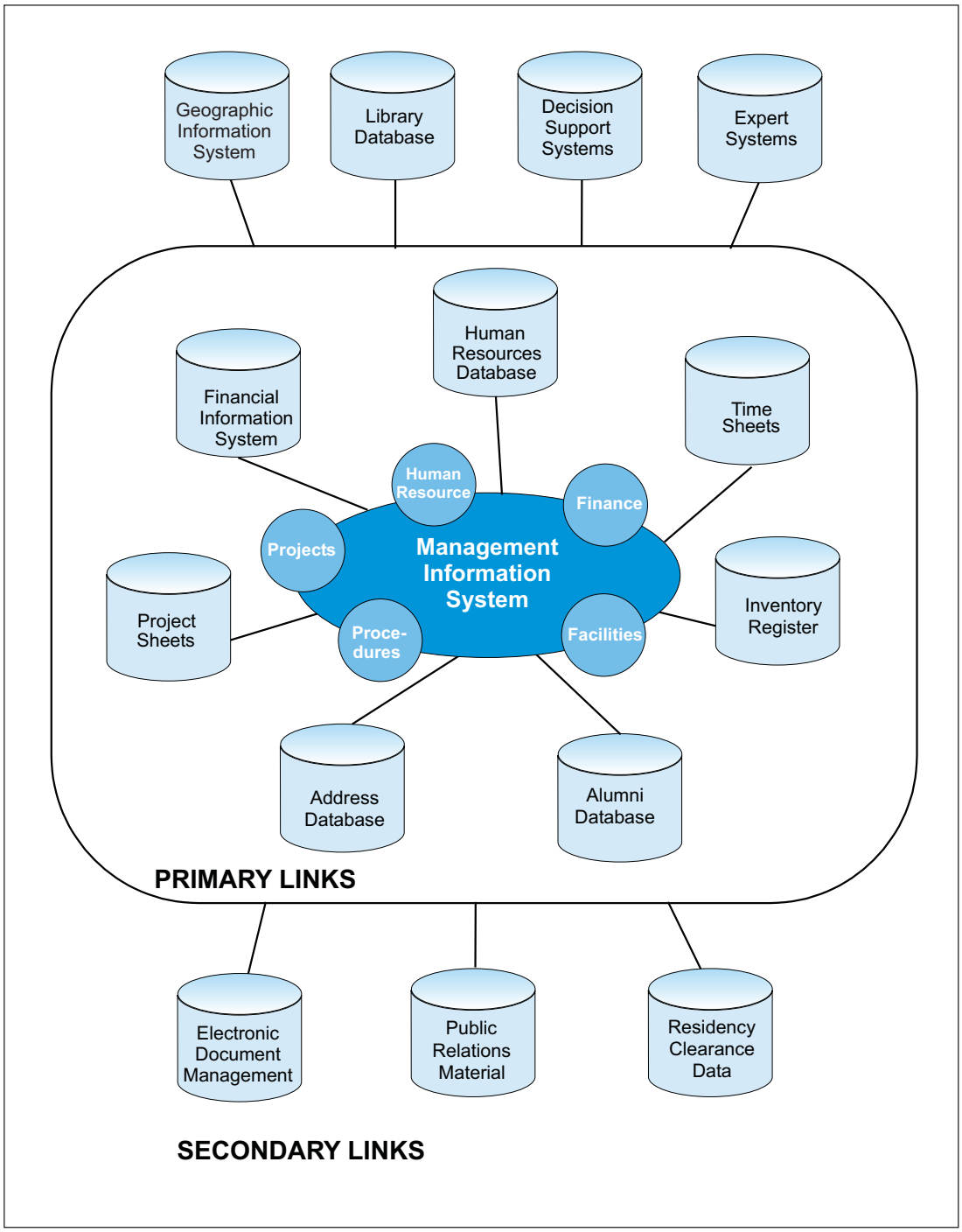
This section provides a summary of the main issues that are related to the storage of data. It deals with data access, storage media and location.

### Data Access

The issue of data access is addressed in the context of storage. Most system queries are made in real-time mode so prompt data access is needed to shorten the system response time. Most data is organised in database management programmes. A relational data model meets response requirements best, since access time can be minimised in comparison to hierarchical data models and network data models (Hansen 1992, Stahlknecht 1993). In a relational database, data are structured according to tables, each of which has a unique name and table header which allow more transparency than to other data models.

Data security has to be considered in relation to data access. Here, data security is discussed only at the software level because the MIS is embedded in the overall institutional security system. There are two aspects of data security to be considered. The first relates to security at the level of database access where rights have to be defined for each database user. Such rights specify the names of users allowed access to the database and their privileges.

**Figure 12.** MIS Infrastructure



Privileges in ascending order include viewing data, entering new data, modifying existing data and administering data. The second security aspect deals with the use of the MIS software itself. Individual access to levels of detail and data types and rights to view, enter, modify and administer all data is defined. In cases where data will be transferred intensively within the LAN or with external partners, encryption mechanisms for sensitive data are needed.

### Storage Media and Location

All corporate data was stored magnetically on the hard disk drive of the LAN server. A daily automated backup was produced on magnetic tapes and kept for one week.

Once the MIS became operational, it was recommended that all data was kept on the network server for common access so that data access time could be minimised, a critical factor in the expected high system usage. Since cost for magnetic hard disks is decreasing relative to the storage capacity it is reasonable to maintain this system. Quarterly backups should be made on optical storage media, in addition to daily magnetic backups. These optical backups serve archiving and documentation purposes, for example to document medium or long term development stages of a project or staff assignments. Such optical backups can be produced on CD-ROM using the CD-ROM production unit already available in CIFOR's Computer Department. It consists of a CD-ROM writer, CD-ROM authoring and pre-mastering software.

## Personnel

Almost every aspect of personnel involvement is related to the implementation and maintenance of the system and is covered in Chapter 3. The concept development took into account information requirements and needs of individual staff members from the survey conducted at the beginning of the study. A briefing session, at the beginning of the implementation process, provided an opportunity for all staff to discuss the concept and its future implications.

Chapter
3

# Implementation and Maintenance

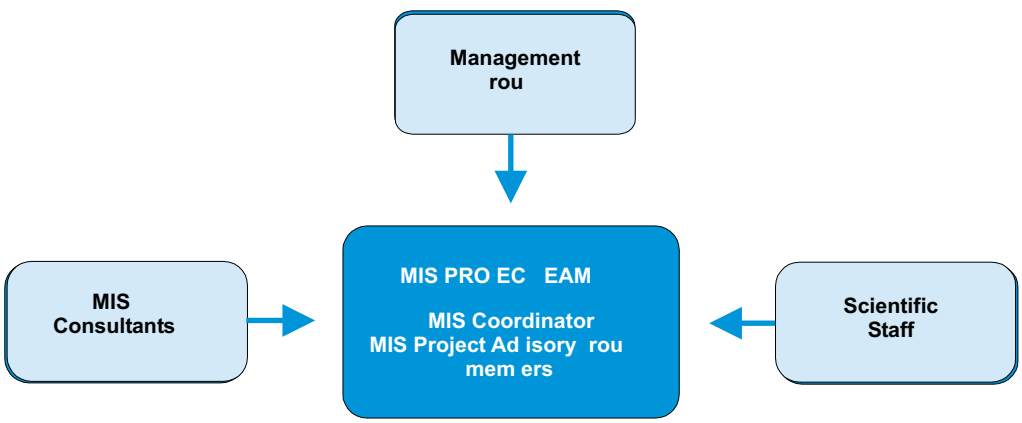
Whereas the focus of the previous chapters was on its conceptual framework, this chapter on implementation and maintenance deals with issues related to the realisation of the MIS. It covers a period of two years of experimenting with, developing and implementing the system. Aspects related to personnel, soft- and hardware, implementation process, system architecture and training are discussed.

## Personnel

A project team, coordinated by CIFOR's Director of Information Services (DIS), was established for the implementation. The DIS was in charge of concept development, management of the implementation process, consultations with staff members involved, project management, and provision of reports. As part of the project implementation team a MIS Project Advisory Group (MIS-PAG) was established comprising three members, one representative each from the Administration and Finance Division, Research Division and Senior Management. This group participated in the implementation process and provided advice from a user perspective. Detailed terms of reference for the MIS-PAG are in Annex 6a. Initially, it was planned to recruit two experts during the implementation process, a MIS expert and a programmer. However, rather than contracting two individual experts, it was more efficient to involve consulting firms with a broad range of expertise in MIS development and implementation. Terms of reference for external services are in Annex 6b. The project team reported to the Management Group. Figure 13 provides an overview of the personnel structure for the MIS implementation process.

At the beginning, it was difficult to foresee personnel implications for the MIS maintenance. However, constant review of the workload associated with the system development and maintenance made it necessary to involve a MIS assistant at a very early stage. As the project evolved this person had both formal and on-the job training to satisfy operational needs. In the medium term,

**Figure 13.** Personnel Structure for the MIS Implementation



though, it may be necessary to develop this position further as MIS manager at the level of national scientific staff.

## Soft- and Hardware

A description of the required features of the MIS software is provided on page 41. In relation to the implementation and maintenance, special attention was given to groupware which consists of software packages allowing integration of a specific group and collaborative access to many kinds of data and applications. It may include shared databases, project management, electronic communication through electronic mail or on-line access to external communication networks or just simple text processing. The fundamental feature of groupware is that it builds on and integrates existing resources. This is more desirable than large database systems which impose the transformation of data to a specific internal format before access to the user.

The groupware concept has also to consider interfaces with other applications. This includes applications where MIS data need to be accessed and not yet integrated systems, such as those maintained through entity service functions. Eventually software interface capabilities will have considerable impact on the future integration of such systems into the MIS.

Experimenting with several software packages was not a viable option, for reasons of cost and increased risk of uncertainty among users and management. The computer supported infrastructure at CIFOR imposed some restrictions on the selection of software. The LAN is PC-based and the MIS software had to be embedded into the PC-based client/server architecture. Since most applications are based on Microsoft Windows NT, the MIS software had to be integrated into this environment. The number of user licenses had to be considered as the capacity of CIFOR's computer network is designed for 250 users. In the long term, most staff will have access to the MIS so the software must be capable of handling such numbers.

Parker and Case (1993) provide a comprehensive list of criteria for selecting software in relation to vendor conditions. Such criteria are price, warranty, nature of support, shipping and installation charges, and delivery terms. Warranty and support are two important criteria given the supply conditions in CIFOR's host country. The configuration of the hardware, as outlined on page 42, was considered sufficient to handle MIS-specific requirements.

External consultants proposed two appropriate software packages for discussion and decision. The first option was a configuration based on internet technology and included an internet browser software as front-end, Microsoft Exchange as messaging platform and a Microsoft Windows NT server. The second was a more integrated solution based on Lotus Notes. Lotus Notes was selected for the following reasons:

- it is a standard off-the-shelf product with advantages described on page 41;
- a positive evaluation of a Lotus Notes based MIS used by one of CIFOR's partner organisations; and
- the internet based solution had risks in relation to system instability, longer system development and implementation periods and a higher number of interfaces.

The Lotus Notes software was purchased directly in the USA as the availability of Lotus Notes in Indonesia at that time was very limited.

## Implementation Process

The implementation process was divided into four major phases: preparation, software installation and integration, system testing, and training. An implementation schedule was established and supported by scheduling tools such as the critical-path-method, or simple gantt charts. In this study,

**Table 13.** Project Implementation Activities

| Activity | Description | Duration (months) | Immediate Predecessors |
|---|---|---|---|
| **1** | **Preparation** | **1.5** | |
| 1.1 | Approval of concept by management | | None |
| 1.2 | Presentation to scientific staff | | 1.1 |
| 1.3 | Contracting experts | | 1.1 |
| 1.4 | Assessment of conditions | | 1.2, 1.3 |
| 1.5 | Recommendation and decision on MIS software | | 1.4 |
| **2** | **Installation** | **1.5** | |
| 2.1 | Proposals from vendors | | 1.5 |
| 2.2 | Evaluation of proposals and decision | | 2.1 |
| 2.3 | Procurement of software | | 2.2 |
| 2.4 | Report on systems integration | | 1.4 |
| 2.5 | Installation of MIS software | | 2.3, 2.4 |
| **3** | **Testing and Implementation** | **20** | |
| 3.1 | System testing | | 2.5 |
| 3.2 | Implementation of first application | | 3.1 |
| 3.3 | Review of implementation and adjustments | | 3.2 |
| 3.4 | Step-wise implementation of all MIS elements | | 3.3 |
| 3.5 | Review of the implementation process | | 3.4 |
| 3.6 | Establishment of maintenance plans | | 3.5 |
| **Total Duration** | | **23** | |

the overall schedule, based on the metra-potential-method, is provided for the whole implementation process, complemented by more detailed schedules for individual steps or sections. The plan in Table 13 gives a summary of individual activities.

## Preparations

The preparation phase was the first step of the implementation process. Once Management formally approved the proposed system, the concept and implementation plan were presented to all scientific staff for further suggestions and discussion. At this stage, MIS consulting firms were selected. The consultants provided an evaluation of the proposed concept, the current conditions and restrictions and recommended the MIS software to the project team for evaluation. The project leader then presented the options to management for approval, after which options for software procurement were evaluated.

The MIS consultants also considered implications for integrating the MIS system with existing data sources, such as CIFOR's financial information system, and the establishment of additional, yet to be developed data systems. Within the scope of this phase, they developed a first draft database structure.

The preparation phase finished with the procurement of the MIS software and a systems integration report of the MIS consultants.

## Software Installation and Integration

The second phase of the implementation process included the installation of the software and its integration with existing data sources. It started with

the installation of the software on the network server and connecting users' personal computers. A small number of users, including members of the Project Advisory Group, were connected first to test the system.

### System Testing and Implementation

Once the system was installed and working properly, a series of tests was conducted. They focussed on the technical and logical functioning of the software, as well as the appropriateness and usability of the draft databases. Two possible approaches for the database implementation were evaluated: a model project approach and a model application approach. The model project approach selects one functional model entity within the organisation, for example a project, where the MIS would be implemented, tested and evaluated before implementing the system organisation-wide. In contrast to the functional focus of this approach, the model application approach selects a certain element in an information category to be implemented organisation-wide. When this element reaches full functionality the next element is implemented and so forth until the whole system is operational.

Management Group decided to follow the model application approach since it allows better review of the process and success can be demonstrated more rapidly to all users. With this approach the project did benefit from the experience learnt and the incorporation of this experience into the immediate next steps. Also, the whole organisation benefitted by better understanding the organisational processes and management of research activities. Major components of the system are described below.

### Training

The system can function only if its users and administrators are well instructed in its operation and are comfortable in its use. Thus, both user and system administrator training is essential to the success of the MIS.

Training was incorporated in the step-wise implementation process through a combination of introductory courses, on-the-job training and supporting documentation, tutorials and presentations. However, the frequency of duty travel of most scientific staff restricted training plans.

The system administrators were trained in operating and maintaining the MIS on a day-to-day operational basis as well as handling system adaptations, modifications and extensions to a reasonable degree. They received on-the-job training during the implementation phase and participated in specialised Lotus Notes training courses.

External trainers conducted all in-house training relating to the introduction of the MIS.

## System Architecture

During the implementation process four major databases were developed covering information related to research activities, research partners, procedures and human resources. In the following sections, each of these four databases as well as some databases of entity service functions are described in detail.

### Research Activities Database

The core data of CIFOR's entire MIS is the description of CIFOR's research. A database, called 'Activities', was designed and developed according to the framework outlined in Chapter 2. Research activities are described on the level of tasks.

The first section of the database covers basic task details which include activity title, short title, and number of the research project to which the

task belongs. It also provides a task title and information about the location of task-relevant documentation in the project filing system. Reference can be made to the location of both electronic files and paper documents. The date of entering the information and a 100-word summary complete the basic description of the task. The next section, titled 'Progress narrative', documents activity outputs and achievements. Scientists can describe examples of research outputs and impacts as well as training, and capacity building activities with NARS.

The task development section documents the evolution of the task in detail. The names of the scientists who proposed the task can be entered from the staff directory. A concept note field provides space to describe the activity's initial research concept and allows electronic files to be attached. In order to document the overall framework of the task, strategic linkages related directly to CIFOR's long-term strategy are entered. They can be weighted relative to their contribution to the selected objectives. References to the CGIAR are included in this section: TAC categories which allow a direct link between a specific activity and its contribution to the overall objectives defined by this CGIAR committee; and CGIAR system-wide initiatives of which users can select one or more.

The decision making process which leads to the approval or rejection of an activity is also documented in this section. It contains the concept note's circulation date and provides space for comments received. The date of the formal review meeting is included and supporting documents in preparation for the review can be attached. There are fields to indicate expected funding sources and the meeting result, i.e. the activity's approval or rejection. If approved, the system prompts the user to assign a multi-digit task code.

The 'titled description' section of the Activities database covers information on the the activities' intended purpose and objectives. The first field consists of the goals where their relevance to CIFOR's overall strategic goals is detailed. Information on the expected impact of the task is entered in the 'purpose' field. Specific outputs can be described with milestones, scheduled, revised and actual delivery dates. Furthermore, information on the probability of success, the actual results and their justification can be recorded. This relatively detailed approach to capture output-related information was designed specifically in support of CIFOR's work on research priority setting and impact assessment. Inputs by both CIFOR and its partners are captured independently and include a description of the actual commitments and comments, and planned, revised and delivery dates.

The timeframe of the task section includes dates for activity start, planned and actual end as well as the date of delivery of reports. The section on human resources allows information on CIFOR staff involved in the activity including the name of the person, gender, CIFOR staff category and the specific role of the scientist in this particular activity. Furthermore time dedicated to this activity can be allocated over a maximum period of five years. Information on collaborators is captured in the subsequent section and covers collaborating organisations and scientists. Organisational data include name, country and type of organisation. The nature of the collaborative agreement is described and reference to the location of paper and electronic files, such as MOU or contracts, can be made. This section also includes data on the nature of the collaborating organisation's contribution categorised by cash, equipment, facilities, and time allocation. Contributions can be described over a period of five years. A field for additional comments completes the data on collaborating institutions. Almost identical data can be entered for collaborating scientists which in addition include name, gender and role.

The section on locations provides geographical information, such as the continents and countries in which the research is conducted. It also allows for specific reference to ecological regions as defined by FAO, TAC zones and eco-floristic regions. The final section of this database gives publications originating from this research activity. They are selected directly from the publications pipeline database (see page 54). A sample print out of a task data set of the activities database is in Annex 7. There are links to other data sources where possible to avoid data inconsistency and redundancy.

The detailed descriptions of CIFOR's research activities in this database provide scientists with a tool to systematically manage basic task-related data. Periodic reporting requirements are facilitated and can be partially automated for use in project management, and in particular monitoring requirements of task leaders. CIFOR's management has a tool for efficient and comprehensive synthesis of research information. Data can be accessed, combined and analysed real-time through multiple filters and consolidation levels meeting strategic information and reporting needs. This database also constitutes part of CIFOR's corporate knowledge on research priorities and procedures which, in the light of staff rotation, becomes crucial for the future understanding and strategic orientation of CIFOR's research.

Data transfer into the database was the major challenge and a three-tier approach was applied. In a first step, the MIS assistant identified and analysed existing centrally accessible data sources (mainly electronic files). This provided 50% of the required data. In a subsequent phase, administrative staff in the Research Division, supervised by the MIS assistant, entered data from existing research documents. At the end of this process, 80% of the available data were entered. The final phase involved scientific staff who were asked to complete the data entry. At present, 90% of the data are entered into the system. Future maintenance of the database is decentralised with administrative staff in the research projects providing regular inputs and updates.

CIFOR encourages an open information access policy which allows all MIS users to view the information in this database so special navigators were developed. These views, as they are called in Lotus Notes terminology, represent different options of accessing the information according to the most common access requirements. Project information, for example, can be accessed by country, region or status. The structured selection and design of the views is based on information gathered through initial interviews and experience gained in the course of the MIS development. Additionally, the database allows full text searches in either selected data fields or the entire database. A sample screen of the tasks database navigator is in Annex 8.

It is planned to use the Lotus Domino server to publish selected information from this database in a research database on CIFOR's homepage on the internet.

## Contacts Database

The 'contacts database' was developed as an integral part of the MIS to manage information related to CIFOR's contacts with organisations, individual scientists and policy makers. The first section gives basic contact details such as name, title, position, gender, department, institute name, address, phone, fax and e-mail. Entries are classified in four categories, depending on the level of involvement in CIFOR's activities: standard contacts who receive CIFOR's newsletter; alumni supported directly by the Center in various ways, such as attending workshops or training courses; collaborators with direct involvement in research activities; and high-level decision makers. This categorisation allows CIFOR to monitor its outreach in various forms and develop targeted information strategies. For similar purposes, organisations are categorised into ten types.

The next section covers mailing information for the distribution of CIFOR's publications. This includes responses to surveys on the distribution of CIFOR's newsletter and allows distribution of other types of publications, such as research publications and annual reports. In the case of alumni and collaborators, a section called 'CIFOR involvement' allows data on specific research interests, CIFOR contact person and events in which the scientist participated.

This database of over 4,500 entries allows CIFOR's Communications Unit to manage the dissemination of information in a targeted manner. It also is an element of the Center's corporate knowledge to monitor and influence the information distribution, taking into consideration geographic and institutional aspects and priorities.

The origins of this database were the critical contact data kept in a relational database in the early stages of CIFOR's operations. The data sets were easily imported into the MIS and the database structure refined to meet the increasing demands for optimal data management. The contacts database is maintained centrally in the Communications Unit with restrictions on database access for data protection. As with other MIS databases, a navigator was developed with structured access tools for the database, such as views by organisational category, country, name or organisation. Annex 9 gives a sample screen of the database navigator.

## Procedures

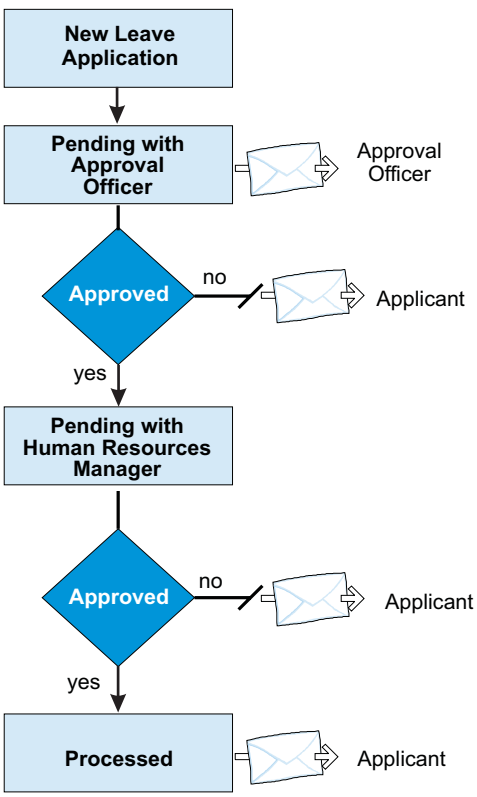
One objective of the MIS was to facilitate administrative processes. A database tool called 'procedures' was developed focusing on three processes, leave applications, travel authorisations and requisition orders. The basic concept in each was to develop a workflow model representing real processes. Leave applications, for example, had to include basic data provided by the applicant, supervisor approval, and monitoring and registration in the Human Resources Office. The workflow concept takes processes beyond static database models into dynamic and interactive communication and documentation tools.

### *Leave applications*

CIFOR maintains a paper-based system for staff leave applications. Given the high frequency of staff travel, delays in processing applications can occur and an electronic system will improve this situation.

The procedure for leave application and the underlying workflow concept is represented in Figure 14.

**Figure 14.** Leave Application Workflow Model



The applicant initiates the process by giving leave details such as start and end dates. The system then calculates the number of days of leave, taking into account weekends and public holidays. For this purpose a database on public holidays is maintained separately and updated annually. The applicant then allocates the number of days of leave to a type of leave on an hourly or daily basis. An e-mail, giving the details, is forwarded automatically to the approval officer who can either approve or reject the application giving a reason. The application status changes accordingly from 'pending for approval' to 'approved' or 'rejected'. The applicant automatically receives an e-mail giving the result and if approved, the Human Resources Officer is likewise informed. After processing by human resources the status of the application changes accordingly and the applicant is again notified.

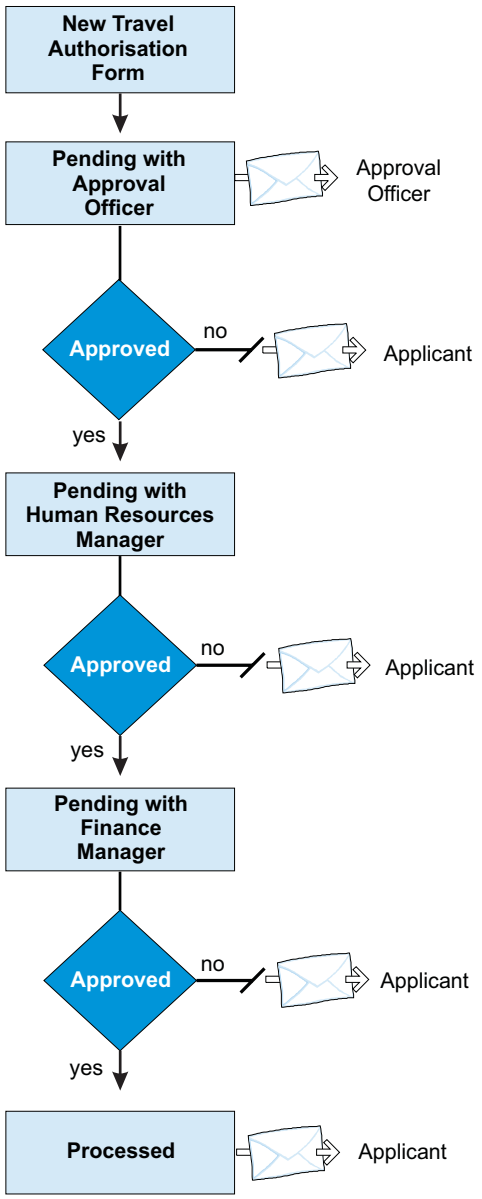
In order to reduce data inconsistency, once the application has been sent for approval it cannot be changed. Changes have to be entered in an amendment to the original leave application form. For authentication purposes electronic signatures of the applicant, the approval officer and the Human Resources Officer are included. In a separate section of the form, the process history is documented.

The advantages of the system are that processing times can be reduced and applicants know the status of their applications. Even while travelling, staff with access to email will be informed about applications, need for action and status. The navigator allows users to view applications by status, employee, pending for approval, pending with human resources and dates of absence. In CIFOR's distributed work environment the potential benefits of the system are considerable. Annex 10 contains a sample of the electronic leave application form.

### *Travel authorisations*

The travel authorisation process for travel also has problems with delays and staff unable to maintain a track record. Another electronic form, called 'travel authorisations' was developed, supported by a workflow application, to improve this situation. Figure 15 provides a graphical overview of the complex travel authorisation process.

**Figure 15.** Travel Authorisation Workflow Model



The applicant initiates the process by entering details of organisational unit and type of travel, mode of travel, dates, flight and accommodation details and a travel justification. The system then asks for a cost estimate and cost allocation to one or more tasks. A travel advance can be requested including amount and date required. National staff members can specifically request travel insurance. Upon completion, the authorisation request is saved and an e-mail message automatically forwarded to the approval officer. The approval officer can approve or reject the application. If approved, the Human Resources Officer receives e-mail notification and verifies leave and travel entitlements, if applicable. The approved request then passes to the Finance Officer who verifies financial details, such as budget allocation and availability, and completes the travel authorisation process. The applicant is automatically informed of the results by e-mail at each stage of the process.

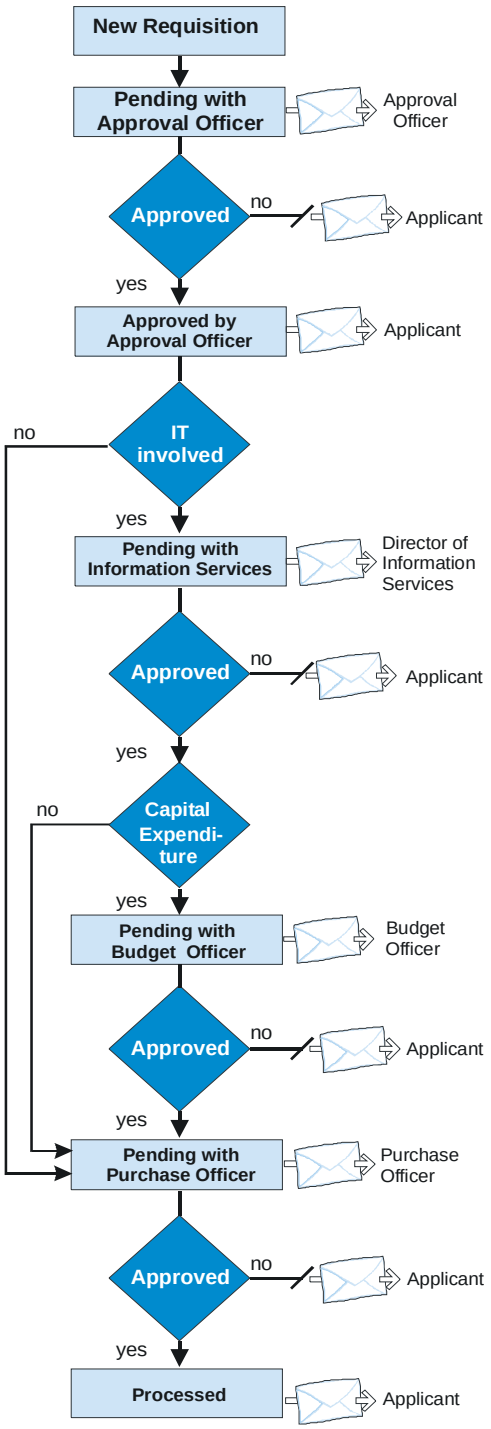
During the entire process a navigator allows easy access to the data sets and the status of the authorisation process can be monitored. Upon return, travellers may attach an electronic form for expense claims. For management this system allows monitoring of travel related expenditures in various ways, such as by research activity, destination or functional unit. A sample of the travel authorisation form is at Annex 11.

### *Requisitions*

A requisition ordering and tracking system was developed under the MIS with the purpose of making this procedure more transparent and manageable. Figure 16 represents the requisition process graphically.

The staff member provides details of the required items, such as quantities, currency, item description and a cost estimate, and indicates if they include computer hard- or software or capital expenditure One or more budget codes can be

**Figure 16.** Requisition Workflow Model



entered for cost allocation. After completion of the form, a notification is automatically sent to the approval officer. If computer equipment is involved, further approval by the Director, Information Services is requested and for capital expenditure by the Budget Officer. These additional steps are automated with e-mail notification and changing processing status. The Purchasing Department then initiates follow-up activities and completes the requisition process. The status of the requisition changes to 'completed'. The person initiating the requisition is automatically notified of the results at each stage of the process via e-mail.

This system allows a better tracking of requisitions and ultimately better planning. Comparisons of cost and available equipment are made easier which will lead to improved management of financial resources.

The use of electronic forms in general requires a change of user thinking. They may need considerable effort to adapt to this paperless, less 'tangible' system. However, given the benefits, users usually adapt quickly and associate less bureaucracy with such a system. Authentication issues also need to be considered as, despite the electronic signature being uniquely created for each user, there could be drawbacks. Annex 12 has a sample purchase requisition form.

## Human Resources

The human resources database was developed to capture all information related to CIFOR's staff. Due to internal re-structuring, the development of this database was delayed and at present covers only a sub-set of human resources information critical for supplying basic data, such as names, position, nationality, address and contact details. A brief summary of the professional background and responsibilities is also provided as well as the option to include photographs. In this regard the database serves more as a staff directory, the 'who's who' of CIFOR.

Wherever possible, human resources data were linked to other databases in the MIS. Data input was centralised and coordinated between Information Services and the Human Resources Office. In the future it is anticipated that the Human Resources Office will maintain data centrally. CIFOR staff can access parts of the database which is useful to new staff members for orientation, and for periodic presentations by staff at various scientific meetings and in publications.

## Databases for Entity Service Functions

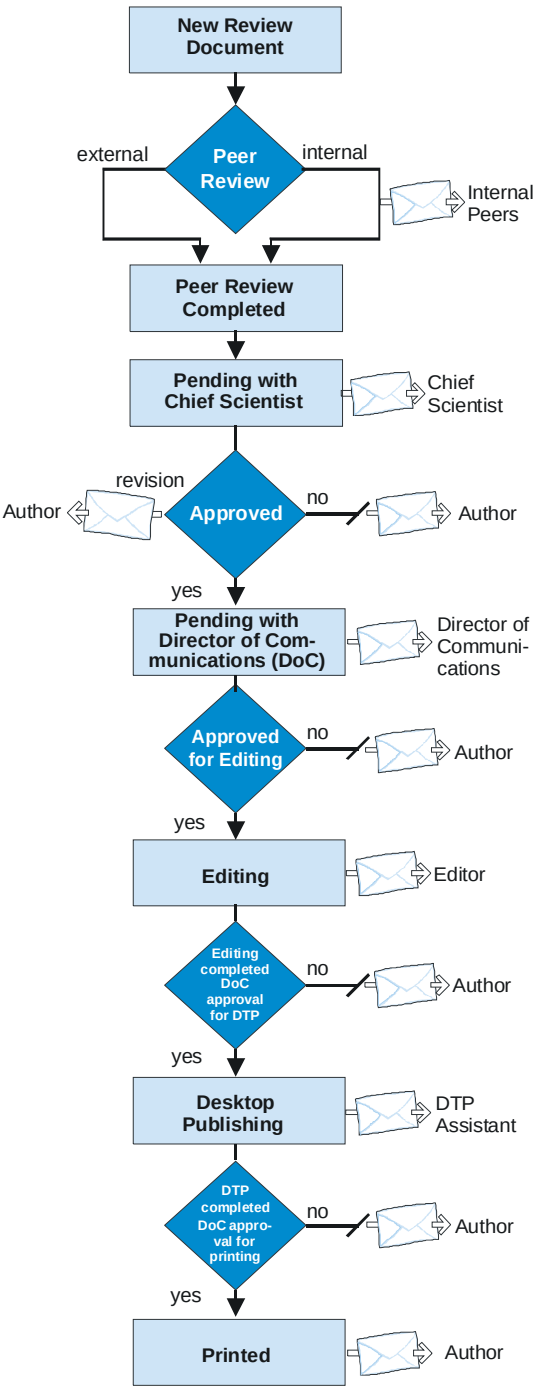
The idea behind the concept of entity service functions (EPS) is described on page 9. The MIS concept initially did not include the development of databases for ESF. However, during the implementation process it became apparent that some ESF databases had to be developed in response to strong demand and high user acceptability. It was also beneficial to the entire MIS introduction process. The following sections describe some of the developed databases.

### *Publications Pipeline*

As a research organisation, CIFOR's most important and visible outputs are scientific publications. Publishing process problems became apparent as the MIS was developed, including the monitoring of the publications review process and tracking the publication status. Sub-optimal situations led to frustration among scientists and staff involved in the publishing process and so, the 'publications pipeline', a publications monitoring and tracking system was developed. Figure 17 gives a graphical overview of this system's structure.

Either the author or a delegate, called contact person or coordinator, makes the initial entries into the database which include data on principal author, co-author(s), contact person, publication title, type of publication, a description of the targeted

**Figure 17.** Publication Pipeline Aplication Workflow Model




readership, estimate of the print run, dates for submission for internal and peer review and editing, a cost estimate and the funding source. A CIFOR task code can be entered for cost allocation as well as comments and supporting documents, e.g. the manuscript or concept note. The number and names of the reviewers have to be entered for both internal and external reviews.

In the internal review process the system automatically notifies reviewers via e-mail once the initial database document is saved. Reviewers can enter comments directly into the database. Authors organise external review independently of the system and indicate when the review process is complete. This triggers an e-mail to CIFOR's Chief Scientist that a publication is waiting for approval. The Chief Scientist has the option to approve, reject or request a revision by the author(s) and the system accordingly informs the author. Once approved, further production of the publication is co-ordinated by the Director of Communications who authorises editing, desktop publishing and printing. Staff are notified about the beginning or completion of each step of internal editing and publishing. The publication's delivery and distribution complete the entire, documented process.

Users can access information via a navigator according to publications under review, published papers and papers not approved. For papers under review, data can be viewed by principal author, current reviewer, contact person, status, title, type, serial number and date an entry was created, submission editing, or publishing date. Initial entries were coordinated by the MIS management staff but later, scientific staff were given responsibility.

The publications pipeline is very successful as a tool, reducing publication processing time, improving the Communications Unit's work plans and allowing better process monitoring by authors

and the Chief Scientist. It also serves as a tool to periodically assess scientists' outputs. Annex 13 shows the main navigator for this database and Annex 14, a sample record from the publications pipeline.

### *Trip Report Library*

Each staff member has to provide duty travel reports as a tool to maintain an overview of travel, existing contacts and regional and organisational foci. Initially trip reports were written in text processing software using file and directory names as the only entry references, making it difficult to search and retrieve information. A simple database on trip reports was established, capturing trip related information, such as countries and organisations visited, travellers' names and travel dates. The traveller can view data by countries visited, travel dates, report title and institutions visited.

## Post-implementation Review

Once the system introduction is complete, constant review is necessary. The review has to monitor the performance of the system, the usage and expansion needs as well as incorporate latest technological developments.

The system performance relates to the objectives specified in the system concept and so it is necessary to check whether those objectives are met and if the expected benefits are realised. Usage monitoring will provide information about the frequency the system is used and by which user groups or individual users. It also has to provide statistics about the frequency of particular transactions in order to identify preferences for certain MIS functions. Such preferences will provide important indicators for future modifications, adaptations and extensions to the system. Technical problems need to be documented as well as system downtime. Performance and usage reviews should be automated to the maximum extent possible.

Expansion needs should be primarily concerned with the integration of entity service functions into the MIS as described in the previous sections. It is expected that as needs arise, links to more ESF will be established which will thus become an integrated part of the MIS. As the organisation develops, expansion requirements need to also consider the system's user capacity. The linking of existing and possible CIFOR regional offices in separate locations on different continents constitutes another challenge for the MIS.

On the technological side, both, hardware and software developments need to be considered. For hardware, systems for electronic document management and related office automation technologies will have to integrate with the MIS if necessary. Staff and management have expressed great interest in such systems. The speed with which electronic communication networks currently develop has also the potential for integrating new communication technologies into the MIS. The extent that MIS data can be extracted and accessed on-line in real-time mode through networks such as the Internet and the World Wide Web needs to be further addressed. This option seems to be particularly attractive for project-related information which the public or specific stakeholder groups, such as donors or collaborating organisations, might wish to access.

For the software, particular attention needs to be given to updated versions of the MIS software as well as eventual improved competitive systems. The maintenance of relationships with suppliers is essential in this regard. New software applications need to be evaluated for their capability of integration with the MIS.

Chapter 4

# Conclusion

Chapter 4 discusses several aspects important to the accomplishment of the MIS. These are: project management structures which have to mirror the approach; factors critical to the success of the MIS; monitoring its impact and success; and its potential for application in other organisations.

## Importance of Project Management

The MIS, described in this study, was designed to reflect the specific conditions and requirements of the organisation and, in particular, the dynamics of the research environment. In this regard, one of the main features is that activities are managed as projects. Although this approach is rapidly gaining popularity among business-oriented organisations, management within most corporations still follow traditional functional rather than project structures.

CIFOR managers must adapt project management thinking to their activities because if not, they risk the loss of efficiency, dissatisfaction with their work and lower productivity (Brunner 1994, Ward 1994). The MIS is only a tool for efficient project management and needs to be embedded into a project-oriented management style. Bowen *et al*. (1994) describe four different categories of a project management framework. They separate functionally organised projects, projects with 'lightweight' organisational structures, heavyweight projects and projects conducted by a dedicated, autonomous team. In CIFOR the pre-conditions can be described as a mixture of projects with 'lightweight' organisational structures and autonomous project teams. Lightweight means that the project leaders' role is to coordinate work and people with different disciplinary background. Functional leaders, in addition, hold authoritative power. The mission of CIFOR's research project falls into the category of autonomous project teams, in generating new ideas and approaches and dealing with new problems and issues. Coordination roles, task assignments, individual actions under a certain activity, themes and subjects, and communication channels need to be clearly specified as a fundamental precondition to successful project management (Lauer and Trecht 1993, Vogel 1994).

## Critical Success Factors

Why dedicate a separate section of this study to critical success factors (CSF)? The system cannot be established as a technical unit in isolation. It meets its objectives only with contribution by and support from a series of factors. These factors will determine the success or failure of the system and therefore need to be addressed specifically. They will support management in understanding the effects of developments and decisions, and ultimately sustain efficient and effective application of information systems.

Several authors discussed the importance of CSF for MIS and similar information systems and a very comprehensive view of CSF in information technology is provided by Pollalis and Hanson Frieze (1993). They provide a 35-item scale of CSF which can be applied for various purposes such as information systems planning and design, needs and priority identification, development of competitive advantage, and strategic planning of information systems. Ackhoff (1967) discusses MIS success factors from the opposite angle, describing 'management misinformation systems'. In his study, five misconceptions are identified which are critical to the success or, in terms of the author, the failure of MIS. These are; abundance of irrelevant information, problems in defining information

needs, inappropriate use of information, ignoring organisational structures and performance in the design of a MIS, and inadequate distribution of responsibilities between MIS staff and managers. In this discussion on how to avoid such failures, diagnosis and control are emphasised whereas information processing itself does not appear to be considered adequately.

Brancheau and Wetherbe (1987) describe key issues in information systems management which are critical to the success of effective systems planning. They also provide a ranking of these issues and consider changes of these priorities over time. In a number of publications, although not mentioned specifically, CSF can be derived from descriptions of preconditions and requirements for information systems planning and implementation. The common, identifiable factors are: support from senior management; a step-wise, well planned development and implementation process; assessment and reflection of user needs and requirements; friendliness of the user interface; training both end-users and system administrators; and presentation of quick results (Ginzberg 1981, Alexander 1986, Bergeron *et al.* 1990, Senn 1991, Angermeyer 1993, Goodman 1993, Howard and Rai 1993, Branin *et al.* 1994, Bryson and Bromiley 1993, Byun and Suh 1994, Wiggins 1994).

Based on the experience gained in the course of this study and the considerations of other authors, a list of CSF was established (see Table 14).

These ten CSF are not listed in any order of priority and are equally crucial to the successful implementation and operation of the MIS. Active support from senior management is critical for several reasons. Senior managers are expected to be key users of the MIS, in particular for analytical purposes. Furthermore, they have to ascertain that staff in charge meet agreed conventions and processes for MIS inputs. Finally, they decide upon the long-term strategic direction and support of the system.

**Table 14.** Critical Success Factors

| | |
|---|---|
| 1. | Active support from senior management |
| 2. | Involvement of end-users in the implementation process |
| 3. | Flexibility of the system to respond to evolving internal and external demands |
| 4. | Provision of required inputs by staff members |
| 5. | Integration of the MIS into the organisational strategy |
| 6. | Development of end-user capabilities |
| 7. | Efficient management and maintenance of the MIS |
| 8. | Capability of the MIS to integrate with other information systems |
| 9. | Simplicity, transparency and user friendliness of the system |
| 10. | Sufficient resources for implementation and maintenance |

System maintenance can only be justified if end-users' expectations are fully met. Their involvement has to extend beyond the planning phase into the implementation and maintenance of the MIS. They also have to feel comfortable with the use of the system, need sufficient transparency to understand it, and require the most user-friendly operations. Moreover most end-users will have to provide the necessary inputs to enable the system to produce required outputs.

As described previously, CIFOR operates in a very dynamic environment, so MIS success depends on its capacity and speed to react to new challenges. Such challenges can originate in new user-demands for applications, desired growth of the system, higher degrees of integration with other systems or latest technological developments. The MIS has to become an integral part of the organisation's overall strategy. The strategic context constitutes the environment in which the MIS is functioning and MIS principles and objectives are

strongly interrelated with it. The capabilities of users and administrators to operate the MIS are also critical to its success. User skills determine if the desired information can be obtained from the system and consequently if the system meets its purposes. They are critical too for the correctness, timeliness and completeness of the inputs. MIS administrative staff must have skills to maintain and adapt the system most, efficiently.

Finally, the system can only be operated successfully with sufficient resources. Not only human resources are required but also financial resources for systems implementation, updates and extensions, and external consultants.

The CSF potentially can serve different purposes. A CSF-oriented approach in the course of the system implementation will guarantee that major factors are considered appropriately. CSF also determine priorities for the long-term development of the MIS and allocation of resources. Moreover, CSF are points of reference for the monitoring of the impact and success of the system as discussed in the following section.

## Monitoring and Evaluation of Impact and Success

Investments and efforts related to MIS development make it necessary to develop tools and procedures to monitor and evaluate its impact and success. Szewczak (1991) describes six main concerns in evaluating MIS. These are related to justification of resource investments, clarification of benefits from such investments, establishment of standards for measurement of the MIS function, control of computer misuse and crime, provision of time series for comparison of MIS performance, and development of an information base for future planning.

The general effectiveness of a MIS can be measured in several ways. They include decision effectiveness and quality, utilisation, user satisfaction, changes in user behaviour and attitudes and organisational performance. The authors cannot provide a synthesised approach to monitoring and evaluation due to a lack of empirical experience in this particular area. The scope of this study does not permit these issues to be dealt with in detail. Nonetheless a practical approach is suggested which can be used in the beginning and integrated into CIFOR assessment of research impact.

CSF can serve as initial reference for monitoring and evaluation of impacts and success. Retrospective evaluation of support from senior management and involvement of end-users in the implementation process can provide an impression of how these factors were considered. Flexibility of the system to respond to evolving internal and external demands can be measured by parameters such as overall capability of the system to handle such developments and related cost and time of the adaptation process.

It is relatively easy to measure provision of required inputs by staff members since, if inputs are not provided, desired outputs cannot be generated. However, the quality of the inputs, their correctness, completeness and timeliness are more difficult to measure. Nevertheless, formal evaluation mechanisms taking these factors into account, will have to be established. A related factor to be assessed periodically, possibly by means of interviews, is staff motivation to provide inputs. Integration of the MIS into the organisational strategy is a less tangible factor to investigate. It might be easy to evaluate the consideration of MIS-related issues in strategic documents produced by the organisations but it is difficult to assess the extent to which such considerations affect strategic decisions and influence the behaviour of senior managers. Periodic discussions with managers might help understand this process and increase awareness.

A first step in monitoring and evaluating development of end-user capabilities is to investigate training measures for using the MIS. Since training can provide only the basis for capability development, other indicators might be the number of problems in the use of the system, the number of errors in data inputs, and the frequency with which end-users require support from the MIS manager. The management and maintenance of the MIS should be evaluated for efficiency. Indicators are capability to solve problems, response time to problem solving and number of problems that occur due to errors in the system or system management. Analogously to end-user capability development, MIS administrators need to be trained in the beginning and receive continuous training.

Assessment of the MIS capability to integrate with other information systems can be made later and will consider the possibilities for systems integration and resources required for specific integration tasks. At the implementation stage, indicators might be the extent to which standards are incorporated in the application development, for example, the capability of the system for SQL processing or links with CIFOR's communication infrastructure. Evaluation of simplicity, transparency and user friendliness might use indicators such as the time required to familiarise users with the system, the decrease of application errors over time and overall user satisfaction.

Resources for implementation and maintenance can be easily evaluated by comparing resource allocation for the MIS with competing activities in CIFOR. It can provide important indications on how the MIS is perceived among senior management and will be strongly influenced by the performance of other CSF.

A weakness of CSF as a performance indicator is that although it potentially provides sufficient data on system efficiency and effectiveness, it only marginally assesses the overall success of the MIS. Additional tools are required to investigate if the objectives of the MIS are met. There are two challenges in this respect. First, efficiency, effectiveness and impact of CIFOR's research need to be assessed and secondly, tools are required which can identify a correlation between positive effects in these areas and the contribution of the MIS. However, more research is required to develop such tools and mechanisms (Szewczak, 1991). CIFOR responded to this demand by dedicating a staff position to the assessment of research capacity and impact of both CIFOR and its partner organisations. Finally it needs to be pointed out that monitoring and evaluation of performance and success can and should be conducted only to the extent management demands such information. Consequently, senior management, the impact assessment scientiest and MIS staff need to be involved.

## Applicability in Other Centres

CIFOR's collaborative research approach involves many partner organisations in industrialised and less developed countries. Although its primary research concerns are forestry and forestry-related subjects, it is frequently associated with developing and supporting capacities in the area of research management. The International Service for National Agricultural Research, one of CIFOR's partner organisations in the CGIAR, developed in 1991 an Information Management System (INFORM) targeted at national research systems (Gijsbers 1991, Nestel 1991a, b, c). It includes features to integrate all information on projects, research costs and budget, standardised cost codes, and a keyword system for analytical purposes. Several INFORM features can be found in CIFOR's MIS concept but there are also different elements. Thus, rather than focus on individual approaches should be structured for research information management purposes.

The analysis and structuring of CIFOR's MIS has the potential of being applied in collaborative

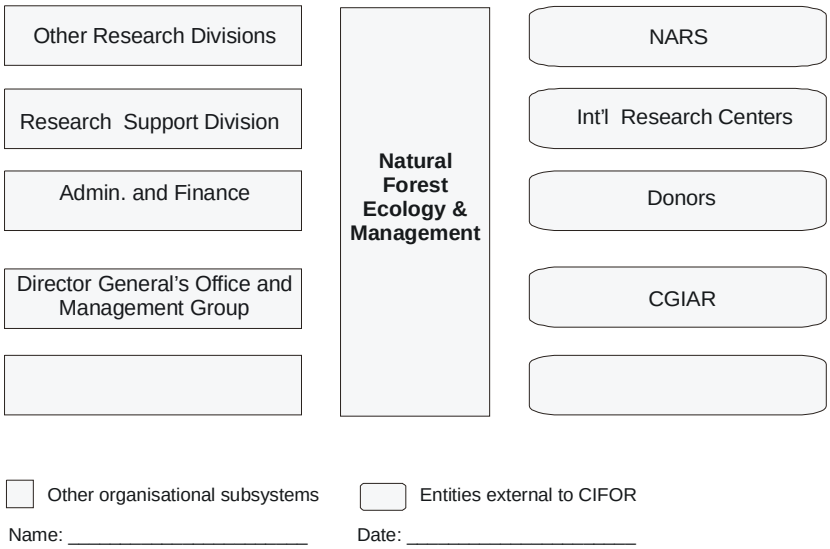
activities with partner organisations benefiting both CIFOR's scientists and their partners. It enables CIFOR staff to collect appropriate data for managing research activities while, on the other hand, CIFOR's collaborators may use structural elements for their own research management. Benefits may include a common base of understanding which helps to improve communications among all partners involved in a specific activity, and increased efficiency through complete management data sets leading to more effective research. In addition, a demonstration effect can be initiated which may result in multiplication of such benefits in similar projects.

There are two reasons for some perceived reluctance to apply MIS within the CGIAR: some centres developed systems in the seventies and eighties that now suffer from lack of maintenance and user-friendliness; and secondly, more recent members of the CGIAR, particularly the smaller centres, are hesitant to invest in such systems because of uncertainty and lack of positive experience. As a consequence, it is expected that CIFOR's MIS development will be watched very closely by its sister organisations within the CGIAR. There is potential for CIFOR to take a leading role in MIS within the CGIAR and its established standards adopted by other centres.

On a cautionary note, CIFOR, to avoid risk of failure, has to gain its own experience with the system before some elements can be generalised. In addition, generalisation of MIS experience is possible only to a certain extent. Most organisations, particularly at the national level, will have to consider requirements from their immediate environment which might limit the potential for generalisation. Finally, CIFOR has its own mandate as a research organisation and its priorities are on research rather than research management. Although these two areas are closely interrelated, in almost all cases, a MIS will have, a role to support research-targeted activities.

# Annexes

**Annex 1.** Sample Information Flow Assessment Chart




**Annex 2.** Information Needs and Requirements Questionnaire

**MIS - Information Requirements Assessment Questionnaire**

Name: _____ Date: _____

1. **Tasks**
   - 1.1 What are your main tasks and what information is needed for fulfilling them?
   - 1.2 What decisions do you make in fulfilling the tasks and what information do you need for decision making?
   - 1.3 In the past, were information requirements satisfied, and how?
2. **Success factors**
   What factors are critical to the success of your activity and what information do you need to achieve success in them or monitor progress?
3. **Outputs**
   - 3.1 What are the outputs of your activities and what information do you need to measure effectiveness in achieving the outputs?
   - 3.2 How are the outputs presented?
   - 3.3 What resources are used in producing the outputs and what information is needed to measure efficiency in use of the resources?
4. **Contributions of MIS**
   - 4.1 How could a MIS contribute to improvement of your work?
   - 4.2 How do you expect to work with a MIS in your daily tasks?

## **Annex 3.** Financial Information System Data Field Structure

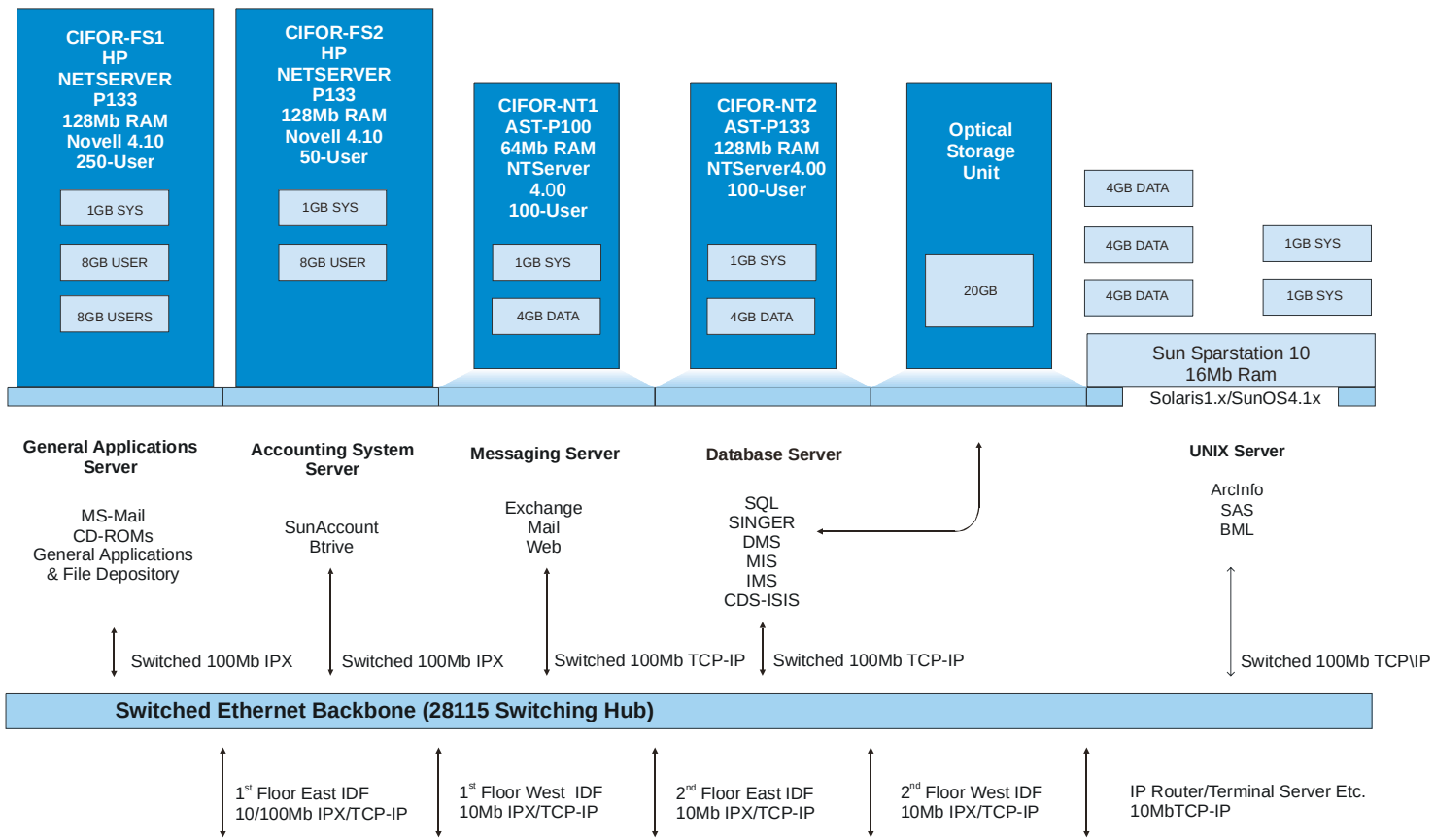
| Physical File Name | SALFLDGddd | SAbF-ddd.dat | (b=L for Actual, B-K for Budget) Ledger Transactions |
|---|---|---|---|
| ACCNT_CODE | char (15) | char (15) | Account code->SSRFACC.ACCNT_CODE |
| PERIOD | integer (7) | char (7) | Posting period format yymm |
| TRANS_DATE | integer (8) | numeric (8) | Posting date format yymmdd |
| JRNAL_NO | integer (7) | decimal (4) | System generated by posting |
| JRNAL_LINE | integer (5) | decimal (3) | System generated by posting |
| filler1 | | char (1) | filler |
| T_TYPE | | char (1) | Record Type |
| AMOUNT | money / 18,3) | decimal (10,3) | Value of transaction + or - |
| D_C | char (1) | char (1) | D or C because std sun uses unsigned |
| ALLOCATION | char (1) | char (1) | Flag - Allocated |
| JRNAL_TYPE | char (5) | char (5) | The SA journal used to create journal |
| JRNAL_SRCE | char (5) | char (5) | Optional initials of operator |
| TREFERENCE | char (15) | char (15) | Transaction reference |
| DESCRIPTN | char (25) | char (25) | Description |
| ENTRY_DATE | integer (8) | numeric (8) | System date when transaction entered |
| ENTRY_PRD | integer (7) | char (7) | Current Period when transaction entered |
| DUE_DATE | integer (8) | numeric (8) | Optional, overides std terms |
| filler2 | | char (10) | filler |
| PAID_REF | integer (9) | decimal (5) | Payment / Allocation reference |
| PAID_DATE | integer (8) | numeric (8) | Payment / Allocation date |
| PAID_PERIOD | integer (7) | char (7) | Payment / Allocation period |
| ASSET_IND | char (1) | char (1) | Flag to indicate that Asset fields are used |
| ASSET_CODE | char (10) | char (10) | Asset Code |
| ASSET_SUB | char (5) | char (5) | Asset Sub Code |
| CONV_CODE | char (5) | char (5) | Conversion code ->SSRFCNV.CODE |
| CONV_RATE | float / (18,9) | decimal (10,9) | Calculated rate |
| OTHER_AMT | money (18,3) | decimal (10,3) | Converted Amount |
| OTHER_DP | char (1) | char (1) | No of Decimal places in other amount |
| ENTRY_OPID | char (3) | char (3) | Operator ID of Journal Entry |
| POST_OPID | char (3) | char (3) | Operator ID of Posting |
| AMEND_OPID | char (3) | char (3) | Operator ID of Allocation |
| REVERSAL | char (1) | char (1) | Amount Reversal |
| LINKED_TEXT | char (1) | char (1) | Linked Text indicator |
| ANAL_T1 | char (5) | char (5) | T1 Analysis ->SSRFANV.CODE |
| ANAL_T2 | char (5) | char (5) | T2 Analysis ->SSRFANV.CODE |
| ANAL_T3 | char (5) | char (5) | T3 Analysis ->SSRFANV.CODE |
| ANAL_T4 | char (5) | char (5) | T4 Analysis ->SSRFANV.CODE |
| ANAL_T5 | char (5) | char (5) | T5 Analysis ->SSRFANV.CODE |

## **Annex 4.** Sample Project Sheet

**Research Support Division**
**PROJECT INFORMATION**

| | |
|---|---|
| **Activity** | 5.2 Publications |
| **Project**: | TREE-CD Service |
| **File Location**: | Dc - Tree-CD |
| **Budget Code**: | 52104 |
| **Guide to Filing System**: | Filing cabinet 2: Dc01-General correspondence; Dc03-Newsletter<br>Desk Task Manager: Dc-Folders on Individual Training Courses |
| **Task Manager:** | Michael Ibach |
| **Task Manager's Input**: | Comprehensive project management |
| **Location of Research**: | Global |
| **Summary**: | This project is integrated in a series of projects supported by the Overseas Development Administration, UK. It includes the distribution of 20 sets of the TREE-CD database on CD-ROM (CAB International) to selected CIFOR partner organisations. Once selected, the information systems managers of these organisations are invited to an introductory training workshop on TREE-CD and CD-ROM technology. |
| **Expected Output**: | The TREE-CD database is installed and operational in partner organisations. Information Systems Managers are trained and able to train other staff in their organisations. Project participants are formally in contact through an information systems network. |
| **Partnerships**: | ODA; FORSPA (Phase 1). CAB International; Participating institutions in 14 countries |
| **Duration**: | April 1993 to March 1997 |
| **Status**: | On-going. All 20 sets of TREE-CD are installed, training was provided in courses in Bogor, Indonesia (in cooperation with FORSPA, April 1995) and Pretoria, South Africa (July 1995). A newsletter to be circulated among participating institutions will be released in October 1995. |
| **Funding**: | Overseas Development Administration |
| **Budget (Total)**: | US$ xxxxxxx |
| **Budget Spent**: | US$ xxxxxxx |
| **Update of Summary:** | September 1995 |
| **Contact Person**: | Michael Ibach |

## **Annex 5**. Local Area Network Configuration Chart



## **Annex 6a.** Terms of Reference: MIS Project Advisory Group

The MIS Project Advisory group will be established for the duration of the implementation of a management information system for CIFOR. The Management Group will determine members of the group.

The overall objective of the MIS-PAG is to advise the MIS project coordinator and Management Group in the course of the implementation of the MIS. In particular, the group will:

- Provide critical inputs into the MIS implementation process;
- Represent staff interests to be considered during the MIS implementation;
- Support the work of the project coordinator and external consultants;
- Assist in presenting the MIS process to Management Group and all staff.

## **Annex 6b**. Terms of Reference: MIS Consultant

The MIS consultant will provide advice to CIFOR, in particular the project team and Management Group, in the following areas:

- Review the MIS concept, in particular integration aspects and interfaces with other systems;
- Propose a MIS software and assist in its procurement;
- Elaborate a detailed work plan for the MIS implementation;
- Review programming implications of the MIS concept;
- Provide programming services as identified in the review, both for the MIS design and interfaces with other systems;
- Ensure that the MIS fully integrates with the existing computer-supported infrastructure;
- Assist the implementation process at critical milestones;
- Elaborate a training programme for users and system administrators.

The MIS consultant will report to the MIS project coordinator.

## Annex 7. Sample Task Data Set

**CIFOR Management Information System**

### 105030 Site management and productivity in tropical forest plantations

Status: Active - 01/01/95

| | |
|---|---|
| **Project Title** | Plantation Forestry on Degraded or Low-Potential Sites |
| **Project Short Title** | Plantation Forests |
| **Project Number** | P5 |
| **Task Title** | **Site management and productivity in tropical forest plantations** |
| **Date** | 11.06.97 |

**Document Location**
C. Cossalter's filing cabinet "Site Management"

**Summary**
If plantations as a technology are to continue to be vigorously promoted, it is essential to understand better their long-term impact on site productivity factors. Do the changes in soil characteristics induced by intensive forms of plantation management lead necessarily to site degradation as it is currently assumed? How can changes in soil characteristics be influenced by silvicultural and harvesting practices? Can successive and equally productive crops of trees be harvested from a site in perpetuity? The project aim is to increase our understanding of the processes controlling productivity of plantations in the long-term and to measure the impact of selected management practices on productivity. These will be the basis for more sustainable management options. The project is conducted as a network of partnerships between several organisations and CIFOR.

**Summary of Outputs and Achievements to date**
Experiments in place in Australia, China, Congo, South Africa (a total of 6 locations). Good progress made in launching the research at 6 additional locations in Brazil, India, and Indonesia.

**Examples of Output Take-up and Impact**
Partners in Congo are taking the opportunity of CIFOR project to develop more basic research aimed at measuring the input/output budgets for water and nutrients and the energy and $CO^2$ balances.

**Details of NARS Training or Capacity Building**

| | |
|---|---|
| **Proposer** | C. Cossalter |
| **Concept Note** | Elaborated with input of collaborators during 1995 and discussed at a workshop with main collaborators in Nov. 1995 |

| Strategic Linkage | Weight |
|---|---|
| Improving Forest Productivity - 2.1 Improved Management Options | 3 |
| Improving Forest Productivity - 2.3 Dissemination of Improved Management Options | 2 |
| Increasing Research Capacity - 4.1 Capacity Building through Partnerships | 2 |
| Understanding Forest Environments - 1.2 Forest Ecosystems and Their Productivity | 3 |
| **Total** | **10** |

| | | |
|---|---|---|
| **TAC Categories** | 4 - Production systems development and management for trees | |
| | 9 - Training | |
| **CGIAR-SWI** | none | |
| **Date Circulated** | Task predates current review process | |
| **Comments Received** | Task predates current review process | |
| **Review Meeting Date** | Task predates current review process | |
| **Meeting Brief** | Task predates current review process | |
| **Sources of Funds** | CIFOR(core) | |
| **Meeting Result** | Approved | Management Group |
| **Task Code** | **105030** | |

## Goals (Link to CIFOR objectives)

Understanding the biophysical and socio-economic environments of present and potential forest systems and forestry, and their functional relationships. Creating the potential for sustainable improved productivity of forest systems for the benefit of people in developing countries.

## Purpose (Impact)

The project aim is to increase our understanding of the processes controlling productivity of plantations in the long-term and to measure the impact of selected management practices on productivity. These will be the basis for more sustainable management options.

## Outputs

In 1996, research sites were selected and research protocols finalised in Australia, Congo, China, South Africa.

| | | |
|---|---|---|
| Completed | 12/31/96 | Research Update |
| Completed | 12/31/95 | Methodology document |

### Inputs

Nov. 1995 workshop with main collaborators to finalize project methodology and discuss implementation of activities and workplan. May-June 1996, visited research sites in Congo and China

### CIFOR Inputs

| | | |
|---|---|---|
| Completed | 11/01/95 | MAINTAIN A SCIENTIFIC ADVISORY GROUP AND FACILITATE THE ACCESS OF COLLABORATORS TO MORE SPECIFIC SCIENTIFIC EXPERTISE WHEN REQUIRED () |
| Completed | 11/01/95 | FACILITATE EXCHANGE OF INFORMATION AMONGST PARTNERS; GATHER AND SYNTHESISE THE REQUIRED DATA; IF NEEDED, HELP PARTNERS TO PUBLISH THEIR RESEARCH RESULTS IN ADDITION TO WHAT WILL BE PUBLISHED THROUGH THE PROJECT () |

### Partner Inputs — Add Input Details by Item

| | | |
|---|---|---|
| Completed | 11/01/95 | BE RESPONSIBLE FOR THE STUDIES WITHIN THEIR SITES; SHARE EXPERIENCE; RELEASE DATA CONSISTENT WITH THE REQUIREMENTS OF THE STUDY () |

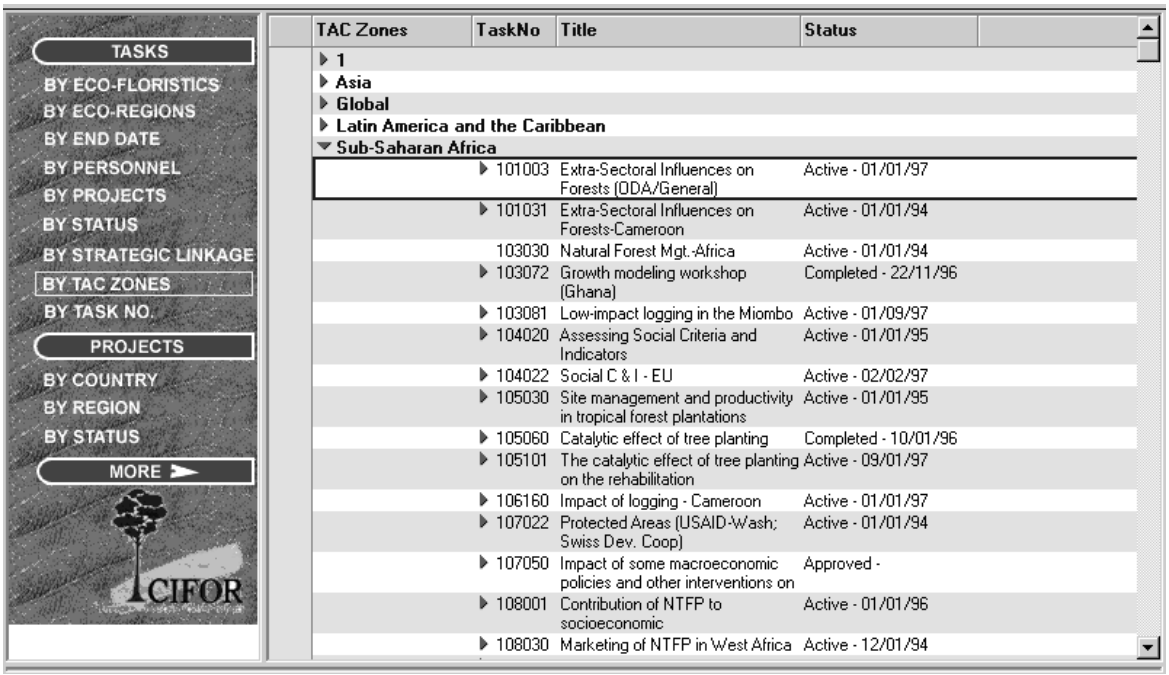
Start Date **01.01.95** Expected End Date **31.12.2000**

Actual End Date

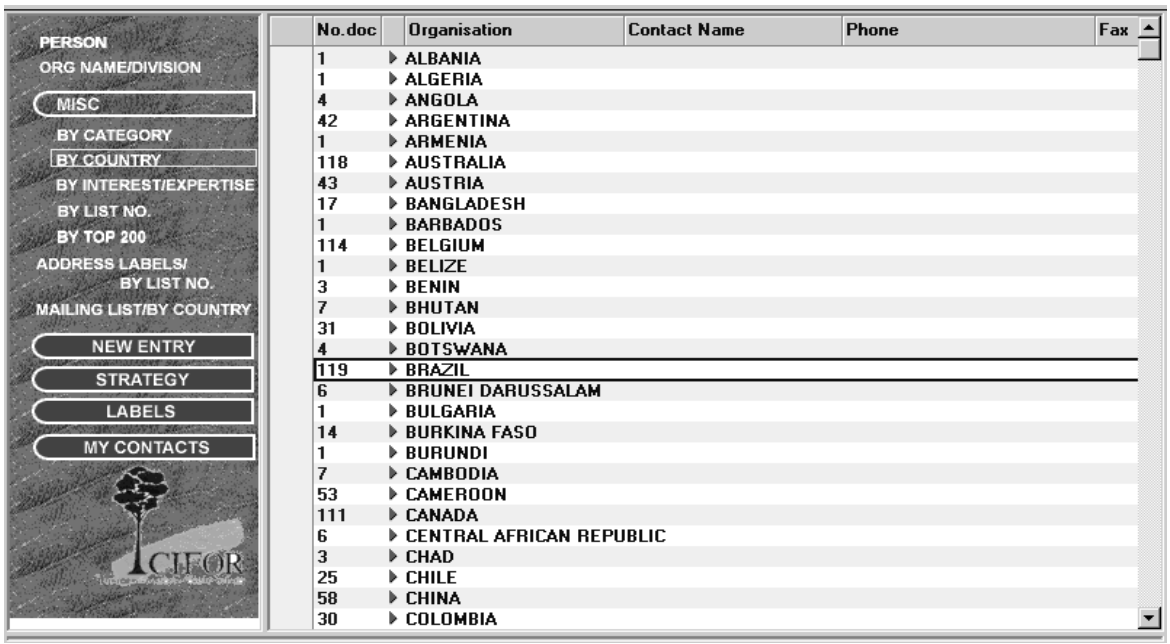
Final Report Submitted

| | | |
|---|---|---|
| TASK MANAGER | COSSALTER, Christian | (Male) |
| SCIENTIFIC STAFF | KOBAYASHI, Shigeo | (Male) |
| **Region** | AFRICA, ASIA, LATIN AMERICA | |
| **Country** | AUSTRALIA, CHINA, CONGO, SOUTH AFRICA | |
| **Eco-region** | Not in eco-region | |
| | Tropical moist forests in central-west Africa and the Congo | |
| **TAC Zones** | Asia | |
| | Latin America and the Caribbean | |
| | Sub-Saharan Africa | |
| **Eco Floristic Zones** | Lowland moist with long dry season | |
| | Lowland moist with short dry season | |
| | Lowland sub-dry | |
| | Lowland very moist | |

## **Annex 8.** Activity Database Navigator Screen




## **Annex 9.** Contacts Database Navigator Screen



## **Annex 10.** Sample Leave Application Form

Status : HR Processed - Completed

Application Number : MI980006
Date : 10.09.98

**Administrative Details**

Date : 10.09.98
Applicant Name

Division ISG

**Leave Details**

From 16.02.98 To 01.03.98 Total Days

| Type | Time(in Hours) | or | Time (in Days) |
|---|---|---|---|
| Annual Leave with Pay | 0 | | 10 |
| Annual Leave without Pay | 0 | | 0 |
| Sick Leave | 0 | | 0 |
| Maternity Leave | 0 | | 0 |
| Compensatory time | 0 | | 0 |
| Total | 0 | | 10 |

**Forward for Approval**

Signed & Forwarded by on date
For Approval by

**Approval**

Approved by on date
Rejected by on date
Reason

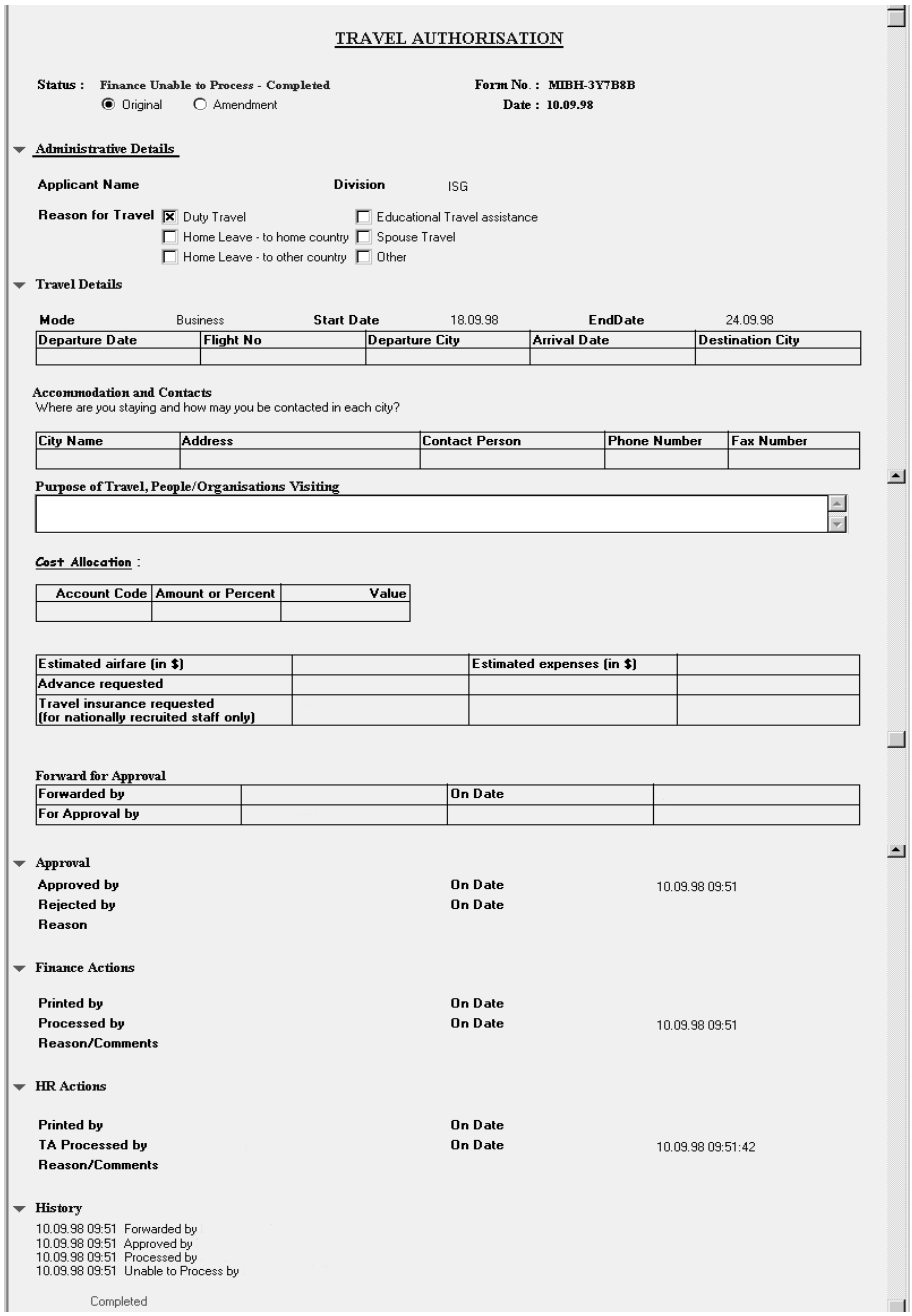
**HR Actions**

Printed by on date
Processed by on date
Reason

**History**

10.09.98 14:35 Forwarded by
10.09.98 14:36 Approved by
10.09.98 14:36 Processed by

## **Annex 11.** Sample Travel Authorisation Form



TRAVEL AUTHORISATION

**Status :** Finance Unable to Process - Completed
(●) Original ( ) Amendment

**Form No. :** MIBH-3Y7B8B
**Date :** 10.09.98

**Administrative Details**

**Applicant Name** **Division** ISG

**Reason for Travel**
[X] Duty Travel
[ ] Educational Travel assistance
[ ] Home Leave - to home country
[ ] Spouse Travel
[ ] Home Leave - to other country
[ ] Other

**Travel Details**

**Mode** Business **Start Date** 18.09.98 **EndDate** 24.09.98

| Departure Date | Flight No | Departure City | Arrival Date | Destination City |
|---|---|---|---|---|
| | | | | |

**Accommodation and Contacts**
Where are you staying and how may you be contacted in each city?

| City Name | Address | Contact Person | Phone Number | Fax Number |
|---|---|---|---|---|
| | | | | |

**Purpose of Travel, People/Organisations Visiting**

**Cost Allocation** :

| Account Code | Amount or Percent | Value |
|---|---|---|
| | | |

| | | | |
|---|---|---|---|
| Estimated airfare (in $) | | Estimated expenses (in $) | |
| Advance requested | | | |
| Travel insurance requested (for nationally recruited staff only) | | | |

**Forward for Approval**

| | | | |
|---|---|---|---|
| Forwarded by | | On Date | |
| For Approval by | | | |

**Approval**

**Approved by** **On Date** 10.09.98 09:51
**Rejected by** **On Date**
**Reason**

**Finance Actions**

**Printed by** **On Date**
**Processed by** **On Date** 10.09.98 09:51
**Reason/Comments**

**HR Actions**

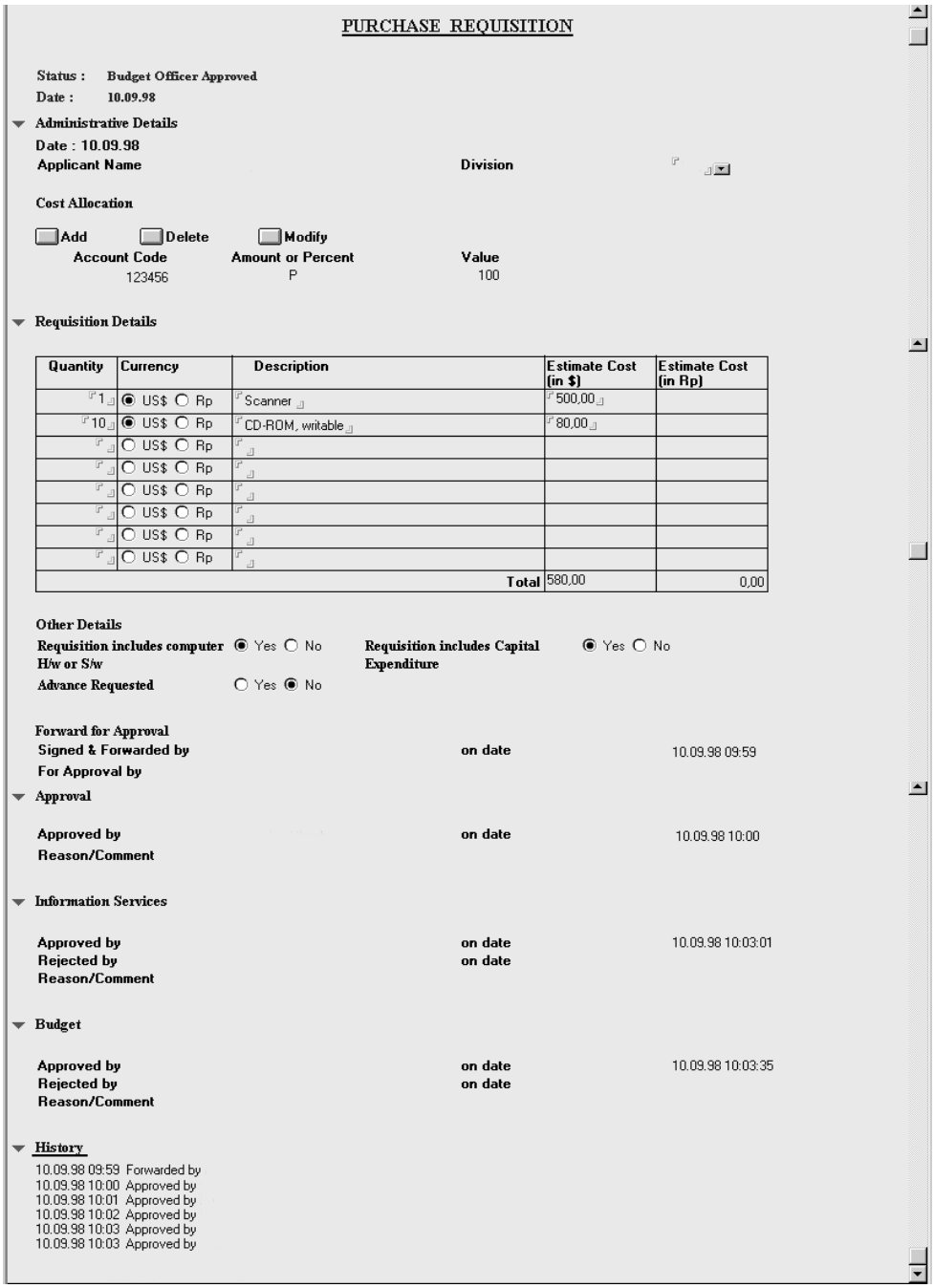
**Printed by** **On Date**
**TA Processed by** **On Date** 10.09.98 09:51:42
**Reason/Comments**

**History**

10.09.98 09:51 Forwarded by
10.09.98 09:51 Approved by
10.09.98 09:51 Processed by
10.09.98 09:51 Unable to Process by

Completed

## **Annex 12.** Sample Purchase Requisition Form



PURCHASE REQUISITION

**Status :** Budget Officer Approved
**Date :** 10.09.98

**Administrative Details**

**Date : 10.09.98**
**Applicant Name** **Division**

**Cost Allocation**

Add Delete Modify

| Account Code | Amount or Percent | Value |
|---|---|---|
| 123456 | P | 100 |

**Requisition Details**

| Quantity | Currency | Description | Estimate Cost (in $) | Estimate Cost (in Rp) |
|---|---|---|---|---|
| 1 | (•) US$ ( ) Rp | Scanner | 500,00 | |
| 10 | (•) US$ ( ) Rp | CD-ROM, writable | 80,00 | |
| | ( ) US$ ( ) Rp | | | |
| | ( ) US$ ( ) Rp | | | |
| | ( ) US$ ( ) Rp | | | |
| | ( ) US$ ( ) Rp | | | |
| | ( ) US$ ( ) Rp | | | |
| | ( ) US$ ( ) Rp | | | |
| | | **Total** | 580,00 | 0,00 |

**Other Details**

**Requisition includes computer H/w or S/w** (•) Yes ( ) No
**Requisition includes Capital Expenditure** (•) Yes ( ) No
**Advance Requested** ( ) Yes (•) No

**Forward for Approval**
**Signed & Forwarded by** **on date** 10.09.98 09:59
**For Approval by**

**Approval**

**Approved by** **on date** 10.09.98 10:00
**Reason/Comment**

**Information Services**

**Approved by** **on date** 10.09.98 10:03:01
**Rejected by** **on date**
**Reason/Comment**

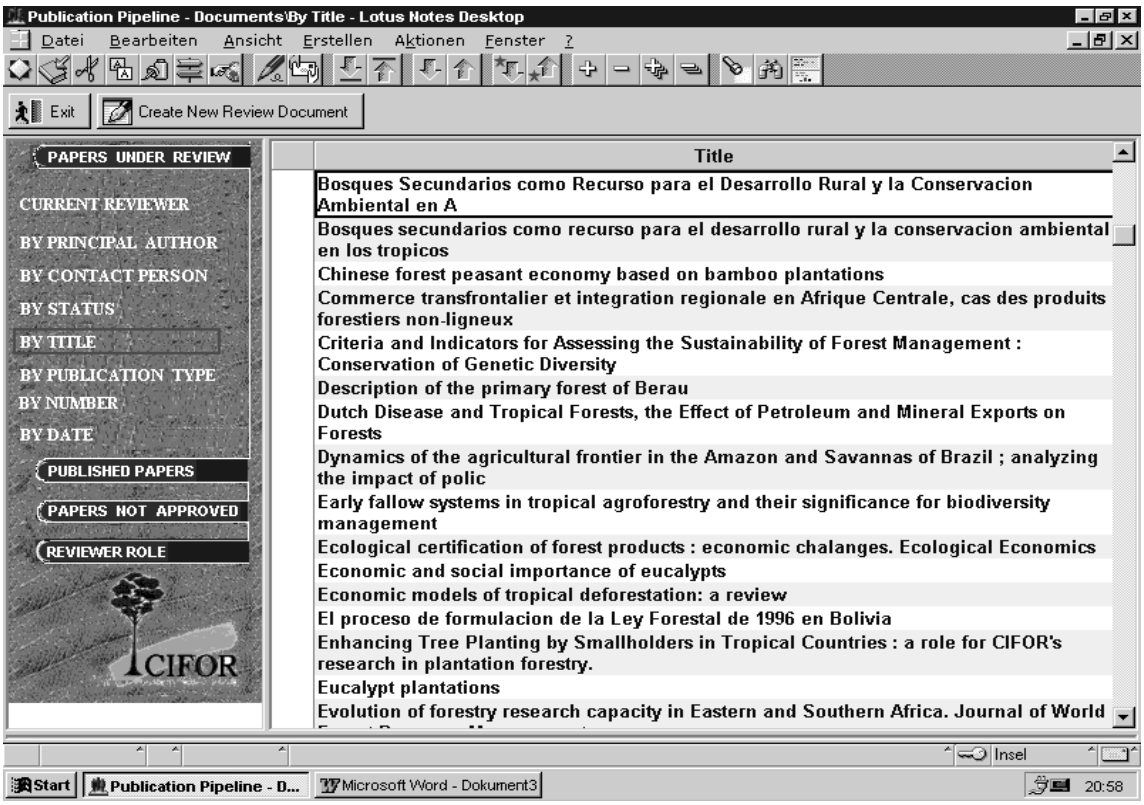
**Budget**

**Approved by** **on date** 10.09.98 10:03:35
**Rejected by** **on date**
**Reason/Comment**

**History**

10.09.98 09:59 Forwarded by
10.09.98 10:00 Approved by
10.09.98 10:01 Approved by
10.09.98 10:02 Approved by
10.09.98 10:03 Approved by
10.09.98 10:03 Approved by

**Annex 13.** Publication Pipeline Navigator Screen



## **Annex 14.** Sample Publication Pipeline Data Set


**CIFOR PUBLICATIONS PIPELINE**

Review of knowledge in Dipterocarp Research

**Sent for peer review** Created on 12.05.98

**Coordinator** Christian Cossalter

**Principal Author Section**

| | |
|---|---|
| Principal Author ◆ | S. Appanah & J. Turnbull (ed) |
| Co-Author(s) | |
| Contact Person | COSSALTER, Christian |

| | | | |
|---|---|---|---|
| **Number** | CC2/00002 | **Title** ◆ | Review of knowledge in Dipterocarp Research |
| **Approx. Length** | 257 pages | **CIFOR Publication Type** ◆ | Monograph |
| | | **Target Readership** | Scientific community |
| **Approx. Print Run** | 1000 | **Submission date for internal review** ◆ | 12.05.98 |
| **Peer review ends on** ◆ | 12.07.98 | **Submission date for editing** ◆ | 15.06.98 |
| **Cost estimate** | | **Funding source** | 105100 |

**Comments**

**Full Description** g:\share\P3\Dipteroc\Pipeline*.*

Actual Date of submission 13.05.98

**CIFOR Peer Reviewer List**

Number of reviewers: 1

**Peer Reviewer Name(s)**

John Turnbull

**External Peer Approval List**

Number of reviewers: 0

**CIFOR and external Peer Review complete** (●) Yes ( ) No

## **Annex 14.** (continued) Sample Publication Pipeline Data Set

**CIFOR Peer Review**

**Comments for** John Turnbull — No comments

**Chief Scientist's Name**

**Chief Scientist's Name** John Turnbull
**Comments**
**Approved on**
**Not approved on**

**DOC Section**

**DOC's Name** Sharmini Blok — **Expected date of publication** 26.10.98

**Internal or External Editor ?** ○ External ◉ Internal

**Approved for editing on**
**Approved for DTP on**

**Printer's name** — **Approved for printing on**
**Printed & Published on**

**Editor Section**

**Actual date of editing**

**Editor's name** Yvonne Byron

**DTP Section**

**Actual date of formating**

**DTP's name** Rahayu Koesnadi

**History**

| History: | New Document created by Christian Cossalter on 05/12/98 02:42:43 PM<br>Submitted by Christian Cossalter for Peer Review on 05/13/98 04:10 PM |
|---|---|

# References


Ackoff, R.L. 1967 Management misinformation systems. Management Science, Dec.: 147-156.

Alexander, D.J. 1986 Planning and building a DSS. Datamation; 15 Mar: 115-121.

Anderson, J.R., *et al.*, 1995 Internally Commissioned External Review; 28 September 1995. CIFOR internal document, 28p.

Angermeyer, H. 1993 Die Einführung von Informations-Management - eine Führungsaufgabe. ZFO, Apr.: 235-241.

Baker, B. 1995 The role of feedback in assessing information systems planning effectiveness. Journal of Strategic Information Systems, 4: 61-80.

Belkin, N.J., *et al.*, 1991 User interfaces for information systems. Journal of Information Science, 17: 327-344.

Bergeron, F., *et al.*, 1990 Investigating the support role of the information center. MIS Quarterly, Sep: 247-260.

Bowen, H.K., *et al.*, 1994 Make projects the school of leaders. Harvard Business Review, Sep.-Oct.: 131-140.

Brancheau, J.C. and Wetherbe, J.C. 1987 Key issues in information systems management. MIS Quarterly, Mar.:23-35.

Branin, J.J., D'Elida, G. and Lund, D. 1994 Integrating information services in an academic setting: the organizational and technical challenge. Cause Effect, Fall: 26-37.

Brunner, P. 1994 Projektmanagement gegen Engpässe. Der Organisator, 10: 22-24.

Bryson, J.M. and Bromiley, P. 1993 Critical factors affecting the planning and implementation of major projects. Strategic Management Journal, 14: 319-337.

Byun, D.H. and Suh, E.H. 1994 A builder's introduction to executive information systems. Journal for Information Management, 14: 357-368.

CGIAR. CGIAR home page on the World-Wide Web; URL: http:\\www.cgiar.org.

CIFOR 1995 CIFOR: a strategy for collaborative research. Draft No. 8, Aug. 1995. 29p.

CIFOR 1993 International forestry research: towards the 21st Century, a provisional medium-term plan for CIFOR 1994-1998. Draft 10, September 1993. 88p.

CIFOR. CIFOR home page on the World-Wide Web; URL: http:\\www.cifor.or.id.

Davis, G.B. and Ohlson, M.H. 1985 Management information systems, conceptual foundations, structure and development. Singapore. 693p.

Dykstra, D. 1996 CIFOR Office Memorandum of 12 Jan. 1996 on Reorganisation of CIFOR Research Units. 4p.

Gablers Wirtschaftslexikon Bd.4., 1988. Gabler, Wiesbaden. 1115p.

Gijsbers, G. 1991 Methods and procedures for the development of INFORM; INFORM guidelines, Part 2. ISNAR, The Hague

Ginzberg, M.J. 1981 Key recurrent issues in the MIS implementatoion process. MIS Quarterly, June: 47-60.

Goodman, S.K. 1993 Information needs for management decision-making. Records Management Quarterly, Oct.: 12-23.

Gremillion, L.L. and Pyburn, P.J. 1985 Justifying decision suport and office automation systems. Journal of Management Information Systems, Summer: 5-17.

Hansen, H.R. 1992 Wirtschaftinformatik I. AKAD, Stuttgart. 952p.

Howard, G.S. and Rai, A. 1993 Making it work: tips for implementing IS innovations. Information Strategy, 9: 5-12.

Lauer, C. and Trecht, U. 1993 Das Managen von Projekten: Informationsverarbeitung und Wissensnutzung in Projekten. Office Management, May: 38-42.

Lederer, A.L. and Mendelow, A.L. 1993 Information systems planning and the challenge of shifting priorities. Information and Management, 24: 319-328.

Mentzas, G. 1994 A functional taxonomy of computer-based information systems. International Journal of Information Management, 14: 397-410.

Mertens, P. and Griese, J. 1993 Integrierte Informationsverarbeitung, 2. Planungs- und Kontrollsysteme in der Industrie. Gabler, Wiesbaden. 256p.

Nayar, M.K. 1993 Achieving information integrity. Information Systems Management, 10: 51-58.

Nestel, B. 1991a An overview of INFORM, an information management system; INFORM guidelines, Part 1. ISNAR, The Hague.

Nestel, B. 1991b Revenue and cost codes for use with INFORM; INFORM guidelines, Part 3; ISNAR, The Hague.

Nestel, B. 1991c A minithesaurus of keywords for use with INFORM; INFORM guidelines, Part 4. ISNAR, The Hague.

Parker, C. and Case, T. 1993 Management information systems, strategy and action. 2nd ed. McGraw Hill, Watsonville. 888p.

Pellow, A. and Wilson T.D. 1993 The management information requirements of heads of university departments: a critical success factor approach. Journal of Information Science, 19: 425-437.

Pollalis, Y.A. and Hanson Frieze, I. 1993 A new look at critical success factors in IT. Information Strategy, 10: 24.

Qirui, Y. and Mingxue, Z. 1993 A management information system for a Chinese university. Information and Management, 24: 283-288.

Rowley, J. 1995 Planning for effective information systems. Information Management and Technology, 28: 39-40.

Schmidt, G. AKAD Arbeitsheft Organisationslehre, Lektion 1. AKAD, Stuttgart, 40p.

Senn, J. A. 1991 User involvement as a factor in information systems success: key questions for research. Journal of Management Systems, 3: 31-40.

Sethi, V., Hwang, K.T. and Pegels, C.C. 1993 Information technology and organizational performance. Information and Management, 25: 193-206.

Stahlknecht, P. 1993 Einführung in die Wirtschaftinformatik. Springer, Berlin, Heidelberg, 536p.

Szewczak, E.J. 1991 Evaluating the impacts of information technology in organizational systems. *In:* Szewczak, E.J., Snodgrass, C. and Khosrowpour, M. (eds.) Management impacts of information technology: perspectives on organizational change and growth, 25-47. Idea Group Pub, Harrisburg.

The, L. 1993 Project management software that is IS Friendly. Datamation, 39: 55-58.

Vogel, N. 1994 Von der funktionalen Gliederung zum Projektmanagement. Beschaffung Aktuell, Mar.: 45-48.

Ward, J.A. 1994 Productivity through project management: controlling the project variables. Information Systems Management, Winter: 16-21.

Wiggins, B. 1994 What do we really mean by information management? How can you make success of it? Information Management and Technology, 27: 162-168.