ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHOOL OF INFORMATION STUDIES FOR AFRICA

RESEARCH ACTIVITIES INFORMATION SYSTEM FOR ADDIS ABABA UNIVERSITY: A PROTOTYPE

A Thesis Submitted in Partial
Fulfillment of the Requirement
For the Degree of Masters of Science
In Information Science

By

KIBRUYISFA DEBEBE

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Ato Getachew Birru, Chairman, Examining Board

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DEDICATION

This thesis is dedicated
to
my mother

Zenebech Woldeamanuel
(Bezash)

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ABSTRACT

This thesis discusses the development of an information system designed for collecting summarizing and presenting information on research and research related activities of the Addis Ababa University (AAU). Research activities made at the various Faculties, Departments and Research units are monitored and managed by central bodies - mainly the Research and Publications Office (RPO). Records on research and publication activities are handled in manual methods in this office, as well as, at the remaining research Units. Unavailability of an organized computer based Research Information System in the University created challenges for researchers in accessing research information; and also for the administrative bodies in planning & managing research activities; monitoring of research progress & fund utilization; in producing summarized periodic activity reports, as well as in providing research information timely and easily. As a result this study is conducted.

The study documents what and how the existing system carries out its activities, identifies problems, requirements and set objectives to be met by the required system. Experiences of other systems in similar environment have been reviewed, evaluated and the structure of the system that is closer to the system under study is partially adapted for Entity Relationship Modeling. The system proposed as a solution to the identified problems is made to model the information/data requirements of the users. This system is designed to support managing and monitoring of research activities & research outputs and reporting on these activities, in two sub systems - Project Sub System and Publication Sub System.

Attempt is also made to demonstrate, through prototyping, how the proposed solutions overcome the major problems of the current system.

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LIST OF ABBREVIATIONS

AAU:	Addis Ababa University
CASIS:	Consortium of African Schools of Information Science
ESTC:	Ethiopian Science and Technology Commission
FIC:	Financial Information Center
IDR:	Institute of Development Research
IER:	Institute of Educational Research
IES:	Institute of Ethiopian Studies
ILRI:	International Livestock Research Institute
IPB:	Institute of Pathobiology
NUFU:	Norwegian Universities Committee for Development Research and Education
PADIS:	Pan-African Development Information System
RAIS:	Research Activities Information System
RPMS:	Research and Publications Monitoring System
SRPC:	Senate Research and Publications Committee
RPO:	Research and Publications Office
SAREC:	Swedish Agency For Research Cooperation for Developing Countries
SGS:	School of Graduate Studies
SIDA:	Swedish International Development Agency
SISA:	School of Information Studies for Africa
UCAA:	University College of Addis Ababa
UICP:	University-Industry Cooperation Program
WHO:	World Health Organization

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Establishment of AAU and Early Development of Research Activities

The existence of research and researchers in Ethiopia, a country with an ancient civilization, could be traced back to the time when foreigners began coming to Ethiopia. However, it is believed that research received an impetus with the establishment of modern education in the country, mainly at primary and secondary levels, in the early twentieth century.

This impetus was strengthened by the foundation of post-secondary institutions. The foundation of the University College of Addis Ababa (U.C.A.A.) in 1950 was, in this context, an important event. However, in the early days of its establishment, the college, like the earlier-established Ethiopian Secondary Schools, was not geared to involving students in research. Also there was little teaching about Ethiopia, for the simple reason that the teachers themselves knew little about the country. (Pankhurst 1990, 12).

In 1961, the Haile Sellasie I University (later to be called Addis Ababa University) was founded and its Faculties of Arts, Education and Science were formed. Due to the fact that students were not being taught in depth about the Ethiopian situations, they not well prepared to satisfy the manpower needs of the country. To change this trend, specialization courses come to be offered in places of the general liberal arts course. New Departments were opened to make this possible (Merid 1988, xxvi).

CHAPTER ONE

INTRODUCTION

1.1 Background

Establishment of AAU and Early Development of Research Activities

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Students of the Faculties of Arts, Education, and Law, and the School of Social Work were required to produce term papers and original research theses in partial fulfillment for the requirements for graduation. These essays become notable not only for their originality, but also for their depth of analysis in terms of relevance to Ethiopian issues and developments (Merid 1988, xxvi).

Addis Ababa University (AAU) which is the largest and the oldest (early established) University in Ethiopia holds about 13 Faculties/colleges and four Research Institutes. The initial structure for research undertaking of AAU was laid in the early 1960s with the founding of the Institute of Ethiopian Studies (IES). Two more, the Institute of Pathobiology (IPB) and the Institute of Development research (IDR) followed in the early seventies. The Institute of Educational Research (IER) was founded in 1984.

Research Setup at AAU

In 1971 the University saw the need to strengthen research administration and decided to set up an Office of Associate Vice-president for Research and Publications. Further organization of this Office in 1978 led to its designation as the Office of Research and Publications, headed by an officer appointed by the President of the University.

An Important body that is responsible for the development of research policy, guidance, leadership and management is the Senate standing Committee on Research and Publications (SRPC). This committee consists of the Dean of School of Graduate Studies (SGS); the Research and Publications Officer (who acts as a chairman and Secretary of the Committee, respectively) and seven representatives from various Faculties elected by the senate. The principal functions of the SRPC are:

- Oversee the research activities to Faculties and Research Institutes;

- initiate policies to develop suitable organization and efficient management of research in the University;
- review and approve proposals of research projects and teaching material preparation coming from Faculties and Research Institutes;
- examine and approve application of visiting scholars/researchers from various Universities/institutions of different countries in the world.

The current policy of the University provides that each Department can allocate 25% of the total staff time for research. Faculty members are also allowed six months of paid research leave every four years and one calendar year of paid sabbatical leave every seven years. Almost all Faculties/Departments and Institutes in the University had been and currently are undertaking research projects in different disciplines.

Research activities of the University are financed both through internal (Government) and external grants and donors. The internal fund is very limited to cover research projects and it is usually used to cover recurrent expenses of the Research Institutes. For example, the annual budget of RPO and the four Research Institutes (IDR, IER, IES, and IPB) is less than 1.4 million Ethiopian Birr. Therefore, grants and other assistance from international agencies and other bilateral foreign donors normally cover majority of research activities carried out by the Institutes. The total grant from Government fund allocated for 988 approved projects for twenty years (1977-1996), for example, is approximately 4 million Birr, out of which, about 1.6 million Birr is for 402 research projects, and the remaining goes to teaching material preparation, journal/proceeding publishing, workshop/conference/seminar organization and other activities. When we see the grant obtained from external Grantors, more than 20 million

Birr was granted for the four Institutes, and about 53 million Birr obtained for the other Faculties within four years (1990-1994).

The School of Graduate Studies

A combination of factors prompted AAU to launch graduate studies in 1978/79 academic year. Among the reasons that necessitated the launching of graduate programs, the desire to stimulate research in the context of graduate studies can be cited as being the major one.

The graduate program, which was initially started with only eight department programs, all of which were at the Master's degree level, now covers 44 Departments - 38 programs of study at the Master's and Medical Specialty and 6 at Ph.D. degree levels - offered in 8 Faculties.

The number of papers published from Departments with graduate programs has significantly increased. The graduate programs have also contributed to research output directly. At present, over 1400 M.Sc. research and 15 Ph. D projects are completed and about 200 M Sc. & Ph. D projects are ongoing (Endashaw, 1996).

Organization and Activities of the RPO

Research proposals get final approval from the Senate Research & Publication Committee (SRPC) after reviewed and evaluated by the RPO. This procedure is required, for proposals to be submitted to external funding agencies also. In practice, however, this is rarely followed. Researchers are also expected to report the progress of the project at least annually, and to submit output reports/summary at completion. The Research and Publications Office is staffed with the Officer, Administrator for Technical and Financial Affairs, a senior Librarian, two Secretaries, two messengers, and a driver.

Publications

Dissemination of research information on research results is done through seminars, symposia, workshops, occasional reports, and the publications in scholarly journals. There are about ten reputable journals, currently being sponsored and published under the AAU in collaboration with other organizations and professional associations.

Research activities made at the various units of the University are not properly recorded. Especially when we come to externally funded projects; there is a little chance of getting complete statistical summary or other information. This is partially because some of the projects are funded directly to the Institutes, bypassing the expected procedure. Even those projects, which are registered at the RPO, are not systematically organized. In order to get statistical information such as the total number of completed and/or ongoing projects by their Institutes, Faculties, department, duration, funding body, etc., one has to examine different tables, figures, or parts of the few publications (yearbooks) of RPO and compile the data. Moreover, there is inconsistency between data obtained from the different parts of the mentioned data sources. However it was tried to provide, at least, partial information on Government funded projects.[1]

From what is available, it was found that 69 research projects have been approved and funded internally in the four Research Institutes since 1977-1996, and the total number of projects in the Faculties/Schools/Colleges of the University in the mentioned years were 402. This figure includes Three Colleges and One University that were under the University, but currently are autonomous.

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[1] The Sources For The Figures In This Section Are:
RPO Year Book, 1994; Endashaw 1995, 1996

Up until July 1996, the total numbers of registered externally funded projects were only thirty-eight. Out of which twelve were completed, four discontinued and twenty-two ongoing. Twenty-three of these projects were funded by SAREC; 3 by NUFU; and 2 by WHO. But these figures represent only the registered projects and there is a possibility of big fallacy when it comes to the actual statistics. The Bi-Annual AAU Research Book (Endashaw, 1996) provided relatively better and nearly complete data on 20 years of research activities at AAU. Nevertheless, there still are discrepancies of the total figures given in tables and the listed project titles. To support this idea, three Faculties (out of the thirteen) and one of the four Research Institutes have been selected from the mentioned book and their lists of ongoing projects only tallied; and, it was found out that 173 of the 207 current projects are externally funded.

Collaboration with other Institutions

AAU has entered into cooperation programs and research collaborations with foreign institutions of higher learning and with national Government ministries and institutions. One of the significant mechanisms for cooperation with national institutions outside the University was the University-Industry Cooperation Program (UICP) whose secretariat had been located within the Office of the Research and Publications Office (RPO). The program had been dismantled, since 1990, due to a change in the Government policy. However, efforts, to restructure, define functions and responsibilities of UICP, are taking place.

The major type of activities that are supported by the RPO include the following

- research endeavors and consultancy work
- preparation of teaching materials

- production of journals, proceedings and other scholarly publications,
- organization of seminars, workshops , conferences, symposia, etc.
- organization of bilateral and multilateral arrangements to get funds and conduct research programs in Addis Ababa University. The Office is responsible for any official signatories and activities on behalf of the University.
- Admitting visiting scholar, and other research related activities

1.2 Statement of the Problem and Justification

Information is a strategic resource that is critical to all levels, sectors, and endeavours of society, including development. The importance of information for rapid social and economic development of a country had long been recognized. (Unesco, 1976; Kuznets, 1966)

One of the major concerns of Third World countries these days is to devise an effective strategy for the development of their society. To achieve this purpose, a number of national and international institutions and groups are established and are working on the topic. Among the various responsible institutions, Research & Development Institutions take the major role in identifying the existing development problems and designing future strategies.

Researchers have a responsibility of carrying out studies whose findings should influence policies and enable planners and decision makers come up with decisions and policies based on sound and timely facts. Being one of the most important development activities, research has to be supported by efficient information services to achieve its objectives, like any development activity. The nature of research activities is information intensive. It involves information inputs at all levels of the research process. In the absence of information, unnecessary duplication of research work may take place. This is expensive in terms of resources spent on rediscovering the same facts. Scientists, researchers, planners, etc. need information to:

- Stimulate thought and action by injection and interaction with other people's ideas, knowledge, experience and achievements;

- Promote continuous awareness of what others are doing so that they may know of developments in their own special fields, and in wider fields such as discipline, or technology;
- Diminish the probability of unwitting duplication of work and to save time and effort. (Atherton, 1977)

To all of the concerned entities, information is unquestionably a vital resource to achieve their objectives.

Access to information is a critical factor to the success of individual members or all sectors of society. For information to have some value, it has to be used. Thompson (1991) explained the necessity of dissemination and utilization of information as: "while it is recognized that the purpose of research is to produce knowledge, it has been postulated, that, much more knowledge required for development is already available than is likely to be produced any time soon. And thus, it is dissemination and utilization of information that has a direct impact on development, rather than, production of new information." However, most often developing countries have no systematic programs for the collection, analysis and dissemination of available information. And the potential users, the individual and institutional decision-makers, scientists, researchers remain unaware of the existence of relevant information. And the quality of their decision may be poor (Boadi, 1987).

The world today is in the midst of information overload. The hard-copy explosion and lack of an efficient information system to capture, process and disseminate information to its users would lead to waste of a large quantity of information and the time of the staff of organisations (Parsaye, 1989).

To exploit the maximum value of information, it should be managed beginning at the level of the individual, the group, the organisation, the country etc. Managing information resources implies,

providing timely and accurate information, which is, relevant to the needs of users and the objective of the organisation. For this purpose the information users and their needs should be identified, and a system which address their actual need in efficient and convenient ways, should be designed.

In Africa in general, and Ethiopia in particular scientific & technological research activities are being hampered by several factors one of which is access to information. Institutions of higher education like the Addis Ababa University are expected to play significant roles in scientific research and development in their countries. Any research is both producer and consumer of knowledge and information. Availability of research information can result in Capacity of a country to take advantage of locally existing knowledge and "know-how" or which is achieved elsewhere. (Atherton, 1977).

AAU recognizes the undertaking of research as an inseparable component of its teaching and service activities. Therefore, it strives to support the Research System in avoiding its constraints. Several research projects are being undertaken at the scattered Institutes and Faculties of the University. Some of these projects are Government funded while majorities of others are funded through grants obtained by different Faculties and Institutions, directly from other/external-funding agencies.

Furthermore, some other sources are offering research scholarships and grants internally in different Faculties and institutions of the University. The Lakashami Neelameghan Research scholarship and CASIS research grant at the School of Information Studies for Africa (SISA), are examples.

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Funding Agencies, Government or other, require reports on fund utilization, progress of the

project, research outputs (findings), potential researchers for an intended project, and so on. The University needs to monitor its research output, cooperation of institutions, Faculties etc. in multi-disciplinary research, and productivity of the Academic Staff for the purpose of academic promotion. Researchers need to know what has been done in a certain discipline, who is interested in a certain subject field, who are the potential partners for a joint project, and so on.

The distribution of research projects in different Research Institutes, Departments and Faculties, and the diversity of funding agencies, together with other factors created challenges to the Research System of the University. The following are some of these challenges. (Endashaw, 1995).

- Research activities are being undertaken independently by different Departments, Faculties or institutions.
- Controlling funding activities on different researches done by various institutions, Departments and Faculties is difficult.
- Multi-disciplinary research programs are not being undertaken and co-ordinated or integrated because of the developing traditions of academic individualism, departmental independence. This can result in duplication of efforts, mismanagement and wastage of manpower and resources.
- Relevance and originality of projected projects is not assured through research information and compilation systems.
- Review of research outputs is not easily and periodically done, this may lead to duplication, poor research planning and management (longer lifetime of research development).
- Suitable infrastructure for communication networks and AAU's research results documentation is extremely underdeveloped.

- Clear research policies, priorities and R&D oriented administration are absent.
- Evaluation of Research performance through bibliometric publication and citation analysis is difficult (untried); and,
- Information on research being conducted by scattered Institutions is extremely scanty. Information collection at AAU is haphazard and no comprehensive database is available on the ongoing and completed research.

In general the Research System in the University is suffering from problems of controlling, coordinating and monitoring research activities and fund utilization, planing and effective dissemination and adaptation of research findings.

In addition, researchers (students as well as academic staff) find it very difficult to assess whether there has been any work similar or related to a given research topic.

All the above-discussed points are indicative to the absence of effective information management and easy access to research information. Therefore, research activities of the University and potential benefits of the country are affected.

Recognizing this fact, the Research and Publications Officer, Professor Endashaw Bekele, had stated : "There is a need to know what research projects are being carried out, what do they lead to, where do they take place, when are they likely to be completed and their expected findings. There is a further need to know which personnel are involved in what, their capability, etc. It shows that the importance of managing research information at AAU has been weak and leads to weak planning, monitoring and evaluation of research programs." (Endashaw, 1995).

Furthermore, at the present stage of development in information technology (IT), availability

of computerized information systems has a crucial importance for providing value added and users' need oriented information services. Information Technology is one facility that information systems can not afford to ignore in this era of information revolution.

From what is emphasized so far, one can see the importance of a Research Activities Information System (RAIS) which shall improve the existing information services through:

- Identifying, capturing, organizing and disseminating research activities information which can be of interest to the academic/research community, and providing enhanced information services that address the needs of users;
- supporting the research activities monitoring process of the University through providing easy access to information on research and funding activities from different perspectives;
- facilitating resource sharing among the different Research Institutes, Faculties and Offices; and, creating easy and convenient access to research activities information;
- Centrally coordinating and standardizing database (system) structures for information storage, retrieval and exchange, reducing repeated efforts.

1.3. Objectives of the Study

In general, the objective of this research is to propose a plan for the establishment of an Information System that would support research activities at AAU by facilitating access to relevant research information by researchers, teachers, managers, and all those who are concerned with the undertaking of academic/scholarly or scientific research.

In order to achieve the general objective, the study particularly aims:

- to analyze the current practices followed in handling information on research activities at AAU, with the aim of identifying user requirements;

under study, and their influence on the design of the proposed system are also indicated. Table 1 presents short descriptions of these systems.

Information Systems in general are designed to achieve two categories of objective, according to Wall (1992), these are functional and performance. The functional objectives are those concerned with what the system does for the user while the performance objective have to do with how will the activities, designed to meet users' needs, are performed.

The general nature of the research environment creates the need for enhanced information services for researchers because, factors in the research environment limit access to information. Krause (1994) argued that: although researchers are different from one another, many of them can be characterized as: - independent/autonomous/multifaceted, too much to do and not enough time in which to do it; driven by deadlines; often very limited in or totally lacking support staff; focused on specific interests, which require detailed information; in need of prompt access to information; operating from multiple locations.

The other factor, which limits access to information, according to Krause, is the ability to synthesize diverse information from many sources and different media into a concise and usable format. Even if the required information is available, retrieval may be difficult due to inconsistency of format. Information that is not organized in a manner specifically designed to aid retrieval add a barrier to access and unnecessary time to the process of getting to it.

Duncan, et. al. (1993); also listed the following points as common to any research environment as.

- The number of projects requiring collaboration across disciplines and organizations are growing; and this implies that, researchers need mechanisms for locating and communicating with potential partners.

- In multi-disciplinary research, sources of information are very diverse. Users need assistance in finding and accessing information and information sources.
- Access must be convenient . Users are less likely to use existing information sources if they have to leave their offices and/or if the process of obtaining that information is difficult or disruptive to the normal workflow.

Atherton (1977: 7, 11) agreed to the above points saying, " the working habits of the individual needing information, the importance placed on getting it, the facilities available for seeking it, the knowledge about these facilities, the judgment of their value... may affect information-seeking behavior." Further emphasizing the point she argued that " access to precise and reliable information at the right time, to the right person in a form most conveniently usable by him/her can help to minimize the wastage of resources due to unnecessary and unintended reinvention, rediscovery, redevelopment".

In their paper, Duncan, et al examined the information use pattern of engineers and scientists to identify the mechanisms of access-to and use-of information by NASA's researchers. The paper highlights how information requirements of users was formulated, and argues why traditional Scientific and Technical Information (STI) mechanisms could not serve user's requirements. The authors argue that, although their prototype is domain specific (supporting NASA scientists and engineers in R & D activities), the information architecture can be applied to other audiences.

The Manual on 'productive R&D Scientific, Technical and Management information Systems' prepared by FAMESA (Financial Management of Research Projects in Eastern & Southern Africa, 1992) provides guidelines to managers of R&D Institutes in Africa. The Manual discusses strategies and methods for effective communication of research results. It

also introduces managers of R&D Institutes to the methods of identifying, selecting, acquiring and processing information for R&D. To give an emphasis on the need for various types of information Systems, the manual describes the design and application of these systems in R&D institutions. The manual is general in coverage and more directed to planning and managing research activities.

Table 1: Representative table for researching information systems developed in other universities

Title	Purpose and Application Area	Relations and Differences to the System under study	Influences on the design
A Research Information System for Baylor College of Medicine	Providing current awareness service to distributed researchers of a single medical faculty	The system boundaries, the technological infrastructure and the scope are different	None
Current Research Information System (CRIS)	To provide Research information on ongoing projects on a National Agriculture Institutes Network as well as the Internet	The purpose of this system is similar to our system, however, monitoring and management part is omitted	Some screens of the user interface and access opines are adapted for the prototype
An Integrated Research Information System at the National University of Singapore	A university wide system planned to serve both the academic and administrative community	The objective and the domain area are similar to the existing system. The scope is broader and the administrative structure of the two systems is different	The E-R Data Model of this system provided an insight for identifying some entities and relationships at the analysis stage of the study

1.7. Organization of the Thesis

The thesis is organized into six chapters. Chapter one provides background information on the research environment, statement of the problem and justification, objectives, methodology, scope and limitations of the thesis, and literature review. In chapter two the main body of the thesis begins, where, the analysis of the existing system are discussed, applying the tools and techniques used in system work. This chapter attempts to investigate the activities of the current system, the problems and limitations of the system and its information requirements. In chapter three, alternative solutions for the existing problems have been discussed.

Conceptual design of the proposed solution are also handled in this chapter, and the data flow diagram of the proposed (required) system are presented. Logical data base design have been given detailed coverage in chapter four. The required logical data model is developed using Entity-Relationship Modeling, and Relational Data Analysis is also applied to transform the data model into relational database model. Chapter five highlights features of the prototype system that is developed to demonstrate some of the functions of the proposed system.. The last chapter is on the overall aspects of the information support system. It concludes the presentation of the work putting forward some recommendations.

CHAPTER TWO

ANALYSIS OF THE CURRENT RESEARCH AND PUBLICATIONS SYSTEM

2.1. *Introduction*

The key ingredients in planning organizational information systems and in implementing applications, as well as in including databases, are correct and complete information requirements (Davis and Oslon, 1984). In order that an information system can meet the needs of its users, the strategies, rules, procedures, and behaviors of individuals within the organization acting shall determine the requirements for the information system individually and collectively.

Analyzing the existing system is one of the major activities required in information system development process. The analysis activity is, simply, studying the existing system closely on the aim of identifying and clearly establishing problems and requirements of the existing system and coming up with realistic propositions as solutions to the identified problems.

To have a good understanding of the system and to propose solutions, facts have to be gathered through all the necessary techniques and tools of information/data gathering, such as asking (using interview or questionnaire) key people in the system, examining important documents, and so on.

In line with the above principle, for this study, the necessary facts were collected through asking using both interviews and questionnaires, examining various publications reports and revising forms, letters, rules, regulations, policies etc. Formal structured interviews as well as

informal follow-up discussions were made with Officers, Managers, Administrators, and other operational personnel including secretaries. The interviewee list and interview Guide are attached in appendix.

The following sections present findings obtained through the above mentioned procedures and techniques. Emphasis is given to documenting the activities of the existing system - what and how the system functions.

2.2. *The Current System*

The mission of Addis Ababa University is to contribute to resolving the basic development problems of the country (AAU, 1994). This entails the objective of producing skilled and highly trained manpower, contribution to knowledge, scientific and technological development, utilizing research and innovation; conducting applied research and consultancy, to identify and solve problems and contribute to socio-economic development & environmental protection and so forth. To actualize this, the Research and Publications System is structured into Research Institutes, Academic Faculties/Schools, ... which do the research; and different offices, committees, boards, etc. that administer and monitor research activities.

As indicated in the earlier chapter, the responsibility of monitoring research activities mainly falls upon two focal points RPO and SGS.

RPO is concerned with all research and research related activities other than thesis (dissertation) research. The Office approves grant to research and related activities for Government funded projects, of course with endorsement from the SRPC, authorizes payment for externally funded projects, process overhead charges, approve admission of visiting scholars, distribute consultancy income, follow up project progress, review research outputs and disseminate research information.

The Office keeps Project Proposals, Grant Applications, Approved Grant Documents, Memorandums of Understanding, Collaboration Agreements, Reports, Publications, and any information related to Projects and Grant. All activities of the Office, except word processing, are done manually.

The Office also maintains four accounts at the University Finance Department- General Research Fund Account, Special Research Fund Account, Consultancy Account and Book Sales Account. Grant for internally funded projects is charged, principally, from the General Research Fund Account, and on conditions from all the remaining accounts but the Special Fund.

Reference number, Project Name and Project Investigator identify these projects. Individual projects do not have a separate Account.

Grant for externally funded projects is transferred to the Special Fund Account from the Grantor, and then distributed to each individual project account, under the Project Title; and the Account Number identifies the Project.

At the end of each budget year, annual reports are generated. Fund utilization report, on projects funded externally through the Ethiopian Science and Technology Commission (ESTC), are produced to the Commission , at the end of the Gregorian Calendar year.

The Office has close interaction with the University Finance Department/ the Financial Information Center (FIC). It is to this department all the payment requests/orders are passed to, and this Department assumes the responsibility of handling all financial transactions (paying, receiving, transferring, settling account, etc.), and reporting financial status upon request, and preparing annual Financial Statements.

The other interacting bodies are presented in the Context DFD – (Figure 1.)

Detailed description of the existing system in terms of the major entities involved in the activities of the system, is presented in the following sections, Major Activities/Processes in the system are also identified.

2.2.1. Project Proposal

Sources of Project. Projects all originate from Academic/Research Unit, i.e. from Departments, Faculties or Research Institutes. A project can be Research Project, Consultancy, Teaching Materials Preparation, Journal/Proceedings Publishing or Conference/Workshop/Seminar Organising. All types of the mentioned projects are funded either internally from Government or from external sources or from both.

Processing of Project Proposals: A Research Unit revises and approves proposals and pass them with minutes of approval/recommendation to RPO (which is to be referred as 'the Office' from now on). After, further review, the Officer approves the proposal and requests the Research Unit to complete Grant Data Sheets (for externally funded projects). This sheets has two parts - One to be filled in by the project investigator and to be authorized by the Research Unit, and the other, which is similar to the first, is to be filled by the Office. For internally funded projects, a letter, which authorize the requested grant, are prepared by the Office. Both the forms and the letters are passed to the FIC, and copies of the letter are also sent to the project leader and the Research Unit.

Information to be filled in the two forms and the letter is obtained from the following sources.

- Project Proposal (History) file. This file stores project proposals, and the actions (decisions) made on them. Meaning, minutes of approval from Departments or Faculties, minutes of the SRPC on approving grant and any information relating to the project approval/rejection.

- Grant Data File: keeps records of every external grant obtained for each project.

Externally funded projects are required to fill Grant Data Sheets/Forms regarding every detail of the Grant, and these sheets are kept in the Grant Data File. Life span of a project and amount of overhead charges are determined using this file. That is, expire date of the Grant tells the project life span and the grant amount decides percentage of the overhead charge.

- Reading File (Project Transaction File): This file holds all outgoing letters or other documents related to Projects. It is categorised into two - Financial and Others. Letters written to the FIC to authorise payment for every transaction are stored in the Financial Reading file separately. It serves as a source not only for new proposals but also for those proposals, which request fund extension or renewal.
- Consultancy Policy: For Consultancy income proportioning, the ratios per University, Faculty, Department, Research Institute and Researchers are used from this policy sheet.
- For Projects Funded by certain external sources (like SIDA/SAREC) and from Consultancy income, 5% overhead charge is made when the Grant Amount <= 1 million Birr and 7%, for when it is more.

2.2.2. Grant

Grant is defined, as an amount of many which is committed to finance a research project, research-related projects and a Consultancy work. For projects funded from government budget, payment authorisation letters are send to the Financial Information Centre (FIC) and copies of the letters are given to the project investigator and the Research Unit. The letter includes Reference No. Project's Name (Title), Total Amount of Grant, Amount of Transaction, Account Number to be charged, Project Investigator (leader), Dates of Instalments, Data of Expire (usually last date of the Budget year).

In the case of externally funded projects, a request of fund Transfer is send to the source of Grant (Grantor), and the above procedures are repeated. However, in this case the total Grant Amount

is transferred to one or every project's account which is granted, and this account number uniquely identifies the project.

2.2.3 Identifying Processes

Description of the functions of the existing system and the document (data) flow, in the current system, is presented in the preceding sections. This description indicates the major activities (processes) carried out with in the system boundary. Process represents operations performed on coming in or getting out documents, by the sources or destination of these documents. These operations or (processes) made on the documents lay down a basis for establishing the data flow diagram. The main functions involved in the monitoring of a research project and/or publication outputs are represented as **'processes'** in words and Figures below.

Process 1. Process proposal: This process consists of

1. Accepting project proposals, Checking the project to be new, renewal, extension or ongoing
2. Checking if the project is internally or externally funded, the amount requested and the existing balance
3. Requesting fund transfer for externally funded projects
4. Approving or rejecting a project, opening an account for it, updating and notifying the involved parties with explanation

Similarly Three other major processes and their sub processes are identified. All of the identified processes are represented in Figures 2. Those processes that need explosion to lower levels are also shown in bottom level DFDs in the other succeeding Figures.

2.3 *Modeling the Current RPMS*

2.3.1. System Modeling Tools

In this section, the tools applied to represent what is described in the earlier sections, in a structured way, are presented. These tools are data flow diagrams (DFDs), and entity relationship diagrams (ERDs). ERDs are included in this chapter as a complementary set to DFDs, and they are more used in the succeeding chapters. The conventions and notations used are also described.

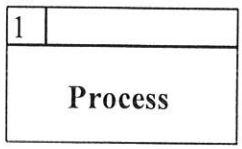
Data Flow Diagrams

Data flow diagrams are appropriate tool in the early stages of analysis and during the production of requirements specification (Green, 1996). Of course there are several structured specification languages which can serve the same purpose. However, the following advantages of DFDs are the reasons for selecting them.

- They are fairly easy to produce
- They can rapidly capture the current and required systems at a number of levels of abstraction;
- Their focus on the flow of information and process within a system give us a complementary view to the data structures of data modelling.

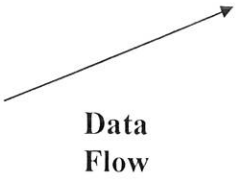
A DFD is constructed from four component elements: process, dataflow, data store and external entity. Different people to represent these components have used several notations. In this paper the below listed notations are used.

♦ **Processes** show what systems do. They have data inputs and produce data outputs. A process is identified by a name (verb plus noun phrase) and a number.

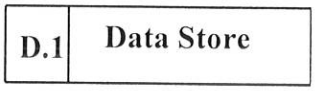


- **Dataflow** between system components is represented by an arrow.

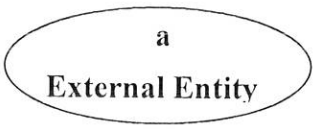
A dataflow is uniquely identified by the label (a noun phrase) of the arrow.



- **A datastore** is a repository of data which might be viewed as a file, entity, collection of information. They are identified by their names (plural noun or noun phrases) and numbers.



- **An external Entity** is something or someone laying outside the context of the system's boundary. Such entities either input data into the system or use system output. External entities are given names using a singular noun.



The following conventions are used in this paper.

When dataflow store/read the whole data store record, these dataflow are not labelled. For example in the figures 'process proposal', stores the whole project record (project detail) in the Proposal File Datastore and 'Generate Report" read the whole record Therefore, the data flows are not labelled.

For bi-directional dataflow of the dame data the flow is represented in a single double headed arrow, and when the data flows into and out of the processes have significant differences two arrows are used, otherwise two labels are written on the arrow. The dataflow into the process is labelled above the double-headed arrow, nearer to the process and the dataflow out of the process is labelled below the arrow and nearer to the datastore.

Entity Relationship Diagrams

Entity Relationship Modelling (ERM) is followed to develop the data model of the current as well as the required systems. Since ERM can be considered to be both an analysis and a design tool, it is applied in this chapter and the next chapters also. Applying this modelling technique, a structured top down approach and progressive refinement of the model to reach to the required details is attempted throughout the next parts of this paper.

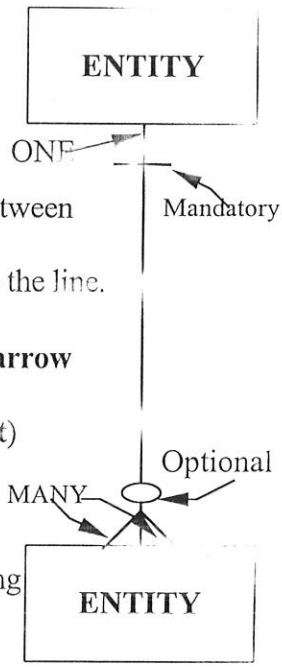
Entity Relationship Diagram (ERD) represents (models) graphically, the major data aspects (Entities) and the relationships between them.

- An Entity is something that has a separate existence and is of interest to the users,

in that, they need to record data about it. Example project, researcher, account.

- A relationship is the interaction of two entities and is represented by a verb.
- Attributes are data elements carried by an entity that describe it and record its state, that is, they are the things we need to know about an entity.

Notations



- **Entities** are represented with a square or rectangle box. The name of the entity is singular and always in capital letters.
- A **line** joining two boxes on the diagram indicates the **relationship** between the two entities. Verbs that describe the relationship are written alongside the line.
- To represent the **cardinality** of relationship between entities a **single arrow head** (straight line) is used for the **'One'** end and **three lines (Crow's foot)** are used for the **'Many'** end, at each end of the relationship (line).

  Participation class of entities in the relationship is also indicated using **ovals** - for optional relationship and **hash** - for mandatory.

2.3.2 The Data Flow Diagram

Figures 1 to 5 show context and the different levels of DFDs of the current system. The data flow diagram in Figure 2 indicates the top level data flows of the existing system. Each top-level process can, be further decomposed into lower level, and /or bottom level processes. Discussion of the bottom level processes is made in the presentation of the existing system under section 2.2. And here, the bottom level processes are represented in DFDs in Figure 3 through Figure 5

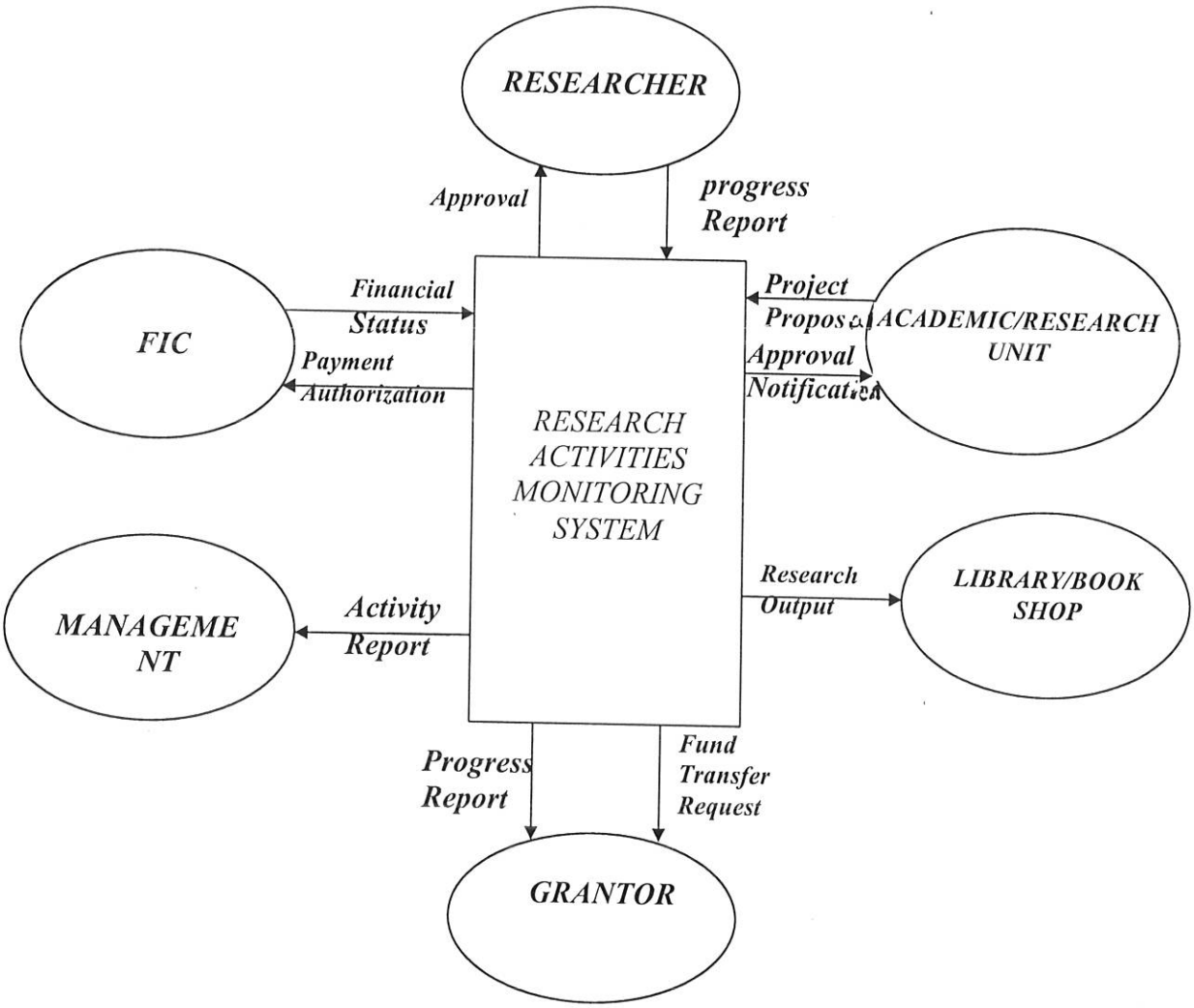


FIG 1: Context Diagram for the Research Activities Monitoring System

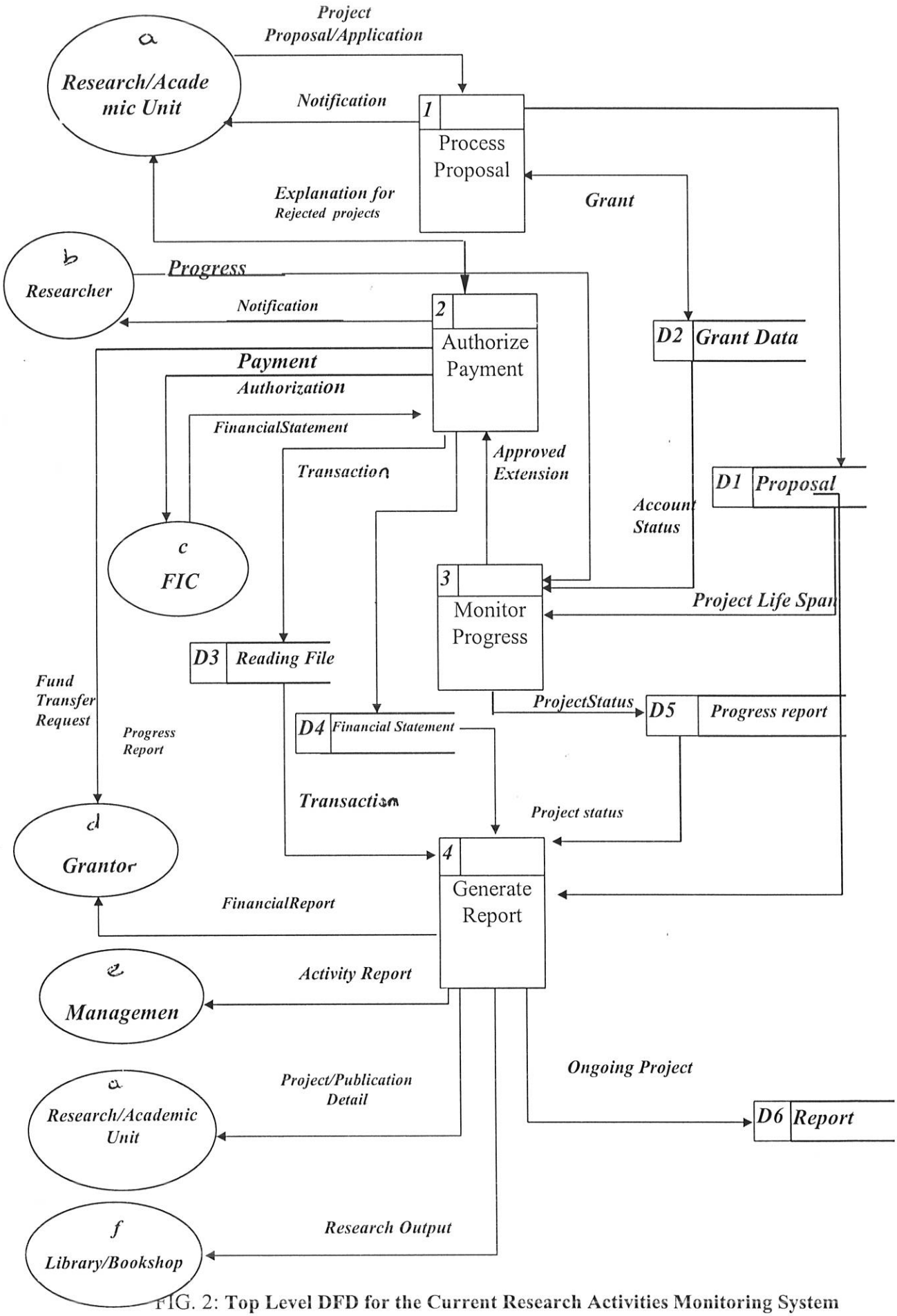


FIG. 2: **Top Level DFD for the Current Research Activities Monitoring System**

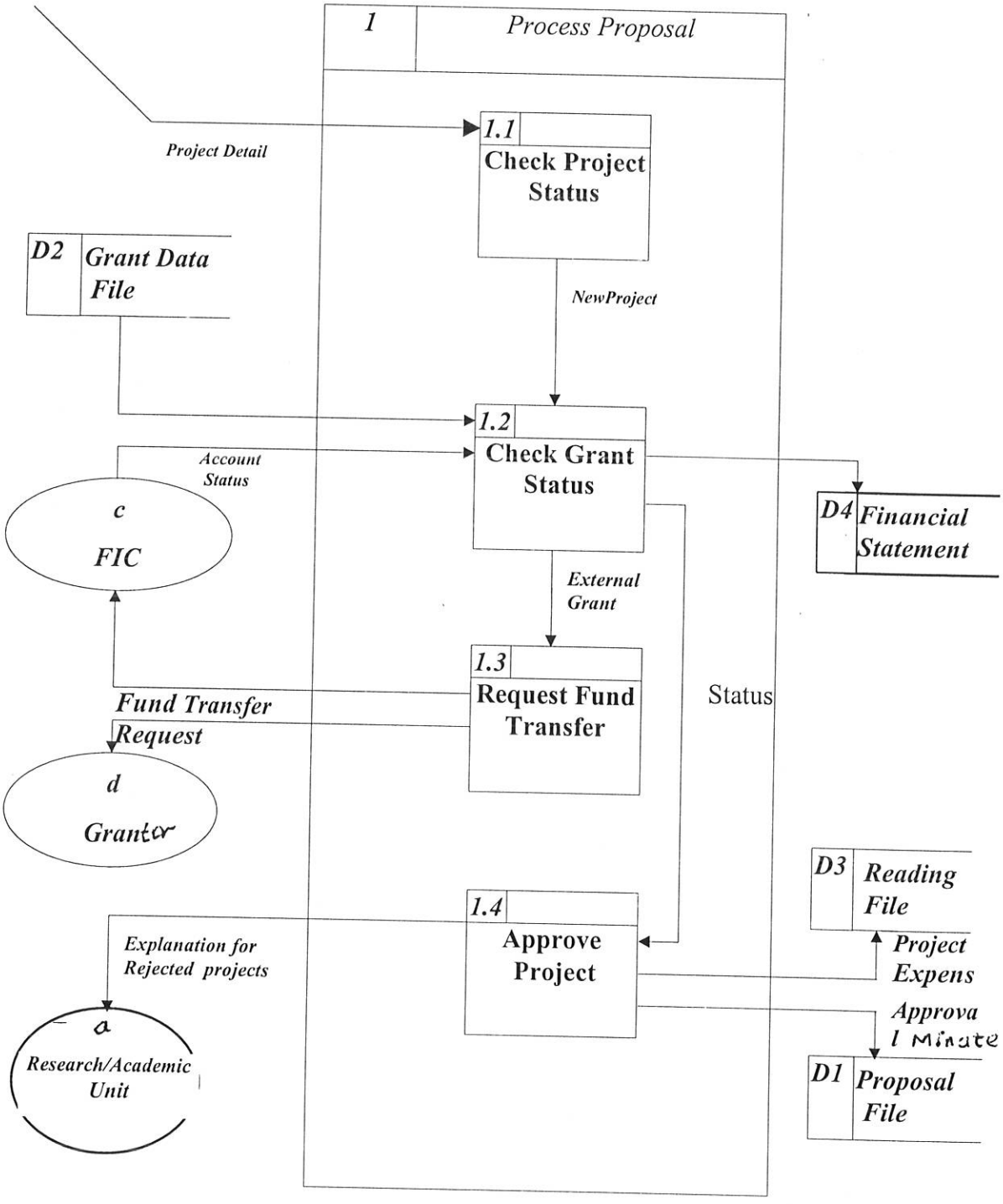


FIG 3: **Explosion of Process No. 1 of The Current System**

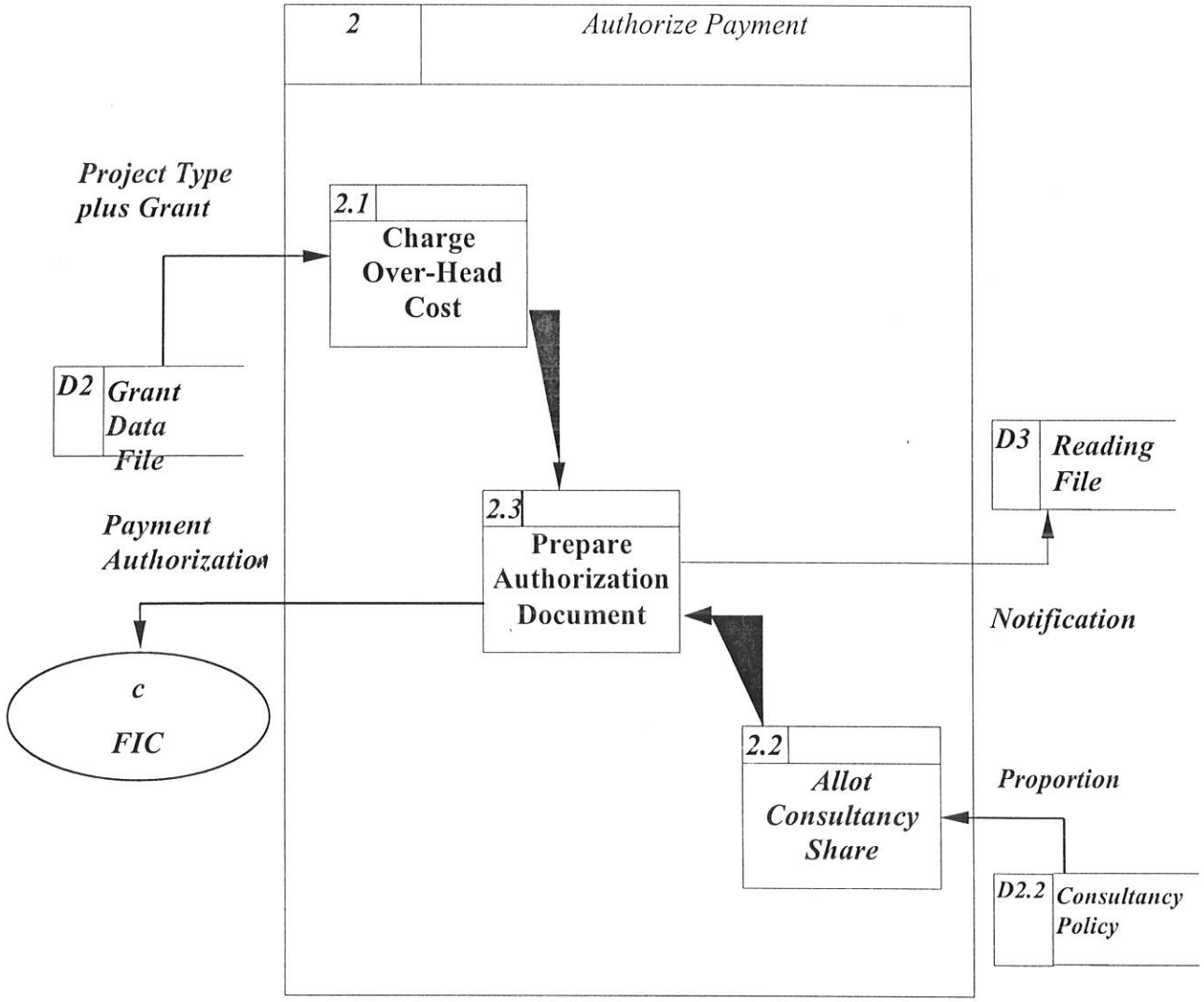


FIG. 4: **Explosion of Process No. 2 of the Current System**

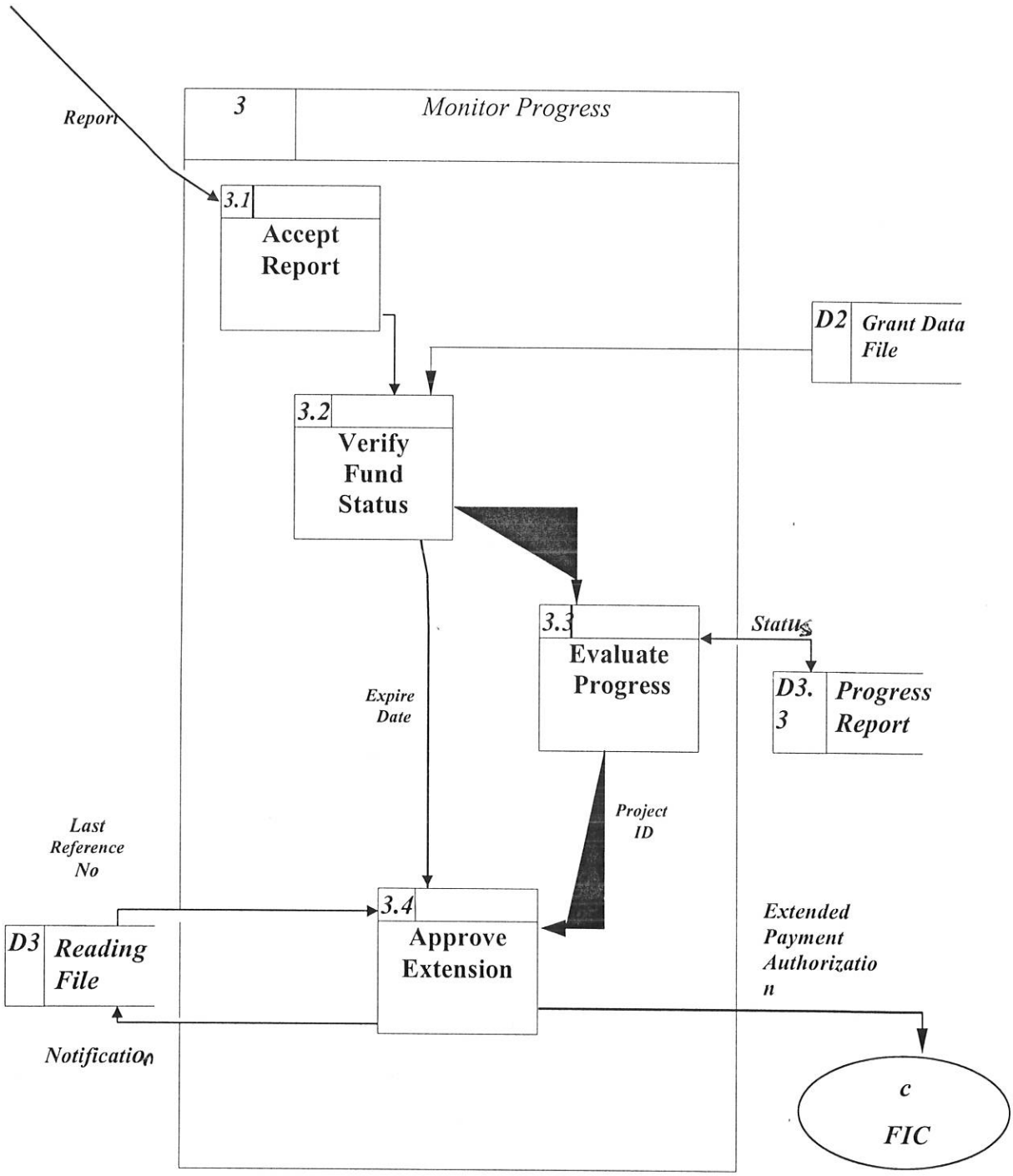


FIG. 5: **Explosion of Process No. 3 of the Current System**

2.4 Problems of the Current System

In the first section of this chapter, the fact gathering tools, methods and sources of the facts were mentioned. Much emphasis was given on collecting data and understanding of the requirements of the system users (the staff of RPO) through interviews and discussions. The requirement identification process is also supported by distributing questionnaires to a limited number of end users (20 researchers and 5 postgraduate students) selected from the four Research Institutes and one Faculty (SISA). Another type of questionnaire is also distributed for the Research Institutes, on the aim of gathering data on the current state of research information services/sources in the University. As it was observed, using the different fact finding tools and techniques, the system users as well as end users of the existing Research Activities Monitoring System face difficulties in accessing organised, summarised, adequate and exhaustive information on current (Ongoing) research activities in a manner which meets their needs and access preferences. Series of interviews and discussions made with the different officials of the current RAMS, including the R&P Officer - Professor Endashaw Bekele, and other operational staff and the analysis made on existing files, forms, and other documents, revealed the above mentioned problems. Furthermore, investigations of these problems is also supported by the questionnaire forwarded to end users (Researchers). The level of information need satisfaction of users and the major problems encountered are summarised from the questionnaire results and presented in the following table.

No.	Problem Areas	No. Of Respondents who Agree	%
1	Existing Research Information services/sources are not well known by users	19	76
2	Lack of Information System and Poor Communication channels are the major reasons for the above problem	19	76
3	Lack of Research Information affects users' research work	25	100
4	There are no established formal ways to access Research Information	20	80
5	The existing information services, sources do not fully satisfy users' information need	22	88
6	Users find it difficult to Access the needed Research Information	18	72
7	The available information is not presented in a summarised way and it is not sufficiently comprehensive to include the relevant parameters	16	64
8	Relevance, Incompleteness and inaccuracy of existing information are the major factors which attribute to users' dissatisfaction	18	72
9	In comparison with similar system outside of the university but with in or outside of the country, the information services/sources available in the current RAMS are inadequate	20	80
	TOTAL NUMBER OF RESPONDENTS	25	

Table 2: Problems of the Current System

In general, problems of the existing system that were identified during the overall assessments of the RAMS, using different tools and techniques can be summarised as follows. The major problems listed below were originally noted in broader terms by the research and publications

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officer (chapter one, section 1.2). Formulating the pre-stated problems from technical and technological aspects and widening the data/information sources, are the major additional tasks involved in the current study. Therefore, what is presented here as well as the next section can be considered as a further confirmation.

* **Organisation of Data:** Available data is not systematically organised and summarised. It is difficult to get: complete information on a certain entity, easily at a certain location. Due to the scattered location of information/data sources a compressive and complete information is not available.
* **Inadequacy, inconsistency and inaccuracy of reports**. RPO, SGS and the Research Units have different reports - at different times, usually on annual basis. From examining some copies of these reports the following points were identified.

- There are considerably large inconsistencies between statistics presented on the same activities in two or more reports. The reports may not be necessarily from different units of the system. Within the same unit itself, for example two consecutively published yearbooks present inconsistent data. Even there are inconsistencies within the same report at different places of presentation. For example regarding the total number of ongoing projects what a table presents and what is listed under each Research Unit are not the same. These inconsistencies get larger and larger when we see detailed breakdown statistics. Such as number of ongoing projects funded by a certain Grantor or amount utilised by these projects, etc.

This problem is related to lack of systematically organised data. One reason for the above mentioned inconsistency is the sources of the reports. For example yearbooks are prepared from project history. Reading file, Progress report file, Agreements file, donors file or Grant Data files. One file may consists the total amount of grant approved for the lifetime of a project, and

an other file may hold expenditure by phase, activity reports may use, as a source, Transaction (Reading) Files, which held amount allowed for the current physical year only. Therefore at their summary both may produce different figures for the same year and the same project.

* **Reports are not exhaustive**. They usually do fail to provide important information on a certain record. For example a report may list ongoing projects having the attributes like title, investigator, fund, grantor, account number. However it doesn't include the date a project was started, when it is going to be completed, what outputs it has so far, and so forth.
* **Retrieval problem:** As mentioned above the current way of information handling does not support the possibility of different access points. This routine and manual work is one of the causes for inconsistency and inadequacy of reports.
* **Access problems:** from what the questionnaire responses indicate, the major problem, which almost all of the respondents agreed to is unavailability or inaccessibility of information/data on ongoing projects. Especially on dissertation/thesis there is almost no information dissemination mechanism. The Office of the Associate Dean for Information Management and Dissemination at the School of Graduate Studies is concerned only on completed theses. Majorities of the Faculties, which run Graduate Programs, do not announce the current Thesis topics even at their notice boards, let alone dissemination in formal media such as newsletters. RPO posts list of ongoing projects on its notice board inside the Office building. However, it doesn't include thesis/dissertation. Moreover, users have to go to the RPO or hear from friends to know of this service. Almost none of the Research Units or the Administrative bodies have periodical publications like Newsletters (except their yearbooks) to disseminate research information (The Newsletters of SISA and some others units are discontinued).

From the discussions made with the users and from the personal observations, the major factors, which contribute to the inability of the system to meet user requirements, are:

⇒ **Manual methods**: the recording, filing, processing and controlling of research activities related information is all done manually. Computers are used for word-processing purposes; i.e. typing letters or writing manually prepared reports. Retrieving a required information from the unorganised bulky manual files is very difficult and time consuming. Specially compiling a comprehensive report that covers more than one year is a 'project work'. For example bibliographic compilation of research projects and publications, and preparation of Dissertations Abstracts had been made in two research projects funded from the Government, and they took more than 2 years to be completed. Had there been a computerised system these could have been immediate outputs of a few search queries.

⇒ **Lack of Centrally Co-ordinated and Organised System:** The different Research Units separately handle their own information. Therefore, it is difficult to access information at one place; rather consulting every Research Unit is required.

⇒ **Lack of skilled information personnel.** Almost all of the Research Units (Institutes schools or Offices) have separate Documentation Centres/Libraries. Nevertheless, the libraries are mainly limited to shelving and issuing their stack only. In any of the units there are no personnel who are assigned to systematically handle research activity information. The school of Graduate Studies holds the above-mentioned Office for information dissemination and management, headed by an associate dean. What the Office does is preparing annual reports, financial reports, abstracts etc. of the completed theses/dissertations. Nothing is done regarding ongoing theses or dissertations. Almost all units have enough computer facilities; however, not a single computer is dedicated for storing organising and systematically handling research information, except for writing reports.

2.5. *Main Requirements of the Research and Publications Monitoring System (RPMS)*

Somerville (1992, cited in Green 1996: 135) proposed that there are three basic levels of specification requiring different levels of abstraction.

1. Requirement definition is a statement in natural language of what user services the system is expected to provide.
2. Requirement specification or functions specification is a structured document which details required system services.
3. Software specification or design specification is an abstract description of the software that is the basis of systems design and implementation.

In this section the first level of requirement specification is presented using statements. The second and third levels are handled in the next two chapters respectively. A summary of the major requirements identified from the system users during the fact gathering process is provided below.

⇒ Generation of various periodical activity reports are required.

⇒ Automatic compilation of bibliographic records of the different entities (publications as well as projects) in different formats is required for the purpose of monitoring staff/University research output.

⇒ Ability to duplicate incoming information into different outputs (forms) is also required.

⇒ Ability to retrieve financial, bibliographic or other information through various access points.

- Summary list of ongoing projects
- Ability to determine status of projects
- Ability to recall progress reporting time of projects.

- Ability to automatically determine status of Grant, account balance, date of expire.
- Ability to compute Consultancy income shares and overhead charges.

⇒ Ability to generate several correspondences to several destinations

⇒ Computer stores ongoing project data and bibliographic detail of published outputs

⇒ Project details to be kept until published or five years from date of completion.

⇒ Publications details to be kept until recorded in CD-ROM or five years.

CHAPTER THREE

PROPOSED INFORMATION SYSTEM DESIGN

3.1. Introduction

Developing an information system requires identifying problems, defining requirements and specifying the defined requirements in structured manner so that a better system that can solve the problems would be designed based on these requirements. In the last chapter problem identification and requirement definition have been handled at the conceptual level. This chapter begins the initial stages of solving the problems of the current system through further specifying information requirements and proposing probable solutions. Logical model of the required system is presented graphically and description of the components of the required system is provided.

3.2. The Proposed System

3.2.1. Main Objectives

On the basis of the preliminary specified requirements of the users, the following objectives are identified for consideration in the design of an automated solution to the identified problems.

The basic objective of the proposed system is to create fast and easy access to research related information from different access points and in different formats. Specifically, the system would:

- Improve timely access to ongoing research activities information
- Completeness in research information through including all the important and required data items.
- Fast retrieval of frequently required information, such as grant financial status.
- improved quality of reports
- provision of various access points to records
- Periodical compilation of bibliographies and abstracts.

3.2.2. Proposed Solution

It was mentioned in chapter 2 (under 2.1) two strategies of establishing information system requirements are used. The two strategies are to specify requirements from the users, the current system, and/or to adapt (customise) what other similar systems have already established. The first part of this section provides users proposed alternatives. The three systems that are reviewed are described in the annex.

3.2.2.1. Alternatives

Among the major alternatives put forward by users, in overcoming the limitations of the existing systems are:

⇒ Increasing the staff of the two central nodes, RPO and SGS and adding a record section to these units. The record section deals with the housekeeping functions and reporting on projects and publications. The library staff should take care of the information management tasks.

⇒ Decentralizing the current structure of the research and publications system, so that each research / academic unit handles relatively manageable size of data.

⇒ Automating some or all of the processes and centrally managing the Information System.

The first option may not be economically as well as technically feasible as it increases the costs for salary, space, overhead etc.; it also increases the paper work; leads to inefficient utilization of investment on computer resources.

The second option is more of a policy issue, and the University is considering it. However, the decentralization decision, would make the current problem of access to research information even worse, unless information management is not taken care of in a coordinated and networked environment. Moreover, this option may lead to repeated efforts and it requires additional skilled human power, equipment and technology at each node.

Most users agreed to the importance of a computerised system development as a solution to overcome the existing limitations. The difference lies in the administrative/functional structure and architecture of the system. From the observation made and the discussion with the top officials of the system, the automation option provides better feasible solutions technically,

economically as well as operationally. To support the requirement specification of users with additional strategies, Information systems in other similar Organizations and in similar area of interest are evaluated. Description of these systems is annexed.

3.2.3. Description of the proposed system

In the above discussion it was tried to make clear that the choice falls on a the centralised computer based system for the following reasons:

1. The manpower requirement for Proposed System will be highly reduced because data entry and management is handled centrally. Furthermore, the current administrative structure as well as technological infrastructure of the University signifies central administration of research activities.
2. Financial, material, as well as human resources, needed to run and maintain the system would not be unaffordable.
3. Managing, controlling and administering the system and its databases can be done without difficulties.
4. With the present technological stage of IT, and the improving state of Internet access in Ethiopia the system can be further upgraded to serve remote on-line searches within and without the country as well as on-line application processing for visiting scholars/researchers from foreign countries and other similar processes.

3.2.3.1. Components of the Proposed System

The proposed system has two subsystem components - Research Projects and Publications subsystem. Staff consultancy work is merged with Research Projects and the staff's research interest is included in the Publications System component. This is done mainly because of the administrative and infrastructure of AAU. Moreover, as indicated in the analysis, consultancy is in the category of research project and passes in the same procedures.

This section describes the component of the proposed system in detail (Refer to Figure 6, 6A to Figure 6D - for the DFD)

Research Projects System

Under this system there are two interrelated subsystems one for projects and one for grant. The Projects subsystem maintains a database of research projects, thesis research, consultancy, conference, workshop/seminar and so on. A project can be government funded, externally funded or un funded (a research project carried out using existing departmental resources with no other funding support). The grant sub-system holds data on all the available grants, their sources, their current status etc. Separate subsystems are needed because majority of the functions/process regarding these subsystems, the data structures they use, frequency of occurrence of related entities, reporting formats, frequency, duration, destination etc. are separate.

The different Proposal Forms for Projects i.e. research Proposal Form, Teaching Material Preparation Proposal Form, etc. will still be in use by the main system however summarized concise forms are designed for the purpose of data entry in the research project and other subsystems. Similarly Visiting Scholars Application Form and Grant Data Sheets will be in use, because, the existing system requires this forms to be filled-in for other operations which are done manually or in external systems. However, the required data items will be selected and stored in the database (in the input forms) from these original forms.

The system generates various reports in different time periods, such as Bi-annually financial reports, quarterly reports, Grant status reminders, notifications, of new research projects Bi-annual progress report, annual reports. It also allows users to design report formats and produce reports on ad-hoc queries.

Research Publications System

This system maintains data on profile of the staff of the University. It includes identification data, staff publications and research interest of staff. The research and publications office has a plan of collecting all publications so far published by staff of the University. It has started collecting publications available in local bookshops. The academic vice presidents office also holds data on staff profiles, which staff submits for Academic Promotion requests. This system is designed to maintain database of staff publications and staff research interest from these sources. Moreover, staff research interest can be judged from their research history, which the project system maintains.

In addition to creating access to comprehensive data on staff publication to the University community, this system resolves the problem of monitoring the universities research output. The system can generate various reports of user needs at needed intervals. For example annual abstracts, bibliographies in a subject area, and so on. It can report to the AVP - on research output of any staff, every 5 years or at any required interval, for the purpose of performance evaluation and academic promotion.

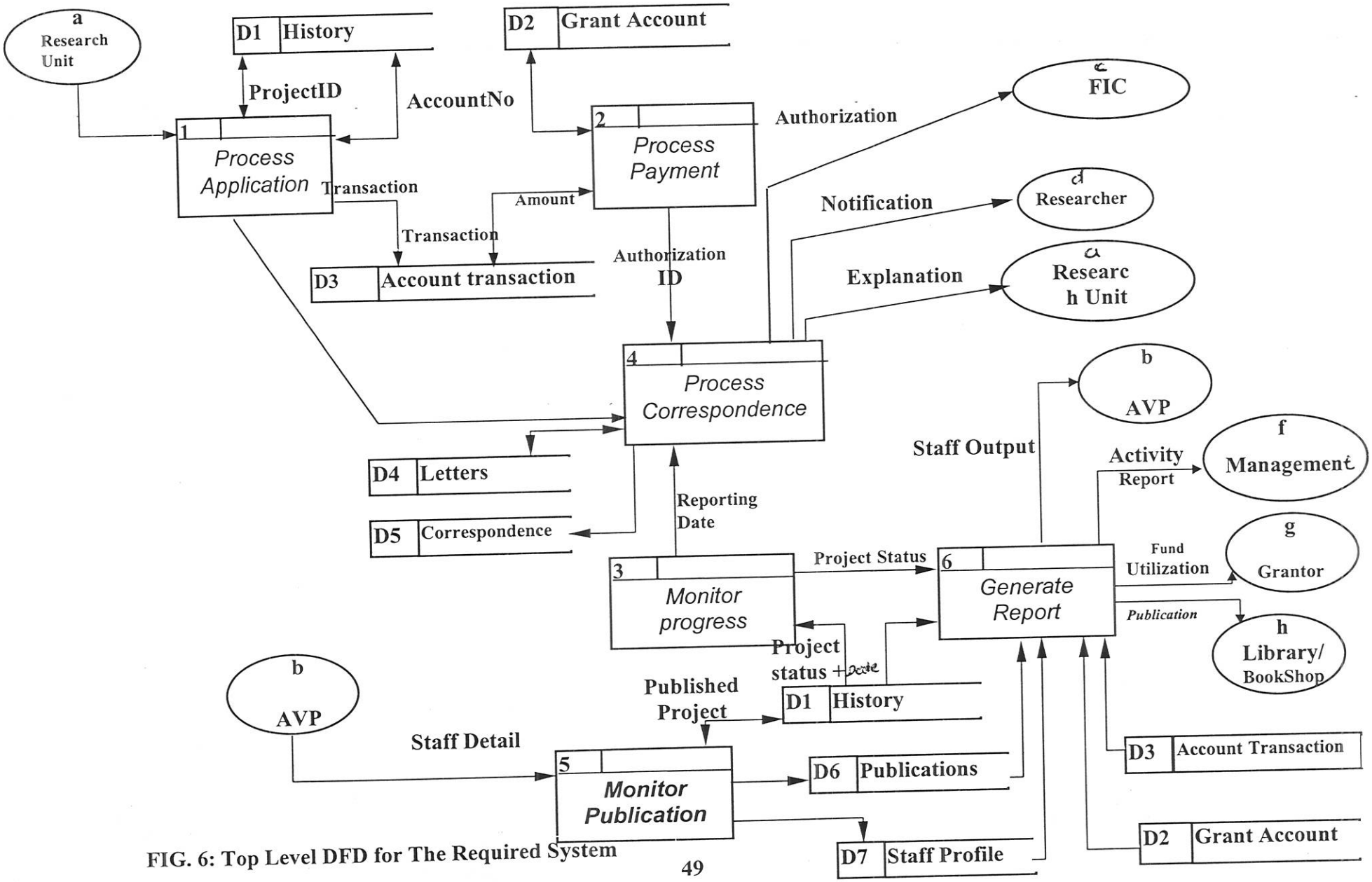

FIG. 6: Top Level DFD for The Required System

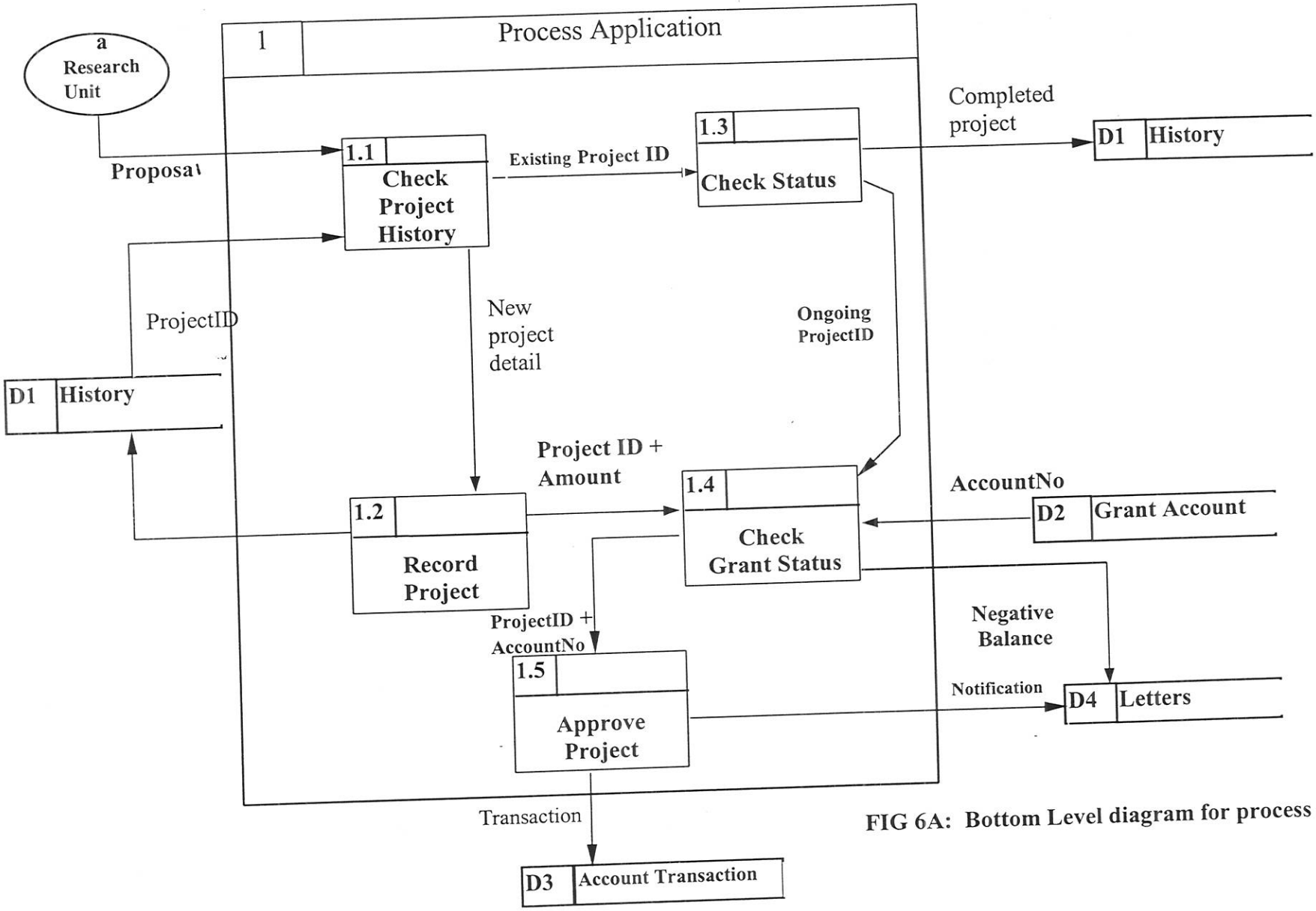

FIG 6A: Bottom Level diagram for process No 1

TABLE 3A: **Bottom Level Process Description Table for Process NO. 1.**

Process ID	Process name	Description
1.1	Check Project History	This process checks an application or a proposal to be for new project or existing project progres report or request for extension. A search will be conducted by project name to find project ID. I found, process 1.3 checks for its status, otherwise the project will be registered as a new one.
1.2	Record Project	This process records details of new projects
1.3	Check Status	When a project is identified to be existing in the file, its status is checked by this process to identify whether it is completed or not, if not completed it is either at the end of a phase or it needs time/fund extension. If completed, its status is updated as completed.
1.4	Check Grant Status	New as well as ongoing projects have to pass through this process before approval of any request is made. This process assumes process 1.2 or 1.3 and grant account data store. It checks grant account balance to be empty or zero, if not zero, it compares the balance with the transaction amount of the project, and stores notification code for negative balance (empty account) in the notification data store.
1.5	Approve Project	This process assumes processes 1.4. It updates the notification data store for rejected projects notice. Approved projects will be assigned account transaction ID here.

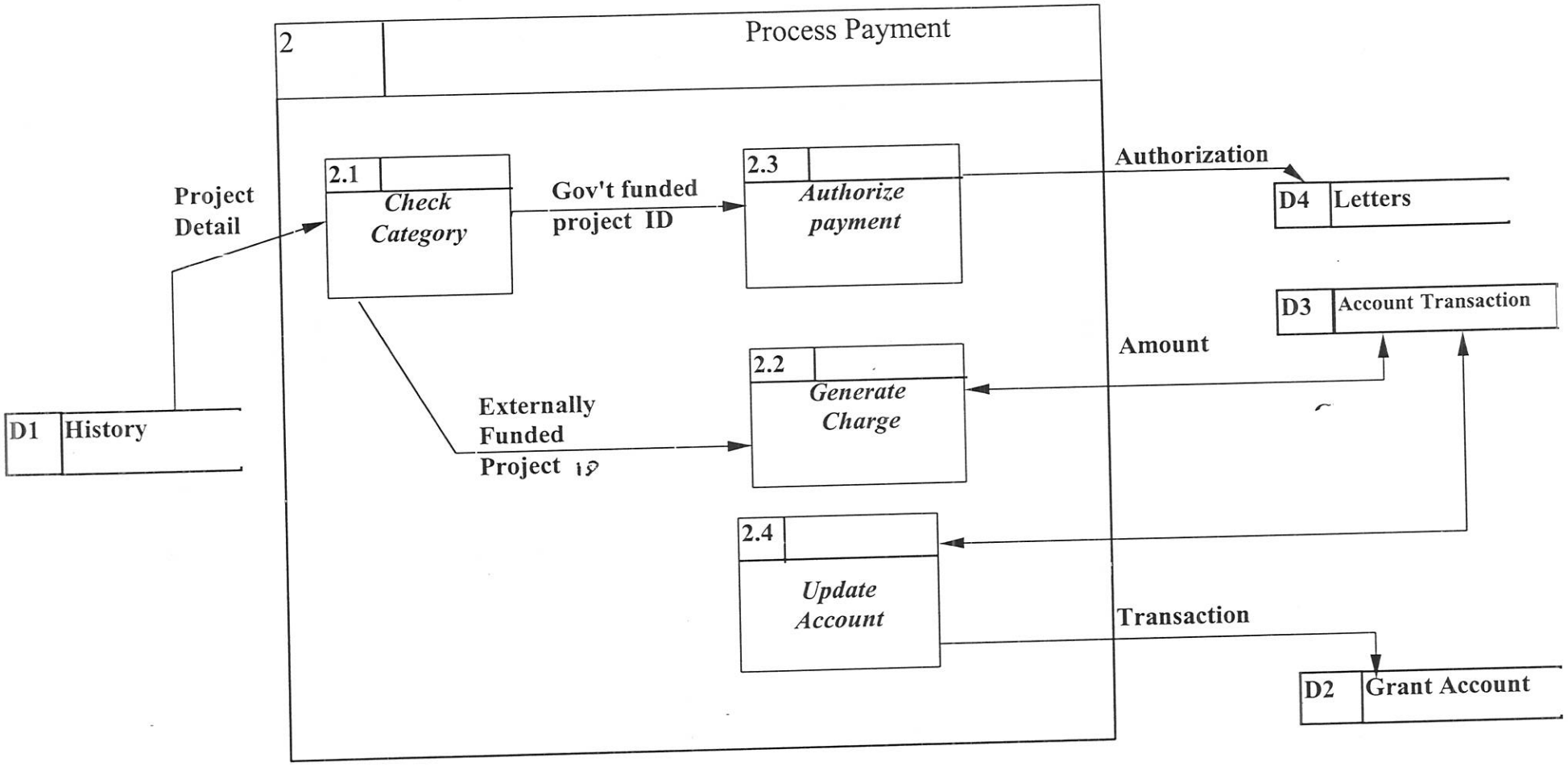

FIG. 6B : Bottom Level diagram for process No 2

TABLE 3B: **Bottom Level Process Description Table for Process No. 2**

Process ID	Process Name	Description
2.1	Check Category	The process checks whether the project is internally or externally funded to identify the need for cal
2.2	Generate Charge	Externally funded projects and consultancy income have to be charged overhead cost; the remaining consultancy income has to be distributed to all involved units and personnel with some fixed ratio. So this process computes all the appropriate charges and updates Account Transaction. ProjectID can tell what the Project Type is (consultancy or other). It assumes Process 2.1 and all bottom level s of Process 1.
2.3	Authorize Payment	This Process assumes Process 2.2 Process 2.1 and all bottom levels or Process 1. It authorizes a transaction.
2.4	Update Account	Settles Transaction Accounts from the respective Grant Account.

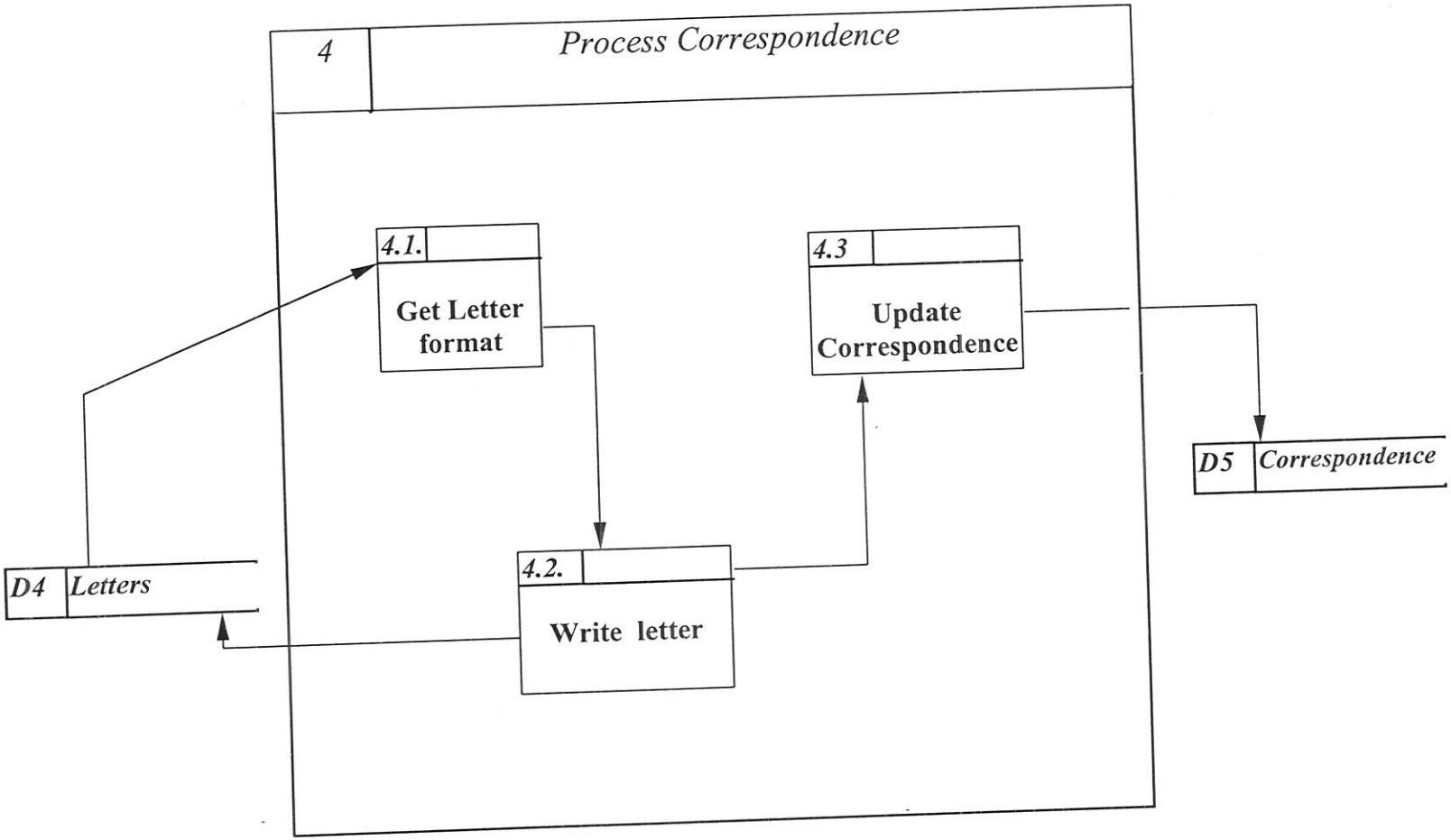

FIG 6C: Bottom Level diagram for process No 4

TABLE 3C: **Bottom Level Process Description Table for Process No. 4***

Process ID	Process name	Description
4.1	Get Letter Format	This Process reads the specific letter format for this particular Correspondence
4.2	Write Letter	Updates the Letter data store
4.3	Update Correspondence	This Process registers every outgoing Letter or Correspondence

* **The entire sub Process assume every Process (1.4, 1.5. 2.3 and 3) which updates the Letter data store.**

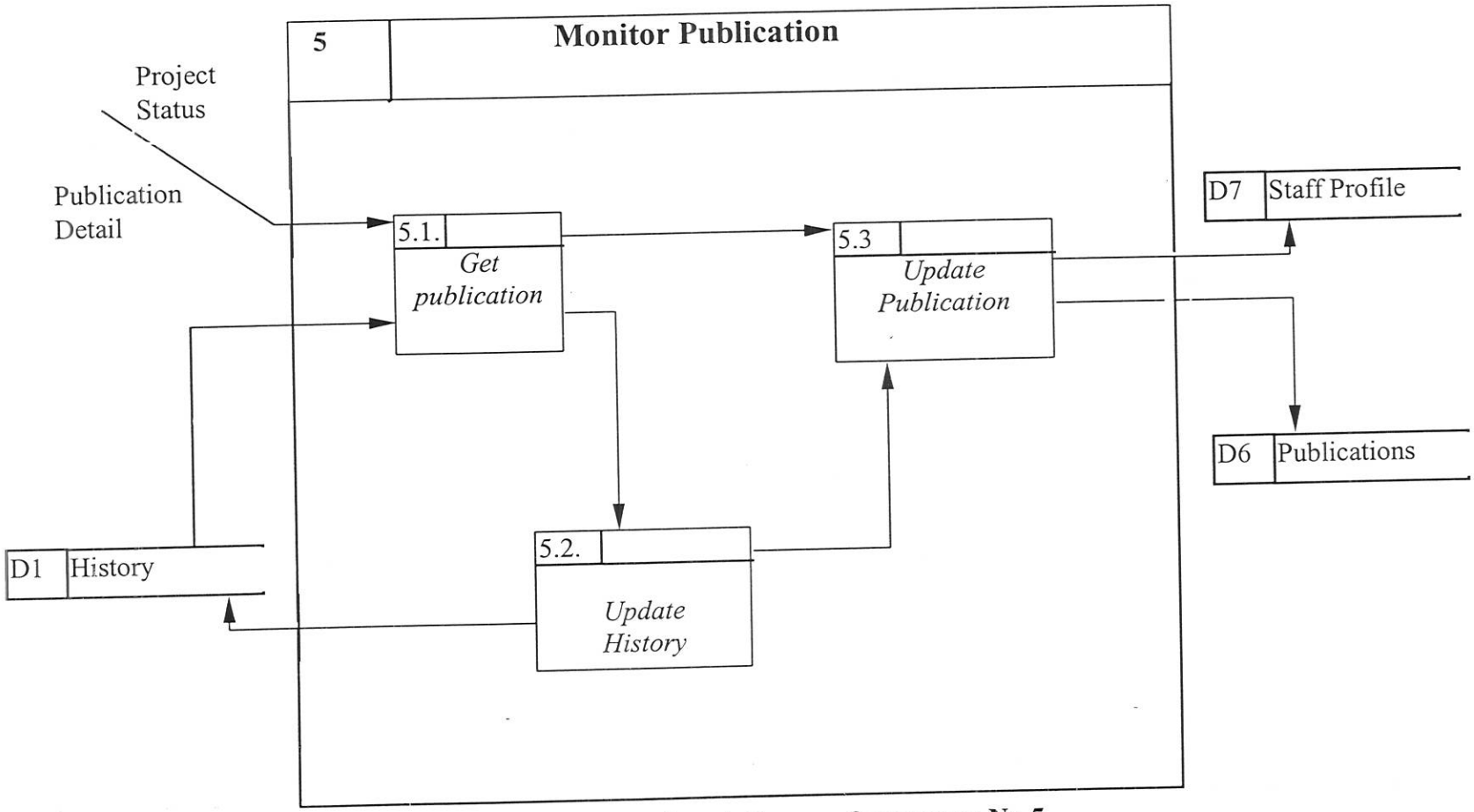

Fig 6D: Bottom Level diagram for process No 5

3.3 Developing the Logical Data Model Using Entity Relationship Analysis (ERA)

The second level of abstraction, mentioned under section 2.1, In specifying requirements of the information system is establishing requirements for databases. At this level, data analysis is applied in describing both current and required systems and models produced can be considered to be both data specification and logical/conceptual data designs.

The key to an effective information system design is an understanding of its data structures, which are the basic building blocks of a database (Green, 1996). The conceptual data model needs to be composed of as few elementary building blocks as possible; it should be logically simple but should model all essential elements. In developing a data model, one of the required steps is to select entities, which model a real world object by virtue of their properties (attributes), which are relevant to the system. Entities are the things users need to know about in order to get their job done, and attributes are the things we [the analyst] need to know about an entity (Brown, 1997). Having identified the entities and attributes, which express them, special attribute groups, which can uniquely identify any one occurrence of the entity, have to be looked for. In the case of the system under consideration, the identified entities and the uniquely identifier attributes are presented in the following table. The remaining data items (attributes) which are associated with each entity are presented in the Data Description Table in Chapter Four.

Table 4: **Entity -unique identifier table**

Entity	Identifier
PROJECT	ProjectID
RESEARCHER	ResearcherID
GRANT	AccountNo
GRANT AUTHORISATION	AuthorizationID
PUBLICATION	PublicationNo
STAFF	StaffID
RESEARCH UNIT	UnitID
GRANTOR	Grantor ID

The existing system provides unique identifiers only for one of the above entities i.e. Grant. The same identifier - Account Number, identifies this entity. Grant Authorization is partially identified by reference number of the authorization letter and by Project name. The remaining are entities are identified either by combination of several attributes or not identified at all.

The next stages of the data modeling process is determining the relationship of one entity to the other, and checking if entities are normalized. The former stage is discussed below and the latter is handled in chapter 4.

Entities that have direct relationships are taken for analysis and design purposes.

Howe (1989, cited in Green, 1996: 226) suggests twelve steps to produce a first level ERD.

The first and second Logical Data Models (LDMs) of the current system are shown in the following ERDs. First level LDM of the required system, and further decomposition of relationships is handled in the next chapter.

The following E-R Diagram (Figure 7) shows the related entities and the cardinality or degree of relationships. Description of the E-R notation is provided under section 2.2.4.

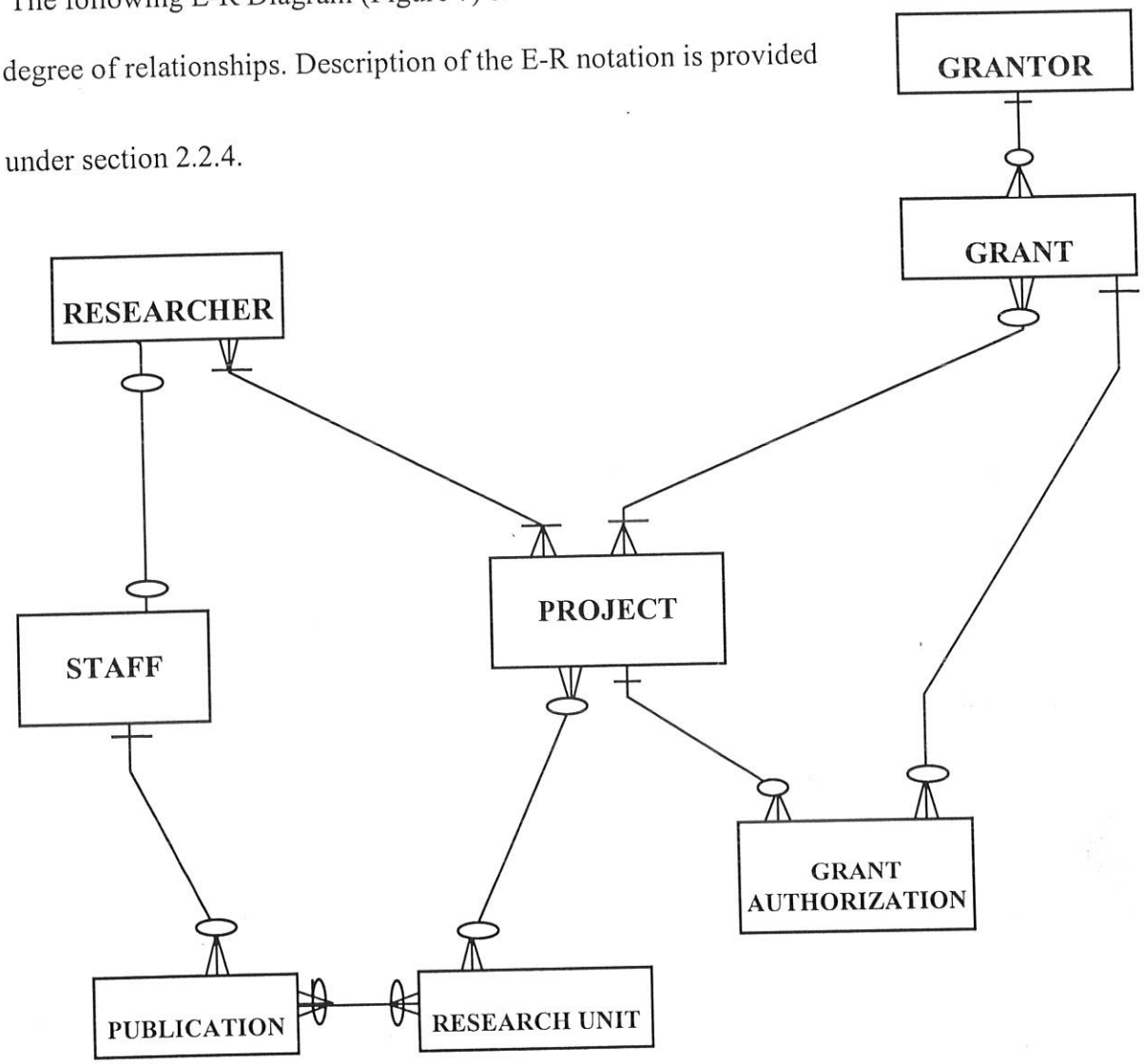

FIGURE 7: ERD: Current Logical Data Model

As shown in the figure each and every entity has direct relationship with Project entity. Of course, many of the entities are indirectly related. However, only the direct relations are considered.

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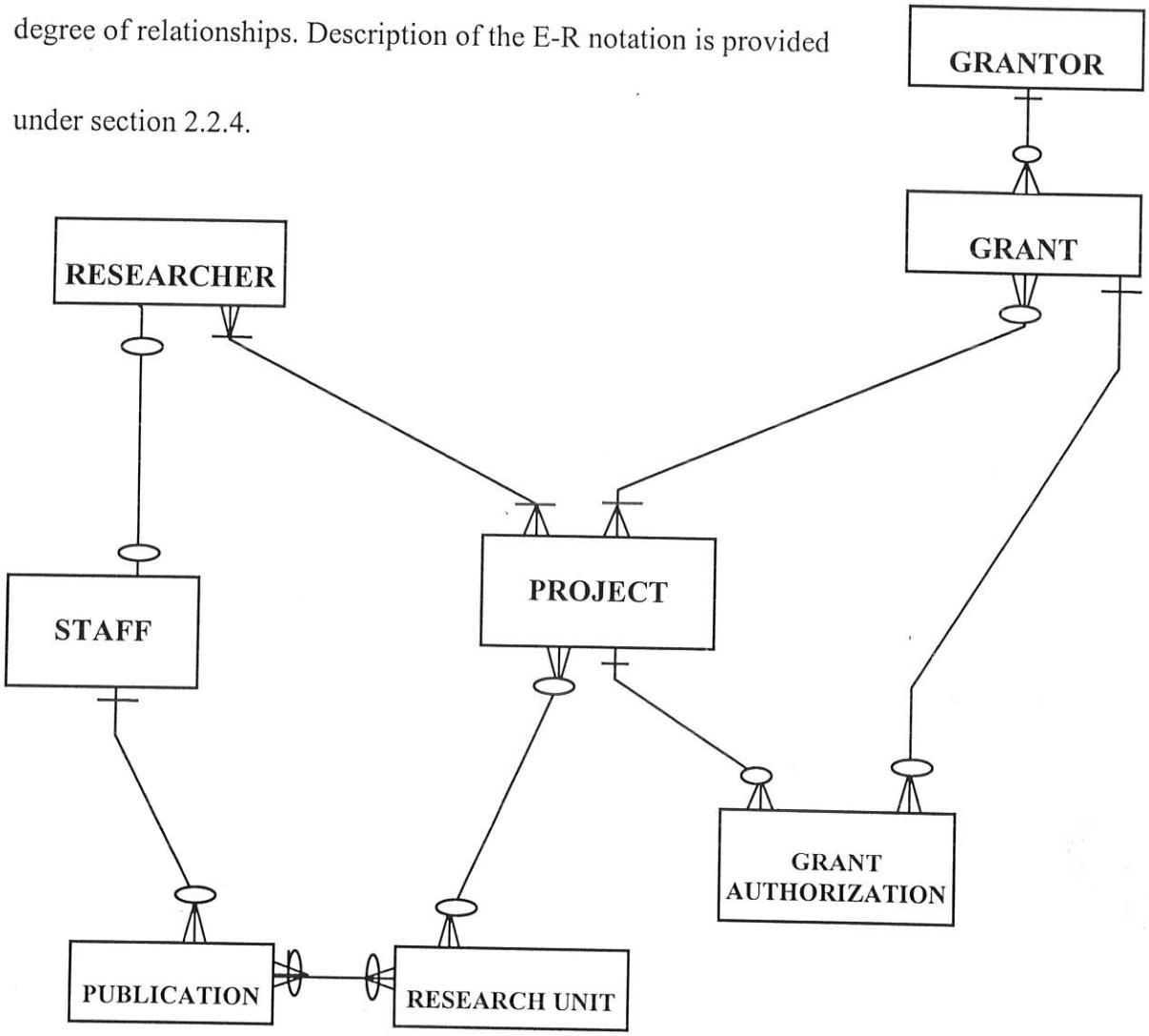

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CHAPTER FOUR

LOGICAL DATABASE DESIGN

4.1. Introduction

The functions of the proposed system have been represented in the last chapter using data flow diagrams. The data that results from the processes would be held in entities. These entities have to be further analyzed and investigated. In section 2.3.3 conceptual model of the current system had been sketched at higher level of decomposition. At the initial stage, identifying the entities the data items that are associated with them and their relationships would not result in exhaustive and detailed data model. Therefore, detailed data analysis and design of data/information requirements of the system is required. The first part of this chapter further refines the data model of the current system that was developed in the preceding chapters to come out with first level ERDs of the required logical data model (LDM). In the remaining part of the chapter, Relational Data Modeling technique (Relational Data Analysis - RDA) will be applied to transform the E-R model in to Relational Model. Applying RDA is required for the purpose of laying the basis for physical relational database design.

4.2. Revisiting The Data Model

In chapter two and three, entity relationship analysis was used at a lesser level. To model the current system, preliminary entities, attributes and identifiers were selected and an ERD that simply shows the degree of relationships was drawn. Identifying all the necessary attributes and composite attributes, assigning them to entities, defining further entities and relationships and developing the finalized first required LDM, are discussed in this section.

4.2.1. Validating the Logical Data Model

The first step here is to check whether the identified entities support all the transaction and rules of the system. A transaction is defined as a sequence of steps defining a certain event - in our case major processes represent transactions. When we see the DFD in chapter 3 Figure 6 and compare it with the Data Model in Figure 7, we can see that the data model does not support the process, which handles correspondence. Therefore further entities have to be formed. And when we examine Figure 6 further we can see that Correspondence is related to Letter and the two datastores are updated by majority of the processes. Therefore, their relationship can be extended to those entities that are related to the updating processes. For now, we represent the relationship of CORRESPONDENCE and PROJECT only. The remaining relationship will be looked after in the subsequent sections.

The other step is validating the logical data structure to avoid redundant relationships. This procedure proceeds by checking for any redundant access paths from one entry to another. When we see the conceptual model (chapter 3, figure 7) we find redundant access paths that are caused because of the GRANT AUTHORIZATION entity. For instance information on publications in a certain unit can be accessed in two ways. One is directly through the Path: PUBLICATION –> RESEARCH UNIT, and the other is indirectly through the Path: PUBLICATION – STAFF/RESEARCHER –> PROJECT –> RESEARCH UNIT. The first path is short and direct; however, if we follow it we may loose important information like Projects related to that Publication, etc. Therefore, we omit this path and use the longest one not to loose our link with other entities.

First level ERD of the required data model is represented in Figure 8. Attributes assigned to entities are presented in Table 5A to 5J. At this level, we can not say that the model is fully validated until rechecking with RDA has taken place. The LDM can be further amended and refined by decomposing "many to many" relationships into one-to-many relationships. Prior to that, each relationship existing in the LDM is described

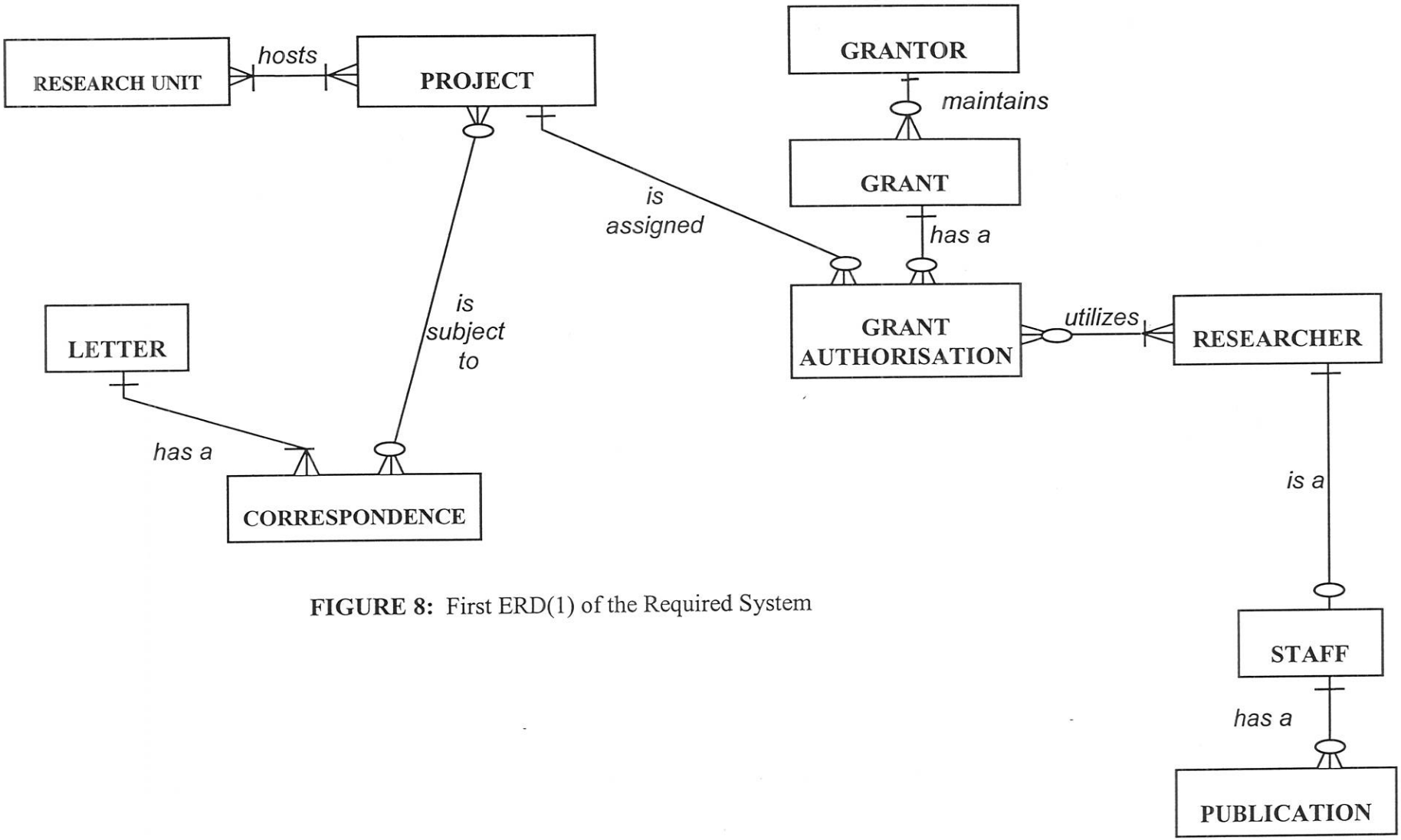


FIGURE 8: First ERD(1) of the Required System

Note that in above Figure, participation class of each relationship is indicated. Relationships can be Mandatory or Optional. For example GRANT must participate in a relationship with GRANT AUTHORIZATION. Likewise, GRANT AUTHORIZATION needs to participate in the relationship with at most ONE GRANT. In the case of PROJECT - GRANT AUTHORIZATION, Project's participation is optional. For example rejected Projects do not participate in relationships with AUTHORIZATIONs. Therefore, Projects can be recorded in databases with the absence of Grant Authorization. However, Grant Authorization need a project record to be held in databases, otherwise referential integrity will be violated.

4.2.2. Description of Relationships

PROJECT - RESEARCH UNIT: A research unit can host one or many projects and a project shall be done in one unit, or in the case of multidisciplinary research projects and Consultancy work, many research units can be involved.

PROJECT - GRANT AUTHORISATION: an approved project is assigned to one or many accounts, especially large projects can have several accounts from different grantors.

GRANT - GRANT AUTHORISATION: GRANT AUTHORISATION is described in the data dictionary (Data Item Description Table) as a link entity to PROJECT and RESEARCHER. It holds data on every transaction made to a GRANT account. Many AUTHORIZATIONs are made to a Grant Account and an Authorisation has to be made to at most one Account.

GRANTOR - GRANT: This relation is discussed under the GRANT Entity (Chapter two, Section 2.2.2). What is to be added here is optionally of the participation class in the case of

external grantors with many Grant Entities. An external Grantor can have a ""one to one"" relation with Grant Entity. In other cases there is a mandatory one to many relationship.

RESEARCHER - GRANT AUTHORISATION: grant payment of a certain Fund or GRANT is authorised to a certain Researcher. ResearcherID is held in transactions of the GRANT AUTHORISATION. That is an indication to the existence of a direct relationship. The relationship is "many to many" but participation of RESEARCHER is not mandatory.

RESEARCHER - STAFF: There exists an optional "one to one" relationship between researcher and staff. A researcher is either a staff or other Entities (Student, Visiting scholars or others). Staff is represented as entity because the output reporting system (chapter three, Process no. 6, Figure 6) is interested in tracking staff's research output or publications.

STAFF - PUBLICATION: One or many publications can be authored by a staff. Of course one or more staff can publish together in one or more publications. This cardinality is omitted purposely to reduce the number of "many to many" relationships and additional link entities. If there are more than one staff who are associated with a publication, they can be held in Author's field (data item) as repeatable.

PROJECT - CORRESPONDENCE: Different Transactions may be made to a PROJECT. Project approval/Rejection, Fund withdrawal deposits, transfers are some of the transactions. For all of this Correspondence is involved. Access to the Correspondence is required to know what kinds of transactions were made to which project and/or to which GRANT. The same Transaction can occur to a number of Projects at the same instance. For example, the system may order transfer of some amount from a certain GRANT to a number of PROJECT Accounts.

Majorities of the correspondences are concerning the financial aspects. There are some correspondences that are not financial. Every Project may have one or more correspondences and a correspondence may be made to one or more Projects.

LETTER – CORRESPONDENCE: Each Correspondence holds at most one relationship with every Letter and each Letter has to have at least one Correspondence; i.e. a Mandatory "One to many" relationship exists.

Further Decomposition of the Data Model

The next necessary action is decomposing "many to many" relationship in to two "one to many" relationships. In our data model three "many to many" relationships exist - PROJECT - RESEARCH UNIT, PROJECT - CORRESPONDENCE, and RESEARCHER - GRANT AUTHORIZATION. Therefore, these relations will be added in the model as link Entities (Intersection relations). Figure 9 presents the first level Logical Data Model of the Required System.

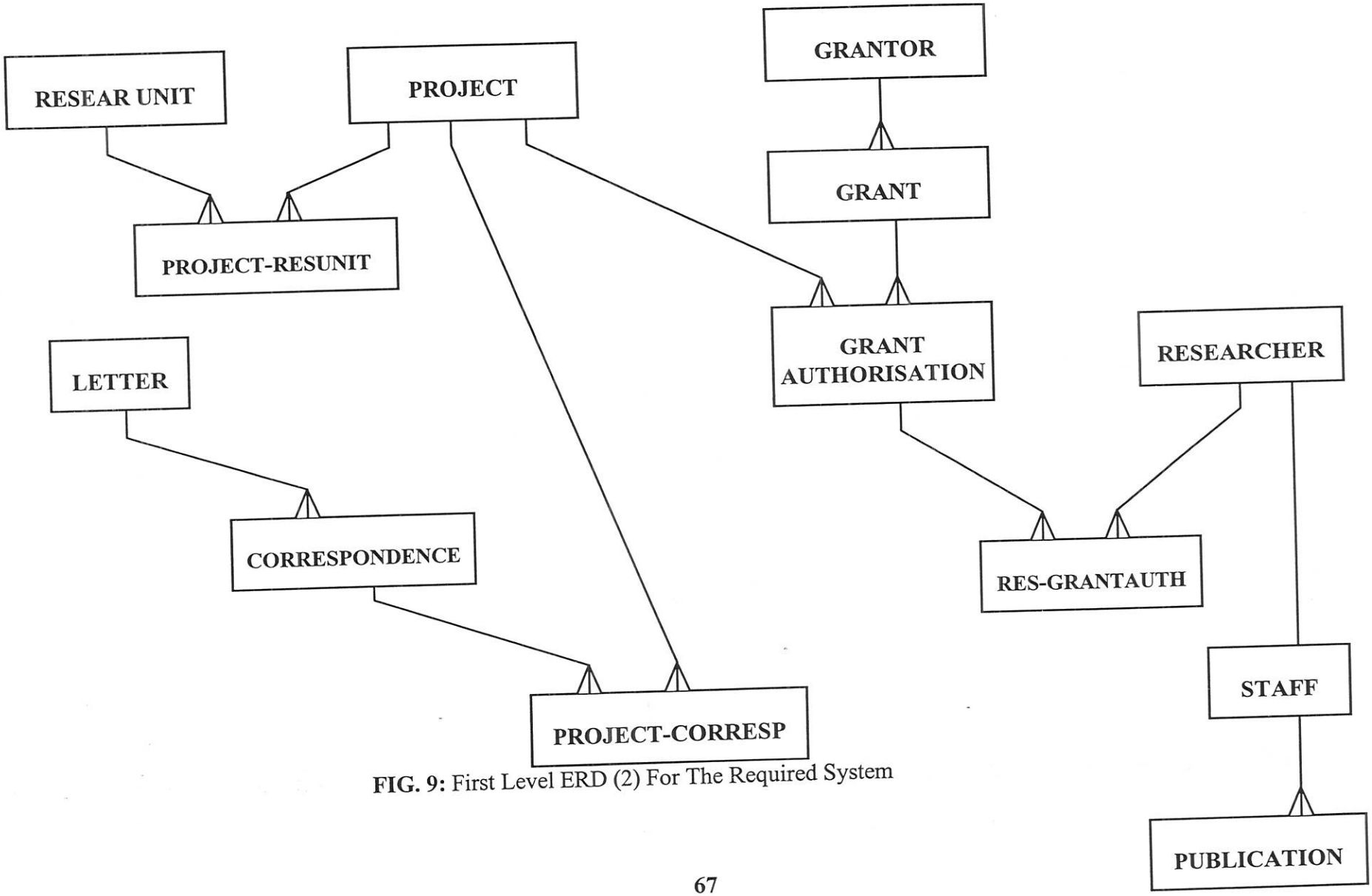


FIG. 9: First Level ERD (2) For The Required System

4.3. *Relational Data Analysis (RDA)*

The top-down approach used in Entity-Relationship Analysis (ERA), applied so far, concentrates first on designing the entities and their relationships, and then leads to analysis of the data item contents of each entity (i.e. the property of the entity). In this section description of data item contents of each entity, using bottom up approach of Rational Data Analysis, is discussed. The purpose of this section is to organize all of the data items into a set of normalized relations that are well formed to meet table restrictions, data integrity and to have a level of stability in the face of change.

The data items (attributes) that were identified and assigned to each entity at the ERA stage were not presented in the previous section. This was because, it was believed that the presentation should be made at the stage of Relations Data Analysis, where the nature of each and every data item will be widely identified and studied. Therefore, descriptions of data item contents of each entity are presented in Table 5A to 5J.

ERA principles that were followed under section 3.2 & 3.3 involve some steps of normalizing the model. As a result of this, most of the entities and their data items described in the next Data Item Description Tables are normalized. However, to check the validity of parts of the data model, further Normalization Process is applied prior to presentation of the tables.

Table 5-A : Data Item Description Table
Entity Name : PROJECT
Description : Details of the Project
Volumetric Information: An Average of 75 Projects Quarterly and 400 Dissertations/Theses yearly

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
PROJECTID	Project Record Identification Code	String	10		M
PROJNAME	Name of the Project	"	100		
BRIEFNAME	Mnemonic name	"	10		
PROJTITLE	Title if Different From Name	"	100		
CATEGORY	Category of the Project by source of Fund	Character		G,E,O	Gfor Government E for External O for others
STATUS	Current Status of the project	String	10	New, ongoing completed, Extended, Published Terminated Rejected	
TYPE	Type of the project	String	2	RS,CO,TM, JP,WK,EX	Research Consultancy TeachingMaterial JournalPublishing Workshop Exception
GOAL	Objectives of the project	String	250		
LANGUAGE	Language of Project	String	15		
GEOCOVER	Geographic Coverage	String	30		
METHOD	Methods used in the research	String	500		
DESCRIPTORS	Descriptions/keywords	String	250		
EXPOUTPUT	Expected Output of the project	String	500		
ACTOUTPUT	Outputs of the Ongoing Project so far	Character		Y/N	
OUTPUTTYPE	Type of the Output	String	10		

... continued

OUTPUTTITLE	Title	String	200		
DESCRIPTION	Description of Output	String	250		
OUTPUTDATE	Date of Output	Date	15		
CONTRIBUTOR	Name of the Involved Researcher	String	45		
PERSONNEL	Support Personnel	String	200		
FACILITIES	Equipment and Other Facilities Required	String	200		
SITE	Current Site of the Project	String	30		
AMTREQUESTED	Requested Amount of Grant	long			
DATES:					
DATE PROP	Date Proposal submitted	Date			
DATERECOM	Date Recommended	Date			
DATE-APPR	Date of Approval/Rejection	Date			
DATE-START	Date started	Date			
DATE-EXPE	Expected Date of completion	Date			
DATE-REPEX	Date Progress Report expected	"			
DATEREPOT	Date Last Progress Report is made	"			
DATE-COMP	Date of Actual Completion	"			
DATE-TERM	Date of Termination	"			
DATE-PUBL	Publication Date	"			
DESCRIPT	Description	String	500		
RELATEDPROJ	Related Project Id	String	10		
RESEARCHERID	Advisor for Thesis research	String	10		
RECOMMENDBY	Name of the person who recommended	String	20		
APPROVED BY	Name of the person who Approved	String	20		
DATEMODIFIED		Date			

Table 5-B : Data Item Description Table
Entity Name : RESEARCHER
Description : Personal Details of the Researcher
Volumetric Information: An average of 3 researchers (one project leader/ investigator and two project members) per project Quarterly

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
RESEARCHERID	Researcher identification code	String	5		M
RESCAT	category to the Researcher	"	10	Staff, Student, Visitor, Other	
POSITION	Position in the project	"	10	Leader, member, collaborator, personnel	
LNAME	Last Name	"	15		
FNAME	First Name	"	15		
MNAME	Middle Name	"	15		
ADDRESS	Address	Structure: Address	180		
SEX	Sex	char		M/F	
RANK	Academic Rank	String	50		
NATIONALITY	Citizenship by Birth and Naturalisation	String	50		
PROFESSION	Profession	"	100		
EDUCATION	Detail of Educational Back ground	Structure: History	300		
TRAINING	Training of researcher	"	300		
EXPERIENCE	Research Experience	"	300		
OCCUPATION	Job History	"	300		
AFFILIATION	Affiliation Institutes	String	200		
MEMBERSHIP	Membership in Professional Bodies	"	200		
LANGUAGE	Language Competence	"	200		
RESINTEREST	Research Interest	"	250		
NOTES	RPO Notes on the Researcher	"	500		

Table 5-C : Data Item Description Table
Entity Name : GRANT
Description : Details of the Status & Balance of the Research Fund
VOLUMETRIC INFORMATION: An Average of 1 Grant Per Project

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
ACCOUNTNO.	Account Number of Grant	String	10		M
ACC NAME	Account Name	String	30		
STATUS	Account Status	Character		O-for opened C-for closed	
OPEBAL	Opening Balance	Long			
OPENDATE	Date Account Opened	Date			
CLOSEDATE	Date Account Closed	Date			
BALANCE	Current Balance	Long			
ENCUMBERED	Total Encumbrances	"			
EXPENDED	Total Expenditures	"			
DEPOSITED	Total Deposits	"			
TRANSFERS	Total Transfers to Other Accounts	"			
DEDUCTED	Total Miscellaneous Deductions from the Account	"			
COMMITTED	Total account committed	Long			
NOTE	Notes about the Account	String	100		
WHODIDIT	Name of Person Modifying the Account Record	"	30		
DMODIFIED	Date Record Modified	Date			
GRANTORID	Identification of Owner of the Account	Character	10		M

Table 5-D : Data Item Description Table
Entity Name : GRANT AUTHORISATION
Description : A link Entity Among GRANT, PROJECT and RESEARCHER, used for recording details on each transaction made to a Grant account for any particular project

VOLUMETRIC INFORMATION: Authorization is made at the time of approval and at the end of each phase, and for extension purposes. Therefore, a PROJECT can have an average of four GRANT AUTHORIZATIONs per year. That is an average of 300 GRANT AUTHORIZATIONs are made quarterly. And for thesis/Dissertation only one authorization is made per year from the research system.

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
TRANSNO	Running Number	Integer			
ACCOUNTNO	Grant Account No	Sting	10		M
AMOUNT	Amount of Transaction	Float			
TRANSTYPE	Type of Transaction	Character		E-Encumber, U-unencumbered T-Transfer to another account P-Deposited E-Expended D-Deducted	
DESCRIPTION	Description	String	100		
PROJECTID	Project identification	String	10		M
RESEARCHERID	Researcher Identification	Sting	10		M
RESRCAT	Researcher Category	Sting	10		M
OVERHCHARGE	Overhead Charge	Float			
TAX	Tax to be charged	Float			
DUEDATE	Date Payment Expire	Date			M
POSTDATE	Date of Authorisation	"		Y/N	
PAID	Has Payment been made	Char			
NOTES	Notes About Authorisation	String	200		
WHO DID	Name of Person Authorising	String	15		
DATEMODIFIED	Date Record Modified	Date			

Table 5-E : Data Item Description Table
Entity Name : STAFF
Description : Personal Details on the Staff
VOLUMETRIC INFORMATION: An Average of 2 staff per publication i.e. 340 staff per year

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
RESEARCHERID	Identification of Staff Researcher	String	5		M
UNITNAME	Department Identification	String	15		M
SERVICES	Services Offered	Char	1	T,R,C,O	T-Teaching R-Research
LASTPROM	Date of Last Promotion	Date			C-Consultancy O-Others

Table 5-F : Data Item Description Table
Entity Name : GRANTOR
Description : Details of Funding Agency
VOLUMETRIC INFORMATION: A Grantor can have many Grants, therefore, the average number of common Grantors is 32.

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
GRANTORID	Grantor Identification Code	String	10		M
GRANTORCAT	Category of Grantor	String	12	Donor, Client, Government, NGO, Ministry, Other	
GRANTOR NAME	Name of Grantor Company	"	50		
CONTACTS	Contact Information at Grantor Company	Structure:Contact	310		
AGENT	Agent Information if any	Structure:Contact	310		
GRANTOR ADDRESS	Grantor's Address	Structure:Address	180		
INTEREST	Research Interest of Grantor	String	200		

Table 5-G : Data Item Description Table
Entity Name : RESEARCH UNIT
Description : Details of the Location of an ongoing/completed project and/or publication
VOLUMETRIC INFORMATION: 13 Faculties and 4 research institutes. The sub-units & collaborating external units are not considered

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
UNITID	Research Unit Identification Code	String	10		M
TYPE	Type of Unit	Character		I,F,D,S,L,O	Institute,Faculty,
UNITNAME	Research Unit Name	String	30		Department,School,
SUBUNIT	Location within the Research Unit	"	30		Library, Other
UNITADDRESS	Research Unit Address	Structure Address	180		
CONTACT	Contact Information	Structure Contact	310		
WDOPENHOUR	Opening hours on Weekdays	String	10		
WDCLOSEHOUR	Closing hours on weekdays	String	10		
WEOPENHOUR	Weekend Opening hours	"	10		
WECLOSEHOUR	Weekend Closing hours	"	10		

Table 5-H : Data Item Description Table
Entity Name : PUBLICATION
Description : Details of Publication of Research Output
VOLUMETRIC INFORMATION: The Distribution of Publications is un-proportional among the different departments of a faculty for example in one faculty a deviation of σ **7.07** was exhibited for the Mean (μ) of 12 publications per year. However an average of 10 publications per Faculty per year (on 20 years data) and total of 170 publication per year is taken for the Whole University

Data Item Name	Description	Type (format)	Size	Range	Com
ITEM ID	Identification of Publication item Record	String	10		M
RESEARCHERID	Identification of Author	String	5		M
TITLE	Title of the item	String	100		
COPYNO	Number of copies	Integer			
PNAME	Name of parent item	String	100		M
PARENTCODE	Code Assigned to Parent	String	10		
PUBLISHER	Publisher	String	100		
PUBDATE	Publication Date of Item	Date			
EDITION	Edition	String	15		
ISSN	International Standard Book Number	String	10		
ISBN	International Standard Serial Number	String	10		
LANGUAGE	Language of Text	String	20		
COUNTRY	Country of Publication	String	20		
FORM	Form of Item : Fiche, issue, disk, ...	String	20		
FORMAT	Format of Parent: Monograph, Journal	String	20		
EDITOR	Editor of Source Publication	String	30		
VOL-ISSUE	Volume and issue information	Structure: Enumeration	50		
ABSTRACT	Abstract	String	250		
PAGES	Starting and Ending Page Numbers	String	10		
AVAILABILITY	A flag indicating availability of item	Char		Y/N	
PROJECTRELATED	A flag indicating if publication is project related	Char		Y/N	
PROJECTNAME	Source Project if any	String	100		

..continued

PUBLICATIONTYPE	Type of the Publication Item	String	10		
UNITID	Location Identification	String	10		
DATEMODIFIED	Date Item is recorded	Date			M

Table 5-I : Data Item Description Table
Entity Name : CORRESPONDENCE
Description : Information about every correspondence made on a project
VOLUMETRIC INFORMATION: The magnitude of Correspondence is related to Grant Authorization. However, the correspondence is made to every researcher, grantor, and every Unit involved in the Project and to FIC. Therefore an average of six correspondences per authorization gives us about 1800 correspondences quarterly, 600 monthly, and about 20 daily

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
CORRESPID	Record Identification Code	String	10		M
LETTER ID	Form Letter Identification Code Used for this Correspondence	String	15		M
CORRESPADD	Address to which Correspondence Sent	Structure:Address	180		
TO-WHOM	Category of Organisation Receiving Correspondence	String	15	Leader, Member, Research-Unit,Finance Grantor	
FORM	Form of Communication	Character		L-Letter P-Phone E-Email F-Fax T-Telex	
INTERNALNOTES	Notes about this Correspondence for Internal Consumption	String	100	O-Other	
DATECORRSP	Date on correspondence	Date			
DATESENT	Date Correspondence sent	Date			
DATECREATED	Date Correspondence created	Date			

Table 5-J : Data Item Description Table
Entity Name : LETTER
Description : This file stores letter text for canned letters generated by the system, such as Payment orders, Notifications, Reminders for Progress Reporting Dates, etc.
Volumetric Information: An average of 10 form letters

Data Ite Name	Description	Type (format)	Size	Range of Values	Comment
LETTERID	Letter identification code	String	15		
TYPE	Type of Letter	Character			O-Order, N-Notification F-Related to finance: Transfer, Encumber,.. M-Miscellaneous
Source	The name of the source query holding codes which indicate the location of field for text insertion	String	15		
TEXT	The Form text holding the canned letter		500		

Table 5-K : Data Item Description Table for a structure type used
Structure Type : Address
Description : Address of an organisation on any other object

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
ADD-LINE 1	First line of street address	String	30		
ADD-LINE 2	Second line of Street Address	"	30		
CITY	City	"	20		
STATE	State, province, etc.	"	35		
ZIP	Postal zip code country	"	19		
COUNTRY	Country code, city code	"	5		
PHONE	Phone no and extension	"	15		
FAX	Fax number	"	15		
EMAIL	Electronic mail address	"	15		
TELEX	Telex Number	"	15		

Table 5-L : Data Item Description Table for a structure type used
Structure Type : Contact
Description : Details on contact

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
PERSON	Contact Person	String	20		
POSITION	Position of person	String	20		
CONTACT	Address of person	Structure address	180		
CONTACT NOTE	Notes about the contact person	String	100		

Table 5-M : Data Item Description Table for a structure type used
Structure Type : Enumeration
Description : Details on issue of a Publication

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
LEVEL 1	1st level of enumeration volume Number	String	10		
LEVEL 2	2nd level of issue number	String	10		
LEVEL 3	3rd level of part number	String	10		
CHRON 1	1st level of chronology year	String	4		
CHRON 2	2nd level of chronology month	String	10		
CHRON 3	3rd level of chronology date		5		

Table 5-N : Data Item Description Table for a structure type used
Structure Type : History
Description : Details on the Academic or Professional Background of A person

Data Item Name	Description	Type (format)	Size	Range of Values	Comment
INSTITUTION	Name of the Institution	String	100		
LOCATION	Address of the Institution	Address	180		
SDATE	Date the History started	Date			
EDATE	Date of Completion	Date			
RESULT	Output of this particular history: Degree, Certificate, Position, and Tittle.	String	100		

4.3.1. Process of Normalization

The Normalization process necessitates presenting all of the data items in a table and inserting actual data occurrences. However, with the existing big member of data item groups, this approach can get unmanageable. Therefore, for the purpose of demonstration, one table is filled in hypothetical values of data occurrence, i.e. the PROJECT Table. The remaining tables are described using only the data items in relational notation.

In the previous chapters a preliminary list of entities and their unique identifiers were listed. The identifier for PROJECT was ProjectID. This data item uniquely identifies the particular table, and we call it a **primary key**, and it will be underlined in all the tables and/or relational notations to be used this point forward. This holds true for all primary keys of every table.

Table six holds the Un normalized PROJECT Table.

TABLE 6: PROJECT 0: Un normalized Project Table

ProjectID	*Name*	*Brief Name*	*Category*	*Status*	*ActOutput*	*Output Type*	*Output Title*	*Description*	*Contributor*	*Date*
RPO/RS/9127	Research Production and Development in Ethiopia	PPDE	E	COMPLETED	Y	Conference Paper	A brief Survey of Development Activities in Northern Shewa	A Paper in the 1st workshop of PPDE held in Norway	Tegene Teka	02/09/89
RPO/RS/9127	Research Production and Development in Ethiopia	PPDE	E	COMPLETED	Y	Conference Paper	Crop Micro climate and Highland Interaction In Northern Shewa	A Paper in the 1st workshop of PPDE held in Norway	Daniel Gamachu	02/09/89
RPO/RS/9127	Research Production and Development in Ethiopia	PPDE	E	COMPLETED	Y	Working Paper	Fertility Behavior	Unpublished	Dahil Jorgensen agla	06/07/91

What people refer to as the data modeler's oath (Green, 1996) is worthy mentioning here.

- Do not repeat
- The columns must depend upon the key,
- The whole key
- And nothing but the key
- So help me codd.

To be in its first normal form, a table has to be free of repeating groups (Oath no. 1) of a data item occurrences for single occurrence of the primary key. In our table, Output type, Output Title, Contributor, Description, and Output Date are repeating groups. And these data items are separated to a new relation shown in Table 6-2. The remaining data items that are not repeating are left in the original relation Table 6.1.

Table 6-1 PROJECT (1 and 2): First and Second Normal form of the PROJECT Relation

ProjectID	*ProjectName*	*Category*	*Type*	*Status*	*Method*	*ProgressReport*	*GeographicCoverage*

Table 6-2 PROJECT OUTPUT (1 and 2): First and Second Normal form of the PROJECT OUTPUT RELATION

ProjectID	*OutputType*	*OutputTitle*	*Contributor*	*Description*	*OutputDate*

Our PROJECT relation has a single primary key, then we need not check for partial dependency for second normal form. When we see the columns of the PROJECT- 1 and 2 Relation, some of the attributes are not supporting the 4th oath - "Nothing but the key". For example the Status, Method, Geographic Coverage, and ProgressReport, are dependent on not only the key but also the type of the PROJECT. For instance, these data items are null to all project types which are different from RS - research, and/or TM - Teaching Material, therefore, we need to take them to a separate relation to avoid transitive dependency as well as make our database space economical. As a result the following Project Relation come out in their third normal form.

Table 6-3: PROJECT 3NF

ProjectID	*ProjectName*	*Category*	*Type*	*Language*	*Goal*	*Method*	*Descriptors*	*Date Repex*	*Geo Cover*	*OTHER DETAIL*	*ActOutput*

Table 6-4: PROJECT OUTPUT 3NF

ProjectID	*OutputTitle*	*OutputType*	*Contributor*	*Description*	*OutputDate*

Table 6-5: PROJECT TYPE 3NF

ProjectID	*Type*	*Status*	*Method*	*Geographic Coverage*	*Date RepExptd*	*Date Reportd*

These relations can be considered as normalized relations (in the third normal from) since they fulfill the Table Restriction in 2nd and 3rd normal forms. That is there are no partial as well as transitive dependencies.

Normalization of the remaining data sources.

- The RESEARCHER Relation

There are some data items in this relation that were presented as Structure: History data types. These are Education, Training, JobHistory, and Experience. When we examine these structures we observe two things that makes them un normalized. First, there is a possibility of repetition; that is, an individual can have rows of repeating history in all the above columns. Secondly, they are not in flat table formats rather they are in structure type. This type is not supported by a relational database model. Therefore they have to be normalized into flat table types. The final outcome of the normalization process is a new relation holding columns common to all the above data items (attributes). The relation is RESEARCHER-HISTORY and it is identified by a composite key of ResearcherID, ResCat and HistoryCode.

RESEARCHER 3 (*ResearcherID, ResCat, Position,* ***UnitName,*** *Services, LastPromoted, Lname, Fname, Mname, Address, Sex, Rank, Nationality, Affiliation, Membership, Language, ResInterest, Notes)*

RESEARCHER HISTORY 3 (*ResearcherID, ResCat, HistoryCode, HistoryType, Institution, Location, Sdate, Edate, Result)*

- The PUBLICATION relation

Similar to PROJECT - PROJECT OUTPUT relation the publication relation exhibits a parent -child relationship, Data Items enclosed in braces in the following Relational Notation are repeating.

PUBLICATION (*ItemID, Title, CopyNo, VolumeIssue, Form, Abstract, Pages,*
ProjectRelated, ProjectName, PublicationType, {*Parentcode, ParentNname , Language, ISSN, ISBN, Format, Country, Publisher, PubDate},* ***ResearcherID, ResCat*** {UnitID,} availability, *DateModified)*

Removing the repeating groups in to a separate relation and avoiding partial dependency we get the following relations.

PUBLICATION (*ItemID, Title, CopyNo, VolumeIssue, Form, Abstract, Pages, ProjectRelated, ProjectName, PublicationType, Availability,* ***ResearcherID, ResCat, ParentCode****, DateModified)*

SOURCEPUBL, *(Parentcode, ParentNname, Language, ISSN, ISBN, Format, Country, Publisher, PubDate)*

PUBLICATION - RUNIT (*ItemID, Unit ID)*

On the same token, it was tried to normalize all the relations at least to the third normal form. Link tables were created for "many" to "many" relationships to decompose the relations in to two "one" to "many" relationships.

As a final touch, an attempt was made to optimize the Data Model by merging the data items having the same unique identifiers together. For instance the STAFF and RESEARCHER relations have been merged into RESEARCHER relation and the Researcher Category (ResCat) data item is made a mandatory data item in this relation, so that staff can be accessed through the composite key. The optimized relations are provided in Table 7.

And finally, back to where we begin, the Normalized relations are represented by a logical data structure diagram (figure -10). In the diagram one to many relationships are dominant, meaning those entities which hold the primary key of another entity as their foreign key take the many end of the relation and vice versa.

The logical data model is required to support the processing to be performed in the new system. The logical processes model of the required system was shown in chapter three

(figure - 6). In the required LDM some changes have been made to the current one. Entities are added, or changed their names.

TABLE 7: Optimized Relation of All the Data Sources

PROJECT *ProjectID* *ProjName* *BriefName* *ProjTitle* *Category* *Type* *Language* *ExpOutput* *ActOutput* *Personnel* *Facilities* *Site* *AmtRrequested* *DateProp* *DateRecom* *DateAppr* *DateStart* *DateExpe* *DateComp* *DateTerm* *DatePubl* *Description* *RelatedProj* *RecommendBy* *ApprovedBy* *DateModified* **PROJTYPE** *ProjectID* *Type* *Status* *Goal* *GeoCover* *Method* *Descriptors* *DateRepex* *DateReptd*	**PROJOUTPUT** *ProjectID* *OutputTitle* *OutputType* *Description* ***OutputDate*** ***Contributor*** **RESEARCHER** *ResearcherID* *ResCat* ***Department*** *Services* *LastPromoted* *Lname* *Fname* *Mname* *Address* *Sex* *Rank* *Nationality* *Affiliation* *Membership* *Language* *ResInterest* *Notes* **RESEARHISTORY** *ResearcherID* *ResCat* *Historycode* *HistoryType* *Institution* *Location* *Sdate* *Edate* *Result*	**RESEACR-GAUTH** *ResearcherID* *ResCat* *TransNo* *Position* **GAUTHORIZATION** *TransNo* *AccountNo* *ProjectID* *Amount* *TransType* *Description* *OverhCharge* *Taxable* *Duedate* *Postdate* *Paid* *Notes* *WhoDidIt* *DateModified* **GRANTOR** *GrantorID* *GrantorCat* *GrantorName* *Contacts* *Agent* *Grantor Address* *Interest*	**GRANT** *AccountNo* *AccName* *Status* *OpeBal* *OpenDate* *CloseDate* *Balance* *Encumbered* *Expended* *Deposited* *Transfers* *Deducted* *Committed* *Note* *WhoDidIt* ***GrantorID*** *DateModified* **PROJECT-RUNIT** *ProjectID* *UnitID* **RESUNIT** *UnitID* *Type* *UnitName* *SubUnit* *UnitAddress* *Contact* *WopenHour* *WcloseHour* *EopenHour* *EcloseHour*

TABLE 7 : Optimized Relation... (continued)

PUBLICATION *ItemID* *Title* *CopyNo* *VolumeIssue* *Form* *Abstract* *Pages* *ProjectRelated* ***ProjectName*** *Availability* ***Parentcode*** ***ResearcherID*** ***ResCat*** *Type* *DateModified*	**SOURCEPUBL** *Parentcode* *ParentNname* *Editor* *Language* *ISSN* *ISBN* *Format* *Country* *Publisher* *PubDate* *Edition*	**PUBLICATION - RUNIT** *ItemID* *Unit ID* **PROJ-CORRESP** *ProjectID* *CorrespID* *LetterID*	**CORRESPONDENCE** *CorrespID* *LetterID* *CorrespAdd* *ToWhom* *Form* *InternalNotes* *DateCorrsp* *DateSent* *DateCreated* **LETTER** *LetterID* *Type* *Source* *Text*

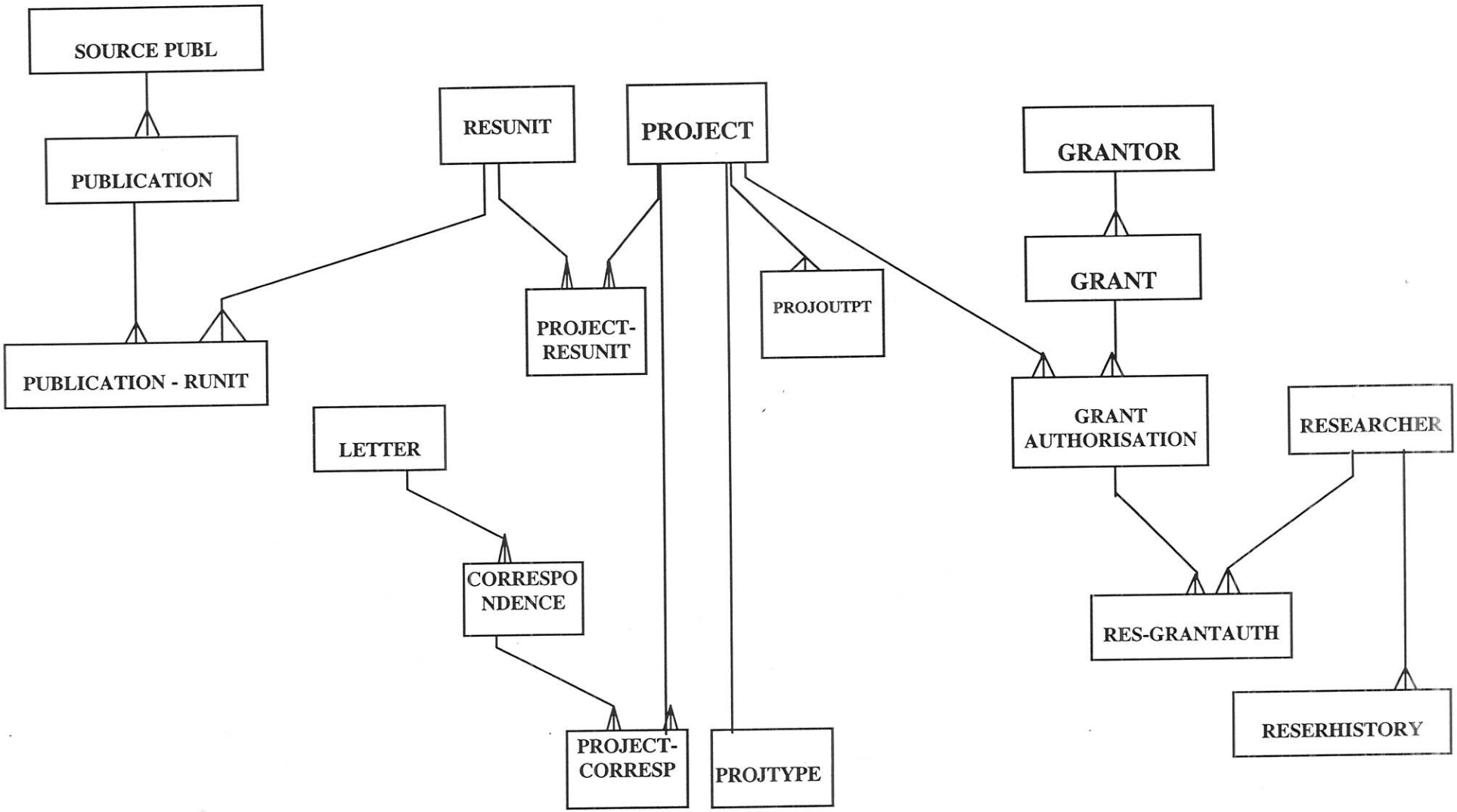


FIG. 10: ERD of the Required Logical Data Model (final)

CHAPTER FIVE

DEVELOPMENT OF THE PROTOTYPE SYSTEM

The purpose of this chapter is demonstrating what the proposed system can accomplish, by taking one component of the system. It has to be clear here that, this is not a fully developed software or simulation of the required system, rather it is just a demonstration. Sample outputs of the prototype and some screen flows are shown in, and the tasks of the prototype are described.

5.1. Introduction

Developing a prototype system, using existing facilities at the School, was found important to test the conceptual model. Microsoft Access 97 was the selected Database Management System (DBMS), amongst the software existing at SISA, for developing the prototype system. Two of the major features of this software, among others, were the factors that make this software a choice. One is its integrity with spreadsheet and word-processing systems. This is an essential feature for the proposed system, because the system supports textual, bibliographic as well as factual (numeric) databases in an integrated manner. And using Microsoft Access 97, the system can produce the required reports financial/Bibliographic/textual etc. in various formats, as per the needs of users. The second feature of this package is its support for linking databases with HTML documents. The University has a plan of having a web page on the Internet, when the necessary technical and administrative procedures are agreed with the Ethiopian Telecommunications Corporation (ETC), which is the sole Internet Service Provider in the country. Therefore, the proposed system can make use of this page and electronically publish its reports, research findings or

other information. The correspondence process can also be handled on-line, using these features of Microsoft Access 97.

MS Access considers each relation/table/entity as an object and the rows of each table as instance of the object. All the objects/tables are stored in one file with .MDB extension. It has to be remembered, here, that the Logical Data Model, which was developed using Entity-Relationship Modeling, have been transformed into relational data base model, in chapter four. This was the first stage of structuring the data model into a set of record types (logical record structure) for latter conversion into data base definition, which is supported by a relational DBMS - in our case MS Access 97.

What is handled in this chapter is the second stage, which is, converting the logical record structure (record types) into database definition. Each table of the Relational Data Model becomes the relation (object) of the DBMS and the name of each relation becomes a table or object name, and the attribute names (the columns) become field names.

The database defined using MS Access, the relationships, and other details of the prototype are presented with different diagrams, charts, tables and figures.

In addition to demonstrating some of the functions of the proposed system, the prototype attempts to indicate the necessary measures that are required at the stage of implementation. For this purpose it was tried to show how data integrity and security could be achieved while implementing the database using a relational DBMS like MS Access.

DATA INTEGRITY

There are three techniques used to keep the integrity of data: - The Domain constraints, the referential integrity constraints, and Entity Integrity.

The Domain constraint enables to reject any attempt to enter data value outside the domain set for each data item. The software chosen for developing the prototype enables controlling domain constraints at the time of database building through defining Validation Rules for every field. When an attempt is made to enter data values that are not in the domain, the Validation Text is displayed commenting on the error and indicating the domain that should be imposed for each field.

Referential integrity enables to keep the integrity of data through enforcement of foreign keys. In the Logical Data Model of the required system the notations of participation class indicate the relationships that impose referential integrity. If an entity participation in a relationship is Mandatory it requires Insertions, Update and Deletion Referential Integrity. In the prototype this was demonstrated using the Impose Referential Integrity, Cascade Delete and Cascade Update features of Microsoft Access, at the time of creating relationships between tables.

Imposing referential integrity on parent and child table relations protects the appearance of orphan records; that is, entering records in the child tables will be impossible if there is no related record in the parent table. Similarly, when a record in the parent table is updated or deleted the related records in the subsequent child tables will automatically be updated or deleted using 'Update and 'Delete' Action queries. Actually it is tried to take safety measures specially in the case of deleting records due to the fact that users may unknowingly delete necessary records. Therefore, prior to running the 'Delete Query', a 'Select Query' searches

for the to be deleted records, display them and requests confirmation for deletion. The user may confirm or cancel the delete event after browsing the record set.

Through these techniques we can maintain the consistency of the fields that relate one table to the other.

Entity Integrity is achieved through setting all the primary key values to 'Required' or 'NOT NULL' specially when the primary key is not composite and the entity is at the one end of one-to-many relationship. Any attempt to insert or add a record without assigning the primary key value would be rejected, if the primary key were set to 'Required' or 'NOT NULL'.

DATA SECURITY

There are different techniques used to secure data from unauthorized personnel from accessing or manipulating complete records or the whole database.

Among the techniques used some of them are: assigning passwords to the whole database or some menu items like- DataEntry, hiding some fields (columns) from display, and creating forms of different status such as read only, insert only, update.

The major technique used for protecting the data from unsecured manipulations (editing, updating or deleting by unauthorized parties, is forming different user groups like Administrator, System User and End User. These groups are assigned their own identifications (passwords) and their scope of accessing the data is limited to their category. For example end users can only view, print or save on disk what they get from pre-stated

queries or the different reports. They cannot add, edit or delete records. Similarly System users as well as end users are not allowed to have access to the Database window so that they could not make modifications to the database structure or any database object without the permission of the Administrator.

LINKING THE TABLES

The prototype system gives more emphasis on the reporting function (module) of the proposed system. There are different periodical (scheduled) reports that are required by the system users, there are also unscheduled ad-hoc queries. Therefore, it was tried to address the requirements of the scheduled reports and to simulate some possible ad-hoc queries. For this purpose different queries that search for answers from different tables of the database were designed. To provide answers to these queries the tables are linked using their primary and foreign keys.

The linking is basically made using the relationships identified through the design stage. This relationship is indicated in the ER Diagrams & in Table 7 in the previous chapters. The data elements/items (attributes) are also described. However, few additional joins were also included to make the information retrieval (access/path shorter for some queries and to reduce the huge number of fields in some data entity forms. These aspects of the prototype are further discussed in the next sections.

5.2. Description of the Prototype Application

The program can be invoked by double clicking its shortcut icon at the desktop or it can be invoked at the time of invoking Microsoft Access program. At the time of invoking the program the welcome screen appears and at a click of OK the main menu, which lists the major functions of the prototype.

The prototype consists of a main menu and different sub menus that are under the different main menu items. Some of these menus are not active menus, i.e.; they may not invoke an application at a click. However, they are designed just as a template to show what full implementation of proposed system may consider Eight of the Eighteen sub menus are active menus that are required for the two modules considered in the prototype. Description of these menus is as follows.

5.2.1. USER INTERFACE

One major issue which have to be considered upon developing a computer based information system is designing an access mechanism that is as friendly and easy as possible to the end users. For these purpose a user interface has to be designed which is suitable for preferences of average users. On this intention, it was tried to include questions, in the questionnaire, which address User Preferences from different dimensions such as access point preferences, format preferences, form and layout preferences. The core user groups (Staff of the RPMS) were also persuaded to comment on the designed interface. On the basis of the information gathered in the mentioned ways the to be described User Interface is developed.

The User Interface comprises the Menu System, Input/Output forms, Dialogue and Message Boxes, and on-line help facility.

THE MENU SYSTEM

The Menu System consists of MenuBars, PullDown Menus, SubMenus, Custom ToolBars, ShortCut keys and ShortCut menus. Creating Custom menu bars and PullDown menus/submenus was believed and agreed upon, with the users, to be better than creating form based switchboards for the following reasons. MenuBars and PullDown menus have two major advantages over switchboard menus. These are the visibility of the MenuBar throughout the application and the visibility of the menus and submenus to the last hierarchy until a command (menu item) is selected or the focus is changed to another MenuItem in the menu bar. In the case of switchboards whenever a submenu is selected the menu at the higher level losses focus and can be hidden behind the current submenu form. Therefore to return to the menu at top hierarchical level, either all the currently opened submenus have to be closed or a link button has to be there in the submenu forms. Unlike switchboards, custom menus do not need opening and closing. Clicking at the menu item in the MenuBar, menu or submenu automatically makes visible the PullDown screen of the lower level menu, and clicking anywhere else enables to loss focus of that menu window.

Furthermore, it was tried to make the menu system not restricted to mouse-clicks only. Selecting a menu item was also enhanced to add keyboard selection. Shortcut keys were also assigned to some basic and repeatedly used functions in order to shorten the menu path and reduce the effort of displaying different menu hierarchies. Therefore, the user may use any of the above mentioned options as he/she wills. For instance, to search the database users may click InfoRetrieval from the MenuBar and SearchDBfromthe PullDown menu, or using the

keyboard they may press ALT+ I then S, or they may simply press F2 all these actions would bring the Search screen.

Custom ToolBars are the other components of the menu system, as said earlier. It was tried to select basic built in commands that are commonly used by majority of the sub modules, and customize the built in toolbar for the prototype. The custom toolbar added greater efficiency to the menu system through directly and instantly executing important commands such as save, print, cancel (undo) etc.

One last component of the menu system, which is added for the purpose of demonstrating the potential of the software (MS Access 97), is custom shortcut menu. For example at a right click of the mouse on an output form, a shortcut menu pops up with options like print, save on disk, publish to the web.

To show the cons and pros of MenuBars in contrast with switchboard menus, a couple of switchboard menu screens are added in the screen flow diagrams.

THE MAIN MENU (The MenuBar)

The main menu appears after the welcome screen has been displayed. This menu provides four major options to access the database and one option to end the application together with other options like File, Tools, and Help. Under each option to access the database there are hierarchies of sub menus. For example when the first menu item (option) in the main menu - DataEntry- is selected, the user is asked to enter his password (ID). At the entry of valid passwords different sub menu hierarchies - in this case four- appear. Under the different options (list) which appear at every sub menu hierarchy, a total of 18 submenu appear under different hierarchical levels. However, if the screen flow is considered the number of sub

menus can grow up to 26. This is because there are some sub menus that are repeatedly invoked from different options at different hierarchies. For example the 'Project Categories' sub menu is invoked from four different sub menus at three menu hierarchies.

Sample screens of the user interface are presented below.

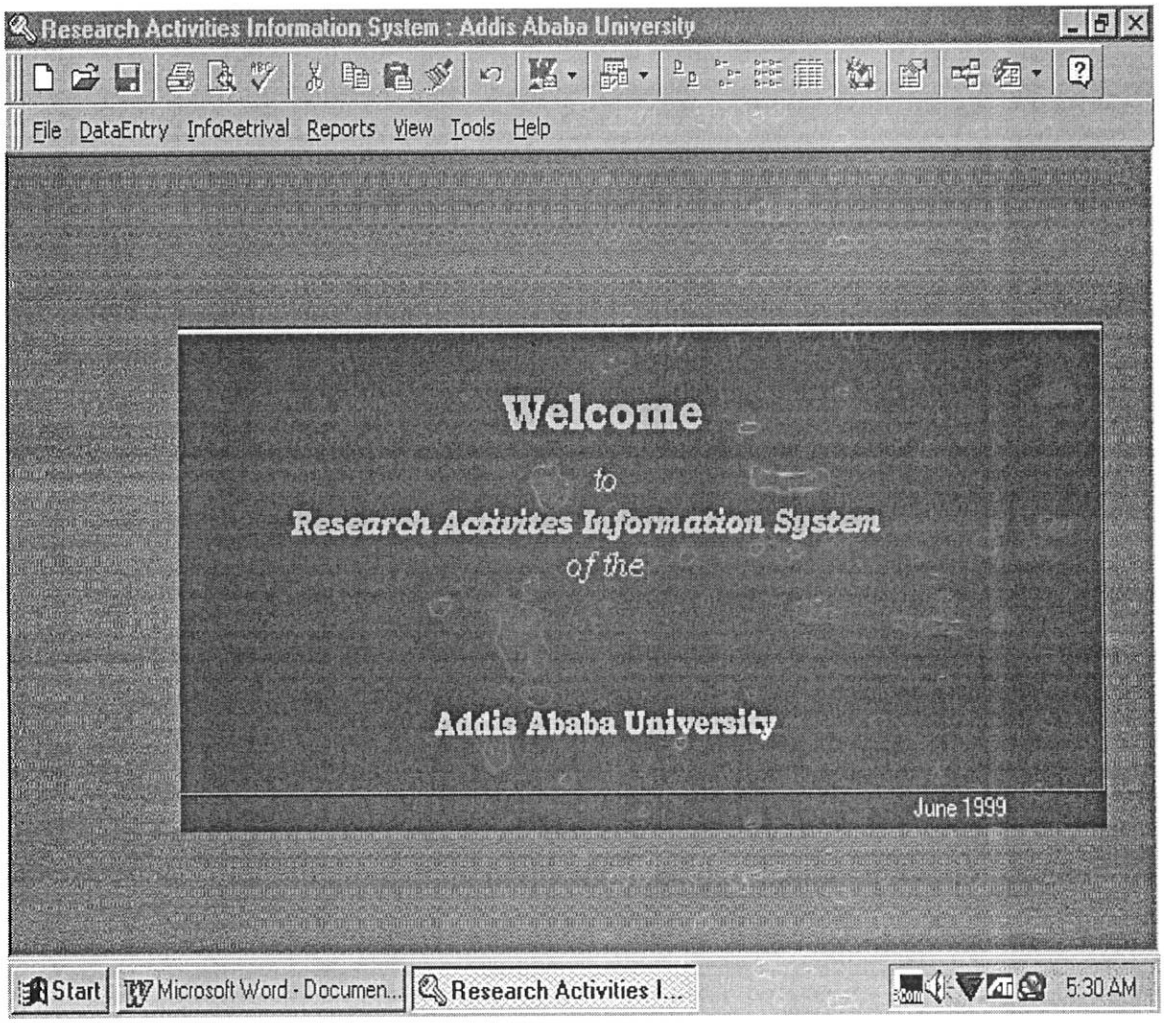


Diagram 1: The Welcome screen

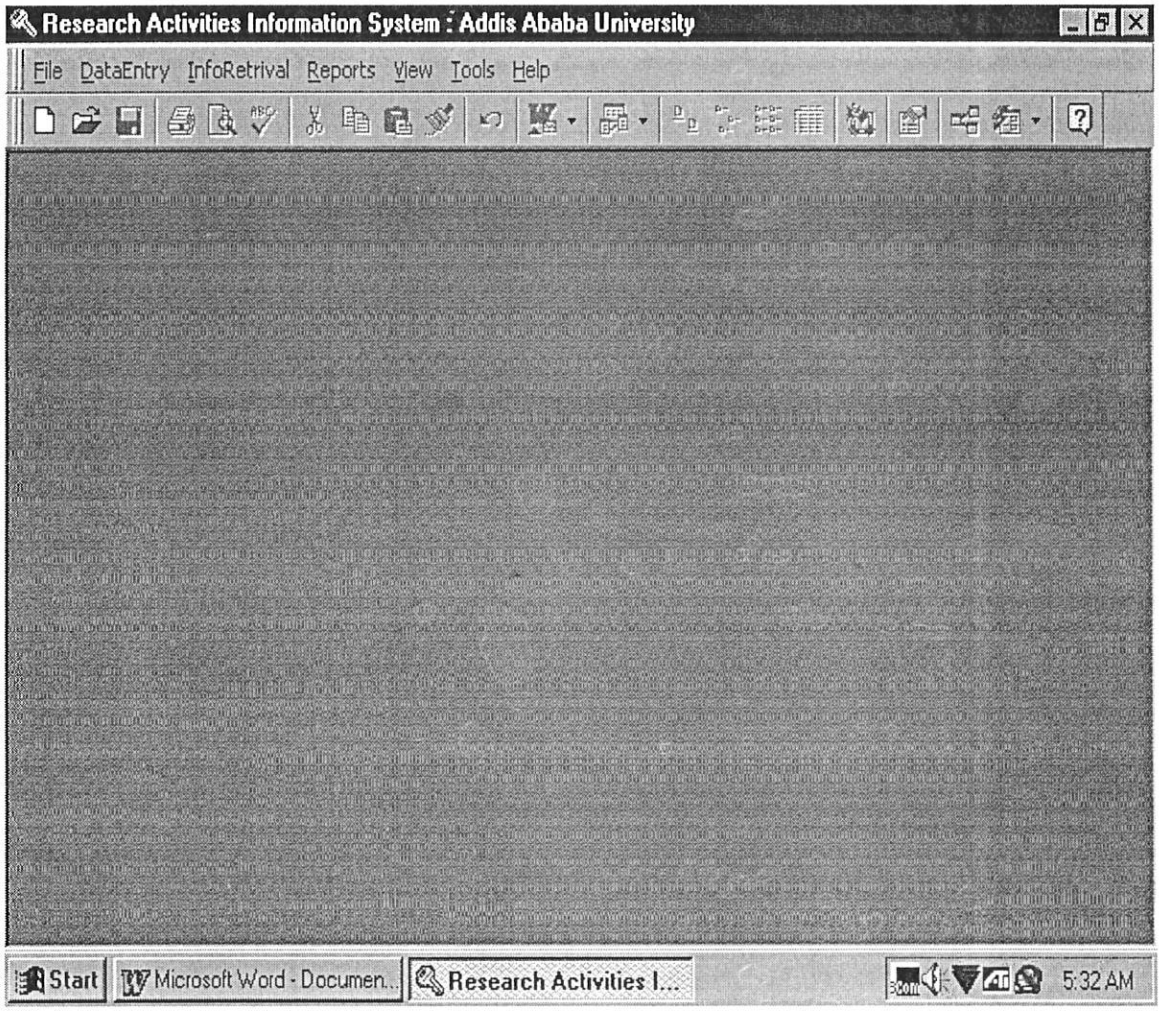
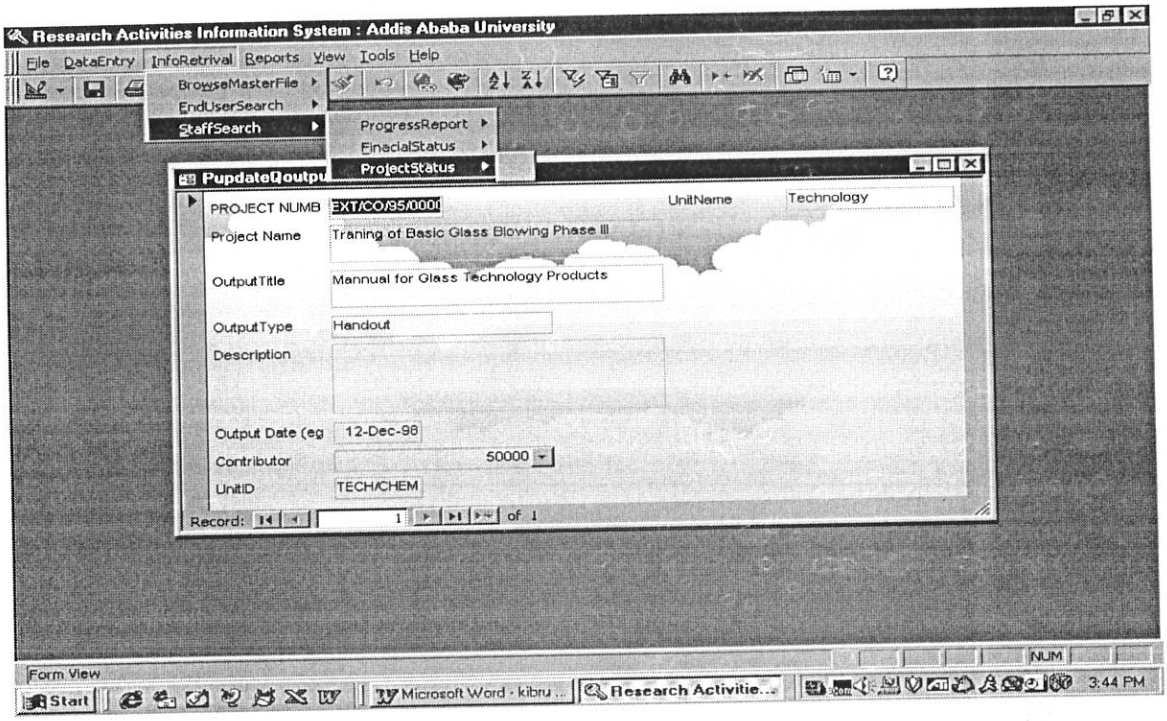


Diagram 2: The Main Menu Screen (the Menu Bar)



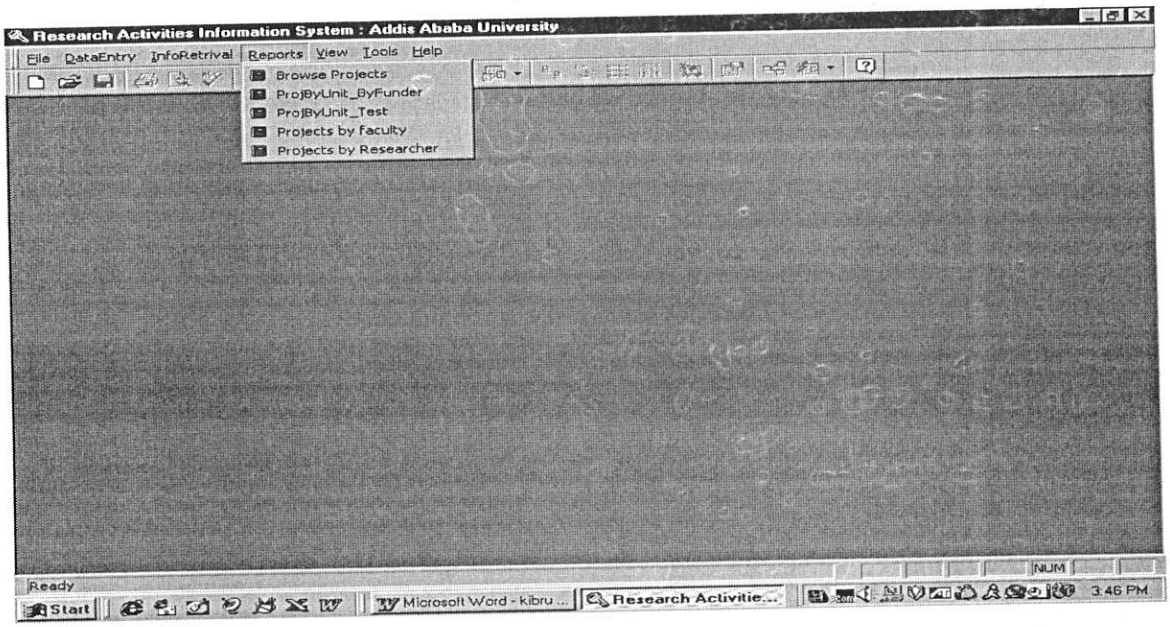
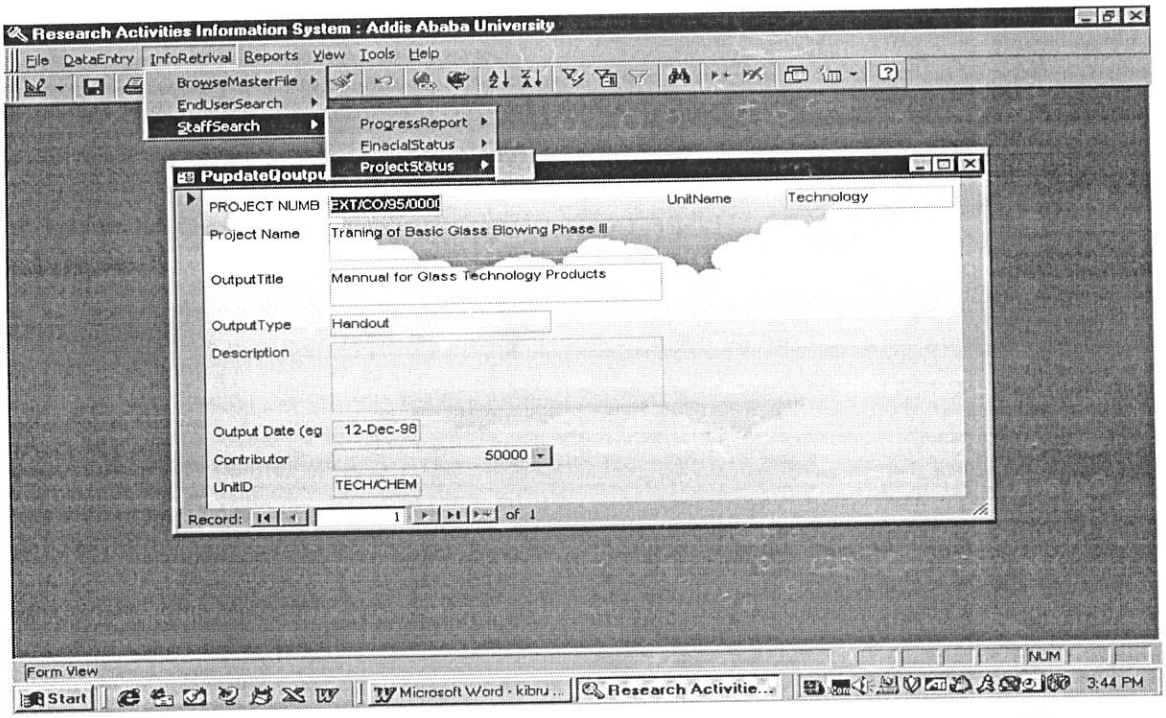
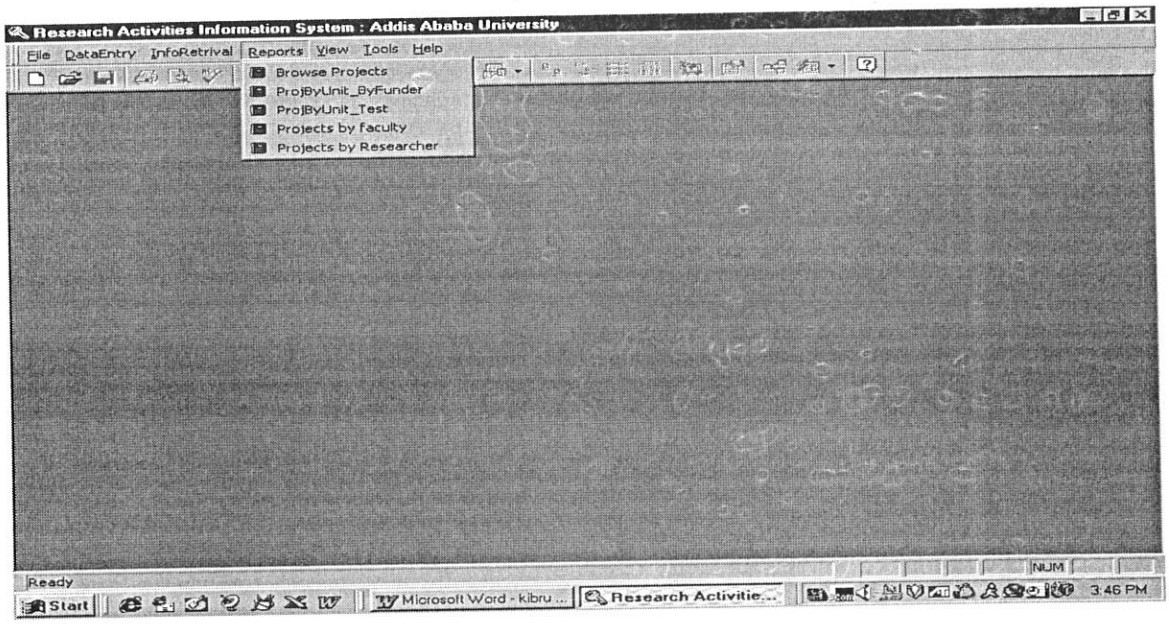


Diagram 3: Sub Menu Screens for two modules (Monitor Progress and Generate Report)





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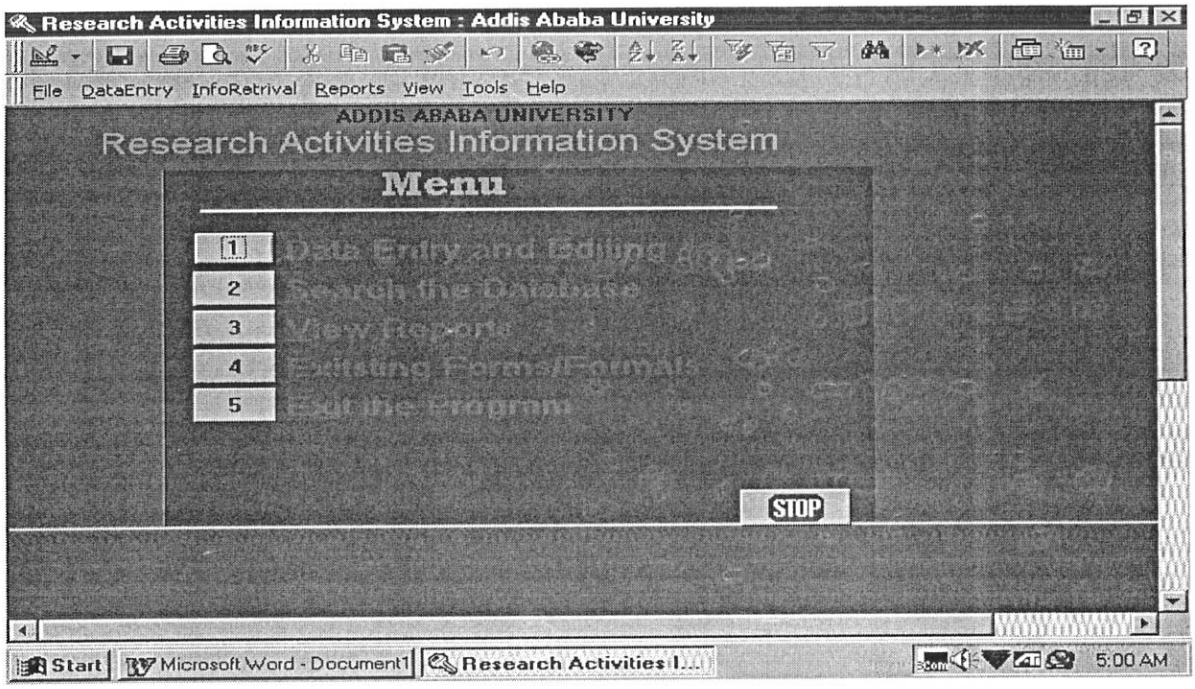


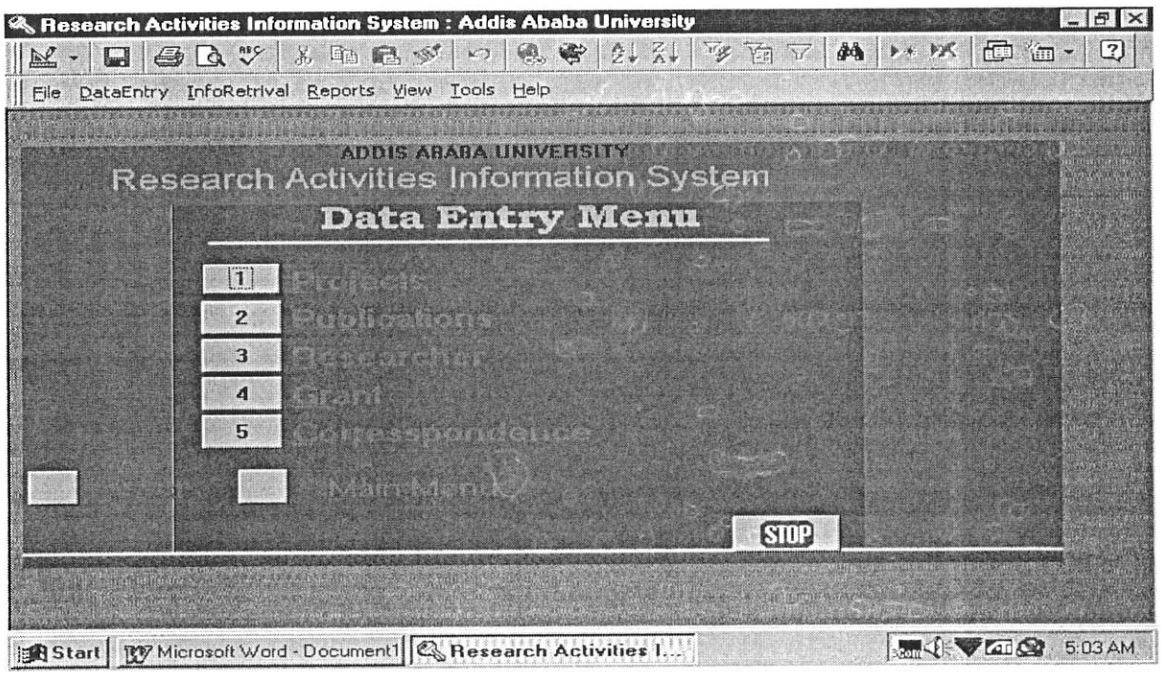
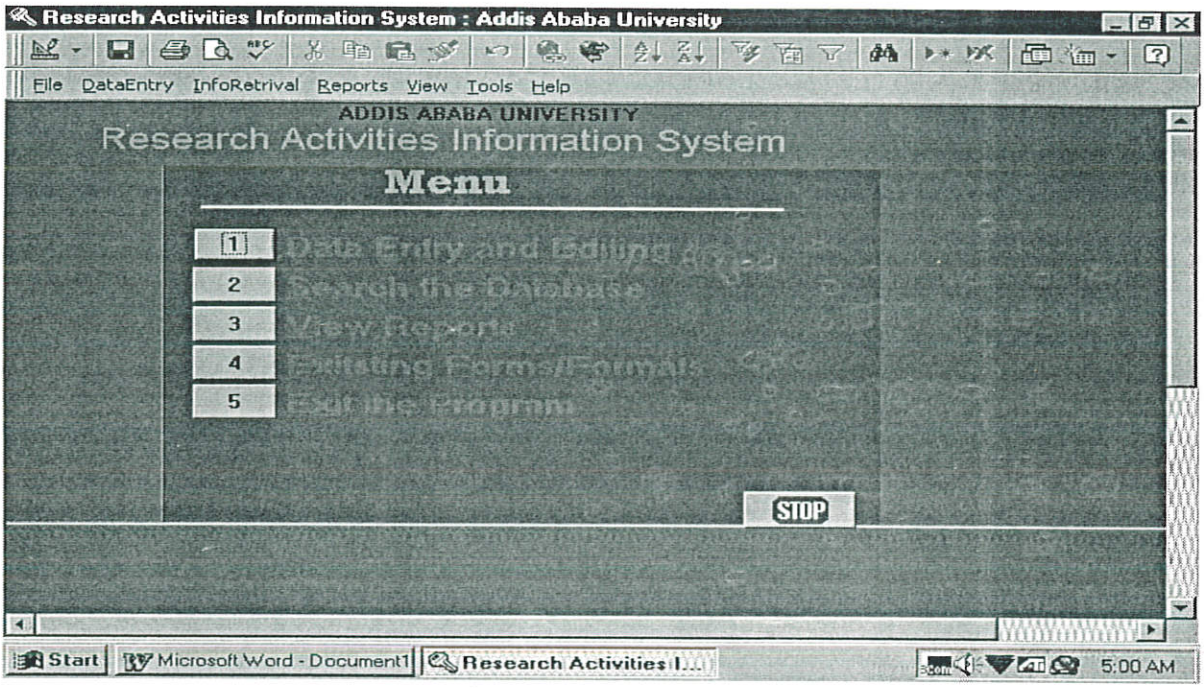
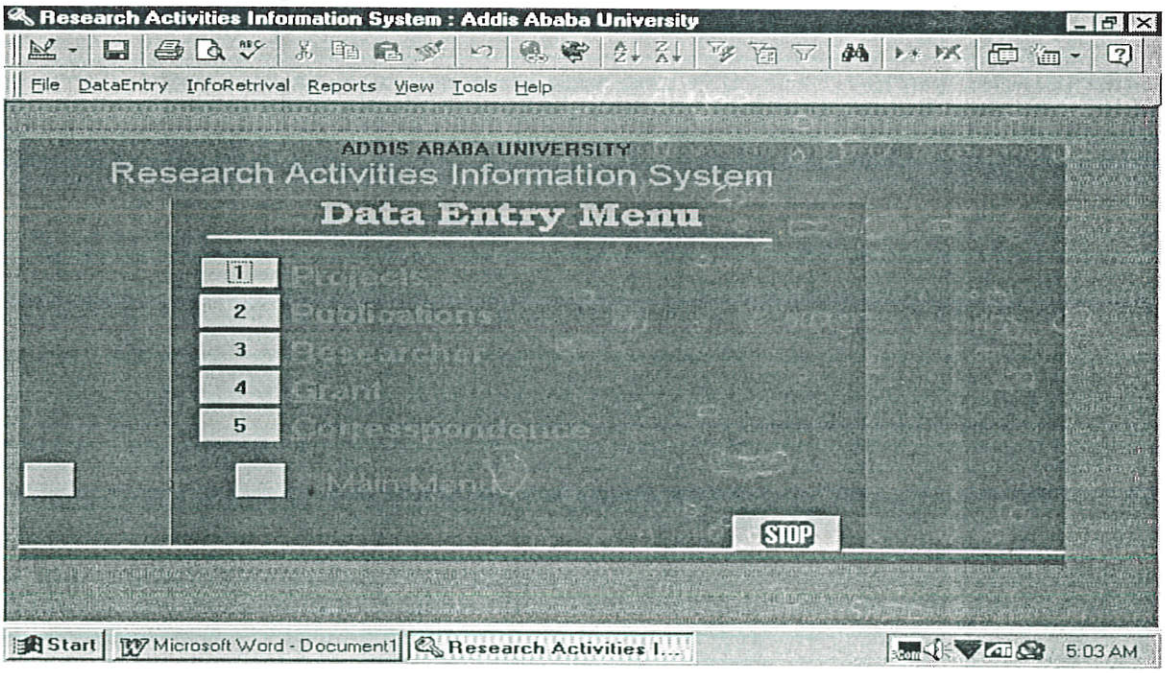


Diagram 3: Screens for Switch Board (form) menus

Note that in the above screens the submenu – Data Entry window covered the main menu





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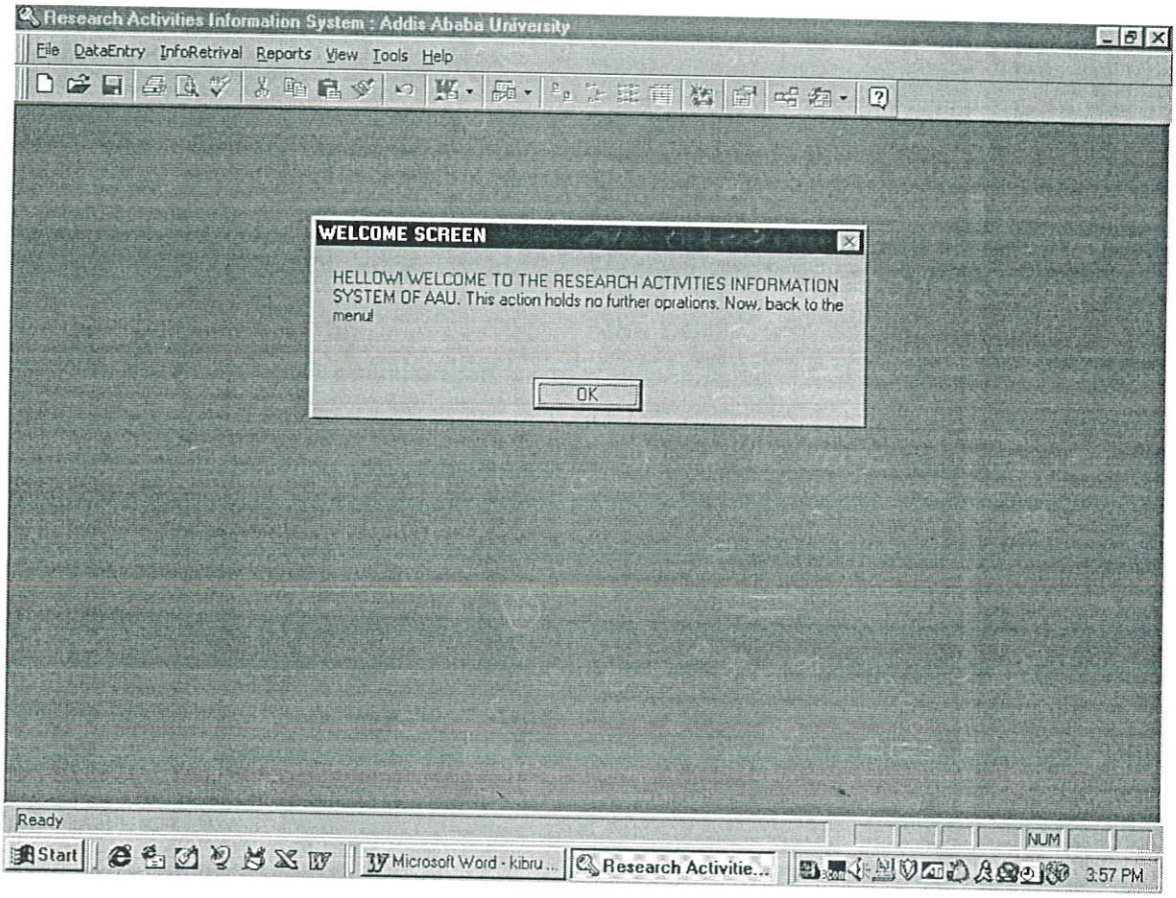


Diagram 5: A Message Screen

The menu items listed in the different menus and sub menus represent the different processes (modules) which the proposed system is required to comprise (These modules are indicated using DFDs in Chapter 3). As indicated earlier this prototype system mainly considers two modules - Monitor Progress and Generate Reports. Specifically the Reporting module is given further emphasis. In fact some sub processes from other modules were included for data entry purposes - e.g. the sub processes of 'Process Application' module. The remaining modules that are out of scope of the prototype were included in the menu system, however, their application couldn't be activatedfromthe menu, rather a message that comments on the now mentioned fact is displayed. Including them in the menu system was done just to create template for the overall system and to point out the applications that shall be included on full implementation.

FORMS DESIGN

Input and output forms are designed to interface the system with the external environment. Similar to the other components of the User Interface the Input Output forms were designed taking into consideration different user categories (group). In line with these categories, different types of forms were included in the prototype. For instance both on-line and printed data entry forms were prepared for system users. These input/output forms were grouped in to two categories. The forms in the first group are prepared for the purpose of adding new records in the master file, and they include almost all the necessary attributes (fields) from several tables. These forms are to be used when a new project is to be registered, a new grant account is to be appended, a new researcher's profile is to be added, etc. Although there are several forms in this category, it was tried to create a harmonious link among the entire major and sub forms that hold related fields to a particular subject. Therefore, when a data entry clerk selects 'Add New Project' from the menu all the appropriate forms will be opened and

The menu items listed in the different menus and sub menus represent the different processes (modules) which the proposed system is required to comprise (These modules are indicated using DFDs in Chapter 3). As indicated earlier this prototype system mainly considers two modules - Monitor Progress and Generate Reports. Specifically the Reporting module is given further emphasis. In fact some sub processes from other modules were included for data entry purposes - e.g. the sub processes of 'Process Application' module. The remaining modules that are out of scope of the prototype were included in the menu system, however, their application couldn't be activatedfromthe menu, rather a message that comments on the now mentioned fact is displayed. Including them in the menu system was done just to create template for the overall system and to point out the applications that shall be included on full implementation.

FORMS DESIGN

Input and output forms are designed to interface the system with the external environment. Similar to the other components of the User Interface the Input Output forms were designed taking into consideration different user categories (group). In line with these categories, different types of forms were included in the prototype. For instance both on-line and printed data entry forms were prepared for system users. These input/output forms were grouped in to two categories. The forms in the first group are prepared for the purpose of adding new records in the master file, and they include almost all the necessary attributes (fields) from several tables. These forms are to be used when a new project is to be registered, a new grant account is to be appended, a new researcher's profile is to be added, etc. Although there are several forms in this category, it was tried to create a harmonious link among the entire major and sub forms that hold related fields to a particular subject. Therefore, when a data entry clerk selects 'Add New Project' from the menu all the appropriate forms will be opened and

closed in sequence until he/she finishes entering the data available on the currently existing Printed 'Project Proposal Form' - or selecting Exit. The second category of data entry forms is prepared for transaction purposes. These forms hold selected fields that are involved in the different transactions of the application. Majority of the forms in this category is used to update fields and some are used to add new transaction. For instance at the time of progress report there may be two forms involved - one which updates the status of the project and the other which records new project outputs (published or unpublished) if there are any.

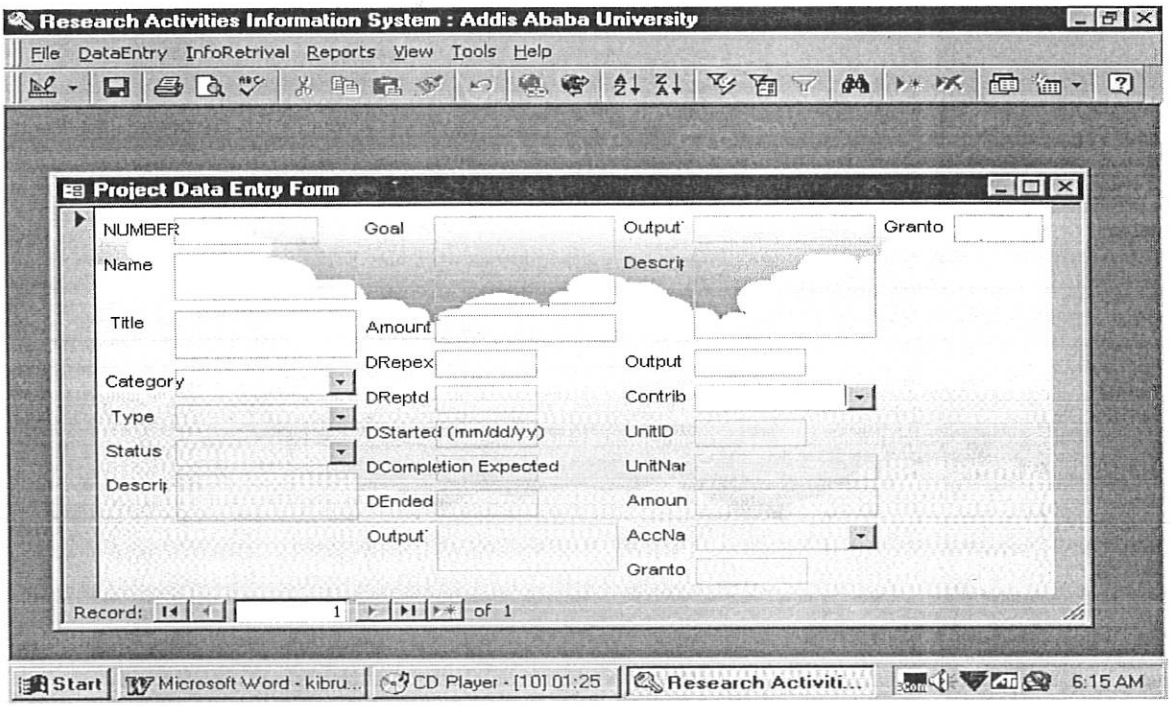


Diagram 6: Sample Input Form

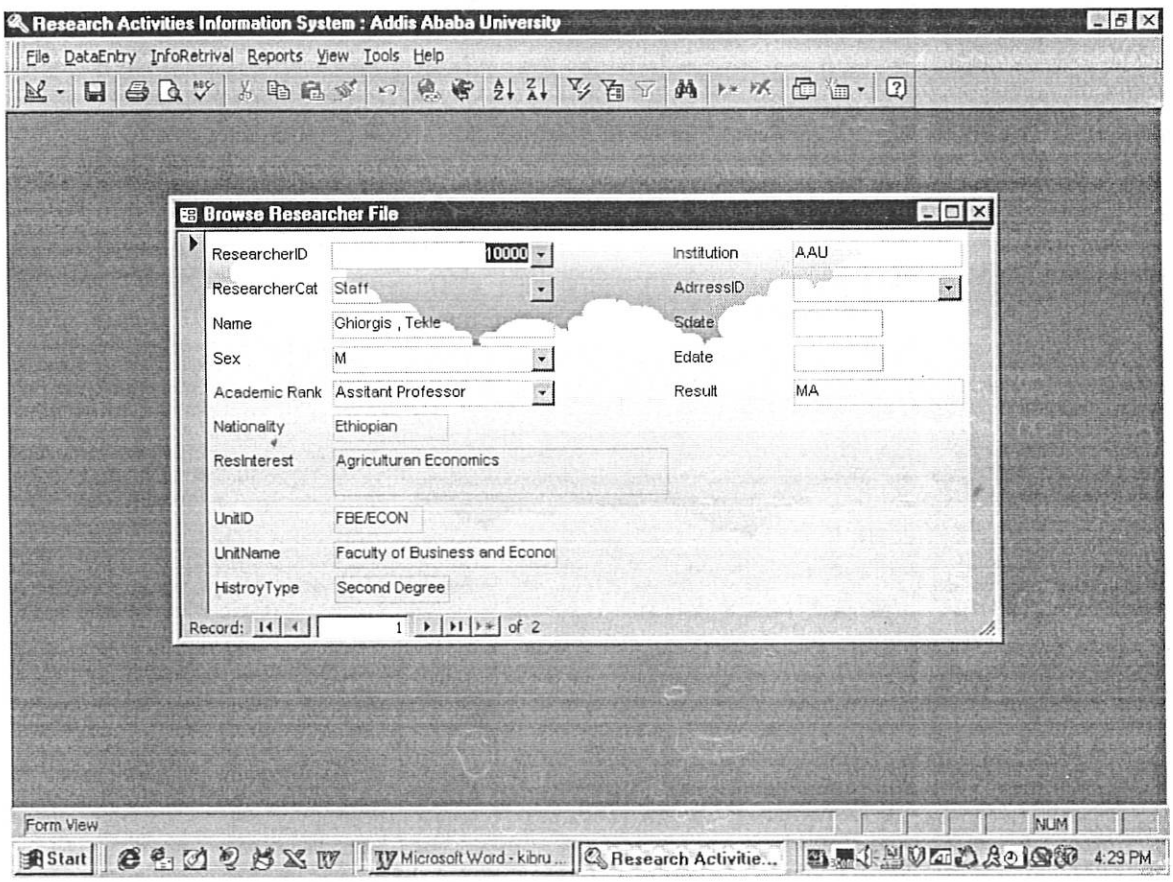
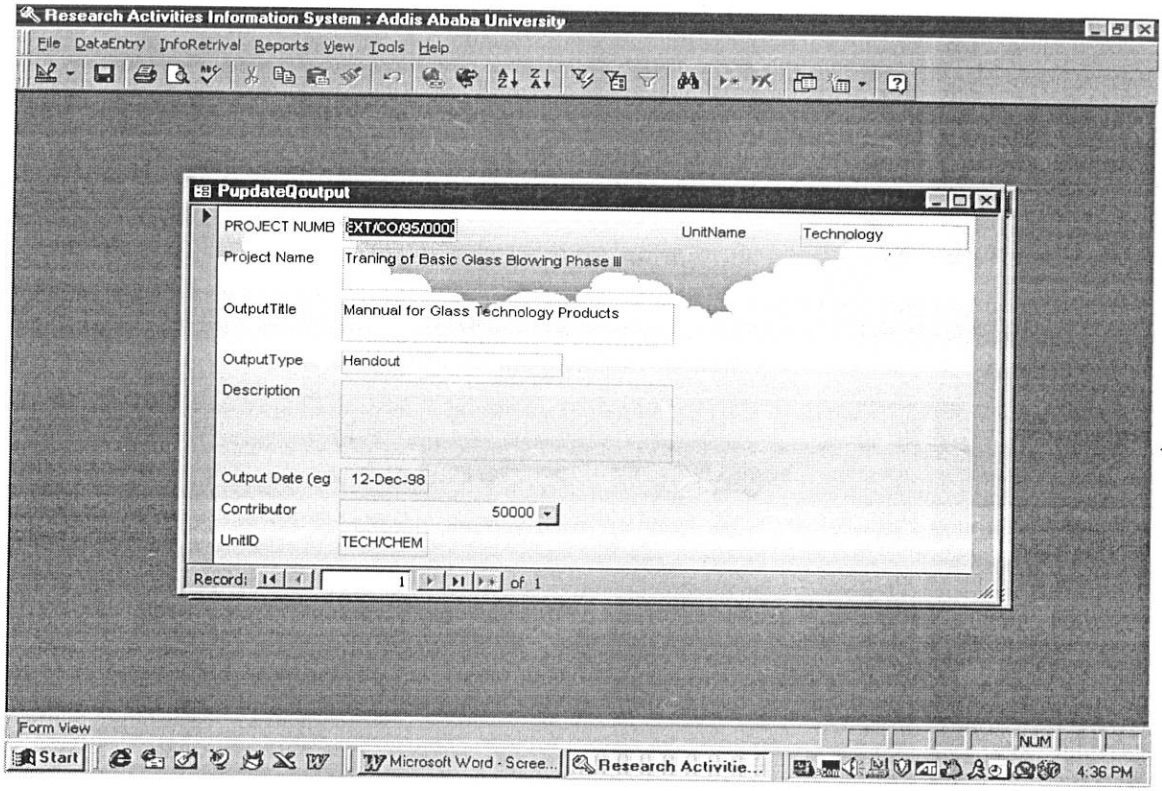


Diagram7: Sample Output Form



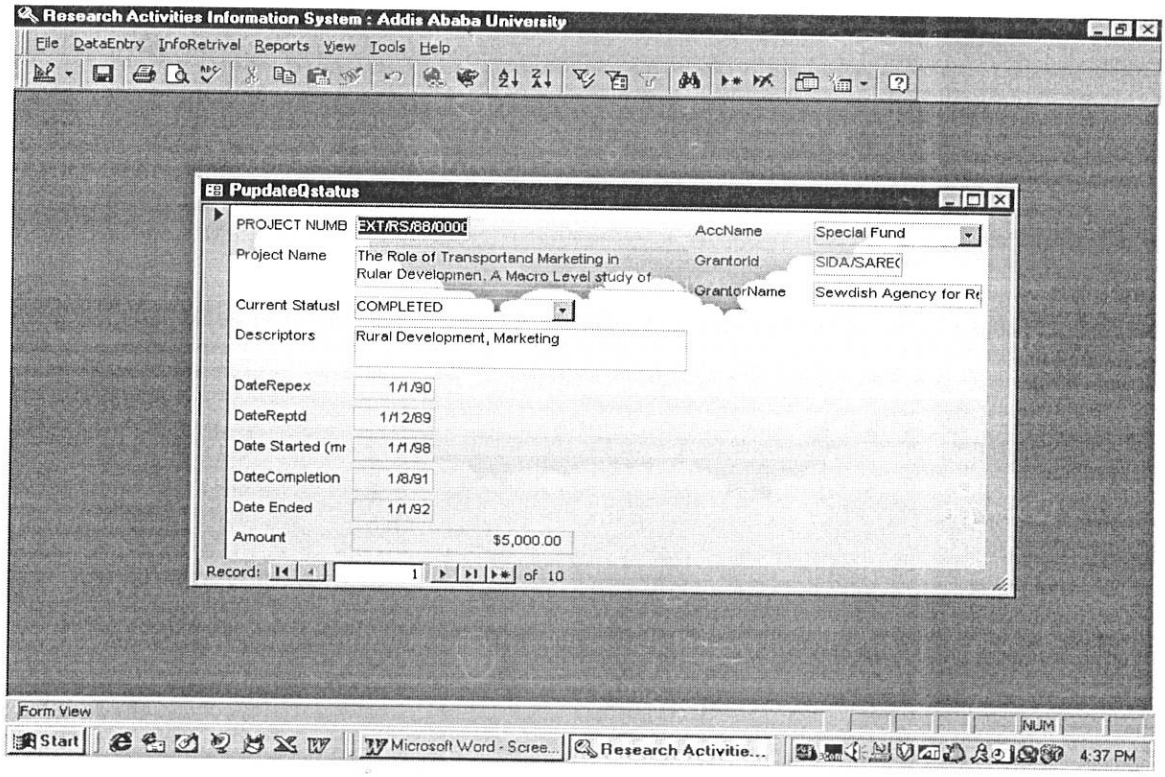


Diagram 8: Transaction (update) forms

The forms in both of the above categories may also be used for Browsing and Editing Purposes. Therefore, they serve as input as well as output forms.

The other types of forms are those which address the end user group. The input forms in this group are prepared for on-line searching (ad-hoc reporting) purposes. These forms are fill-in templates that expect input from the user for different fields, i.e. the search screen with blank spaces to be filled. Query results are also displayed in read-only output forms.

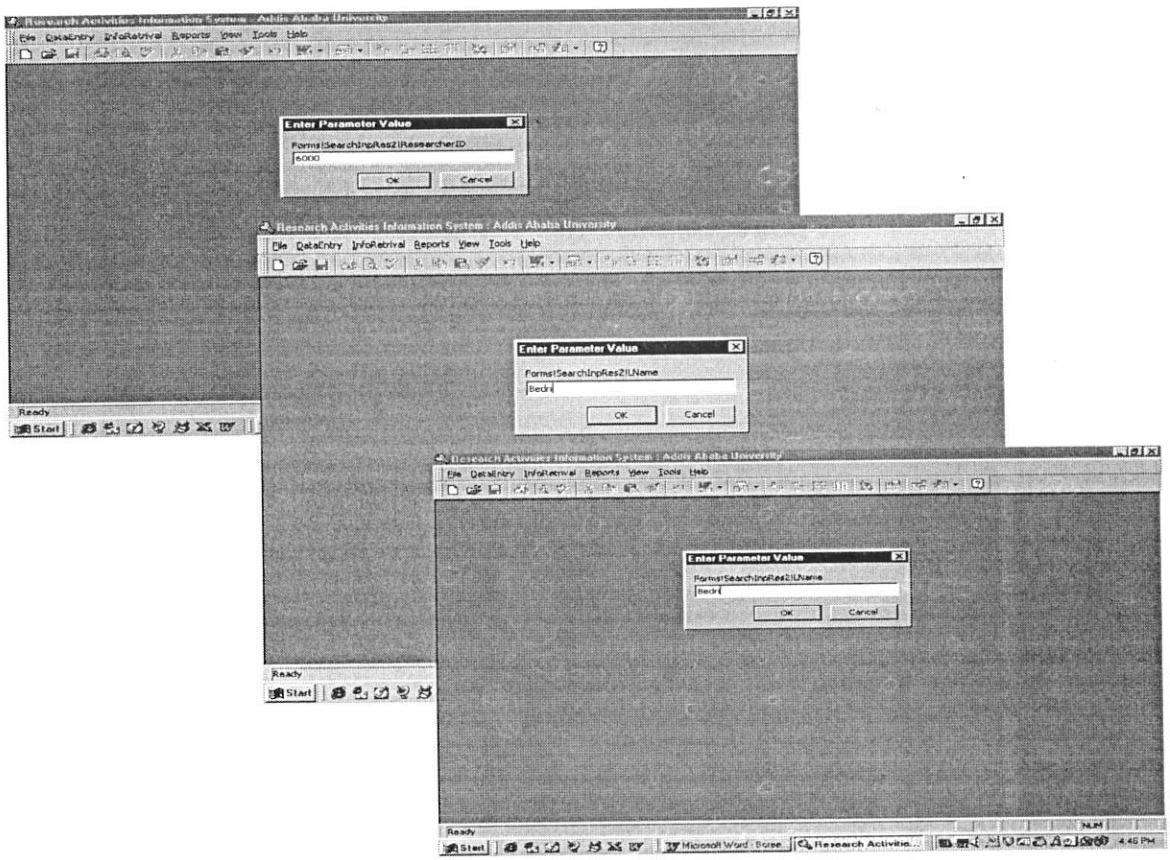


Diagram 9: Search Screens

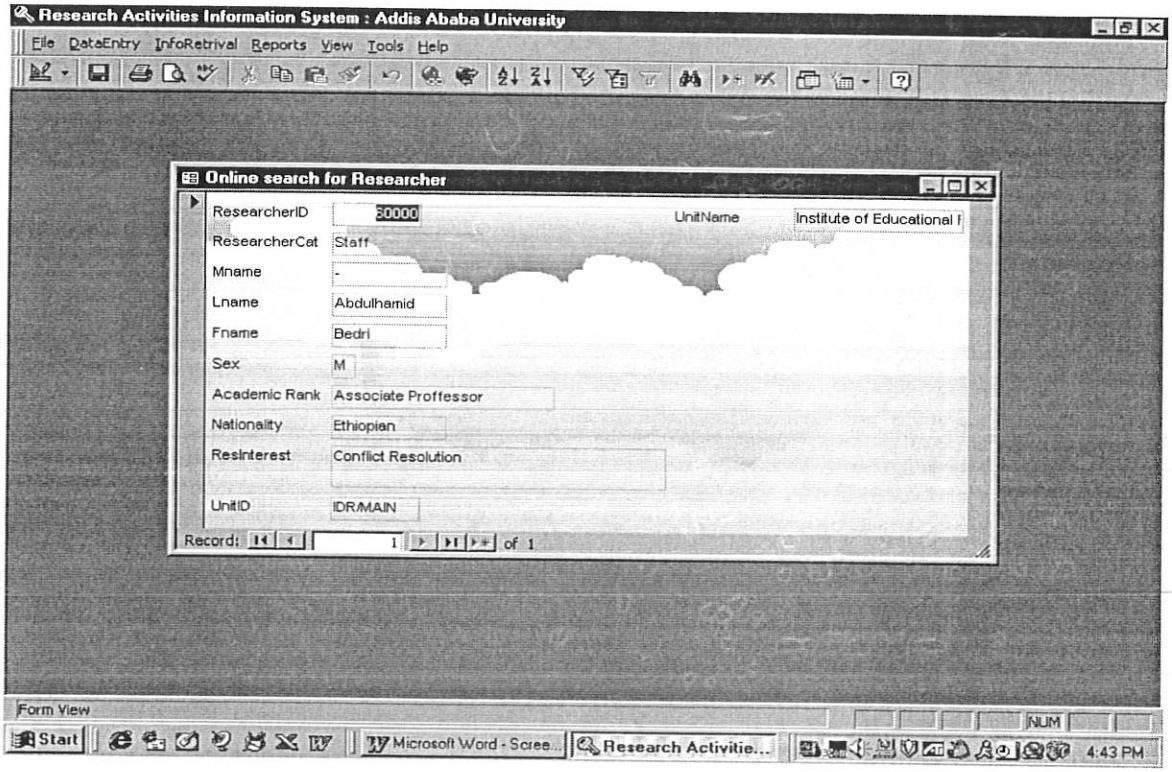


Diagram 10: Search Output

In general majority of the input forms described above are designed in relation to every table (data source) available in the system. Almost all the major tables have distinct forms. Except link/intermediate or child tables. In the case of child tables two techniques were used. When the number of data items in the parent table is few, one form is designed for both the parent and child tables. For those tables with many data items, a sub form, which is invoked at a click of a button on the main form, is designed for the child tables.

Each form is assigned a form number and a form type using the source table it accesses and the purpose it serves for.

Some common data items that appear repeatedly in different tables are also grouped under one structure and a separate form is designed for them. For example Address appears in different tables and instead of repeatedly designing entries for address at the different tables, a single form is designed that is invoked whenever data entry of Address in a certain table is required. Similarly, contact is also handled in a separate sub form.

On every sub form there is a button [BACK] that, upon click, closes the form and returns control to where the form was invoked.

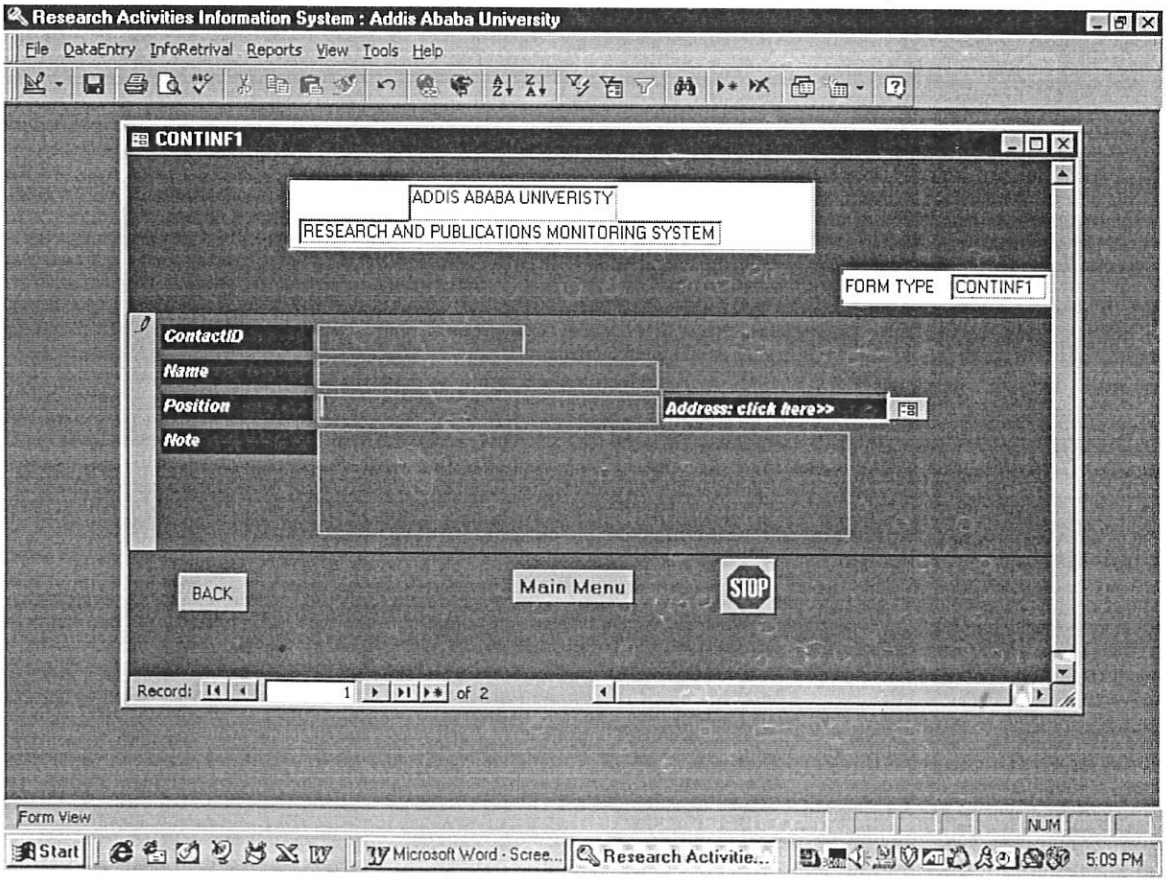


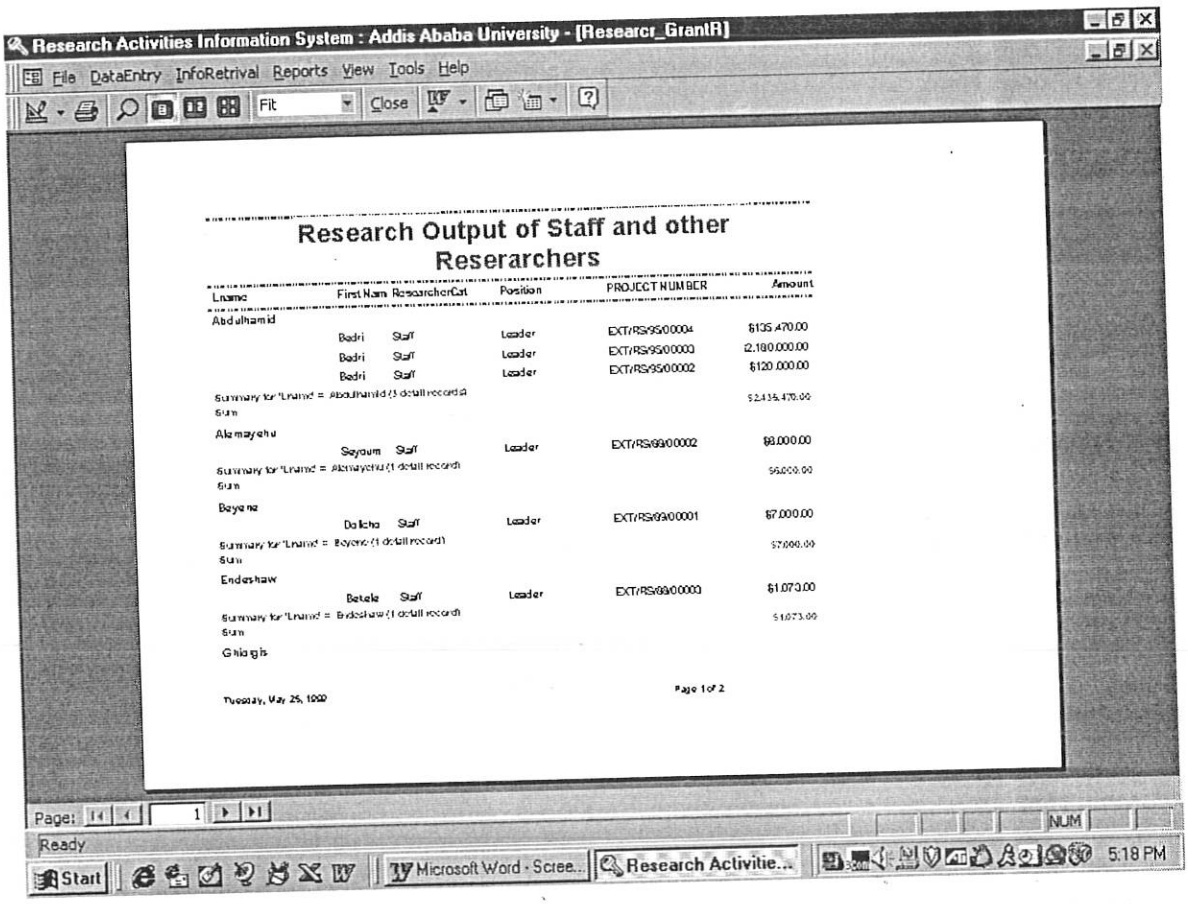
Diagram 11: Sample Input/Output Form for Common Data Items

In most of the forms, as it can be seenfromthe above illustrations, there are different facilities added to make the data entry easier and friendly with the user. To protect users from defying validation rules and inputting incorrect formats ranges and formats are indicated. For example for fields which shall receive values in a domain a list box, combo box or options groups are displayed for the user either to select and click one or to key in a value in that domain. Redefined formats are also indicated on the forms. Otherwise, different validation messages are displayed when a user attempts to enter data deifying the validation rules.

Quires and Reports

The proposed system is required to generate, on implementation, different scheduled reports at different intervals from different parameters, for different purposes and destinations. Bi-annual Financial Reports, Quarterly Progress Reports, Monthly Progress Report Notifications, Annual Research Activity Reports, Annual Faculty Grant Utilization Reports, etc. are some of the required reports. The prototype system includes some of these reports - except the Finance related ones- to demonstrate what could be achieved when implementing the proposed system.

Majority of the Reports use the above mentioned queries as their record source. What they add is giving the presentation a better illumination and including some features like grouping in section, presenting a spread sheet looking outputs, and so forth. One additional feature of the reports is the Publish to the Web facility. Using this feature it is possible to simulate (present) sample reports at static web pages so that users who have access to the page may view them.



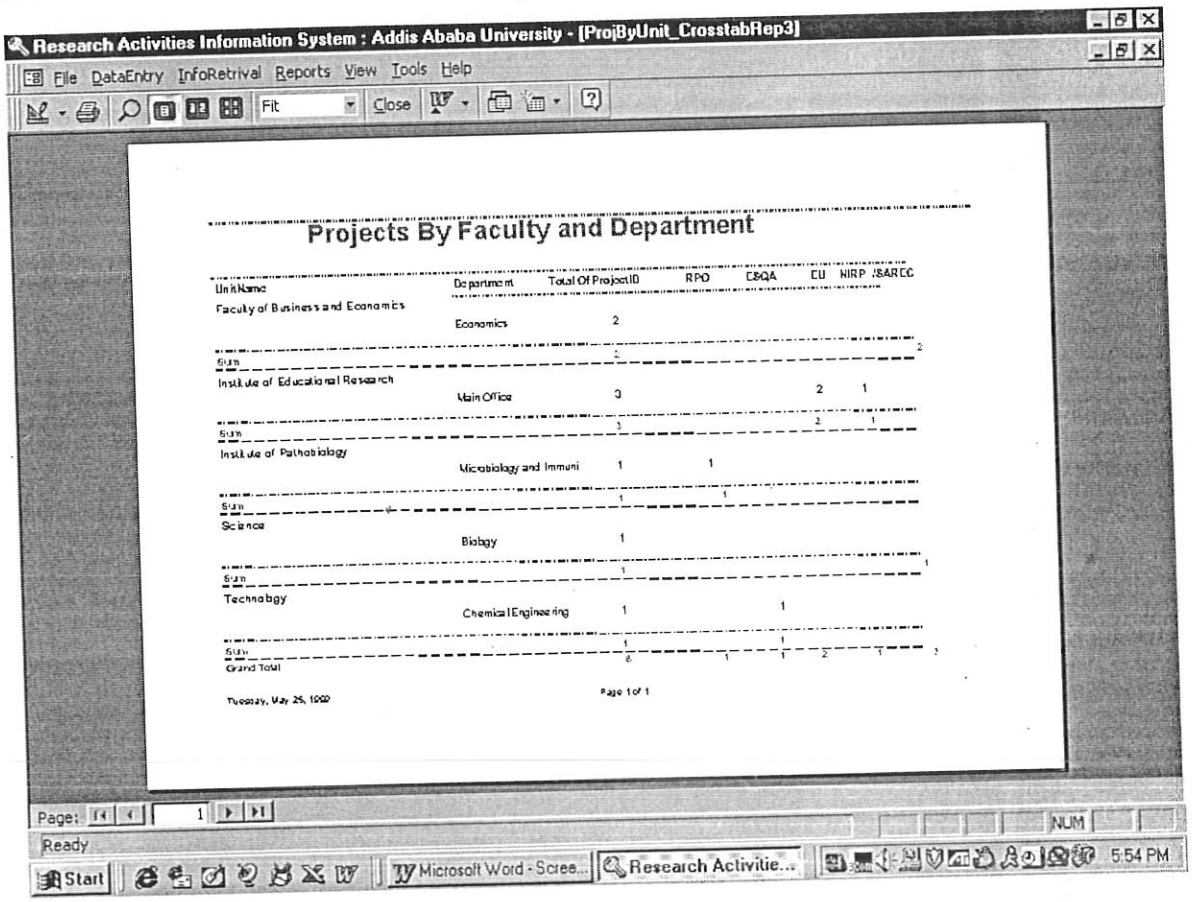


Diagram 12: Sample Reports

MACROS AND MODULES (VISUAL BASIC CODES)

Microsoft Access 97 Macros are useful in creating professional looking automated applications with lesser effort and shorter time than writing Visual Basic Codes. Specially, for prototypes, which are not true applications, most of the functionality needed could be achieved using macros. In this prototype it was tried to exploit the best out of macros and to add a few modules using Visual Basic for Application (VBA). The major areas macros were used include- Opening and closing and harmoniously linking input/output forms, customizing and adopting in-built commands, running queries, setting values to fields based on User's input, and creating .exe file for the prototype.

As the above paragraph indicates majority of the functionality required for an application which may need writing VB codes was handled through customizing in-built commands and functions and exploiting the potential of MS Access macros. Therefore, sweating on VB Programming was not found to be that much important.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATION

6.1 Conclusion

The study is aimed at examining information handling mechanisms of the research and publications system of the Addis Ababa University, and proposing a computer based information system that would support tasks of monitoring research activities as well as disseminating research outputs of the University. Attempts have been made to develop the conceptual model of a more flexible system that would allow design of different applications with different reporting formats as per the needs of users, and to organize and manipulate statistical data useful for research administration, planning, staff research output monitoring and budgeting purposes.

An Information System that aims at supporting research activities at a University wide level, can be expected to cover a vast domain. The absence of an organized computer based Research Information System in AAU, necessitated this study. Planning a system to fully address the problem with such magnitude and complexity, amidst scarcity of time and financial resources, could not be a wise decision. Instead of attempting to deal with the rather vast segment of this problem, working on a component, based on existing resources, was believed to be fruitful though limited in scope, and significant in terms of initiation of work in this direction. In this regard, this work attempts to plan an information system that would

alleviate the problems in the research activities administration and monitoring component of the Research System of the University. Therefore, the study limits its scope to the University's current (ongoing) research projects and recently completed but unpublished projects. Monitoring the University's research output, i.e. staff publications, being one of the major duties of the system under study, is also covered.

The first task of the study has been surveying the activities involved, in the research and publications monitoring and reporting operations of the University. For this purpose the responsibility, scope and tasks of each unit, which is connected to the above operations, is revised. The survey focused on the Research and Publications Office (RPO), which is the focal point and responsible body for research Administration and Management.

This office is given the responsibility of revising research proposal and approving fund; authorizing payment to externally funded projects; following up progress of projects; monitoring Grant utilization; collecting, summarizing, storing and distributing information on ongoing projects as well as outputs of completed projects and publications; and reporting financial and other aspects of research activities. The existing system, however, is not fully capable of carrying out these activities as required by users. It has been investigated that lack of systematic organization of records and redundant handling of data created difficulties in finding a summary of data on certain research activities, consistent statistical data for periodic reports and administrative purposes, and above all, finding information on current as well as completed projects from different access points were the major problems encountered.

The problems were sensed by the system users and the need for a better system had been stated by its officials. This study confirms the pre-stated problems, through applying research

methodologies, tools and techniques. Detailed analysis of the system results in identification of further problems and formulating and structuring them from information systems' angle.

To find out the reasons of which the system is incapable of meeting its requirements and to come up with possible solutions for the limitations, close examination of the system was made. The necessary facts for carrying out this study were gathered from users of the system through interviews and questionnaires. Relevant documents were also revised. In this step, the processes involved, the incoming and outgoing data movement, the data stores and relationship between different entities has been identified and presented using Structured System Analysis and Design Methodology (SSADM) and tools.

As a result of analyzing the problems of the current system and defining requirements, alternative solutions were considered. At this stage users were provided with design choices, and from the alternatives, computerizing the major system components is proposed, on the belief that this solution will overcome the existing problems.

In order to propose the plan of a system that would best meet the information requirements, the study modeled all the major processes involved in the project and publication monitoring and management activities of the University, using SSADM and tools. Data Flow Diagrams are used to model processes, and Entity Relationship Diagrams for data modeling. Experiences of other systems that are developed in similar environments have also been reviewed from literature.

The step in solving the problems proceeded by avoiding duplicated data stores, adding data stores that represent objects of interest, combining disintegrated processes and decomposing the complex ones, and restructuring the data flow diagrams and the logical data structures.

Data Analysis and Design have been given a special emphasis for the purpose of database development. Both Entity-Relationship Modeling and Relational Data Analysis techniques were used to model the system's data and to transfer the data model into a relational database model, respectively.

A prototype system is developed to demonstrate that the newly designed system could meet uses requirements. The prototype is developed using the existing facilities at SISA, i.e.; Microsoft Access 97 is the Package used to develop the database. The prototype can be used both by end-users - researchers, and system users - the staff of the Research Administration System. Thus, users are categorized accordingly and are permitted to access parts of the database that are relevant to their category.

Major strength and limitations of the work

The work documents concrete and real examples of application of Structured Systems Analysis and Design techniques. Specifically, applying E-R Modeling in combination with RDA, the work demonstrated a practical example of developing a conceptual data model in an effective and handy manner. Starting from higher level of abstraction and progressively refining until coming out with detailed and normalized entities (at least to the 3NF) and validating and transferring (mapping) ER Model into a Relational model that exhaustively include the important relations and attributes and that is ready for implementation. This is one experience that the worker believes to be worth sharing. It is also the hope of the worker that,

the study contributes important practical lessons in the area of data modeling for those who may be involved in the development of database applications in similar domains.

Design structure of the proposed System, although more exhaustive on ongoing research projects, can also be implemented for completed projects as well as research related publications with minimum restructuring. However, the prototype and the software used for it (MS Access) are not recommended for free-text manipulation. That is, storage and retrieval of research related publications, is not in the scope of the prototype.

The database structure that resulted from exhaustive identification of entities, relationships and attributes, may be found detailed and complex for small-scale implementation. The big number of data fields, for instance in the Project Relation, and its relationship with many other Relations may create challenges at the time of implementation. In fact, the challenge was faced by the worker, at the time of prototype development. The problem can be solved, by grouping related fields together, and taking them to a new, separate child relation.

The other challenge encountered was, concerning those Relations whose primary key is a composite key. When one element (a field) of the composite key is a primary key of another Relation, defining it as non-repeatable becomes difficult. In fact, the non-repeatable attribute belongs to the whole key (the composite key) rather than each and every element. However, in DBMS like MS Access, assigning this attribute to the whole key without making every field in the key non-repeatable is impossible. Hence, defining some of the keys as repeatable is unavoidable. Therefore, database integrity may be violated by the occurrence of repeating records. To solve this problem, a single field which uniquely identify the Relation, like a running or random number, can be added and the fields in the ex-primary key would be

defined as required (not null). However, other mechanisms shall be considered to protect referential integrity of the Relation

While developing the database, experimenting of some powerful features of MS Access was another exiting experience to the worker. Using the database definition facilities of this software, its built in user-interface development features, and, being assisted by the wizard, any one even a layman can develop a simple database with a professional looking interface, provided that, a well established database structure (data model) is at hand, and the above limitations are considered.

The entities were normalized in to Third Normal Forms, as indicated earlier. It was also tried to make the data model meet the Boyce-Codd Rule (to bring the Relations in to BCNF). However, advanced data modeling techniques, such as forth or fifth normal forms, are applied only to a few sample cases like the Grant Authorization Relation. Applying this techniques and further optimization of the data model may answer to some of the implementation challenges.

To sum up, this study identified that, with the current manual system, users requirement are not fully met. Therefore, the proposed computerized system can be a solution to the limitations of the current system in specifying and representing the system's requirements in terms of information content and context (data items, interrelationships between data and access requirements), so that retrieving data/information could be made easier and faster, from various access points, and the retrieved data could be summarized, consistent and reliable. The developed prototype confirms practicality of the conceptual model of the proposed system.

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6.2 Recommendations

This study has demonstrated development of an information system using structured methods of system analysis and design. The outcomes of the study lay the basis upon which the remaining tasks to come up with the overall information system that supports research activities of AAU can further be developed and implemented. The University is currently deliberating to develop a University wide network connecting all faculties/colleges and research institutes. It is hereby, recommended that a technical group shall be formed to carry out further development task of the proposed system. The composition of that group is recommended to include representatives of the management body, operational staff, faculty/institute representatives, selected researchers, and finance personnel.

Planning the implementation of the proposed system and evaluating feasibility of off-the-shelf package or in-house system development shall be one of the tasks of this group. Be off-the-shelf or in-house system, there are two factors that have to be considered in selecting a system. They are meeting user requirement and optimal utilization of available resources. Each alternative has its own advantages and limitations. Off-the-shelf systems are usually more tested, less costly and their implementation, as compared to in-house developed system, requires less time. Nevertheless, they are usually not tailored to requirements of users as in-house developed systems are. Many of the existing off-the-shelf systems are prepared to handle distinct functions of a particular system separately, that is, like financial/accounting activities or bibliographic activities separately. Of course, there are integrated Off-the-shelf packages like text information management packages that support integrated approach. However, these systems may not fit to the research system's requirements and its

administrative as well as functional structure. They are either, very exhaustive and detailed, which need much effort to customize, or they focus on areas, which are, of little interest to the system under study. It has to be admitted here that a thorough evaluation of the existing off the shelf packages was not done in this study. This is recommended for consideration in the further development operations of the implementation. The prototype can be evaluated in contrast with an alternative off-the-shelf package, and the system that better fit into users' requirements can be selected.

The other factor that makes the choice of in-house development more feasible is that, the Research and Publications system many not need to exert cost for hiring professional programmers, analysts or consultants from outside of the University. The System Design and Data Processing Center (SDDPC) of the University may take the responsibility of developing the in-house system. The Center is staffed with the people who have the required skill for the development, and it is this center's responsibility, accomplishing such tasks. Therefore, the in-house developed system may not be as costly as it is usually feared to be, since it can make optimal use of available resources (skill of personnel). Therefore, developing in house system, using internally available human power and other resources, is the recommend option, at lest at this stage.

The prototype can serve as a starting point for determining software specification, or it can be found feasible for further development and polishing. Even though the prototype includes features to serve both the researchers and people involved in research administration, due to time limitation; however, demonstrating to researchers and receiving their feedback could not be made possible. Only the staff at the Research and Publications Office and students at SISA had commented on it. These groups can not be sample representatives of the researcher

population because of their level of familiarity with computers and their homogeneity. Therefore, if implementation of the prototype is desired, further testing it with end users is recommended.

The implementation plan shall also consider different project management software, together with MS Access, for evaluation. In this line, multilingual nature of the data involved shall also be taken into account.

Although research activities and research outputs are distributed among the different institutes, faculties, and departments, a centralized administration of information system and management and control of information on these activities is necessary, to insure coordination of activities, resource allocation and effective flow of information on research activities. The current administrative structure and technological infrastructure of the University also signifies this fact. Thus, the RPO shall take the responsibility of managing centralizing & coordinating information flow in the network of the research units under the University.

The existing University Networking Committee, together with the recommended team, shall consider further upgrading of the system to client/server architecture. This could reduce the operational load on the central system, and makes the system more closer and convenient for the end users. The server, residing in RPO and/or SGS shall hosts the database (developed by MS Access), and Visual Basic Interfaces can be on the Clients at the Faculties, & Research Institutes.

The Financial Information Center (FIC) has to adopt a uniformly applicable accounting mechanism for both internally and externally funded projects. Therefore, it is recommended

that each and every project shall be assigned a unique account number by which details of the Grant Account and Grant Source (Grantor) of a particular project can be easily and directly inferred from it.

The study focused on internally done research only (University research). However, it is recommended that the system have to include links to external bibliographic and research databases existing within and out side of the country.

The research system should hire or get transferred a professional staff, who will be responsible in Database Administration and system maintenance. And, at least two operational staffs are required for data entry and retrieval purposes.

Training for users is also required, if the proposed system is to be implemented. Users should be trained on how to use computers in general and how to formulate simple queries for information retrieval.

The current study deals with supporting the monitoring and administration function of research activities and processing and dissemination of research information. Further studies shall consider issues like applying agent technology in developing Researchers' Profile (research interest), automatic evaluation of project proposals and/or outputs, validating projects through matching content against specified criteria or requirements and/or regulations.

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APPENDIX I

LIST OF INTERVIEWED PEOPLE

1. Professor Endashaw Bekele, Research and Publications Officer:- Research and Publications Office

2. Hailu Zewge, Ato, Administrator for Technical and Financial Affairs :- Research and Publications Office

3. Seme Dawit, Ato, Associate Dean for Student Affairs:- School of Graduate Studies

4. Amsalu Abebe, Ato, Associate Dean for Information Management and Dissemination :- School of Graduate Studies

5. Wondu Tesfa, Ato, Administrator for Financial and Technical Affairs:- Institute of Development Research.

6. Alemayehu Bisrat, Ato. Senior Librarian:- Institute of Development Research.

7. Getachew Setotaw, Ato, Senior Librarian:- Research and Publications Office.

8. Rahel Tadesse, W/o, Secretary : - Research and Publications Office

9. Chora Bogale, W/t, Secretary :- Research and Publications Office

10. Aster Zemedkun, W/o, Secretary :- Demographic Training and Research Center (DTRC), Institute of Development Research (IDR).

11. Melaku Endale, Ato, Lecturer and Researcher, Demographic Training and Research Center (DTRC):- Institute of Development Research (IDR) .

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6. Alemayehu Bisrat, Ato. Senior Librarian:- Institute of Development Research.

7. Getachew Setotaw, Ato, Senior Librarian:- Research and Publications Office.

8. Rahel Tadesse, W/o, Secretary : - Research and Publications Office

9. Chora Bogale, W/t, Secretary :- Research and Publications Office

10. Aster Zemedkun, W/o, Secretary :- Demographic Training and Research Center (DTRC), Institute of Development Research (IDR).

11. Melaku Endale, Ato, Lecturer and Researcher, Demographic Training and Research Center (DTRC):- Institute of Development Research (IDR) .

APPENDIX II

DISCUSSION GUIDE

1. What is the main purpose of the office/unit/ and/or your position?

2. What data/information you require for your daily activity, for long range activities and for general awareness?

3. What basic decisions does your position usually is concerned with and what information are required for the decisions?

4. What problems do you face with regard to information handling (accessing and disseminating), what do you think are the causes for the problems, and what solutions do you suggest?

5. What questions are frequently asked at your office/position and what information sources you consult to give answers?

6. How important are reports or other forms you receive from other research units and offices within the research system for your decision making or problem solving?

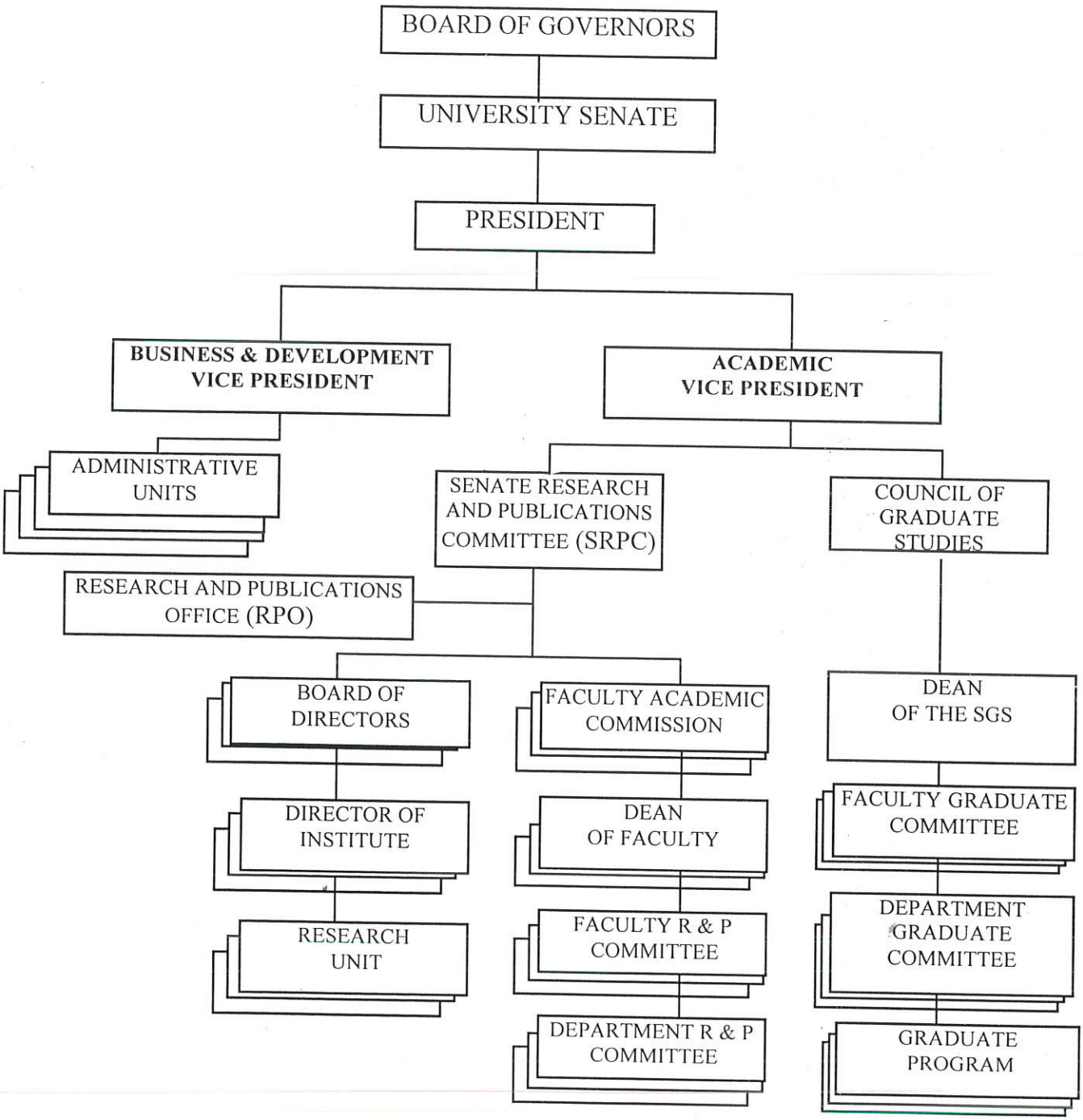
7. What outputs (reports or others) does your office/unit produce or required to produce?

8. At what frequency and to which destination are these reports (outputs) are targeted?

9. Which activities (information needs) you give priority to be computerised?

APPENDIX III

ORGANISATIONAL STRUCTURE OF THE CURRENT RESEARCH AND PUBLICATIONS SYSTEM OF THE ADDIS ABABA UNIVERSITY



APPENDIX IV
EXISTING FORMS

TITLE	DESCRIPTION	SOURCE	DESTINATION	FRQ	COPIES
F1	Project Proposal Form	Research. Units	RPO, other Grantors	Q	5
F2	Teaching Materials Preparation Proposal Form	Research Units	RPO	Q	5
F3	Grant Data Sheet 1	Research Units	RPO FIC	Q	3
F4	Grant Data Sheet 2	RPO	FIC	Q	1
F5	Visiting Scholar Application Form	Visiting Scholar	RPO	I	2
F6	Memorandum of Agreement	Visiting Scholar Research Units Grantors	RPO FIC	I	2
F7	Memorandum of Understanding	Research Units	RPO FIC	I	1
F8	Progress Report Form	Researcher	RPO Grantors	Bi.A	1
F9	Teaching Material Evaluation Form	Research Units	RPO	I	1
F10	Proposal Evaluation Form	Researcher	RPO	I	1
F11	Fund Transfer Request	RPO	Grantors FIC	I	1
F12	Explanation for Rejected Projects	RPO	Research Units Researcher	I	1
F13	Financial Statement Report	FIC	RPO	A	1
F14	Fund Utilisation Report	RPO SGS	Grantor Research Unit Management	Bi-A	1
F15	Thesis Proposal Form	Research Unit	SGS	A	5
F16	Grant Authorisation and Notification	RPO SGS	FIC Research Units Researcher	D	1
F17	Letter Registration Book	Secretary	Administrator	Bi-A	1
F18	Miscellaneous Payment Request Letter	RPO SGS	FIC Researcher Res-Personnel	D	1
F19	Visiting Scholar Admission Letter	RPO	V-Scholar Research Unit Immigration	I	1
F20	Research Output Report Form	Researcher	RPO Grantor Research Unit	I	5
F21	Ongoing Project Report	RPO	RPO	A	1

A = Annually, Q = Quarterly, Bi-A = Bi Annually, I = Irregular, D = Daily

APPENDIX V

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHOOL OF INFORMATION STUDIES FOR AFRICA (SISA)

QUESTIONNAIRE PREPARED FOR A SURVEY ON THE PRESENT STATUS OF RESEARCH INFORMATION SERVICE & USERS' INFORMATION NEEDS AT AAU

DESCRIPTION OF CONCEPTS

Research information : is used in this questionnaire to refer to information on **ongoing and recently completed but unpublished** research projects made at AAU. This includes information on: **The project**:- (title, goal, starting and finishing dates, progress report, summary of findings, publications related to it, etc.); **The project members; Parent Institution; Funding Body/Grant,** and so on.

PART I. IDENTIFICATION DATA

1. Name : _____
2. Date of establishment
3. Objective (Activity)
   [ ] Research [ ] Teaching [ ] Training
   [ ] Other (please specify) _____

4. Major Field of Specialization: _____

PART II. ON MECHANISMS OF HANDLING RESEARCH INFORMATION

5. What method(s) do you use to handle Research Information ?
   [ ] Office files [ ] Computer databases
   [ ] Published reports [ ] Periodic progress reports (specify time)
   [ ] Other publications (such as Newsletters,). Please specify._____
   _____
   [ ] Others (please specify): _____
6. Please list the user groups (institutes/individuals) which have access to Research Information at your institute.

_____
_____
_____
_____
_____

7. Where does your institute acquire Research Information from?

_____
_____

APPENDIX V

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHOOL OF INFORMATION STUDIES FOR AFRICA (SISA)

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1. Name : _____
2. Date of establishment
3. Objective (Activity)
   [ ] Research [ ] Teaching [ ] Training
   [ ] Other (please specify) _____

4. Major Field of Specialization: _____

PART II. ON MECHANISMS OF HANDLING RESEARCH INFORMATION

5. What method(s) do you use to handle Research Information ?
   [ ] Office files [ ] Computer databases
   [ ] Published reports [ ] Periodic progress reports (specify time)
   [ ] Other publications (such as Newsletters,). Please specify._____
   _____
   [ ] Others (please specify): _____
6. Please list the user groups (institutes/individuals) which have access to Research Information at your institute.

_____
_____
_____
_____
_____

7. Where does your institute acquire Research Information from?

_____
_____

8. In what format and at what frequency do you acquire Research Information?

9. What problems do you encounter in accessing and dissemination research information ?

10. Are there efforts made to solve the problems?

[ ] yes [ ] No

If yes, please describe them

11. What do you claim for the failure of your efforts?

12. Is there any computer facility which is being used or ordered or planned for use of handling research information?

[ ] yes [ ] No

If yes, please describe.

a) Computer

Name	Model	No.

b) Software packages used

c) Peripherals:

13) Is there any Research Information Database ?

[ ] yes [ ] No

If yes, please describe.

Name of database	Access points (fields used)	No. of Records	DBMS used
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

14) Your comments on other relevant information are valuable (Please write your comment, if any, on how you think your information requirements could be met).

_____
_____
_____
_____
_____
_____
_____
_____
_____

THANK YOU.

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHOOL OF INFORMATION STUDIES FOR AFRICA (SISA)

QUESTIONNAIRE PREPARED FOR A SURVEY ON THE PRESENT STATUS OF RESEARCH INFORMATION SERVICE & USERS' INFORMATION NEEDS AT AAU

INTRODUCTION

Dear colleague,

I am an academic staff at the Addis Ababa University as well as a graduate student at the School of Information Studies for Africa (SISA). Currently I am working on a research project in title **Research Activities Information System for AAU**, in partial fulfillment for the requirement of the M.Sc.I.S. Degree. The purpose of my thesis research is to identify the extent at which information needs of researchers is satisfied through the existing ways and mechanisms of information exchange in the University, and to assess the problems associated with accessing research information and to come up with a plan of an Information System which tackles existing problems and meets your information needs. Therefore, it is only through your kind assistance in genuinely completing this questionnaire that the goal of my research will be fully met.

Thank you.

KIBRUYISFA DEBEBE
P. O. BOX 150195
ADDIS ABABA

DESCRIPTION OF CONCEPTS

Research information : is used in this questionnaire to refer to information on **ongoing and recently completed but unpublished** research projects made at AAU. This includes information on: **The project**:- (title, goal, starting and finishing dates, progress report, summary of findings, publications related to it, etc.); **The project members; Parent Institution; Funding Body/Grant,** and so on.

ABBREVIATIONS

CAS Current Awareness Service: Providing information for users whenever new information is obtained.
ESTC Ethiopian Science and Technology Commission
PADIS Pan African Development Information System
ILRI International Livestock Research Institute
RPO Research and Publication Office
SDI Selective Dissemination of Information : Providing specific information to specific individual about new information relevant to field of specialization only.

SISA School of Information Studies for Africa
SGS School of Graduate Studies

Please mark **'X'** against your choice when appropriate. If some questions do not apply, indicate N/A for 'Not Applicable'.

PART I. IDENTIFICATION DATA

1. Name (Optional) : _____

2. Nationality : _____ Sex: [ ] Male [ ] Female

3. Affiliation :
   a) Employer Organization/Institute : _____
   b) Institute/Faculty/Department/Office
      you are currently working in: _____

4. Services offered (the category of work you are involved in. (Tick where appropriate)
   [ ] Research [ ] Teaching [ ] Consultancy [ ] MA/MSc/Ph.D. student
   [ ] Others (Please specify) : _____

5. Address:
   P.O.Box : _____
   Telephone : _____
   Residence (optional) : _____
   Office : _____
   e-mail : _____
   Fax : _____

6. Academic qualifications :

Degree	Field of Study	Institution	Year
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

7. Total year of service in the field _____

8. Field(s) of interest (specialization). (Please indicate what you consider to be the subject areas in which
   you are particularly interested and competent. Being specific is very important).

   _____
   _____
   _____
   _____

9. Please indicate professional societies/associations which you are a member

Society	Type of Membership

10. Is there any recently completed but unpublished research project which you were involved in?

[ ] Yes [ ] No

If yes please use the table under the next question to list.

11. Are you involved in any ongoing research project currently?

[ ] Yes [ ] No

If yes, please list.

Project Title	Description	Funding Body	Year started	Year of Completion

12. Please list main Consultancy or expert assignments undertaken in the last five years. (If there are any).

Description of Assignment	Duration

13. Please list your employment history (Give current employer last).

Employer	Designation	Period

PART II. ON INFORMATION NEED SATISFACTION OF RESEARCHERS (USERS)

14. How much aware you are of Research Information sources/services (Files, Databases, Reports, Newsletter, yearbooks, etc.) available at other Institutions/Faculties/Offices in the University (such as RPO, SGS, SISA,...)

[ ] Well Informed [ ] Not much

[ ] Not Interested [ ] Not at all

If your answer to question no is 'Not at all' please answer question no. 15 & 16 and skip to question no. 23

10. Is there any recently completed but unpublished research project which you were involved in?

[ ] Yes [ ] No

If yes please use the table under the next question to list.

11. Are you involved in any ongoing research project currently?

[ ] Yes [ ] No

If yes, please list.

Project Title	Description	Funding Body	Year started	Year of Completion

12. Please list main Consultancy or expert assignments undertaken in the last five years. (If there are any).

Description of Assignment	Duration

13. Please list your employment history (Give current employer last).

Employer	Designation	Period

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14. How much aware you are of Research Information sources/services (Files, Databases, Reports, Newsletter, yearbooks, etc.) available at other Institutions/Faculties/Offices in the University (such as RPO, SGS, SISA,...)

[ ] Well Informed [ ] Not much
[ ] Not Interested [ ] Not at all

If your answer to question no is 'Not at all' please answer question no. 15 & 16 and skip to question no. 23

15. What do you think is the reason for your lack of awareness? (You may choose more than one)

[ ] Not Interested.
[ ] Poor Communication Channels with the Institutions (Do not have easy access).
[ ] Lack of Information System which facilitates access to research information.
[ ] Other (please specify) _____

_____

16. Please indicate if possible the extent to which your research work is affected because of lack of research information?

[ ] Not affected
[ ] Partially affected
[ ] Highly affected

17. How important are/is the information you get to your work?

[ ] Very important
[ ] Not so crucial
[ ] Not Important

18. How do you come across the information on the mentioned information sources/services

[ ] Formally through established ways
[ ] Informally through personal contacts
[ ] Other (please specify) _____

_____

19. Do you face problems in using these services/sources?

[ ] yes
[ ] No

If yes please describe.

_____

_____

_____

20. How satisfied is your information need through these services?

[ ] Not satisfied
[ ] Partially satisfied
[ ] Satisfied
[ ] Highly Satisfied

21. If your Answer to Question No. 20 is 'Not satisfied' or 'Partially satisfied', what do you think is the cause of your dissatisfaction? (If you choose more than one please rank them).

[ ] Access difficulty
[ ] Incomprehinsiveness
[ ] Relevance (Not Relevant to your need)
[ ] Information overload
[ ] Others (please specify) _____
[ ] Presentation Formal
[ ] Timelines (outdated)
[ ] Inaccuracy
[ ] Incompleteness

_____

22. Does your Library/ Documentation/Information Center (if there is any) facilitate your access to such sources/services?

[ ] Yes
[ ] No

If yes please describe how is it facilitated? _____

_____

23. Do you use other Information Centers/Systems (external to the University: such as PADIS, ESTC, ILRI... or other systems on the Internet) to get Research Information?

[ ] Yes [ ] No

If yes, how often (on the average)?

[ ] More than ones in a month [ ] More than Ones in a year
[ ] Ones in a month [ ] Ones in a year
[ ] Only ones
[ ] Other _____

24. How do you rate the Information Services in the University in relation to the service at the above mentioned systems.

[ ] Better [ ] Not much difference
[ ] Worse [ ] Not aware
[ ] Other (please specify) _____
_____

25. Which Information Service /Center you find better (list their names)

1._____
2._____
3._____

26. What is your general assessment of the information services of:

	a) Your Institute	b) RPO	c) SGS	d) Other Institutes in the University
- Satisfactory	[ ]	[ ]	[ ]	[ ]
- Inadequate	[ ]	[ ]	[ ]	[ ]
- Improving	[ ]	[ ]	[ ]	[ ]
- Other	_____	_____	_____	_____

PART III. ON USERS' (RESEARCHERS) PREFERENCE OF INFORMATION SERVICES

27. Have you ever searched computer databases (CD-ROM or other) to look for information?

[ ] Yes [ ] No

If no, what is the reason?

[ ] Unavailability of computer facilities [ ] Unavailability of CD-ROM databases

[ ] Lack of searching skill [ ] Uninterested

[ ] Other (please specify) _____

28. If your answer to the above question is yes, what access points do you usually look for?(you may rank your preference).

[ ] Author [ ] Title

[ ] Subject Descriptor [ ] Abstract

[ ] Institution/Corporate body [ ] Date of publication

[ ] Others (please list) _____

_____

29. Using the access points you ranked 1 to 3 what would you say on how you get the required information?

[ ] Very easy [ ] Easy

[ ] Fair [ ] Difficult

[ ] Very difficult

If difficult, please briefly explain the difficulties/problems you encounter when searching for the desired information.

_____

_____

_____

30.How do you prefer getting research information ? (you may rank your preferences).

a) Access/service preference

[ ] SDI

[ ] CAS

[ ] Self searching (searching the database yourself for the needed information)

[ ] Question and answer (where you ask questions somebody else for specific required information)

[ ] Others (please list)_____

_____

b) Time preference

[ ] Whenever new addition (modification) is received

[ ] When you request only

[ ] On a fixed time period (please specify the time) _____

[ ] Other (please specify) _____

c) Format and content preference

Format

[ ] Printed copy

[ ] On diskettes
[ ] Full length (original Document)

Content

[ ] Descriptive review of original document
[ ] Abstract (summary)
[ ] Progress report
[ ] Others (please list) _____
_____

d) Access point preference (you may choose more than one).

[ ] Project title
[ ] Major goal
[ ] Starting and ending period
[ ] Project leader's address
[ ] Other Project members they can consult in)
[ ] Specialty of members (Topics
[ ] Funding body
[ ] Fund amount
[ ] Grant /Research Scholarship
[ ] Policy/Rules/Regulations
[ ] Other (please specify) _____
_____

PART IV. ON DISSEMINATION OF RESEARCH INFORMATION

31. What do you do to disseminate information on your ongoing/unpublished research project?

[ ] Add in your institutional database
[ ] File in your office/Institute
[ ] Present at a seminar or conference and colleagues
[ ] Distribute/inform to fellow researchers
[ ] Do not disseminate
[ ] Publish in your institute's/parent organization's Newsletter (or other media). (Please specify the time range). _____
[ ] Other (please specify): _____

32. Do you encounter problems in disseminating research information?

[ ] Yes
[ ] No

If yes, what are the problems? (you may choose more than one).

[ ] Lack of Disseminating media (databases, Newsletters, etc.)
[ ] Lack of Communication channels (workshops, seminars, etc.)
[ ] Financial constraints
[ ] Lack of interest
[ ] Others (please list) _____

33. Your comments on other relevant information are valuable (Please write your comment, if any, on how you think your information requirements could be met).

_____
_____
_____
_____

THANK YOU.

Annex one: Research Information Systems in Other Universities

1. A Research Information System for Baylor College of Medicine (Krause, 1994).

This system was designed for Baylors College of Medicine, a private, free Standing Medical School. Baylor College of Medicine full-time faculty are located at distributed places and the Office of research intended to develop a model which shall provide around the clock access, a variety of access methods, ease of access with synthesis of information to researchers. Therefore, a model which integrates cellular phones, voice mail, fax publishing and distribution, Gopher and E-mail was devised to allow researchers to retrieve research information at their convenient time and place. The system is administered centrally since it serves a single faculty

2. Current Research Information System (CRIS, 1997)

CRIS is the U.S. Department of Agriculture's (USDA) Documenting and Reporting System for ongoing and recently completed research projects in Agriculture Food and Nutrition, and Forestry. Projects are conducted or sponsored by USDA research agencies, State Institutions and participants in USDA's National Research Initiative Competitive Grants Program. CRIS is a part of Science and Education Resource Development (SERD), co-operative State Research, Education and Extension Service (CSREES).

The system maintains databases on projects; experts and links are provided to other related files. One of the sub-systems which is under the National Biological Service (NBS), i.e. the NBS Annual Work Plan Database, serves as a management tool for planning scientific research

projects conducted by NBS. The System establishes and documents NBS research activities and their relationships to the budget process.

CRIS has a page on the WWW and its databases can be accessed using different access points like full text terms, individual data fields (Project number, title, start dates etc.) It also provides theme reports and bibliographies, on-line manuals and forms, staff phone and e-mail listing.

Some ideas from some features of this system, such as the search template and some access points had been taken for the prototype system.

3. An Integrated Research Information System at the National University Of Singapore. (Wong, 1991)

The third system is a Research Information System (IRIS) developed by The National University of Singapore. The system was planned as a University wide system and its general objective is to serve the needs of - Faculties, the Research and Publications Office, Libraries, Personnel Department and the University Liaison Office. Specifically the system is aimed at:

- promoting and facilitating multi-disciplinary research as well as industrial cooperation within and without the University;
- to enable the University to identify staff members with particular research interests and thus facilitate matching them with research opportunities; and,
- To enable the University library to identify and disseminate appropriate materials to support faculty research.

Description Of The System

Prior to development of the system, there existed two computerized information systems, which deal with the expenditure of outside funded research projects, and monitoring the progress of University funded research projects. Both of these were under the R&P office (which is called the Bursar's Office). There was also a textual database setup by the University Liaison office for the on-line retrieval of information

pertaining to the current research interests of staff members. The development of research activities and commissioning of new Research Institutes in the University brought up the need to devise a mechanism of monitoring and measuring the research output of the University. Therefore an integrated information system was designed to monitor the various research activities made at the different units of the University.

Methodology Followed

The system followed a data management approach customizing University wide data model as the foundation for systems development. The data model, which is a schematic representation of the various entities in the system, shows the relationships between each entity. It has been tried to define users' information requirement through: - interviews (discussions) made with Officers, Deans of different Faculties and Offices; collecting data on staff current research interestfroma file containing curriculum vitae of staff members which is submitted to personnel department for the annual staff review.

Overview of the System

The system incorporated four Application systems namely: -

1. Research Publications
2. Research Projects
3. Staff Constancy Work
4. Current Research Interests.

The system is designed to fit into the existing University's Campus Wide Network. The description of the databases, The DBMS used, the interfaces developed, the programming language applied or other detailed technical specifications of the system are not mentioned in the document.

Relations of the three Systems to the proposed System

The first system is developed for a homogeneous group, i.e. researchers of a single faculty, and it focuses only on creating convenient access to end users, i.e. researchers. The aspects of monitoring research activities (such as fund monitoring) and reporting are not dealt with. Moreover the different technologies used are far advanced to apply in cases like Ethiopia.

The second and third systems are designed to serve similar purposes of that of RPOs. However, the 2nd system is not developed in a similar environment and scope with the AAU. It is aimed at providing a nation wide service and creating links to other similar systems, like NBS.

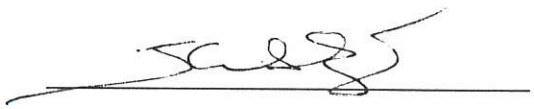
The most appropriate system, which is very closer to the current systems requirements, environment, and scope, is the 3rd system.

Therefore, the third system (An Integrated Research Information System at The National University Of Singapore), which is more closer to the problem area of this work, is selected for partial adaptation of its data model.

However, there are some differences in the administrative structure of the two systems. The third system, as described ~~in~~ above, has four components. The proposed system merges the consultancy system component into the project component and the staff's research interest is included in the Publications system component. This is done mainly because of the administrative and infrastructure differences between AAU and National University of Singapore. Moreover, as indicated in the analysis of the existing system, consultancy is in the category of research project and passes in all the same procedures.

DECLARATION

I declare that this thesis is my original work and it has not been submitted to any degree in any University before.



Kibruyisfa Debebe
21 May 1999

The thesis has been submitted for examination with our approval as University Advisors.

Tesfaye Biru (Ato)