



METHODOLOGY AND SYSTEMS ANALYSIS OF DATA MINING MODEL FOR SUCCESSFUL IMPLEMENTATION OF DATA WAREHOUSE IN TERTIARY INSTITUTIONS

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ABSTRACT

This research work with title “Methodology and system analysis of data mining model for successful implementation of data warehouse in tertiary institutions” is a proposal that provides a framework that is used to structure, plan, and control the process involved in information discovery for tertiary institutions. It equally deals with series of steps or procedures which governs the analysis and design of this particular Data Mining Model for Tertiary Institutions. The methods, techniques and procedures which are used to collect and analyze information were also provided and implemented. Structured Systems Analysis and Design methodology (SSADM) and Object oriented Analysis and Design methodology (OOADM) were deployed to develop this model. The current system was analysed by using Use Case approach to identify the existing objects in the current system. Use Case diagrams were equally developed and the relationship between the objects was drawn. Iskawa diagram was drawn to represent the identified problems. Finally the High Level Model (HLM) that would be used to design the proposed system was drawn to enable the System Designer to develop a computer based model that forecasts educational behaviours with little or no user intervention.

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Keywords: Methodology, Systems analysis, Data mining model and data warehouse.

1. INTRODUCTION

Data Mining Model for management of Data Warehouse in tertiary institutions was geared towards data mining tertiary institutions’ gigantic data warehouse which involves digging through tons of data in search of information which the management uses for proper running of the institution as well as to make future predictions based on the current trend of events (Eze, 2008). Structured Systems Analysis and Design (SSADM) and Object oriented Analysis and Design (OOADM) methodologies were deployed to design this model. Source data were collected from

three departments of the University. They include: Admissions/academic planning, Exams and records and Bursary (precisely budget and estimate).

1.1. Objectives of the study

The objectives of the study are to develop a system that should be able to:

- (i) Find association between result of courses and the lecturers that thought them in different sessions
- (ii) Find association between results and admission
- (iii) Find association between results and budget
- (iv) Find association between results and admission and budget

2. METHODOLOGY

Methodology is defined as a framework that is used to structure, plan, and control the process of developing an information system. It is used to refer to a specific series of steps, methods, techniques and procedures which governs the collection, analysis and design of a particular project. In the dynamic world, the subject methodology, system analysis and design mainly deals with the software development activities (Uba, 2011). The researcher used Structured Systems Analysis and Design (SSADM) and Object oriented Analysis and Design (OOADM) methodologies to analyse the present system as well as to design the proposed system with the primary aim of

- (i) Identifying the problems inherent in the present system.
- (ii) Investigating the causes of these problems
- (iii) And proffering solutions to these systems

The Object Oriented Analysis and Design Methodology (OOADM) perform four major activities namely:

(a) Modelling the functional description of the system. To achieve this the following steps has to be taken:

- (i) Identifying all actors and use cases
- (ii) Construct a use case model
- (iii) Document use case course of events
- (iv) Define the analysis use case.

(b) Finding and identifying business objects. To achieve this task, the steps given below must be accomplished.

- (i) Review each use case to find potential objects (which are usually noun corresponding to business entities or events)
- (ii) Select the proposed objects.

(c) Organizing the objects and identifying their relationships. To achieve this task, the steps given below must be accomplished.

- (i) Identify associations and multiplicity
- (ii) Identify generalization/specification relationships
- (iii) Identify aggregation relationships
- (iv) Prepare class diagram.

(d) Model the behaviour of each object using state chart diagram.

Details of these activities and their respective sub steps are given in section 2.4 of this chapter where they are employed to identify the weaknesses of the present system.

3. ANALYSIS OF THE PRESENT SYSTEM

The three units under study carry out the functions to the university in a manner that is satisfactory to their job description. A study of these units revealed the disparate methods they engage to carry out their daily activities.

3.1. Admissions Procedure

The admissions department is charged with the responsibility of processing:-

- (i) Students admission application
- (ii) Students change of department application.
- (iii) Students direct entry application.

The processing of these applications takes the following stages for undergraduate studies

- (i) Unified Tertiary Matriculation Examination (UTME) sends list of successful candidates to the university.
- (ii) Department fixes cut off mark.
- (iii) Admissions board in the university sets post UTME exams and fixes cut off mark for successful candidates.
- (iv) Candidates whose UTME score and post UTME exam score exceed the UTME cut off and post-UTME cut off is short listed.
- (v) Direct entry student must
 - (a) Possesses Ordinary National Diploma (OND) or Higher National Diploma (HND) from a reputable polytechnic.
 - (b) HND holders must have lower credit.
 - (c) OND holders must have upper credit
- (vi) Students pay school fees and document self

The above narrative describes the admission process into the various undergraduate programmes ran by the university. The admission procedure for post graduate studies is currently handled by the school of post graduate studies.

- (i) Students apply for post graduate studies by the purchase of a Postgraduate (PG) form which he fills.
- (ii) Students apply for their transcript for registration.
- (iii) The registry issues student with transcript application form.
- (iv) The student fills the form and submits to his or her department.
- (v) The department prepares the student transcript and so sends such to the registry.
- (vi) The registry vets the transcripts forwarded by the departments and resends the transcript to either the school of post graduate studies or the school which requires the transcript.
- (vii) The school of post graduate studies now sends a list of students who have applied for post graduate student.
- (viii) The department vets the list sent by the PG school, and enlist student based on their qualification and criteria for admission.

- (ix) Students who possess the required qualification and met with the condition for admission are short listed or recommended by the department and forwarded to the school of Postgraduate Studies (PG school).
- (x) The school of Postgraduate Studies compiles the short listed candidates' names and the programmes (according to Postgraduate diploma, Master's degree, Doctorate degree) and publish the list.
- (xi) Student pays school fees and documents self.

Almost the same procedure holds for admission into other programs (Pre-Science, sandwich, continuity education programme, CEP) except that there are special unit responsible for processing their admission.

The processes narrated above are illustrated by the system flow chart below.

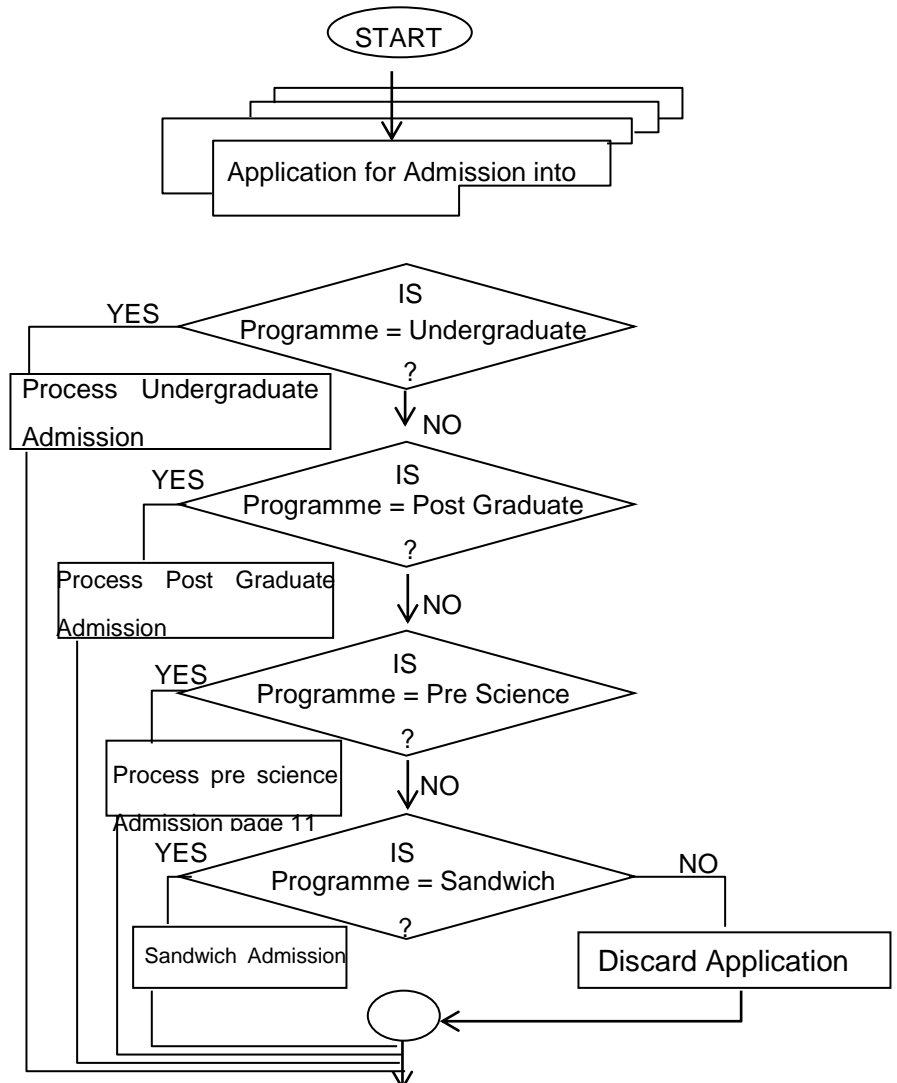


Fig-2.1. System flowchart of admissions subsystem

FIGURE 3.2: SYSTEM FLOWCHART OF UNDERGRADUATE ADMISSION PROCEDURE.

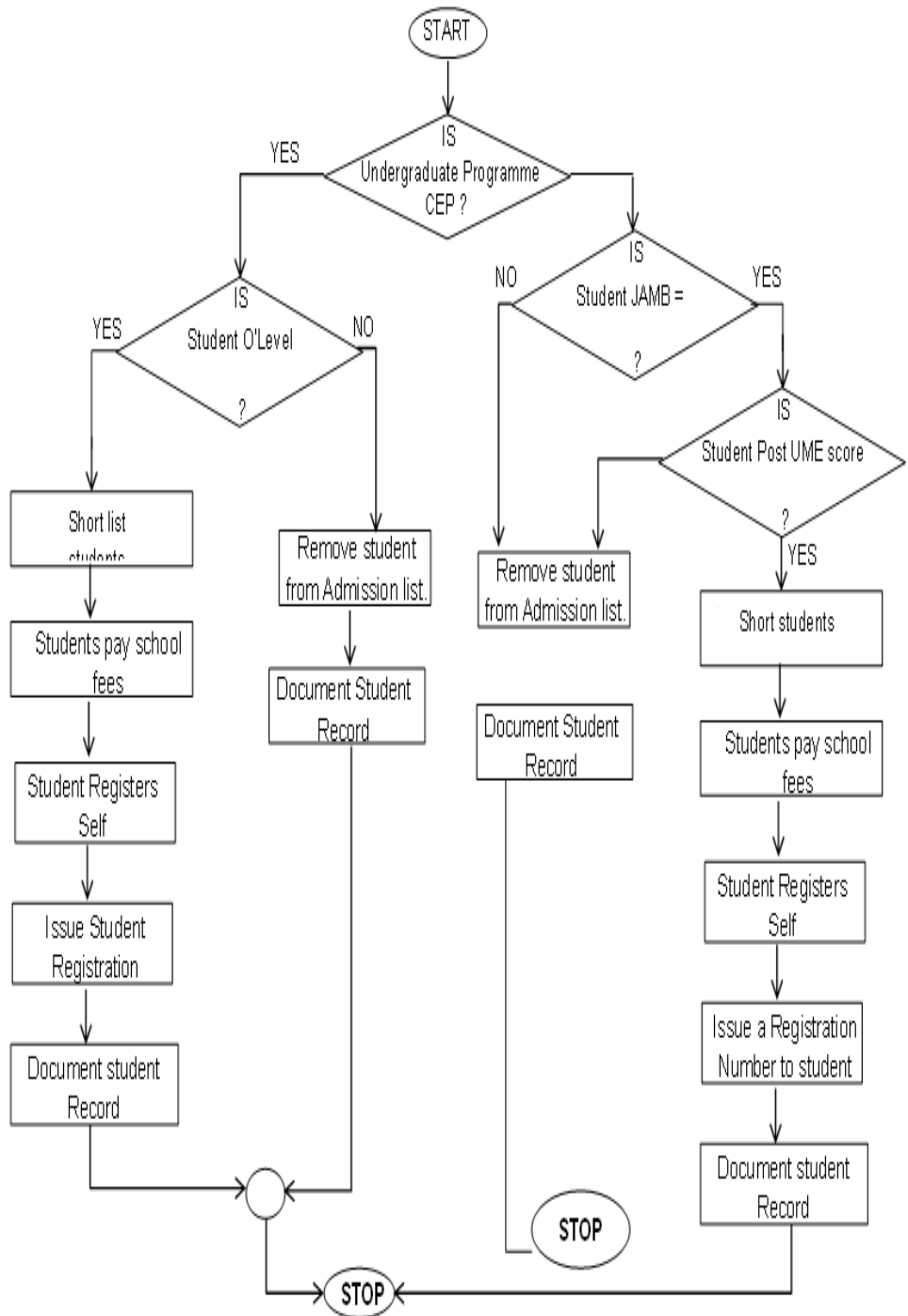


Fig-2.2. System flowchart of Undergraduate Admissions Procedure

FIGUR 2 3.3: SYSTEM FLOWCHART POSTGRADUATE ADMISSION PROCEDURE.

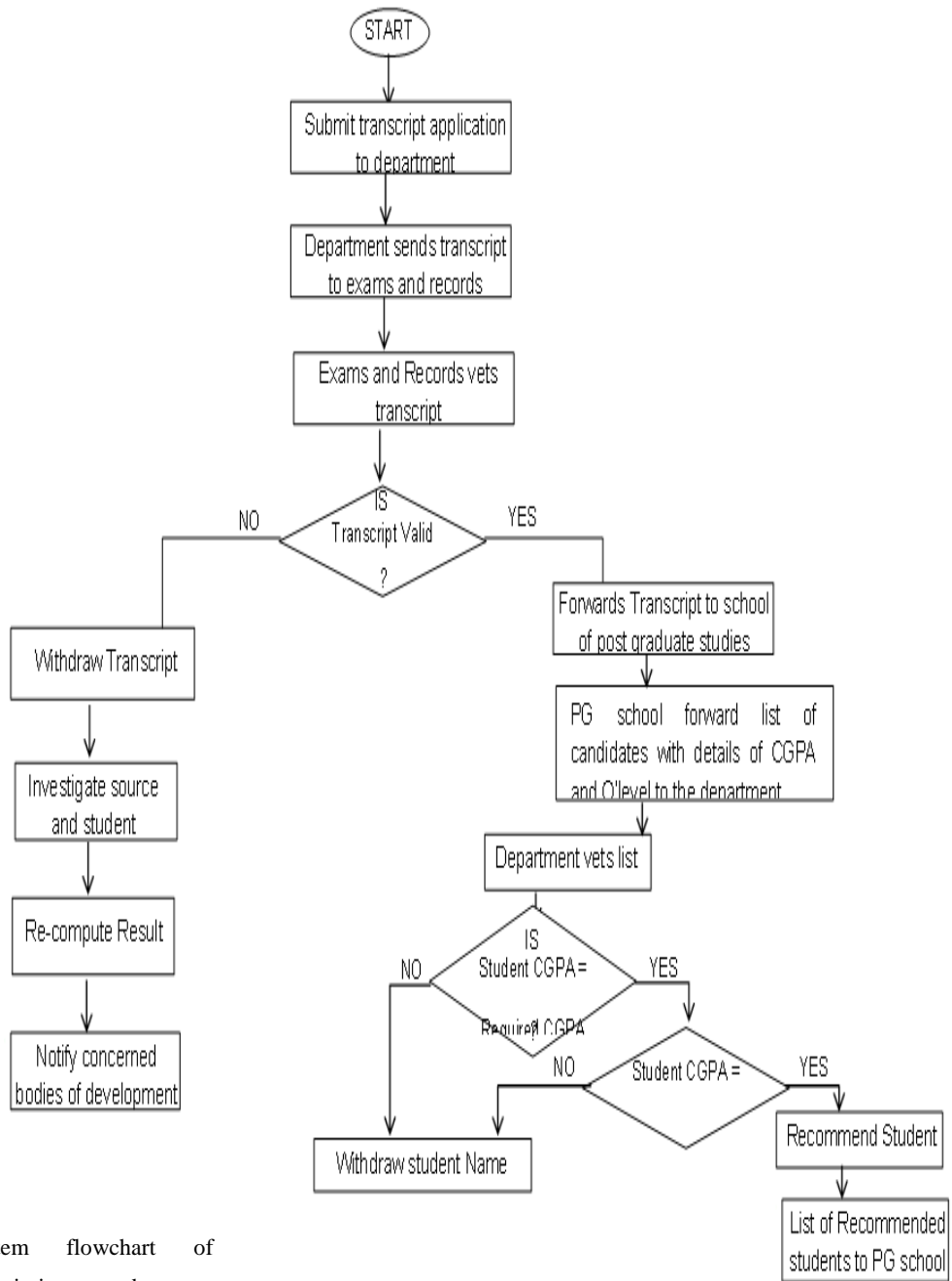


Fig-2.3. System flowchart of Postgraduate admission procedure

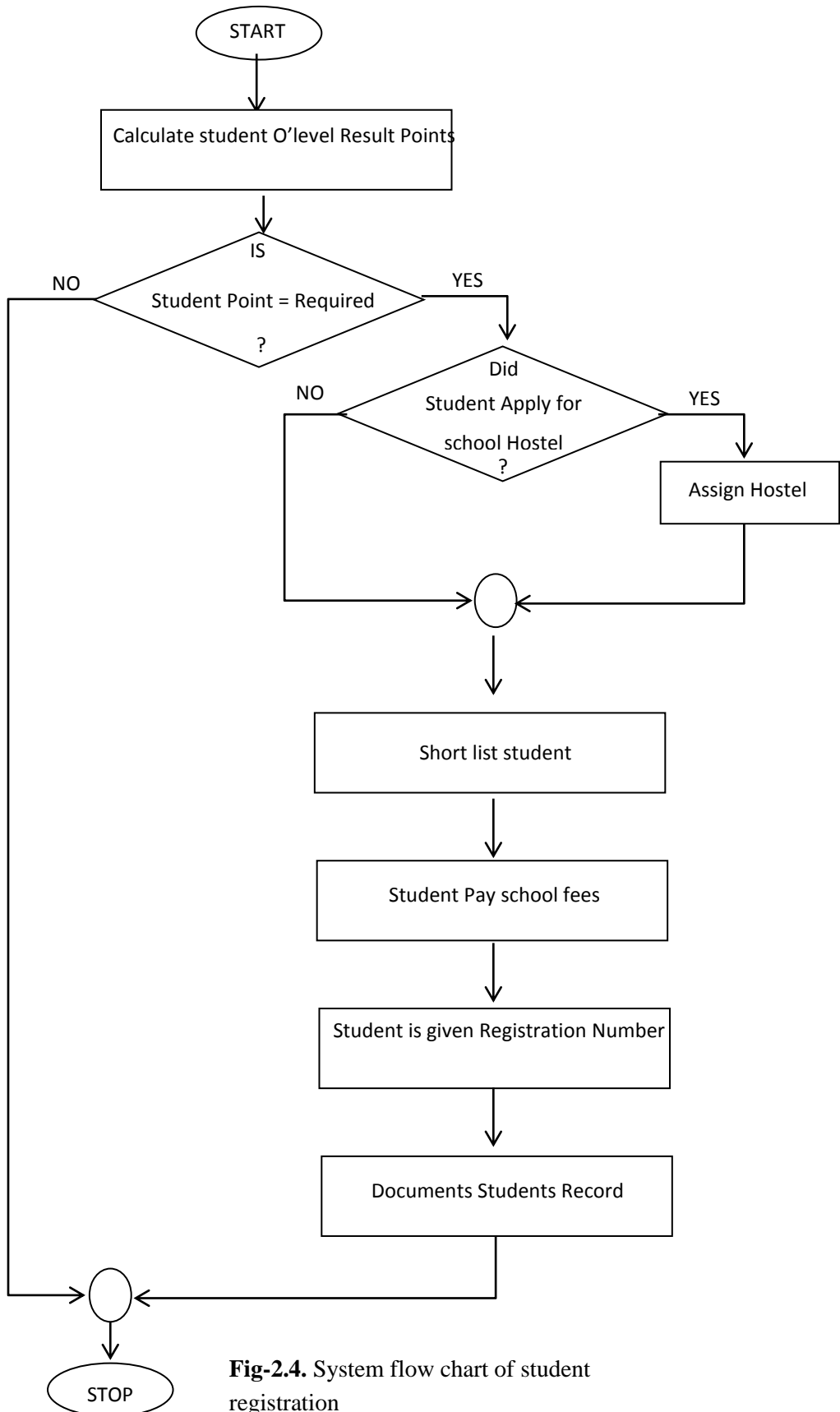


Fig-2.4. System flow chart of student registration

3.1.1. Budget Estimate Procedure

Budget is a financial plan that identifies items and the dollar amounts that the organization estimates it will spend (Ralph and George, 1998). Budget transaction processing system is the system that manages budget data, distributes it to the users and consolidates prepared budget. The budget and planning department/unit which is under the bursary unit is responsible for planning and estimating budgets and budgeting allocations to facilities, departments, academic programme units like Continuous Education Programme (CEP), Pre-science, sandwich and school of post graduate studies, school senate, the registry, the library, security, works etc. The procedure employed by the budget and planning unit is captured below as follows.

- (i) Get number of academic and non-academic staff in each department and faculty in a session.
- (ii) Get the number of students in a department and faculty for each academic session.
- (iii) Get the budgetary needs of each department and faculty.
- (iv) Cut the budgetary needs of each programme unit like CEP, pre science, sandwich and school of post graduate studies.
- (v) Determine projected income for the school.
- (vi) Determine projected capital expenditure by the school.
- (vii) Determine the projected recurrent expenditure by the school.
- (viii) Document all recurrent and capital expenditures of departments, faculties, various programme unit (CEP, PG school, etc), and the school management.
- (ix) Document all projected income to various departments, faculties, programme units and the school management.
- (x) Submit the budget proposal to school senate for amendment and approval.

3.1.2. Exams and Record Procedure

The result and transcript record of students are important documents that originate from various departments and finally kept at the exams and records department of the university (Eze, 2001). This unit uses the following method in collating and documenting students' results.

- (i) Lecturers forward copy of the result of courses they handled for a semester to exams and record.
- (ii) These results are documented.
- (iii) Any time a student request for his transcript, the students department is notified.
- (iv) The students department raises the student transcript, and forwards it to exams and record.
- (v) The transcript generated by the department is cross checked with the records at hand in exams and record.
- (vi) The transcript is then recomputed at exams and records.
- (vii) The recomputed transcript is then vetted by the vetting officer.
- (viii) The vetted transcript is then dispatched to the address requesting it.

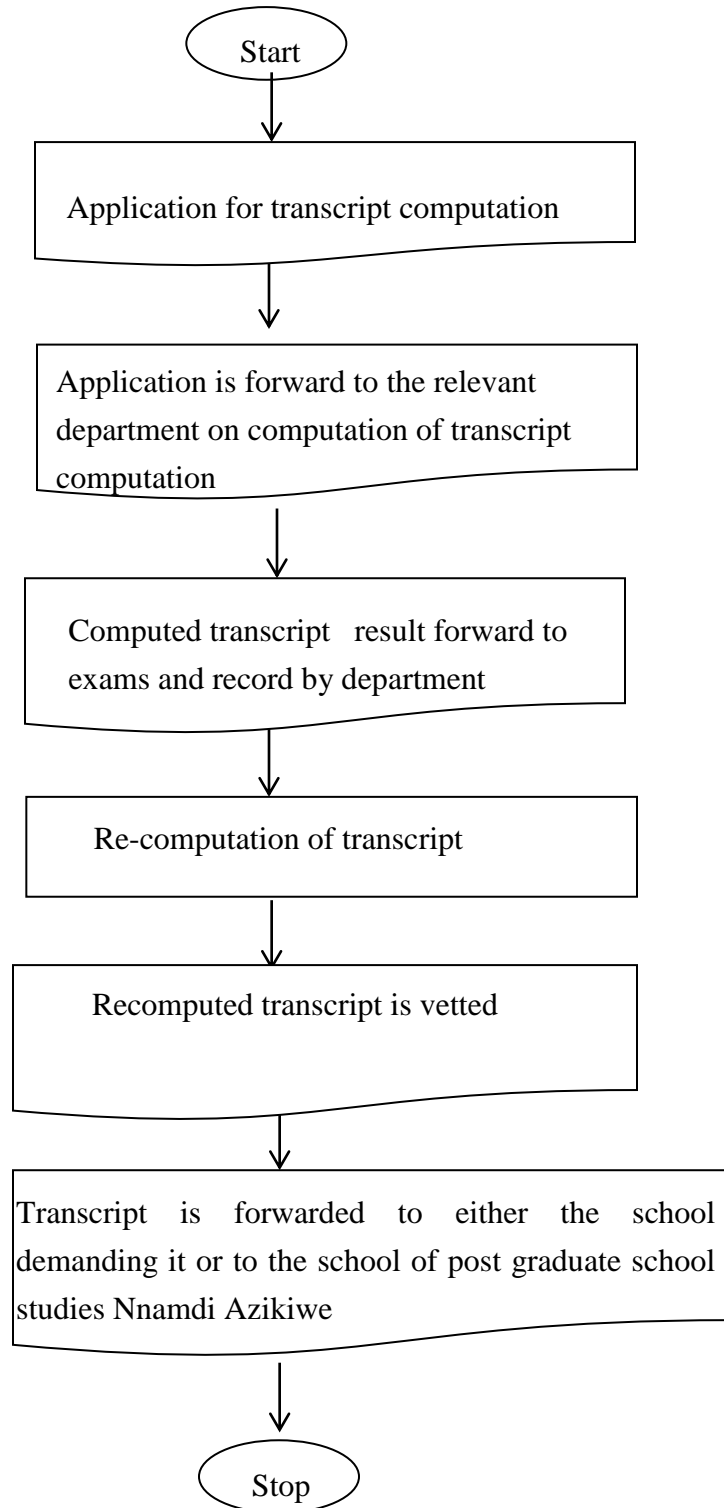


Figure-2.5. Transcript Computation Procedure in Exams and Records

Apart from the computation of transcripts, final result statement is also issued at the exams and records.

The process of result statement is carried out thus,

- (i) Departments forwards final result of students at the end of their study to the school senate.
- (ii) Senate vets the result to make sure that there are no students who have over stayed and there was no from fraud in the result computation process.
- (iii) Senate sends back the approved result to the department.
- (iv) The department forwards a copy of the senate approved result to exams and records.
- (v) Exams and records prepare a statement of result for each student in the result sheet.
- (vi) Students sign the duplicate of the result statement and keep the original copy.
- (vii) Exams and records documents the duplicate copy signed by the student.
- (viii) Prepares a certificate to be awarded the student on the next convocation

4. ANALYSIS OF THE PROPOSED SYSTEM

The following steps or phases are used in object oriented analysis and design methodology to analyse and design a system within its boundary.

4.1. Preliminary Investigation (initial survey) phase

The initial survey phase or the preliminary investigation answers the question to the project worth undertaking. To answer this question, the analyst must concern him/herself with the following activities:

- (i) List problems, opportunities and directives that may trigger the project.
- (ii) Define the project scope base on the outcome of activity.
- (iii) Assess the project worth
- (iv) Scan the project.
- (v) Present the project and plan.

4.2. Problem Analysis Phase

Answers the questions “Are the problems really worth solving?” and “is a new system really worth building?” This phase provide the analyst with ample opportunity to understand thoroughly the problem, opportunities and/or directives that triggered the project. This phase is primarily concerned with system owners and system users view of the existing system.

The following activities need to carry out in this phase.

- (i) Study the problem domain (system boundary)
- (ii) Analyse the problems and opportunities to establish objects and their relations.
- (iii) Analyse the business processes to establish:
 - i. The current business rules.
 - ii. The objects associated with each business process in the system.
- (iv) Establish system improvement objectives.
- (v) Update project plan
- (vi) Present finding and recommendation.

4.3. Requirement (use case) Analysis Phase

This phase defines the business requirement for the new system. This phase answers the question “what do users need and want from the new system?” To answer this question, the following activities must be embarked upon at this place:

- (i) Define use cases
- (ii) Analyze use cases (requirements)
- (iii) Trace and complete use cases (requirements)
- (iv) Prioritize use cases (requirement)
- (v) Update project plan.

4.4. Decision Analysis Phase

Identifies candidate solutions, analyses those candidate solutions, and recommends a target system that will be designed, constructed and implemented. This phase typically includes the following activities.

- i. Identify candidate solutions
- ii. Analyse candidate solutions
- iii. Compare candidate solutions
- iv. Update project plan.
- v. Recommend a solution.

4.5. Design Phase

Designs the recommend solutions that business rule system users and system owners requirements. This is primarily achieved with the following activities:

- (i) Modeling (design) of business objects with respect to business data and processing.
- (ii) Modeling system database.
- (iii) Modeling the user interface of the system
- (iv) Modeling the relationship amongst business object
- (v) Modeling the interaction between business objects and user interface objects.
- (vi) Update project plan.

4.6. Implementation and Testing Phase

This phase involves the implementation of the model obtained in the design phase, using any programming language of choice, and testing the implementation to see if it confirms to business, system owners and system users requirement. Testing is the process of running the program with a set of values to check for the correctness of the program (Eze, 2007)

The activity involved in this phase, usually takes the form of the execution cycle of the programming language.

4.7. Documentation and Maintenance Phase:

The analyst at this phase documents the newly designed system for:

- (i) System owners,
- (ii) And system users

To enable them use the system in the most appropriate way. Any maintenance in terms of upgrading to meet with new specification or directive government is usually carried out in this phase.

The principal activity carried out in this section of is the object oriented analysis of the present system (OOA) which is composed of the following sub activities.

- i. Modeling the functions of the system.
- ii. Finding and identifying the business objects
- iii. Organizing the objects and identifying their relationship.
- iv. Modeling the behavior of the objects

5. OBJECT-ORIENTED ANALYSIS AND DESIGN TERMINOLOGY

- (i) Actor: This represents anything (such as users or roles) that needs to interact with the system to exchange information.
- (ii) Use case Modeling: This is the process of modeling a systems function in terms of business events, who initiated the event, and how the system responds to the event.
- (iii) A use case: One of the techniques or tools that allow analysts to clearly and exactly specify system requirements. It is a behaviourally related sequence of steps both automated and manual, used for the similar purpose of completing a business task.
- (iv) Polymorphism: This term when applied in object oriented analysis means that the same named behaviour (method) may be completed differently for different objects classes.
- (v) Message: Is passed when one object hooks to one or more of other objects methods to request information or action.
- (vi) Inheritance: Means that methods and/or attributes defined in one object class can be reused in another object class.
- (vii) A class: Is a set of object that shares the same attributes and methods behaviour.
- (viii) Behaviour: Are things that an object can do, which corresponds to functions that act on their attributes (data).
- (ix) Attribute: Are data that represents characteristics of interest about an object.
- (x) Object: Is anything that is capable of being see, touched or sensed, and about which users store data (attributes) and associate behaviour.
- (xi) Unified Modeling Language: Is a set of modeling tools/conditions used to specify a software system in terms of objects.
- (xii) Encapsulation: This is a conceptual independence where everything in the product that relates to the portion of the world modeled by that object is found in the object itself (Stephen, 1996). It is the packing of several items together into one unit.

5.1. Use Case Diagram

The use case diagram represents the relationships among the actor and the use cases and equally specifies the interaction between a user and the system (Jeffrey *et al.*, 2000). This use case diagram also shows what a system does from the stand point of an external observer and its emphasis is on what a system does and not how.

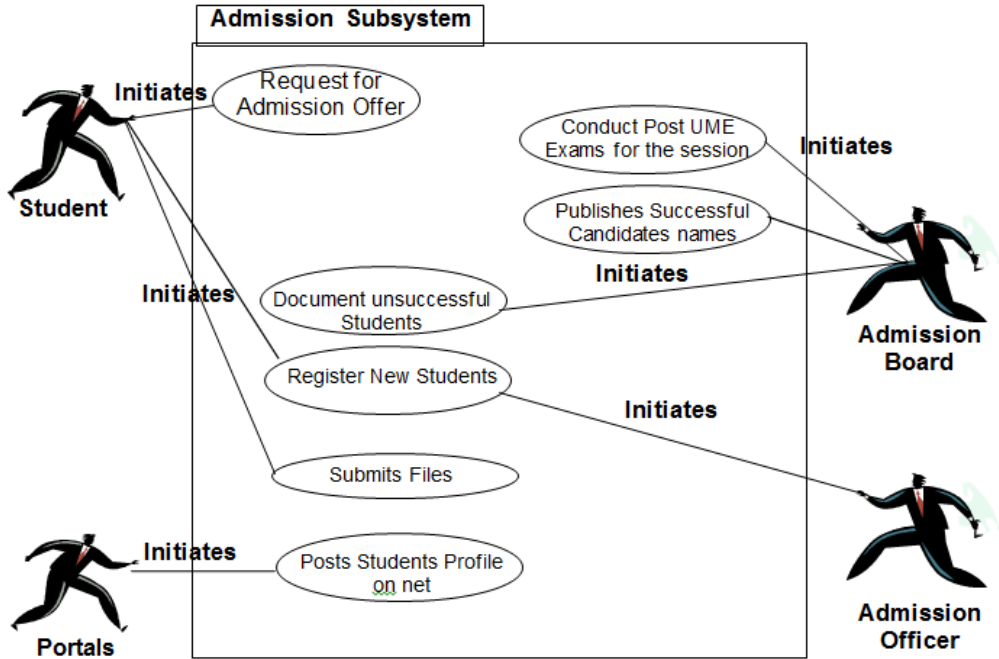


Figure-4.1. Use Case diagram of Transcript Subsystem

Source: Author

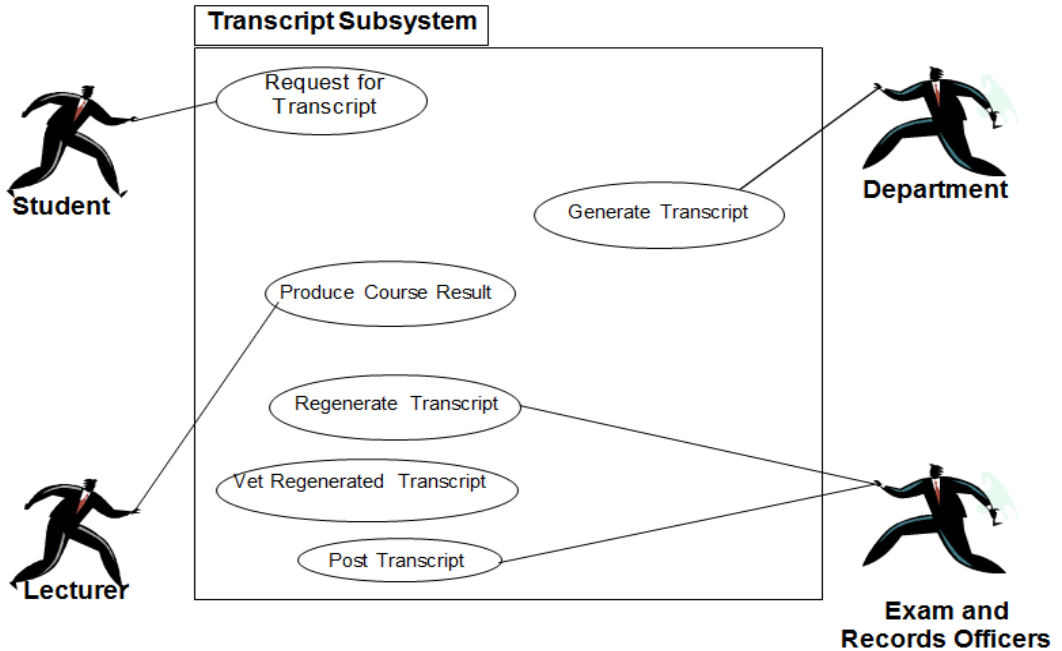


Figure-4.2 Use Case diagram of Admission subsystem

Source: Author

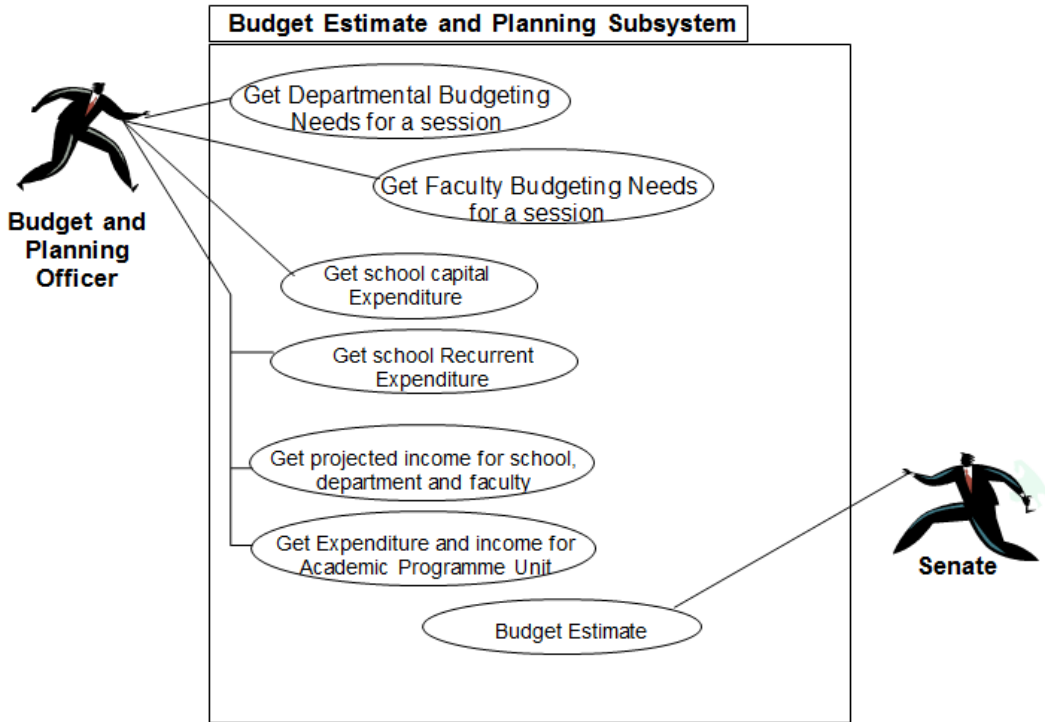


Figure-4.3. Use case diagram of Budget Estimate Subsystem.

Source: Author

5.2. Analysis Use Case

Table-4.1. Use case analysis table of generating information Admission use case.

Author: Mrs. Eze

USE CASE NAME	REGISTER NEW STUDENT	
DESCRIPTION	This use case describes the process of a student registration. On completion, the student is issued a registration number	
REFERENCE	NAUDMinner – 1.0	
Typical course of events	Actor Action	System Response
	STEP 1: This use case is initiated when the student prints letter of admission from portals.	
	STEP 2: Students submits the admission offer to admission office.	
	STEP 3: The admission officer verifies the student’s particulars with the list of admitted students from the admission board.	
	STEP 4: Issues medical test form, acceptance form, and other forms to the student.	
	STEP 5: Students pays school fees and	STEP 6: Accepts students form,

	performs medical tests	issues registration number to student.
ALTERNATE COURSE	STEP 3: If student particulars are not found in the original admission list, the student is arrested and investigated.	
PRE-CONDITION	Registration can only be carried by bonafide who met the post unit and unit criteria for admission	
POST CONDITION	Registered students are documented and filed	
ASSUMPTIONS	None at this time.	
FIGURE 3.11	Analysis use case of register new student use case.	

Table-4.2. Use case analysis table of generating Budget Estimate use case.

Author: Mrs. Eze

Date: 8/9/2011

USE CASE NAME	GET BUDGET ESTIMATE	
DESCRIPTION	This use case describes the process of generating budget estimates for each academic year.	
REFERENCE	NAUDMinner – 2.0	
Typical course of event	Actor Action	System Response
	<p>STEP 1: This use case is initiated when departments, faculties, school of post graduate studies, school medicine and pharmacy, CEP unit, Pre Science unit and all other units draws up a list of what they have and need for smooth running of an academic year in terms of finance and personnels.</p> <p>STEP 9: University Senate reviews the budget, proposal for approval.</p> <p>STEP 11: This use case terminates when the Vice Chancellor, Bursar and Auditor general gets their copy of the budget proposal.</p>	<p>STEP 2: Sorts all the recorded “haves” and “needs” received in their various categories.</p> <p>STEP 3: The needs of departments, faculties, academic units and administrative units are noted down.</p> <p>STEP 4: A list of all capital projects needed to be embarked upon is noted down.</p> <p>STEP 5: A detailed lasting of the projects listed are carried out.</p> <p>STEP 6: All the income sources of the university are cited, and the monies accruing from such sources calculated.</p> <p>STEP 7: A summary of the income and expenditure of the university is prepared.</p> <p>STEP 8: A Break down of all income and expenditure by the university is prepared and presented to the university senate along side the summary for approved.</p> <p>STEP 10: The approved budget proposed is hard bind and copies sent to</p> <ol style="list-style-type: none"> i. Vice chancellor ii. School Bursar iii. School Auditor General
ALTERNATE COURSE	STEP 9: If there are grey areas/or areas that don’t suit the senate, these areas are amended and sent back to budget and planning for reworking/correction.	

PRE-CONDITION	Budget estimate (proposal) can only be done by budget and planning unit.
POST CONDITION	Budget estimates has been hard bonded and the copies sent to the relevant quarters.
ASSUMPTIONS	None
FIGURE 3.12	Analysis use case of cut budget estimate use case.

Table-4.3. Use case analysis of generating transcript use case.

Author: Mrs. Eze

Date: 8/9/2011

USE CASE NAME	GENERATE TRANSCRIPT	
ACTOR(S)	Student, Exam and Record Officer, Dept Secretary	
DESCRIPTION	This use case describes the process of generating a student transcript.	
REFERENCE		
Typical course of events:	Actor Action	System Response
	STEP 1: This use case is initiated when student apply for transcript.	STEP 2: Students personal and academic record are validated. STEP 3: Students file is retrieved at exams and records, and transcript request forwarded to Dept. STEP 4: The transcript is generated for students. STEP 5: The transcript is then vetted and sent to the where it is being requested.
	STEP 6: This use case terminates when transcript is received by those demanding it.	
ALTERNATE COURSE	STEP 3: If student file is not found the admissions record is checked to see if student was properly and admitted, and if so a new file is generated. STEP 4: If no transcript has been raised for the student before, the request is forwarded to the department where the transcript is raised and sent back to exams and records.	
PRE-CONDITION	Transcript can only be raised for bonafide students of the university who have completed their undergraduate studies.	
POST CONDITION	Transcript is sealed and forwarded to its destination.	
ASSUMPTIONS	None at this time	

5.3. Finding and Identifying Objects

The second phase of this analysis is finding and identifying business objects. The business objects identified from the fore going analysis are enumerated below.

- Student
- Transcript
- Admission Officer
- Exams and Record Officer
- Faculty
- Department
- Admission Record
- Result
- Destination
- Admission List
- Budget Estimate
- Session
- Expenditure
- Income
- Capital Expenditure
- Recurrent Expenditure

- Lecturer
- Portal
- University Senate
- Medical test forms
- Student File
- Course
- School fees
- Academic Programme'

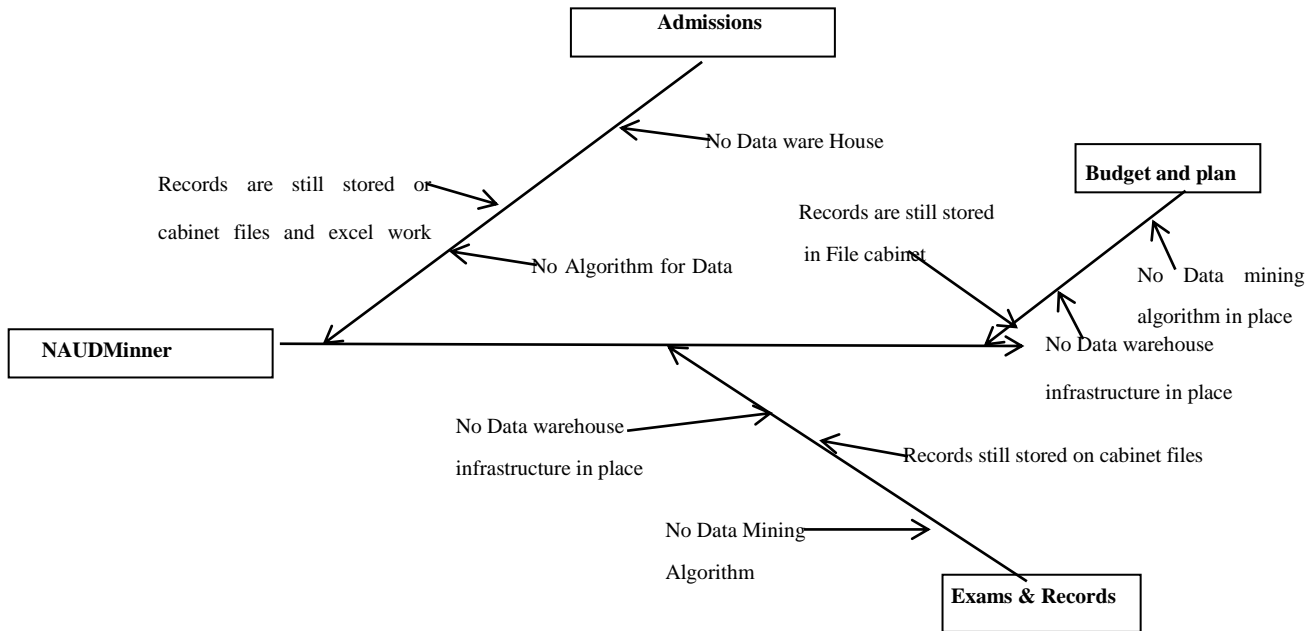


Figure- 4.4. Isikawa diagram that states the weaknesses identified. Source: Author

5.4. Problems Identified With Present System

The itching problems to be solved by this new system were stated below.

- (i) Poor performance evaluation,
- (ii) unstable and abnormal admission procedures and statistics
- (iii) poor generation and management of the tertiary institutions external fund and internally generated revenue.

5.5. Advantages of the Proposed System

The new system has great advantages because it provides the facilities to:

- (i) Load data to the warehouse
- (ii) Clean data in the warehouse
- (iii) Purge data in the warehouse
- (iv) Extract data from the warehouse

5.6. Disadvantages of the Proposed System

- (i) Requires expensive computing equipment.
- (ii) Requires too much work load
- (iii) Requires extensive research laboratory ready with internet connections to source information

- (iv) Requires plenty fund to commence.
- (v) Requires a lot of brain storming ideas-

5.7. Justification of the New System

The new system will help the universities to find association between results of courses and the lecturers that thought them in different sessions, find association between results and admission, find association between results and budget and finally find association between results and admission and budget.

6. CONCLUSION

Using a particular methodology to analyse a given system in a dynamic world scenario is the major activity in software development. The researcher applied all the necessary methods, techniques and procedures to investigate and analyze the existing system in order to proffer solutions to the identified problems. Finally, the proposed system tends to provide inter-relationships amongst various departments of the tertiary institutions for adequate decision making and proper management.

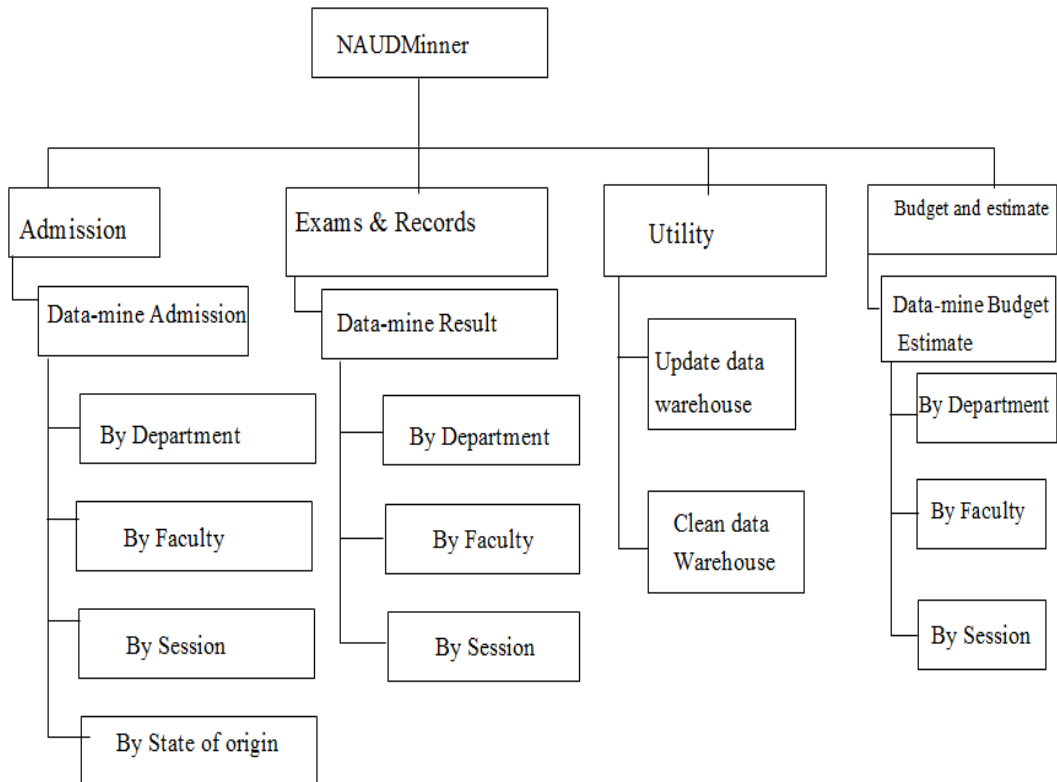


Figure-4.5. High Level Model of the new system.

Source: Author

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