

Asset Remaining Life Cycle Assessment (ARLCA)

by

Adnan Iqbal Chandio

A project dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
Information Communication Technology Programme

JANUARY 2008

Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

TABLE OF CONTENTS

| | | | | | | | | |
|-------------------------------------|--|--|--|--|--|--|--|------------|
| CERTIFICATION OF APPROVAL. | | | | | | | | i |
| CERTIFICATION OF ORIGINALITY | | | | | | | | ii |
| ABSTRACT | | | | | | | | iii |
| ACKNOWLEDGEMENT | | | | | | | | iv |
| ABBREVIATIONS | | | | | | | | v |
| CHAPTER 1: | INTRODUCTION | | | | | | | 1 |
| | 1.1 Background of Study | | | | | | | 1 |
| | 1.2 Problem Statement | | | | | | | 3 |
| | 1.3 Aim, Objectives and Scope of Study | | | | | | | 4 |
| CHAPTER 2: | LITERATURE REVIEW | | | | | | | 5 |
| | 2.1 Introduction | | | | | | | 5 |
| | 2.1.1 Types of RBI assessment | | | | | | | 6 |
| | 2.1.2 Quantitative/Semi-Quantitative Implementation | | | | | | | 6 |
| | 2.1.3 Qualitative Implementation | | | | | | | 7 |
| | 2.1.4 Risk Assessment Methods | | | | | | | 7 |
| | 2.1.5 Tischuk | | | | | | | 8 |
| | 2.1.5.1 Semi-Quantitative T-OCA | | | | | | | 8 |
| | 2.1.5.2 Qualitative T-REx | | | | | | | 9 |
| | 2.2 Asset Remaining Life Cycle Assessment. | | | | | | | 9 |
| | 2.2.1 ARLCA Process includes | | | | | | | 10 |
| | 2.2.2 ARLCA Process is capable of generating | | | | | | | 10 |

| | | | |
|-------------------|-------|---------------------------------------|-----------|
| | 2.2.3 | Key Elements in ARLCA Documentation | 11 |
| CHAPTER 3: | | METHODOLOGY | 12 |
| | 3.1 | The Spiral Model | 12 |
| | 3.1.1 | Planning | 13 |
| | 3.1.2 | Risk Analysis | 14 |
| | 3.1.3 | Engineering | 14 |
| | 3.1.4 | Customer Evaluation | 14 |
| CHAPTER 4: | | RESULTS AND DISCUSSION. | 15 |
| | 4.1 | System Architecture | 15 |
| | 4.2 | Use Case Diagram | 17 |
| | 4.3 | Class Diagram. | 18 |
| | 4.4 | Entity Relationship Diagram | 19 |
| | 4.5 | Database Diagram | 20 |
| | 4.6 | Graphical User Interface | 21 |
| | 4.6.1 | Asset Registration Form | 22 |
| | 4.6.2 | Client Registration Form | 23 |
| | 4.6.3 | Failure Consequences Form | 24 |
| | 4.6.4 | Failure Mode Form | 25 |
| | 4.6.5 | Remaining Life Form | 26 |
| | 4.6.6 | Task Master Form | 28 |
| | 4.7 | Evaluation Results | 29 |
| | 4.8 | Tools used | 29 |
| | 4.8.1 | Programming Platform Used | 30 |
| | 4.8.2 | Database Server Used | 30 |
| | 4.8.3 | Visual Studio.NET | 31 |
| CHAPTER 5: | | CONCLUSION AND RECOMMENDATION. | 32 |

CERTIFICATION OF APPROVAL

Asset Remaining Life Cycle Assessment (ARLCA)

By

Adnan Iqbal Chandio

A project dissertation submitted to the
Information Communication Technology Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirement for the
BACHELOR OF TECHNOLOGY (Hons)
(INFORMATION AND COMMUNICATION TECHNOLOGY)

Approved by,

(MS. NOREEN IZZA Bt. ARSHAD)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
JANUARY 2008

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

A handwritten signature in black ink, appearing to read 'Adnan Iqbal Chandio', written in a cursive style. The signature is positioned above a horizontal line.

(ADNAN IQBAL CHANDIO)

ABSTRACT

Asset Remaining Life Cycle Assessment is a practical and cost effective system for calculating the remaining life of the Assets. It also gives the graphical representation of that calculated value of the equipment. The remaining life is calculated based on certain formula. It provides semi-quantitative analysis. Applications include piping, static equipment, rotating equipment, relief valves and control valves. It has integrated Task Master Technology that allows the user to easily develop an inspection work program based on the asset assessment results. It requires a serious commitment of resources to implement and maintain and also require a large amount of data. It meets all the requirements of API RP 580 for an effective program. But it is much faster, easier and cheaper to implement. This application is hope to benefit for Inspectors in order for them to inspect the equipments and to find the remaining life of the equipments.

ACKNOWLEDGEMENTS

Firstly, I would like to thank Almighty Allah for giving me the chance to be able to engage in this project. With Him, all things are possible.

Secondly, I would like to thank my supervisor, Ms. Noreen Izza Bt. Arshad, for her guidance, advice and patience that has proven to be valuable in communicating how a Final Year Project should be done.

Lastly but certainly not least, I express my gratitude towards friends and family members who have indirectly contributed towards the success of this project.

ABBREVIATIONS

- ARLCA: Asset Remaining Life Cycle Assessment
- RBI: Risk Based Inspection
- SQL: Structured Query Language
- VB.Net: Visual Programming .Net
- API: American Petroleum Institute
- ASME: American Society of Mechanical Engineers
- T-OCA: Tischuk Operational Criticality Assessment
- T-Rex: Tischuk Risk Expert

CHAPTER 1

INTRODUCTION

1.1 Background of study

Oil and Gas Refineries uses Equipments including pipes, valves etc, after some times these equipments get problems and suddenly block the flow of liquid or gas due to corrosion rate, or damage the equipment, in the result, plant shut down and faces a great loss. So all oil and gas refineries need to inspect their equipments whether they are working well or not, and when they can damage.

Asset Remaining Life Cycle Assessment (or ARLCA) system is based on this concept to calculate the remaining life of the equipments with the help of measurement of thickness and corrosion rate of the equipment. It can be calculated using formula

$$\text{Remaining Life} = \frac{\text{Thickness} - \text{Retire Thickness (Tmin)}}{\text{Corrosion rate}}$$

ARLCA evaluate the risk profile and provides the remaining life indicators covering all damage mechanism. The ultimate goal of ARLCA is to develop a cost-effective maintenance program that provides assurance of acceptable mechanical integrity and reliability. ARLCA provide economic benefits: less inspection, shorter shutdowns, longer run length, less unplanned shutdown.

The ARLCA plans also identify equipment that does not require inspection or some other form of mitigation because of the acceptable level of risk associated with the equipment's current operation. In this way, inspection and maintenance activities can be focused and more cost effective. This often results in a significant reduction in the

amount of inspection data that is collected. This focus on a smaller set of data should result in more accurate information. In some cases, in addition to risk reductions and process safety improvements, ARLCA plans may result in cost reductions. ARLCA is based on sound, proven risk assessment and management principles. ARLCA will not compensate for inaccurate or missing information, inadequate designs or faulty equipment installation, operating outside the acceptable design envelope, not effectively executing the plans, lack of qualified personnel or teamwork and lack of sound engineering or operational judgment.

1.2 Problem Statement

Inspection companies inspect the equipments in the companies. They need to know what, where, when and how to inspect to assured integrity at affordable cost. Many inspection companies don't have any proper system, they use Microsoft Excel to manage the documentation and they need to present to their client, since Microsoft Excel is not an appropriate system and it doesn't have any relational database, so they get following problems

- Miss a lot of important points to be considered.
- High risk and high probability of failure
- More expensive.
- Unstable system which is prone to errors.

So Inspection companies are looking forward for some new and advanced software which can provide more user friendly options in regard of managing the documentation. So by having new software, they can enhance their inspection service as well as the reports.

1.3 Aim, Objectives and Scope of Study

1.3.1 Aim

The aim of this research project is to learn, understand and acquire the knowledge experience and expertise to develop a ARLCA System for Inspection Companies, along with studying the fundamentals of Risk Based Inspection. This project is aimed to come out with a user friendly Interface for different level of users.

1.3.2 Objective and Scope of study

Every project has its own objectives that work as drivers to achieve success at the end of the whole progression. The objectives of the system that need to be implemented are as stated below:

- To conduct a feasibility study
- To design a cost effective system with less failure probability.
- To calculate the remaining life of the equipment
- To design user friendly interface for different level of users.

In completing this project, the ARLCA system studied through the finding the information through any resource available. The modified system is being created using VB.NET, C# and MY SQL. These include creation of necessary database and user interface in fabricating and implementation of this system. Its characteristic and functionality is being tested in the Visual Studio.NET.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Asset Remaining Life cycle has the same concept of Risk Based Inspection. Risk based Inspection (or RBI) is a risk-based approach to Oil and Gas industries inspection which analyses both the likelihood of failure and the consequence of failure, often in industrial pipe work. It is also called Risk Based Asset Management (RBAM), Risk Based Integrity Management (RBIM) or simply Risk Based Management (RBM).^[2]

Risk-based inspection refers to the application of risk analysis principles to manage inspection programs for plant equipment. These risks from a safety/health/environment perspective and/or from an economic standpoint. RBI has been used in the nuclear power generation industry for some time and is also employed in refineries and petrochemical plant. The ultimate goal of RBI is to develop a cost-effective inspection and maintenance program that provides assurance of acceptable mechanical integrity and reliability.

Risk Based Inspection (RBI) schemes are a planning tool used to develop the optimum plan for the execution of inspection activities. RBI uses the findings from a formal risk analysis, such as a Corrosion Risk Assessment, to guide the direction and emphasis of the inspection planning and the physical inspection procedures.

Risk assessment is the most important step in risk management process. Risk assessment measure two quantities of risk; the magnitude of loss and the probability that loss occurs. A properly conducted risk assessment helps to minimize the failure or harm. To conduct a risk assessment, it requires the inputs of different disciplines, identifies the risk and records the significant findings of assessment, decide the probability of failure and decide the precautions, also review assessment time to time.

Risk Based Inspection (RBI) is a process that factorize risk into decisions concerning when, where and how to inspect a process plant. The purpose of RBI is to focus inspection resources on equipment that will prevent failures. It's a tool to help make process of plant safe, more reliable and cost effective.

2.1.1 Types of RBI assessment

- **Qualitative approach:** It is based on descriptive data using engineering judgement and experience.
- **Quantitative approach:** It is based on probabilistic or statistical models.
- **Semi-Quantitative approach:** It is being any approach that has elements of both qualitative and quantitative methods.

We can adopt any approach to develop RBI.

2.1.2 Quantitative/Semi-Quantitative Implementation

There are several quantitative/semi-quantitative RBI products are available in the market that have been widely used in for some years. A common feature of all is the relatively large demand for data personal to complete the RBI assessments.

2.1.3 Qualitative Implementation

A qualitative approach requires data inputs based on descriptive information, using engineering judgement and experiences as the basis for the analysis of probability and consequences of failure. “Inputs are typically given in data ranges instead of discrete values. Results are typically given in qualitative terms such as high, medium or low. The value of this type of analysis is that it enables completion of risk assessment in the absence of detailed quantitative data. It also produces results more quickly. The accuracy of results from a qualitative analysis is dependent on the background and expertise of the analysts”. [9]

2.1.4 Risk Assessment Methods

Risk Assessment includes methods; API (American Petroleum Institute) RP580, ASME (American Society of Mechanical Engineers).

2.1.4.1 American Petroleum Institute (API)

API is the only national trade association that represents all aspects of America’s oil and natural gas industry. Our 400 corporate members, from the largest major oil company to the smallest of independents, come from all segments of the industry. They are producers, refiners, suppliers, pipeline operators and marine transporters, as well as service and supply companies that support all segments of the industry. For more than 75 years, API has led the development of petroleum and petrochemical equipment and operating standards. These represent the industry’s collective wisdom on everything from drill bits to environmental protection and embrace proven, sound engineering and operating practices

and safe, interchangeable equipment and materials. API maintains more than 500 standards and recommended practices. [5]

2.1.4.2 American Society of Mechanical Engineers (ASME)

ASME is one of the oldest and most respected standards-developing organizations in the world. It produces approximately 600 codes and standards, covering many technical areas, such as boiler components, elevators, and measurement of fluid flow in closed conduits, cranes, hand tools, fasteners, and machine tools. [6]

2.1.5 Tischuk

Tischuk International is a leading provider of software and engineering services, specifically for Risk-Based inspection and maintenance strategy development. Tischuk's T-OCA and T-REx software systems evaluate plant operational criticality, producing a risk matrix based on the likelihood and consequences of plant failure. Inspection and maintenance activities can then be prioritized and targeted to best effect.

2.1.5.1 Semi-Quantitative T-OCA

T-OCA is a practical, cost effective system for RBI. It provides a semi-quantitative, rule based risk assessment for the pressure envelope; piping, static equipment, rotating equipment, relief valves and control valves. T-OCA incorporates a feedback module to modify the risk assessment with inspection and monitoring data. It has integrated taskmaster technology that allows the user to easily develop an inspection work program based on the risk assessment.

2.1.5.1.1 Tischuk's System features

- Management system for maintaining documentation, personnel qualifications, data requirements and analysis updates
- Documented method for probability of failure determination
- Documented method for consequences of failure determination
- Documented methodology for managing risk through inspection and other mitigation activities
- Generate risk ranking of all equipment evaluated.
- Generate detailed inspection plan for each item including inspection methods, coverage and intervals

Tischuk International has a suite of application specific systems for qualitative RBI called T-REx (Tischuk Risk Expert).

2.1.5.2 Qualitative T-REx

T-REx is a family of software tools for assessment of specific equipment critically or risk rating based on consequences and probability of failure. The Task Master module is used to schedule tasks and generate inspections and maintenance plans. Substantial cost savings can be made together with improvements in safety and plant reliability. ^[7]

2.2 Asset Remaining Life Cycle Assessment System

ARLCA uses API RP 580 Risk Base Inspection and API RP 581 RBI Base Resource Document.

Tischuk system gives the inspection report while ARLCA gives the inspection report as well as calculate the remaining life of the equipment.

2.2.1 ARLCA Process

1. Planning the RBI Assessment.
2. Data and Information Collection.
3. Identifying Deterioration Mechanisms and Failure Modes.
4. Assessing Probability of Failure.
5. Assessing Consequence of Failure.
6. Risk Determination, Assessment and Management.
7. Risk Management with Inspection Activities.
8. Other Risk Mitigation Activities.
9. Reassessment and Updating.
10. Roles, Responsibilities, Training and Qualifications.
11. Documentation and record-keeping.

2.2.2 ARLCA Process is capable of generating;

- a. A ranking by risk of all equipment evaluated.
- b. A detailed description of the inspection plan to be employed for each equipment item, including:
 1. Inspection methods that should be used (e.g. visual, UT, Radiography, WFMY).
 2. Extent of application of the inspection methods (e.g. percent of total area examined or specific locations).
 3. Timing of inspections/examinations.
 4. Risk management achieved through implementation of the inspection plan.
- c. A description of any other risk mitigation activities (such as repairs, replacements or safety equipment upgrades).
- d. The expected risk levels of all equipment after the inspection plan and other risk mitigation activities have been implemented.

2.2.3 Key Elements in ARLCA Documentation

- Management systems for maintaining documentation, personal qualifications, data requirements and analysis updates.
- Documented method for probability of failure determination.
- Documented method for consequence of failure determination.
- Documented methodology for managing risk through inspection and other mitigation activities.

This system use Semi-Quantitative method. It is not necessarily a substitute for quantitative or semi-quantitative but it may be an adequate substitute. It is useful compliment, identifying the higher risk items upon which quantitative, semi-quantitative techniques can then be focused.

Asset Remaining Life Cycle Assessment (or ARLCA) system calculates the remaining life of the equipments with the help of measurement of thickness and corrosion rate of the equipment. It can be calculated using formula

$$\text{Remaining Life} = \frac{\text{Thickness} - \text{Retire Thickness (Tmin)}}{\text{Corrosion rate}}$$

ARLCA evaluate the risk profile and provides the remaining life indicators covering all damage mechanism. The ultimate goal of ARLCA is to develop a cost-effective maintenance program that provides assurance of acceptable mechanical integrity and reliability. ARLCA provide economic benefits: less inspection, shorter shutdowns, longer run length, less unplanned shutdown.

CHAPTER 3

METHODOLOGY

3.1 The Spiral Model

In order to accomplish this project, it was decided to use a good guideline which is represented by the “Spiral” Model, as it serves as the conceptual guideline for most projects. The Spiral Model abstracts the essential activities of software development and lists them in their most primitive sequence of dependency. Real development projects rarely follow such a model literally, mainly because the model can and is applied to itself recursively, yielding an almost fractal fabric of actual activity (Royce, Winston W, 1997).

The spiral model is a software development process combining elements of both design and prototyping-in-stages, in an effort to combine advantages of top-down and bottom-up concepts. It is also known as the spiral lifecycle model, is a systems development method (SDM) used in information technology (IT). This model of development combines the features of the prototyping model and the waterfall model. The spiral model is intended for large, expensive, and complicated projects. ^[13]

There are four phases in the "Spiral Model" which are: Planning, Risk Analysis, Engineering and Customer Evaluation. . These four phases are iteratively followed one after other in order to eliminate all the problems. Iterating the phases helps in understating the problems associated with a phase and dealing with those problems when the same phase is repeated next time, planning and developing strategies to be followed while iterating through the phases. The phases in "Spiral Model" are:

- Planning
- Risk Analysis
- Engineering
- Customer Evaluation

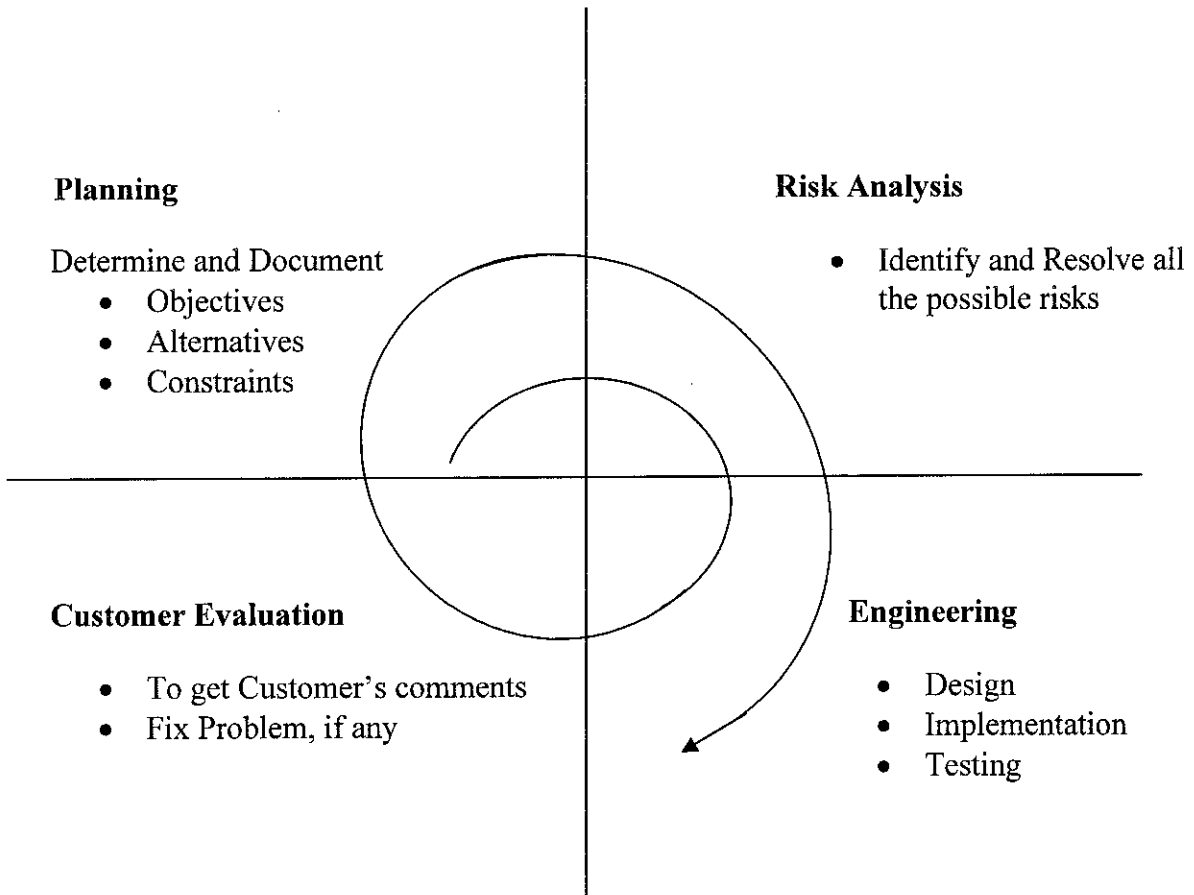


Figure 1: Spiral Model

3.1.1 Planning

In this phase, the objectives, alternatives and constraints of the project were determined and were documented. The objectives and other specifications were fixed in order to decide which strategies/approaches to follow during the project life cycle.

3.1.2 Risk Analysis

This phase is the most important part of "Spiral Model". In this phase all possible alternatives, which could help in developing a cost effective project were analyzed and methodologies were decided to use them. This phase identified and resolved all the possible risks in the project development. If risks indicated any kind of uncertainty in requirements, prototyping used to proceed with the available data and found out possible solution in order to deal with the potential changes in the requirements.

3.1.3 Engineering

- Design
- Implementation

This phase included two parts, in the first part of design, UML Modeling, was done and in the other part all the coding part was done and the actual development of the project was carried out. The output of this phase was passed through all the phases iteratively in order to obtain improvements in the same.

3.1.4 Customer Evaluation

In this phase, developed product was passed on to the customer in order to receive customer's comments and suggestions which could help in identifying and resolving potential problems/errors in the software developed. The customer evaluation was done by the chemical and mechanical students of UTP. The form of Customer Evaluation is given in Appendices A. The result is given in the Result session. This phase is very much similar to TESTING phase.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 System Architecture

The architecture of Asset Remaining Life Cycle Assessment is data centre architecture which all component of the system have to interact with central database server in retrieving or updating data. On top of the system are Client and Administrator (Management) that control access to the system and Inspection System itself. See figure 2

System's Components:

1. Management: is the administrator platform for controlling and managing the inspection system. Working from this platform the client can input the detail of equipment and administrator can update the information.
2. Inspection System: is the information platform for calculating the remaining life of equipment. With this platform the system can easily find the remaining life of any equipment and its consequences in case of failure.

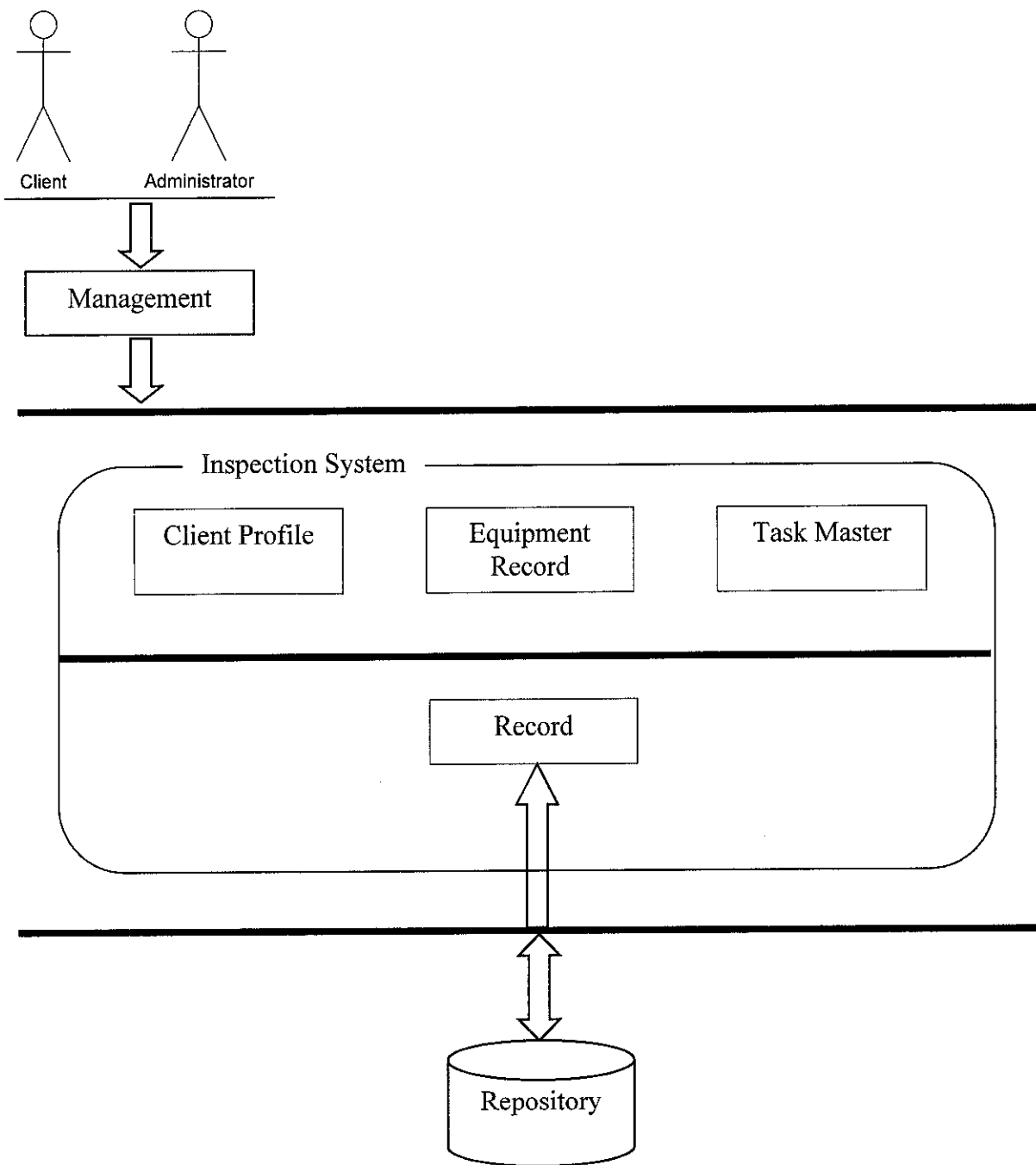


Figure 2: System Architecture

4.2 Use Case Diagram

Use case of Asset Remaining Life Cycle Assessment System was design to provide the view of use case and interaction between users and the system. There are five main use cases. Each use case presents the core module of ARLCA Study that was implemented to provide the functionality and interaction with the users.

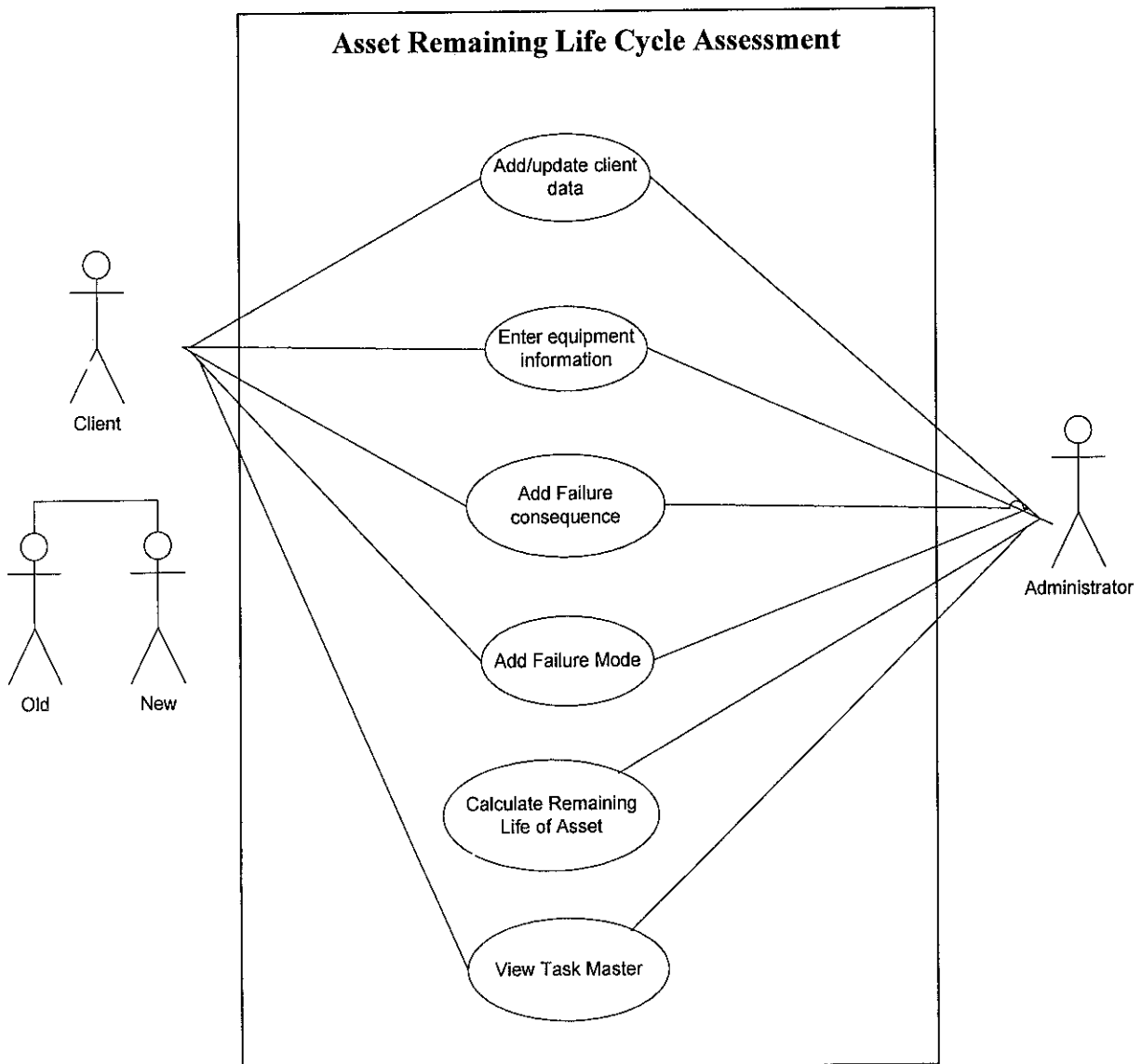


Figure 3: Use Case Diagram

4.3 Class Diagram

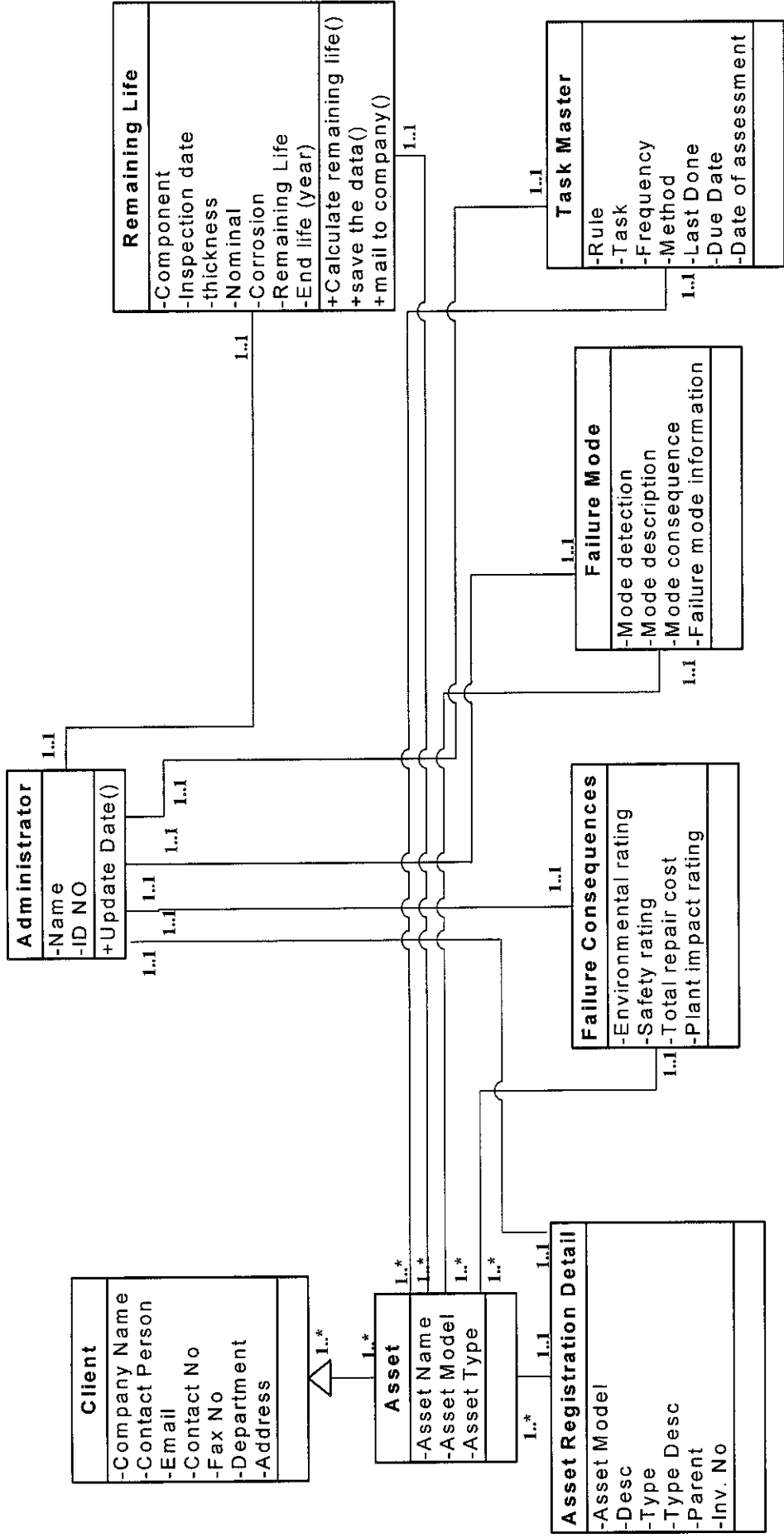


Figure 4: Class Diagram

4.4 Entity Relationship Diagram

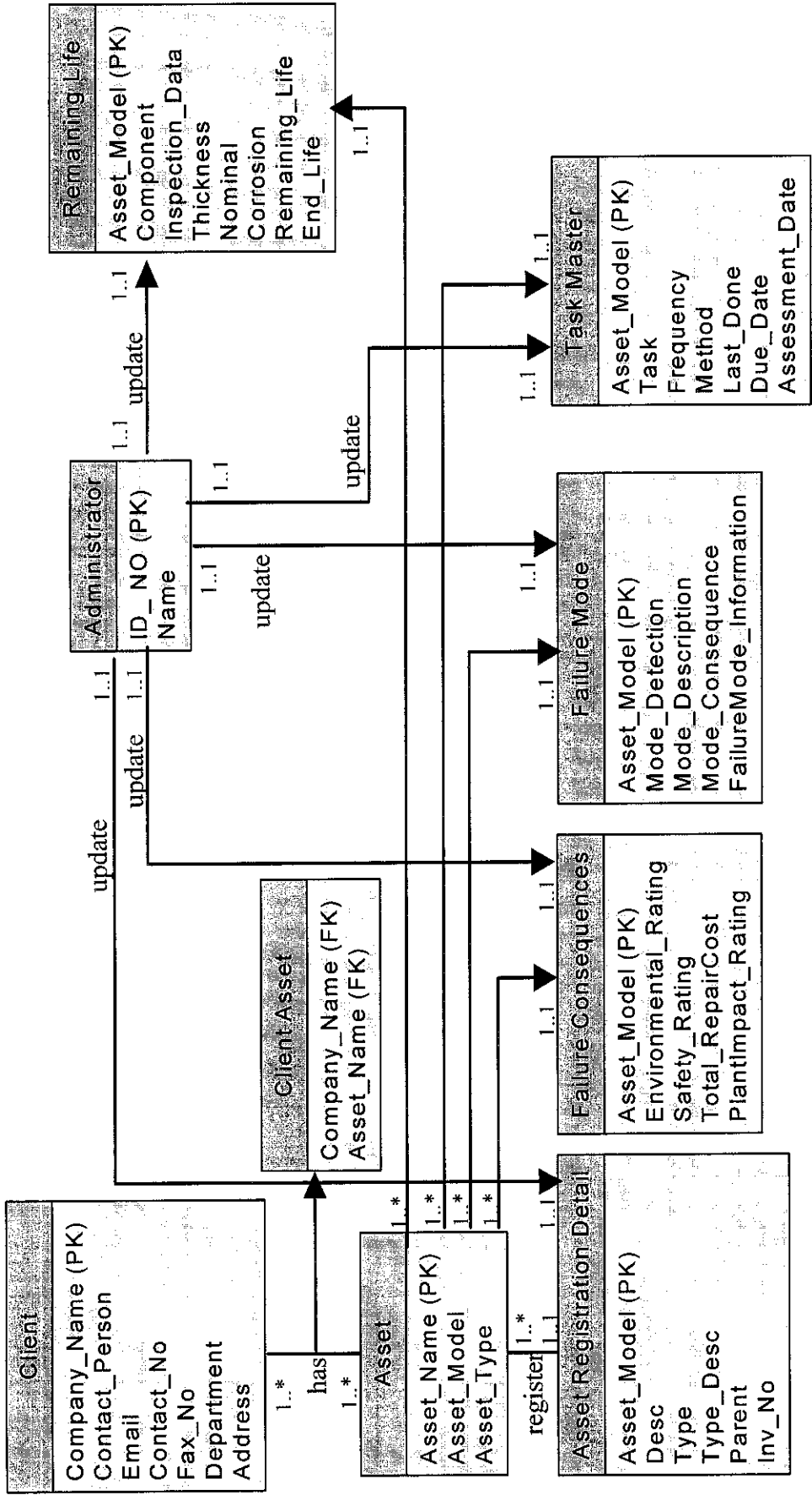


Figure 5: Entity Relationship Diagram

4.5 Database Diagram

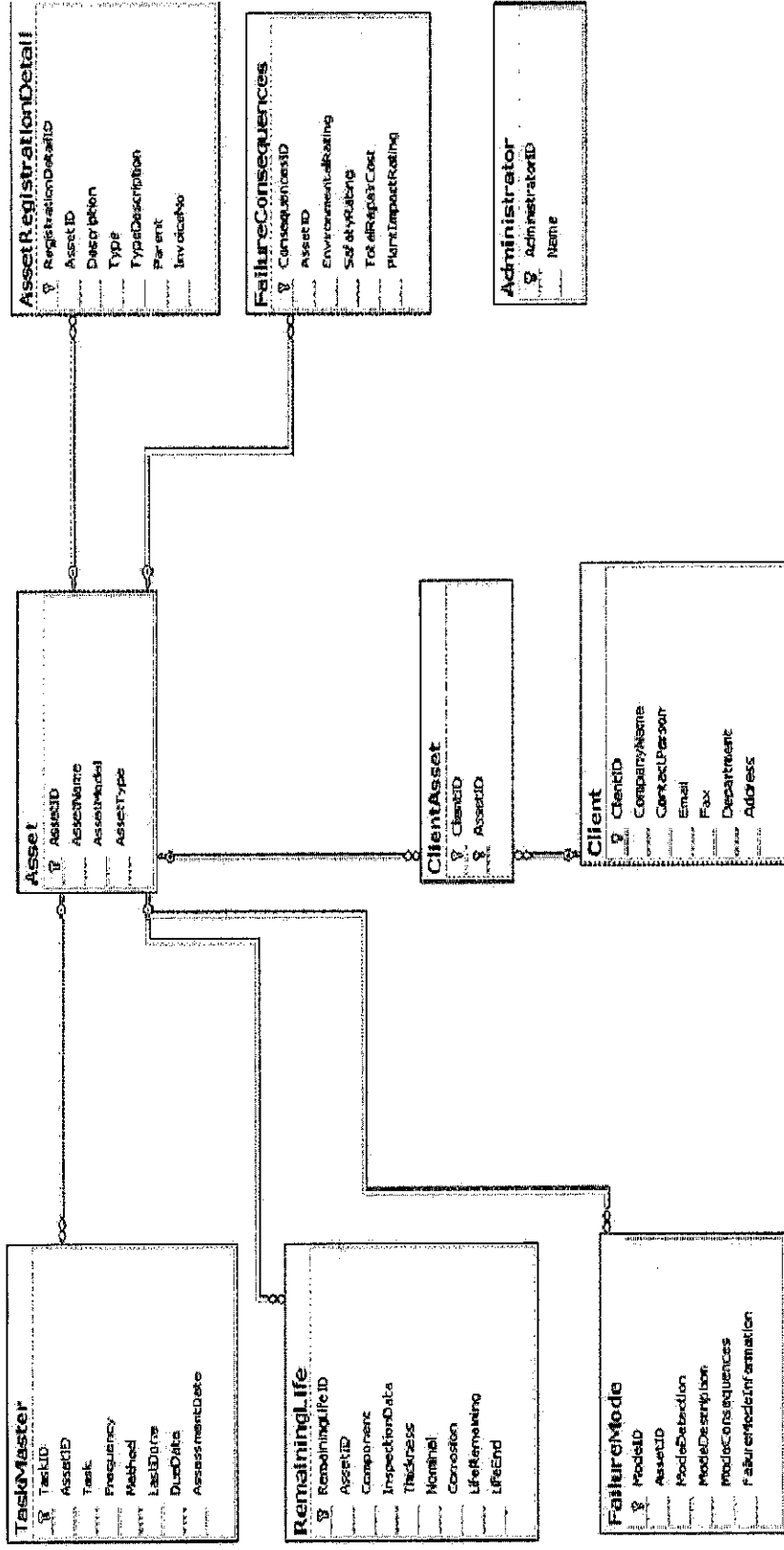


Figure 6: Database Diagram

4.6 Graphical User Interface (GUI)

From all above information, we have completed the Analysis Part where we gather all information about the user requirement, define the scope of the concept and define the methodology that going to used. We have completed the UML Modeling. Now we are going to transform these all information into complete detail system. Here are user interface;

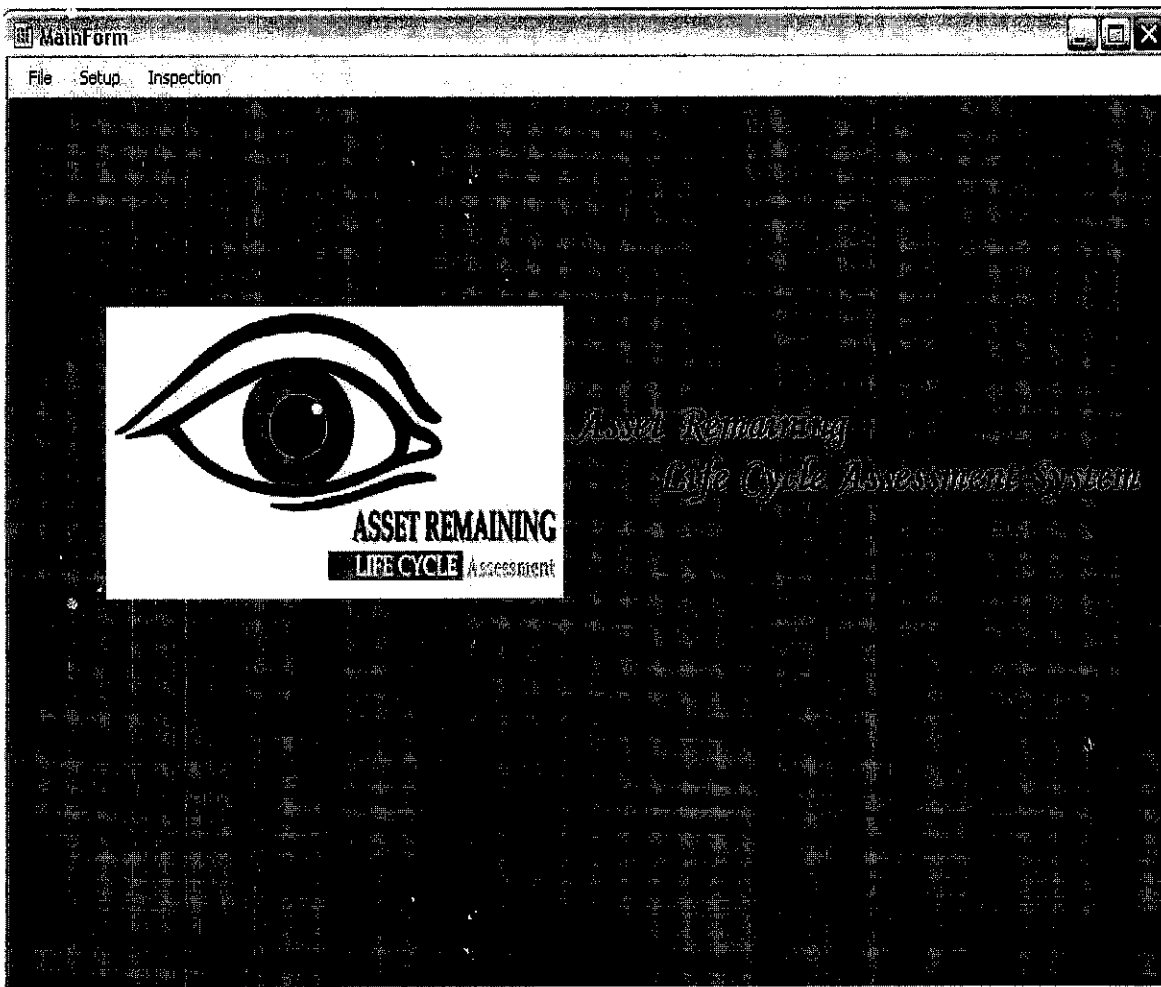
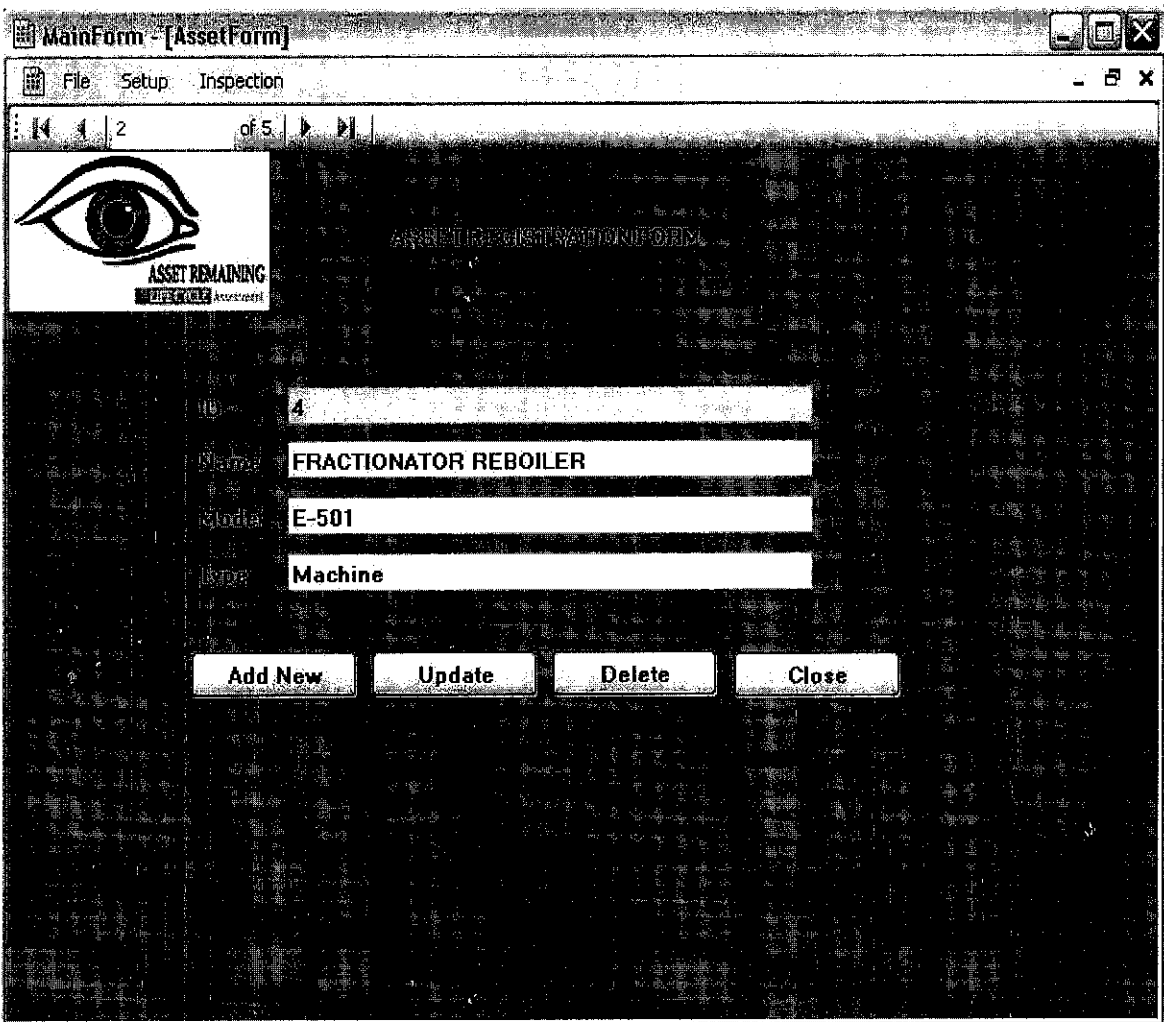


Figure 7: Home Page

4.6.1 Asset Register

This option is used to add asset/equipment in the system by giving the name of asset and its model, the system will give its id automatically then click add new to save in the system, there also can be changed or modify by clicking the update button or can delete the equipment information by clicking the delete button. So after adding the equipment it will be saved in the system with specific id given by the system.

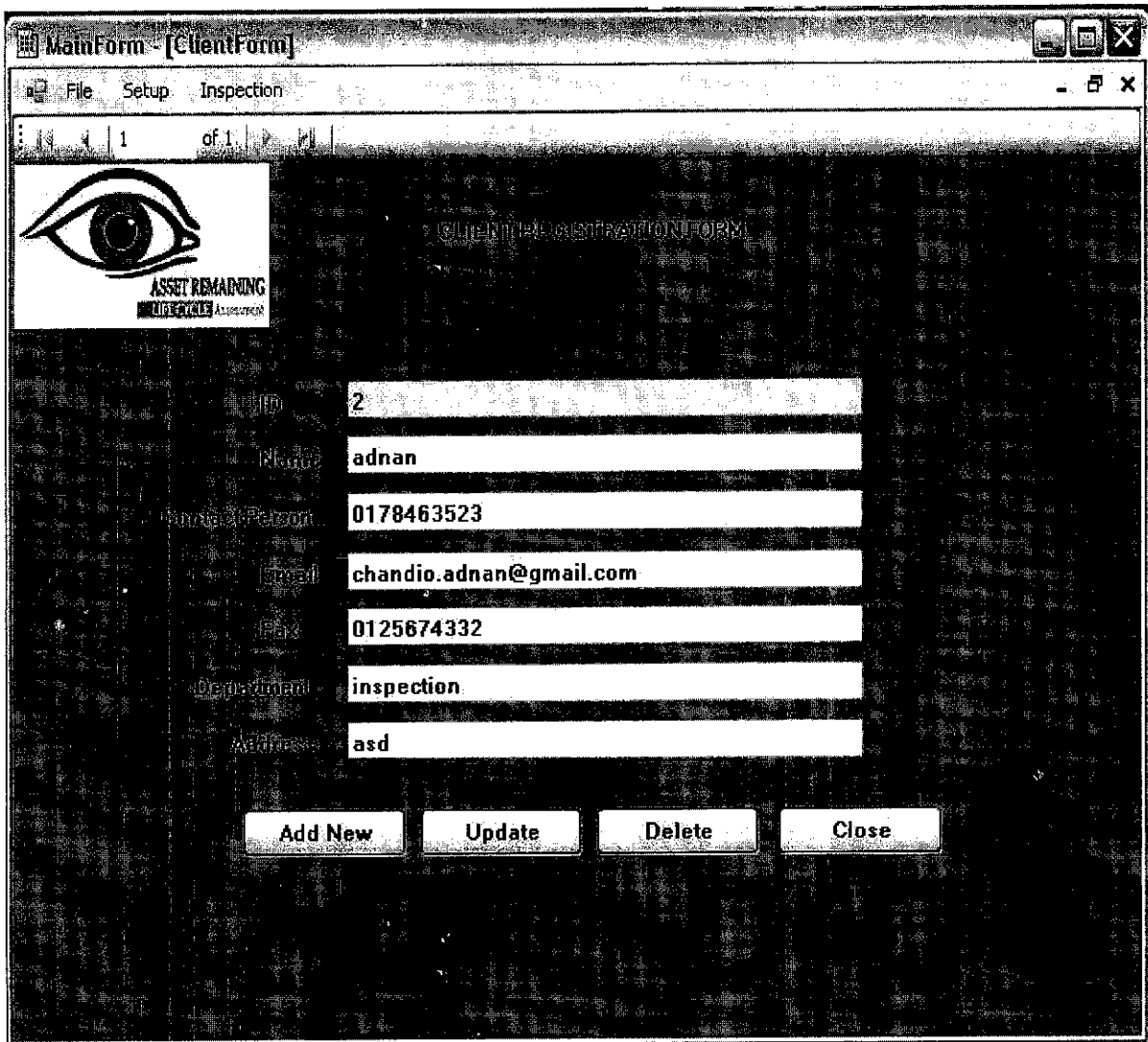


The screenshot shows a software window titled "MainForm - [AssetForm]". The window has a menu bar with "File", "Setup", and "Inspection". Below the menu bar is a navigation bar with "1" and "2" of 5. The main area contains a logo of an eye with the text "ASSET REMAINING" and "LIFE CYCLE Assessment". The form is titled "ASSET REGISTER/ADD NEW FORM". It has four input fields: "ID" with the value "4", "Name" with the value "FRACTIONATOR REBOILER", "Model" with the value "E-501", and "Type" with the value "Machine". At the bottom, there are four buttons: "Add New", "Update", "Delete", and "Close".

Figure 8: Asset registration Form

4.6.2 Client Register

This option is used to add the information about the company and the person who is authorized by the company. The system will give its id automatically then click add new to save in the system, there also can be changed or modify by clicking the update button or can delete the company information by clicking the delete button. So after adding the company information it will be saved in the system with specific id given by the system.

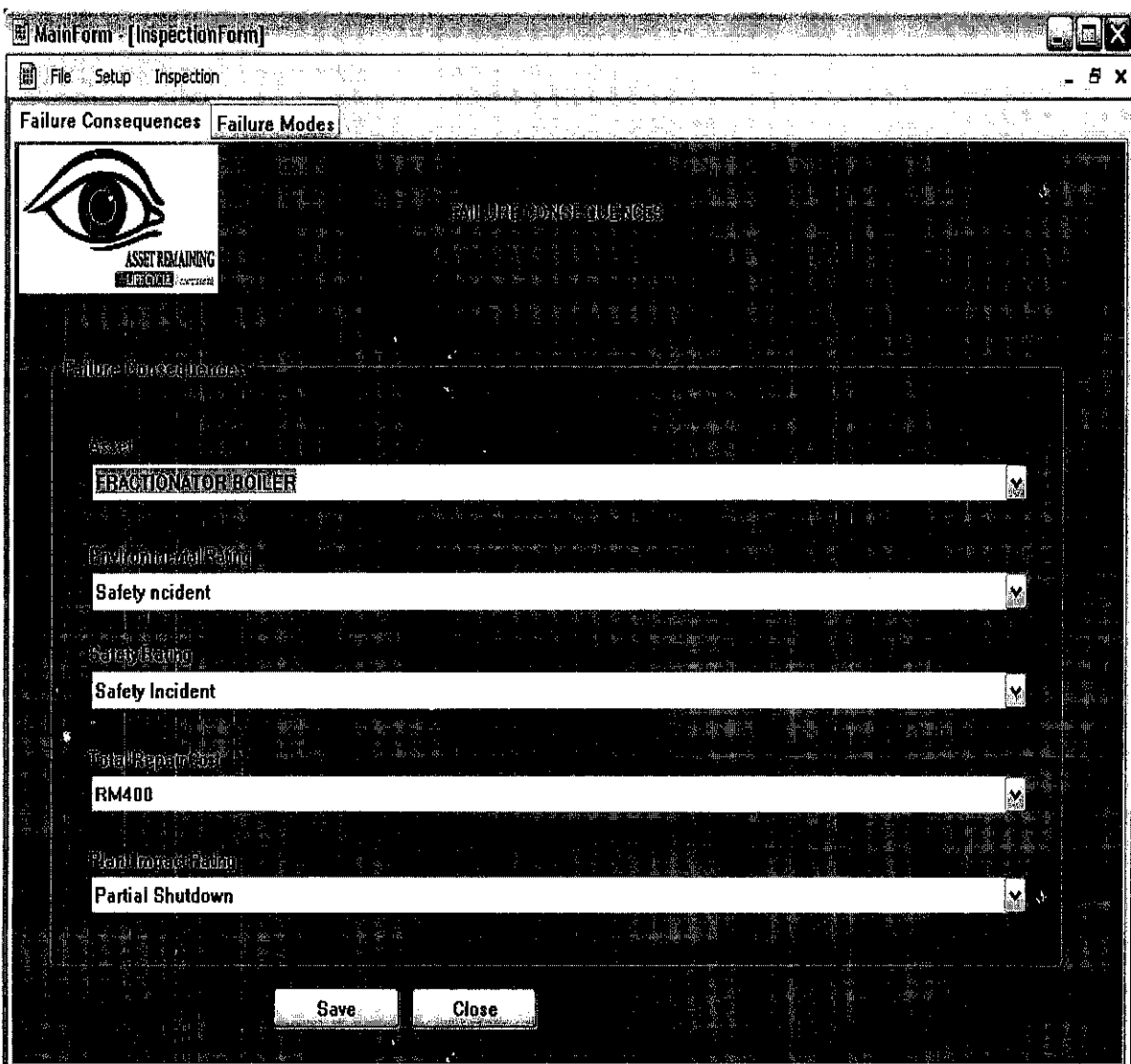


The screenshot shows a software application window titled "MainForm - [ClientForm]". The window has a menu bar with "File", "Setup", and "Inspection". Below the menu bar, there is a status bar showing "1 of 1". The main content area features a logo on the left with an eye icon and the text "ASSET REMAINING" and "INSURANCE". The central part of the form is titled "CLIENT REGISTRATION FORM" and contains several input fields with the following values: ID: 2, Name: adnan, Phone: 0178463523, Email: chandio.adnan@gmail.com, Mobile: 0125674332, Org: inspection, and Address: asd. At the bottom of the form, there are four buttons: "Add New", "Update", "Delete", and "Close".

Figure 9: Client registration Form

4.6.3 Failure Consequence

This option is used to give the consequences of the failure, its environmental and safety ratings. It also defines the expected repair cost of that particular equipment. It also gives detail after the failure of the equipment, the plant partially shutdown or any other thing happened with plant.



The screenshot shows a software window titled "MainForm - [InspectionForm]". The menu bar includes "File", "Setup", and "Inspection". The window is divided into two tabs: "Failure Consequences" (selected) and "Failure Modes". On the left side, there is a logo of an eye with the text "ASSET REMAINING LIFE CYCLE" below it. The main area is titled "FAILURE CONSEQUENCES" and contains several dropdown menus for data entry:

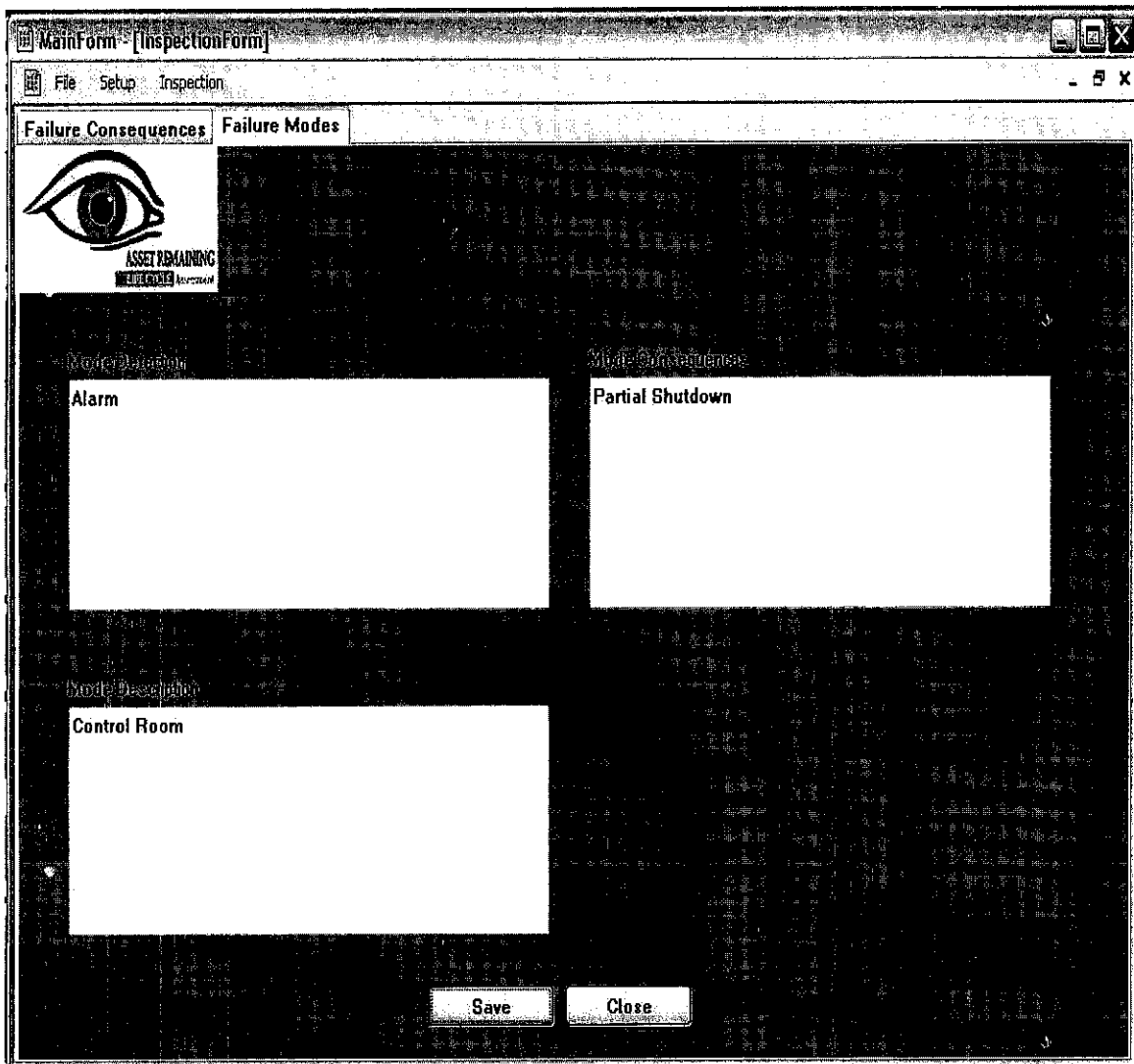
- Asset: FRACTIONATOR BOILER
- Environmental Rating: Safety incident
- Safety Rating: Safety Incident
- Total Repair Cost: RM400
- Plant mode after failure: Partial Shutdown

At the bottom of the form, there are two buttons: "Save" and "Close".

Figure 10: Failure Consequences Form

4.6.4 Failure Mode

This option is used to give the failure mode, it means that how they knew that equipment is fail to work. It was due to alarm or there were some other reasons to know and it gives detail of what happened after the failure of equipment.



The screenshot shows a software window titled "MainForm - [InspectionForm]". The window has a menu bar with "File", "Setup", and "Inspection". Below the menu bar are two tabs: "Failure Consequences" and "Failure Modes". The "Failure Modes" tab is active. In the top-left corner, there is a logo of an eye with the text "ASSET REMAINING" and "MULTI-COMPLEX Assessment" below it. The main area of the form is dark and contains three white rectangular input fields. The first field is labeled "Alarm" and is under the heading "Mode Description". The second field is labeled "Partial Shutdown" and is under the heading "Mode Consequence". The third field is labeled "Control Room" and is under the heading "Mode Description". At the bottom of the form, there are two buttons: "Save" and "Close".

Figure 11: Failure Mode Form

4.6.5 Calculate Remaining Life of Equipment

This option is used to calculate the remaining life of that particular equipment by the thickness given of that equipment. By clicking the calculate Remaining Life button, the system will show the remaining time and day and date calculated by the system. It also gives the graphical representation of that calculated value.

ASSET REMAIN

Asset: Assel6

Component Name:

Initial Thickness: 09.80

Date: Saturday, September 09, 2006

Thickness: 09.80

Date: Saturday, September 09, 2006

Thickness: 09.80

Date: Wednesday, May 16, 2007

Thickness: 09.64

Date: Friday, March 11, 2005

Thickness: 03.08

Calculate Remaining Life

Last Thickness: 6.56

Date: Thursday, April 10, 2008

Corrosion Rate: 0.2346987951807228 Remaining Life (NR): 27.950718685831622176

Figure 12: Calculate Remaining Life Form

The graphical representation of the calculation

It shows two values. At X-axis it gives the value of the life of the equipment, while at Y-axis it gives the value of thickness of the equipment. So at this current thickness, without any increase in thickness, this equipment can work till 2028. It also save in Microsoft Excel in anywhere on the system and it also print.

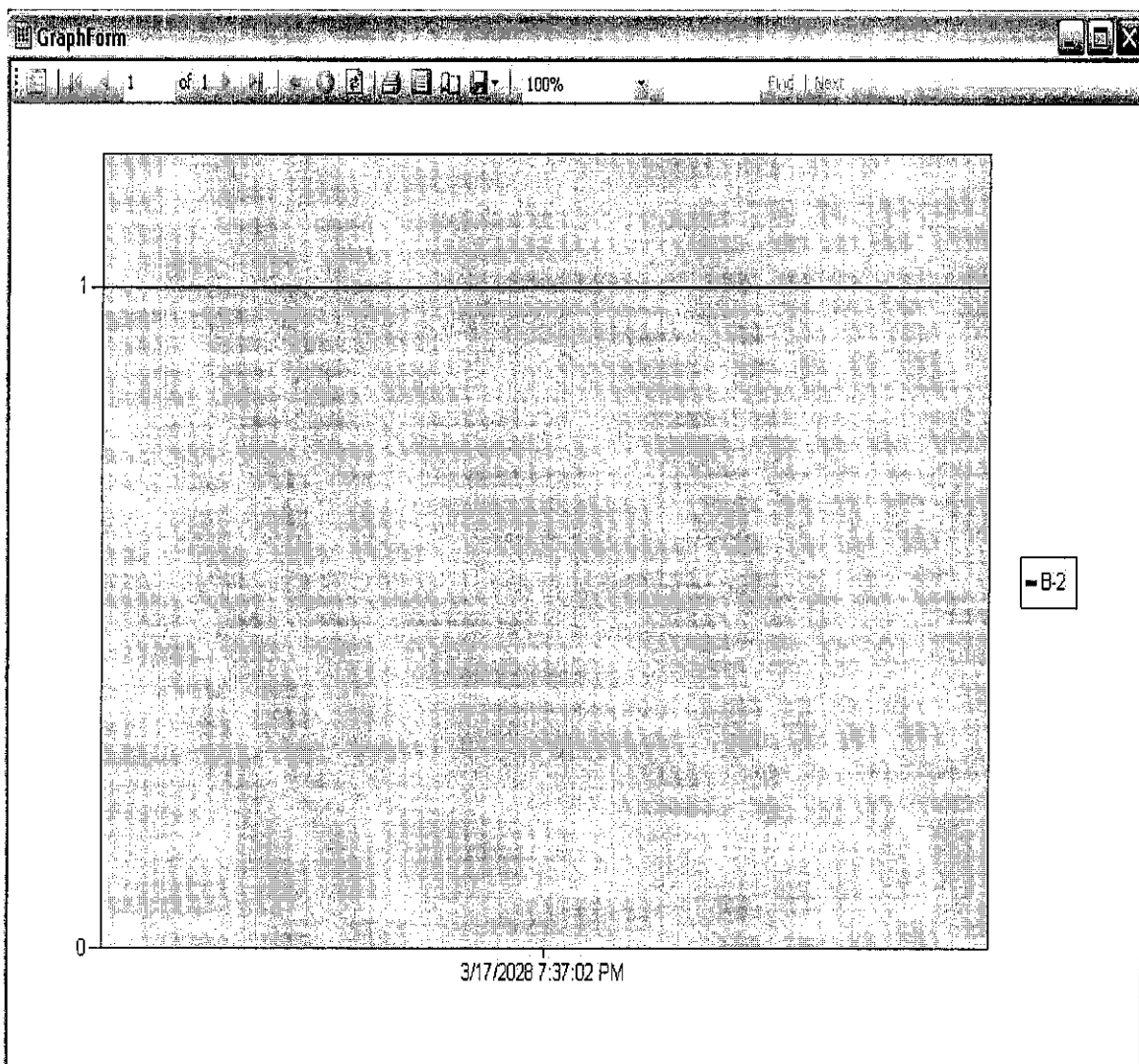


Figure 13: graphical representation of calculation

4.6.6 Task Master

This option is used to view the record of the registered assets. This record includes the whole report of each equipment inspected. In this form there is an option to print out the report of selected assets or equipment registered in database, so that user can get full report of their inspected equipment.

| Task | DueDate | LastDone | Frequency | AssessmentDate | Method | AssetID |
|------|-----------------|-----------------|-----------|-----------------|--------|---------|
| | 3/26/2008 2:... | 3/26/2008 2:... | | 3/26/2008 2:... | | 4 |
| | 5/7/2009 9:3... | 4/9/2008 9:3... | | 4/9/2008 9:3... | | 4 |

| LastDate | InitialDate | LastThickness | LastDate | RemainingLife | LifeRemaining | Installed |
|-----------------|-----------------|---------------|-----------------|---------------|---------------|-----------|
| 10/4/2007 1:... | 4/4/2006 1:0... | 09.64 | 4/4/2006 1:0... | 4 | 87.9746126... | 12/8/20 |
| 10/4/2007 1:... | 8/8/2005 1:0... | 09.64 | 11/16/2005 ... | 12 | 110.289341... | 12/8/20 |

Figure 14: Task Master Form

4.7 Evaluation Results

Here are the results from the customer evaluation

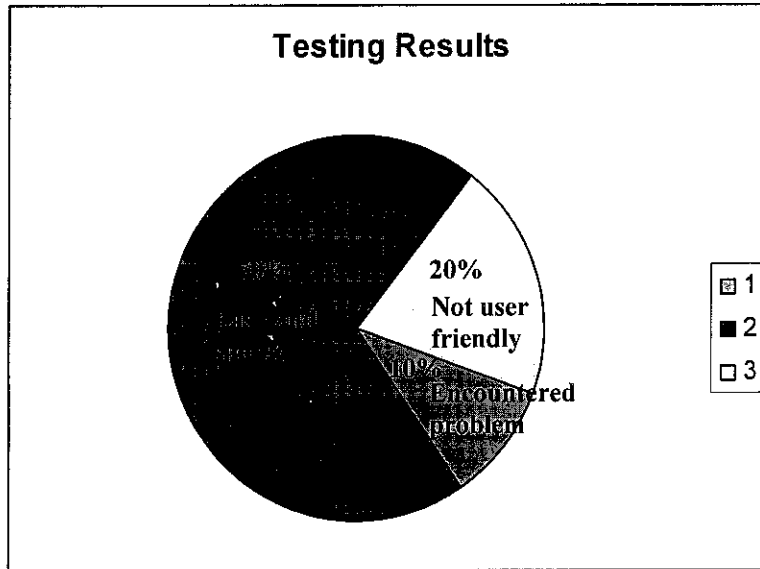


Figure 15: Pie chart of evaluation

The customer evaluation form is given in Appendices A. From the Customer Evaluation Form, it is concluded that the 70% of the customers are satisfied from the system and they feel that the system is very simple and easy to use, while the 20% of the customers feel that the system should be more user friendly, and can be more effective. With these testing 10% customers have encountered some problems in the system at that time. The above results prove that certainly the current system has room for improvements.

4.8 Tools used

Research on technical matter explains the reasons as to why the programming language, database server and other relevant technical matters are chosen. This section explains to the reader in detail what made the developer chose and why it was chosen to help with the development and implementation of the system at hand.

4.8.1 Programming Platform Used (VB.NET)

Visual Basic .NET (VB.NET) is an object-oriented computer language that can be viewed as an evolution of Microsoft's Visual Basic (VB) implemented on the Microsoft .NET framework. Visual Basic (VB) is an event driven programming language and associated development environment from Microsoft for its COM programming model. Visual Basic enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases. In business programming, Visual Basic has one of the largest user bases; it currently competes with C++, JavaScript, C# and Java for dominance in the business world. A simple program can be created without the programmer having to write many lines of code. The great majority of VB.NET developers use Visual Studio .NET as their integrated development environment (IDE).

4.8.2 Database Server Used (MySQL Server)

MySQL Server is one of the most robust and scalable relational database management system. It is a multiuser, multithreaded server i.e. it allows simultaneous connections and uses SQL Language, the most common database language to manipulate and interact with data. One of its characteristics is its ability to handle large databases and that it supports various programming languages, including VB.

4.8.3 Visual Studio.NET

Microsoft Visual Studio is Microsoft's flagship software development product for computer programmers. It centers on an integrated development environment which lets programmers create standalone applications, web sites, web applications, and web services that run on any platforms supported by Microsoft's .NET Framework. Visual Studio includes the following:

- Visual Basic (.NET)
- Visual C++
- Visual C#
- Visual J#
- ASP.NET

The reason Microsoft Visual Studio used is that it runs very well with VB.NET, C# and MySQL.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

As for the conclusion, the findings and results of this study has been obtained and analyzed. Analyzing the data took quite a while, where the researcher had to properly understand and identify the points responded by the respondents. Feedbacks obtained from the first testing audience were quite constructive in nature. Several suggestions were provided, Help Menu, send report by mail and few others.

In summary, for the future the objectives would be:

- 1 ARLCA programme can be costly to implement and maintain and may impose a heavy burden on plant resources because of the volume and complexity of data required.
- 2 ARLCA system satisfies the requirement of API RP 580
- 3 ARLCA system can be enhanced by upgrading it to Web Based System
- 4 ARLCA can be more users friendly

REFERENCES

1. Risk Based Inspection (RBI). Available online: <http://www.corrosion-doctors.org/Inspection/RiskBased.htm>. Last accessed 20 August 2007
2. Risk based inspection. Available online: <http://en.wikipedia.org/wiki/Special:Search?search=risk+based+inspection>
Last accessed 20 August 2007
3. Risk Assessment. Available online: <http://www.runningsports.org/AlreadyASportsVolunteer/toptips/RiskAssessment.htm>. Last accessed 20 August 2007
4. Risk assessment Available online: http://en.wikipedia.org/wiki/Risk_assessment. Last accessed 21 August 2007
5. About API. Available online: <http://www.api.org/aboutapi/>. Last accessed 22 August 2007
6. American Society of Mechanical Engineers. Available online: <http://en.wikipedia.org/wiki/ASME>. Last accessed 22 August 2007
7. Tischuk Products/Introduction. Available online: http://www.tischuk.com/site.php?pagename=products_intro. Last accessed 22 August 2007
8. Available online: <http://www.cap-eng.com/content.asp?secnum=97&pid=135> Last accessed 22 August 2007
9. J.L.Tischuk: T-Rex – An alternative approach to Risk Based Inspection and maintenance. Available online: http://www.rbitech.com/Technical%20Papers/Papers%20for%20Public%20Consumption/tp6_alternative.pdf. Last accessed 22 August 2007
10. Risk Based Inspection Services. Available online: <http://www.taskserver.com/BPA.htm> Last accessed 25 August 2007
11. Maureen Weicher, William W. Chu, Wan Ching Lin, Van Le and Dominic Yu: Business Process Reengineering: Analysis and Recommendations.

Available online: <http://www.netlib.com/bpr1.shtml>. Last accessed 25 August 2007

12. Peter Carter: Business Process Reengineering. Available online: <http://www.teamtechnology.co.uk/business-process-reengineering.html>
Last accessed on 25 August 2007
13. Spiral Model. Available online: http://en.wikipedia.org/wiki/Spiral_model
Last accessed on 26 August 2007
14. The Spiral Model. Available online: <http://scitec.uwichill.edu.bb/cmp/online/cs22l/spiralmodel.htm>. Last accessed on 26 August 2007
15. Nilesh Parekh (2005): Spiral Model - A New Approach Towards Software Development. Available online: <http://www.buzzle.com/editorials/1-13-2005-64082.asp>. Last accessed on 26 August 2007
16. Alan Dennis, Barbara Haley Wixom, David Tegarden: Systems Analysis and Design with UML Version 2.0: An Objected Oriented Approach. 2nd ed. P9

APPENDICES

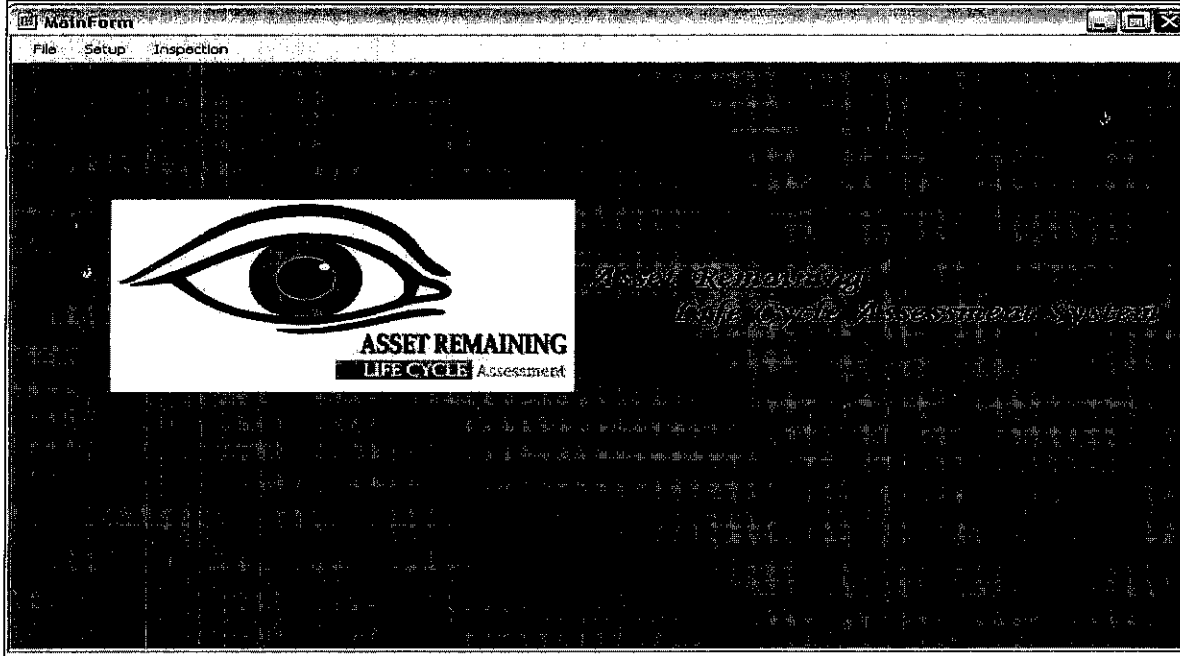
APPENDIX A

Customer Evaluation Form

Scenario 1

Objective: To Explore Asset Remaining Life Cycle Assessment (ARLCA) and give their first impression about the system

Time limit: 10 minutes



Task A:

Open Asset Remaining Life Cycle Assessment (ARLCA)

Task B:

Explore the System within 5 minutes before proceeding to the next step. Enjoy the observation.

Task C:

What was your first impression towards the layout and the design of the systems? Please state your answer below.

Task D:

What are your comments towards the calculating remaining life of the asset using Asset Remaining Life Cycle Assessment (ARLCA)?

Task E:

What items features did you look at? What was your observation about what you saw?

Task F:

What do you think of the font size and type of Asset Remaining Life Cycle Assessment (ARLCA)? Is it easy to read?

Task G:

Do you find the system useful?

- Yes
- No

Task H:

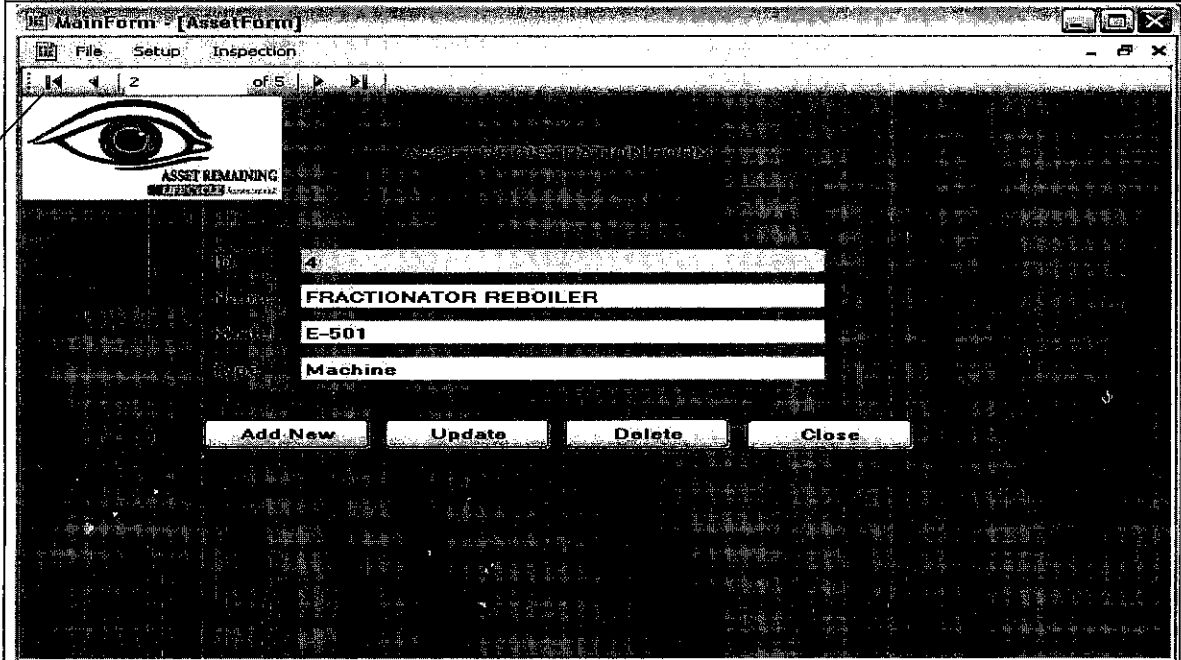
On the following scale, rate your impression on the speed and responsiveness of ARLCA

- Very Slow
- Moderately Slow
- Neither fast nor slow
- Moderately fast
- Very fast

Scenario 2

Objective: To add the asset using ASSET Form in SETUP menu provided by ARLCA.

Time limit: 2 minutes



Task A:

Try to use ASSET form in setup menu. How do you find the form? Is it satisfying? Does it meet your expectation? State your answer

Task B:

Try to use Update and delete functions. How do you find the usage of these functions? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Task C:

Try to use Navigation buttons provided in Asset form. How do you find the usage of this function? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Task D:

Is the navigation buttons user friendly enough for you?

- Yes
- No

Task E:

Do you find the Move Previous button useful?

- Yes
- No

Task F:

Do you find the Move First button useful?

- Yes
- No

Task G:

Do you find the Move Next button useful?

- Yes
- No

Task H:

Do you find the Move Last button useful?

- Yes
- No

Scenario 3

Objective: To add the client using CLIENT Form in SETUP menu provided by ARLCA

Time limit: 5 minutes

The screenshot shows a window titled "MainForm - [ClientForm]". The window has a menu bar with "File", "Setup", and "Inspection". On the left side, there is a logo of an eye with the text "ASSET REMAINING" below it. The main area of the window contains a form with the following fields and values:

| | |
|------------|-------------------------|
| ID | 2 |
| Name | adnan |
| Phone | 01 78463523 |
| Email | chandio.adnan@gmail.com |
| Address | 01 25674332 |
| Inspection | inspection |
| Address | asd |

At the bottom of the form, there are four buttons: "Add New", "Update", "Delete", and "Close".

Task A:

Try to use Client form in setup menu. How do you find the usage of this form? Is it satisfying? Does it meet your expectation? State your answer

Task B:

Try to use Update and delete functions. How do you find the usage of these functions? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Task C:

Try to use Navigation buttons provided in Client form. How do you find the usage of this function? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Task D:

Is the navigation buttons user friendly enough for you?

- Yes
- No

Task E:

Do you find the Move Previous button useful?

- Yes
- No

Task F:

Do you find the Move First button useful?

- Yes
- No

Task G:

Do you find the Move Next button useful?

- Yes
- No

Task H:

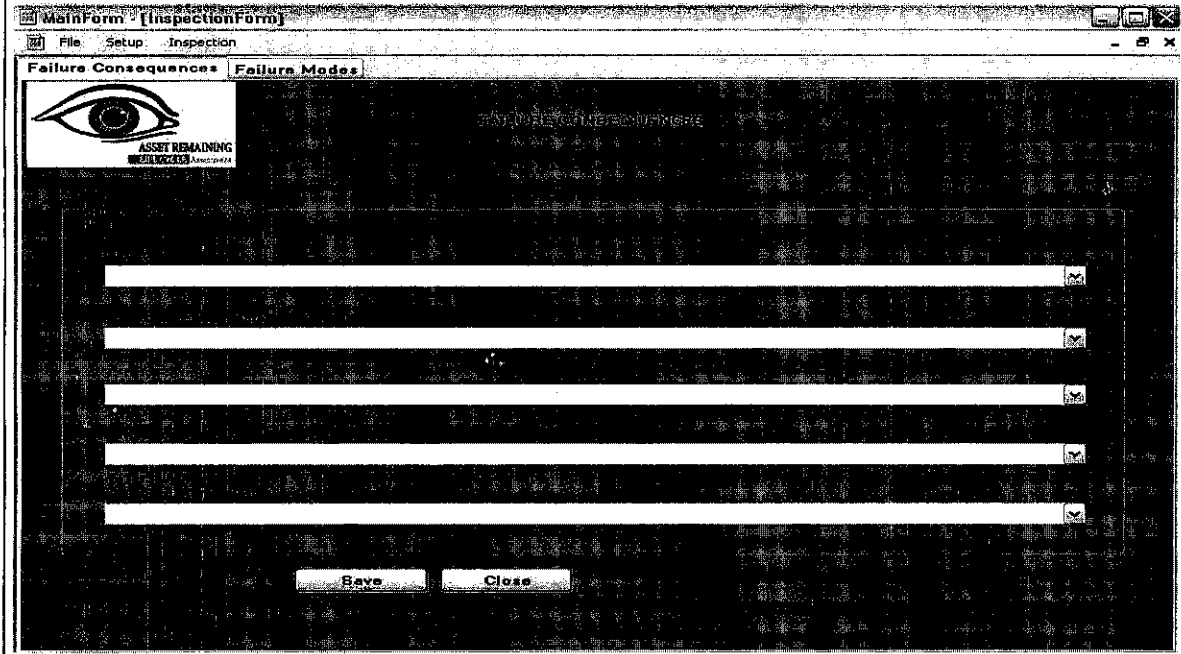
Do you find the Move Last button useful?

- Yes
- No

Scenario 4

Objective: To add the Failure Consequences using INSPECTION in INSPECTION menu provided by ARLCA

Time limit: 5 minutes



Task A:

Try to use Failure Consequences form in Inspection menu. How do you find the usage of this form? Is it satisfying? Does it meet your expectation? State your answer

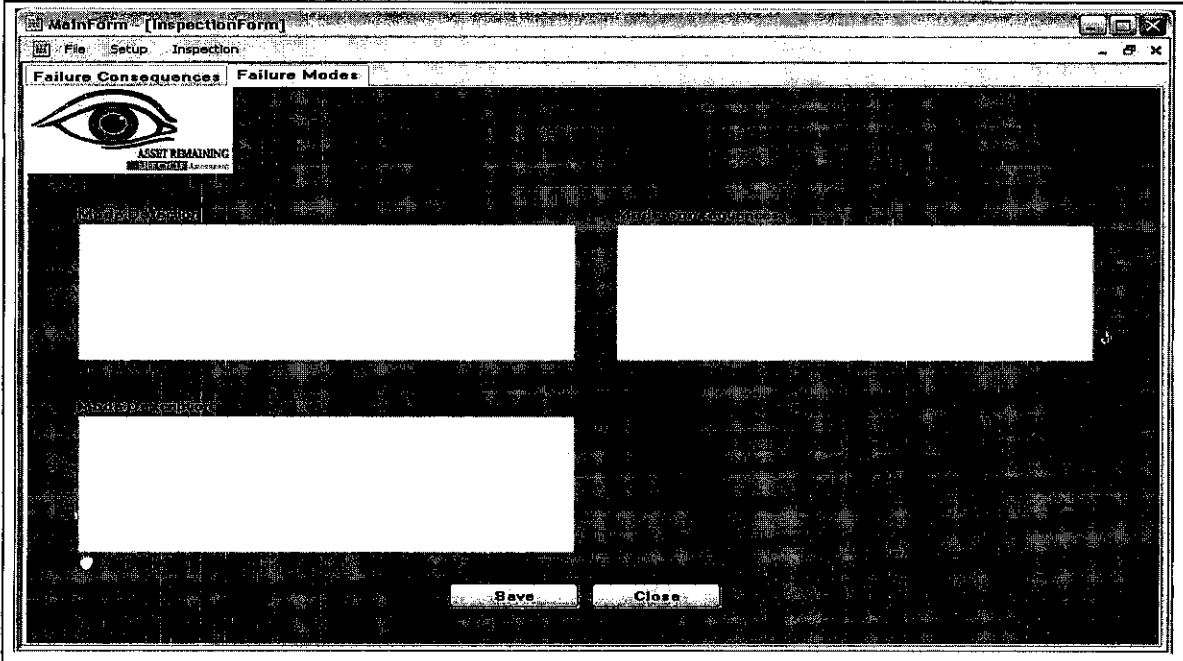
Task B:

Try to use save and close functions. How do you find the usage of these functions? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Scenario 5

Objective: To add the Failure Modes using INSPECTION in INSPECTION menu provided by ARLCA

Time limit: 5 minutes



Task A:

Try to use Failure Modes form in Inspection menu. How do you find the usage of this form? Is it satisfying? Does it meet your expectation? State your answer

Task B:

Try to use save and close functions. How do you find the usage of these functions? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Scenario 6

Objective: To calculate the remaining life of the asset using REMAINING LIFE in INSPECTION menu provided by ARLCA

Time limit: 10 minutes

| Asset | Date | Remaining Life |
|--------|------------------------------|--------------------|
| Asset6 | Saturday, September 09, 2006 | 09.80 |
| | Saturday, September 09, 2006 | 09.80 |
| | Wednesday, May 16, 2007 | 09.64 |
| | | 09.53 |
| | Friday, March 11, 2005 | 03.09 |
| | | 6.56 |
| | Thursday, April 10, 2008 | 0.2346987951807228 |

Calculate Remaining Life

27.950718685831622176

Task A:

Try to use Remaining Life form in Inspection menu. How do you find the usage of this form? Is it satisfying? Does it meet your expectation? State your answer

Task B:

Try to use Calculate Remaining Life function. How do you find the usage of this function? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Task C:

Try to use View Graph function. How do you find the usage of this function? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Task D:

Try to use Save Data function. How do you find the usage of this function? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Scenario 7

Objective: To view the save data or record of the asset using TASK MASTER in INSPECTION menu provided by ARLCA

Time limit: 5 minutes

The screenshot shows a software window titled 'MainForm [TaskMasterForm]'. The window has a menu bar with 'File', 'Setup', and 'Inspection'. On the left, there is a sidebar with an eye icon and the text 'ASSET REMAINING'. The main area contains two tables. The top table lists tasks with columns: Task, DueDate, LastDone, Frequency, AssessmentDz, and Method. The bottom table lists asset data with columns: LastDate, InitialDate, Last2thickness, Last2Date, RemainingLife, and LifeRemaining. At the bottom of the window are buttons for 'Print', 'Save', and 'Close'.

| Task | DueDate | LastDone | Frequency | AssessmentDz | Method |
|--------------|-----------------|-----------------|-----------|-----------------|--------------|
| Check Clean | 3/4/2009 1:0... | 3/24/2007 1:... | 2 | 3/24/2008 1:... | Undecided |
| SHELL CHE... | 3/24/2009 1:... | 3/24/2008 1:... | 48 hrs | 3/24/2008 1:... | checking |
| cover check | 3/24/2010 1:... | 3/24/2008 1:... | 48 hours | 3/24/2008 1:... | Installation |
| | 3/27/2008 3:... | 3/27/2008 3:... | | 3/27/2008 3:... | |
| | 10/17/2008 ... | 4/8/2008 12:... | | 4/8/2008 12:... | |
| | 4/9/2008 6:1... | 4/9/2008 6:1... | | 4/9/2008 6:1... | |
| | 4/9/2008 7:5... | 4/9/2008 7:5... | | 4/9/2008 7:5... | |

| LastDate | InitialDate | Last2thickness | Last2Date | RemainingLife | LifeRemaining |
|-----------------|-----------------|----------------|-----------------|---------------|---------------|
| 5/16/2007 1:... | 9/9/2006 1:0... | 09.80 | 9/9/2006 1:0... | 1 | 27.9507186... |
| 5/16/2007 1:... | 9/9/2006 1:0... | 09.80 | 9/9/2006 1:0... | 2 | 27.9507186... |
| 5/16/2007 1:... | 9/9/2006 1:0... | 09.80 | 9/9/2006 1:0... | 3 | 27.9507186... |

Task A:

Try to use Task Master in Inspection menu. How do you find the usage of this form? Is it satisfying? Does it meet your expectation? State your answer

Task B:

Try to use Print function. How do you find the usage of this function? Is it satisfying? Does it meet your expectation? Did you encounter any problem? State your answer

Answer the following questions. Tick [X]
Only in **ONE** box for each question.

(1 = Very Bad; 2 = Bad; 3 = Neither Good nor Bad; 4 = Good; 5 = Efficient)

A. How do you rate Adding the Asset using Asset Form in Setup menu?

| | | | | | | | | | |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|
| <input type="checkbox"/> | 1 = very Bad | <input type="checkbox"/> | 2 = Bad | <input type="checkbox"/> | 3 = Neither good nor bad | <input type="checkbox"/> | 4 = Good | <input type="checkbox"/> | 5 = Efficient |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|

B. How do you rate Adding the Client using Client Form in Setup menu?

| | | | | | | | | | |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|
| <input type="checkbox"/> | 1 = very Bad | <input type="checkbox"/> | 2 = Bad | <input type="checkbox"/> | 3 = Neither good nor bad | <input type="checkbox"/> | 4 = Good | <input type="checkbox"/> | 5 = Efficient |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|

C. How do you rate Adding the Failure Consequences information using Inspection Form in Inspection menu?

| | | | | | | | | | |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|
| <input type="checkbox"/> | 1 = very Bad | <input type="checkbox"/> | 2 = Bad | <input type="checkbox"/> | 3 = Neither good nor bad | <input type="checkbox"/> | 4 = Good | <input type="checkbox"/> | 5 = Efficient |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|

D. How do you rate calculating the Remaining Life of the Asset information using remaining life Form in Inspection menu?

| | | | | | | | | | |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|
| <input type="checkbox"/> | 1 = very Bad | <input type="checkbox"/> | 2 = Bad | <input type="checkbox"/> | 3 = Neither good nor bad | <input type="checkbox"/> | 4 = Good | <input type="checkbox"/> | 5 = Efficient |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|

E. How do you rate viewing the record information of the Assets using Task Master Form in Inspection menu?

| | | | | | | | | | |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|
| <input type="checkbox"/> | 1 = very Bad | <input type="checkbox"/> | 2 = Bad | <input type="checkbox"/> | 3 = Neither good nor bad | <input type="checkbox"/> | 4 = Good | <input type="checkbox"/> | 5 = Efficient |
|--------------------------|--------------------|--------------------------|------------|--------------------------|--------------------------------|--------------------------|-------------|--------------------------|------------------|

End of Evaluation Form.
Thank you very much for your time and cooperation