Procurement Process Management System
For Ministry of City Planning and Water Supply

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Declaration

DECLERATION

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Abstract

Ministry of City Planning and Water Supply is the government organization providing safe drinking water for the country. In the process of handling water projects, the organization need to handle investments such as works, goods and services. So the investment should be procured before award. The process of procurement is carried out manually using huge paper-based documents, limited staff availability, lack of proper storage etc. Automated system implementation will be a great solution to overcome these barriers and provide more efficient transparent service.

This system has provided many facilities such as project assignment, funding agency registration, contract assignment, procurement entity and contractor registration, committee appointment, bid registration, bid evaluation, generate reports to the right time etc.

The procurement process management system has been developed based on the SCRUM framework.

JavaFX which is an object-oriented language as well as good teaching language has been selected as the programming language to implement this system and NetBeans has been selected as the IDE (integrated development environment). Further MySQL workbench tool use to create database to store the data of the system. Scene builder has been used to generate UI of the system.

Acknowledgement

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List of Acronyms

CCEM	–	Cabinet Committee on Economic Management
CRUD	_	Create, Read, Update, Delete
EOI	–	Expression of Interest
MPC	_	Ministry Procurement Committee
NPD	_	National Planning Department
NWSDB	–	National Water Supply and Drainage Board
PC	_	Procurement Committee
PPC	–	Project procurement committee
RPC	–	Regional Procurement Committee
SCAPC	–	Standard Committee appointed Procurement Committee
SCARC	–	Standard Committee appointed Regional Committee
TEC	_	Technical Evaluation Committee

CHAPTER 01.   INTRODUCTION

1.1.   Background

Ministry of City Planning and Water Supply is most significant fundamental government organization which aid to facilitate drinking water and sanitation facility to the country. The organization consist of two other agents namely National Water Supply Drainage Board and Department of community Water Supply. The Ministry situated at Pelawatte in the Colombo district.

The process undertaken by the ministry is huge and unique. The way over the procurement undergoes choosing most appropriate vendors for the projects. The process handling having bulk of paper works, time consuming and vendor dissatisfaction. The system developed will make the process efficient effective and progressive by information management and automation. Therefore, delay over the process can be avoided.

1.2.   Motivation of the project

The Organization proceed through process of providing sustainable water and sanitation solutions. The organization wish to be the most prestigious utility organization in Sri Lanka, through technological and service excellence. To achieve organizational goals all sectors in organization should work concurrently.

In its procurement section, huge work is done by selecting best suppliers for handling water projects.

The organization carries out the process manually based on paper works. The managing of the works has been inefficient due to limited file storage, system highly needed decision making. So, very time consuming. In sometime they were unable to achieve their goals effectively, efficiently. Procurement process management system development is motivated due to inconvenient failures in existing process such that given below.

1. Existing way provide all the documents in huge file-based approach takes much time to search a document.
2. The huge files and bids which have no proper storage facilities.
3. There is no proper way to view project details, relevant funding agency details. So, it is difficult review at a glance.
4. There are several contracts handling in the same project. But the existing system not provide appropriate easy mechanism to review them in detail
5. contact detail of procurement entity corresponding to a contract difficult to find.
6. The committees appointed, committee member details cannot view at all. Therefore, difficult to organize meetings and cannot proof the member assignment conditions.

7. The bid evaluation process is very time consuming. Difficulty in decision making and contractor dissatisfaction.
8. There is no way to catch out contractor details in particular contract. Redundancy in registering same user repeatedly.

To get rid of above mentioned problems the system develop would be emerged. It will minimize the time and cost that will have to spend for the tasks of procurement. Further, it can improve the efficiency and the productivity of their services, so that, they can also provide a better and a reliable service for their beneficiaries.

1.3.   Objectives of the project

Main objective of system is to give an efficient service to do the procurement activities with accurate transparent and fast way in order to provide the water and sanitation facilities in progressively. And further to increase their productivity and efficiency of their work through the system. The rest of the objectives are listed below.

- Improve the efficiency of project registration, funding agency registration.
- Manage Contract details with the corresponding procurement entity details.
- Improve efficiency in appointing committees, appointing members and handling meetings for contracts.
- Efficient way to contractor registration and minimizing redundancy.
- Minimize the time taken in pre-bid evaluation.
- Improve efficiency in choosing substantially responsive bids.
- Speedy the process of bid evaluation by give suggestion to make decisions.
- Manage access of the user according to the privilege authority.

1.4.   Scope of the Project

When deciding to develop project scope is most important to consider. The scope of project is given below.

- Record project details, funding agency details and contract details of organization
- Record procurement entity details of corresponding contracts.
- Appointed committee records such as procurement committee records, Technical Evaluation committee records in the system
- Appointed member details in a contract
- Record contractor details with their contacts.
- Record bid observations and other bid details.
- Comparing the bids according to the given contract criteria and allocate points.
- Change status of bid according to the points have gain and compulsory field achievement.
- Generating reports to committee to take action according to the bidders ranking.
- Giving user privileges to authorized persons access the system accordingly.

1.5.   Chapters in Brief

This Dissertation provides the overall knowledge about the Procurement Process Management System. Dissertation structure as follows.

Chapter 02 - Analysis

This chapter explains the requirement gathering techniques, details of the manual system, functional nonfunctional requirements and details of the existing system.

Chapter 03 - Design

This chapter explains the use case diagram of the proposed system, ER diagram of the system and main interfaces of the system.

Chapter 04 - Implementation

This chapter explains the hardware software requirements, development tools which is used for system, code features of the system.

Chapter 05 - Evaluation

This chapters explains the techniques of testing, details of software testing, high level test plan of the system and client evaluation of the system

Chapter 06 - Conclusion

This chapter explains the critical assessment, future enhancements of the system and lesson learnt of the overall project work.

Appendixes

These are provided further details about the content of the dissertation chapters which were not included in the chapters.

CHAPTER 02.   ANALYSIS

2.1. Introduction

"Requirements analysis is critical to the success or failure of a systems or software project. The requirements should be documented, actionable, measurable, testable, traceable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design" [1].

System Analysis is an important task to consider in system development life cycle. As design of system, implementation of system severely depends on the system analysis. So, before analysis it is needed to gather required facts in most accurately efficiently by multiple requirement gathering techniques.

The analysis of the system gets overall figure of system which need to implement. The phase provided what services system should provide, required performance of the system. The analysis of system can be shown using high level diagramming tools.

2.2. Fact Gathering Techniques

The existing system handled by so many managerial people. So the level detail each could know is different from one to another. The way of the expressing info different in each. So, there could be conflicts about the system if we gather details without using gathering techniques. The techniques that used for the fact gathering of this system are listed below.

1. Manuals and Guidelines
    The process how procurement of organization is done, who responsible for the service, how they appointed, how the task assigned, how the bid evaluation take place details are studied through the procurement manual [2].

    And rules, regulation what need to follow in procurement process are studied using procurement guidelines [3].

2. Interviewing
    The team which the process is handled are interviewed to gather info by questioning structured and unstructured way. The feedback they provided is mostly affected to gather and verify information accurately.

3. Observation
    Observed how bid open would occur. How organization interact with bidders to give them proper service.

4. Web references

   Web references of National Water Supply and Drainage Board [4] mostly affected to gather info about projects, procurements take place.

5. Sampling and documentation

   Studied the documents they prepare during handling a contract. And how they tabulate the info to make summary, evolutionary and review.

2.3. Analyzing Current Manual System

The Figure 2.1 shows the process handle by current system.
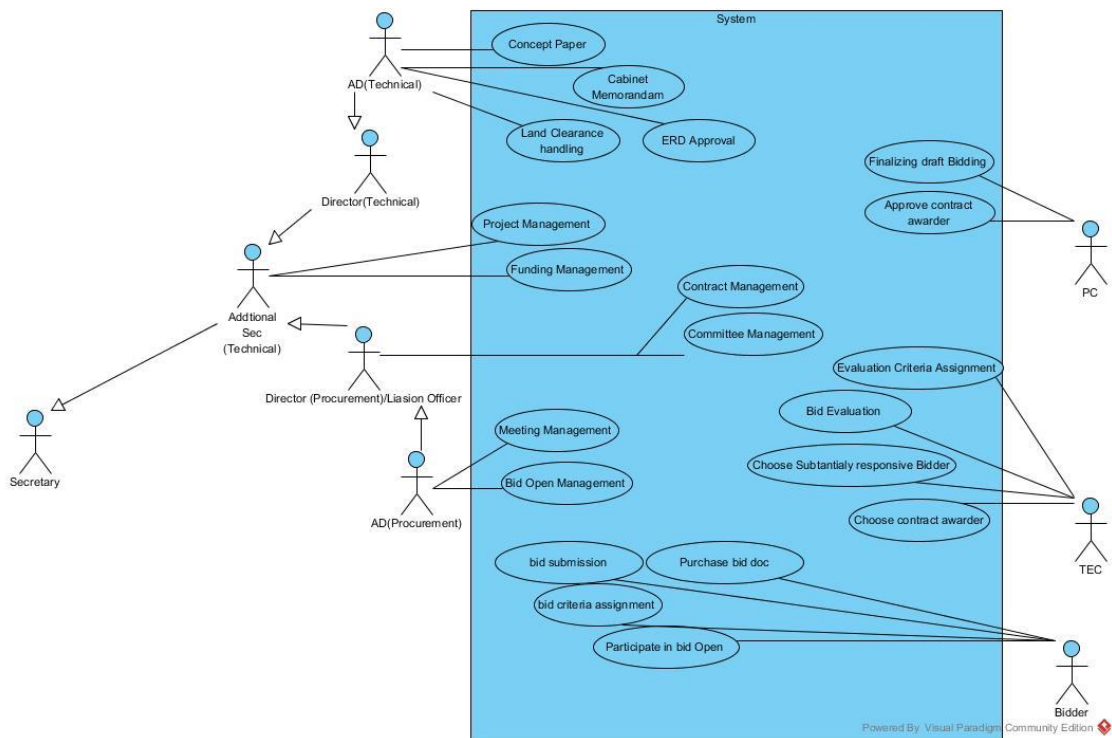
Figure 2.1 - Use Case for Current Manual System

2.3.1. Project Registration

They first prepare concept paper for the relevant project including all the details of project and have NPD approval, SCARC, CCEM approval. Then prepare cabinet approval for it.

2.3.2. Funding Agent Registration

They call Expression of Interest for the project. The EOI is a document consisting all relevant details of funding agency. Collect EOI of funding agents. EOIs are Screened by the NWSDB. NWSDB screening committee chooses suitable funding agent produce screening report. The chosen funding agency is

recorded as needed to check funding agency concurrency when needed to procure.

2.3.3.   Contract Registration

After funding agent for the project is chosen project divided into tasks. In most of projects such as Supply and Lain, Treatment plant construction etc. Then that tasks are assigned to contracts. For example, Supply and Lain has three contracts such as work, good, consultancy.

2.3.4.   Contract Condition Assignment

Then they made engineering estimate for the contract including all the evaluation criteria such as including amount of similar work experience, financial capability etc. Those could deviate with type of contract.

2.3.5.   Procurement Committee Assignment

After that they appoint a committee for the bidding the contract. Namely SCAPC, MPC, PPC, RPC are several procurement committees in this scope. According to total estimated cost of contract, committee is chosen. The committee is responsible to approve or reject TEC decisions.

2.3.6.   TEC Assignment

Each PC have TECs which assign specifically for the contracts. That would responsible for evaluation of all bids received. The TEC should supply a report regarding all bids received whether they good to award.

2.3.7.   Supplier Registration

Request for proposals are called by relevant procurement entity. Suppliers who borrow RFPs are recorded with contact information as they needed to contact if necessary.

2.3.8.   Bid Registration

The suppliers submit the bids at the bid open by assigning their criteria values for the contract evaluation criteria assign by the procurement entity. Then procurement entity recorded minutes of bid open.

2.3.9.   Bid Evaluation

Submitted bid docs are evaluated by checking that the bids have undertaken the contract condition as required for the contract.

2.3.10. Bid Evaluation Report

TEC submitting the results of bid evaluation who would able to give the contract. And it is approved by the PC and approved bid contract is awarded to the approved bid belong customer.

2.4. Functional Requirements

What done by system to user are specified in functional requirements. These should be tally with what user expect to do with the system. The requirement could be calculation, technical detail etc. Following are the requirements that would be deliver to the user.

2.4.1. Funding Agent Module

- When new project is commenced the funding agent who giving the financially to go through project is registered in this form including their contact information.
- In this module, user able to view funding agent is supply funds alone or with sharing GOSL.
- User would able to find out funding agents of particular country.
- If user need to know local funding agents or foreign. System facilitate search method.
- System facilitated to generate report including funding agents details.

2.4.2. Project Module

- When the new project is commenced the details of projects, such as project category, project type, project handling director, funding agent etc. These are included in to the system by this form.
- User can update, delete, view project details that entered.
- User can search a project by particular project name, project type, project status.
- Specially user able to search projects handle by relevant funding agent.
- User able to generate reports of the information.

2.4.3. Procurement Entity Registration

- Contracts of projects are handle by a particular entity. Those are the organization who responsible for doing the procurement of the contract. The organization details are can be included here.
- System facilitate way to provide liaison officer details and office in charge of the entity.

- User can search particular Procurement Entity by liaison officer, officer in charge.

2.4.4. Contract Registration

- System facilitate add new contract for a particular project including details such as date of bid open, bid close, procurement committee handling, TEC handling, Total Estimated cost of contract etc.
- System has ability to filter contracts by project name, Contract Type, Procurement committee.
- System facilitate to provide reports including contracts group by projects, group by contract type

2.4.5. PC registration

- When a contract is registered, Procurement committee should be appointed to bid the contract. the Procurement committee details registered in this form
- User able to view, update, delete particular Procurement committee
- System facilitate way to generate reports including appointed PC committees' details

2.4.6. TEC registration

- The bids of particular contract are evaluated by the particular TEC. So TEC committee for a particular PC are registered in this module.
- User able to view, modify, delete assigned TECs.
- System has ability to generate report group by particular PC.
- User able to validate 1 member cannot have assigned more than 3 TECs in the same project.

2.4.7. Member registration

- If any procurement committee or TEC should assign with including new member the system facilitates the member registration module to add new members
- User able to view, update, delete registered members.
- Generate reports including registered members details.

2.4.8.   Contract Condition assignment

- When the contract is registered, the conditions are assigned to the particular contract is done by this module.
- User can add, view, update contract condition of particular contract.
- User can search contract condition of particular contract by contract name.

2.4.9.   Supplier registration

- When request for bid is called, the suppliers who bought bid docs are registered by the system including their contacts.
- User able to add supplier details who bought bid doc.
- System provide way to view, update, delete supplier details who bought bid doc.
- User can search Supplier by purchase date
- User can search domestic suppliers as in evaluating given offers for domestic bid suppliers
- System facilitate to search supplier by name because at some time most contract awarded supplier could supply bids.

2.4.10.   Bid Registration

When Bidders supplied the bid at bid open,
- System registered the bid using bid suppler name.
- System evaluate bid preliminary by checking whether bid is completed. signed, alternatives allowed etc.
- Then bid status is changed according to the pre-bid evaluation results to pass or fail.
- Then report is generated including pass and fail bids

2.4.11.   Bid Evaluation

- Preliminary examination pass bids allowed to move for secondary evaluation by the system.
- Then the pass bids are evaluated again by contract condition and evaluate the results to the user.
- Then report is generated including pass and fail bids

2.5. Non-Functional Requirements

"In systems engineering and requirements engineering, a **non-functional requirement** (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. They are contrasted with functional requirements that define specific behavior or functions. The plan for implementing *functional* requirements is detailed in the system *design*. The plan for implementing *non-functional* requirements is detailed in the system *architecture*, because they are usually Architecturally Significant Requirements" [5].

2.5.1. Usability

If a system is fully user-friendly but not usable system is not useful. So, every system must be useable even if it is not user friendly. To make the system usable interfaces, navigation, searching is added.

2.5.2. Security

Security is needed to considered because system containing confidential information for the organization. If the information is misplaced the organization should be accountable for the situation.

2.5.3. Accuracy

Data accuracy is important in this system because GIGO (Garbage in Garbage Out) concept over the system. The Output produce in here is strictly depend on the input. Therefore, considered to

1. Set style on validity, Update and Invalid
2. Prompt error message if data invalid in update or add

2.6. Existing Similar Systems

When searching procurement process management software, most found managing suppliers and contracts.

"Gatekeeper is a Supplier and Contract Management solution. We are on a mission to make your working life easier, more enjoyable, and more productive" [6]. It not provide method to manage bids evaluation. The UI of it shown below Figure 2.2.

" Promina provide the most efficient improvement in cost, productivity, transparency and risk management parameters within your supply chain. Carry your purchasing activities to the cloud through web based strategic sourcing platform" [7].

RubberStamp [8] is another procurement software which manage procurement process which also not provide similarity in developing system. Figure 2.3 shows it in summary.

Most of system contain managing supplier, contracts, supply chain etc. But this client required a software manage procurement process mainly by evaluating bids and have suggestion in decisions. That similar kind of software are not found so need to make reflect to client requirement is only solution.

Figure 2.2 - Gate Keeper UI

Figure 2.3 - Rubber Stamp System Functions

CHAPTER 03.   DESIGN

3.1.   Introduction

"System design is the phase that bridges the gap between problem domain and the existing system in a manageable way. This phase focuses on the solution domain, i.e. *"how to implement?"* It is the phase where the SRS document is converted into a format that can be implemented and decides how the system will operate. In this phase, the complex activity of system development is divided into several smaller sub-activities, which coordinate with each other to achieve the main objective of system development" [9].

3.2.   System Development Life Cycle

"The systems development life cycle (SDLC), also referred to as the application development life-cycle, is a term used in systems engineering, information systems and software engineering to describe a process for planning, creating, testing, and deploying an information system" [10].

3.3.   Methodology for proposed System

The scrum is chosen as system development methodology as the it makes the product iteratively and incrementally. This way minimizes requirement ambiguity and have more client feedback and make progressive development. According reference [11] below describes the scrum methodology in brief.

"Scrum is an agile framework and, as such, is consistent with the values of the Agile Manifesto.

3.3.1. Common Values from the Agile Manifesto

- ✓ **Individuals and interactions over processes and tools**
  This focus on team responsibility in Scrum is critical.
- ✓ **Working software over comprehensive documentation**
  Scrum requires a working, finished product increment as the primary result of every sprint.
- ✓ **Customer collaboration over contract negotiation**
  Scrum is a framework designed to promote and facilitate collaboration. So, the product will be as valuable as possible.
- ✓ **Responding to change over following a plan**
  Scrum teams constantly respond to change so that the best possible outcome can be achieved. Scrum can be described as a framework of feedback loops, allowing the team to constantly inspect and adapt so the product delivers maximum value.

The Scrum framework

- A product owner creates a prioritized wish list called a product backlog.
- During sprint planning, the team pulls a small chunk from the top of that wish list, a sprint backlog, and decides how to implement those pieces.
- The team has a certain amount of time — a sprint (usually two to four weeks) — to complete its work, but it meets each day to assess its progress (daily Scrum).
- Along the way, the Scrum Master keeps the team focused on its goal.
- At the end of the sprint, the work should be potentially shippable: ready to hand to a customer, put on a store shelf, or show to a stakeholder.
- The sprint ends with a sprint review and retrospective.
- As the next sprint begins, the team chooses another chunk of the product backlog and begins working again".

The below Figure 3.1 describe the scrum framework in brief.

Figure 3.1 - Scrum Framework

Scrum Phases

Scrum methodology can be done in five steps in simply explained below. The web reference [12] provides the phase descriptions in brief as given below.

1. **Product Backlog Creation**.

   "Product backlog is a list that consists of features that should be implemented during the development process. It's ordered by priority and its every item is called a **User story**. Every user story gets a unique ID. The description of every user story should include

   - o **Importance** of a user story.
   - o **Initial estimate** describes the overall capacity of work. It's measured in story points

  o **How to demo**. Describes the way of how the working product will be demonstrated

2. **Sprint Planning and Sprint Backlog Creation**

The product owner determines the importance of a proper user story, while the scrum team defines the appropriate labor costs.

The scrum team can select the most important user stories from the product backlog. Then team members should decide how they will solve this or that task. The **Sprint backlog** should be created next. It consists of user stories that will be completed during the current sprint.

3. **Working on the Sprint and Scrum Meetings**

After actual user stories for the current phase are chosen, the system development process begins. To track the current working process, a task board is commonly used. Figure 3.2 show task board how the tasks arranged.
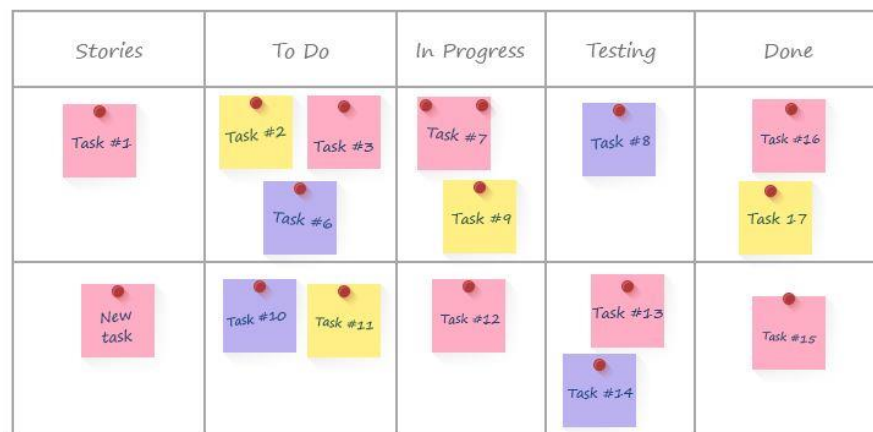
Figure 3.2 - Task Board

Other important scrum feature is everyday **Scrum meetings**. During these meetings, every single team member should tell about the task that he has finished, which task he will choose next and what problems he faced during his work.

Moreover, a **burn down chart** is what the scrum team gets as a result of scrum meeting. It shows you how many tasks remains uncompleted. This chart gives an ability to control the development process and should be updated after every meeting.

4. **Testing and Product Demonstration.**

Since the ideal result of every sprint is a working product, the full life-cycle testing process is very important. The result of every sprint is product demonstration. The Scrum team creates a review and demonstrates the results of their work.

5. **Retrospective and Next Sprint Planning**.

Retrospective's main aim is to discuss the results and determine the ways how to improve development process on the next step. The team should conclude what went well during the working process and what can be done better during the future iteration. When the ways of improvement are defined, the team can concentrate on the next sprint planning".

3.4. Alternative Solution to System

As analyst should able to go through range of options to analysis the decision. These describe some options and analyzed feasibility of the solutions.

3.4.1. Reengineer the Manual Process

The current system is done through file-based approach. All the contracts are arranged in file with an identification number and stored as required. System can be redesign to enhanced file-based approach with storing facilities
But it is too difficult because it need to consume more resources such as expert knowledge, storing facilities. It incurs operational feasibility and technical feasibility.

3.4.2. Purchase Web based System

System would perfectly have arranged all the tasks and retrieved when necessary. But the system cannot be web based as cannot use without internet facility. And system maintaining and purchasing need to have high financial capability. Third party access may occur over the web will make the security of data vulnerability. So solution is not perfect to implement as infeasible in legally, economically.

3.4.3. Free Software Package

Software packages can be used to increase the utilization of resources in efficient manner. This not a good solution in current system because system problems are not properly solved using software packages. As packaged software not facilitate decision making software packages. They give only solution for common business strategies.

Selected solution is standalone software which may handle by own property rights. It will give following benefits

- Client mostly preferred to a standalone system.
- Standalone systems not needed to pay additional cost for web hosting.
- Can be customized according own functional requirements not like free software.
- It can perform much faster than web-based system.
- Easy to develop and easy to maintain.

3.5.   Object Oriented Analysis and Design

"Object-oriented analysis and design (OOAD) is a technical approach used in the analysis and design of an application or system through the application of the object-oriented paradigm and concepts including visual modeling. This is applied throughout the development life cycle of the application or system, fostering better product quality and even encouraging stakeholder participation and communication" [13].

Object Oriented Analysis and Design is chosen to analyses the system as it makes easy understandable the proposed system. As OOAD methodology uses 14 UML (Unified Modeling Language) diagrams, can make system describe in 14 different ways in change of structure and behavior of system.

3.5.1. High-level Use Case Diagram for proposed system
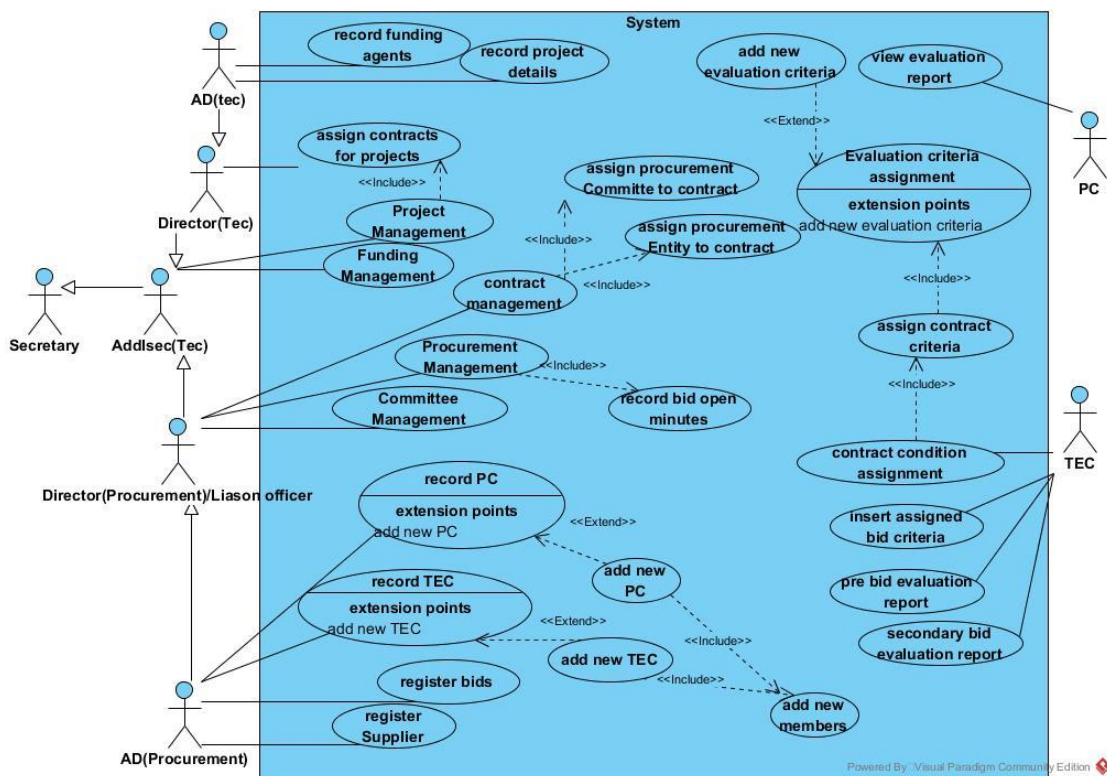
Figure 3.3 - High Level Use Case for the system

The Figure 3.3 shows proposed system use case diagram including actors of current system and how would they able to perform their tasks from proposed system. Use Case diagram is main diagram can use to identify system behaviors/requirements of relevant users.

More details about the design of the system has mentioned in the design documentation attach herewith as appendix - B.

3.5.2. High level class diagram for proposed system
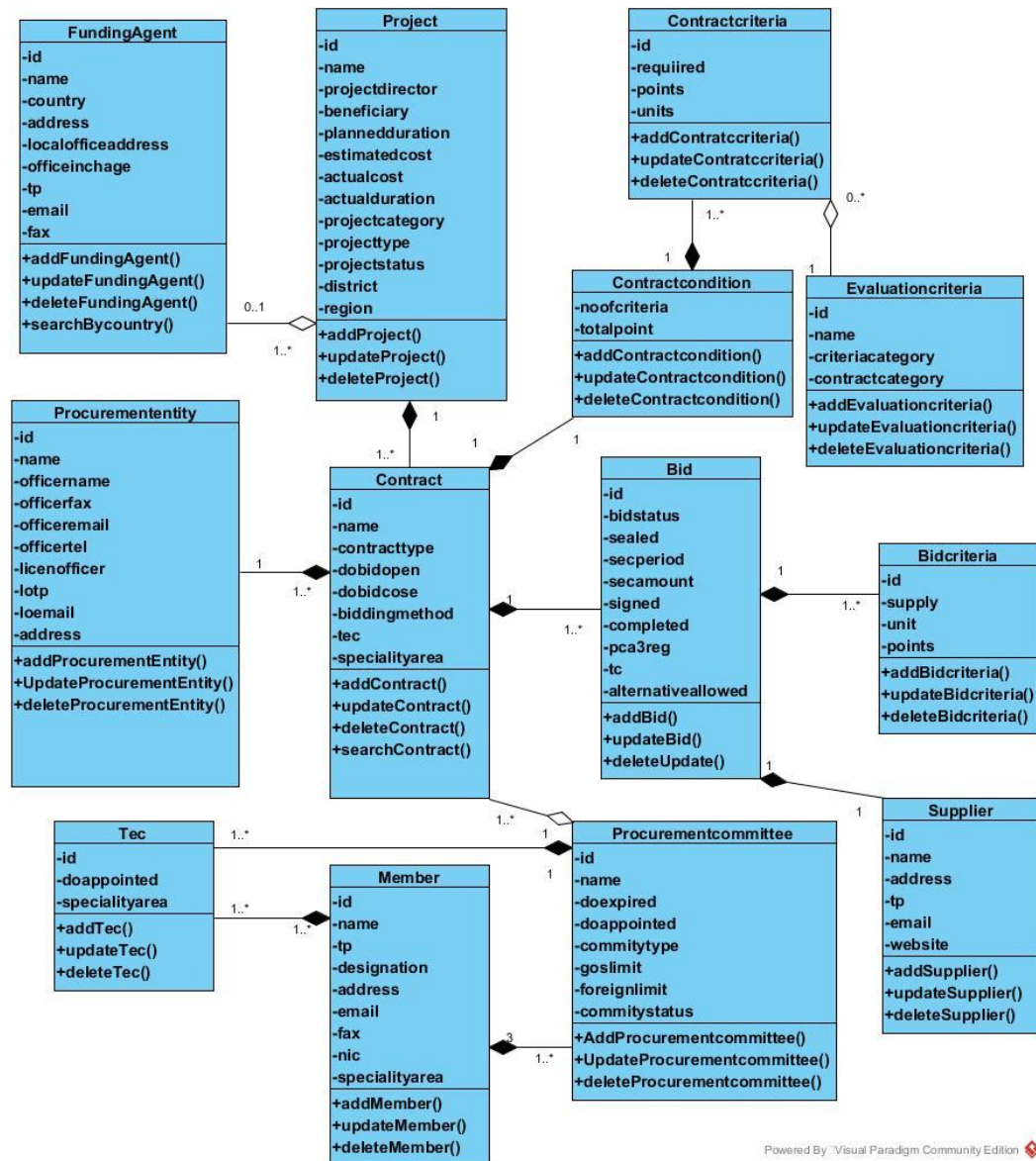
Figure 3.4 - Class Diagram for the system

Class diagram in Figure 3.4 represent the system as sub units which has data and operations called classes and the interaction between them. That emphasize the system structure and the subunits dependency by relationships such as aggregation, composition, association. Minimum number of occurrences of one object of single occurrence of related object shown by multiplicity.

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3.5.3. Activity Diagram for Login Module
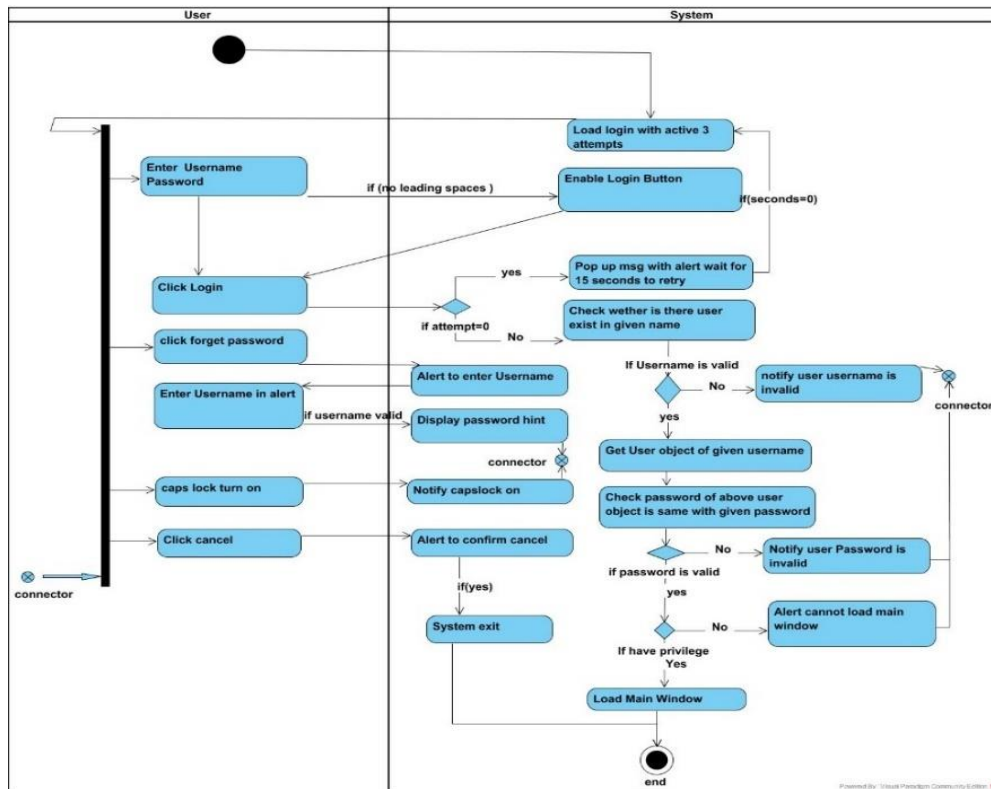
Figure 3.5 - Activity diagram for login module

The diagram shown in Figure 3.5 describes the process how the system check user in login and secure the system for authorized users.

3.5.4. Sequence Diagram for adding contract
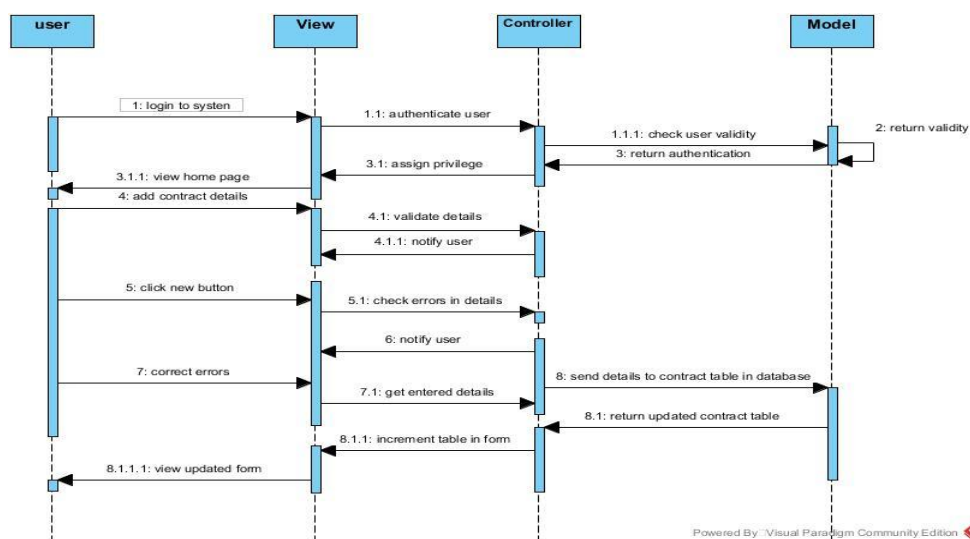
Figure 3.6 - Sequence diagram for adding contract

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The Figure 3.6 in above indicates what happened in system interiorly when user adding contract to the form. It was describe using MVC (Model View Controller) architecture.

3.6. Database Design
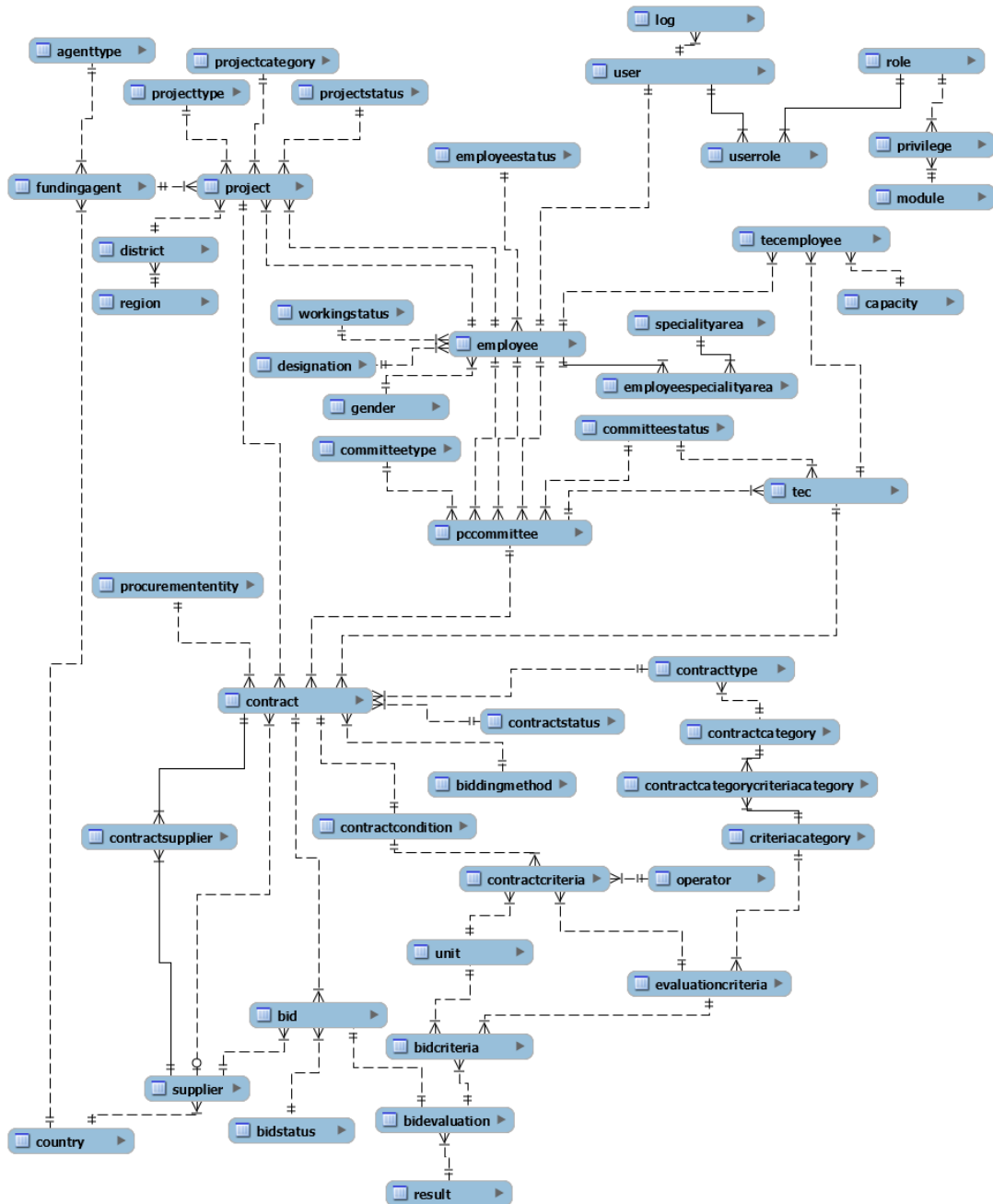
Figure 3.7 - Database Design for Procurement Process Management

The Figure 3.7 describe database for procurement process management using entity relationship diagram indicating primary keys and foreign keys with relationships. Database also needed to design unless inappropriate data would make mess in storage and need to manage in consistency.

The database is normalized to 3NF by removing non-primary key dependent attributes to another table.

Normalization of Database

"Database Normalization is a technique of organizing the data in the database. Normalization is a systematic approach of decomposing tables to eliminate data redundancy and undesirable characteristics like Insertion, Update and Deletion Anomalies. It is a multi-step process that puts data into tabular form by removing duplicated data from the relation tables. Normal form types describe below.

- **1ˢᵗ Normal Form** - any row must not have a column in which more than one value
- **2ⁿᵈ Normal Form**- there must not be any partial dependency of any column on primary key
- **3ʳᵈ Normal Form**- applies that every non-prime attribute of table must be dependent on primary key. there should not be the case that a non-prime attribute is determined by another non-prime attribute" [14].

3.7. User Interface Design

"User Interface (UI) Design focuses on anticipating what users might need to do and ensuring that the interface has elements that are easy to access, understand, and use to facilitate those actions. UI brings together concepts from interaction design, visual design, and information architecture" [15].

In here discussed about how UI has design for increase usability of system. Highly User-friendly system which is not usable is useless. So, system need to design UI well to have good Human Computer Interaction. Usability, Accessibility, Acceptability features needed to develop in user interfaces.

Usability can achieve by user centered design which have key aspects

- ✓ learning about human abilities and limitations
- ✓ designing fora particular group of people
- ✓ working with these people throughout the design process

3.7.1. 5E's of Usability

Following reference [16] describe the 5E's of Usability as described below.

- ➢ **"Effective**-Software is useful and helps users achieve their goals accurately.
    - o Procurement Process Management Software provide solutions for bid evaluation delaying, ineffectiveness in file base system.
- ➢ **Efficient**-The speed (with accuracy) with which work can be done.
    - o User need only to facilitate accurate data, system out the evaluation results at a glance.

➢ **Engaging**-How pleasant, satisfying, or interesting an interface is to use.
  o Interface provide pleasant look and have chain of doing tasks user attract to get work done.
➢ **Error tolerant** -How well the product prevents errors and helps users recover from any errors that do occur.
  o Most mistakes slip occur by user are minimized in system by error tolerance and avoidance.
➢ **Easy to learn** -How well the product supports both initial orientation and deeper learning.
  o User frequent doing, infrequent not need to remember system facilitate chain of tasks"

3.7.2. Usability Principles Used in System

Moreover, the system emphasizes following design principles of usability to make better interface design.

▪ **Visibility and style -** In use of colors light blueish gradient which make eye pleasant look, watery background in user interfaces, font type, font color, font size and minimum no of colors used make user observable the content well.
▪ **Constraints** -Every User Interfaces having CRUD operations seek confirmation from user whether need to do the action. It displays all details contended. As this will prevented user making serious errors.
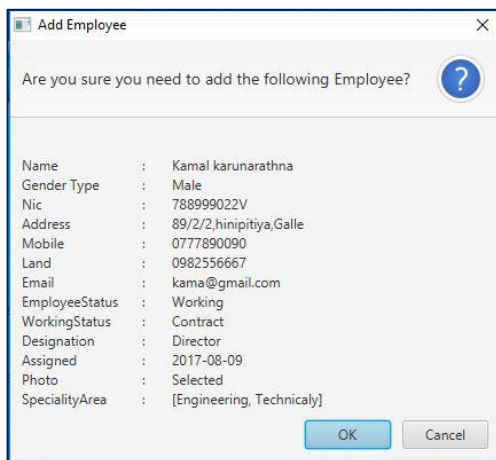
Figure 3.9 - Add Employee Confirmation
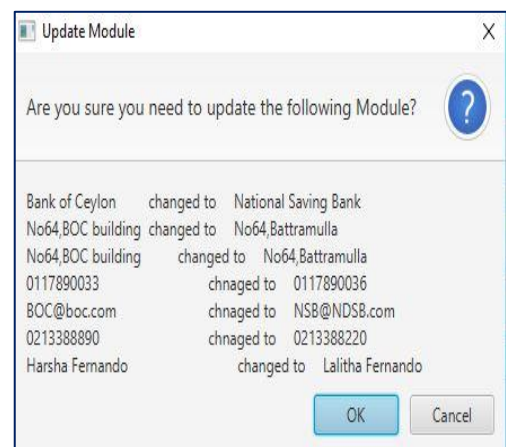
Figure 3.8 - Update Employee Confirmation
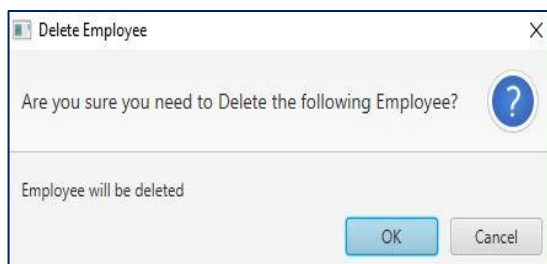
Figure 3.11 - Delete Employee Confirmation
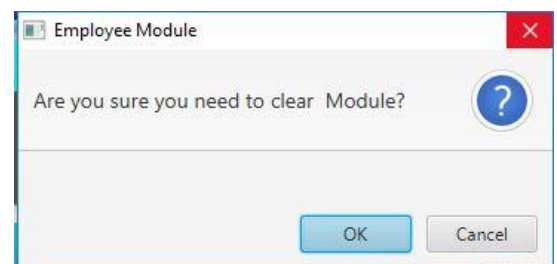
Figure 3.10 - Clear Employee confirmation

21

- **Control** - Every User Interfaces emphasized error messages (shown by Figure 3.12, Figure 3.13, Figure 3.14, Figure 3.15) in invalid details or not provided compulsory details in adding, updating, adding or changing photo. Only can add image file is also emphasized.
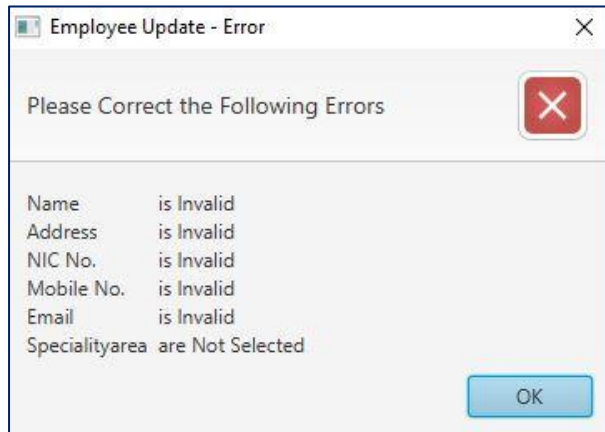
Figure 3.13 - Alert Employee Update Invalid Details
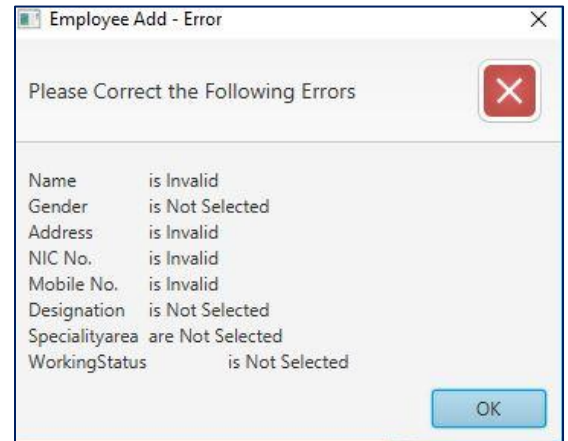
Figure 3.12 - Invalid Details In Employee Add Error
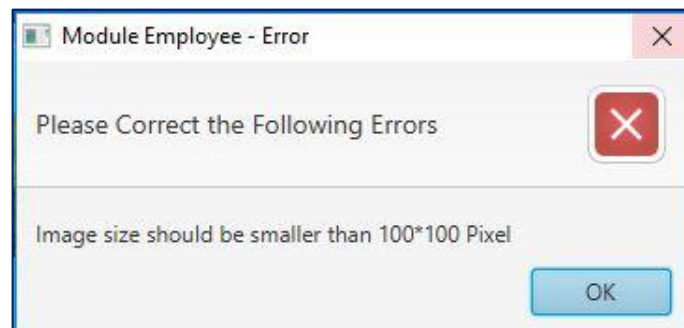
Figure 3.14 - Invalid Image Size Error
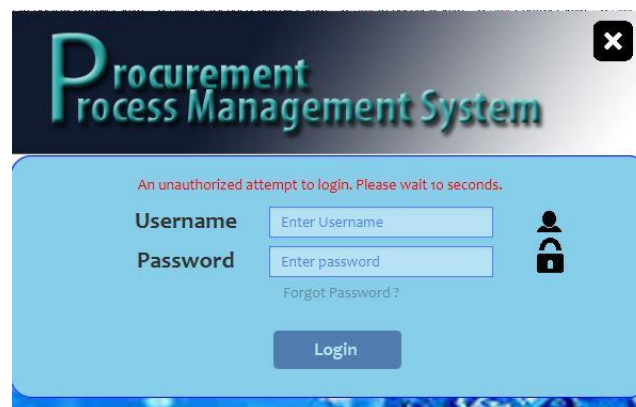
Figure 3.15 - Error in Login Alert Time Error

▪ **Recovery** – In user entering data for input controls color change occur according to data validity. So, minimize slips and mistakes. Colors used for validation is given below by Figure 3.16.
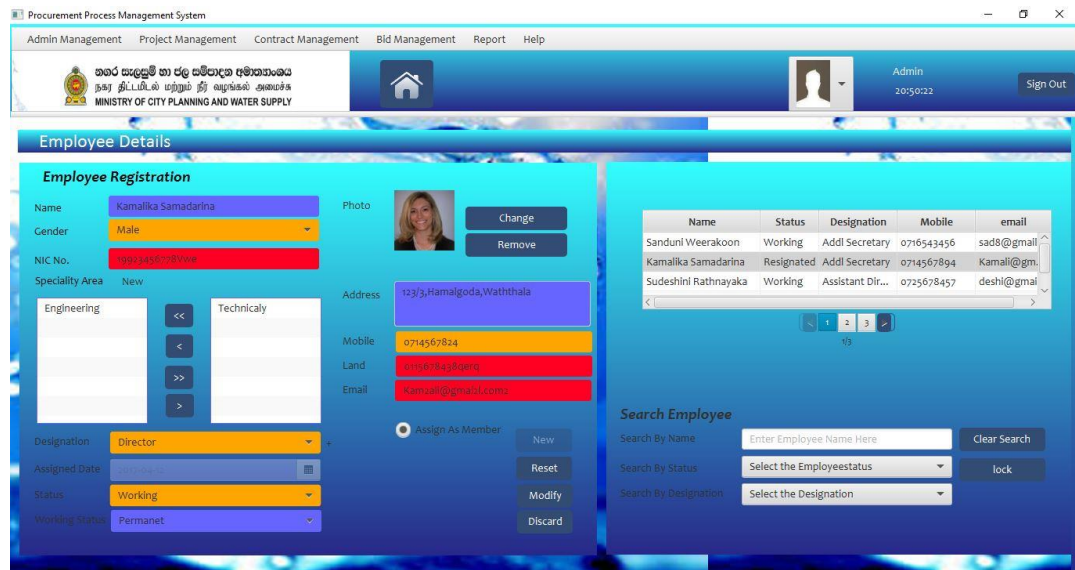
Figure 3.16 - Employee UI With Validation Colors

- o White – initial fields
- o Red – Error fields
- o Orange – Update fields
- o Blue – Valid fields

▪ **Consistency –** The user interfaces have been divided into two parts. As one part for enter details and other for display details entered. And every form CRUD buttons in similar area. Those constraints in layout of user interface provide in similar interfaces make easy to user recognized. Shown below are User Management UI (see the Figure 3.17) and Privilege Management (see the Figure 3.18) shows consistency.
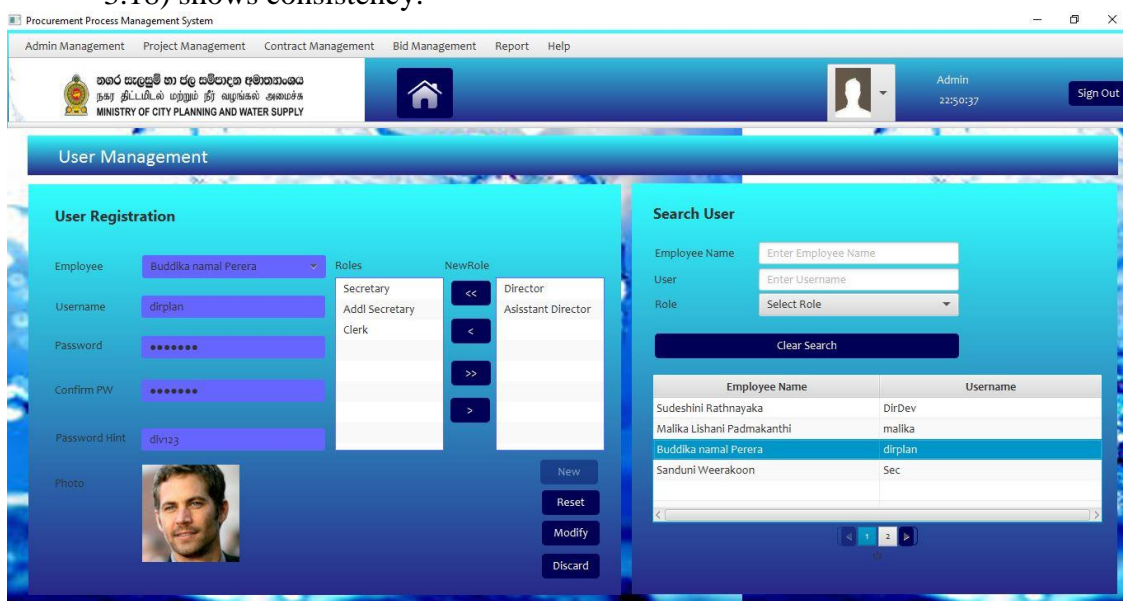
Figure 3.17 - User Management User Interface

23
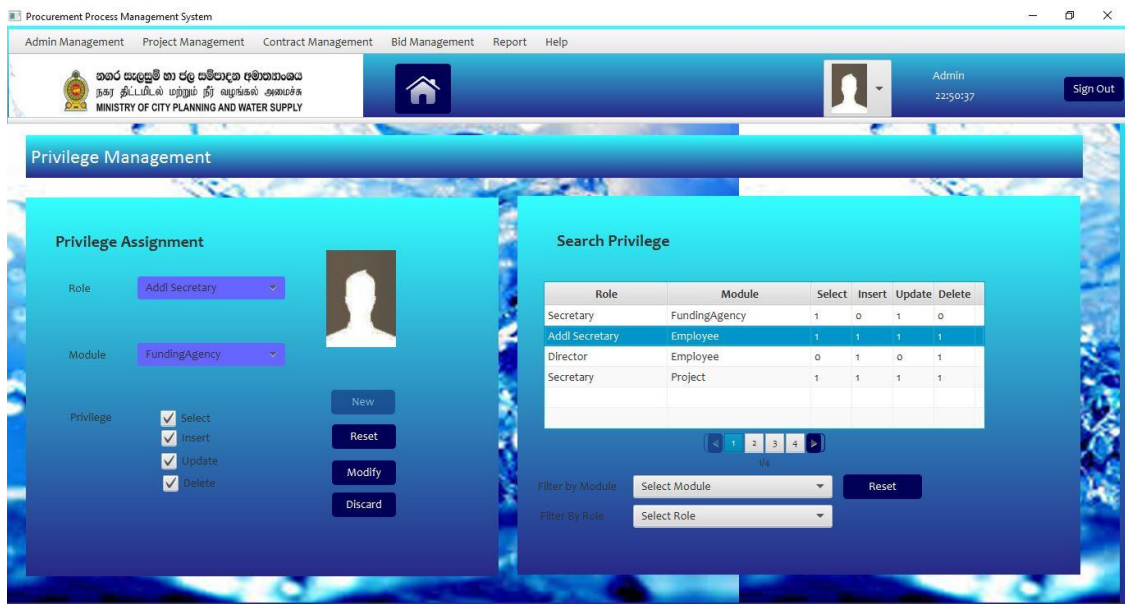
Figure 3.18 - Privilege User Interface

- **Familiarity –** The messages mentioned words are well known by user which means most words used are in jargon of domain.
- **Affordance –** To make buttons afford the button hover is used in every button and links make behavior of hyperlink such as underline.
- **Conviviality -** polite, friendly, generally pleasant messages conveying make user interaction well. In error messages please is used first.
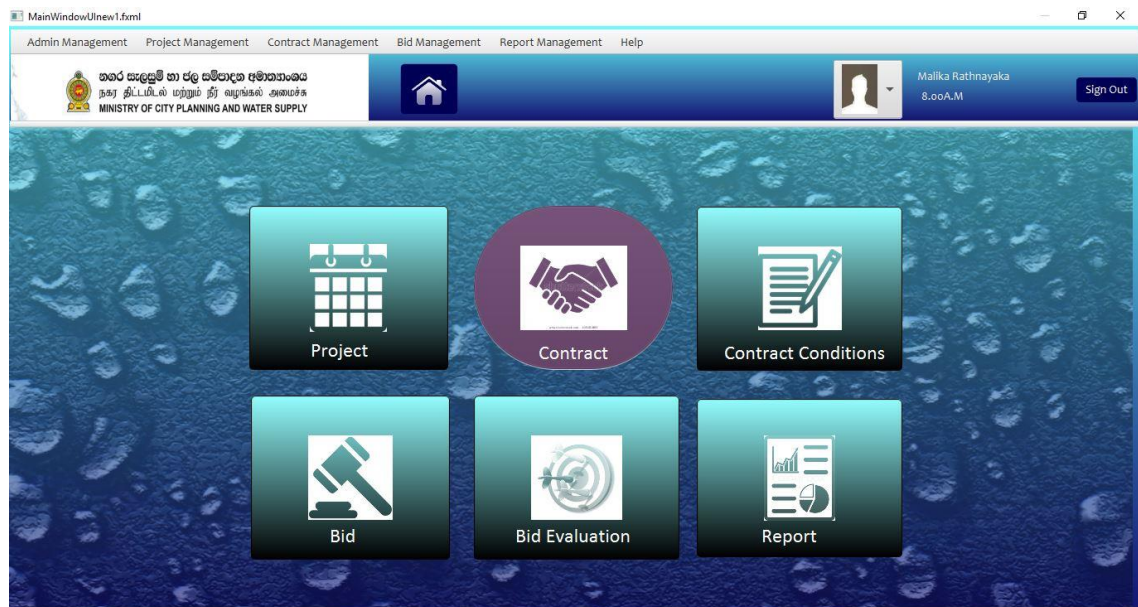
Figure 3.19 - Main Window Design

3.7.3. Main Window Design

The main window is design in a split pane. The top anchor pane describes a Menu, Logo, Login User name, time and pic with menu for user account settings. (The design is shown in Figure 3.19)

The bottom anchor describes the Main anchor pane which load relevant UI when click a menu Item. The anchor contains main modules as toggle buttons to increase flexibility of system.

The menu use for navigation is 3 level menus. In menu bar consist mainly level distribution shown below Table 3.1. The hierarchy of menu described in Figure 3.20

1 st Level	2 nd Level	3 rd Level
Admin Management	Employee	
	User	
	Privilege	
Project Management	Project	
	Funding Agent	
Contract Management	Contract	Contract Registration
		Contract Conditions
	Committee	PC
		TEC
Bid Management	Bid	
	Bid Criteria	
Report	Report	
Help	About	
	User Guide	

Table 3.1 - Menu Level Distribution
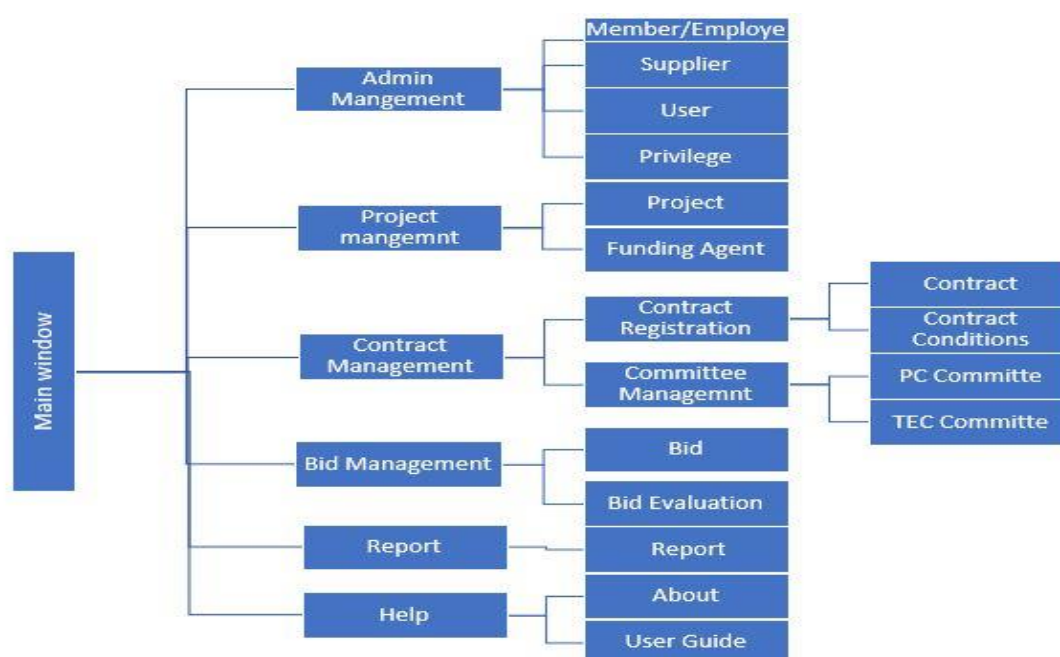
Figure 3.20 - Hierarchy of menu levels in menu bar

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3.7.4. Login Window Design
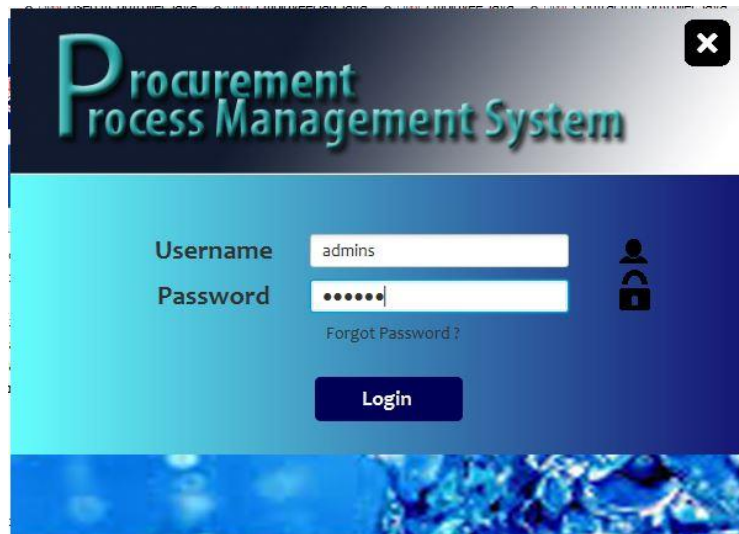
Figure 3.21 - Login Interface

Login window shown by Figure 3.21 facilitate nonfunctional requirements to satisfy usability, accessibility to have good human computer interaction. Above picture shows login window UI. System login should have nonfunctional needs satisfaction which make good UI design,

Non-Functional requirements facilitate by Login Window

1. Reliability
   a. Error Avoidance
      i. Login button disable if username or password not entered.

   b. Error Tolerance
      i. User Validation
         - Check typed username is valid by having user entered text.
         - Check typed password is valid by checking with actual password of user object of valid username with given password.
2. Security
   a. User can try only 3 times at a time by entering username, password
      i. If user attempts are over login form blocks for 15 seconds.

3. User Friendliness
   a. If user forgot password give password hint.
   b. If caps lock on notify user.

3.7.5. Login Settings Interface
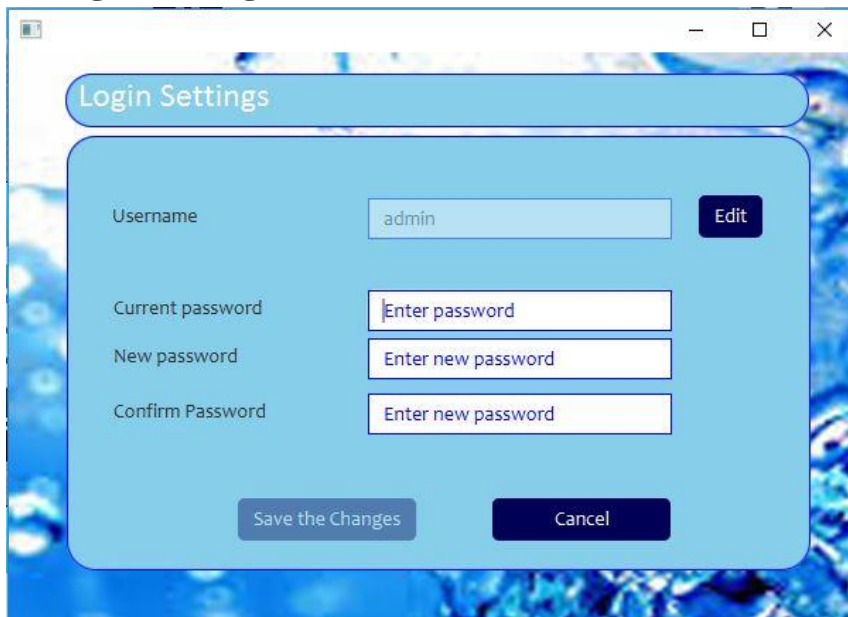
Figure 3.22 - Login Settings Interface

Figure 3.22 shows interface of login settings facilitate user to change his account details by resetting password, resetting username. It makes essence of user friendliness

3.7.6. Project Registration Interface
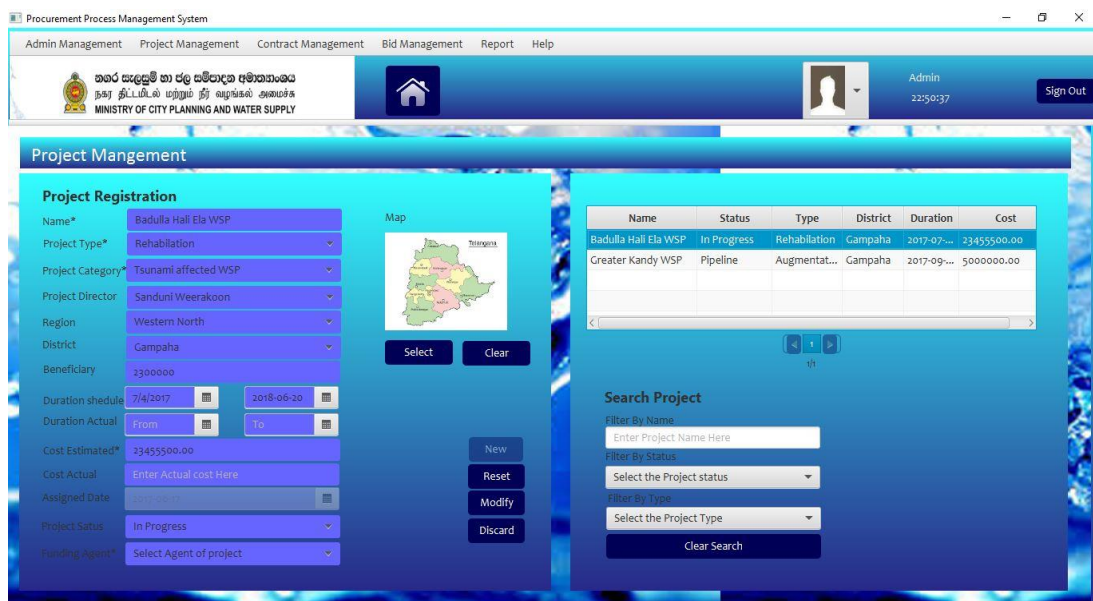
Figure 3.23 - Project Registration Interface

Project registration interface shown in above Figure 3.23 provide ability register project by assigning planning duration, cost, name, category, type etc. It has mostly organized combo boxes which avoid user invalid data entry. It makes error control in system.

3.7.7. Funding Agent Registration Interface
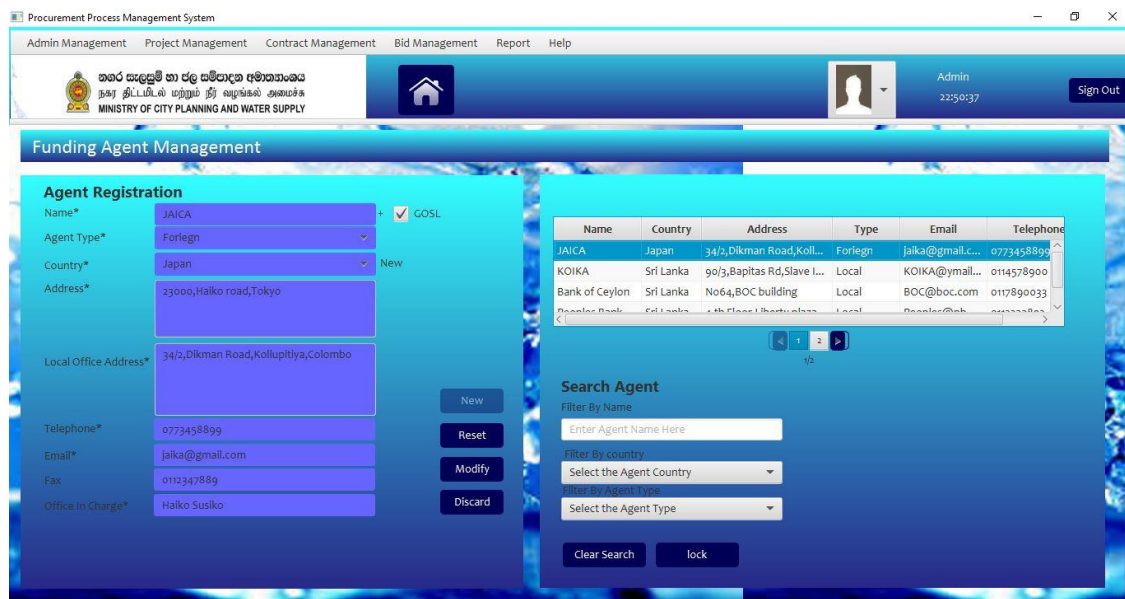
Figure 3.24 - Funding Agent Interface

The funding agent contact information are added in here by interface shown above Figure 3.24. It provides consistency with similar forms.

3.7.8. Technical Evaluation Committee Interface
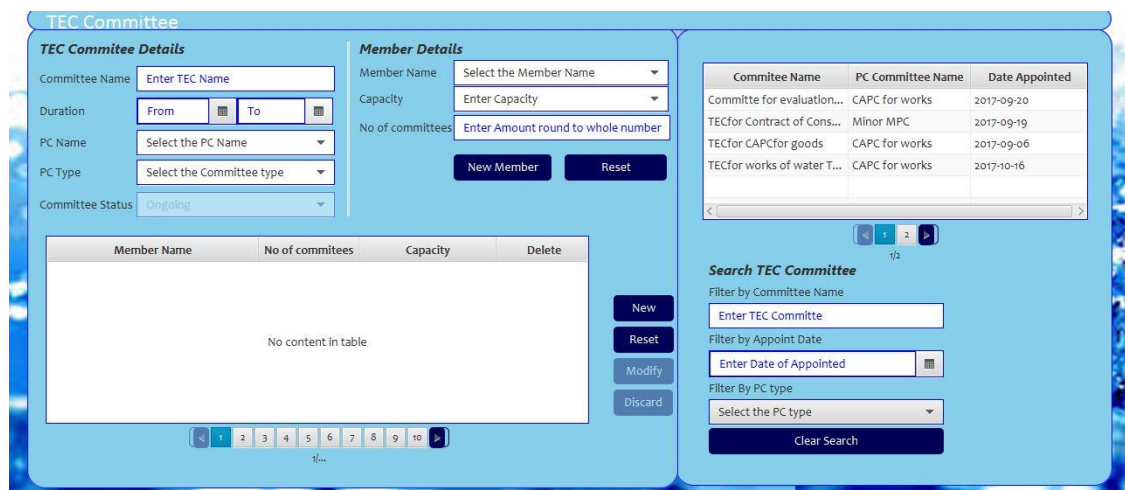
Figure 3.25 - TEC Module Interface

The above Figure 3.25 describes the interface design for TEC module registration. It shows the appointed member properties in inner table as shown above.

CHAPTER 04.   IMPLEMENTATION

4.1. Introduction

This chapter describe how the designed technical solution has been transformed to executable solution. So, if the design is perfectly and clearly arranged, the implementation not need more effort.

The coding should be followed in with standard to minimize the errors. And coding should follow best practices. Mainly coding should be readable, reliable, reusable. The process of implementation including the hardware and software requirements, code and module structure description are described in brief.

4.2. Implementation Environment (Hardware/Software)

The environment which the system can be survive need to be implemented in order to build system in high performance, maintainability.

Hardware Requirements	Software Requirements
Computer with processing power 2.00Hz or above	Windows 10 or above
RAM – 4GB or above	Java SE Development Kit 8
Hard disk – 450GB or above	Jasper Soft Plugin
	MySQL Server 5.7

Table 4.1 - Implementation Environment

4.1. Module Structure Description

4.1.1.   MVC Architecture

"MVC framework in Java application development, from desktop applications for basic programs to enterprise solutions written in Java. MVC framework is used to separate the data access layer, business logic code and the graphical user interface that has to be defined and designed to let the user interact with the application. This application has separated in to 3 sections,

1. Model - this part of the framework is to store the data of the application, such as databases, text data, files and/or other web resources.
2. View - this is the graphical user interface of the application. That would contain different buttons, text boxes and other controls to let the user interact with the system to complete his functions
3. Controller - the actual back-end code constitutes the controller of the framework. A controller controls the data coming from the users, or going to the user from a model.

This sets up a condition of validation, because the stream of data (coming from or going to the user) is always validated on the controller. That is why it makes the data more
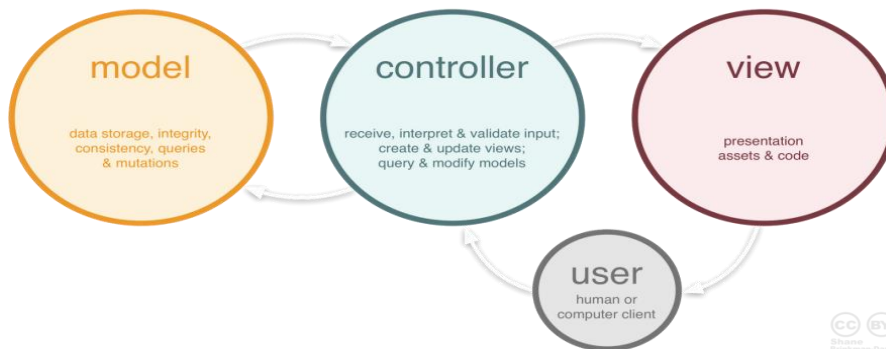
Figure 4.1 - MVC Architecture Behavior

consistent by removing any chance of invalid data entry or unauthorized data deletion from the system's data source" [17]. The above Figure 4.1 shows MVC architecture behavior in generally.

4.1.2. MVC Architecture in System

MVC Architecture of System
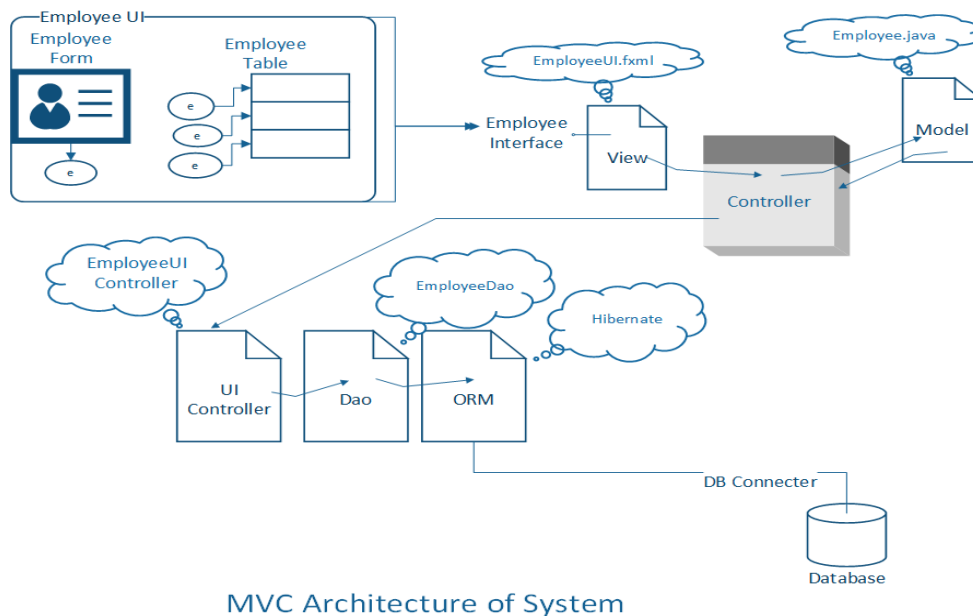
Figure 4.2 - MVC architecture of System

The system was implemented by following MVC architecture. The Figure 4.2 above shows the MVC architecture followed employee module implementation in brief.

As an example, when user added employee details to form it invokes employee controller to add details to database. Then the employee controller call dao. The dao execute queries in model by connecting database using the ORM (Object Relational Model). Then the updated table recall by dao due to controller request. That updated details shown in the employee user interface.
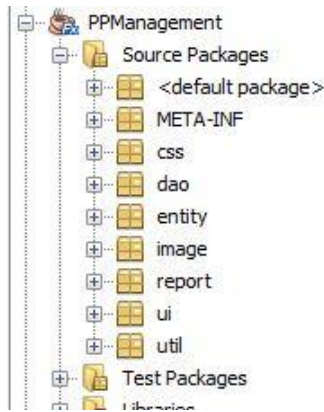
Figure 4.3 - File Organization of system

Likewise, the modules are structured in the MVC architecture.

The file organization of system is shown in the Figure 4.3. The structure of module implemented in the project by using the NetBeans IDE. The project of NetBeans has divided into three main packages called Entity(Model), Dao(Controller) and UI(View).

The controller needed further assistant is done by Object Relational Model(ORM). The ORM used is hibernate.

4.2. Code Structure

The code has structured as initializing methods, Binding methods, Operation methods, Search methods.
In initializing methods consist declaration of methods loadForm(), disableButtons(), setStyles(), loadTable(), fillTable().

In loadForm() method the form all input fields are initialized with required data and disableButtons() and setStyle() are called. The buttons applied disable feature with assigned privileges in method disableButtons(). And every input field set style with setStyle() method.

The loadTable() method initialized the table and search input fields and buttons. The fillTable() methods fills data object to the database table.

In binding methods included the key release or action performed methods of the input fields. In key release methods user entered data has been set to the model and indicated color change if valid.

In operational methods consisting the CRUD operations such as add, update, delete and reset of buttons. And also the getErrors() method to display invalid data errors, getUpdates() to display changes and fillForm() method to get selected data object to fill the form.

The search methods has been arranged with updateTable() which checks the given criteria and selected required dao to load table in relevantly. The action performed or key release of search input fields are also included here with search Lock and clear search buttons.

That was the basic form structure which be deviated with some minor modification in module to module depend on the entity mapping such as many to many, one to many, many to one etc. (Please reference the appendix – F for further information)

4.3. Development Tools

The tool kit which used to implement the system are discussed below.

4.3.1.   NetBeans 8.2

"NetBeans IDE is an open-source integrated development environment. The IDE supports development of all Java application types (Java SE (including JavaFX), Java ME, web, EJB and mobile applications) out of the box. All the functions of the IDE are provided by modules which provides a well-defined function, such as support for the Java language, editing" [18].

4.3.2.   MySQL Server

"MySQL is an open source relational database management system. It is based on the structure query language (SQL), which is used for adding, removing, and modifying information in the database" [19].

4.3.3.   MySQL Workbench

"MySQL Workbench provides data modeling, SQL development, and comprehensive administration tools for server configuration, user administration, backup, and much more. MySQL Workbench is available on Windows, Linux and Mac OS X" [20].

4.3.4.   JavaFX Scene Builder

"JavaFX Scene Builder is a visual layout tool that lets users quickly design JavaFX application user interfaces, without coding. Users can drag and drop UI components to a work area, modify their properties, apply style sheets, and the FXML code for the layout that they are creating is automatically generated in the background. The result is an FXML file that can then be combined with a Java project by binding the UI to the application's logic" [21].

4.3.5.   Visual Paradigm

"Visual Paradigm is a software tool designed for software development teams to model business information system and manage development processes. Visual Paradigm supports key industry modeling languages and standards such as Unified Modeling Language (UML), SysML, SoaML, BPMN, XMI etc" [22].

4.3.6.   Jasper Report

"Jasper Reports is a powerful open source Java (LGPL) reporting tool that has the ability to deliver rich content onto the screen, to the printer or into PDF, HTML, XLS, CSV and XML files" [23].

4.4. Used Technologies

4.4.1. Java Language

Java is a high-level object-oriented programming language. Programming languages describe a process for generating a result. Also, Java supports portability, which means that computer programs written in the Java language must run similarly on any hardware/operating-system platform.

4.4.2. SQL (Structured Query Language)

"SQL is a popular relational database language first standardized in 1986 by the American National Standards Institute (ANSI). SQL was originally based on ordering logics such as relational algebra and calculus. SQL can be used to create databases, modify them, access control and also data inserts, updates, deletions and querying" [24].

4.4.3. Hibernate

"Hibernate ORM enables developers to more easily write applications whose data outlives the application process. As an Object/Relational Mapping (ORM) framework, hibernate is concerned with data persistence as it applies to relational databases (via JDBC)" [25].

4.4.4. HQL (Hibernate Query Language)

"Hibernate provides an SQL inspired language called Hibernate Query Language (HQL) that allows SQL-like queries to be written against Hibernate's data objects. Criteria Queries are provided as an object-oriented alternative to HQL" [26].

4.4.5. JPQL (Java Persistence Query Language)

"JPQL is based on the Hibernate Query Language (HQL), an earlier non-standard query language included in the Hibernate object-relational mapping library. Hibernate and the HQL were created before the JPA specification. As of Hibernate 3 JPQL is a subset of HQL" [27].

4.5. Specific Code Components

The special features used in system are explained below as specific code components.

4.5.1. Text Formatter Used in Field Validation

The text formatters are used to validate fields which are integers or char need to be kept in specific format before saving the content. The below code explains security period converter to specific format.

```
        //Convert the entered string object to another string object(given object)
        StringConverter PeriodConverter = new StringConverter<String>() {

        //to convert string object(given object) to String object
            @Override
            public String toString(String object) {
              if(object== null)
                  return "invalid";
                return  object;
            }

        //to convert String object to given object(String)
            @Override
            public String fromString(String string) {
              if (string.matches("^[1-9]\\d*")) {
                  return string;
              }
              return string;
            }

          };
         //to add or remove operator
          UnaryOperator periodoperator = new UnaryOperator<TextFormatter.Change>(){

           // to apply any change to text formatter object
            @Override
            public TextFormatter.Change apply(TextFormatter.Change change) {

              //to return object having only digits

              for(int i=0; i<change.getText().length(); i++){
                  return(Character.isDigit(change.getText().charAt(i)))?change:null;

               }
              return change;
            }
          };

TextFormatter<String> periodFrormatter =
newTextFormatter<>(PeriodConverter,"",periodoperator);
```
----------------------------------text formatter in bidUIcontroller to eliminate non digits------------------------

4.5.2.   Renders in Cell Formatting

The cell can be formatted in three ways by using converters, editors and renders. The renders apply when the object need to act as another object. Appending button object on a cell also features the same property. In here explained how the evaluation criteria object is shown as criteria category object.

34

```
//set evaluation criteria object to criteria category column
 colCriteriaCategory.setCellValueFactory(new
PropertyValueFactory("evaluationcriteriaId"));

//set cell factory which define new table cell for col criteria category
     colCriteriaCategory.setCellFactory((TableColumn<Contractcriteria,
Evaluationcriteria> param) -> {
        final TableCell<Contractcriteria, Evaluationcriteria> cell =  new
TableCell<Contractcriteria, Evaluationcriteria>(){
          @Override
          public void updateItem(final Evaluationcriteria item,boolean empty){
            super.updateItem(item, empty);
            if (empty)
            {
               this.setText("");
            }
            Else
            {
               this.setText(item.getCriteriacategoryId().toString());
            }
          }

        };
        return cell;
     });
```
-------column criteria category in load inner form method in contractconditionUIcontroller--

4.5.3.   Salt and Pepper in Password storing

Salt is a randomly generated number. Password stored hashing with appended salt. So the stored password is pepper as cannot even guess. User given password check against stored password by hashing given password appending salt.

"The reason is that a **salt** is not a secret. It is just a value that can be known to an attacker. A **pepper** on the other hand, by very definition is a cryptographic secret. The current **password** hashing algorithms (bcrypt, pbkdf2, etc) all are designed to only take in one secret value (the **password**).Jun 3, 2013" [28].

```
public boolean setPassword(String password) {
     boolean validity = password.matches("[A-Za-z0-9]{5,20}"); // validate regex
    if(validity)
    {
        String saltedpaswrd = password+salt;     // append salt to valid password
       this.password =Security.getHash(saltedpaswrd);}    // create pepper

    else { this.password = null;}       // return null if invalid password

    return validity;
  }
```
        ---------set password method in user.java in entity package. ------------------

```
public static String getHash(String password) {
    StringBuffer sb = new StringBuffer();
    byte[] hashedPasseword = null;
    try {
        MessageDigest digest = MessageDigest.getInstance("SHA-1");
        digest.reset();
        digest.update(password.getBytes("UTF-8"));
        hashedPasseword = digest.digest();

        for (int i = 0; i < hashedPasseword.length; i++) {
            sb.append(Integer.toString((hashedPasseword[i] & 0xff) + 0x100,
16).substring(1));
        }

    } catch (NoSuchAlgorithmException | UnsupportedEncodingException ex) {
        System.out.println(ex.getMessage());
    }
    return sb.toString();
}
```

------------------get Hash method in security.java in util package------------------------

```
public static String generateSalt() {
    SecureRandom random = new SecureRandom();
    byte bytes[] = new byte[20];
    random.nextBytes(bytes);
    String s = new String(bytes);
    return s;
}
```

------------------generate Salt method in security.java in util package------------------

```
String actualPassword = user.getPassword();        //get pepper
        String salt = user.getSalt();              //get salt
        String passwordSalt = Security.getHash(givenPassword + salt);
   // check salted password not equal to pepper
 if (!actualPassword.equals(passwordSalt)) {
        lblAttempt.setText(" Invalid Login. You have " + (--attempt) + " more attempts.");
            lblAttempt.setStyle(error);
            txtUsername.setText("");
            txtPassword.setText("");
            btnLogin.setDisable(false);
   } else {

<<<<<<<<<<<<<<<<Database Connectivity>>>>>>>>>>>>>>>>>>>>>>>>>>>>
        }
```

---------Check given password with stored password in LoginUIController.java---------

4.5.4. Block Invalid User in three consecutive attempts

Used a count down of 15 seconds to block invalid user in three consecutive attempts.

```
private void startCountDown() {

    Timer timer = new Timer();
    timer.schedule(new TimerTask() {
       @Override
       public void run() {
         Platform.runLater(() -> { // block the platform if given condition true

            if (seconds-- > 1) {
              lblAttempt.setText("An unauthorized attempt "
                              + "to login. Please wait "
                              + seconds
                              + " seconds.");
               setdisable(true); //disable form fields

            } else {
               timer.cancel(); //stop timer if condition fail
              loadForm();
               setdisable(false); //enable form fields
            }
         });
       }
    }, 1000, 1000);
    }
```
----------------------Start countdown method in LoginUI Controller.java-----------------

4.6. Acknowledgement of any reused existing code

Stack Overflow community supplied solution for most difficulties in coding are acknowledged. Follow the reference link

4.6.1. To Move/Drag the Login Window

Method is used to drag the undecorated JFrame. Acknowledged to stackoverfllow community who supplied the feature [29] .

```
@FXML
  private void apnLoginMD(MouseEvent event) {
    stage.setX(event.getScreenX() + X); // set X coordinate of stage by adding mouse X coordinate
     stage.setY(event.getScreenY() + Y); // set Y coordinate of stage by adding mouse Y coordinate
  }
  @FXML
  private void apnLoginMP(MouseEvent event) {
    X = stage.getX() - event.getScreenX();  //get X coordinate in stage relative to screen.
    Y = stage.getY() - event.getScreenY(); //get Y coordinate in stage relative to screen.
  }
```
--------LoginUIController.java Mouse Dragged and Mouse Pressed event to anchor pane Login--------

CHAPTER 05. EVALUATION

5.1. Introduction

"Evaluation is a process that critically examines a program. It involves collecting and analyzing information about a program's activities, characteristics, and outcomes. Its purpose is to make judgments about a program, to improve its effectiveness, and/or to inform programming decisions" [30].

The implemented standard must to be evaluated by the system testing. That will assure the quality of the system.

5.2. Testing Plan

The evaluation need to be done in several angles. That will catch the errors which could occur at system. To do the task effectively, efficiently should be managed. The test plan should be followed to manage the task. The Table 5.1 below describe the test plan in brief.

Introduction	Test goal	To ensure the quality of system whether the system is usable, user friendly, accurate
	Scope	The system modules in development environment
		The system modules in client environment
	Scheduling	In Progress of Implementation After Implemented After Delivery
Objective	Module Testing	To check the functionality of module as independent to system. That falls under the white box testing.
	Integration Testing	To check functionality of modules with dependent modules to have desired output. That falls under the both white box testing and black box testing
	System Testing	To check the overall system functionality in different environments. That falls under the black box testing.
	Acceptance Testing	To check acceptability and usability of system to client. That falls under the black box testing.
Required Resources	Hardware	Hardware Environment in Implementation
	Software	Procurement Process Management System and software environment in implementation
	Staff	Client staff, supervisor

Table 5.1 - Test Plan Summary

5.3. System Test Cases

Test case is which need to be design before implementation and evaluate test results after implemented. The test case needs to have ability to check the system functionality properly. Some test cases design for major modules are follows. (Please see the Appendix E for all the test results of following test cases)

5.3.1. Test cases for Login Module

The test cases and expected results of login module was displayed in Table 5.2 below.

Test No	Test Description	Steps to Test	Expected Result
1.	Validate User Input Details	Enter correct username Enter correct password Click login	Successfully Login into the system loading Main Window
2.	Validate User Input Details	Enter correct username Enter incorrect password Click login	Display error message "Invalid username or Password and you have n no of attempts"
3.	Validate User Input Details	Enter incorrect username Enter correct password Click login	Display error message "Invalid username or Password and you have n no of attempts"
4.	Validate User Input Details	Enter incorrect username and password Click login	Display error message "Invalid username or Password and you have n no of attempts"
5.	Validate User Input Details	Enter incorrect username and password and click login 3 consecutive times	Display error message Blocking login "wait for 15 seconds with timer to retry the window"
6.	Login Button Functionality	Not enter any details Click login	Do nothing. Login Button disabled
7.	Login Button Functionality	Enter username and click login	Do nothing. Login Button disabled
8.	Login Button Functionality	Enter password and click login	Do nothing. Login Button disabled
9.	Login Button Functionality	Enter username and Password	Enable login button
10.	Close button Functionality	Click close button	Close the login form

Table 5.2 - Test Case of Login Module

5.3.2. Test Cases Common for All Modules

The below Table 5.3 describe the test cases need to be test for all modules.

Test No	Test Description	Steps to Test	Expected Results
1.	Form Functionality	In form loading without doing nothing	Indicate auto fill fields and update, discard button disabled

2.	Input details validation	Enter valid value for field	Indicate color change to blue
3.	Input details validation	Enter invalid value for field	Indicate color change to red.
4.	Input details validation	Update a field value	Indicate color change to orange.
5.	Input details validation	Fill all compulsory attributes with correct values and click new	Alert the confirmation "Are you sure need to add the following details to the project module" with showing all details.
6.	Input details validation	Add incorrect/empty information to compulsory fields and Click New	Display error message with indicating required fields
7.	Table Functionality	select row of table	Fill the row object values to the form. And modify, discard button enables while new disable.
8.	Update form details	update fields validly	Alert confirmation do u need to modify with details showing
9.	Update form details	update fields invalidly	Display error message with indicating required fields
10.	Delete a module object	click discard button	Alert confirmation do u need to delete and inactive the info of the object
11.	Clear the form	click reset button	The form was reset to initial
12.	Search module objects by one criteria	search by giving one criteria	Load table with relevant rows satisfying criteria
13.	Search module objects with two or more criteria	search two criteria select and lock button click	Load table with satisfying both criteria
14.	Clear the table filter and search	click clear search	Load table with search fields as initial

Table 5.3 - Test Case for Common Modules

5.3.3. Test Case for Project Module

The test cases written for project module are displayed below in Table 5.4

Test No	Test Description	Steps to Test	Expected Result
1.	Valid Districts map to relevant region	Select region	Load items to district combo
2.	Input field Validation	Enter scheduled start date as finished date	Indicate color change to red
3.	Update field dependency validation	Update status to progressing, and click modify	Alert error need to add actual start

4.	Update field dependency validation	Update status to completed and click modify	Alert error need to add actual duration and cost
5.	Input field Validation	Select map too large than required	Alert error message
6.	Input field Validation	Select map not .jpg format	Not showing files rather than . jpg

Table 5.4 - Test Case for Project Module

5.3.4. Test case for Contract Module

The contract module need to be test to satisfy following cases as given in Table 5.5.

Test No	Test Description	Steps to Test	Expected Result
1.	Dependency fields error avoidance	In form loading without doing nothing	Contract type, Total estimated cost, PC, TEC, Contract awarder disabled.
2.	Valid total estimated cost relevant to agent type	Select project	Enable Total estimated cost
3.	Valid contract type map to contract category	Select contract category	Load contract types relevant to category. And contract type enable
4.	Valid dependency between total estimated cost and pc limits	Enter total estimated cost after select project	Load PC items that are relevant to goslimit/foriegnlimit and PC combo enable.
5.	Field dependency validation	Select Procurement Committee	Load TEC of relevant PC
6.	Field dependency validation	Enter value greater than estimated cost in project	Color change of field to red
7.	Field dependency validation	Select bid open date	Select bid close date

Table 5.5 - Test Case for Contract Module

5.3.5. Test case for Contract Condition

The contract condition needed to be test as case describe below in Table 5.6

No	Test Description	Steps to Test	Expected Result
1.	Field dependency validation	Select contract	the contract type selected automatically
			contract category selected automatically
			Load items to criteria category automatically
2.	Field dependency validation	Select Criteria category	Evaluation criteria items are loaded
3.	Input Field Validation	Select unit as Boolean	Alert" add 1 for YES or 0 for NO"

4.	Inner Input Fields validation	Click new criteria with no values	Alert error message "The below fields are Invalid"
5.	Add Contract Criteria	Click add criteria after filling all required fields	New criteria will add to contract criteria table
6.	Delete contract criteria	Click delete button in contract criteria row	The row is deleted. And can add value to evaluation criteria

Table 5.6 - Test case for Contract Condition

5.3.6. Test case for Bid

The test cases written for bid module are given below Table 5.7.

No	Test Description	Steps to Test	Expected Result
1.	Dependency field validation and auto generation	Select contract	Load items to supplier combo unassigned to contract. Generate bid no automatically
2.	Form Functionality	In form loading without doing nothing	evaluate button, Auto fill fields are disable
3.	Input field validation	enter all 3 values sec amount, sec period, total cost	Evaluate button enable
4.	Input field validation	If not filled any of 3 fields	Evaluate button disable
5.	Evaluate Bid details	click evaluate button	Set total points automatically. Select Bid status automatically. If status reject set reason automatically

Table 5.7 - Test case for Bid

5.3.7. Test case for Bid evaluation

The bid evaluation module need to be test using test cases given below Table 5.8.

No	Test Description	Steps to Test	Expected Result
1.	Dependency field validation	Select contract	Set items on evaluation criteria combo box. Set items on Bid no
2.	Dependency field validation	Select bid item	Select supplier
3.	Dependency field validation	Select evaluation criteria	Select unit automatically. Set needed value automatically
4.	Generate evaluation points	Set supplied value for bid criteria	Set points gained automatically
5.	Generate total points and status	Click new bid criteria after fill all required	Set total points automatically. Select Bid status automatically
6.	No enough input fields validation	Click new without add all evaluation criteria	Alert error message

Table 5.8 - Test Case for Bid Evaluation

5.4. User evaluation

The user acceptance testing need to be evaluated with the client to have verify the business requirements are fulfilled by the system. Although system provide the required business cases it could not be user friendly, usability, accessibility. So finally, the client will not accept the system.

To overcome the drawbacks always need to have good communication between client and developer. And developer need to have good knowledge about the business domain. Eventually before the delivery of system to optimize the system further evaluation need to carry out. It is called as user acceptance testing.

The user acceptance testing of this system was carried out by introducing system in meeting. Feedback has taken using questionnaire. The user evaluation questionnaire form design is shown by Figure 5.1 below.

Figure 5.1 - User Evaluation Form

The user have responded to the questionnaire in positively. The gained positive response was given using the user acceptance certificate. The all feedbacks are analyzed further and attach in appendix D.

CHAPTER 06.   CONCLUSION

6.1. Introduction

The Ministry of City Planning and Water Supply is a leading government organization in Sri Lanka, which provide safe drinking water supply to the entire country. The organization handle water projects to make their objective success. The water projects are contracted. So, these contracts need to be procured to have good quality standard.

The procurement of contracts is a huge complex task as it need to follow government rules and regulations, time consuming process of bid evaluation, managing committee meeting, no enough storage etc.

Due to those mal functions the organizational process not acquire it's stand. So the system development was motivated.
The system provides overall process management by storing required records, automating the evaluation, generating useful documents.

6.2. Critical assessment of project

The system is a decision support system which may give user systematic decisions guidance. From the very beginning the domain understanding was very difficult due to unfamiliarity. By referencing manuals, guidelines, interviewing, internet references domain was understood.

As the scope of the subject was very far, bounded to some extent. The scope was decided by catching most critical and important parts in the process which need to be smoothen.

The system analysis was done using client interviewing has two problems. The client has no free time to communicate with due busy works and client not understanding the system technically. So, needed to convert technical things to business domain to get the information.

System designing was become a brainstorming task which means to how the business solution was converted to technical implementation. The design diagrams sketched repeatedly to make optimize the design of system. The diagramming has mapper to the conversion.

Due to the frequent communication with client has solved most business cases while supervisor vice versa. Finally, the solution has become reality which fed the clients best responses as it provided

- Automated bid analysis by pre-bid evaluation and advance bid evaluation
- Committee Management by choosing the matching committee to total estimated cost.
- Contract Management etc.

And it would be new chapter in the organization to transfer the task easy systematic approach.

6.3. Lesson Learnt

As this was very first experience of developing a system, felt how much it was complex and what effort need to be hold to get the solution alive. It was guided to learn

- How to be successful project manager by doing the scheduled work in timeframe, risk analyzing.
- How to be an engineer to see the business in eye of IT.
- How to practically map the BIT course learnt theories in real world.
- Implementing system with following standard using a framework by following good coding practices.
- How to maintain and obtain required information and facilities from client and supervisor.
- How to use the developing tools such as NetBeans IDE, JavaFX Scene Builder, Visual Paradigm, Jasper soft etc.

6.4. Future work

The scope bounded the system need to be broaden to enhance the solution further. To make it enhanced as online web-based system it will further effective.

- **Develop supplier visible content in web**

  Then can have ability send appeals and complaints request via system.

- **Manage the process in scheduled procurement plan.**

  The process can manage further without violated the procurement schedule as system pop up notifications in every threaten task before overflow.

- **Arrange meetings online through network.**

  It will make ability to call instant meetings in immediately in easy efficient.

- **Messaging facility**

  Communication between users via messaging through system in instant make organization users closer ever.

- **Optimizing bid evaluation further via criteria restriction**

  Reducing the manual work and easy smart decisions handling. Not required much space.
- **Systematic the procurement processes up to contract awarder.**

References

[1] "article: wikipedia," [Online]. Available: https://en.wikipedia.org/wiki/Requirements_analysis. [Accessed 15 March 2017].

[2] "http://www.treasury.gov.lk/procurement-manual," [Online]. Available: http://www.treasury.gov.lk. [Accessed 15 March 2017].

[3] "http://www.treasury.gov.lk/web/guest/Procurement-Guidelines," [Online]. Available: http://www.treasury.gov.lk. [Accessed 15 March 2017].

[4] "http://www.waterboard.lk/web/index.php?lang=en," [Online]. Available: http://www.waterboard.lk/. [Accessed 15 March 2017].

[5] "https://en.wikipedia.org/wiki," [Online]. Available: https://en.wikipedia.org/wiki/Non-functional_requirement. [Accessed 23 March 2017].

[6] "www.gatekeeperhq.com," [Online]. Available: https://www.gatekeeperhq.com/. [Accessed 13 April 2017].

[7] "www.promena.net," [Online]. Available: https://www.promena.net/home. [Accessed 13 April 2017].

[8] [Online]. Available: https://www.procurementexpress.com/. [Accessed 10 March 2017].

[9] "www.tutorialspoint.com," [Online]. Available: https://www.tutorialspoint.com/system_analysis_and_design/system_design.htm. [Accessed 20 April 2017].

[10] "wikipedia.org," [Online]. Available: https://en.wikipedia.org/wiki/Systems_development_life_cycle. [Accessed 20 April 2017].

[11] "www.scrumalliance.org," [Online]. Available: https://www.scrumalliance.org/why-scrum/core-scrum-values-roles. [Accessed 21 April 2017].

[12] "www.xbsoftware.com," [Online]. Available: https://xbsoftware.com/blog/software-development-life-cycle-sdlc-scrum-step-step/. [Accessed 25 April 2017].

[13] "www.techopedia.com," [Online]. Available: https://www.techopedia.com/definition/21104/object-oriented-analysis-and-design-ooad. [Accessed 07 May 2017].

[14] "www.studytonight.com," [Online]. Available: http://www.studytonight.com/dbms/database-normalization.php. [Accessed 03 May 2017].

[15] "www.usability.gov," [Online]. Available: https://www.usability.gov/what-and-why/user-interface-design.html. [Accessed 12 April 2017].

[16] "wqusability.com," [Online]. Available: http://wqusability.com/articles/getting-started.html. [Accessed 05 May 2017].

[17] "www.codeproject.com," [Online]. Available: https://www.codeproject.com/Articles/879896/Programming-in-Java-using-the-MVC-architecture. [Accessed 05 May 2017].

[18] "https://en.wikipedia.org," [Online]. Available: https://en.wikipedia.org/wiki/NetBeans. [Accessed 05 May 2017].

[19] "https://techterms.com," [Online]. Available: https://techterms.com/definition/mysql. [Accessed 05 May 2017].

[20] "https://www.mysql.com," [Online]. Available: https://www.mysql.com/products/workbench/. [Accessed 05 May 2017].

[21] "http://www.oracle.com," [Online]. Available: http://www.oracle.com/technetwork/java/javase/downloads/javafxscenebuilder-info-2157684.html. [Accessed 05 May 2017].

[22] "https://www.visual-paradigm.com," [Online]. Available: https://www.visual-paradigm.com/support/faq.jsp. [Accessed 05 May 2017].

[23] "https://struts.apache.org," [Online]. Available: https://struts.apache.org/docs/jasperreports-plugin.html. [Accessed 05 May 2017].

[24] "https://en.wikipedia.org," [Online]. Available: https://en.wikipedia.org/wiki/SQL. [Accessed 05 May 2017].

[25] "http://hibernate.org," [Online]. Available: http://hibernate.org/orm/. [Accessed 05 May 2017].

[26] "https://en.wikipedia.org," [Online]. Available:
https://en.wikipedia.org/wiki/Hibernate_(framework). [Accessed 05 May 2017].

[27] "https://en.wikipedia.org," [Online]. Available:
https://en.wikipedia.org/wiki/Java_Persistence_Query_Language. [Accessed 05
May 2017].

[28] "https://stackoverflow.com," [Online]. Available:
https://stackoverflow.com/questions/.../best-practices-salting-peppering-
passwords. [Accessed 24 October 2017].

[29] "https://stackoverflow.com," [Online]. Available:
https://stackoverflow.com/questions/24476496/drag-and-resize-undecorated-
jframe. [Accessed 25 October 2017].

[30] "meera.snre.umich.edu," [Online]. Available: meera.snre.umich.edu/evaluation-
what-it-and-why-do-it. [Accessed 07 June 2017].

Appendix A. System Documentation

This documentation provides info how to make feasible to install the procurement process management system. This information will be useful if the solution need to be enhanced or maintain further. The system installation described in step wise.

1st Step – Implementation Environment

To make the system develop further required carry out in possible operating environment with hardware and software. The requirements are listed in Table A.1 and Table A.2.

Hardware Requirements

Hardware Equipment	Recommended Requirement level
Processor	Intel core i3 (2.0Ghz) or above
Memory	2GB minimum for Windows 8 or Windows 10
Hard Disk	2GB free space
CD Drive	42x

Table A.1 - Hardware Requirements

Software Requirements

Software Equipment	Recommended Requirement level
Operating System	Windows 8 or above
Java	jdk 1.8_112
DBMS	MySQL Server 5.7 or above and
DBMS Tools	MySQL Query Browser, MySQL Administrator
Integrated Development Environment	NetBeans 8.2 (For Future enhancement)
Reporting Plugin	iReport 4.7 (For Future enhancement)
UI design	JavaFX Scene Builder 8.3.0 (For Future enhancement)

Table A.2 - Software Requirements

2nd Step - Install Java Run Time on Client Machine describe by Figure A.1 – A.6

Step 2.1: Download the java development kit 1.8 and run the setup.

Figure A.1 - Installation progress of JVM (Step 2.1)

Step 2.2: Select Optional features and click next
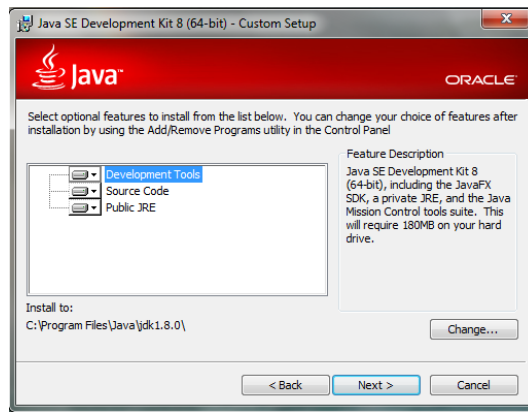
Figure A.2 - Installation progress of JVM (Step 2.2)

Step 2.3: Wait till copying files.
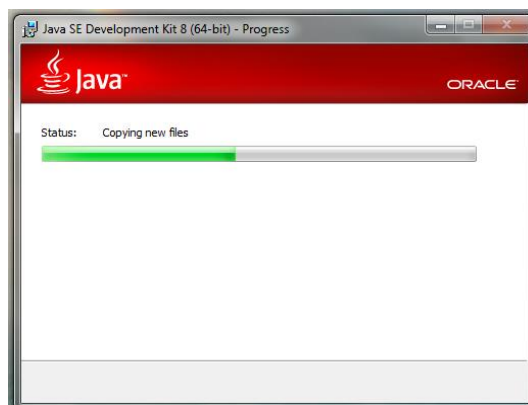
Figure A.3 - Installation progress of JVM (Step 2.3)

Step 2.4: Select destination folder to install
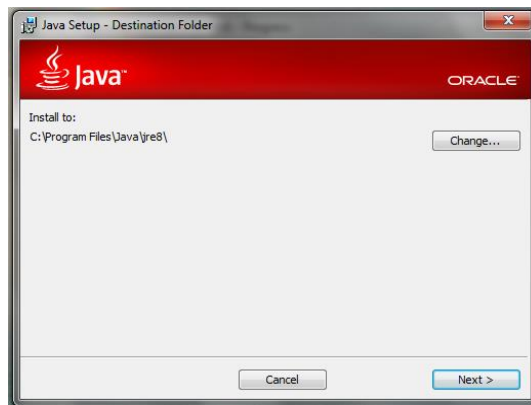
Figure A.4 - Installation progress of JVM (Step 2.4)

Figure A.5 - Installation progress of JVM (Step 2.5)

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Step 2.6: click close to finish installation

Figure A.6 - Installation progress of JVM (Step 2.6)

3rd step - Installing My SQL Server 5.7 described from Figure A.7 – A.15

Step 3.1: Download MySQL Community Server 5.7 installation file appropriate for the platform. Open installation file for MySQL Community Server and press "Next".

Figure A.7 - Installation Progress MYSQL server (Step 3.1)

Step 3.2: Accept the License agreement
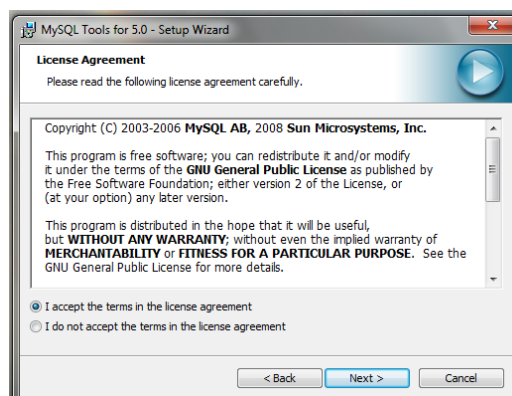
Figure A.8 - Installation Progress MySQL server (Step 3.2)

.

Step 3.3: Choose "Typical" setup type, click "Next" and "Install".
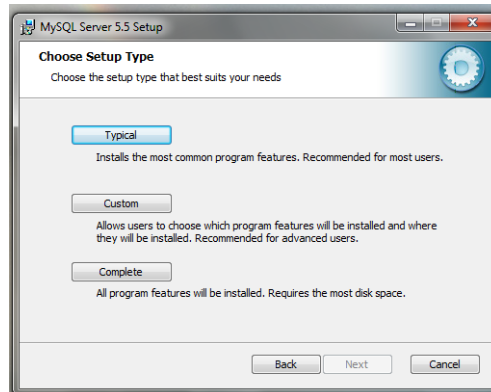
Figure A.9 - Installation Progress MySQL server (Step 3.3)

Step 3.4: Click "Install" to begin the installation
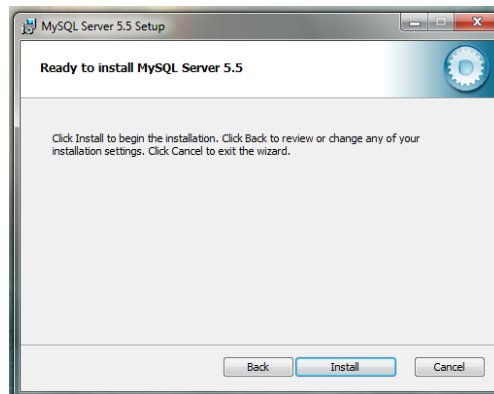
Figure A.10 - Installation Progress MySQL server (Step 3.4)

Step 3.5: After installation process is completed, check "Launch the MySQL Instance Configuration Wizard" and click "Finish".
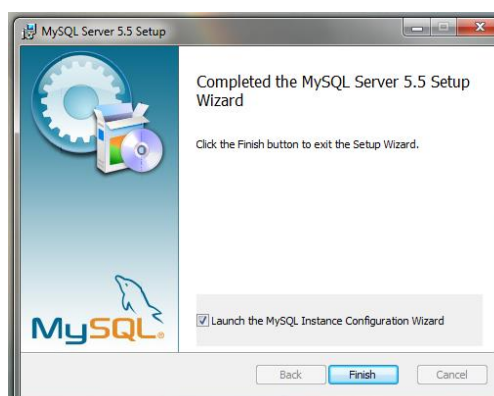
Figure A.11 - Installation Progress MySQL server (Step 3.5)

Step 3.6: Click "Next" when "Configuration Wizard" appears.
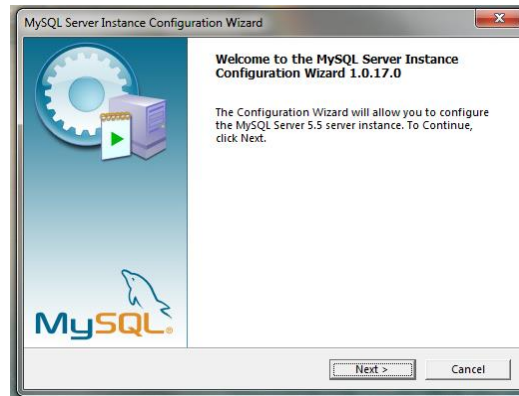
Figure A.12 - Installation Progress MySQL server (Step 3.6)

Step 3.7: Choose "Standard Configuration" and click "Next".
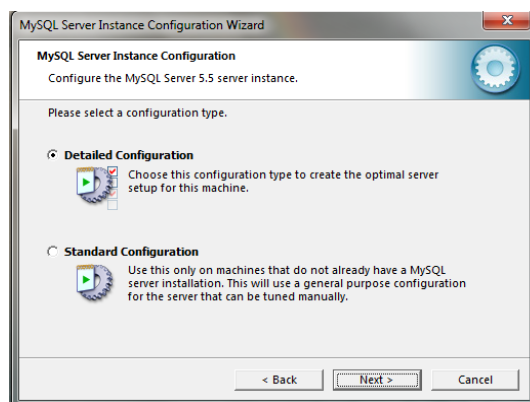
Figure A.13 - Installation Progress MySQL server (Step 3.7)

Step 3.8: Check "Install as Windows Service", select service name "MySQL". Check "Launch the MySQL Server automatically". Then check "Include Bin Directory in Windows PATH" and click "Next".
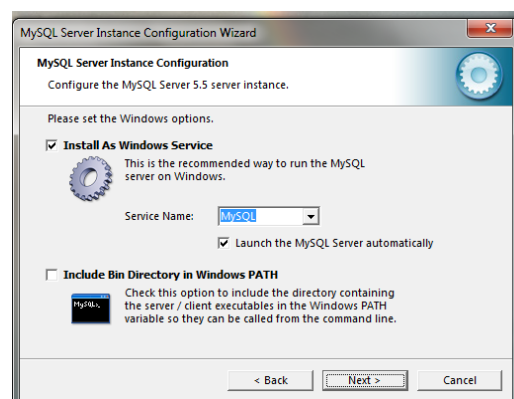
Figure A.14 - Installation Progress MySQL Server (Step 3.8)

Step 3.9: Check "Modify Security Settings", Set a new password to the "root" user. Check "Enable root access from remote machines". Click "Next" and then "Execute".
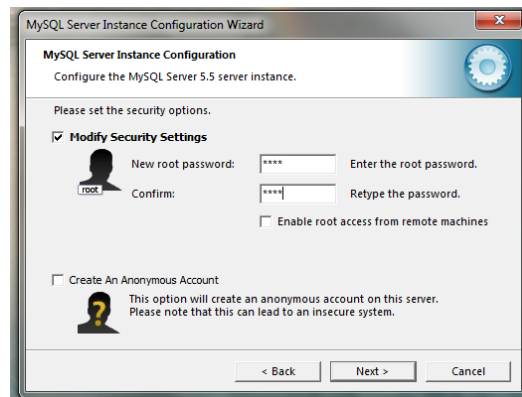
Figure A.15 - Installation Progress MySQL Server (Step 3.9)

Step 3.10: After configuration process is completed click "Finish".
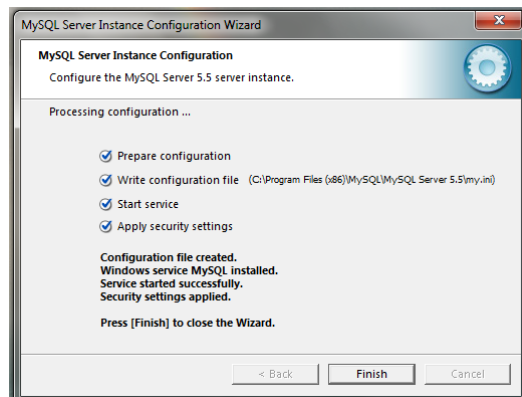
Figure A.16 - Installation Progress MySQL Server (Step 3.10)

4th Step - Installing Microsoft SQL Query Browser describe Figure A.17 – A.22

Step 4.1: Download MySQL Tools for 5.0 and run the setup.

Figure A.17 - Installation Progress MySQL Query Browser (Step 4.1)

Step 4.2: Accept License Agreement
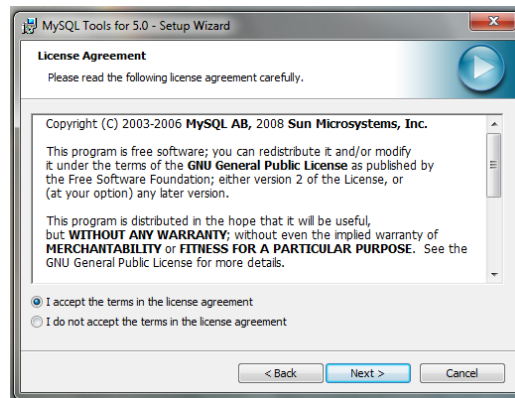
Figure A.18 - Installation Progress MySQL Query Browser (Step 4.2)

Step 4.3: Select destination folder and click "Next"
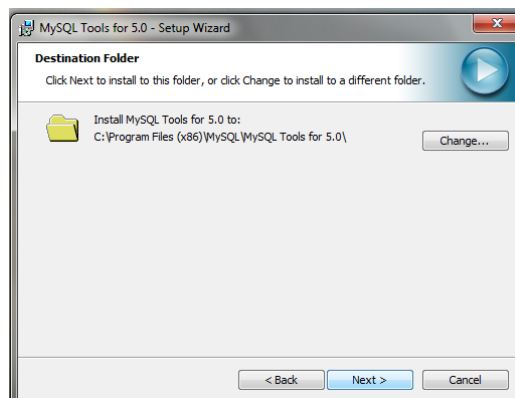
Figure A.19 - Installation Progress MySQL Query Browser (Step 4.3)

Step 4.4: Click "Finish" to complete the wizard.
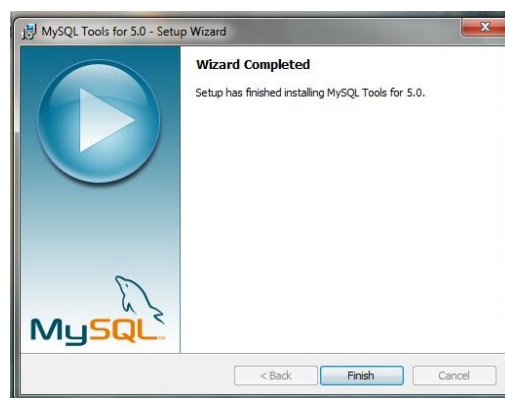
Figure A.20 - Installation Progress MySQL Query Browser (Step 4.4)

Step 4.5: Open MySQL Administrator & Insert server host, port & the user name as given above & enter the given password.
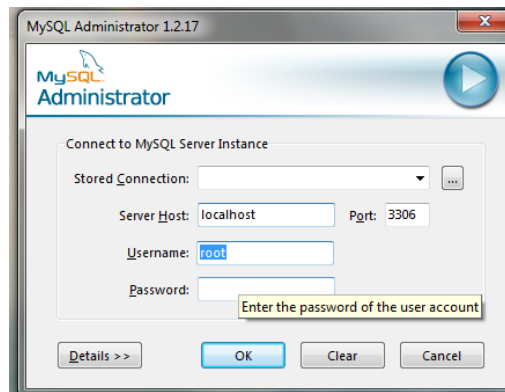
Figure A.21 - My SQL Administrator Launch (Step 4.5).

Step 4.6: To restore the database, create a new database then select restore database & last set database to system database.
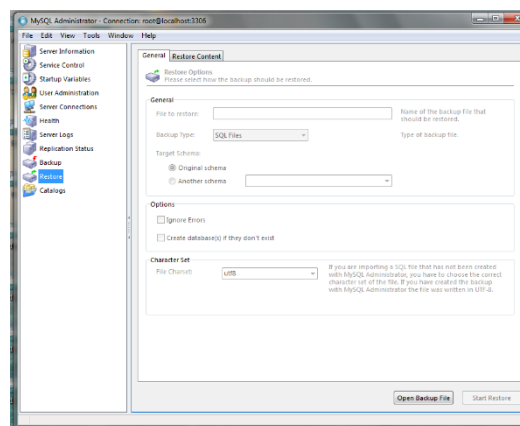
Figure A.22 - To restore database (Step 4.6)

5th Step - Install Procurement Process Management System set up final the installation process.

To install NetBeans, Download "NetBeans IDE" installer from http://netbeans.org/downloads/index.html. Run the setup

To install Scene builder, download the installer from http://gluonhq.com/products/scene-builder/

To install the MySQL workbench, Download installer from https://dev.mysql.com/downloads/workbench/

It provides both MySQL administrator and Query Browser facilities.

Appendix B.   Design Documentation

The documentation provides the further information about the design by explaining use case with use case description.
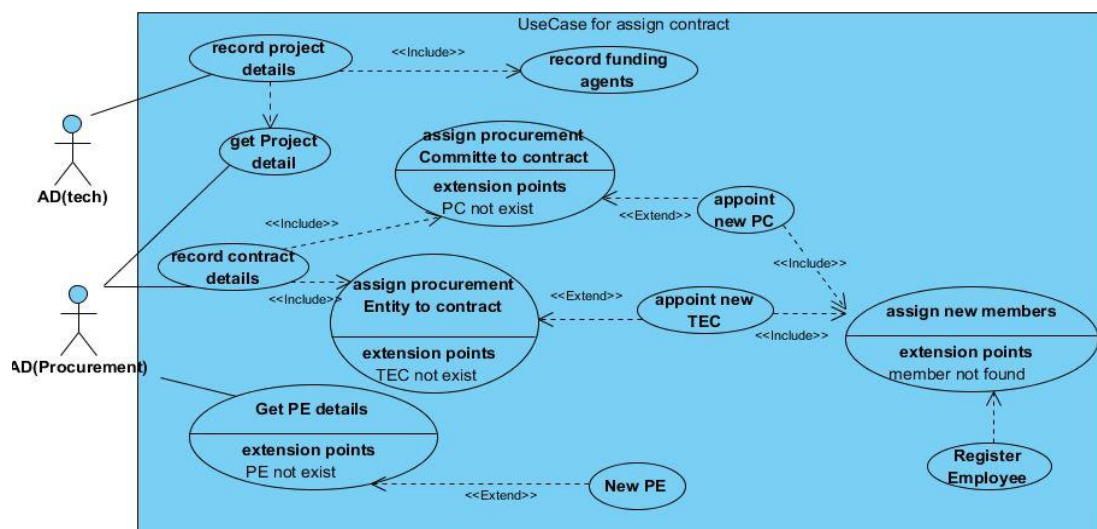
Figure B.1 - Use Case for Contract Assignment

The above Figure B.1 describe the how the contract assignment task is taken place. To do the task needed to the relevant project need to be registered in the system described in Table B.2.Then can assign contracts for the registered projects as Table B.1. The contract also needed to appoint a TEC committee to evaluate bids of contract described in Table B.4.

Use case name	Contract Assignment	
Actors	AD(Technical), Clerk	
Description	Assign Contracts for registered projects	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click contract menu, contract Button	2. Load contract status as pipeline, assign date as system date
	3. Enter contract name	
	4. Select contract category	5. Set items into contract type
	6. Select contract type	
	7. Select bidding Method, Procurement entity, Project	
	8. Enter date of bid open, close	9. Set items on district relevant to region
	10. Enter estimated cost for the contract	11. Set items to PC which has minimum upper limit of cost.
	12. Select PC Committee	Set items relevant tec committee
	13. Select Tec	
	14. Select Specialty Area	

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	15. Click new button	16. Alert confirmation with details added
Alternative courses	7. If Procurement Entity is not found add new. 12.If PC is not found add new 12. If Tec is not found add new 15.System display error message	
Conclusion	This use case emphasize contract registration	
Post conditions	Contract Details save in the database.	

Table B.1 - Contract Assignment Use Case Description

Use case name	Project Assignment	
Actors	AD(Technical), Clerk	
Description	Projects are registered in this module	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click project menu, project Button	2. Load project status as pipeline, assign date as system date
	3. Enter project name	
	4. Select project type	
	5. Select project category	
	6. Select project director	
	7. Select Region	8. Set items on district relevant to region
	9. Select district	
	10. Enter Beneficiary, duration dates, Estimated cost	
	11. Enter Funding Agent	
	12. Click new button	13. Alert confirmation with details added
Alternative courses	2.If project status change to completed – add actual duration, actual cost. If project status change to in progress – add started date. 13. System display error message	
Conclusion	The use case emphasize how to add new project	
Post conditions	Project details will save in database	

Table B.2 - Project Assignment Use Case Description

To assign a project needed to assign funding agent which registered as the funding agent in the system describe by use case description given in Table B.3.

Use case name	Funding Agent Assignment	
Actors	AD(Technical), Clerk	
Description	Funding Agent is registered in this module	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click Funding Agent menu or button	
	2. Enter agent name	
	3. If with local tick the gosl check box	
	4. Select agent type	5. If local select Sri Lanka
	6. Select agent Country	
	7. Enter Address	
	8. Enter local office address	
	9. Enter tel, fax, email, office in charge	
	10. Click new button	11. Alert confirmation with details added
Alternative courses	7.If local agent –local address filled by enter as same as address 11. System display error message	
Conclusion	Use case displays how to register new funder.	
Post conditions	Funding agent details are added to the system.	

Table B.3 - Funding Agent Description

Use case name	TEC Assignment	
Actors	Director (Procurement), AD(Procurement)	
Description		
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click TEC in menu	2. TEC status selected in default
	3. Enter TEC name	
	4. Enter Committee Duration	
	5. Enter PC Name	6. Select PC Type
		7. Set items in members
	8. Select member name	
	9. Select Capacity	
	10. Add new member	
	11. Click new button	12. Alert confirmation with details added
Alternative courses	Repeat process eight to ten until no any evaluation criteria. 12.System display error message	
Conclusion	This use case says how to appoint TEC for particular PC	
Post conditions	TEC Details save in the database.	

Table B.4 - TEC Assignment Use Case Description
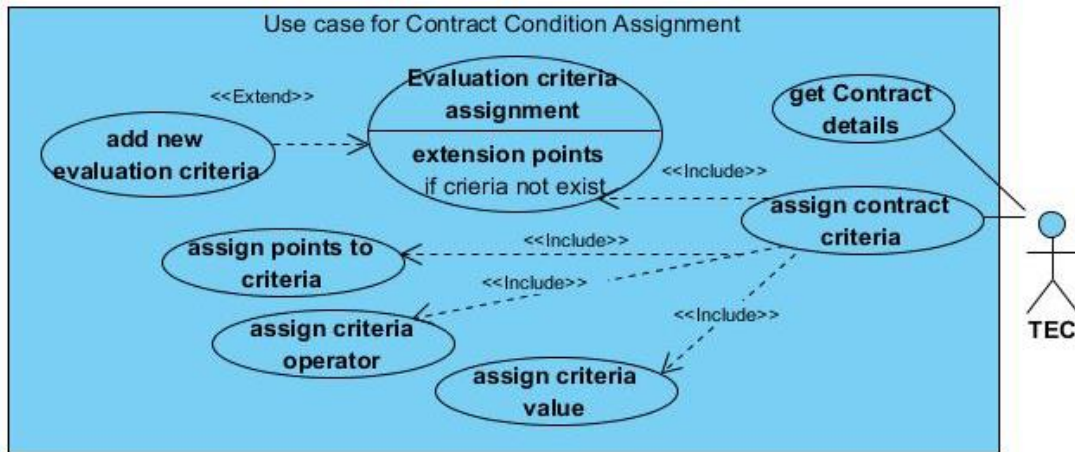
Figure B.2 – Use case for Contract Condition Assignment

To assign contract condition the contract should be registered first. The use case (see the Figure B.2) describe the dependencies and actors in contract condition.

Use case name	Contract Condition Assignment	
Actors	TEC, Clerk	
Description	Assign condition to registered contracts	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click contract Condition menu, contract condition button	2. Set default points and criteria value as one.
	3. Enter contract name	4. Select contract type , contract category
		5. Set Items in Criteria Category
	6. Select Criteria Category	7. Set items into Evaluation Criteria
	8. Select Evaluation Criteria	
	9. Enter criteria value.	
	10. Select Unit	
	11. Enter Points	
	12. Select Evaluation Operator	
	13. Click new Criteria	14. Add Criteria to Contract Criteria
		15. Set Total points and total criteria
	16. Click new button	17. Alert confirmation with details added
Alternative courses	Repeat process five to twelve as required. 5. If Criteria Category required is not found add new. 7.If Evaluation Criteria is not found add new 12. If Unit is not found add new 16.System display error message	
Conclusion	This usecase emphasize how to assign condition to contract	
Post conditions	Contract Condition Details save in the database.	

Table B.5 - Contract Condition Use Case Description
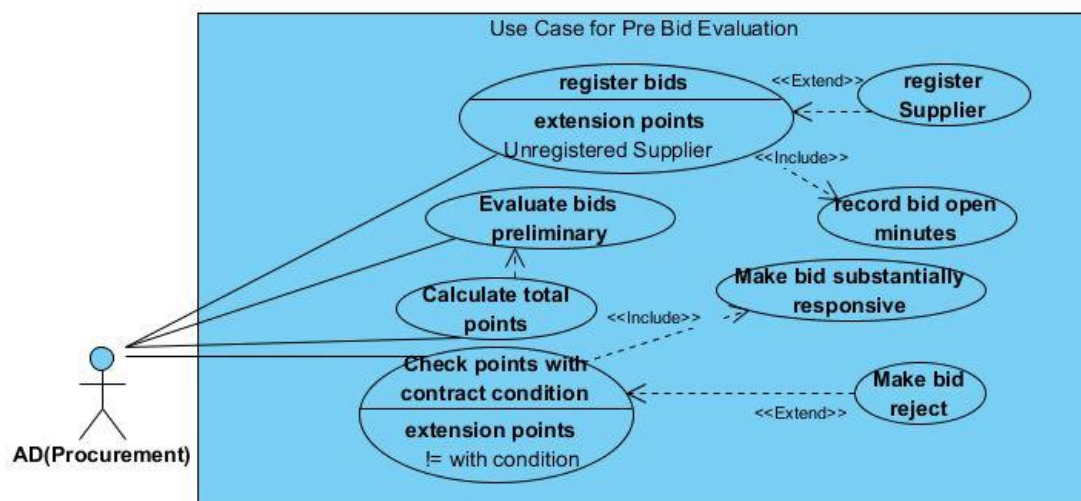
Figure B.3 - Use case for Pre-Bid Evaluation

Bid has to registered in the system before perform the evaluation. But system does pre-evaluation when the bid is registered. And should note that registered suppliers can only register bids shown in Figure B.3 figure and description in Table B.6.

Use case name	Bid Registration Management	
Actors	Clerk ,TEC	
Description	Register bids of registered suppliers who borrow bid doc of contract	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click Bid menu, Bid Button	Set Register date as system date
	2. Enter contract name	3. Set Items suppliers who not add bids
		4. Generate Bid No
	5. Select Supplier	
	6. Insert Bid Details Such as Signed, sealed, completed etc	
	7. Enter Securtiy amount, Security period, Cost of bid	8. Enable Evaluate Button
	9. Click evaluate	10. Set Total points Gained
		11. Select Bid Status
	12. Click new button	13. Alert confirmation with details added
Alternative courses	5. If Supplier Required is not found add new. 13.System display error message	
Conclusion	This use case emphasize how to register bid and how to perform pre evaluation.	
Post conditions	Bid Details save in the database.	

Table B.6 - Bid Registration Use Case Description
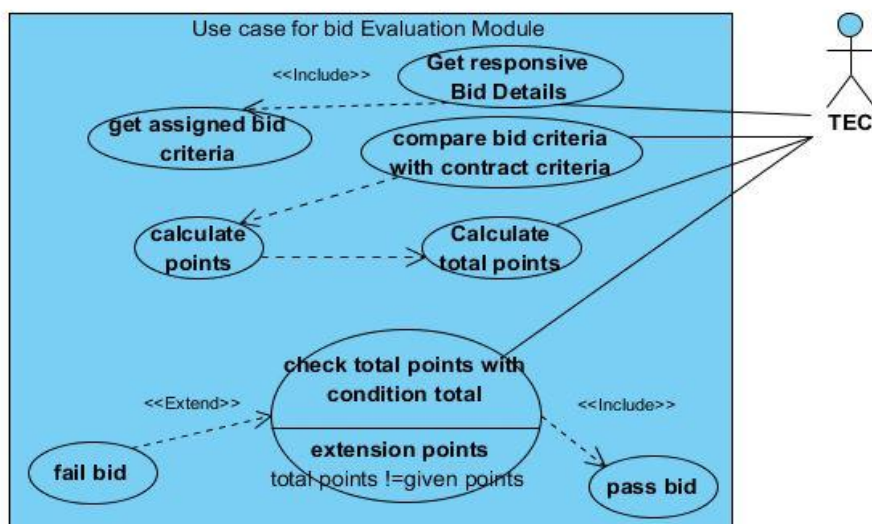
Figure B.4 - Use Case for Advance Bid Evaluation

The system evaluates the substantially responsive bids in advance by design describe in Figure B.4 and description of use case in Table B.7

Use case name	Bid Evaluation Management	
Actors	TEC, Clerk	
Description	Substantially responsive bids are reevaluating with advance criteria.	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click bid evaluation menu, bid evaluation Button	
	2. Select Contract name	4. Set items into Bid No added to Contract
		5. Set items into Evaluation Criteria
	3. Select Bid No	6. Select Supplier
	7. Select Evaluation Criteria	8. Set criteria value
		9. Select unit
		10. Set Points in Evaluation Criteria
	11. Enter Supplied Value	12. Enable Evaluate Button
	13. Click evaluate button	14. Set points
	15. Click new Criteria	16. Add Criteria to Bid Criteria
		17. Set Total points
		18. Set Result of bid
	19. Click new button	20. Alert confirmation with details added
Alternative courses	Repeat process 7,11,13 until no any evaluation criteria. 20.System display error message	
Conclusion	This use case emphasize how to evaluate bid in advance	
Post conditions	Contract Condition Details save in the database.	

Table B.7 - Bid Evaluation Use Case Description
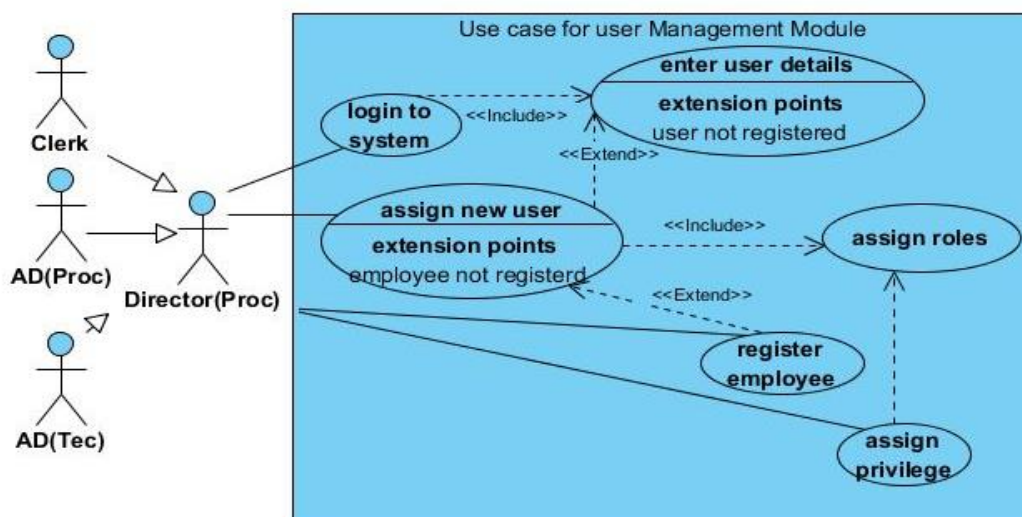
Figure B.5 - Use case for User management

The user management module need to be appointed only for registered employees describe in use case description by Table B.8. In user registration describe in Table B.9 need to assign roles which are privileged by privilege module describe in Table B.10. The above Figure B.5 shows the association of three modules.

Use case name	Employee Registration and Member assignment	
Actors	Director(Procurement),AD(Procurement),clerk	
Description	New employees who like to be member or user are added	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click employee in Admin menu	
	2. Enter employee name	
	3. Enter NIC number	4. Format to new NIC format (if type old)
		5. Select Gender
	6. Select Specialty area list	
	7. Select designation	
	8. Select working status	
	9. Assign as member	
	10. Select Photo	
	11. Type address	
	12. Enter land phone number	
	13. Enter mobile phone number	
	14. Enter Email	
	15. Click new button	16. Alert confirmation with details added
Alternative courses	14. System display error message	
Conclusion	This use case emphasize how to add employee to the system and assign as member.	
Post conditions	Employee Details save in the database.	

Table B.8 - Employee Registration and Member Assignment Use Case Description

Use case name	User Registration	
Actors	Director(Procurement),AD(Procurement),clerk	
Description	Assign employee as user	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Click User in Admin menu	
	2. Select employee	Display employee photo
	3. Enter user name	
	4. Enter password	
	5. Enter Confirm password	
	6. Enter password hint	
	7. Select Roles	
	8. Click new button	9. Alert confirmation with details added
Alternative courses	9. System display error message	
Conclusion	This use case emphasize how to add user to the system	
Post conditions	User Details save in the database.	

Table B.9 - User Registration Use Case Description

Use case name	Privilege Assignment	
Actors	Director(Procurement),AD(Procurement),clerk	
Description	Assign privilege to roles	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Select privilege in admin menu	Load privilege form with disable modify, discard buttons
	2. Select Role	Set items unassigned modules
	3. Select module	
	4. Check assign privileges	
	5. Click new button	6. Alert confirmation with details added
Alternative courses	6. System display error message	
Conclusion	This use case emphasize how to add privilege to the roles.	
Post conditions	Privilege Details save in the database.	

Table B.10 - Privilege Assignment Use Case
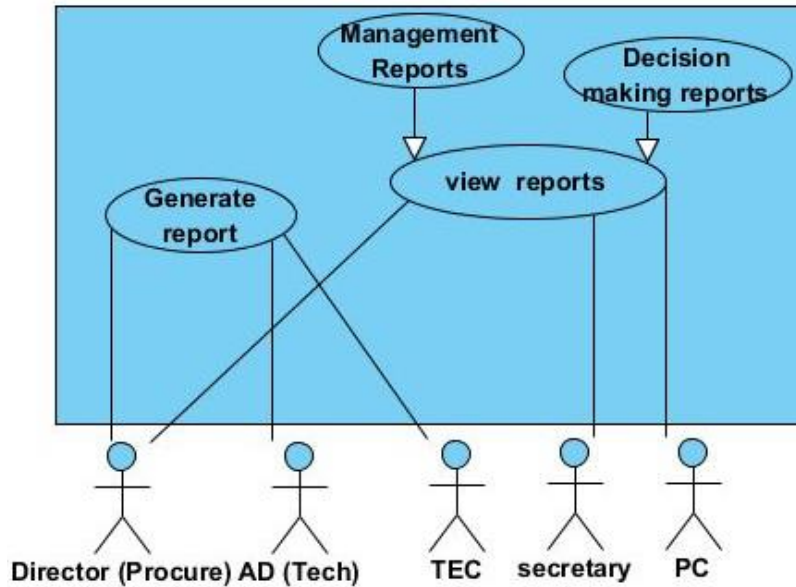
Figure B.6 - Use case for Report Management

The use case describe in Table B.11 shows the design of report module there can be generate report to more generalized users of system who are not describe by above Figure B.6.

Use case name	Generate Reports	
Actors	Director(Procurement), AD(Tech), AD(Procurement), TEC, PC, Secretary and clerk	
Description	Generate system reports	
Pre – conditions	User should log in to the system	
Typical course of events	**Actor action**	**System Response**
	1. Select report type	
	2. Click on required report button	3. Generate report
Alternative courses	3. If report has condition, get required by UI	
Conclusion	This use case emphasizes how to generate report.	
Post conditions	View Report	

Table B.11 - Generate Report Use Case

Appendix C. User Documentation

Documentation provide brief explanation how the system should have executed for the desired tasks.

Users who involve in procurement process activities directly or indirectly in organization are authorized to involve in system. But at first every user should be an employee of system and need to assign roles that have assign privileges. As example

Registered Employee Name: Kamal Pathrana
Username: Director proc
Roles assigned to user (Director proc) : Director, Assistant Director, Clerk
Privileges: Privileges assign to role director, Privileges to role assistant director, Privileges assign to role clerk.

Login page Functionality

Every valid user can log in to the system by entering their username and password correctly. If any user forget password can use forgot password link to have password hint.

Main Window

The logged user visible the main window (see Figure C.1) which facilitate navigation to any form, logged user details, sign out facility, changed password facility.
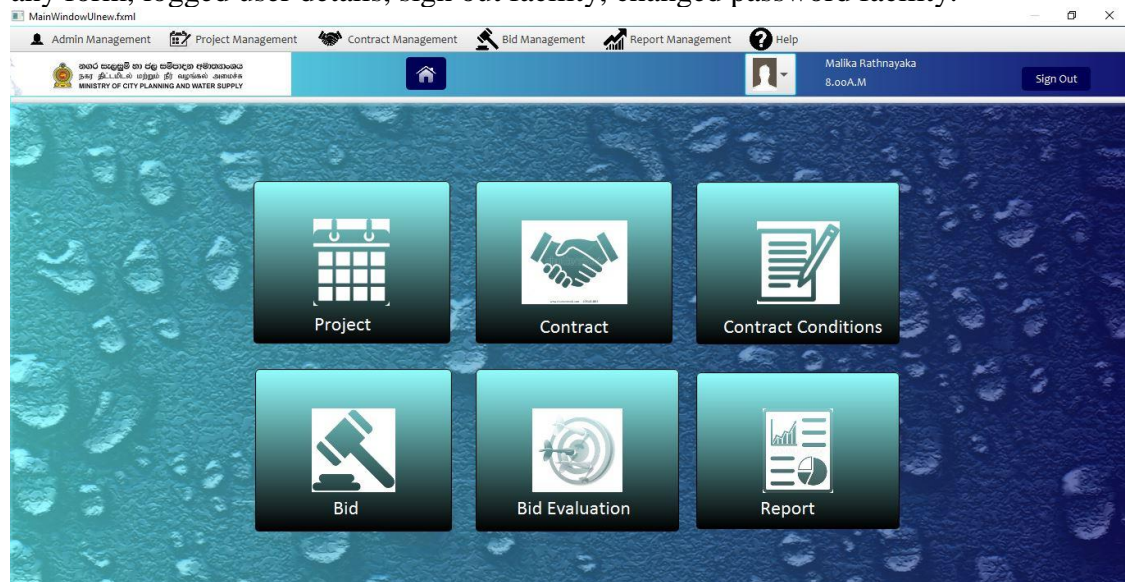
Figure C.1 - Main Window UI

Navigation between Pages

User can use any of three ways to navigate between pages. The three ways of navigation are

1. Menu bar

All the forms navigation is categorized into 5 main menu items according to functions of organization. The categorized menus are shown below by Figure C.2.

Figure C.2 - Menu bar

2. Recently used icons

These icons are arranged in main window. By clicking home button user can access the icon pane. User just need to have click on relevant icon to load the form.

3. Shortcuts

User can use the shortcuts using key board load relevant form.

Password Reset
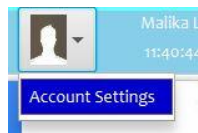
Path: Click on user picture →click load menu Account Settings
The logged user have ability to change its username or password using password reset form given below.
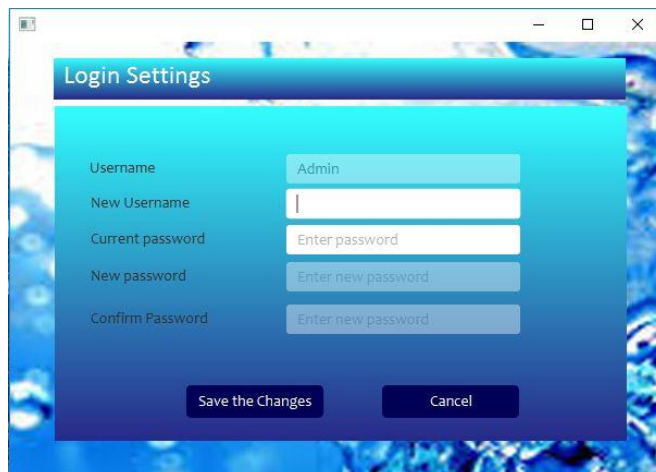
Figure C.3 – Logging Settings Form

The Figure C.3 shows login setting form. The logged username is indicated in the username field. if user need to change the current username enter new username in new username field and click save changes will ask confirmation and updated the info. The same way can change password too. And user restricted to have current password to have as new password.

Common Operations to All Forms

Form Operation   Table Operation
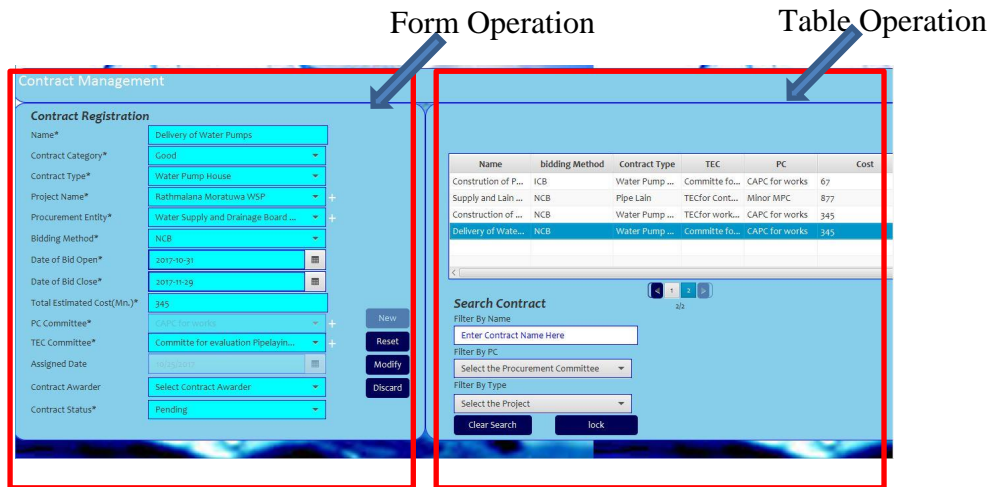
Figure C.4 - UI Explanation- Contract UI

Every UI is having two parts as form operation and table operation. The part called form operation is used to enter the data and the other to view or search data. Every UI left side was arranged for form operation while right for table operation whereas sample shown by Figure C.4.

Form can be varying with interface according to the business case. But need to remember that every form need to fill from top to bottom.

Form Operation

Figure C.5 given below describe the features of the form operations.

Data field Labels

All the data need not enter every time. As the form data fields can be four types describe below.

1. **Compulsory data fields**
   The data are labeled with a * which need to be filled manually.
2. **Optional data fields**
   The data fields enabled without *. Can neglect if not necessary.
3. **Auto Fill data fields**
   Fields which are disabled and empty at beginning. Fill data after an operation. (will arise errors if not filled)
4. **Auto filled data fields**
   Fields which are disabled and filled at beginning.
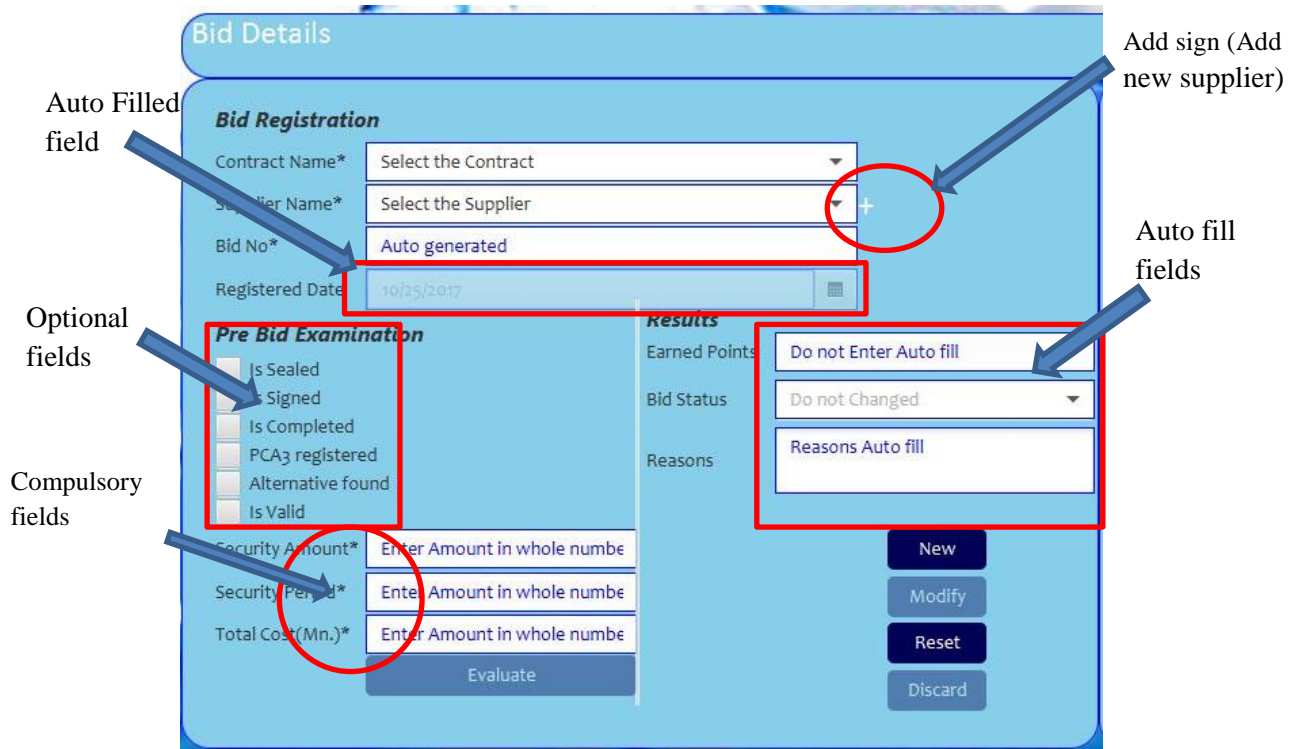
Figure C.5 - Form Operations - Bid UI

Add sign

The add sign display if user need add new entry for the list. User can click on the sign and add new information. After closing the sub form, the list updated with new entry.

Form Buttons
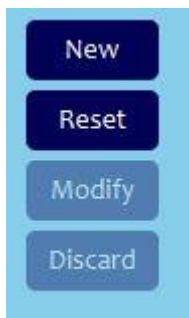
Figure C.6 - Button Layout

At the begin user can use buttons (see the Figure C.6)
- "New "Button - to add new entry to the table.
- "Reset" Button- to clear the form.

To perform modify and discard user need to select particular row in the table (discussed below)
- "Modify" Button - to update the form elements in table
- "Discard" Button- to delete an entry from table.
- "Evaluate" Button-to evaluate given info and display results (only in bid and bid evaluation forms). The button will be disable until enter required.

Inner form

Inner form is a form which is under the main form. Inner form elements are sub list of a main form element. So, to fill inner form user need to enter required in main form. The inner form also contains inner table which could discussed later.

The form (see Figure C.7) below consist fields as discussed above and consist two buttons normally. The two buttons are appended as new and reset. That describes the normal form operations (Ex – New Criteria – Add new entry of criteria).
When user fill required and click New appended button will add entry to the inner table.

Figure C.7 - Inner Form bounded in main form

Table Operations

Every form (except sub UI forms) consist a table. When do the form operations the table will be updated (except reset operation).

When click New button after adding required – if validly added ask confirmation need to enter the following data. When click ok the data will added to the table.
If not, error message will have displayed.

Row operation
Click or select row by arrow keys the row detail will appear in the form.

Page Operation
To move to the next page of table click on right arrow key. While to move the previous click left arrow key. To see specific page, click on page number.

Search Operation
Search field – entered value or selected item in search field will act as criteria. It can be used to filter the table rows for specific criteria.

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When enter a value or select a field in search will automatically update the table which satisfy the given criteria.

Search lock operation
If needed to filter the table by more than one criteria.
Click search lock → select or enter values on more than one field.
Then the table will filter in matching to all given criteria.

Clear Search Operation
When click the clear search button the values in search fields and filtered table will redesign to initial (clear).
Sample table operation indicate below as Figure C.8.
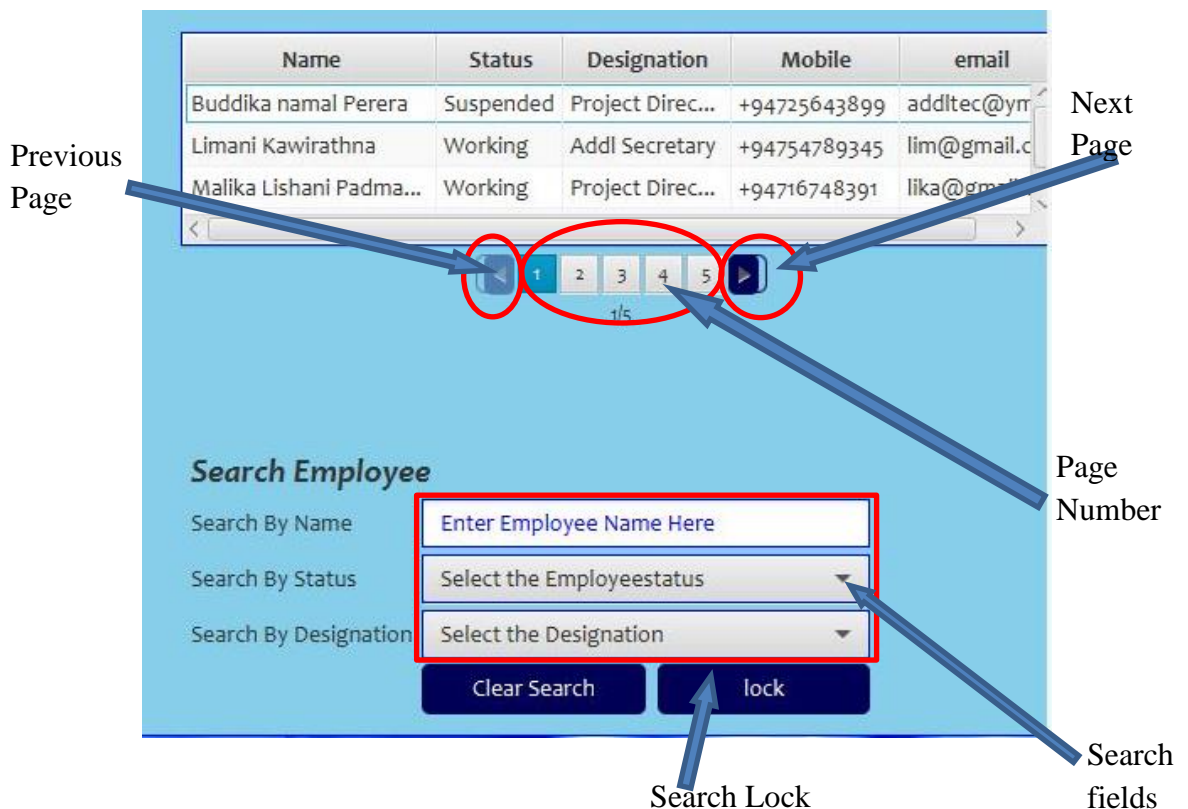
Figure C.8 - Table Operations

Inner Table

Inner table shown in Figure C.9 is a table inside the main form. The specialty in this table is required to fill inner table rather than fields to add an entry to main table. That means inner table act as an input field in main table.

Inner table delete operation
The inner form delete operation has being rendered in table. That means every row in inner table consist a delete button column. When click on specific delete button will delete entire row respectively.

Figure C.9 - Inner Table Operation

Note: The criteria which explained above are applied to all form with minor deviations.

Add Project Details

Path: Project icon, Project Management → Project, Alt + p

Figure C.10 - Project Management Module

This form displays in Figure C.10 facilitates to add, update, delete a project. And users are allowed to search the project details by category, name, status.

The important things need to be consider when adding project are describe below.
1. User has not allowed to enter district until select region.
2. Beneficiary, Cost estimated, Cost actual should be whole numbers.

Important when modifying project are describe as follows.
1. When changing project status to "in progress" compulsory to add Actual start date. (indicated by actual duration - from date)
2. When changing project status to "Completed" compulsory to add Actual duration and actual cost.

Follow the below process to add new project.

Enter project Name →Select project category→Select Project Type→Select Project director→Region→District→beneficiary→Scheduled start and end→Scheduled cost→Select find agent→Click new button

Add Contract Details

Path: Contract icon, Contract Management → Contract Registration → , Alt + c

Figure C.11 - Contract Management form

This form figured Figure C.11 facilitates to add, update, delete contract details. And users are allowed to search the contract details by Contract name, Procurement Committee and Project

Specially need to fill the form top to bottom as most top inputs are used by bottom inputs. User need to add dependent fields first to remove restrictions. So consider following restrictions.

Restrictions
1. Cannot select the contract type until select contract category
2. Cannot enter total cost estimate until select project
3. Cannot select Procurement Committee (PC committee) until enter total estimated cost
4. Cannot select Total Estimated Cost until select PC committee.

By selecting compulsory fields and clicking new can add the entry to the table.

Add signs
+ sign right to Project field – Add new project
+ sign right to PE field – Add new PE
+ sign right to PC field – Add new PC
+ sign right to TEC field – Add new TEC

Add Contract Condition to Contract

Path: Contract Condition icon, Contract Management → Contract Registration→ Contract Condition, Ctrl+ C

Figure C.12 - Contract Condition Form

This form indicated in Figure C.12 facilitates to add, update, delete contract condition details. The form indicates added records in contract table and contract criteria in inner table. And users are allowed to search the contract condition details by contract name, total points, no of criteria.

To add contract condition to a contract, contract should have registered first.
User need to add dependent fields first to remove restrictions.

Restrictions
1. Cannot add contract criteria until select contract.
2. Cannot select evaluation criteria until select criteria category.

To add contract condition, follow the path below.
Select Contract → Then contract category, type, will updated in fields and criteria category field will enable→Select Criteria category→
Will enable evaluation criteria →Select evaluation criteria, unit, criteria value, points and operator → Click new criteria

(Follow above underlined three steps repeatedly as required) →Then fill value to total points, total criteria and contract criteria table will updated.→ Click new.

Add Bid details and Evaluate details

Path: Bid icon, Bid Management → Bid, Alt + B
This form figured in Figure C.13 facilitates to add, update, delete bid details such as bid observation details etc. The form indicates added records in bid table. And users are allowed to search the bid details by supplier, Contract name, and bid status.

Figure C.13 - Bid Registration Form

User need to add dependent fields first to remove restrictions.

Restrictions
1. Cannot select supplier until select contract
2. Cannot enter bid observation details until select contract.
3. Cannot evaluate bid details until enter values to security and total cost details.

To add bid, follow the path below.

Select Contract →Select Supplier (If not register by + sign)→Then bid no will generate automatically →Enter bid observation details and security and total cost→Click evaluate →Then filled values to total points, status and reason→ Click new button

Evaluate Bids in Advance

Path: Bid Evaluation icon, Bid Management → Bid, Ctrl + B

Figure C.14 - Bid Evaluation Form

This form (see Figure C.14) facilitates to add, update, delete bid evaluation details such as bid observation details etc. The form indicates added records in bid evaluation table. And users are allowed to search the bid evaluation details by supplier, Contract name, and Result.

User need to add dependent fields first to remove restrictions given below.

Restrictions
1. Cannot select bid no until select contract
2. Cannot select Evaluation criteria until select bid no.
3. Cannot evaluate bid details until enter values to supplied value.

To add bid, follow the path below.

Select Contract →Select bid no→Then supplier will have updated automatically and evaluation criteria enable. →
Select Evaluation criteria→ Enter Supplied value→Click evaluate → Click new Bid criteria button
(Follow above underlined four steps repeatedly until empty the evaluation criteria field)
Then will fill values to total points, result → click new

Report Generation
Path :Report Management → Report, Alt + R
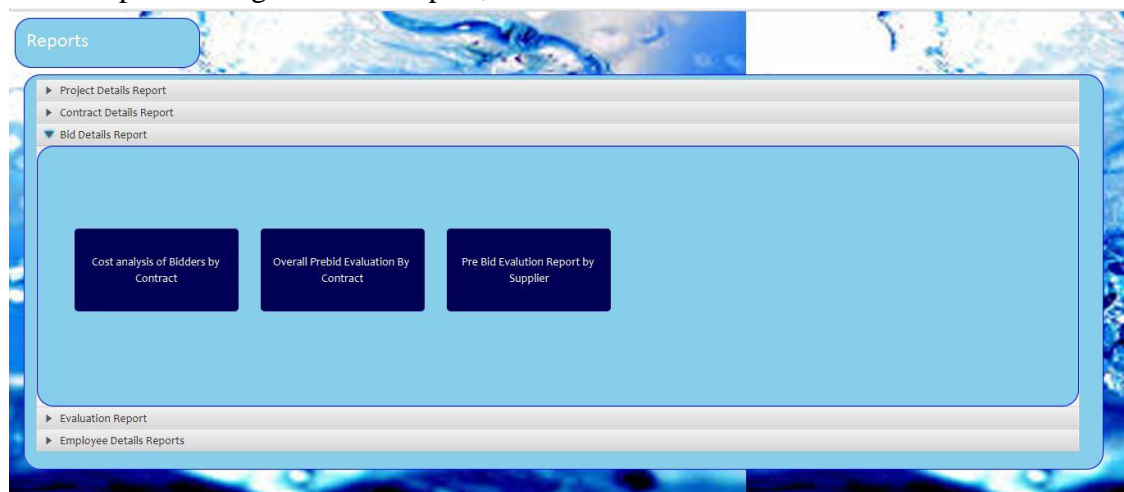
Figure C.15 - Report Generation Module

This form (see Figure C.15) facilitates to view reports by choosing relevant report category. Some may require user inputs to display report. The reports such as progress, cost analysis and summary reports are generated by the module.

Appendix D. Management Reports

Progress Report

Progress of the contracts and the projects can be identified using the given reports. It makes decision of overall projects or contracts. The below Figure D.1 show a report of progress of all projects up to date.

Figure D.1 - Progress Report of Projects

Cost analysis Report

The report shown in Figure D.2 describe the cost analysis of all projects. In detail it describe the what contracts project hold and project cost in main. The report calculate the total expenditure for contracts in project and the remain cost in project.

So the report make decision support to what contract need to be done and which amount need to allocate.

Figure D.2 - Cost Analysis Report

Summary Report

Figure D.3 - Summary Report

The report Figured in Figure D.3 describes the summary detail of procurement of the contract indicating how much bid docs issued, how much bids received, who are responsive and who are passed in advance evaluation.

The chart shows the detail in graphically to grabbing user attention.

Evaluation Report

Figure D.4 - Passed Bidders Comparison

The evaluation report shown in Figure D.4 describes the bid evaluation which is the main subject of the system. The evaluation reports have many types such as pass bidders comparison.
Overall evaluation, pre-bid evaluation minutes etc. The reports in this type provide user support to make decisions.

Overall Bid evaluation report

The overall evaluation means the report shown in Figure D.6 describes the all suppliers of contract with ranking according to points gain.

Figure D.5 - Overall Bid Report

Pre-Bid Result Report

Figure D.6 - Pre-Bid Result Report

The report shown in Figure D.6 generates depend on contract all the bids whether substantially responsive or not. If rejected reason stated. And also stated related information of procurement.

Appendix E.   Test Results

The test cases which described in evaluation chapter are evaluated and results obtained are indicated below.

Test case results for login module

Test case results for login module is displayed by Table E.1.
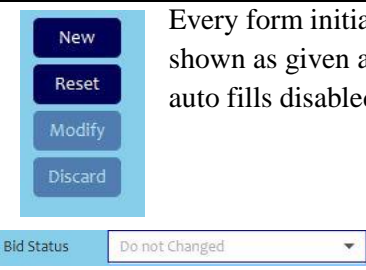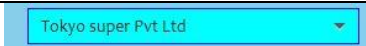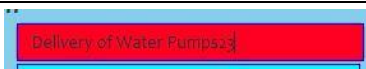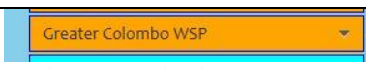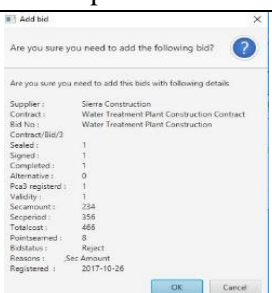
Test No	Steps to Test	Expected Outcome	Actual Outcome	Status
1.	Enter correct username Enter correct password Click login	Successfully Login into the system loading Main Window	Successfully Logged into the system and main window was loaded.	✓
2.	Enter correct username Enter incorrect password Click login	Display error message "Invalid username or Password and you have n no of attempts" and form cleared		✓
3.	Enter incorrect username Enter correct password Click login	Display error message "Invalid username or Password and you have n no of attempts" and form cleared		✓
4.	Enter incorrect username and password Click login	Display error message "Invalid username or Password and you have n no of attempts"		✓
5.	Enter incorrect username and password and click login 3 consecutive times	Display error message Blocking login "wait for 15 seconds with timer to retry the window"		✓
6.	Not enter any details Click login	Do nothing. Login Button disabled	Cannot click login as disabled	✓

7.	Enter username and click login	Do nothing. Login Button disabled	Cannot click login as disabled	✓
8.	Enter password and click login	Do nothing. Login Button disabled	Cannot click login as disabled	✓
9.	Enter username and Password	Enable login button	Login button enabled	✓
10.	Click close button	Close the login form	Login form disappeared	✓

Table E.1 - Test Result for Login Module

Test Case Results for Common in every Module

Test case results for common functions in every module are displayed by Table E.2

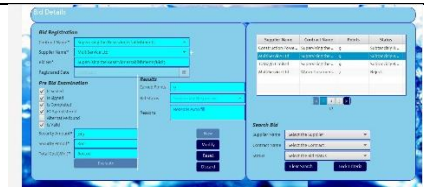| No	Test Case	Expected Outcome	Actual Output		Status
1.	When form loading	indicate auto fill fields and update, discard button disabled	Every form initially shown as given and auto fills disabled.		✓
2.	When enter valid value for field	Indicate color change to blue	Tokyo super Pvt Ltd Valid entry indicated as above		✓
3.	When enter invalid value for field	Indicate color change to red.	Delivery of Water Pumps23 Invalid entry indicate as above.		✓
4.	When update a field value	Indicate color change to orange.	Greater Colombo WSP Valid update indicated as above		✓
5.	When add all compulsory attributes and new is clicked	Alert confirmation is displayed if click YES object is added to database while NO object is not added.	 Confirmation displayed in adding		✓
6.	When form values are invalid/ empty and clicked new	Alert error message with indicating required fields	Error message displayed in every invalid/empty field		✓

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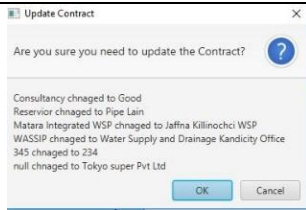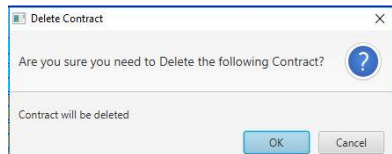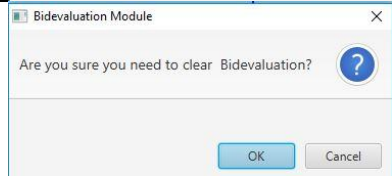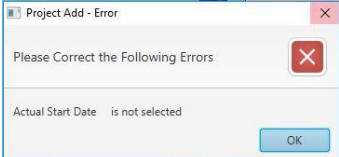
7.	When select row of table	Fill the row object values to the form. And modify, discard button enables while new disable.			✓
8.	When update fields validly	Alert confirmation do u need to modify with details showing	Confirmation in every update	Asked	✓
9.	When click discard button	Alert confirmation do u need to delete and inactive the info of the object	In Every form when click discard		✓
10.	When click reset button	The form was reset to initial			✓
11.	When search by giving criteria	Load table with relevant rows satisfying criteria	Table filtered by given criteria		✓
12.	When search two criteria select and lock button click	Load table with satisfying both criteria	Table filtered by all given criteria		✓
13.	When click clear search	Load table with search fields as initial	Table set to initial		✓

Table E.2 - Test Results Common for All Modules

Test Case Results for Project Module

Test case results for project module are displayed by Table E.3

No	Test Case	Expected Outcome	Actual Outcome	status
1.	When select region	Load items to district combo	items to district combo was loaded	✓
2.	When enter scheduled start date as finished date	Indicate color change to red	Color was changed	✓
3.	When update status to progressing,	Alert error need to add actual start		✓

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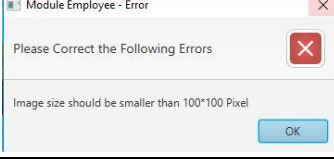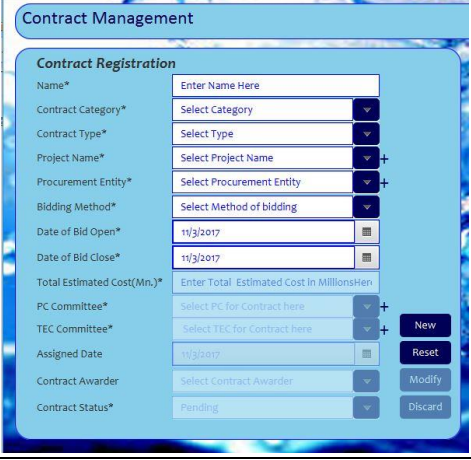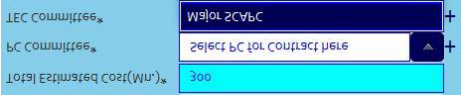
	and click modify				✓
4.	When update status to completed and click modify	Alert error need to add actual duration and cost			✓
5.	When select map too large than required	Alert error message			✓
6.	When select map not .jpg, .png, .gif format	Alert error message	No file displayed rather than image file		✓

Table E.3 - Test Case for Project Module

Test Case Results for Contract Module

Test case results for contract module is displayed by Table E.4

No	Test Case	Expected Outcome	Actual Outcome	status
1.	When form loaded	Cannot input total estimate cost, PC, TEC, Contract awarder		✓
2.	When select contract category	Load contract types relevant to category and enable contract type	contract types loaded	✓
3.	Enter total estimated cost after select project	Load PC items that are relevant to goslimit/foriegnli mit and enable pc	PC items loaded	✓
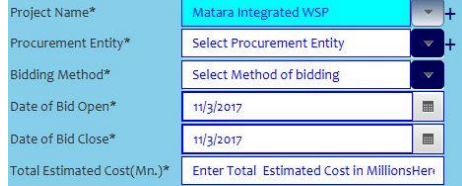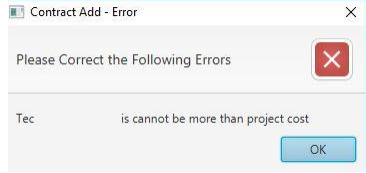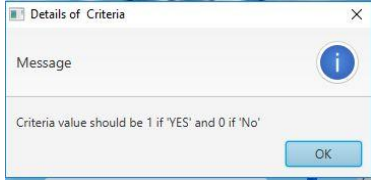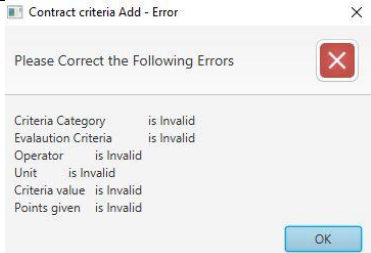
4.	When select project	Enable Total estimated cost		
5.	When select Procurement Committee	Load TEC of relevant PC	Load TEC items loaded	✓
6.	When enter value greater than estimated cost	Alert error message		✓
7.	When select bid open date	Select bid close date	Bid close date was selected	✓

Table E.4 - Test Case Results for Contract

Test Case Results for Contract Condition

Test case results for contract condition module are displayed by Table E.5

No	Test Case	Expected Outcome	Actual Outcome	status
1.	When select contract	Select the contract type		✓
		Select contract category		✓
		Load items to criteria category		✓
2.	When select Criteria category	Evaluation criteria items are loaded	Evaluation criteria items was loaded	✓
3.	When select unit as Boolean	Alert " Add 1 for YES or 0 for NO "		✓
4.	Click new criteria with no values	Alert error message "The below fields are Invalid "		✓
5.	When click add criteria after filling fields	Add criteria to contract criteria table	Criteria was added to the table contract criteria.	✓

No.		Expected Outcome	Actual Outcome	
6.	When click delete button in contract criteria row	The row is deleted	The row indicating was deleted from table	✓

Table E.5 - Test Case Result for Contract Condition

Test Case Results for Bid Registration Module

Test case results for bid registration module are displayed by Table E.6
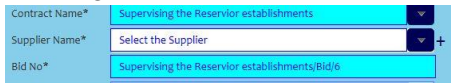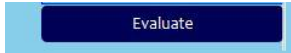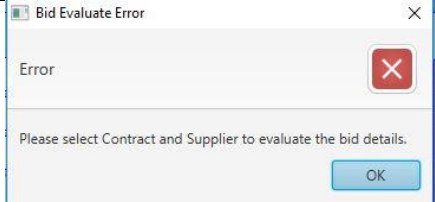
No	Test Case	Expected Outcome	Actual Outcome	status
1.	When select contract	Load items to supplier combo unassigned to contract.	Suppliers are loaded to combo.	✓
		Generate bid no automatically	Bid no generated Contract Name* Supervising the Reservior establishments Supplier Name* Select the Supplier + Bid No* Supervising the Reservior establishments/Bid/6	✓
2.	When loading form	evaluate button disable	Evaluate button was disabled Evaluate	✓
3.	When enter all 3 values sec amount, sec period, total cost	Evaluate button enable	Evaluate button was enabled Evaluate	✓
4.	When click evaluate button	Set total points automatically	Total points were set Bid status has changed	✓
		Select Bid status automatically	Reasons loaded if rejected	✓
		If status reject set reason automatically	Earned Points 6 Bid Status Reject Reasons ,PCA3 Registered,alternative allowe	✓
5.	When click evaluate without select contract and supplier	Alert error message cannot evaluate until select supplier and contract	Bid Evaluate Error ✕ Error ✕ Please select Contract and Supplier to evaluate the bid details. OK	✓

Table E.6 - Test Case Result for Bid Registration

Test Case Results for Bid Evaluation Module

Test case results for bid evaluation module is displayed by Table E.7
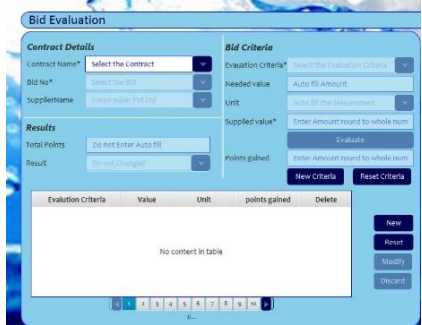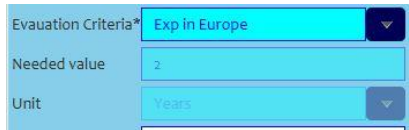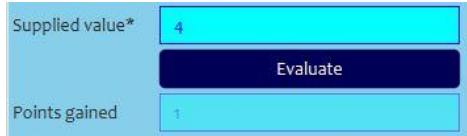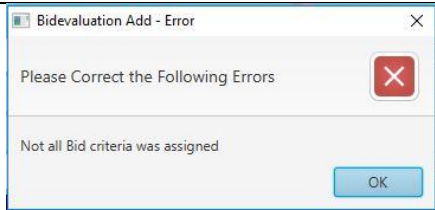
No	Test Case	Expected Outcome	Actual Outcome	status
1.	When form loading	Contract combo, New criteria, reset criteria are enable while all other disable.		✓
2.	When select contract	Items will set to bid No which substantially responsive bids and enable bid no combo	Items were set to bid no which bidders substantially responsive	✓
3.	When select bid item	Select supplier	Supplier was selected	✓
		Set items on evaluation criteria combo box which are contract criteria	Items of evaluation criteria were set	
4.	When select evaluation criteria	Select unit automatically	Unit selected automatically	✓
		Set needed value automatically	Needed value was set	✓
5.	When set supplied value for bid criteria	Set points gained automatically	points were set relevant criteria	✓
6.	When click new bid criteria after done 3, 4	Set total points automatically	Total points were set	✓
		Select Bid status automatically	Bid status was changed	✓
7.	When click new without add all evaluation criteria	Alert error message		✓

Table E.7 - Test Case Result for Bid Evaluation

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User Acceptance Test Results

The system users can be arranged in organization hierarchy as given below in Figure E.1. The hierarchy describe the internal roles of users in the system.

```
                              ┌───────────┐
                              │ Secretary │
                              └───────────┘
        ┌──────────────────────────┐
        │ Addl Secretary(Technical)│
        └──────────────────────────┘
   ┌─────────────────────┐         ┌─────────────────────┐
   │ Director (Procurement)│        │ Director (Technical) │
   └─────────────────────┘         └─────────────────────┘
        ┌──────────────────┐            ┌──────────────────┐
        │ Asistant         │            │ Asistant         │
        │ Director(Procurement)│        │ Director(Technical)│
        └──────────────────┘            └──────────────────┘
        ┌──────────────────┐            ┌──────────────────┐
        │ clerk            │            │ clerk            │
        └──────────────────┘            └──────────────────┘
```
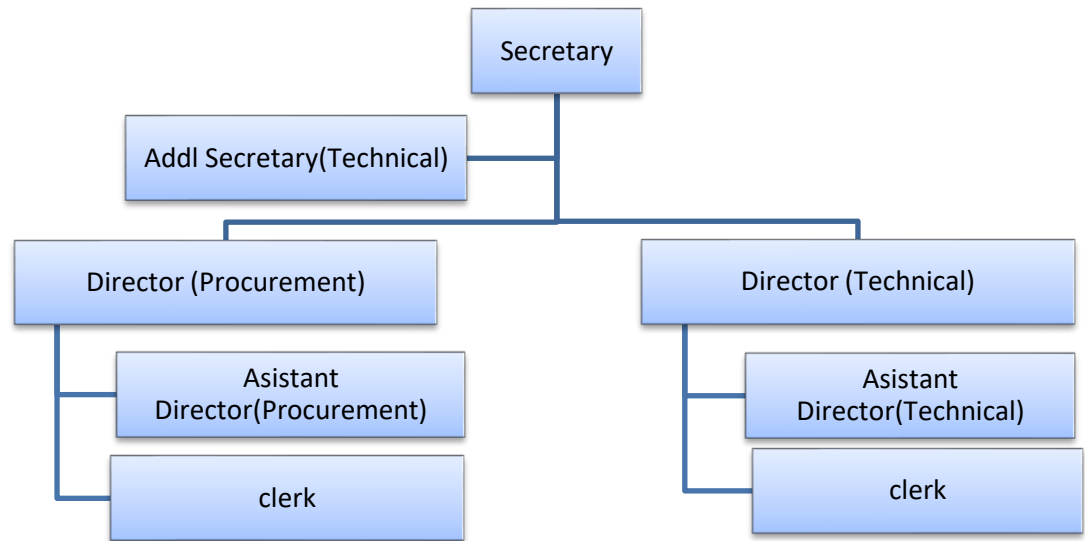
Figure E.1 - Organization Hierarchy

There are further system users who are not indicated such as committee member who contracted as employer.

The External entities who deals with the organization are can be another organization or an employee which are shown in Figure E.2 below.

Funding agent	Supplier	Procurement Entity	Contracted Employee

Figure E.2 - External Entities of Organization

The organization hierarchy employees and the contracted employee can be interacting with system via the privilege of roles they possess.

At the analysis stage identified that funding agent, supplier, Procurement Entity are particular organizations which provide services. So, it was impossible to interact the system with them. And also, system contain info cannot be flush over the external parties due to government regulations.

The overall system testing has been done using internal parties of organizations using a questionnaire feedback method. The system was explained over meeting in the organization and provided the questionnaire to catch up feedback. The analyzed feedbacks and obtained an overall picture as given below as Figure E.3.
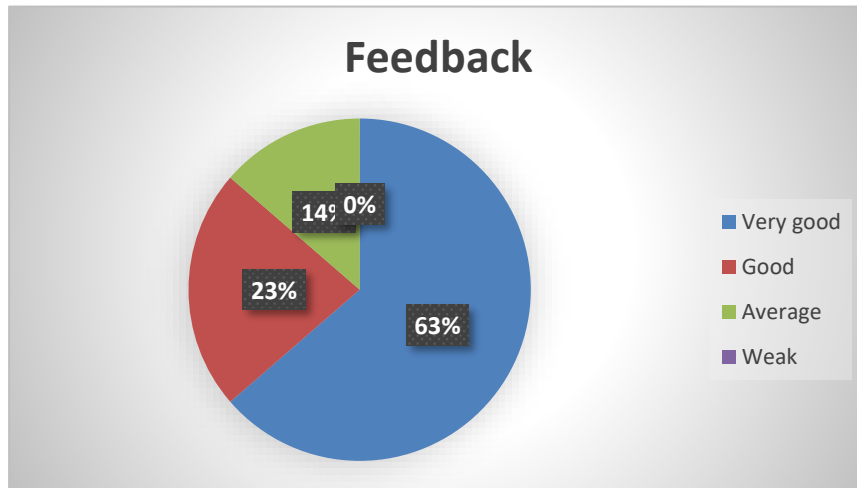
Figure E.5 - User Feedback Evaluation Chart

The users are faced some difficulties in answering the questions due to the unfamiliarity of technical terms used in the form. But by explaining through the system the user has easily get rid of the difficulty.

Due to busy sessions in the work all employers are not able to participate for the event. So, needed to be do the feedback evaluation again in another day.
And users have feedback that system is very useful and it can be further developed.
The below Figure E.4 shows the user feedback questionnaire sample.

User Feedback for Procurement Process Management System
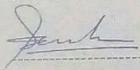
Name: A.R.D.B.J Wijayabandara

Designation: Financial Assistant , Procurement Division , MCPSWS

No	Question	Very Good	Good	Average	Weak
Common Areas					
1)	Overall understanding of the system	✓			
2)	Security provide to the system	✓			
3)	Privileges assign to users	✓			
4)	Data Entering Easiness	✓			
5)	User friendliness of the system	✓			
6)	Usability of the system to the business	✓			
7)	User Guidance (Ex. Error messages, Confirmations)	✓			
8)	System generate useful reports				
Form wise Feedback					
1)	Project registration form	✓			
2)	Funding agent registration form	✓			
3)	Contract registration form	✓			
4)	Contract condition assignment form	✓			
5)	Procurement entity registration form	✓			
6)	TEC appointing form	✓			
7)	PC appointing form	✓			
8)	Supplier registration form	✓			
9)	Bid registration and pre- evaluation form	✓			
10)	Bid evaluation form		✓		
11)	Report generating form	✓			
12)	User registration form	✓			
13)	Employee registration form	✓			
14)	Privilege assignment form	✓			
15)	**Overall Feedback**	✓			

Comments

System can be further developed by developing bid evaluation form

27. 10. 2017

Employee Signature   Date

Figure E.8 - Feedback Sample

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Appendix F. Code Listing

Load Form Method Declaration

The below describe the load form method which call under class initializing. The sample code explained the UnitUI Controller. In here all the input fields are initialized with relevantly.

```
private void loadForm() {
    unit = new Unit();    //Initialize globally declared object by creating new object instance
    oldUnit = null;        //Initialize globally declared object by passing null

    lstUnit.getItems().clear();  //clear list items
    lstUnit.setItems(UnitDao.getAll()); //set Unit objects to unit list view

    txtName.setText(""); //set empty string to text field

    dissableButtons(false, false, true, true);  //call disableButtons method
    setStyle(initial);  //call setStyle method

    }
        -----------------------------UnitUI controller loadForm method--------------------
```

 The method below describes to handle buttons such as add, reset should be enabled in form loading while update and delete disable. But they should be disable in fill form while update, delete enabled. To change these behavior at loading and fill form below method was used

```
private void dissableButtons(boolean select, boolean insert, boolean update, boolean delete)
{
    btnAdd.setDisable(insert );
    btnUpdate.setDisable(update );
    btnDelete.setDisable(delete );

    }
-----------------------------UnitUI controller dissableButton method--------------------
```

 To have validate inputs in event handlers, used color scheme. To apply those color scheme need to assign the style to the inputs.

```
private void setStyle(String style) {

    txtName.setStyle(style); //set style to input field

    }
-----------------------------UnitUI controller setStyle method--------------------
```

Binding Methods

To make color changes according object is set to the main object the binding methods are used.

```
@FXML
  private void txtNameKR(KeyEvent event) {
// check that name string object set to unit object
   if (unit.setName(txtName.getText().trim())) {
       if (oldUnit != null && !unit.getName().equals(oldUnit.getName())) {
          txtName.setStyle(updated); // if inserted value changed
       } else {
          txtName.setStyle(valid); // if insert new value valid
       }
     } else {
       txtName.setStyle(invalid); // if insert new or change value invalid
     }
   }
```
-----------------------UnitUI controller key relese in textfield name method-------------------

The get errors method return a string which loaded if not contain relevant info according to required.

```
 private String getErrors() {
     String errors = "";
        if (unit.getName() == null) {
           errors = errors + "Unit \t\tis Invalid\n";


        }
 return errors;
```
------------------------------UnitUI controller getErrors method declaration-------------------

The operation methods supplied here trigger when click new button in unit form. It check errors and if found alert errors if not add confirmation displayed. If click ok in confirmation add given object to unit table.

```
@FXML
  private void btnAddAP(ActionEvent event) {
     String errors = getErrors();

     if(errors.isEmpty()){

        String details = "\nName  \t:  \t" + unit.getName();

        Alert alert =new Alert(Alert.AlertType.CONFIRMATION);
        alert.setTitle("Add Unit");
        alert.setHeaderText("Are you sure you need to add the following Unit?");
        alert.setContentText(details);

        Optional<ButtonType> result = alert.showAndWait();
```

```
        if(result.get() == ButtonType.OK){
            UnitDao.add(unit);
            loadForm();
            lstUnit.setItems(UnitDao.getAll());
        }
        else{

            Alert alert =new Alert(Alert.AlertType.ERROR);
            alert.setTitle("Unit Add - Error");
            alert.setHeaderText("Please Correct the Following Errors");
            alert.setContentText(errors);
            alert.showAndWait();



        }
    }
```
-----------------------UnitUI controller new button action performed method--------------------

The fill form method facilitate to load the selected object items to the form.

```
private void fillForm() {
    if (lstUnit.getItems() != null) {
        dissableButtons(false, true, false, false);
        setStyle(valid);
// get oldUnit and Unit object by dao methods
        oldUnit = UnitDao.getById(lstUnit.getSelectionModel().getSelectedItem().getId());
        unit = UnitDao.getById(lstUnit.getSelectionModel().getSelectedItem().getId());

        txtName.setText(unit.getName());


    }
}
```
------------------------------UnitUI controller FillForm method--------------------

The get updates method do the collect string if found valid changes. This would be used in modify button to get confirmation about updates.

```
private String getUpdates() {

    String updates = ""; //initialize string update
//updates check if unit object has previously inserted
        if (oldUnit != null) {

            if (unit.getName() != null && !unit.getName().equals(oldUnit.getName())) {
                updates = updates + oldUnit.getName() + " changed to " + unit.getName() +
"\n";
            }


        }
    return updates;
}
```
------------------------------UnitUI controller getUpdates method--------------------

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The update table method use in search to update table to given criteria. This method call in every search filed to fill table according to given criteria.

```
private void updateTable() {

    String name = txtSearchName.getText().trim();

    boolean sname = !name.isEmpty();
    Contract biddoc = cmbSearchBiddoc.getSelectionModel().getSelectedItem();
    boolean sbiddoc =  cmbSearchBiddoc.getSelectionModel().getSelectedIndex() != -1;

    Country country = cmbSearchCountry.getSelectionModel().getSelectedItem();
    boolean scountry = cmbSearchCountry.getSelectionModel().getSelectedIndex() != -1;

    if (!sname && !sbiddoc && !scountry) {
        fillTable(SupplierDao.getAll());
    }
    if (sname && !sbiddoc && !scountry) {
        fillTable(SupplierDao.getAllByName(name));
    }
    if (!sname && !sbiddoc && scountry) {
        fillTable(SupplierDao.getAllByCountry(country));
    }
    if (!sname && sbiddoc && !scountry) {
        fillTable(SupplierDao.getAllByBiddoc(biddoc));
    }
    if (sname && sbiddoc && !scountry) {
        fillTable(SupplierDao.getAllByNameBiddoc(name, biddoc));
    }
    if (sname && !sbiddoc && scountry) {
        fillTable(SupplierDao.getAllByNameCountry(name, country));
    }
    if (!sname && sbiddoc && scountry) {
        fillTable(SupplierDao.getAllByBiddocCountry(biddoc, country));
    }
    if (sname && sbiddoc && scountry) {
        fillTable(SupplierDao.getAllByNameBiddocCountry(name, biddoc, country));
    }
}
```
------------------------------UnitUI controller Update Table method--------------------

Selecting PC committee by given tec (Total Estimated cost)

The given tec amount in contract will affect to choose a procurement committee. That is done by limits assigned in procurement committee as goslimit and forignlimit.
If the project of the contract is local funded, PC which has minimum goslimit > = tec is considered and if the project of the contract is foriegn funded, PC which has minimum foriegnlimit > = tec is considered.

```
@NamedQuery(name = "Pccommittee.findPcByMinGoslimit"

query = "SELECT        p
        FROM        Pccommittee  p
        WHERE        p.goslimit
                        =    (SELECT min(p.goslimit)
                             FROM Pccommittee p
                             WHERE p.goslimit >= :tec)")

@NamedQuery(name = "Pccommittee.findPcByMinForiegnlimit"
query = "SELECT        p
        FROM        Pccommittee p

        WHERE        p.foriegnlimit
                        =    (SELECT min(p.foriegnlimit)
                             FROM Pccommittee p
                             WHERE p.foriegnlimit >= :tec)")
```
------------------------------Entity Pccommittee namequeries--------------------

```
/**
  *
  * @param tec
  * @returns observable list of pccommitte as result set of given query
  */
  public static ObservableList<Pccommittee> getPcByminGoslimit(Integer tec) {
     HashMap hmap = new HashMap();
     hmap.put("tec", tec); // map tec given to tec parameter in name query

     return CommonDao.select("Pccommittee.findPcByMinGoslimit", hmap);
  }

  /**
  *
  * @param tec
  * @returns observable list of pccommitte as result set of given query
  */
  public static ObservableList<Pccommittee> getPcByminForiegnlimit(Integer tec) {
     HashMap hmap = new HashMap();
     hmap.put("tec", tec); // map tec given to tec parameter in name query

     return CommonDao.select("Pccommittee.findPcByMinForiegnlimit", hmap);
  }
```
-------------------- PccommitteeDao methods relevant to above name queries--------------------

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```
  txtTec.focusedProperty().addListener(new ChangeListener<Boolean>() {
        @Override
//check focus is changed
        public void changed(ObservableValue<? extends Boolean> observable, Boolean
oldValue, Boolean newValue) {
            if (!newValue) {
//if project agent type is local
                if ("Local".equals(agenttype)) {
cmbPc.setItems(PccommitteeDao.getPcByminGoslimit(Integer.parseInt(txtTec.getText())));
                } else {
```
```
cmbPc.setItems(PccommitteeDao.getPcByminForiegnlimit(Integer.parseInt(txtTec.getText(
)))));

                }
                cmbPc.setDisable(false);
            }
        }
     });
   }
```
-------------------- Focus Listener method to total cost text field in ContractUI controller------

Evaluate Bid Observation Details

The bid evaluation in the bid registration is take place. The Bid observation details and the important details are catch up according to the given bid. So after entering the details need to be review and need to set total points, Status of bid and reason if existed.

For the task two methods are written to calculate points for given criteria and calculate total points of all criteria.

Calculate get points of given evaluation criteria

In calculating points for given evaluation criteria done by taking given criteria value, contract and evaluation criteria object selected. Then by contract and evaluation criteria id contract criteria is set.

Then from set criteria operator and given points were taken. After that by switch case according to operator validity of given value in bid to the criteria value in contract criteria is checked. According to validity points earn is set.

If invalid reasons were set as by taking evaluation criteria name. The method was describe the page below as getPoints() method.

Calculate total points

By calling the getpoints() method to bid examination details including checklist total points are calculated. By a for loop the total points given to common criteria category of contract is calculated. Then by checking whether given points equal to obtain total results are set.

```
/**
 *
 * @param id evaluation criteria
 * @param contract
 * @param given  value for evalautionCriteria in bid
 * @return generate points and reason for criteria
 */
 public int getpoints(Integer id,Contract contract,Integer given){


 Integer pointsearn = 0;
 Contractcriteria criteria =  ContractcrieriaDao.getCriteriaByEvaluation(id,contract);
 if(criteria!= null){
    String reason = "";   // initialize variables
    String totalreason = ""; // initialize variables
    Integer required = criteria.getRequired(); // get value required for criteria
    Integer points = criteria.getPoints(); //get points given to criteria
    Integer operator = criteria.getOperatorId().getId(); // get operator of criteria
    boolean validity = false;
//swich the validity according to operator
    switch (operator) {
       case 1:
          validity = given.equals(required);

          break;
       case 2:
          validity = (given >= required);

          break;
       case 3:
          validity = (given <= required);


    }
   if(validity) //true if one of case get  true
   { pointsearn = points; //set points to pointsearn variable
   }
   else {pointsearn = 0;
   reason =  criteria.getEvaluationcriteriaId().getName(); // set reason as evaluation criteria
   if(txtReason.getText().trim().isEmpty()){ totalreason = reason;}
    totalreason = txtReason.getText() +","+ reason;
     txtReason.setText(totalreason);
   }
   }


   return pointsearn; //return earnpoints to given evaluation criteria and
    }
```

-----------------------------------getPointsMethod in BidUiController---------------------------

The update total method declaration shown below.

```
    public void updateTotal(){
     Integer totalPoints = 0; //initialize total points
     contract = cmbContract.getSelectionModel().getSelectedItem();

     if(bid.getContractId()!= null){
        //get checkbox is selected or not
      bid.setSealed(cbxSealed.isSelected() ? 1 : 0);
      bid.setAlternativefound(cbxAlternativefound.isSelected() ? 1 : 0);
      bid.setCompleted(cbxCompleted.isSelected() ? 1 : 0);
      bid.setSigned(cbxSigned.isSelected() ? 1 : 0);
      bid.setPca3registered(cbxPca3registered.isSelected() ? 1 : 0);
      bid.setValidity(cbxValidity.isSelected() ? 1 : 0);

      // calculate total points of bis by calling getPoints and appending
       totalPoints = getpoints(21, contract, bid.getSealed())
            + getpoints(22, contract, bid.getSigned())
            + getpoints(23, contract, bid.getCompleted())
            + getpoints(27, contract, bid.getPca3registered())
            + getpoints(29, contract, bid.getAlternativefound())
            + getpoints(26, contract, bid.getValidity())
            + getpoints(24, contract, bid.getSecamount())
            + getpoints(25, contract, bid.getSecperiod())
            + getpoints(28, contract, bid.getTotalcost());

      bid.setPointsearned(totalPoints); //set total point to bid object

     txtearnedpoints.setText(String.valueOf(bid.getPointsearned())); //set points to text field
     txtearnedpoints.setStyle(valid);
     if( txtearnedpoints.getText()!=  null){
     Integer giventotal = 0;

      //get list of contract criteria in common category of the contract
ObservableList<Contractcriteria> list = ContractcrieriaDao.getTotalCommonByContract(contract);
      for (Contractcriteria s : list) {
//calculate total points of contract criteria in common category
         giventotal = giventotal+s.getPoints();

     }
        // if bid total points equal to contract condition common category total
     if (totalPoints.equals(giventotal)){
     cmbBidStatus.getSelectionModel().select(0);
     }
     Else
     {cmbBidStatus.getSelectionModel().select(1);}

     }
   }
}
```
--------------------------------UpdateTotal Method in BidUiController----------------------------

Appendix G. Client Certificate

නගර සැලසුම් හා ජල සම්පාදන අමාත්‍යාංශය
நகர திட்டமிடல் மற்றும் நீர் வழங்கல் அமைச்சு **MINISTRY OF CITY PLANNING AND WATER SUPPLY**

මගේ අංකය எனது இல. My Ref. }	ඔබේ අංකය உமது இல. Your Ref. }	දිනය திகதி Date } 2017.11.02

Project Examination Board,
University of Colombo School of Computing,
No 17, Swarna Road,
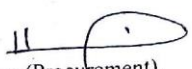Colombo 06.

Dear Sir/Madam,

LETTER OF CERTIFICATION

This is to certify that the Procurement Process Management System that developed by Miss. R.M.M.M. Rathnayaka (BIT Registration No: R141599) has submitted successfully to us after granting the permission on request for fulfillment of final project.

I'm pleased to inform that the proposed system for procurement process management has fulfilled all requirements that the organization required. Proposed system makes smooth operations of organization by enabling decision making process to achieve the organization goals.

It's glad to mention that proposed system can be implemented successfully for the process of procurement of our organization which acquires all needed requirements in best level.

Thank You,

Yours Faithfully,

Director (Procurement),
Ministry of City Planning and Water Supply

Eng. H C J Thilakarathne
Director (Procurement)
Ministry of City Planning & Water Supply,
No. 35, " Lakdiya Medura", New Parliament Road,
Pelawatta, Battaramulla.

නො. 35, "ලක්දිය මැදුර", නව පාර්ලිමේන්තු පාර, පැලවත්ත, බත්තරමුල්ල. இல. 35, "லக்திய மெதுர", பாராளுமன்ற வீதி, பெலவத்தை, பத்தரமுல்லை. No. 35, "lakdiya Madura", New Parliament Road, Pelawatta, Battaramulla.	දුරකථන தொலைபேசி Telephone } 011 2177240 011 2177241	ෆැක්ස් தொலைநகல் Fax } 011 2177240 Email. secretary@mcpws.gov.lk 011 2177213 Web. www. mcpws.gov.lk

"සීමිත ජල සම්පත අනාගත පරපුර වෙනුවෙන් සුරකිමු" Protect the Scarce Water Resource for Future Generation
"வரையறுக்கப்பட்ட நீர்வளத்தை வருங்கால சந்ததிக்காகப் பாதுகாப்போம் - அபெන் හරන රත් දියර ජාතියේ"
"සුපැන් ජනත පැන් තාලිය දේශයේ - අපැන් හරන රත් දියර ජාතියේ"

GLOSSARY

Bid – Formal offer of potential bidder indicating price and other terms at which bidder agrees to provide the goods or services or execute works.

Contract – The part of work or good or consultancy service outsource to get done the task in project.

Funding Agency – Agency enter into an agreement with government of Sri Lanka to provide funds for handle projects.

Goods – means commodities, raw materials, products, equipment and other physical objects of every description

Procurement – obtaining goods, services or works by most appropriate means, With public funds or any other source whether local or foreign

Procurement Entity – Government Ministry, Provincial council, Government department, government cooperation, Government owned company local authority such body who engage procurement.

Procurement Committee (PC) – The committee responsible for results of procurement

Technical Evaluation Committee – Committee who responsible to do the evaluation of bids

Services – Services other than Consultancy services

Works – all activities associate with construction, reconstruction, repair or renovation of a building.

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