



**TENDER NOTIFICATION
SYSTEM FOR
SRI LANKA ARMY**

**A dissertation submitted for the Degree of Master
of Information Technology**

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ABSTRACT

TENDER NOTIFICATION SYSTEM FOR SRI LANKA ARMY

The Army being the oldest and largest of the Sri Lankan Armed Forces comprises of approximately 10,000 Officers and 170,000 Other Ranks in active service. In order to cater the Army members, Organization needs to procure bulk of items. For these procurements, Army has to follow the tender procedure unlike other government organizations. Government procurement involves a lot of manual processes which are known to be time-consuming and may be error-prone. Present tender system of Sri Lanka Army is a manual and inefficient process.

This project focuses on developing and implementing a web-based procurement system. As one of innovative ways of enhancing procurement process, an attempt to develop and implement electronic tendering system is to be made. In designing the system, not only technological aspects, but also issues related to procurement process improvement are considered. The designing of a Web-based Tender Management System aims at improving the efficiency as well as transparency of the tendering process. As an analysis and design approach, prototype method was chosen and UML was used. PHP as a development language was preferred because the resulting system is expected to be portable. The system was implemented using MySQL and PHP technology and has been successfully implemented on-site. Since the system was designed to be portable, it can be easily implemented.

Keywords

Sri Lanka Army, Procurement, Tendering, electronic tendering, Web-based Tender Management

DECLARATION

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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LIST OF ABBREVIATIONS

| | | |
|---------|---|--|
| AHQ | - | Army Head Quarters |
| CMS | - | Content Managements Systems |
| DAMS | - | Directorate of Army Medical Services |
| DAQ | - | Directorate of Army Quartering |
| DBA | - | Database Administrator |
| DDS | - | Directorate of Army Dental Services |
| DEME | - | Directorate of Electrical & Mechanical Engineers |
| DES | - | Directorate of Engineer Services |
| DOS | - | Directorate of Ordnance Services |
| DSports | - | Directorate of Sports |
| DST | - | Directorate of Supply & Transport |
| IDP | - | Internally Displaced People |
| MGO | - | Master General Ordnance |
| QMG | - | Quarter Master General |
| RAD | - | Rapid Application Development |
| RICS | - | Royal Institution of Chartered Surveyors |
| RUP | - | Rational Unified Process |
| SLA | - | Sri Lanka Army |
| SLADN | - | Sri Lanka Army Data Network |
| SLATNS | - | Sri Lanka Army Tender Notification System |
| SQL | - | Structured Query Language |
| TEC | - | Technical Evaluation Committee |
| UML | - | Unified Modeling Language |

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This introductory chapter consists of seven sections and it highlights the problem domain, the problem, motivation, aims, objectives and scope. The Chapter starts off by presenting the problem domain which readers can get idea of organizational background. It then proceeds to explain the problem and motivation. Then it describes the aims and objectives of the project. The objectives are elaborate as the core objective and the secondary (other) objectives. Then the chapter briefs the scope of the project and how the proposed solution can handle them. Finally, this chapter overviews the structure of the thesis.

1.2 The Problem Domain

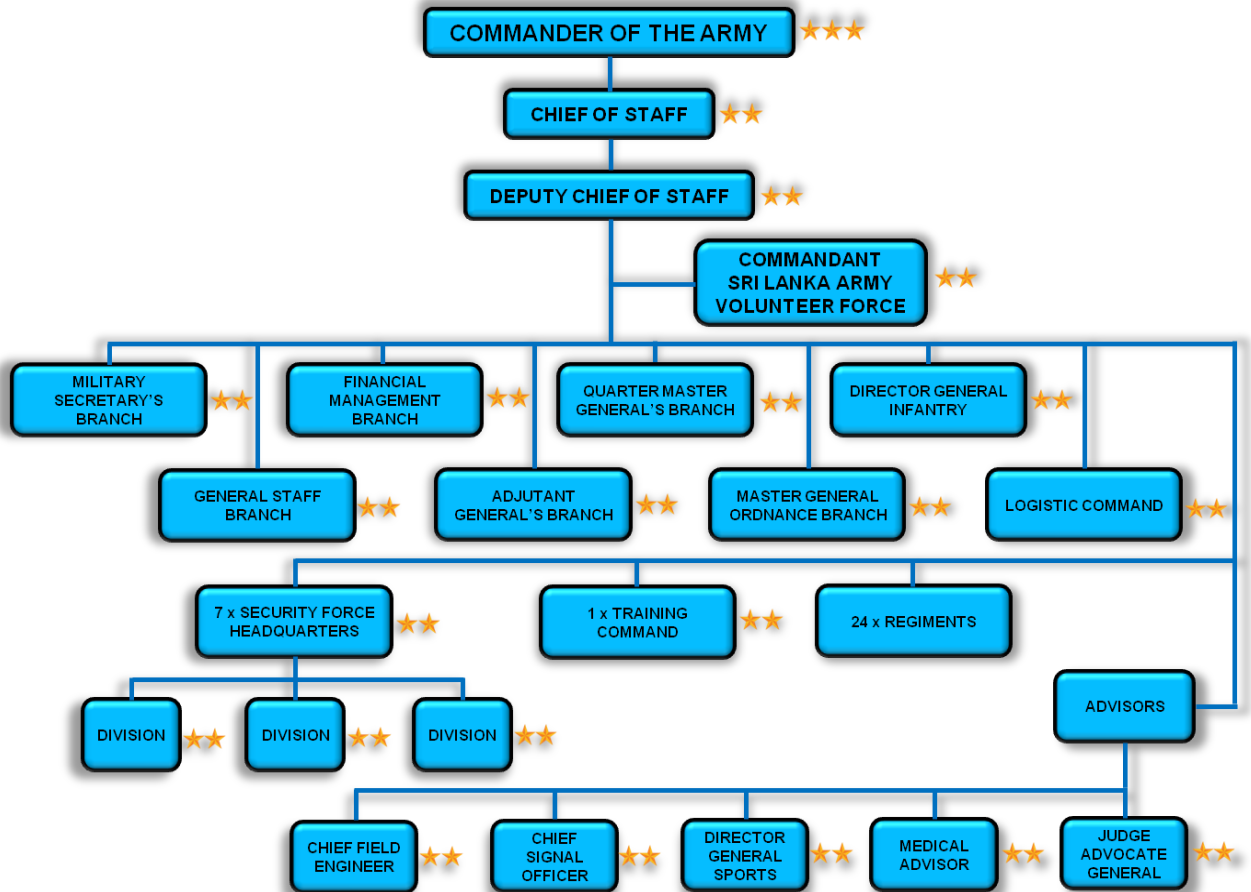
The Army being the oldest and largest of the Sri Lankan Armed Forces comprises of Regular Force, Regular Reserve, Volunteer Force and Volunteer Reserve[1]. It is responsible primarily for military and humanitarian operations in the country. An overview of the organizational structure of the Sri Lanka Army is shown below as Figure 1[2] to clearly understand how the Sri Lanka Army is in operation.

For ease of Administration, Army has divided into many branches and each branch is headed by a two star General (Major General).

Over the last few decades, Sri Lanka has committed its Army to fight against the internal conflicts including the one in which it made the greatest contribution to defeat the world's most ruthless terrorist organization. In addition, the Sri Lanka Army has also responded to disasters and emergency situations such as natural disasters (e.g. Tsunami, landslides, floods and forest fire) and resettlement of Internally Displaced People (IDP). There are two categories of members in the Army. They are Officers and Other Ranks. According

to the Directorate of Pay & Records of the Sri Lanka Army, by the end of 2018, approximately 10,000 Officers and 160,000 Other Ranks were on active service.

Figure 1: Organisational Structure of the Sri Lanka Army



Source: www.army.lk

In order to cater approximately 170,000 people, Army needs to procure barrack items, quatering items, consumables and other equipment such as Office equipment, computer software etc. Some categories of calling for tender as mentioned below.

Medical Category

The supply of drugs/Dressings, medical gases, orthopaedic/General surgical accessories, dental Accessories / drugs & dressings dental & Other medical items

Food Category

Dry ration items, fresh ration items and processed food items

Vehicle Category

Vehicles and used vehicles

General Category

General goods

Engineering Category

Engineering Items

Communication Category

Communication equipment and accessories

Electrical & Mechanical Category

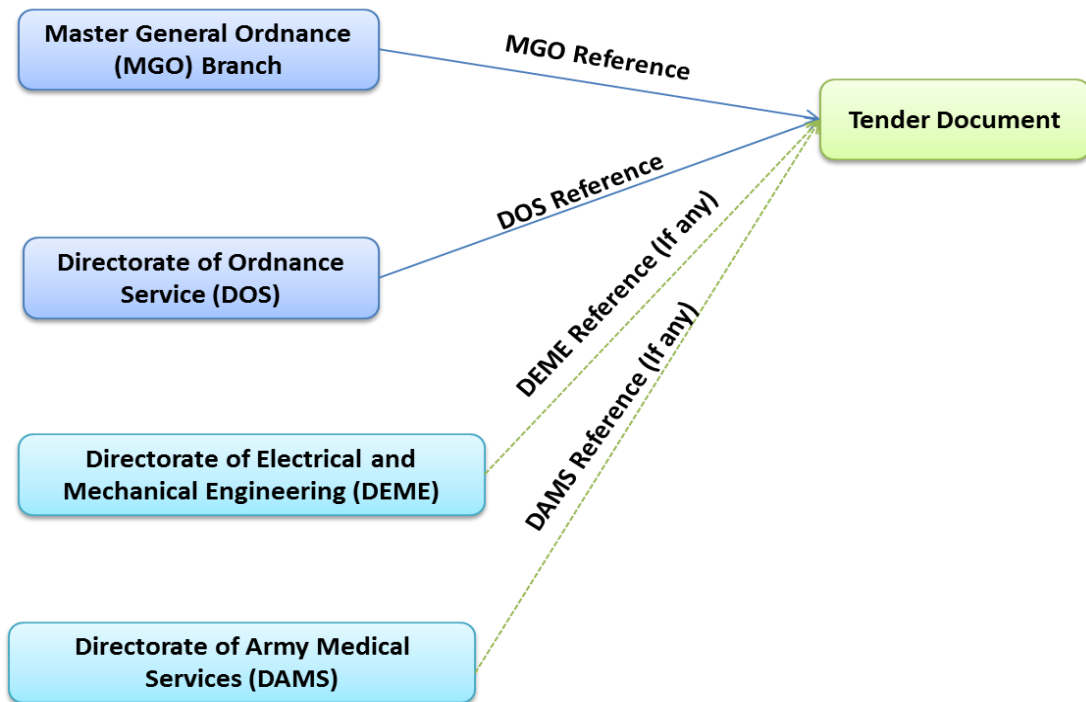
Electrical & Mechanical equipment and accessories

For these procurements, Army has to go through the tender procedure unlike other government organizations. Government Tender Procedure is very lengthy and complex process[3]. Government Procurement Procedure is established by the National Procurement Agency[4]. In the Army, basically two main branches are dealing with the tender system[5]. They are Master General Ordnance (MGO) Branch and Quarter Master General (QMG) Branch. In addition to that, following Branches and/or Directorates are dealing with tender procedure.

- Directorate of Army Quarters (DAQ)
- Directorate of Supply & Transport (DST)
- Directorate of Sports (D Sports)
- Directorate of Engineer Services (DES)
- Directorate of Ordnance Services (DOS)
- Directorate of Electrical & Mechanical Engineers (DEME)
- Directorate of Army Medical Services (DAMS)
- Directorate of Army Dental Services (DDS)

Structure of Basic Tender relationship of Branches and Directorates of Sri Lanka Army is shown below as Figure 2.

Figure 2: Basic Tender relationship of Branches and Directorates of Sri Lanka Army



Source: Developed by Author

According to Figure 2 Master General Ordnance (MGO) branch is the Main the Branch for tenders. All tender procurement for Army is handled by the Master General Ordnance (MGO) branch. When a tender is open, MGO branch gives a unique Reference Number for each and every tender. It will be the main field for this tender procedure and going throughout rest of the procedures to complete.

Generally, in the Army, there is a criteria to spend allocations and for tender purchasing. The tender value spend varies as per the appointment held by the officer. Table 1 shows the appointment wise tender approval categories.

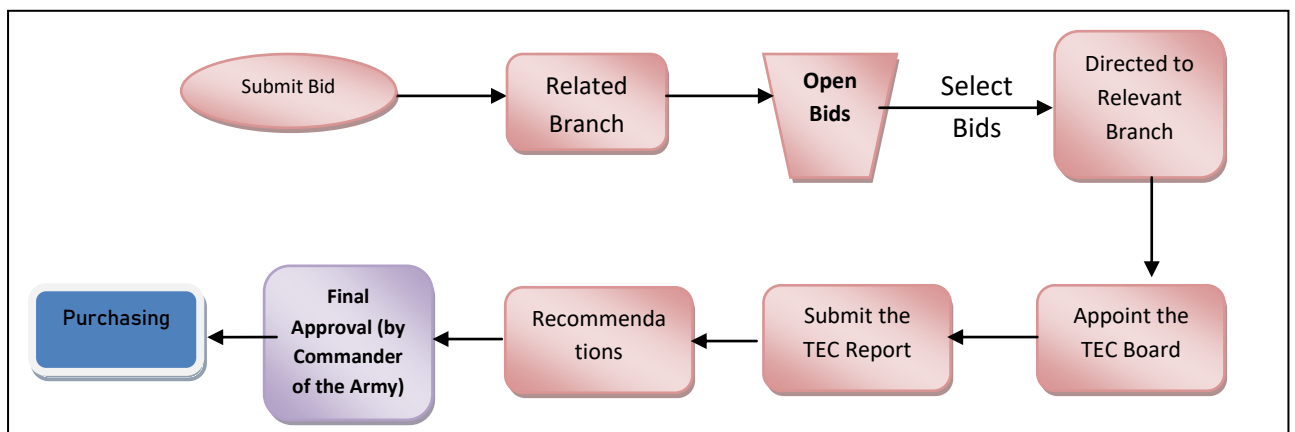
Table 1: Tender Approval Limits for Relevant Authority of Sri Lanka Army

| S/No | Appointment | Approval granted by | Maximum Amount can Approve (Rs.) |
|---|--|--|----------------------------------|
| 1. | Regimental Tender Board | Regimental Commandant Rank : (Major General) ★ ★ | 3 Million |
| 2. | Regional Tender Board (Security Force Headquarters) | Security Force Commander Rank : (Major General) ★ ★ | 5 Million |
| 3. | Army Headquarters Mini Tender Board | Director General Rank : (Major General) ★ ★ | 5 Million |
| 4. | Army Headquarters Main Tender Board | Commander of the Army | 100 million |
| <p>★★ After completing Regimental, Regional and Mini Tender boards, Board Proceeding to be sent to Army Headquarters for Army Commanders Final Approval. Only after final approval by the Commander of the Army can proceed with the procurement.</p> | | | |
| <p>Tender amount more than 100 Million, approval should be taken from Ministry of Defence Tender Board.</p> | | | |

Source: Developed by Author

First phase of the proposed system expects to plan to implement at Army Headquarters. It integrates Army Headquarters Mini Tender Board and Army Headquarters Main Tender Board. Then the system will be expanded to regional and regimental level by integrating regional and regimental headquarters with Army Headquarters in the second phase. After completion of second phase, new system will cover the entire country. Through the army network, relevant authorities can access the system effectively. Structure of existing Tender procedure of Army Headquarters is shown below as Figure 3.

Figure 3: Structure of existing Tender procedure of Sri Lanka Army



Source: Developed by Author

1.3 The Problem and Motivation

At present, the tendering processes monitoring and data entry are happen manually of Sri Lanka Army is functioning manually; data is entered using Microsoft Excel. The information such as tender number, procurement value, tender owner, and several important dates are inserted into the system using the ordinary table in Microsoft Excel. In this case, some of the data might be wrongly inserted as well as leading to data redundancy. In fact, stand-alone Microsoft Excel file might loss due to several factors such as file corrupted, storage data broken and failure in computer system. Present manual system deals with paper based records and records delay to distribute among related branches. It is unable to get approval, get signed on time and delays at main key positions of the organization. It affects to complete system. Hence, this system is time consuming and difficult to produce much more descriptive reports for decision making process. However, using the conventional approach, some human error might have occurred thus lead to inefficiency and delay in works which unfortunately will result in some losses faced by the organization.

To overcome those problems there is a requirement to have a web based information system which interconnects all branches and for ease of access by users. This project focuses on developing and implementing a web-based procurement system. As one of innovative ways of enhancing procurement process, an attempt to develop and implement electronic tendering system is to be made. In designing the system, not only technological aspects, but also issues related to procurement process improvement are considered. This in turn should motivate suppliers to participate and empower officials of the organization to cut down the cost and bring internal efficiency and economy by using automation of the complex manual activities. Tender tracking is another vital process in procurement. The system should introduce enhanced tracking system be used in the organization to covering end-to-end activities in the tendering process.

1.4 Aim

When performing tender and procurement activities the manual process is widely practiced in the Sri Lanka Army. This process occur practical circumstances which affects for the outcome of the process. It leads for complications and creates inconvenient working phenomenon. The aim of this project is to provide online intranet web base interface for the Sri Lanka Army personnel to perform tender and procurement activities and facilitate effective and efficient strategy for admin personnel to manage the tender procurement activities.

1.5 Objectives

1.5.1 Core Objective

Objective of this project is to develop a user friendly interactive web based application for existing manual Tender Notification of Sri Lanka Army. It enables users to view appropriate details of tenders and to send notifications to higher managements' decision making and take decisions based on the correspondence.

This in turn should motivate suppliers to participate and empower officials of the organization to cut down the cost and bring internal efficiency and economy by using automation of the complex manual activities. The system should introduce a paperless environment in the organization by covering end-to-end activities in the tendering process and yet provide enough control over planning and management of different tendering activities.

1.5.2 Sub Objectives

In addition to above core objective, the following sub objectives are set. They are:

1. To reduce time to complete the tasks. By interactive web based application user enable to complete the tasks efficiently.
2. To fulfill users' requirement and improve users satisfaction
3. To optimize the workflow automation

4. To minimize the paper wastages
5. To increase in efficiency and productivity
6. To compliance with the government regulations
7. Transparency and accountability in the process
8. To speed up the process
9. To improve the communication
10. Cost savings for supplier and sourcing agency

By implementing proposed system, the organization can achieve the above sub objectives as well.

1.6 Scope of the Project

In support of Directorate of Information Technology of Sri Lanka Army, Master General Ordnance (MGO) Branch wants to simplify, streamline and computerized the Tender Management System. To this end, plan to develop a comprehensive web based Tender Management System that will allow users to interact online via the Internet.

This web based system will have the following features – it will be accessible from any browser, capable of handling, monitoring, recording tenders and getting approvals of tenders by higher authority. This system will let users (soldiers, junior and senior officers of Sri Lanka Army) to freely interact with user friendly (in terms of ease of use) web based system, which is secure, improved performance, reliable and efficient. Users will be able to request and receive approval. The prototype to be developed is based on problem tracking technique. Proposed system is capable of managing, processing, approvals and viewing reports related to tender procurement for the relevant authorities. As further modification, hope to develop a module to send SMS notifications to mobile phones of higher authorities. The detailed description of the scope includes the system functionalities are shown below.

Registered Users' Panel

- Login to the System
- Manage Account
- Change Password
- Tender Details Management
- Reports Generation
- Log out

Admin Panel

- Login
- Dashboard Control
- Administrator User Management
- System Members Management
- Security Level Allocation
- Suppliers' Management
- Tender Category Management
- Attributes Management
- Logout

Super User Panel

- Login
- View and Manage all Tender details
- Facility to Searching of Tenders.
- Appointing TEC Boards
- Browse for Tender Status
- Approval Granted or Reject
- View or customise reports
- Logout

Major Functionalities of the System

- User can login by using their user id.
- User can view reports.

- User can check the status of the tenders.
- User can search the tender details online.

Other Functionalities of the System

- Provide a centralized web application for entering data to the System.
- Submit bids through system
- Appointing TEC Boards
- Generate Agreements
- Integration of many related branches to the system.
- Registration of Suppliers
- Maintain the Suppliers details.
- Maintain the item details.
- Generate reports according to management's requirements.
- Facility to Searching of Tenders.
- Personalised push notifications for higher authorities in addition to SMS text messaging

Deliverables:

Deliverables are the documents used by the project team to ensure the achievement of the objectives and functional requirements. As such, they are not the end results of the project itself. It is agreed that all deliverables will be presented to and accepted by users.

- The Project plan
- System education schedule
- Reference/User Manual
- System knowledge manuals

1.7 Structure of the Thesis

The thesis consists of the following chapters:

Chapter one is the introduction chapter and contains the overview, problem and motivation, aim, the objectives and the scope of Tender Notification system. Chapter two describes the background, analysis, review of similar system and alternative design strategies. of the system. Further it describes the functional and nonfunctional requirements of the Tender Notification system. Current system analysis considers the critical point of current knowledge including substantive finding as well as theoretical and methodological contributions to a SLATNS. Then Chapter three describes the methodology and methods followed to develop proposed system and consisting techniques that have used to design the system such as use case, use case narratives, sequence diagrams and activity diagrams to illustrate new system. Consequently, design of data base and the user interfaces are also indicating here. Chapter four has testing and evaluation overview. This chapter gives an overview about the implementation testing, testing tools and the evaluation of Tender Notification System. The test plan, test schedule, test strategy and test cases are presented in this chapter. Furthermore, it indicates the evaluation of the system. Final chapter gives an overview about the implementation tools and the technical details of Tender Notification System. The chapter is presented under three headings; Conclusions, Recommendations and finally the Future Works.

CHAPTER TWO

BACKGROUND

2.1 Introduction

This chapter has two parts and they are categorized as Analysis and the review of similar systems. Section 2.2 describes the analysis of the system while section 2.3 points out about the review of similar systems.

2.2 Analysis of the System

At present there is no online Tender Notification System of Sri Lanka Army. Existing Tender Notification System of Sri Lanka Army is done manually. Using this existing manual system, it is very difficult to find the details of a particular tender and it is a time consuming process. Proposed Web based Tender Notification System is the best solution to avoid these problems. In order to design a new system, Analysis is very important process.

2.2.1 Requirements Gathering

Systems are designed to automate the processes, to optimize the resources, to increase efficiency, to improve performances and to enforce security in order to user's satisfactions. Basically systems are designed to fulfill user's requirements. To design a best system for give the best customer satisfaction, the complete analysis of existing system and comprehensive requirement gathering is essential factor. To get the comprehensive requirement gathering, several Fact Finding techniques have been used. Those are;

2.2.1.1 Fact Finding Methods Used

- a. Questionnaires:** For the quantitative data analysis, semi-structured questionnaire method was widely used. By using well-designed semi-structured questionnaire

can collect data from stake holders/users. By analyzing questionnaire results can identify the functional and nonfunctional requirements of the system.

- b. Interviews:** Individual depth interviews are used to collect data for qualitative data analysis. Basically face to face interview and focused group interview methods are used to collect data from stake holders. The stake holders include internal users', higher authorities and technical staff such as DBAs, Network Administrators etc. By interviewing the middle-level staff and top-level management designer has been able to get a good idea of the system from the view of management and as well as analyst has been able to find the special features that have been added to the system in the future.
- c. Gather data from existing documents:** Since existing system is manual and much paper type records are involved, designer can gather data from existing documents. Those documents are help to get deep understanding of existing system. By reviewing the existing documents, the structure and format of the reports generated by the proposed system can be design.
- d. Observation:** Analyst observes the tender procedure by visiting relevant branches. Then data is gathering by studying (observation) the exiting manual system, and unpublished records and anecdotal evidence gathered from Sri Lanka Army have been taken into account. In some occasions, analyst also has been able to be a part of a team and perform the work. This helped the analyst to identify the normal practices of the staff.

By anlysing data which collected using above Fact Finding techniques, Analyst can be identified Functional requirements and Non-functional requirements.

2.2.1.2 Functional Requirements

The application's main focus was to automate most of the tasks. Some of the key activities and functional requirements that involved in the entire tendering are as follows:

Pre-Tendering

- Login to the System
- Log out
- Manage Account
- Change Password
- Dashboard Control
- Administrator User Management
- System Members Management
- Security Level Allocation
- Suppliers' Management
- Tender Category Management
- Attributes Management
- Registration of Suppliers
- Maintain the Suppliers details.
- Maintain the item details.

Tender publication and communication

- Personalized push notifications for higher authorities in addition to SMS text messaging
- Facility to Searching of Tenders.
- User can check the status of the tenders.
- User can search the tender details online.
- Provide a centralized web application for entering data to the System.
- Integration of many related branches to the system.

Tender processing

- Tender Details Management
- Submit bids through system
- Generate Agreements
- Appointing TEC Boards
- Browse for Tender Status
- Approval Granted or Reject

Virtual tender opening

- Generate reports according to management's requirements.
- User can view reports.
- View and Manage all Tender details
- View or customise reports

2.2.1.3 Non-functional Requirements

- a. Performance:** The website should perform well because the Army personnel being facilitated to view all tenders without any interruptions and anyone should be able to check the status of tenders without much delay. This will totally depend on the bandwidth of their internet connection.
- b. Appearance:** The proposed system will be a new system for most of the users and some users have not work with web based systems earlier. Therefore, appearance of proposed system should be beautiful and the users/visitors should not feel bored while working with the system.
- c. Availability/Reliability/Security:** The System should be operated on 24 hours a day. It should available to everyone in intranet. Reliability and Security of the system and intranet should be very high because it handles calculate the returns of the respective Army personnel. There should not be any crashes in the system and should available for anyone when in need.
- d. User-friendly:** Because most of the staff is new to an IT system, anyone should be able to easily understand the system and work with it without any problem.
- e. Effective/Efficient:** Data gathered from the system should not be wasted and the reports generated from the system should be accurate.

2.3 Review of Similar System

Examined some similar procurement management system through internet and some of procurement management systems are shown and evaluated below.

a. A Web-Based Public Procurement System [6]

This system focuses on developing and implementing a web-based public procurement system. As one innovative way of enhancing public procurement, an attempt to develop and implement electronic tendering system is to be made. In designing the system, not only technological aspects but also issues related to public procurement process improvement are considered. As an analysis and design approach, object oriented methodology was chosen and UML was used. Java as a development language was preferred because the resulting system is expected to be portable. This system also puts forward propositions as to how the government should perform direct purchases to ensure that both public and private sector benefit from e-Procurement to achieve full value.

b. Online Tender Management System : eTenderer - a revolutionary online procurement system [7]

This system enables purchasing teams to compile detailed tender contracts, invite private bidders to tender online, distribute tender reports and award tenders online.

eTenderer is the first electronic tendering solution to meet the RICS guidelines for tendering. This system is introduced by Sarcophagus, Yorkshire, UK based company. For the first time in the construction industry, suppliers' tenders could be published as sealed bids, into an online safe deposit box. They can only be opened by specified purchasing representatives on the pre-determined tender opening date. Pre-qualification and multi stage tenders are supported. The system reproduces the traditional tendering process.

The user friendly system means administrators and bidders do not require knowledge to IT or online tendering.

c. Procurement Management System | Oracle [8]

Procurement organizations must respond by taking on a more strategic role in all of the activities surrounding purchasing. They need solutions that are up to the task. So Oracle has developed the cloud procurement management system to digitize procure-to-pay processes with embedded mobile, social, and analytic capabilities and a richer, consumer-like user experience. With modern technology, such as built-in collaboration, embedded analytics, and a more intuitive user experience, companies can build a more effective purchasing system to control employee spending, reduce supplier risk, and improve cost savings.

This system is a comprehensive system with a complete procurement solution. It is an integrated, cloud-based procurement management solution consists of Supplier Management, Sourcing, Contract Management, Requisitioning, Payment and Purchasing.

d. Procurement Management System | WMS Procurement System – Datex [9]

Procurement management system of WMS Procurement System – Datex is functionality developed for complex asset management, such as of specialized equipment, and materials, including serialized inventory tracking. This system provides tools to enable users to properly administer contracts and amendments, manage specialized equipment and bulk material purchases and to provide bid and vendor analysis. Users can monitor the approval process, including revisions and purchase orders in order to ensure proper cost control.

The system allows users to manage pre-and post-award contracting activities and to assign and manage critical project resources. Project delivery features include project schedule planning and an easy to use system for non-technical users to create their own customized reports.


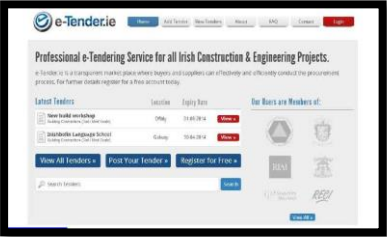
e. Tender Management System Fully Explained [10]

A simple electronic tender management system has introduced by Purchasing & Procurement Center in Chicago, USA. It permits procurement organizations to manage the main activities in procurement process. It should be able to compile online tender documentation, allow the pre-qualifying of suppliers, be able to invite and receive bids. A really good feature is to have a function that allows internal messaging and provides collaboration tools. It has some good features such as ability to manage the entire process from issue of the tender to awarding the contract, Issuing tender requests on-line to qualifying registered companies either for free or for a fee, Automatically notify participating companies with any changes to tender or specifications, Access control allowing for limited procurement persons to manage the tender process using passwords and Capacity to store and retrieve historical tenders.

2.4 Comparison of Alternative Design Strategies

There are various types of online procurement technologies (proprietary and open source) such as online procurement portals and Content Managements Systems (CMS). But there are some negative qualities of using those as well. For an example, if we customize CMS more and more it may tend to loose certain features as well. What's more likely is that we may not be able to take advantages of any new changes in a new version of the same core components, because of the large number of custom modifications. CMS is a system that needs periodic upgrades such as security patches, upgrades. In that case system has to undergo certain regular maintenance. Hence, the proposed solution will be based PHP, MySQL and with open source extensions that is available.

The comparison of Alternative Design Strategies of software solutions are indicated below.

| Name | Description | Pros | Cons |
|-------------|--|--|---|
| EMAT |  <p>It uses an award mechanism based on the Economically Most Advantageous Tender (EMAT) where the bid is evaluated in quality award criteria set by the client besides the project's cost components.</p> | <p>Improve the delivery of client best value, meaning the best value-price ratio, the contractor has to convince the client that he is capable of providing added value on the development for the standing bid price.</p> | <p>Clients face difficulties on applying the EMAT award mechanism. They lack confidence in value based procurement.</p> |
| e-Tender.ie |  <p>e-Tender.ie is a fully managed online tendering platform designed to benefit both buyers and suppliers in the market. Users can post tenders in specific tender categories and interested suppliers can then apply for tender and provide relevant quotations.</p> | <p>User friendly and has the functionality needed to manage the tendering process in an efficient, effective and professional manner. The service has been designed for use by: quantity surveyors, architects, costs management consultants, energy consultants, facilities managers and general home owners etc.</p> | <p>Less Security Specially designed to selected people</p> |

tenders.in
ndia



The Indian Government Tenders Information System is the Central source for government and public sector procurement/Tenders/ Notifications issued by the central and state government and other public bodies across India for goods, services and works.

User friendly and has the functionality needed to manage the tendering process in an efficient, effective and professional manner.

Tracing of tender is very easy.

Only Indian Citizen can access the System.

Customization is difficult.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the methodology and methods followed to develop proposed system and consisting techniques that have used to design the system such as use case, use case narratives, sequence diagrams and activity diagrams to illustrate new system. Consequently, design of data base and the user interfaces are also indicate here.

3.2 Methodology

After gathering data, based on these data, an object-oriented analysis and design approach is used to design the Tender Notification system. In accordance with this selection and due to the requirement of platform-independency and web based application PHP is chosen as the development language. The PHP Web Development program is an open source scripting language that is fast and is widely used to develop various web applications or Internet applications. For database management system, SQL server is use as backend.

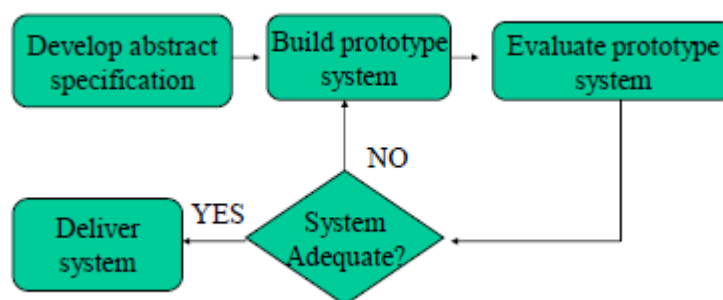
As an analysis and design approach, object oriented methodology was chosen and UML was used. UML modeling notation is utilized during analysis and design phases. Use-case diagrams, activity diagrams and class diagrams are used to model the Tender Notification system.

There are several methodologies have defined for system development. Waterfall Model, Prototyping model, Evolutionary model, the spiral model, Formal development, Incremental development and Rapid Application Development are some of widely used methodologies in System development process. Among those methodologies the Water Fall model is suitable for projects which have clear and stable requirements. A prototype method can be used to clear the vague requirements. If requirements are well understood

and project scope is constrained, the RAD process enables a development team to create a ‘fully functional system’ within very short time periods (eg. 60 to 90 days)

After analyzing requirements and **Prototyping method is selected** to develop the system. A prototype (a small version of the system) can be used to clear the vague requirements. A prototype evaluated with the user participation. Effort of prototype is not wasted. It is faster than the waterfall model and prototype has high level of user involvement from the start. Since technical or other problems discovered early, risk is reduced. Considering above factors and requirements, existing system has high user involvement Prototyping method is selected rather than using the waterfall model. The Evolutionary Prototyping Model is shown below as Figure 4 [11].

Figure 4: The Evolutionary Prototyping Model

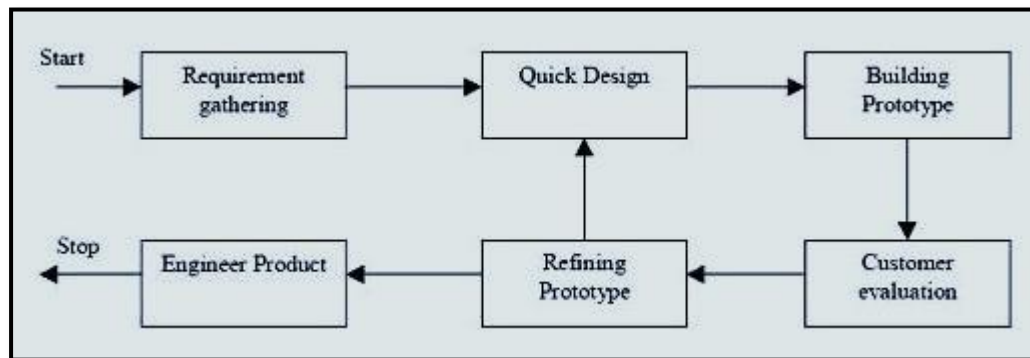


Source: <http://crackmba.com/evolutionary-prototype-model/>

Typically, online systems, web interfaces have a very high amount of interaction with end users, are best suited for Prototype model. It might take a while for a system to be built that allows ease of use and needs minimal training for the end user. Hence, Prototype model is use as the Software Development Life Cycle Model. Prototyping ensures that the end users are actively involved in the development and constantly work with the system and provide a feedback which is incorporated in the prototype to result in a useable system. They are excellent for designing good human computer interface systems. Since in this methodology a working model of the system is provided, the users get a better understanding of the system being developed. The proposed system architecture will be client-server architecture.

Structure of Prototype development for existing Tender process of Sri Lanka Army is shown below as Figure 5[12].

Figure 5: Structure of Prototype development for existing Tender process of Sri Lanka Army



Source : <http://istqbexamcertification.com/what-is-prototype-model-advantages-disadvantages-and-when-to-use-it>

There are several other methodologies can be used while developing a system. In most cases, if the developers have clear-cut idea about what are the deliverables and the requirements are not changing in the future, developers can use Waterfall Model to develop the system. If there is a risk of requirement changing throughout the project duration, it is highly recommended that to use the iterative development models. Rational Unified model has been the most widely used iterative development model in the field nowadays.

3.3 Unified Modeling Language (UML) Design

Unified Modeling Language (UML) is very powerful modeling language. Many diagram can be developed using UML. It provides users with ready-to-use, expressive modeling examples. Moreover, the UML gives a standard way to write a system's view, covering conceptual models such as business processes and system functions, as well as classes written in a specific programming language, database schemas, and reusable software components. UML can be applied in many areas like embedded systems, web

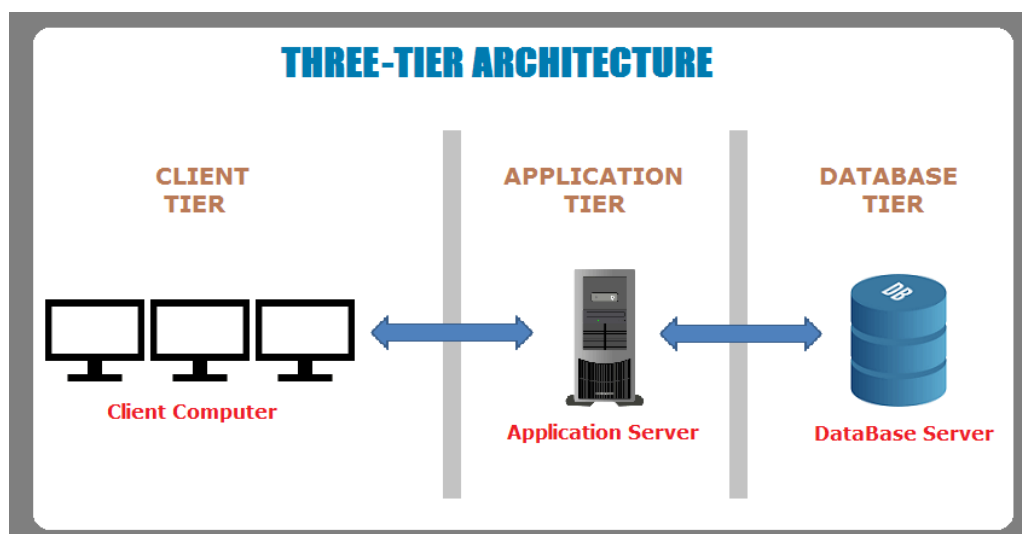
applications and commercial applications. Some UML tools generate program language codes and produces bug free, deployable applications that run quickly if the code generator incorporates best practice scalable patterns. UML can be used for modeling the whole system independent of platform language. Since UML is graphical language, it facilitates visualizing, specifying, constructing, and documenting information about software-intensive system. In the presence of large community of software developer's, it is necessary to understand the importance of modeling, its application and use of UML to make software development process more efficient.

3.4 Technologies and Architecture

Sri Lanka Army Tender Notification System is a web based system which will use PHP, Apache and MySQL as web technologies. So, the system can be used by users whenever they want at any time. Hence, there is no any barrier for user to access this service.

This system is a three-tier architecture[13] that consists of user, web/application server and a database. It has a presentation tier also where users access the system via web based GUI. Application tier contains the business logic and it controls an application's functionality by performing detailed processing. The bottom database tier consists of database server.

Figure 6: Three-tier architecture



Source: <https://www.softwaretestingmaterial.com/software-architecture/>

The web based systems can be developed by programming languages such as Java, .NET, PHP, C#. In this project, development is done by PHP programming language.

PHP is one of the most popular server side scripting languages running today. It is used for creating dynamic webpage that interact with the user offering customized information. It offers many advantages, operating system, supporting multiple database systems, stable and easy to use are some of the benefits that can be gain from using PHP as programming language.

3.5 Use Case Diagram

A use case diagram is a graphical representation of users' interaction with the system in describes the specifications of use case. A use case diagram can provide different type of users of a system and numerous ways that they interact with the system.

3.5.1 Actors

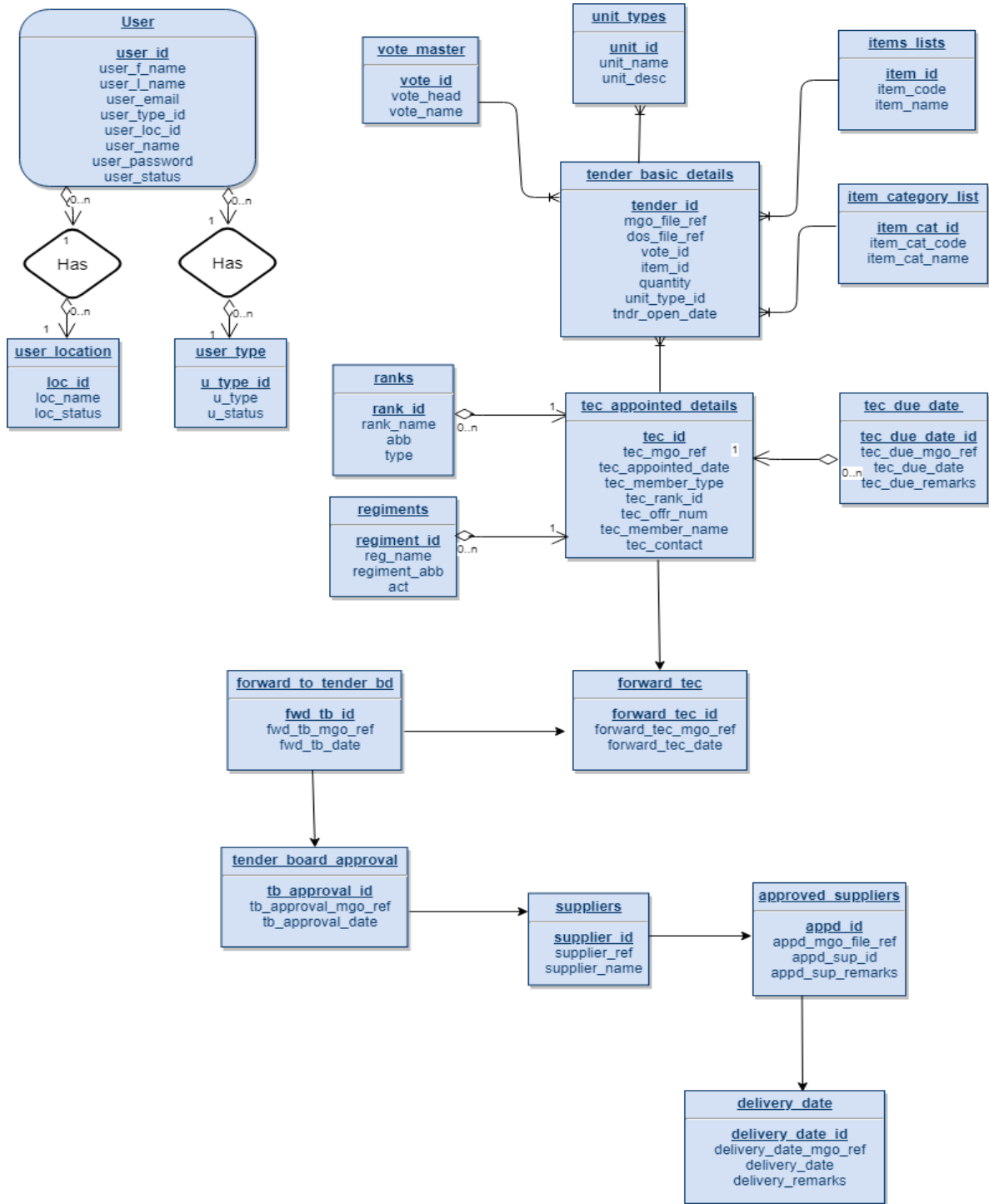
It is identified seven actors associate with the Sri Lanka Army Tender Notification System. They are

1. Director – MGO Branch (System Administrator)
2. Super Administrator (IT Section)
3. Supplier
4. User
5. Item
6. SQL Server
7. Tender Notification System

3.5.2 Use Cases

To work with a system, users have to control and assess the state of the system. Since the application is web based and intranet system web user interface is used.

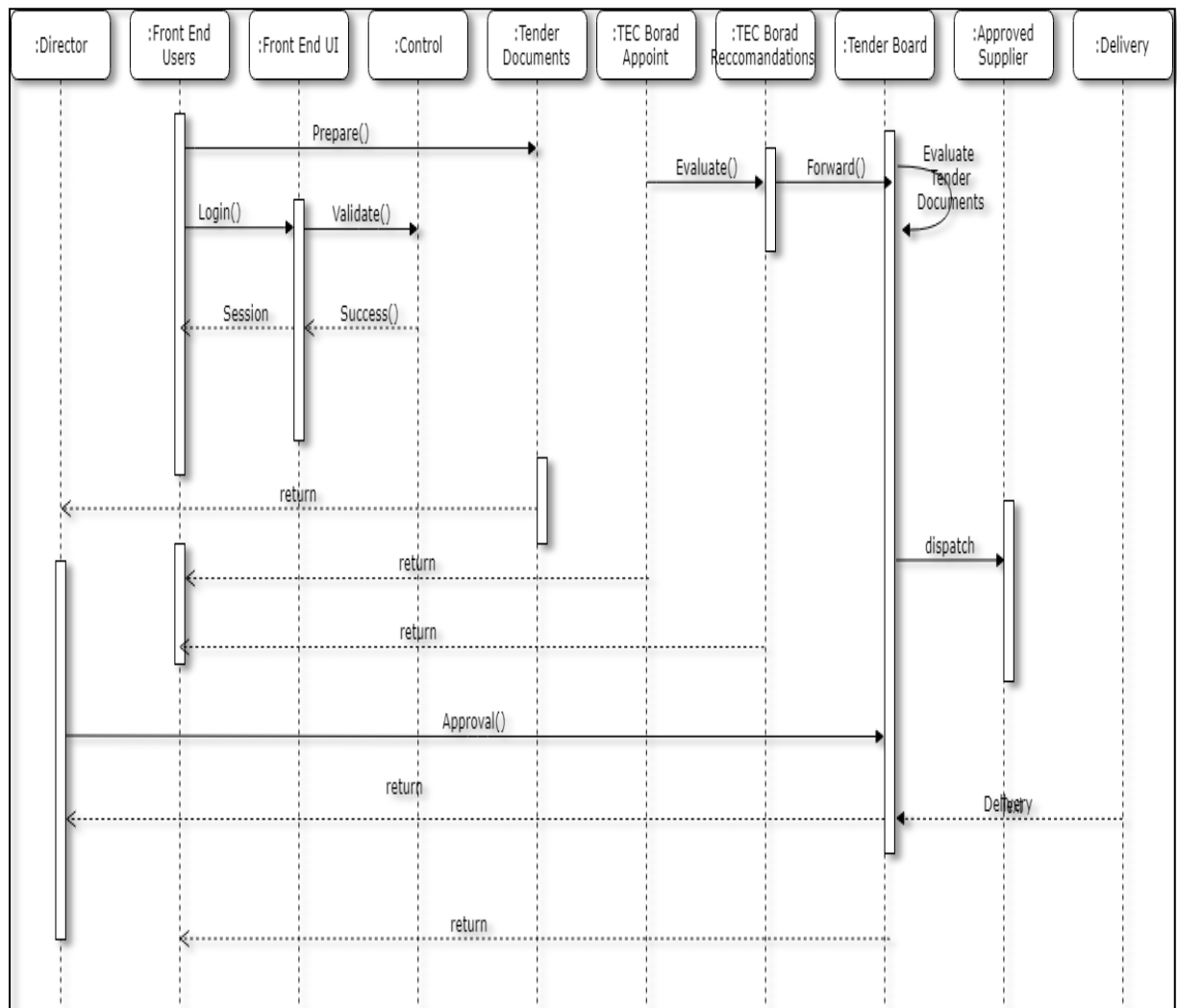
Figure 8: Logical View of Database structure (Entity Relation Diagram)



3.7 Sequence Diagram

The Figure 9 depicts the sequence of the tender procedure and rejects process. It shows the overall system level sequence diagram. After successful login to the system all the users will be able to access the tender notification System depending on their preferences. After that they will be able to perform the tender procedure.

Figure 9: Sequence Diagram

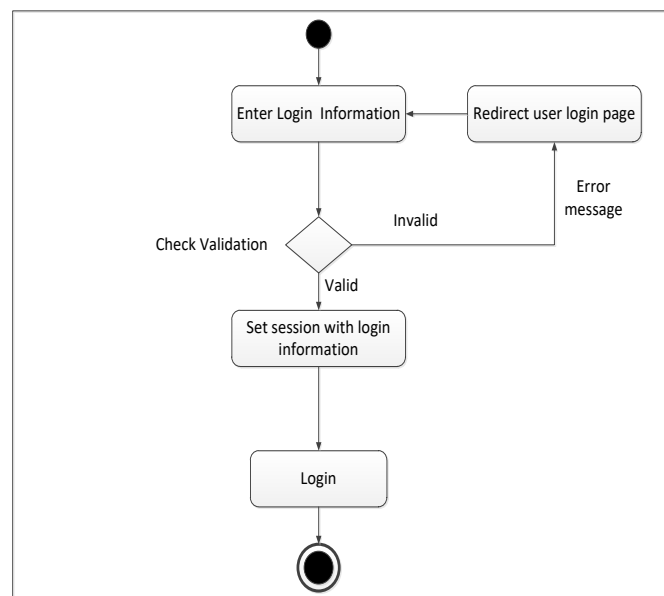


3.8 Activity Diagram

An activity diagram visually presents a series of actions or flow of control in a system similar to a flowchart or a data flow diagram. Activity diagrams are often used in business process modeling. They can also describe the steps in a use case diagram. Activities modeled can be sequential and concurrent. According to this Tender Notification System the activity diagrams would be benefited to identify the general overview of the entire system. Hence, the most important activity diagrams are indicated below.

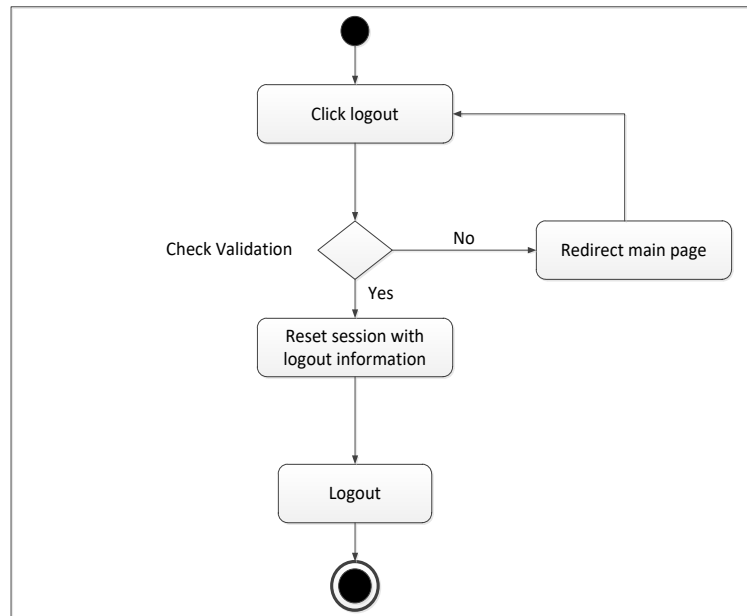
3.8.1 Activity Diagram for Login

Figure 10: Activity Diagram for Login



3.8.2 Activity Diagram for Logout

Figure 11: Activity Diagram for Logout



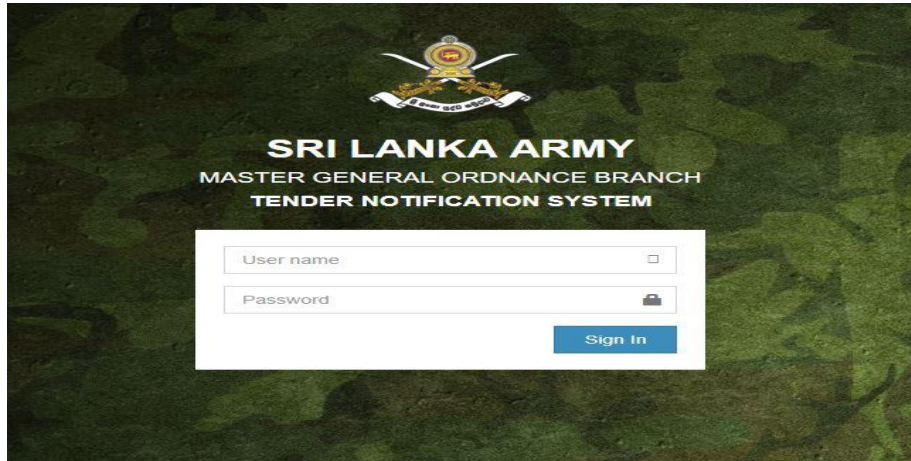
3.9 Interface Design

To smooth work with a system, users have to be able to control and assess the system very interactive and easy manner. To make the system interactive it should be designed to support the way humans interact with the all function and information

3.9.1 Home Page

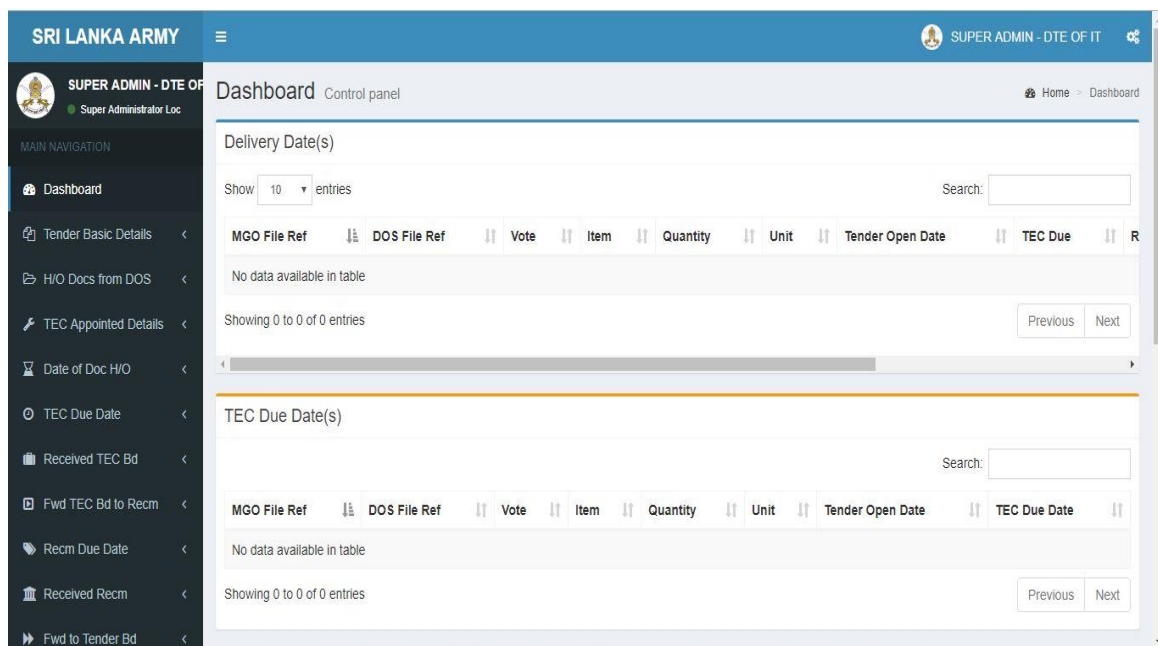
The home page is designed to increase user attraction and with more informative data.

Figure 12: Home Page



3.9.2 Dashboard (Main Screen)

Figure 13: Dashboard (Main Screen)



3.9.3 Manage Items (Add New Items)

Figure 14: Manage Items (Add New Items)

The screenshot displays the 'Manage Item(s)' interface. On the left is a navigation menu with options like 'Dashboard', 'Tender Basic Details', and 'H/O Docs from DOS'. The main content area shows a table of items:

| Item Code | Item Name |
|-----------|---|
| | Ultrasonic Thickness Gauge |
| 00000001 | PULSE OXIMETER |
| 00000002 | New Sample Item |
| 00000003 | RVG SENSOR FOR OCLUSAL STANDARD - 01 NO/PULP TESTER - 06 NOS AND ENDO MOTOR (MICRO WITH APEX LOCATOR) - NOS |
| 00000004 | VENTILATOR ICU- 01 NO |
| 00000005 | ICE - Line Type Refrigerator |
| 00000005 | BED DOUBLE WOODEN 6x4 |
| 00000006 | VESSEL SEALER WITH ELECTROSURGICAL UNIT - |

3.9.4 Users (Create User)

Figure 15: Users (Create User)

The screenshot shows the 'Create User' form. The fields are filled with the following information:

- First name: Roshan
- Last name: Jayasinghe
- Email: droshanj@gmail.com
- User type: SYSTEM ADMINISTRATOR
- User location: Super Administrator Loc
- User name: super_administrator
- User password: ...

At the bottom, there are radio buttons for 'Active' (selected) and 'Deactivate'.

3.9.5 Tender Basic Details (Update Tender Details)

Figure 16: Tender Basic Details (Update Tender Details)

The screenshot shows a web application interface for the Sri Lanka Army. The header includes the logo and name 'SRI LANKA ARMY' on the left, and the user profile 'SUPER ADMIN - DTE OF IT' on the right. A sidebar on the left contains navigation options: Dashboard, Manage Vote(s), Manage Item(s), Manage Supplier(s), User(s), Tender Basic Details, and TEC Appointed Details. The main content area is titled 'Tender Basic Details' and 'Update Tender Details'. It contains several input fields: MGO File Reference (MGO/2019/1508), DOS File Reference (DOS/2019/2250), Vote Name (222-01-3-2102 - Furnitures and Office Equipment), Item Name (11101003 - Air Condition Spilt Type BTU 24000), Quantity (50), Unit Type (Nos), and Tender Opening Date (06/27/2019). A blue 'Submit' button is located at the bottom of the form.

3.10 Implementation Tools

This section describes the implementation tools. Implementation is the stage in the software engineering process at which an executable software system is developed. Following table shows the implementation tools used to develop Sri Lanka Army Tender Notification System.

Table 2: Implementation Tools

| | |
|-----------------------------|-------------------------------|
| Operating System | Window 10.1 |
| Web Server | Apache (App Server) |
| Hosting Provider | Sri Lanka Army Server |
| Database | MySQL |
| Development Language | PHP |
| Diagram Design Tool | MS Visio |
| Development Tool | Notpad ++ |
| Client Script | Javascript, JQuery, Ajax |
| UI Design Tool | Adobe Photoshop |
| Development Method | Rational Unified Process(RUP) |

3.11 Hardware and Software Requirements

Following Hardware and software requirements are proposed to set up newly developed Sri Lanka Army Tender Notification System.

Table 3: Hardware Software Requirements

| Minimum Server Hardware Requirements | Server Software Requirement |
|--|--|
| Core2 Duo server 2.8 GHz or higher | Windows 2008 or higher Server/ Any Linux distribution |
| 4GB RAM (minimum) | Apache Web Server Version 2.4.25 (Win32) OpenSSL/1.0.2 PHP/5.6.30 |
| 1TB HDD | PHP Script Language Version 5.2.6 |
| 2 Network interface card with 10/100 Mb/s (To implement public IP & private IP) | My SQL Database Version 5.7.17 |
| USB Port – (To connect an external HDD drive for Backups) | PHP MyAdmin Database Manager Version 3.4.4 |
| Uninterrupted Power Supply Unit (UPS) | |
| CD/DVD Drive | |
| Other required hardware devices (USB mouse and keyboard) | |

3.12 Implementation Environment

Developed Army Tender Notification System (SLATNS) is based on PHP programming language. Bootstrap has used as framework for developing the web based system. Bootstrap is the most popular framework for quickly styling your website and it skips writing CSS and focus instead on HTML. Most of the code segments have been developed from scratch and same time it uses some predefined code segments.

3.12.1 Back-end of the System

Database of SLATNS used MySQL. It is widely used in web based applications. It is known as a very fast database and is the most popular database. It is easy to install, maintain and it work well with SLATNS.

3.12.2 Front-end of the Application

The system is used Bootstrap as framework for developing the web based system. Bootstrap is the most popular framework for quickly styling your website and it skips writing CSS and focus instead on HTML. It was focused on the easy navigate, efficient and user friendly interfaces. The tools HTML, CSS and Adobe Photoshop have used to design the front end.

3.12.3 PHP

PHP is a widely-used, open source scripting language and PHP scripts are executed on the server. Since PHP runs on various platforms (Windows, Linux, UNIX, Mac OS X, etc.) and compatible with almost all servers (Apache, IIS, etc.), PHP used to develop the system. In addition to that PHP supports a wide range of databases too.

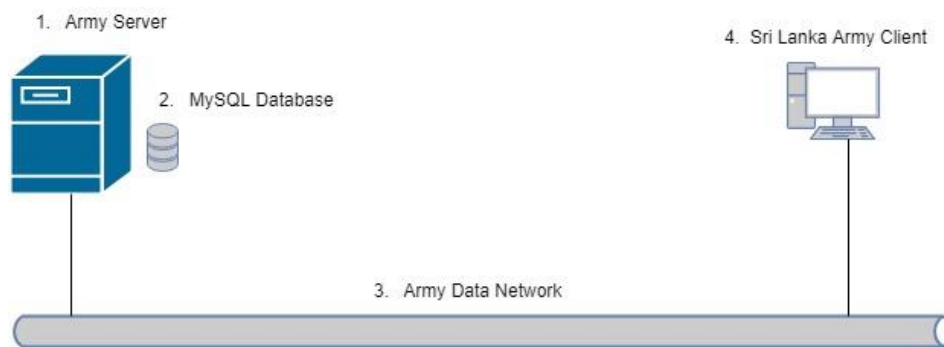
3.12.4 Apache

Apache is the most widely used web server software. Apache is an open source software available for free. It runs on 67% of all web servers in the world. It is fast, reliable, and secure. It can be highly customized to meet the needs of many different environments by using extensions and modules. It provides a secure, efficient and extensible server that provides HTTP services in sync with the current HTTP standards.

3.13 Overview Diagram

Following overview diagram in Figure 17 depicts the physical manner of how the system is implemented in the Army Data network.

Figure 17: Overview Diagram

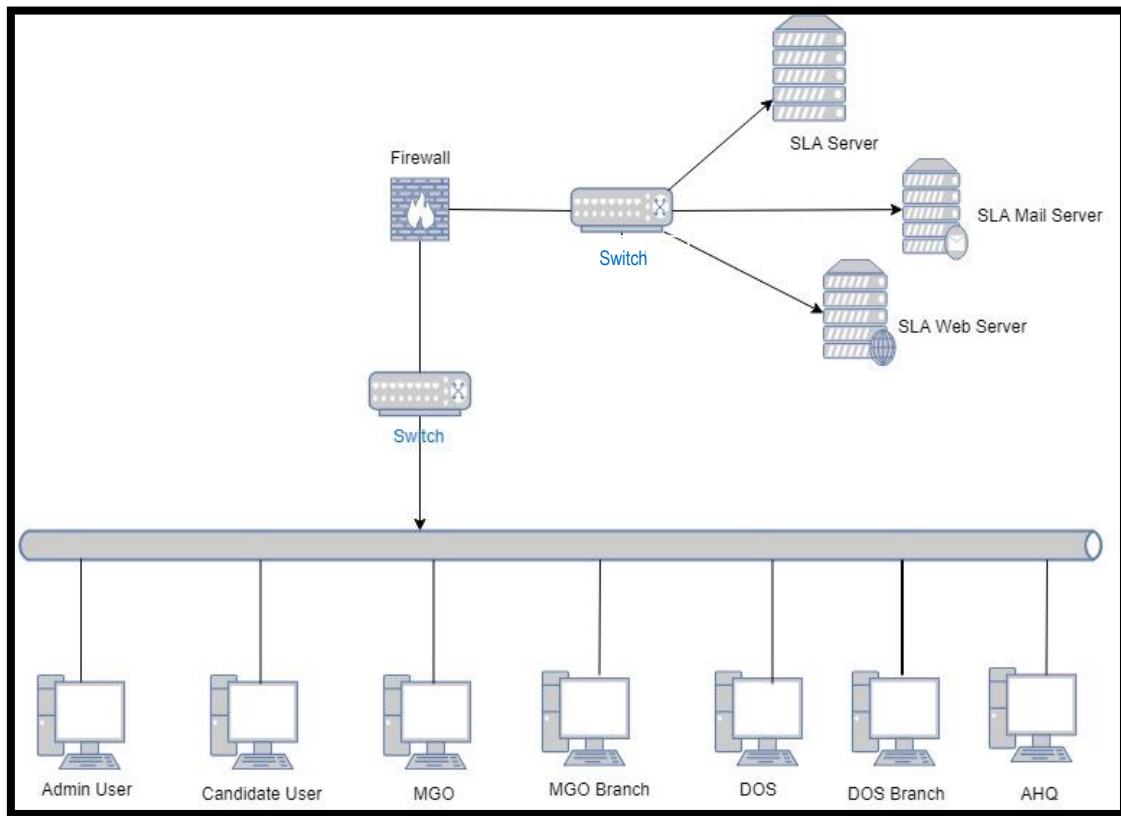


1. Sri Lanka Army Tender Management System (SLATNS) is installed on a server which can be either a Linux flavor or Windows based.
2. Both Application and MySQL database runs in the same server with business rules and support for queries.
3. Sri Lanka Army candidate users will request for data from server.
4. SLATNS server is also connected to the main SLA network as the client.

3.14 Network Diagram

The Network diagram of this system is shown in Figure 3.16 below graphically shows how the SLATNS system is implemented in Sri Lanka Army Server. It depicts the physical components or the hardware that has been used for the system to interconnect SLATNS server with the all kind of users.

Figure 18: Network Diagram



3.15 Web URL Details

The entire web base system will be hosted in Sri Lanka Army Web Server. The candidate users and the admin users have access the system only through the Army Data Network (through Army Intranet). The URL is as http://army.lk/MGO_BR.

CHAPTER FOUR

TESTING AND EVALUATION

4.1 Introduction

This chapter gives an overview about the implementation testing, testing tools and the evaluation of Tender Notification System. The test plan, test schedule, test strategy and test cases are presented in this chapter. Finally, it indicates the evaluation of the system.

4.2 Testing

The testing of software is playing a major role in Software Development Life Cycle. The testing of software is very important and it assesses the software to determine the quality. Software testing typically consumes 40% to 50% development efforts and more effort is required for higher levels of reliability of the system. Despite advances in formal methods and verification techniques, the Tender Notification System needs to be tested before it is used. The general aim of software testing is to confirm the quality of systems by systematically exercising the software in carefully controlled circumstances. There are many software testing methods exist in the software industry. Testing is involved in every stage of the software life cycle, even though the testing done at each level of software development is different in nature and has different objectives.

4.2.1 Test Plan

The test plan is started during the early stage of the software development process and carried through out as parallel activity. The components of the system are tested basically with respect to Windows environment. Further it is tested on web browsers, such as Firefox, Google Chrome, Opera and Microsoft IE or Edge which are widely used. The test plan is prepared to ensure that the system archives the expected output. The

objectives of the test plan are to confirm that systems provide the maximum benefits, required features and to ensure it work as expected. Sample set of test data is used to illustrate the test cases and results are identified to verify the testing scenarios. In a software system there are many features and functions to be tested.

The non-functional requirements are also has to be tested in the process of Software testing. User interfaces are tested for user interactivity and flow of event to give smooth user friendliness to the end users. Security test also perform to check any security issues incur with the system. The recovery test is carryout to ensure the system can be recovered from the last successfully backup in case of a failure or crash of the system,

4.2.2 Scope of Testing

The scope of testing for the system is three levels as follows.

- Functional Testing
- UI/Navigation Testing
- Non Functional Testing

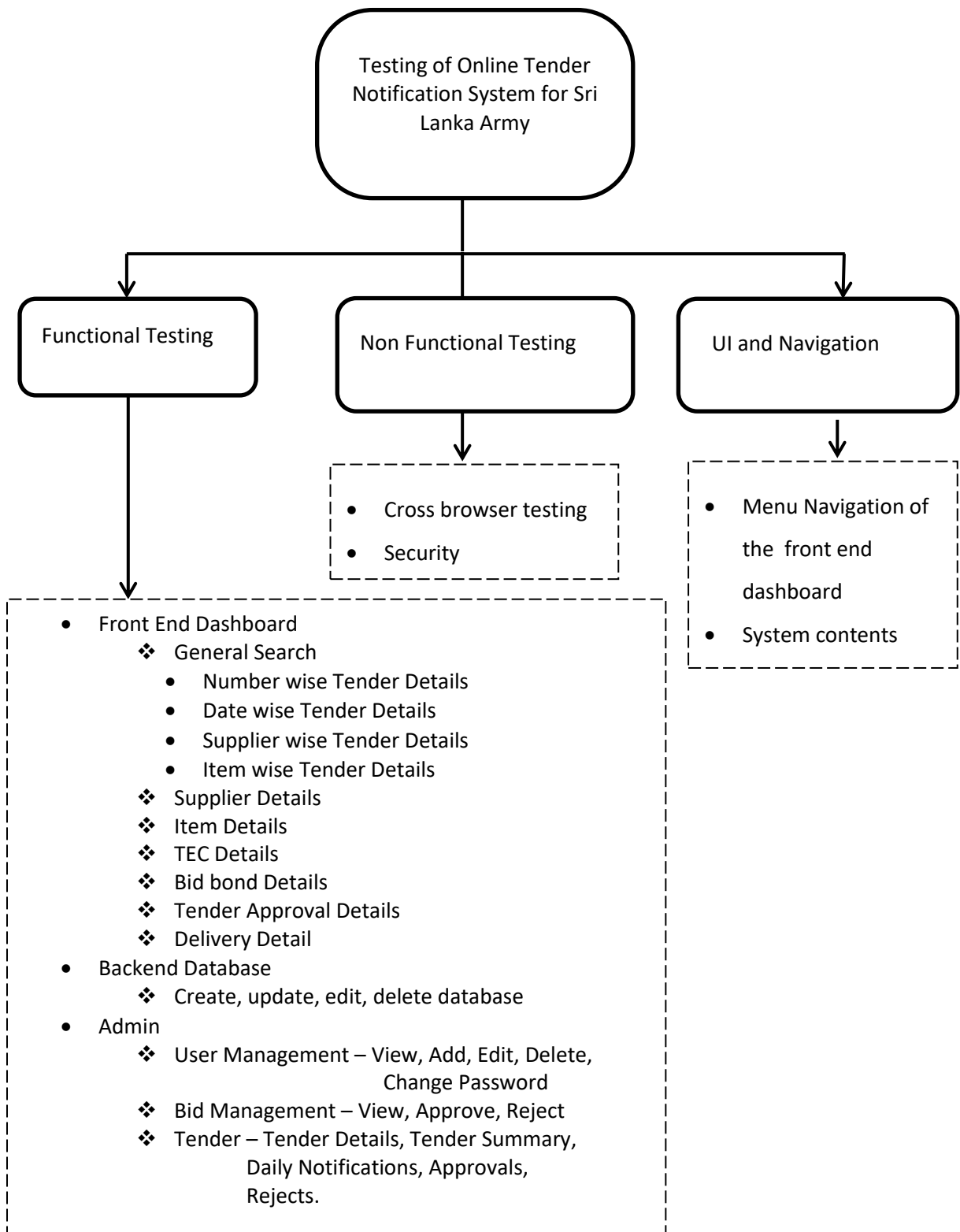
The test functionalities is shown in Table 5 and the testing layout is shown on Figure 19 below.

Table 4: Functionalities

| Serial Number | Functionalities |
|----------------------|--|
| 1 | Validations |
| 2 | Error Messages |
| 3 | Click On |
| 4 | Key Press |
| 5 | Data Filtering |
| 6 | Calculations of Technical Evaluation Report |
| 7 | Boundary values of Technical Evaluation Report |
| 8 | Calculations of Tender Document |
| 9 | Boundary values of Tender Document |

| | |
|----|--|
| 10 | Manage User : User - Create, Update, Delete |
| 11 | Manage User : Reset password |
| 12 | Manage Tender : Bid Details – Create, Update, Delete |
| 13 | Manage Tender : Supplier Details – Create, Update, Delete |
| 14 | Manage Tender : Item Details – Create, Update, Delete |
| 15 | Manage Tender : TEC Committee Details – Create, Update, Delete |
| 16 | TEC Report : Availability – Display |
| 17 | Item Details : Availability – Display |
| 18 | Supplier Details : Selected Supplier – Display |
| 19 | Bid Details : Bid Bond – Approve, Reject |
| 20 | Bid Details : Tender Details Report |
| 21 | Bid Details : Tender Summary Report |
| 22 | Bid Details : Daily Tender Notification |
| 23 | Login & Logout |
| 24 | Admin User Change Password |
| 25 | Front End : Tender Submit |
| 26 | Front End : Availability – Display |
| 27 | Front End : Input Details |
| 28 | Front End : Search Contents |
| 29 | Backend : Update Database |
| 30 | Admin > Tender Notification > System Dashboard > Display approved, rejected Tenders, display notifications |
| 31 | Admin > Database > Manage Database > Add, edit, delete database, Automatic calculation. |

Figure 19: Testing Layout



Source: Developed by Author

4.2.3 Test Deliverable and Schedules

4.2.3.1 Test Deliverables

The following table 5 displays all the major deliverables that are planned to deliver.

Table 5: Test Deliverable and Dates

| Deliverable | Description | Delivery Date |
|-------------------------------------|--|----------------------|
| Quality Assurance plan (QATP) | This describes the overall test approach and strategy. | 2019 June 20 |
| Quality Assurance test Cases (QATC) | The Quality Assurance Test Cases (QATC) document lists all the test cases which are used during QA testing. The QATC is not intended for unit test cases | 2019 June 30 |
| User Acceptance Test Cases | Test cases to be used for UAT testing. | 2019 July 06 |
| Test Results | This summarizes the result of test case execution. it is used to understand progress of testing and the quality of the system | 2019 August 30 |

4.2.3.2 Test Schedule

The following Table 6 depicts all the planned testing release and release date

Table 6: Testing Time Schedule

| Task Name | Start | Finish | Effort | Comments |
|------------------------------------|--------------|---------------|---------------|-----------------|
| Smoke testing | | | 2d | |
| Content verification for all pages | | | 3d | |
| Content validation for all pages | | | 3d | |
| Defect Verification | | | 1d | |
| Regression testing on IE8 | | | 1d | |

| | | | | |
|---|--|--|----|--|
| Functional testing on IE8 | | | 1d | |
| Functional testing on Google Chrome | | | 1d | |
| Functional testing on Firefox | | | 1d | |
| Functional testing on Opera | | | 1d | |
| Resolution of final defects and final build testing | | | 3d | |
| User Acceptance Testing (UAT) | | | 5d | |
| Staff and train new test resources | | | 5d | |
| Deploy to Staging environment | | | 2d | |
| Performance testing | | | | |
| Release to Production | | | 2d | |

4.3 Test Strategy

Manual Testing is performed to Tender Notification system and it is one of the oldest and rigorous methods of software testing. But this testing strategy gives the best opportunity to check every page thoroughly and make sure it works in the expected manner. Due to the complexity of the various automation tools and the available time frame for testing, selected the manual testing strategy is selected considering the fact that it is one of the best methods of testing suggested for a beginner. The results of the manual testing are represented in the following Table 7.

Table 7: Manual Testing Result

| Serial Number | Functionalities | Test Results |
|---------------|--|--------------|
| 1 | Validations | Passed |
| 2 | Error Messages | Displayed |
| 3 | Click On | OK |
| 4 | Key Press | OK |
| 5 | Data Filtering | Passed |
| 6 | Calculations of Technical Evaluation Report | Passed |
| 7 | Boundary values of Technical Evaluation Report | Passed |

| | | |
|----|--|-----------|
| 8 | Calculations of Tender Document | Passed |
| 9 | Boundary values of Tender Document | Passed |
| 10 | Manage User : User - Create, Update, Delete | OK |
| 11 | Manage User : Reset password | OK |
| 12 | Manage Tender : Bid Details – Create, Update, Delete | OK |
| 13 | Manage Tender : Supplier Details – Create, Update, Delete | OK |
| 14 | Manage Tender : Item Details – Create, Update, Delete | OK |
| 15 | Manage Tender : TEC Committee Details – Create, Update, Delete | OK |
| 16 | TEC Report : Availability – Display | Displayed |
| 17 | Item Details : Availability – Display | Displayed |
| 18 | Supplier Details : Selected Supplier – Display | Displayed |
| 19 | Bid Details : Bid Bond – Approve, Reject | Passed |
| 20 | Bid Details : Tender Details Report | Displayed |
| 21 | Bid Details : Tender Summary Report | Displayed |
| 22 | Bid Details : Daily Tender Notification | Pending |
| 23 | Login & Logout | OK |
| 24 | Admin User Change Password | OK |
| 25 | Front End : Tender Submit | Passed |
| 26 | Front End : Availability – Display | Displayed |
| 27 | Front End : Input Details | OK |
| 28 | Front End : Search Contents | OK |
| 29 | Backend : Update Database | Updated |
| 30 | Admin > Tender Notification > System Dashboard > Display approved, rejected Tenders, display notifications | OK |
| 31 | Admin > Database > Manage Database > Add, edit, delete database, Automatic calculation. | Passed |

4.4 Test Approach

This describes the testing approaches used to test the entire Tender Notification System. The various testing approaches for each functional and non – functional testing area is

mentioned below. The entire web based Tender Notification System is tested under following criteria.

- Unit Testing
- Integration Testing
- Smoke Testing
- System Functional Testing
- Regression Testing
- UI / Navigation Testing
- Browser Compatibility Testing
- User Acceptance Testing

4.4.1 Unit Testing

Unit testing performed at the lowest level. Basically this test is used to test the basic units of software, which is the smallest testable piece of software is often called “unit”, “module”, or “component” interchangeably. Unit testing refers to tests that verify the functionality of a specific section of code, at the beginning of function levels.

4.4.2 Integration Testing

Integration testing is any type of software testing that seeks to verify the interfaces between components against a software design. Normally the former is considered a better practice since it allows interface issues to be localized more quickly and fixed. Tender Notification System is tested with test data that made expected results.

4.4.3 Smoke Testing

The smoke testing is targeting factors that would hinder the main functionality of the application. The smoke test cases are a set of functional test cases which cover the system requirements as specified in the requirement specifications.

The smoke testing validates below points.

- The database is properly configured for the system to function.

- Major functionalities are working as expected.
- System is ready for further functional testing.

4.4.4 System Functional Testing

The System functional testing commences upon satisfactory completion of the smoke test and it is the entry criteria for functional testing. Functional testing is done by creating and documenting the functional test cases to evaluate the correctness of the application. It is designed to ensure that all the functional requirements of the application are covered.

4.4.5 Regression Testing

A regression testing is performed in order to confirm that the changes and defect fixes do not adversely impact previously released versions of the application.

4.4.6 UI / Navigation Testing

UI and navigation testing assessed the User interface for adherence to requirements.

4.4.7 Browser Compatibility Testing

All the test cases documented in the test case document will execute only in Internet Explorer 10.25% of the test cases which cover the smoke and the UI/navigation test cases will be executed in Google Chrome and Mozilla Firefox.

4.4.8 User Acceptance Testing

User Acceptance testing commence on the successful completion of all the above tests. This testing is generally performed when the project is reached to end. This test mainly qualifies the project and decides if it will be accepted by the users of the system. The

users or the client of the project are responsible for the test. Table 8 below described the checklist of the system testing.

Table 8: Checklist of User Acceptance Testing

| Serial Number | Functionalities | UAT Test Results |
|----------------------|--|-------------------------|
| 1 | Validations | OK |
| 2 | Error Messages | OK |
| 3 | Click On | OK |
| 4 | Key Press | OK |
| 5 | Data Filtering | OK |
| 6 | Calculations of Technical Evaluation Report | OK |
| 7 | Boundary values of Technical Evaluation Report | OK |
| 8 | Calculations of Tender Document | OK |
| 9 | Boundary values of Tender Document | OK |
| 10 | Manage User : User - Create, Update, Delete | OK |
| 11 | Manage User : Reset password | OK |
| 12 | Manage Tender : Bid Details – Create, Update, Delete | OK |
| 13 | Manage Tender : Supplier Details – Create, Update, Delete | OK |
| 14 | Manage Tender : Item Details – Create, Update, Delete | OK |
| 15 | Manage Tender : TEC Committee Details – Create, Update, Delete | OK |
| 16 | TEC Report : Availability – Display | OK |
| 17 | Item Details : Availability – Display | OK |
| 18 | Supplier Details : Selected Supplier – Display | OK |
| 19 | Bid Details : Bid Bond – Approve, Reject | OK |
| 20 | Bid Details : Tender Details Report | OK |
| 21 | Bid Details : Tender Summary Report | OK |
| 22 | Bid Details : Daily Tender Notification | OK |
| 23 | Login & Logout | OK |
| 24 | Admin User Change Password | OK |
| 25 | Front End : Tender Submit | OK |

| | | |
|----|--|----|
| 26 | Front End : Availability – Display | OK |
| 27 | Front End : Input Details | |
| 28 | Front End : Search Contents | |
| 29 | Backend : Update Database | |
| 30 | Admin > Tender Notification > System Dashboard > Display approved, rejected Tenders, display notifications | |
| 31 | Admin > Database > Manage Database > Add, edit, delete database, Automatic calculation. | |

4.4.8 Non-functional Testing

Non-functional testing is done to ensure that a system/application meets the specified performance requirements. Here, by performance we do not only mean response time, but several other factors such as security, scalability, and usability of the application as well.

Performance Testing

In order to ensure that the response time of a system is acceptable, performance testing is carried out. By setting up a considerable load and a production-sized database, the system is tested for response times of several business critical processes.

Security Testing

To test how well the system can preserve itself and the data it holds in situation of malicious attacks is called security testing. Confidentiality, integrity, availability, authentication, and authorization are the main areas that are tested when security testing is considered. Also, network security, system security and application security are other areas that will be tested in this case.

Scalability Testing

When an application is tested for its ability to increase and scale up on any of its non-functionality requirements such as load, number of transactions, number of servers, volume of data etc., it is known as scalability testing.

Usability Testing

To verify the ease of usage of an interface within an application is what usability testing is about. Learnability and memorability of the application are main factors in this case. This testing is particularly important when testing GUI.

4.4.9 Application and Data Recovery

Suitable management procedure shall be deployed for regular back-up of application and data. The regularity of data backup shall be in commensurate with the nature of transaction/business translated into Tender Notification System. For new system Review of backup policies, procedures and the backup and restoration records are needed to be implemented at the Network level.

4.4.10 Integrity of the Application

Suitable management control shall be implemented on availability of updated source code and its deployment. Strict configuration control is recommended to ensure that the latest software in the production system. Review of the configuration management procedure, mechanism and its implementation to be performed at Network level.

4.5 Test Cases

Test cases are developed using various level technology to achieve more effective and accurate testing. Software can be tested in two methods. Basically the system is tested with black box and white box testing methods. Software faults can occur through many processes. If this defect is executed in certain software the system will produce wrong results. Therefore software testing plays a major role in any development. The results of

this systems testing are displayed below in tabulate format in Table 9 to Table 16. It described the how test cases are generated, steps followed and the results of the test cases.

Table 9: User Login Validation

| No: 01 | Test Case: User Login | |
|-------------------------------|--|--|
| Test Case | Steps to follow | Expected Results |
| Successful login verification | Enter correct username and correct password | Display particular user profile page. |
| | Enter incorrect username or incorrect password | Error message and redirect to login page |
| | Attempt to login without user name or password | Error message and redirect to login page |

Table 10: Admin Login Validation

| No: 02 | Test Case: Admin Login | |
|-------------------------------|--|--|
| Test Case | Steps to follow | Expected Results |
| Successful login verification | Enter correct username and correct password | Display the main page according to user type |
| | Enter incorrect username or incorrect password | Error message and redirect to login page |
| | Attempt to login without user name or password | Error message and redirect to login page |

Table 11: Admin Manage Users

| No: 03 | Test Case: Admin manage : Create, Update, Delete user | |
|----------------|--|---|
| Test Case | Steps to follow | Expected Results |
| Add new user | Admin Create for new user with valid information | Successful message and redirect to main page |
| | Admin Create for existing user with valid information | Error message and redirect to create user page |
| | Admin create with empty fields | Error message and redirect to create user page |
| Reset Password | Admin insert existing off no and then insert common password | Successful message and redirect to main page |
| | Admin insert not existing Off no | Error message as “User does not exist” and redirect to update user page |
| | Admin create with empty password field | Error message and redirect to update user page |
| Delete user | Admin insert existing off no and delete existing user | Successful message and redirect to main user page |
| | Admin insert not existing Off no | Error message as “User does not exist” and redirect to Delete user page |

Table 12: Admin Change the Password

| No: 04 | Test Case: Admin Change the Password | |
|-----------------|---|--|
| Test Case | Steps to follow | Expected Results |
| Change password | User change password with valid information | Successful message and redirect to main page |
| | User change password with mismatch password | Error message and redirect to change password page |
| | User change password with empty fields | Error message and redirect to change password page |

Table 13: User Add New Tender

| No: 05 | Test Case: User Add new Tender | |
|---|---------------------------------------|---|
| Test Case | Steps to follow | Expected Results |
| Adding a new Tender to the system | Enter new Tender Reference Number | Tender is allowed to add to the system. System will ask other information related to new tender. |
| Adding another Tender of same tender number | Enter existed Tender Reference Number | Display error message “Tender with same Reference already exists” and redirect to Tender Add page |

Table 14: User Add New TEC Board Details

| No: 06 | Test Case: User Add New TEC Board Details | |
|--|---|--|
| Test Case | Steps to follow | Expected Results |
| Enter TEC Board Details | Enter relevant Tender Reference Number | System is allowed to add to TEC Details to the system. System will ask TEC board member details for relevant Tender. Display successful message. |
| Adding invalid Tender reference number | Enter invalid Tender Reference Number | Display error message “Tender Details not available” and redirect to TEC Members add page |

Table 15: User Add New Supplier Details

| No: 07 | Test Case: User Add New Supplier Details | |
|--|---|---|
| Test Case | Steps to follow | Steps to follow |
| Enter New Supplier | Enter New Supplier Reference Number | System is allowed to add New Supplier to the system. System will ask other information related to new supplier. |
| Adding another Supplier of same number | Enter Supplier Reference Number | Display error message “Supplier with same Reference already exists” and redirect to Add Supplier page |

Table 16: User Add New Item Details

| No: 08 | Test Case: User Add New Item Details | |
|------------------------------------|---|---|
| Test Case | Steps to follow | Steps to follow |
| Enter New Item | Enter New Item Number | System is allowed to add New Item to the system. System will ask other information related to new Item. |
| Adding another Item of same number | Enter Item Number | Display error message “Item with same Number already exists” and redirect to Add Item page. |

4.6 Evaluation of Work

Evaluation of the work is doing mainly to identify how much users are satisfied with the system. The decision to proceed with this project was dependent on critical evaluation. Heuristic evaluation is an informal method of identifying the problems associated with the user interface. Jacob Nielsen’s Heuristic Evaluation would be the based on usability evaluation which will carry out with a sample of users by means of a carefully designed questionnaire which can be found in Table 4.14 below. The prepared Questionnaire to be distributed among selected stakeholders for getting the feedback. For that, sample population has to be identified. The sample population or sample size will be determined to evaluate the system.

4.6.1 Sample Size

The Sample size to carry out this questionnaire will be determined by the expected response rate. For this system evaluation, the questioner forms distribute among 72 Army Personal in various ranks and within various branches who are directly involved in this manual system at present and distribution of questionnaire is shown in the Table 4.15 below.

Ratings

- 1. **Poor** ★
- 2. **Fair** ★ ★
- 3. **Average** ★ ★ ★
- 4. **Good** ★ ★ ★ ★
- 5. **Excellent** ★ ★ ★ ★ ★

Table 17: Questionnaire

| Description | Ratings (Fill with the Number) |
|------------------------------|--------------------------------|
| Easy to Use | 4 ★ ★ ★ ★ |
| Errors are Clearly Described | 3 ★ ★ ★ |
| Easy to Navigate | 4 ★ ★ ★ ★ |
| Response Time | 5 ★ ★ ★ ★ ★ |
| User Interfaces | 4 ★ ★ ★ ★ |
| Security | 4 ★ ★ ★ ★ |
| Maintenance | 3 ★ ★ ★ |
| Easy to Learn | 4 ★ ★ ★ ★ |
| Comments (If any) | |
| Name (Optional) | |
| Contact Number (Optional) | |

Table 18: Distribution of Questionnaire

| Srl No | Users | | Count |
|---------------|---|---------|--------------|
| 1 | All ranks personal (02 for each rank, except Brigadier and Major General ranks) | 13 x 02 | 26 |
| 2 | 1 x Director (Major General) | 01 x 01 | 01 |
| 3 | 2 x Assistant Directors (Brigadier) | 02 x 01 | 02 |
| 4 | 3 x IT Professionals | 03 x 01 | 03 |
| 5 | 8 x Branches/ Sections of existing system is functioning (05 for each Branch/section) | 08 x 05 | 40 |
| | Total | | 72 |

4.6.2 Analysis of the Feedback

Feedback from the user evaluation questionnaire will be processed to and summarized to get a clear idea of the new system. By using this result we can identify user friendliness, error handling and overall view or the user interface of the system.

The feedbacks show that the proposed solution is welcomed by most employees in the organisations. Employees welcome the changes as they improve productivity, ensure work efficiency and less repetitive work through data and information reuse. Employers have the perception that proposed tender management system made the tendering process less tedious and less costly as well as ensuring better control and management over the tender process. This enabled organisations to handle more jobs in a single timeframe when compared to the traditional method of tendering.

One of the many good responses from users is attributed to the software itself, i.e. that it is designed with user friendly features and demands very little computing knowledge to use the system efficiently. The basic set-up only needs intranet access and a web browser.

The simplicity of the interface and functionalities made acceptance of the system easy for all users, particularly when combined with the training provided to all participants.

The overall impact of introducing Tender Notification System in collaborative environments is significant. Organisations using Tender Notification System enjoy better efficiency, accuracy and productivity in their tendering activities.

The feedbacks show that the tender process was not changed to embrace the power of technology, but rather technology was used as a tool to record and accelerate the communication process.

Preparation of tender

The process of preparing the tender remains virtually the same in both the traditional and Tender Notification System process. Tender documents also remain the same, whereby the documents are prepared using word-processors and spread sheets, enabling users to edit and change items easily. Tender documents are prepared and checked manually.

Tender Notification System will gather all documents and drawings to be compiled in a softcopy format and ready for upload to the system, replacing the traditional and tedious paper-based system. Employees at this stage show increased motivation and better attitudes to their duties.

Estimating task

Traditionally, bidders start estimating and measurement works manually when the tender documents received. The Tender Notification System allows the bidders to view the documents in softcopies or print as they like which allows bidders to access the system at anytime, regardless of location. However, the Tender Notification System requires fewer personnel than the traditional system. Unlike tendering, the estimating process still follows the traditional method. Tender Notification System did not include provisions for estimating, therefore, estimating work continues to be tedious and costly.

Tender enquiries

Tender enquiries involve both the consultant and the bidder. The new Tender Notification System provides a quick and systematic approach to responses to tender enquiries, correction and replacement of tenders. In addition, response times are extremely fast and

accurate. The Tender Notification System process is the same, work efficiency and quality is vastly improved. The management views that the manpower involved, experience, background, qualification and responsibility of the employee remain the same as the traditional process.

Tender analysis

Tender analysis is completed manually and the process remains similar to the traditional method. The only clear difference is that the traditional method refers directly to the paper-based tender documents, while Tender Notification System can be printed in hardcopy or viewed in softcopy format. As for the people factor, manpower, background, qualification and responsibility of the personnel involved are similar for both the traditional and Tender Notification System systems.

CHAPTER FIVE

CONCLUSION

5.1 Introduction

This chapter gives an overview about the implementation tools and the technical details of Tender Notification System. The chapter is presented under three headings; Conclusions, Recommendations and finally the Future Works.

5.2 Conclusion

The goal of this project was to build a Web based Tender Notification System for Sri Lanka Army. The System has installed on the Server at Sri Lanka Army Data Center where is at Headquarter premises in Colombo. This will help users to access the system from their work location through the Army Intranet (Army Data Network (SLADN)). Furthermore, the users who use the SLADN can be aware of the Tender Management and Procurement process of Sri Lanka Army by using this system.

In order to establish the system successfully it requires having proper infrastructure in each branches and Army Headquarters. Some of those are Internet Connections, Dedicated Server, Uninterrupted Power Supply, Computer Network, Computers with accessories and resource person is mandatory to operate this system. At present all these locations are equipped with requirement and all are interconnected via SLADN.

The dissertation discussed the design and implementation of this system by using conceptual methodology. At the design and implementation phase of this system faced many challenges. Dealing and understanding the end user requirements was a major concern. End users were tended to change their requirements frequently when the prototype is running. In addition to that there were many restrictions of some modules and had to concern of this scenario at the design and implementation phase. Therefore system was developed from the scratch in order to fulfill the requirements of stake

holders by using web programming languages of detailed learning of PHP, JSP (Java Scripts), HTML and MySQL database.

The system was unit tested properly at the development stages. It helped to reduce the number of defects/errors in the final product. However, while the implementation and running was in progress, errors such as run-time errors that were not anticipated in the testing plan were cropped up. Those errors would have to fix when emerged in the system.

5.3 Recommendations

One of the key objectives of this research is to make a web based tender notification System. In this context, for fully functional of the system, to optimize the resources and to improve the system, some key recommendations are listed below;

- Improve Security features on various threats
- To implementing online payment facility through payment gateway.
- To develop Mobile Applications for Management Staff

5.4 Future Work

Accessing the Tender Notification System through internet is more beneficiary to the users and it will make the task easy. But presently this Tender Notification System will be running only through SLADN. It is proposed to develop the system even accessible to the stakeholders by applying the security measures. At present Sri Lanka Army is not allow perform online payments in any means from third party. If online payment is approved the system has to improve further by implementing online payment facility through payment gateway.

Presently, there is no redundant server available. Therefore in case of a crash, it requires system down time. The system backups can be used to recover the system. But to minimize the downtime it is possible to host the system in some other server as well.

Create mobile application for Tender Notifications is another aspect that developers can work on. In modern era mobile applications are very common and most of people prefer to use smart phones. So developing a mobile application for Management to display notifications of five recent tenders' status and it will definitely beneficiary to Management for proper decision making.

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TABLE STRUCTURE OF TENDER NOTIFICATION SYSTEM

Database : db_mgo_br

Table i. Table structure for table tbl_approved_supplier

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|---------------------|--------------------|--------------------|-----------------------|
| <i>appd_id</i> | int(11) | No | |
| appd_mgo_file_ref | varchar(25) | Yes | NULL |
| appd_sup_id | int(11) | Yes | NULL |
| appd_sup_remarks | varchar(1000) | Yes | NULL |

Table ii. Table structure for table tbl_date_of_doc_ho

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|--------------------------|--------------------|--------------------|-----------------------|
| <i>date_of_doc_ho_id</i> | int(11) | No | |
| date_of_doc_ho_mgo_ref | varchar(25) | Yes | NULL |
| date_of_doc_ho | date | Yes | NULL |

Table iii. Table structure for table tbl_delivery_date

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|-------------------------|--------------------|--------------------|-----------------------|
| <i>delivery_date_id</i> | int(11) | No | |
| delivery_date_mgo_ref | varchar(25) | Yes | NULL |
| delivery_date | date | Yes | NULL |
| delivery_remarks | varchar(255) | Yes | NULL |

Table iv. Table structure for table tbl_forward_to_tender_bd

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|---------------------|--------------------|--------------------|-----------------------|
| <i>fwd_tb_id</i> | int(11) | No | |
| fwd_tb_mgo_ref | varchar(25) | Yes | NULL |
| fwd_tb_date | date | Yes | NULL |

Table v. Table structure for table tbl_doc_ho_from_dos

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|-------------------|-------------|-------------|----------------|
| <i>ho_date_id</i> | int(11) | No | |
| ho_mgo_file_ref | varchar(25) | Yes | NULL |
| ho_date | date | Yes | NULL |

Table vi. Table structure for table tbl_forward_tec

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|-----------------------|-------------|-------------|----------------|
| <i>forward_tec_id</i> | int(11) | No | |
| forward_tec_mgo_ref | varchar(25) | Yes | NULL |
| forward_tec_date | date | Yes | NULL |

Table vii. Table structure for table tbl_items_list

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|----------------|--------------|-------------|----------------|
| <i>item_id</i> | int(11) | No | |
| item_code | varchar(10) | No | |
| item_name | varchar(200) | No | |

Table viii. Table structure for table tbl_item_category_list

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|--------------------|--------------|-------------|----------------|
| <i>item_cat_id</i> | int(11) | No | |
| item_cat_code | varchar(10) | Yes | NULL |
| item_cat_name | varchar(255) | Yes | NULL |

Table ix. Table structure for table tbl_ranks

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|----------------|--------------|-------------|----------------|
| <i>rank_id</i> | int(11) | No | |
| rank_name | varchar(150) | No | |
| abb | varchar(100) | No | |
| type | int(11) | No | |

Table x. Table structure for table tbl_received_recommendation

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|--------------------|-------------|-------------|----------------|
| <i>rece_rec_id</i> | int(11) | No | |
| rece_rec_mgo_ref | varchar(25) | Yes | NULL |
| rece_rec_date | date | Yes | NULL |

Table xi. Table structure for table tbl_received_tec

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|------------------------|-------------|-------------|----------------|
| <i>received_tec_id</i> | int(11) | No | |
| received_tec_mgo_ref | varchar(25) | Yes | NULL |
| received_tec_date | date | Yes | NULL |

Table xii. Table structure for table tbl_recommandation_due_date

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|------------------------|--------------|-------------|----------------|
| <i>recomma_date_id</i> | int(11) | No | |
| recomma_date_mgo_ref | varchar(25) | Yes | NULL |
| recomma_due_date | date | Yes | NULL |
| recomma_remarks | varchar(255) | Yes | NULL |

Table xiii. Table structure for table tbl_regiments

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|--------------------|--------------|-------------|----------------|
| <i>regiment_id</i> | int(11) | No | |
| reg_name | varchar(255) | No | |
| regiment_abb | varchar(100) | No | |
| act | int(11) | No | |

Table xiv. Table structure for table tbl_suppliers

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|--------------------|--------------|-------------|----------------|
| <i>supplier_id</i> | int(11) | No | |
| supplier_ref | varchar(20) | No | |
| supplier_name | varchar(255) | No | |
| supplier_vatno | varchar(20) | Yes | NULL |
| supp_blacklist | varchar(3) | No | |
| supp_remarks | varchar(50) | Yes | NULL |

Table xv. Table structure for table tbl_tec_appointed_details

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|--------------------|--------------|-------------|----------------|
| <i>tec_id</i> | int(11) | No | |
| tec_mgo_ref | varchar(25) | Yes | NULL |
| tec_appointed_date | date | Yes | NULL |
| tec_member_type | varchar(10) | Yes | NULL |
| tec_rank_id | int(11) | Yes | NULL |
| tec_offr_num | varchar(10) | Yes | NULL |
| tec_member_name | varchar(200) | Yes | NULL |
| tec_contact | varchar(10) | Yes | NULL |

Table xvi. Table structure for table tbl_tec_due_date

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|------------------------|--------------|-------------|----------------|
| <i>tec_due_date_id</i> | int(11) | No | |
| tec_due_mgo_ref | varchar(25) | Yes | NULL |
| tec_due_date | date | Yes | NULL |
| tec_due_remarks | varchar(255) | Yes | NULL |

Table xvii. Table structure for table tbl_tender_basic_details

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|------------------|--------------|-------------|----------------|
| <i>tender_id</i> | int(11) | No | |
| mgo_file_ref | varchar(25) | Yes | NULL |
| dos_file_ref | varchar(25) | Yes | NULL |
| vote_id | int(11) | Yes | NULL |
| item_id | int(11) | Yes | NULL |
| quantity | varchar(255) | Yes | NULL |
| unit_type_id | int(11) | Yes | NULL |
| tndr_open_date | date | Yes | NULL |

Table xviii. Table structure for table tbl_tender_board_approval

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|-----------------------|-------------|-------------|----------------|
| <i>tb_approval_id</i> | int(11) | No | |
| tb_approval_mgo_ref | varchar(25) | Yes | NULL |
| tb_approval_date | date | Yes | NULL |

Table xix. Table structure for table tbl_unit_types

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|----------------|--------------|-------------|----------------|
| <i>unit_id</i> | mediumint(9) | No | |
| unit_name | varchar(50) | No | |
| unit_desc | varchar(100) | Yes | NULL |

Table xx. Table structure for table tbl_user_location

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|---------------|-------------|-------------|----------------|
| <i>loc_id</i> | int(11) | No | |
| loc_name | varchar(50) | Yes | NULL |
| loc_status | int(11) | Yes | NULL |

Table xxi. Table structure for table tbl_user

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|----------------|--------------|-------------|----------------|
| <i>user_id</i> | int(11) | No | |
| user_f_name | varchar(50) | Yes | NULL |
| user_l_name | varchar(50) | Yes | NULL |
| user_email | varchar(50) | Yes | NULL |
| user_type_id | int(11) | Yes | NULL |
| user_loc_id | int(11) | Yes | NULL |
| user_name | varchar(50) | Yes | NULL |
| user_password | varchar(100) | Yes | NULL |
| user_status | int(11) | Yes | NULL |

Table xxii. Table structure for table tbl_user_type

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|------------------|-------------|-------------|----------------|
| <i>u_type_id</i> | int(11) | No | |
| u_type | varchar(20) | Yes | NULL |
| u_status | int(20) | Yes | NULL |

Table xxiii. Table structure for table tbl_vote_master

| <u>Field</u> | <u>Type</u> | <u>Null</u> | <u>Default</u> |
|----------------|--------------|-------------|----------------|
| <i>vote_id</i> | int(11) | No | |
| vote_head | varchar(30) | No | |
| vote_name | varchar(100) | No | |

Table xxiv. Table structure for table tbl_bid_details

| <u>Field</u> | <u>Type</u> | <u>Null Default</u> |
|----------------------|--------------------|----------------------------|
| <i>bid_id</i> | int(11) | No |
| bid_mgo_ref | varchar(25) | No |
| bid_supp_code | varchar(25) | No |
| bid_tec_spec | text | No |
| bid_unit_price | double | No |
| bid_novat_total | double | Yes NULL |
| bid_total_vat | double | Yes NULL |
| bid_withvat_total | double | Yes NULL |
| bid_sample | varchar(3) | No |
| bid_bond | varchar(3) | No |
| bid_valid | varchar(3) | Yes NULL |
| bid_price_valid | varchar(3) | Yes NULL |
| prod_country | varchar(25) | No |
| prod_brand | varchar(25) | No |
| prod_model | varchar(25) | No |
| manu_year | varchar(4) | Yes NULL |
| max_days_for_service | varchar(3) | No |
| pres_mkt_price | double | No |
| bid_comply | varchar(3) | No |
| bid_recomm | varchar(3) | No |
| bid_comments | varchar(255) | No |