Web-based procurement handling system for NIBM

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Web-based procurement handling system for NIBM

A dissertation submitted for the Degree of Master of Information Technology

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University of Colombo School of Computing

2021

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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This is to certify that this thesis is based on the work of

~~Mr./~~Ms. R.M.E.A.Rathnayaka
under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name: Dr.(Mrs) Thushani A Weerasinghe.

Signature: Date: 30-11-2021

ABSTRACT

The National Institute of Business Management (NIBM) is a leading higher education institute in Sri Lanka that operates as a statuary body under the Ministry of Skills Development, Vocational Education, Research, and Innovation. NIBM owns its main campus at Colombo 07 and six other regional campuses at Kandy, Kurunegala, Galle, Matara, Kirulapone, and Peradeniya.

Each non-academic department of NIBM supports its academic departments to accomplish the main vision of NIBM to facilitate a better education to the nation by facilitating a magnificent environment for all their students. The procurement department of NIBM plays a major role in building the environment. As the NIBM operates under a government ministry, it should also follow government procedures in its daily engagements. The requirement of following a set of old procedures and doing many more manual routines are the main reasons for the department's inefficiency.

The proposed system has been started to develop to increase the efficiency of the department by digitalizing their routine jobs according to the Sri Lankan government procedures. This system will help NIBM to increase the department's efficiency by completing tasks sooner.

As the system is a web-based system, people at the department and any employee of NIBM can access it from anywhere. Also, as the system's database is centralized, the department head will get all requests from any regional campus at the same time they requested. Therefore, this system will help all people at NIBM from the beginning of the procurement process till it completes. This system will allow the NIBM management for their future decision-making.

As the system is used many latest technologies, users of the system will get a user-friendly environment in their procurement process.

The implemented system is used the agile methodology in the development process by considering all advantages over other methodologies. The system was developed as a web-based application since NIBM includes several branches in their network to be managed in real-time on a centralized server. To develop the web-based application, the project used ASP.net MVC technologies in the .Net framework. HTML, CSS, Bootstrap, and JavaScript were used to develop the frontend, and SQL Server was used to manage the database of the system.

ACKNOWLEDGMENTS

I would like to express my deepest appreciation and gratitude to all those who provided me necessary guidance and support to complete my project successfully. At the very first time, I would like to thank the course coordinator of the MIT program and the academic staff of UCSC for giving me this valuable opportunity to follow this recognized master's degree program and provided me with the guidelines for successful completion.

I extend my sincere gratitude to my supervisor, Dr Thushani Weerasighe for constant guiding, motivating, and supervising me throughout the development from the beginning of the project. And also, I would like to thank my advisor Mrs G.C.Wickramasinghe for advising me all the time when I needed it.

Furthermore, I extend my heartfelt thanks to Mr Jayathilaka the Head of the Procurement Department, Mr Kolitha Ranawaka the Director SOB, Mr Saman Rodrigo the Director-HRM, and the Management Assistants Ms Kumari De Mel, Ms Piumi Fernando of NIBM for helping me during the project by providing me with the required data to make this project successful.

Finally, I thank my friends and family for helping me to make this project a success.

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LIST OF ACRONYMS

NIBM – National Institute of Business Management

TEC – Technical Evaluation Committee

HOD – Head of the Department

DG – Director-General

HR – Human Resource Management

HTML – Hypertext Markup Language

CSS – Cascading Style Sheet

SQL – Structured Query Language

MA – Management Assistant

ER – Entity Relationship

ERP – Enterprise Resource Planning

PO – Purchase Order

UI – User Interface

ASP – Active Server Pages

MVC – Model View Controller

UAT – User Acceptance Testing

UML – Unified Modeling Language

SDLC – Software Development Life Cycle

DB – Database

GUI – Graphical User Interface

URL - Uniform Resource Locator

LINQ - Language-Integrated Query

DOU – Digital Operations Unit

1 CHAPTER – INTRODUCTION

This chapter describes the introduction related to the project of a web-based procurement system for NIBM. The project overview describes the company, its current process, and its drawbacks. Additionally, the chapter includes a feasibility study regarding the project process and the dissertation structure of the project.

1.1 Project Overview

The National Institute of Business Management (NIBM) provides its services to the nation since 1968. With a legacy of over 50 years of service in higher education, it is focusing on the professional practice gaps in the fields of Management, Information Technology, Engineering, Design, and Languages. Currently, the NIBM operates as a self-financed statuary body under the Ministry of Skills Development, Vocational Education, Research, and Innovation. It is also recognized as one of the higher educational institutes to be awarded ISO 9001-2015 which certifies that its processes and systems are according to the internationally recognized standards.

Currently, all operations of NIBM are carried out through six campuses covering four main regions of the country. The principal place of the business is situated at Colombo 07. Apart from two campuses located in Colombo, they serve their customers through other campuses located in Kandy, Kurunegala, Galle, Matara, and Peradeniya. All the above campuses include all main academic departments. Apart from academic departments, non-academic operations are handling through other departments located in the Colombo campus. Non-academic departments can be listed as Examination, Maintenance, Digital Operations Unit (DOU), HR and Administration, Finance, Marketing, Stores, Software Development Unit (SDU), and Procurement.

All mentioned non-academic departments are receiving several kinds of internal requests such as maintenance, new procurement, etc. Similarly, some of the above departments will receive requests from external parties such as parents and students. Currently, NIBM handles all mentioned requests manually and without having proper process or documentation.

Among others, the procurement department plays a unique role in NIBM, which uses the government purchasing (Commission, 2018) guidelines including technical committee evaluation. The whole process of procurement going forward is a manual process starting from user request till it ends to purchasing.

Due to the department is not automated, it has now led to many issues in their process (claritum.com, 2018) and tracking their services in several ways to top management and to themselves.

1.2 Motivation

As the procurement process of NIBM is a manual process, it leads to many issues to their business process such as delays in completing a request, misplacements of documents, communication mismatches and, etc.

As a practice, the procurement department is handling all internal requests through emails or memos from individuals or a department. Due to lacking recording user requests, sometimes these requested documents will get misplaced or delayed in a proceeding by the procurement department. Also, they serve First in Last Out basis due to their manual process.

During the process of purchasing, the department maintains a vendor list and they normally call for quotations from the registered vendors, by notifying the deadline and the tender opening. In the quotation calling process, some of the most suitable vendors will get missed in sending quotations as procurement department staff is doing it manually.

The staff of the department is facing the major issue of keeping remembering deadlines of quotation open dates and times. They are looking for a notification system to get reminders on quotation deadlines. Due to the mentioned issue, the department is currently maintaining an MS excel document, and it is also not appropriately updated by themselves.

Appointing a technical committee and following up to prepare the TEC document is also not properly functioning because the staff at the procurement department lack technology. Finding past TEC records and TEC recommendations also becomes more time have-consuming to go through their manual file system.

The procurement department takes a long period to process the same request the same has proceeded with in the last three months. According to government guidelines, the procurement department is authorized to proceed with the same quotation for a similar request which has already proceeded during the last three months. But due to the time-consuming finding the same quotations within their manual file system, the procurement department is now not effectively working on that process and will process a new quotation open without attending to process the same quotation. Opening a new quotation consumes more time than finding the same on their file system and the whole procurement process will take many months to complete the same request.

Also, the management of NIBM or the head of its department is currently unable to track the ongoing procurement processes on time as data is not available in one place. Due to this tracing the staff's efficiency at the department is not properly workout during their performance evaluation.

Also, the requester never gets any update regarding his request from the procurement department. Therefore, they are not in a place to get any action regards delays, and if the request is completed, they are also not in a position to give their feedback. Due to this issue, the procurement department is unable to measure the user feedback on their duty.

1.3 Goal and Objectives

The goal of the project is to provide a digitalized platform to the NIBM procurement department to shift their paper-based environment to a fully automated computerized system.

The following objectives were defined to achieve the above goal.

- Increase the efficiency of the department's administrative tasks by reducing manual paper delivery processes.
- Increase the efficiency of procurement department duties by increasing the user involvement more than in the manual system. The proposed system will implement with a notification system to the requester from the order request started until it is complete. At the completion level, users will be able to record their feedback.
- Make the process more transparent and flexible to the requester and the immediate supervisor. The system proposed a way to access from anywhere of the NIBM without passing internal memos or emails with an approval cycle to the requester's immediate supervisor.
- Resolve a major issue of misplacements and delays of requests, the proposed system will store data securely and in one place.
- Increase the data security and availability of tender documentation and vendor details than the manual system.
- Reduce the time consuming during the report creation by collecting data from several places in the manual system. The proposed system will provide a facility to the managerial staff of NIBM to generate reports and visualization of live dashboards for the procurement duties in one central place.

1.4 Scope of the study

The project aims to automate the manual process of the procurement department at the NIBM from user request handling to TEC-approved vendor awarding.

The proposed system will allow any employee of the NIBM to request a new purchase. But the purchasing will proceed depending on the immediate supervisor of the requester's approval. The office assistant of the Procurement department will get access to the approved request notifications through the system.

The proposed system will include a live dashboard to show notifications and major visualizations to the procurement department and the management of NIBM using data visualization tools such as charts.

When the procurement process is ongoing, the head of the department will involve on-call for a quotation for selected vendors for a request if the request is using tender procedure after the request gets approval from the DG or Director HR. Vendor details, Tender details, and tender closing data also need to be managed through the system. Tender closing notifications need to be handled to remind the department regarding tenders.

The system will provide a facility for the procurement department to send emails by attaching a tender document and closing date notifications to vendors in the same category. An office assistant on the system will manage the tender quotation summary. The system will keep vendor quotation details as a summary without supporting scanned documents. The head of the procurement department will get access to appoint a technical evaluation committee for any tender.

Awarding of the technical evaluation process will be maintained on the system and final award letter generation will be automated in the system. Award approval cycle will be integrated into the system, so the Director-General of NIBM or the Board Members of the NIBM will be able to approve the awarded party using the system.

All staff of NIBM has to get access to the system to make a request and to get notified regarding the requests. The updated status of the requests will be shown to the requester, and he/she will be able to give feedback regarding the request once the procurement process is completed.

Within the scope of the project, the system will grant access only to the NIBM employees, including the procurement department staff.

Out of the Scope

The proposed system will not include the following due to resource limitations and the deficiency of time.

- Distributing materials from the stock to the requesting department.
- Generating reports when the materials are received.
- The system will not support money transfers.
- The system will not support resources repairs.
- System availability to tenders to submit online tender documents and online tender winner details.

1.5 Feasibility Study (Bridges, 2019)

1.5.1 Financial Feasibility

The product will have a hosting cost. Also, the system consists of several multimedia data transfers. Therefore, this requires cloud data storage to store the transferred multimedia files.

As the NIBM is a partner of Microsoft, OneDrive cloud space can be used for data storing.

Besides the associated cost, there will be many benefits for the department of procurement. Especially the extra effort associated with the procurement request process will be significantly reduced since reports generated are fully automated.

Therefore, the project is financially feasible.

1.5.2 Technical Feasibility

The following technologies will be used as the project is a complete web-based application.

- HTML
- CSS
- JavaScript
- SQL Server
- .Net
- Diagram drawing tools
    - Visio
    - Microsoft Project
    - Draw.io
    - Just-in-mind

Each of the technologies is freely available and the technical skills are manageable. Therefore, the project is technically feasible.

1.5.3 Resource Feasibility

Resources that are required for the project are as follows.

- Programming device – Laptop
- Programming tools – Freely available
- Programming individuals
- Cloud storage – Available at NIBM
- Hosting space – Available at NIBM

As the project has required resources, this is resource feasible.

1.6 Structure of the thesis

- Chapter1. Introduction
    - This will include a brief introduction to the project.

- Chapter 2. System Analysis
    - The chapter will include requirement analysis, a review of similar systems.

- Chapter 3. System Design
    - The chapter will include the proposed system design with related UML diagrams, prototype designs, and its high-level architecture.

- Chapter 4. Development and Implementation
    - The design of the system will be discussed including important codes and the test plan.

- Chapter 5. Evaluation
    - The chapter will be discussed whether the project objectives were satisfied and if not, the reasons for them. Lessons learned during the project and failures and reasons for failures.

- Chapter 6. Conclusion
    - The chapter will include the work indicating a summary of the results of the project.

1.7 Summary

The first chapter of the thesis discussed the basics of the entire project implementation. It presented the current problem, which is manual processes. Hence, the utmost aim of this project is to supply a feature-rich digital solution to manage limited resources efficiently and effectively in the procurement department of NIBM.

2 CHAPTER – SYSTEM ANALYSIS

This chapter describes and analysis step of the project. The existing system was analyzed by gathering and analyzing the user requirements of the procurement department of the National Institute of Business Management (NIBM), Sri Lanka. The procurement department of NIBM is located at their main campus at Colombo 07 and facilitates their services to all six campuses of NIBM around the country.

Approval obtained to use the company details attached on the Appendix E.

2.1 Current System Study

Among others, the procurement department plays a unique role in NIBM, which uses the government purchasing guidelines including technical committee evaluation. The whole process of procurement going forward is a manual process starting from user request till it ends to purchasing.

Since the department process has not been automated, it has now led to many issues in their process and tracking their services in several ways to top management and themselves.

This project will be designed to overcome the department's process issues by automating their process from request gathering till the end to purchasing under the government and NIBM's guidelines.

2.1.1 Contextual Background

The Procurement department of NIBM plays a huge role in the whole institute by managing all purchasing requests including their branches. As it is a manual process, the current process of the procurement department is as follows.

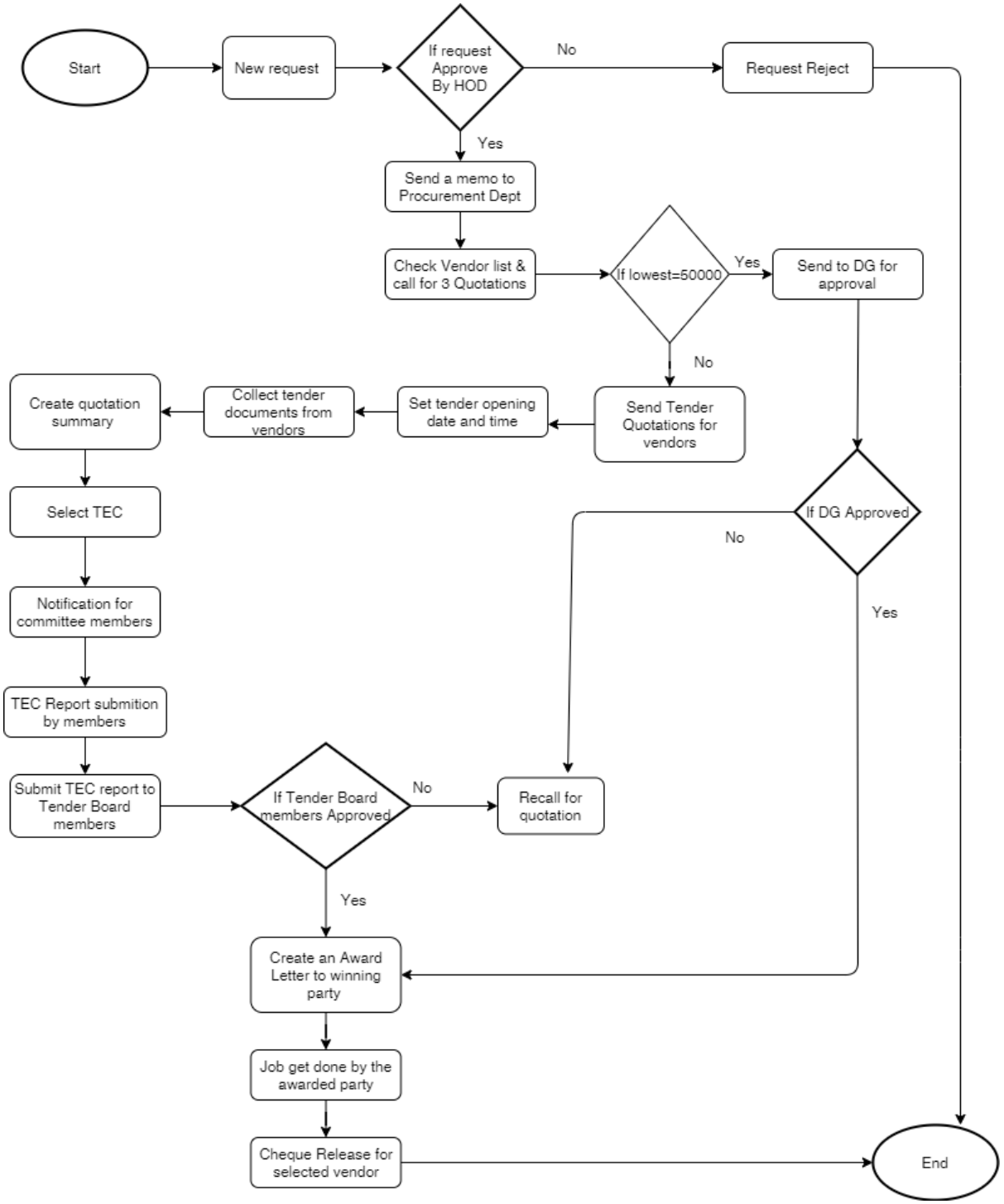


Figure 2.1: Data Flow Diagram of the Current Process

Referring to Figure 2.1 attached above, a request to the procurement department for a new purchase can be made by any employee of the NIBM with the immediate supervisor's approval. If the immediate supervisor rejects the request, the procurement department will not attend to it.

Once the approval level increased, the request is sent to the procurement department manually. The HOD of the procurement department will attend to the request by calling for 3 quotations

from selected vendors after getting approval from Director HR and Director General of NIBM. The supervisor of the procurement department is authorized to reject a user request if the request is incomplete. However, the procurement department supervisor is not authorized to accept any request without the approval of HR or DG.

Vendors are listed on an excel sheet in the procurement department. If the lowest quotation is stated as lower than Rs.50,000/-, the DG of the NIBM has the authority to approve it and get the job done by the mentioned vendor. If all quotations are not at the approval level of DG, the HOD of the procurement department has to proceed with government procurement guidelines. He will call for the quotations from his selected vendor list and set the tender closing date and time.

Apart from vendor quotation calling, the procurement department is using two other options such as "Completed by Petty cash" and "Completed by Advance" for such requests which are at a high priority level. Also, if the same kind of product is purchased recently (within the last 3 months) from one of the vendors, the departmental supervisor is authorized to proceed with the same quotation with DG's approval without calling quotations again.

Once all quotations are collected and the tender is closed, HOD will immediately appoint a TEC to evaluate quotations and TEC will submit the report by awarding a vendor. TEC report should be submitted to the tender board of NIBM to get approval. If approved, the procurement department will send an awarding letter to the selected vendor, and they will attend to processing the purchasing.

2.1.2 Use Case of the current system

The employees from all other departments except the procurement department of all branches of the NIBM are engaging in the procurement process as requesters at the beginning and the purchasing orders are processed upon the approval of their immediate supervisors.

The use case diagram of the purchasing process is shown in Figure 2.2.

Referring the Figure 2.2 the requester, the immediate supervisor of the requester, HOD, and MA of the procurement department, and TEC members will be directly involved in the system as actors.

The process is beginning according to a request from an employee, and it needs to get approval from the immediate supervisor of the requested employee. The purchasing process will begin after receiving the mentioned approval. The HOD of the procurement department will be involved in quotation calls and TEC appointment processes. According to TEC's recommendation and the tender board's approval purchasing process will get started.

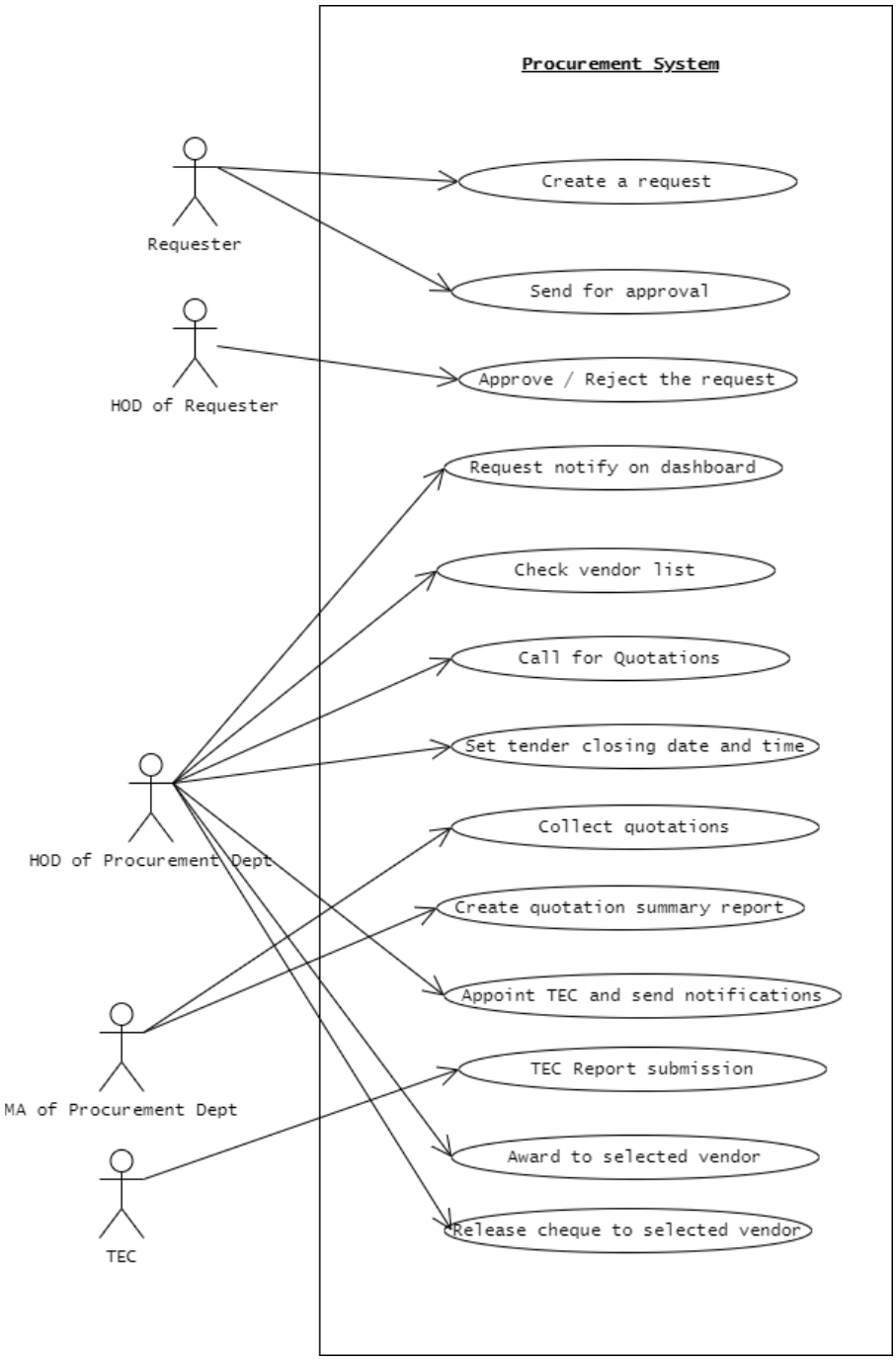


Figure 2.2: Use Case diagram of the current system

2.2 Data Collection Procedures

Techniques to find facts and gather requirements from the department used the following.

- Interviews
- Observations
- Inspecting existing documents

2.2.1 Interviews

The HOD and the Management Assistant of the procurement department, three employees from three branches of the NIBM were interviewed to gather facts as it is the best way of gathering information for an existing process. Summary of interviews shown below.

Interview 1:

Interviewer	R.M.E.A.Rathnayaka
Interviewee	The HOD of the Procurement Department The Management Assistant of the Department
Venue	NIBM, Colombo 07
Date	10th -20th December 2020
Time Duration	4 Hours
Information & Decisions	• The existing manual process of the Department. • The problems that occur with the existing system. • Solutions to overcome the issues of the current manual process.

Table 2.1: Interview Details 1

Interview 2:

Interviewer	R.M.E.A.Rathnayaka
Interviewee	Director of SOB – Colombo Branch Management Assistant of SOCE – Galle Branch Assistant Programs Director – Kandy Branch
Venue	NIBM, Colombo 07, Galle and Kandy
Date	16th -30th December 2020
Time Duration	3 Hours
Information & Decisions	• Existing manual process for procurement requests. • The problems that occur with the existing system. • Solutions to overcome the issues of the current manual process.

Table 2.2: Interview Details 2

2.2.2 Observations

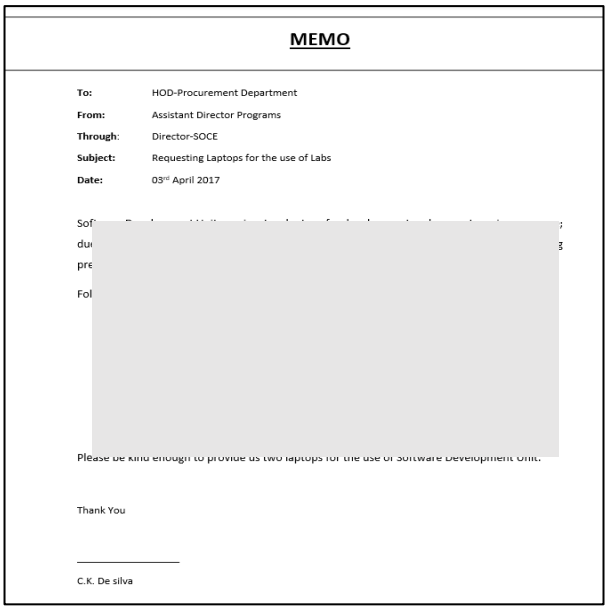
The observation was a very supportive method to understand the current business process. It gave a good understanding of their office tasks, workflows, and their communication methods related to the process.

2.2.3 Inspecting Existing Documents

Inspecting existing documents is a common fact-finding technique that can use to understand the existing process easily. Following are some of the documents which exist at the procurement department.

- Procurement Request Memo.

Figure 2.3 refers to a manual memorandum created by the requester regarding a purchase request. Once the HOD (the person who is appointed as "through" in the header) is approved this will be received by the HOD of the procurement department.



MEMO

To: HOD-Procurement Department
From: Assistant Director Programs
Through: Director-SOCE
Subject: Requesting Laptops for the use of Labs
Date: 03rd April 2017

Thank You

C.K. De silva

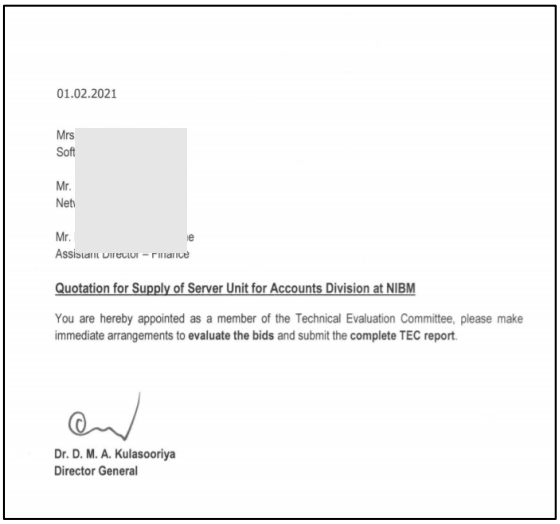
Figure 2.3: Request Memo

- Tender Quotation.

This is a manual document used to send for vendors by the procurement department, informing that the tender is opened to bid.

- TEC Appointment Letter.

Figure 2.4 refers to the manual document which is sending by the procurement department to the TEC members by informing them that they are appointed as a Tender Evaluation Committee member.



01.02.2021

Mrs
Soft

Mr.
Net

Mr.
Assistant Director – Finance

Quotation for Supply of Server Unit for Accounts Division at NIBM

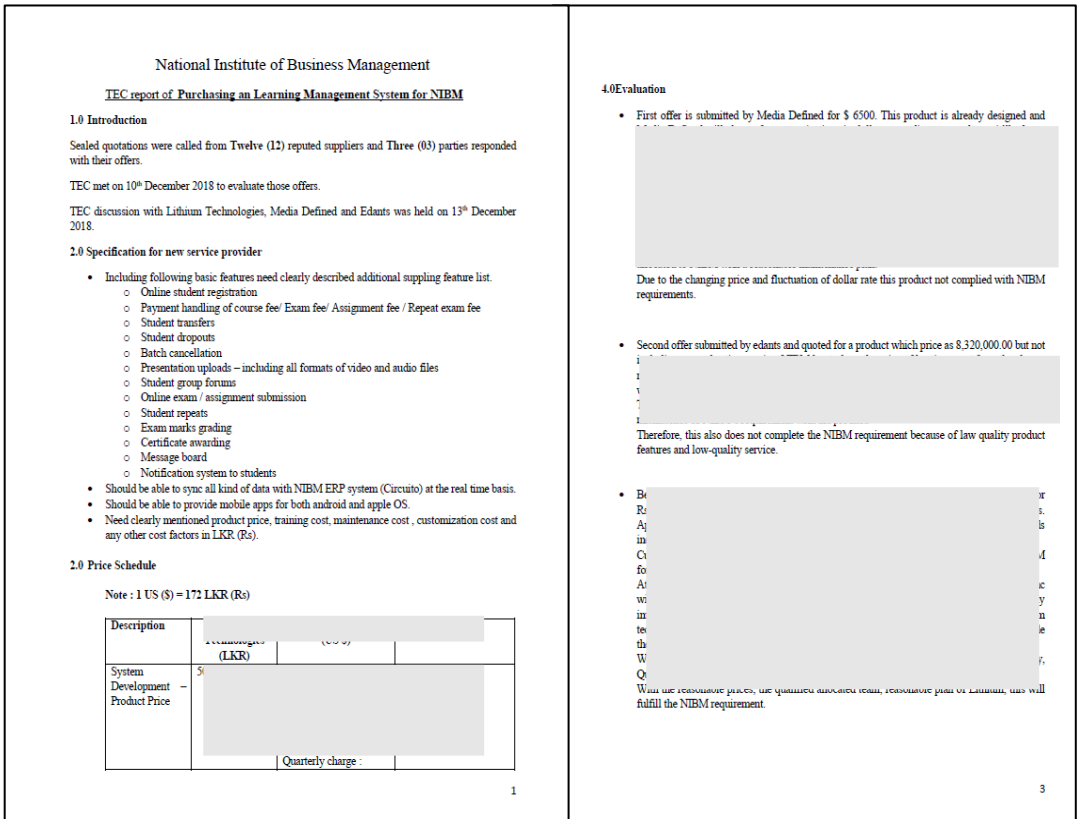
You are hereby appointed as a member of the Technical Evaluation Committee, please make immediate arrangements to **evaluate the bids** and submit the **complete TEC report**.

Dr. D. M. A. Kulasooriya
Director General

Figure 2.4: TEC Appointment Letter

- TEC Recommendation Memo.

Figure 2.5 refers to a manual TEC recommendation report which is submitting by the TEC members to the procurement department. This report includes the selected vendor details and reasons in detail for not selecting other vendors.



National Institute of Business Management

TEC report of **Purchasing an Learning Management System for NIBM**

1.0 Introduction

Sealed quotations were called from **Twelve (12)** reputed suppliers and **Three (03)** parties responded with their offers.

TEC met on 10th December 2018 to evaluate those offers.

TEC discussion with Lithium Technologies, Media Defined and Edants was held on 13th December 2018.

2.0 Specification for new service provider

- Including following basic features need clearly described additional suppling feature list.
  - Online student registration
  - Payment handling of course fee/ Exam fee/ Assignment fee / Repeat exam fee
  - Student transfers
  - Student dropouts
  - Batch cancellation
  - Presentation uploads – including all formats of video and audio files
  - Student group forums
  - Online exam / assignment submission
  - Student repeats
  - Exam marks grading
  - Certificate awarding
  - Message board
  - Notification system to students
- Should be able to sync all kind of data with NIBM ERP system (Circuito) at the real time basis.
- Should be able to provide mobile apps for both android and apple OS.
- Need clearly mentioned product price, training cost, maintenance cost , customization cost and any other cost factors in LKR (Rs).

2.0 Price Schedule

Note : 1 US ($) = 172 LKR (Rs)

Description			
	(LKR)		
System Development – Product Price			
		Quarterly charge :	

1

4.0Evaluation

- First offer is submitted by Media Defined for $ 6500. This product is already designed and

Due to the changing price and fluctuation of dollar rate this product not complied with NIBM requirements.

- Second offer submitted by edants and quoted for a product which price as 8,320,000.00 but not

Therefore, this also does not complete the NIBM requirement because of law quality product features and low-quality service.

-

fulfill the NIBM requirement.

3

Figure 2.5: TEC Recommendation Memo

2.3 Functional Requirements

Functional requirements are the essential functionalities that should fulfil in mainly in the software as the customer expected.

The following are recognized as functional requirements of the users of the system.

Functions based on Requesting user:

- The system should provide a facility to create a new procurement request for any employee of the NIBM.
- The system should provide a facility to get the approval for the added request by appropriate parties.
- The requester should be able to add any document regarding the request at the time of the request.
- The system should facilitate all requested employees to search for the status of the request.
- The requester should be able to add feedback once the procurement process is completed.

Functions based on Heads/Directors:

- Immediate supervisors should be able to get notified regarding their pending request approvals.
- The system should facilitate making remarks when approving or rejecting the request.
- The system should provide a facility to get a complete view of the request including any attachments at the approving event.

Functions based on HR Director/Director-General:

- The system should provide the facility to approve or reject bulk requests at a time once the immediate supervisor recommended them.
- The system should facilitate making remarks when approving or rejecting the request.
- The system should provide a facility to get a complete view of the request including any attachments at the approving event.

Functions based on Head or MA of the Procurement department:

- The procurement department should be able to get notifications regarding newly added requests and their approval status.
- The request needs to be able to update to an indicator as the “procurement department received”.
- The system should facilitate the procurement department users to select the procedure of the requested new order.
- The system should follow the guidelines of the procurement process once the department received the request.

- The system should allow the facility to generate managerial reports and request wise reports to the procurement department users.

2.4 Non-Functional Requirements of the System

Following non-functional requirements need to be satisfied within the system to help the functions of the system to behave effectively.

- Security
- Usability
- Efficiency

2.4.1 Security

As the procurement process is aligned to government procurement guidelines, records need to be more secured and safer. Also, these records are auditing by ISO, and government audit all documents and data need to be collected and kept confidentially. Therefore, security is the main concern according to the requirement.

2.4.2 Usability

To accomplish this requirement, the system needs to be more user-friendly through interfaces. Therefore, the system needs to be designed according to the good practices of UI/UX designing to get more attraction from users.

2.4.3 Efficiency

As the existing process caused huge delays for the department's tasks, the designed system needs to be able to overcome it through the system. The designed system should be supported to keep all records in one centralized database and should be able to notify the department users, to make their process streamline.

2.5 Review of Similar Systems

Google has listed down several Procure to Pay Software products. As per (trustradius.com, 2021), "Kissflow Procurement Cloud" and "Precoro" products winning the best e-procurement software in 2020 among others.

2.5.1 Precoro: (precoro.com, 2021)

As per user comments related to the "Precoro" product, it makes it easy to create requisitions and place orders. Also, reports of "Precoro" are easy to integrate with third-party business systems like ERP platforms.

The product consists of the following features and can integrate with QuickBooks Online, Xero, NetSuite, etc.

- Purchase Requests
    - All the requests are in one place
    - Clear statuses
    - Streamlined approval workflow
    - Ecommerce experience with a product catalogue
    - Request analytics
- Purchase Orders
    - Automatic Purchase Order creation
    - Instant conversion of Requests into Orders
    - Automatic supplier sending
    - File attachments, PO export
    - Internal comments
- Approval Workflow
    - Customizable approval workflow
    - Approvals on locations, departments, custom fields
    - Smart notifications
    - Thresholds and policies for a precise routing
    - Mobile on-the-go approvals
- Budget Management
    - Budget for locations, departments, custom fields
    - Automatic budget limits
    - Insightful reports
    - Real-time budget control with a progress bar
    - The bulk upload and management
- Inventory
    - Warehouse management
    - Stock tracking
    - Goods receipts on the warehouse

- Stock requests and approvals
- Stock transfers

- Supplier Management
  - Suppliers Portal
  - Infinite product catalogue
  - Contract Management
  - Reports on supplier performance
  - Supplier's list and contact storage

But the product does not include the tender process which NIBM is highly looking for.

Some of the user interfaces of the product are as follows.

Figure 2.7 refers to a list of purchase orders created with a notification label of pending approval and a create button to proceed for a new order. The filtering option is also available here to filter the list of orders.

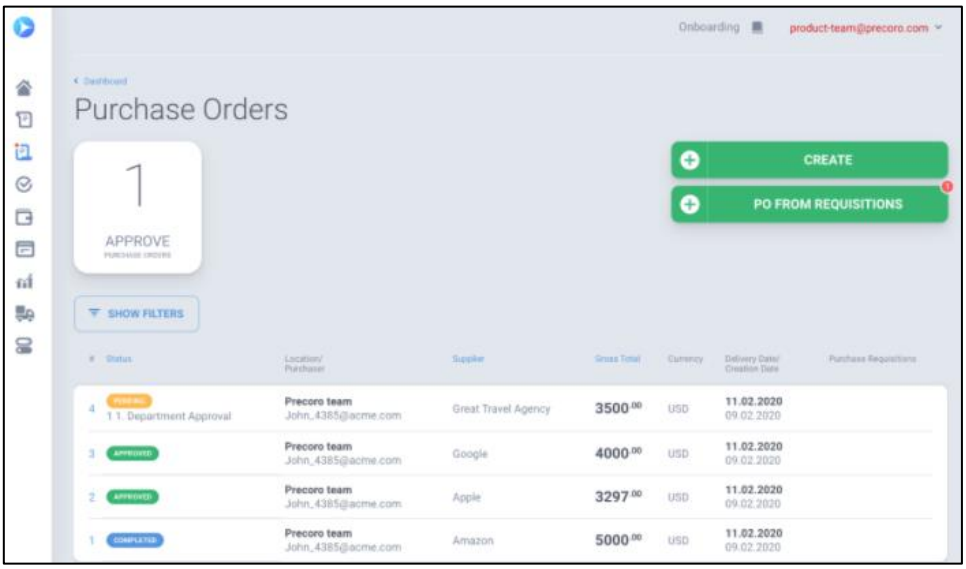


Figure 2.6: Precoro UI - 1

Figure 2.8 refers to the purchase requisition shows to the purchasing department in Precoro software. Department staff can confirm the requisition using the UI. When confirming they can add documents and add more products to the same list of items in the requisition.

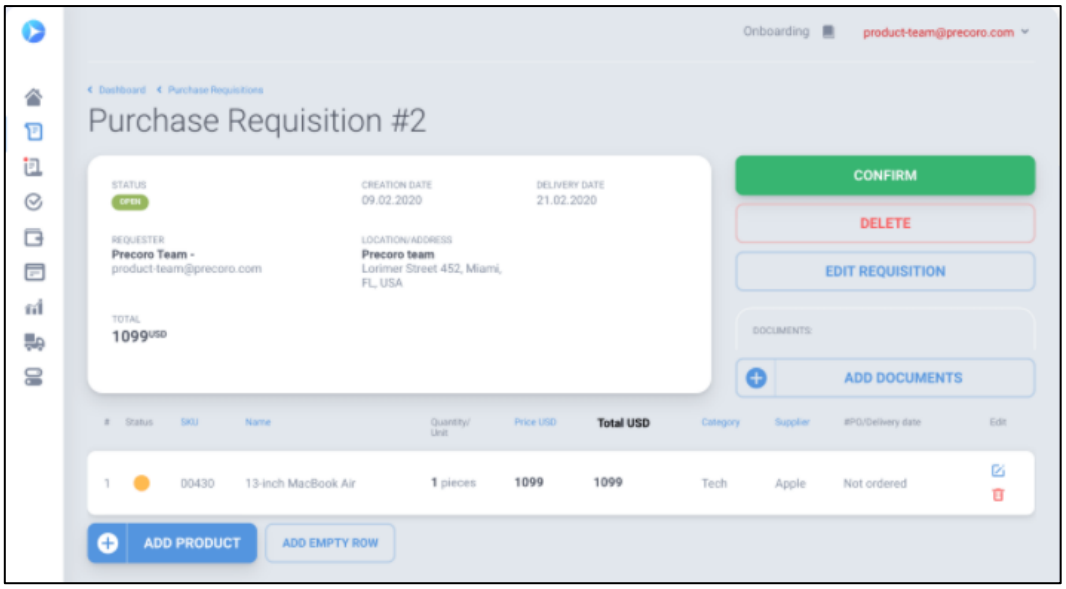


Figure 2.7: Precoro UI - 2

Figure 2.9 refers to the UI of add suppliers of the Precoro product.

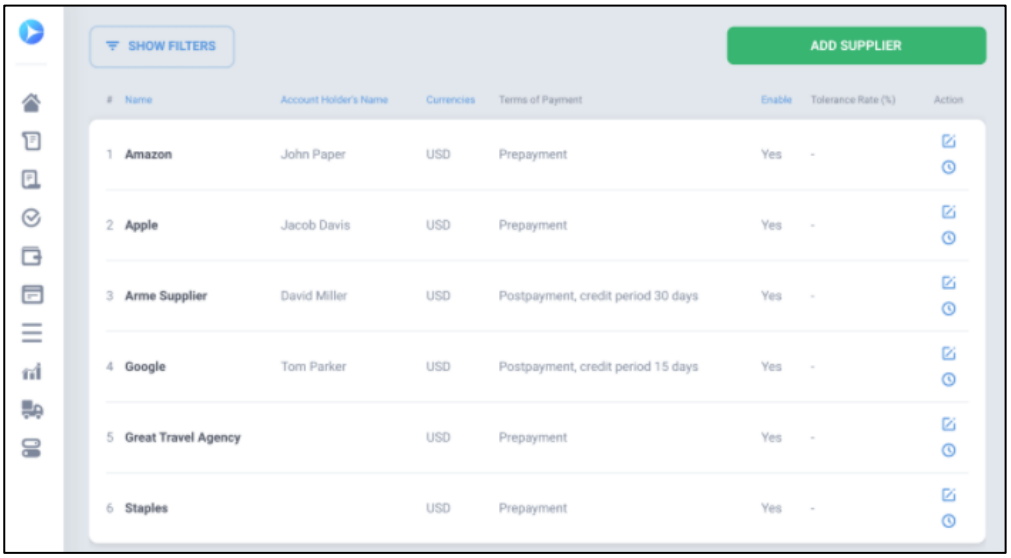


Figure 2.8: Precoro UI - 3

2.5.2 Kissflow Procurement Cloud: (Anon., 2021)

This product consists of many features related to the procurement process and as per user comments, it is very much easy to use and good for smaller companies as a replacing tool for their manual process.

“Kissflow Procurement Cloud” product consists of the following features.

- Dynamic approvals
- Rule-based workflows
- Automated three-way matching
- Real-time budget tracking
- Spend management
- Supplier management
- Spend analytics & reporting
- Mobile app
- Comprehensive audit logs
- Role-specific user permissions

However, this product also does not include the tender process which is in use highly by the NIBM procurement department. The product’s starter pack is available for $690.00 for up to 100 users to purchase. A free trial is also available for 14 days.

Some of the user screens of the product are as follows.

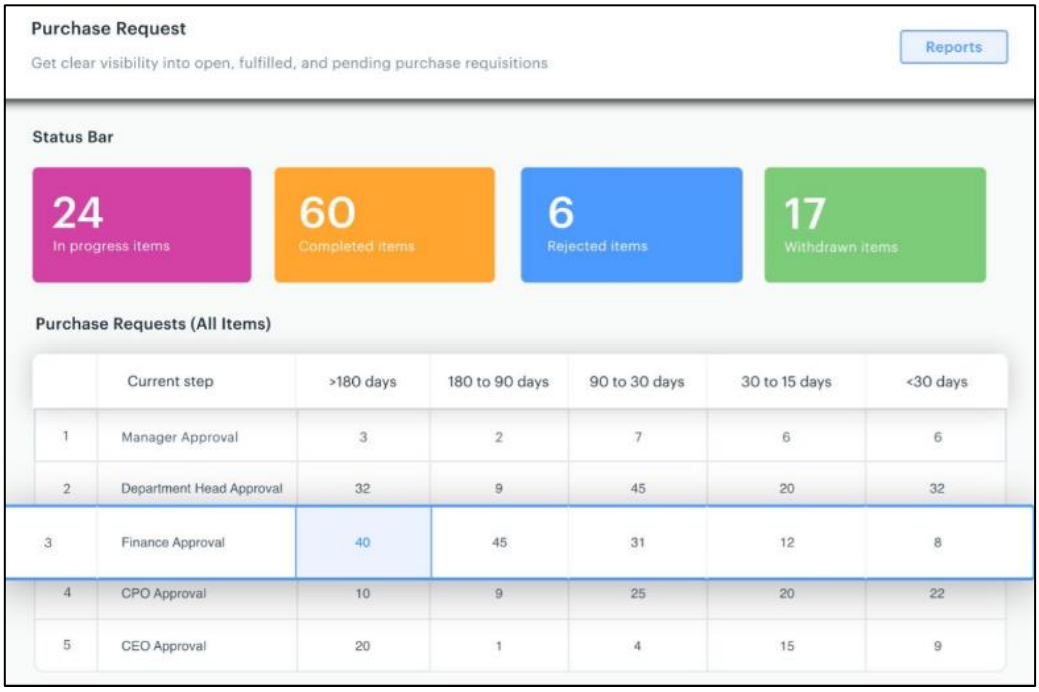


Figure 2.9: Kissflow UI - 1

Figure 2.10 refers to the purchase requests UI of Kissflow software. The interface gives a numerical dashboard for each status of requests to increase user-friendliness.

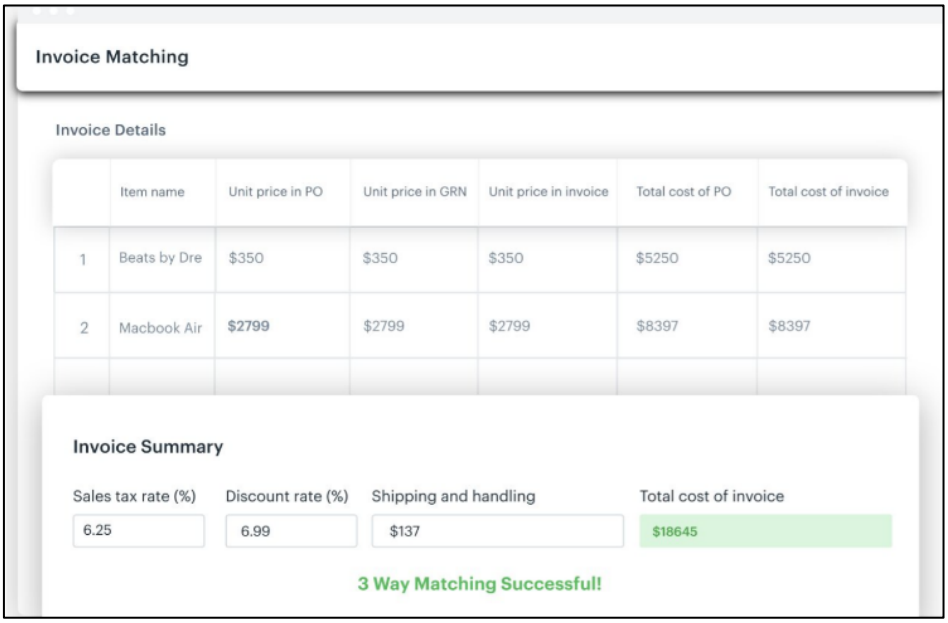


Figure 2.10: Kissflow UI - 2

Above Figure 2.11 refers to the invoice matching of past requests. If the same kind of invoice matched the searching request, the kiss flow software helps the user to find them.

Figure 2.12 refers to the vendor registration of the product.

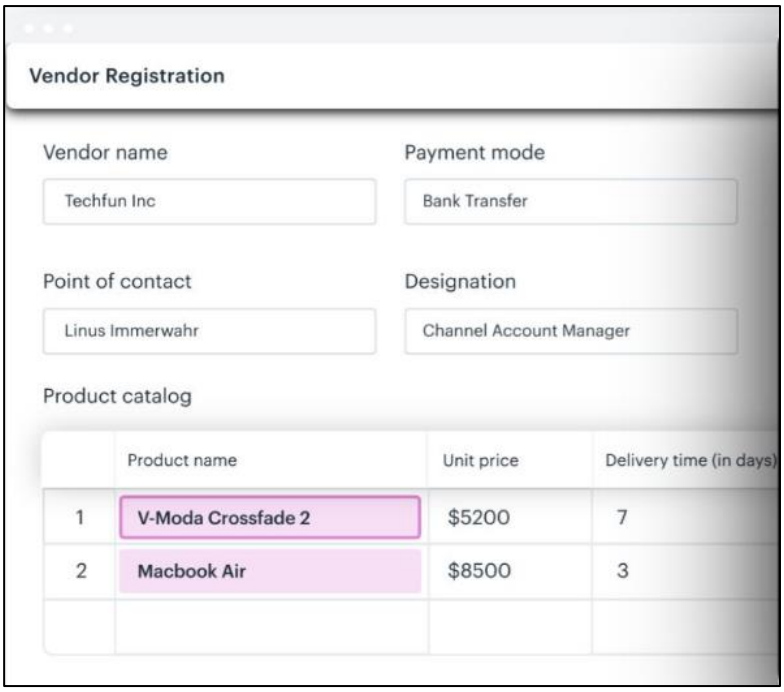


Figure 2.11: Kissflow UI - 4

Figure 2.13 refers to the purchase order creation for a purchase request in the kiss flow product.

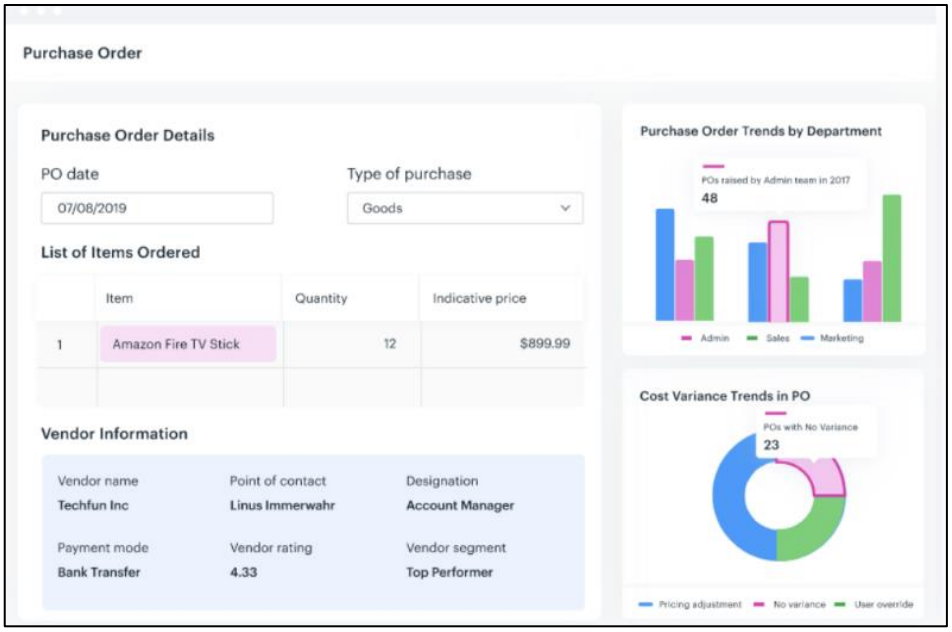


Figure 2.12: Kissflow UI - 3

Apart from “Kissflow” and “Precora” products, the following are similar software products that are used to automate procurement services.

2.5.3 SAP Ariba Procurement

2.5.4 JAGGAER (formerly SciQuest)

2.5.5 Coupa

All the above procurement management software provides several key benefits. It centralizes the purchasing, invoicing, and documentation processes, which can generate immense efficiencies for larger organizations and production-focused businesses. It also gives the businesses better visibility into their spend patterns and management, catching wasted spend or suspected fraudulent spending in the process.

All procurement software is providing businesses with the ability to manage suppliers and invoicing, digitally managing the accompanying documentation, and establish some level of automated workflows to streamline procurement.

Most of the above-mentioned procurement software has developed more extensive native reporting tools around spending, inventory, and efficiency. However, not all of them have invested in analytics to the same degree, or around the same functions.

As businesses can vary dramatically in their exact procurement environments, from the materials being sourced to the necessary approval processes to the most valuable reporting features. Also, it is very much important that most of the above products are customizable to unique business environments upon a customizing cost.

Product Comparison:

Features	**Precoro**	**Kissflow Procurement Cloud**	**SAP Ariba Procurement**	**JAGGAER**	**Coupa**
Request Management	✓	✓	✗	✗	✗
Dynamic approval process	✓	✓	✗	✗	✗
Evaluation process	✗	✗	✗	✗	✗
Purchasing process	✓	✓	✓	✓	✓
Invoicing process	✓	✓	✓	✓	✓
Vendor management	✓	✓	✓	✓	✓
Customizable report generation	✓	✓	✓	✓	✓
Cloud support	✓	✓	✓	✓	✓
Mobile support	✓	✓	✓	✗	✓

Table 2.3: Similar systems feature comparison

2.6 Summary

This chapter focused on providing the system analysis of the current process and similar applications related to the process in the market. The chapter provided a detail of the market product comparison as well.

3 CHAPTER – SYSTEM DESIGN

This chapter describes the system design for the proposed process of the Procurement Department of the NIBM. System design is concerned with understanding how the system should be organized and designing the overall structure of the system.

This chapter includes the system architecture and its related UML diagrams, such as the use case diagram, class diagram, sequence diagrams, and the activity diagram as the first stage of the product design. Also, the chapter will help to identify the main structural components of the system and the relationships between them.

The output of the architectural design process is an architectural model that describes how the system is organized as a set of communicating components.

3.1 UML Diagrams for the Proposed System

3.1.1 Use Case Diagram

Use case model is a dialogue between an actor and the system. Use cases represent the functionality provided by the system. The collections of use cases of a system represent all the defined ways the system may be used. Identifying actors and use cases are critical but important in analyzing a system.

Actor	Description
Requester	Any employee who is requesting an item for them or their divisions.
HOD of the requester	Department Head of the requester. This person is the immediate supervisor of the requester.
HOD of Procurement Department	Department Head of the Procurement Department.
MA of Procurement Department	Management Staff Assistant of the Procurement Department.
TEC	Members of the Technical Evaluation Committee.

Table 3.1: Main actors of the project

The use case diagram of the project is as follows in Figure 3.1.

The proposed system will begin with a request from any employee of NIBM and it needs to get approval from his/her immediate supervisor (HOD). The approval cycle will be automated in the proposed system and the approval status will be updated. Approved requests will show on the notification bar of the procurement department's heads.

The procurement process will begin after receiving the recommendation of DG. The HOD of the procurement department will be involved in quotation calls and TEC appointment processes. According to TEC's recommendation and the tender board's approval purchasing process will get started.

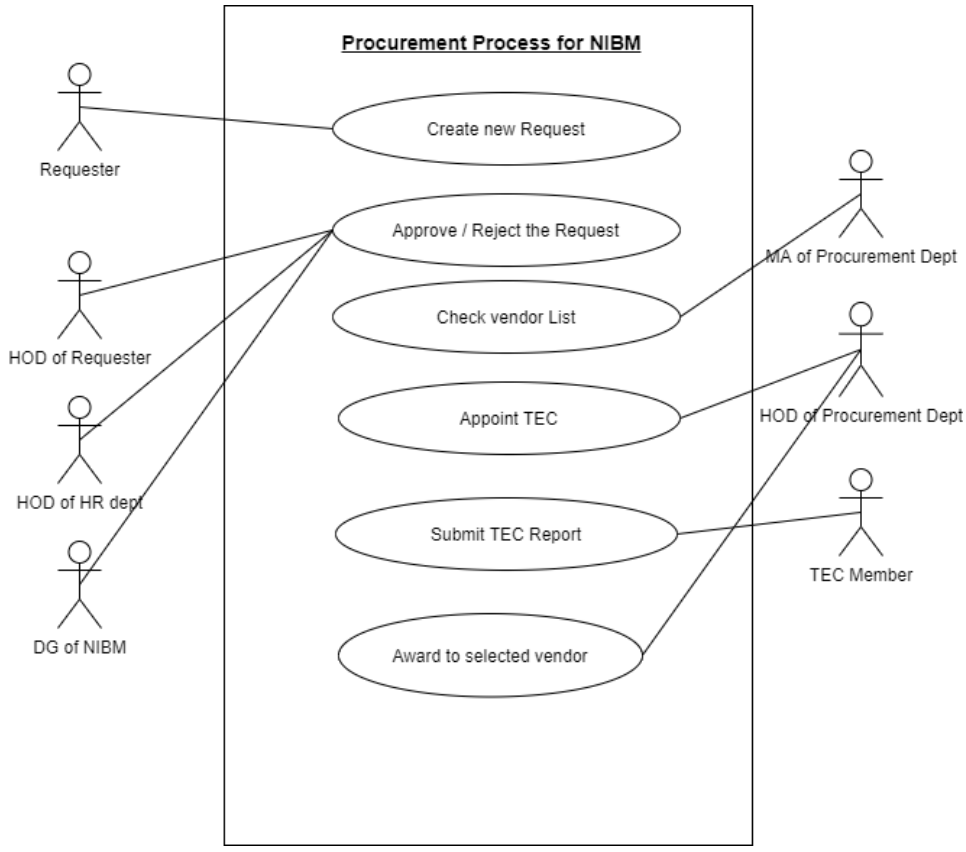


Figure 3.1: Use Case Diagram of the Proposed System

Use case narratives of the project explain as follows.

1. Create Request

Use case name	Create a request.
Goal in Context	Create a request to proceed.
Primary Actor	Requester.
Pre-Condition	The requester has to log in to the system to access the function of the request.
Trigger	The request will create on DB.

Scenario	1. User login to the system. 2. Users fill the request form in the system. 3. Save the filled details.
Exceptions	• If the user does not log, the user is not able to access the function. • Users need to be an employee of the organization. External parties are not allowed to use the system.
Post-Condition	Once the request is created successfully, It should follow the approval process to proceed with the request.

Table 3.2: Use case Narrative - Create Request

2. Approve/ Reject request

Use case name	Approve/ Reject request
Goal in Context	• Update the request status to "Approved" or "Rejected" status. • If any comments include, they need to be saved on DB. • Status changed by name and changed date needs to be updated on the record.
Primary Actor	HOD of the requester.
Pre-Condition	• HOD should be logged in to the system. • The request needs to be in "Sent for Approval" status.
Trigger	The status of the record will be updated.
Scenario	1. Click on the notification. 2. Go through the request. 3. Update the status, date approved, and comments by clicking the button.
Exceptions	• If HOD is not logged in or the session timed out, he/she will not be able to update the status.
Post-Condition	• When it updates the status successfully, the request should show on the procurement department's dashboard and notifications. • The notification count for the procurement department should be increased.

Table 3.3: Use case Narrative - Approve/Reject Request

3. Check Vendor List

Use case name	Check Vendor List
Goal in Context	• Check the vendor list to find vendors to call quotations.
Primary Actor	HOD of the Procurement Department.
Pre-Condition	• HOD should be logged in to the system. • The request needs to be in "Approved" status. • Vendor details need to be recorded in the system.
Trigger	Search operations need to trigger for a particular category of vendors.
Scenario	1. Select the category of items need to purchase.

	2. The system should filter and show the vendors who are in the same category with their contact details and internal reviews.
Exceptions	• If the vendors are not available on the system, the system will not be able to filter vendors for the particular category.
Post-Condition	• HOD of the procurement department should be able to generate the "Call for Quotation" letter for selected vendors with their contact details. • Envelopes also should be able to print according to their contact details.

Table 3.4: Use case Narrative - Check Vendor List

4. Appoint TEC and send Notifications

Use case name	Appoint TEC and send Notifications
Goal in Context	• Once the quotations are collected on the tender closing date, the quotation summary report needs to generate to submit to TEC.
Primary Actor	HOD of the Procurement Department.
Pre-Condition	• HOD should log in to the system. • The request needs to be in "Tender Closed" status. • Internal employee details need to be in the system.
Trigger	• The status of the request should be updated to "TEC Appointed" and the TEC appointed date need to be stored. • Appointed TEC members should notify it through the system or an email.
Scenario	1. Appoint internal employees as the TEC for request. 2. Send them notifications with a summary report via email and system.
Exceptions	• To send emails, the email address needs to be correctly entered into the system. • Employee details need to enter into the system.
Post-Condition	• TEC members should update the tec report.

Table 3.5: Use case Narrative - Appoint TEC and send notifications

5. TEC report submission

Use case name	TEC report submission
Goal in Context	• Upload the TEC report by one of the TEC members and all TEC member approval need to be obtained.
Primary Actor	TEC members
Pre-Condition	• TEC members should log in to the system. • The employee should be a TEC member for a request to get access to the function.

Trigger	• Upload a PDF document to the system. • TEC report submission date should be updated. • Member-wise approval status and approved date need to be stored in DB. • Update the status of the request to "TEC Approved".
Scenario	1. Upload the PDF document and save it on DB. 2. TEC report submission date updated on DB. 3. Access is granted only to TEC members to view the report. 4. TEC member-wise update recommendation status of the report.
Exceptions	• To access the feature, the employee should be a TEC member. • The attached TEC report should not be able to edit by anyone.
Post-Condition	• HOD of the Procurement Department should get notified about the report submission.

Table 3.6: Use case Narrative - TEC report submission

6. Tender Board Approval and Tender award to selected Vendor

Use case name	Tender Board Approval and Tender award to selected Vendor
Goal in Context	• Update the tender board approval decision and generating an award letter to the selected vendor.
Primary Actor	HOD of the Procurement Department.
Pre-Condition	• HOD of the Procurement department should log in to the system. • Request status should be in "TEC Approved".
Trigger	• Update the status of the Tender Board Approval and the approved date of the record. • Generate the awarding letter to the selected vendor.
Scenario	1. Update the selected vendor details. 2. Update the Tender Board decision and the date. 3. Generate awarding letter according to a preformatted report to the selected vendor with terms and conditions.
Exceptions	• Vendor selection is limited only to quoted vendors. • One-time awarding letter generation to the selected vendor.
Post-Condition	• Send a letter to the vendor.

Table 3.7: Use case Narrative - Tender board approval and tender awarding

3.1.2 ER Diagram of the proposed system

The following Figure 3.2 describes the ER diagram of the proposed process for the Procurement department of NIBM.

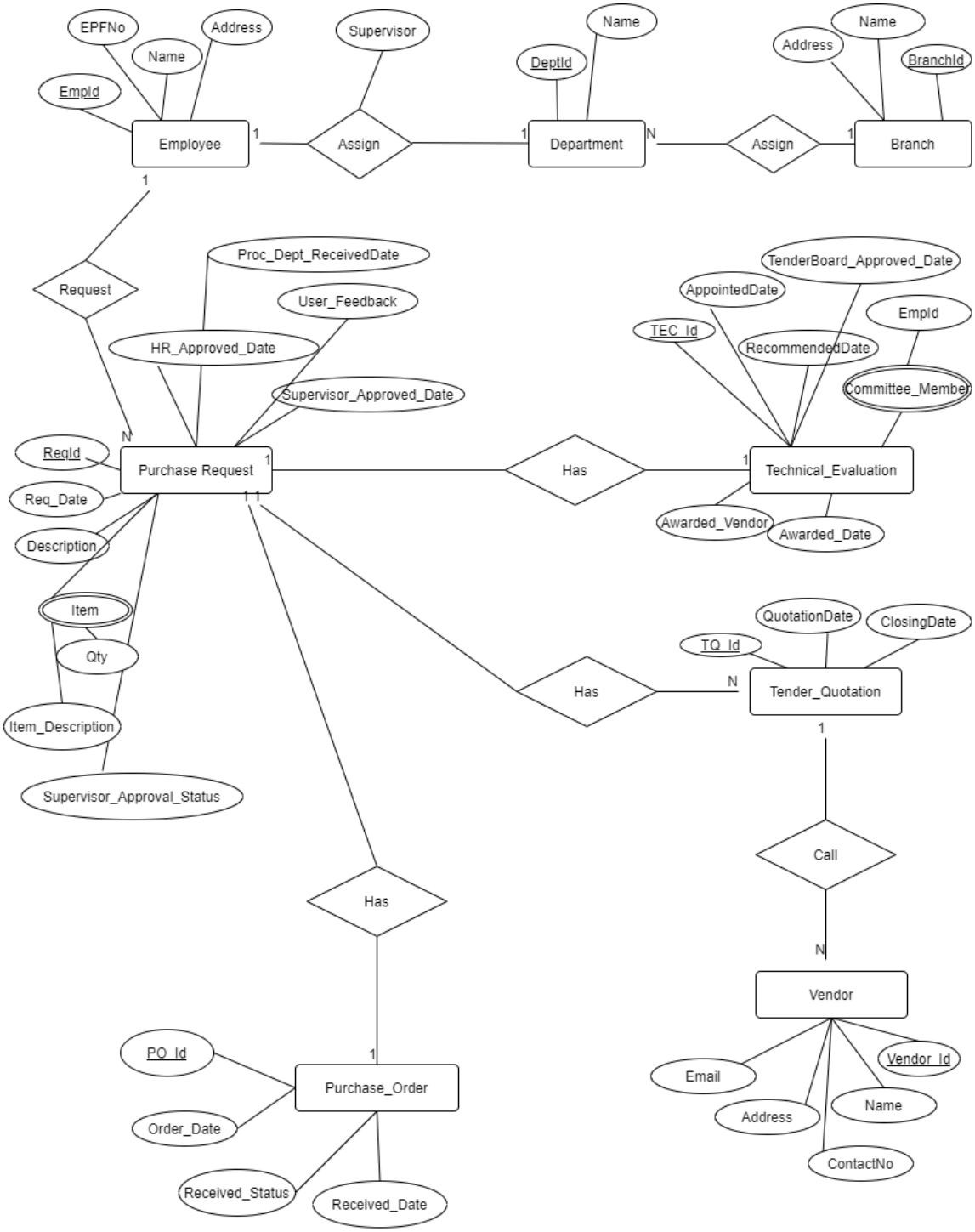


Figure 3.2: ER Diagram of the Proposed System

The employee should be a requester and he/she is assigned to a department of branches of NIBM. Each of the departments is managed by a supervisor. Approval for the request needs to be received by the mentioned supervisors to follow procurement guidelines.

The purchase request may consist of several requesting items including different items or several quantities for the same item. Item description may consist of item specification.

The HOD of the procurement department will call for quotations for selected vendors for each request. TEC will be appointed soon after the quotation is opened, and the vendor will be awarded as per TEC's recommendation and the tender board's approval.

Items will be purchased from the selected vendor and the request will be completed by the HOD of the procurement department. After the completion of the purchase of requested items, the requester can send his feedback on the purchase to the procurement department.

3.1.3 Sequence Diagram for the proposed system

Sequence diagrams show in Figures 3.3, 3.4, 3.5, and 3.6 describe the object interactions arranged in the time sequence of the Procurement process of NIBM. It illustrates the objects involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of scenarios.

3.1.3.1 Scenario 1: Create Procurement Request

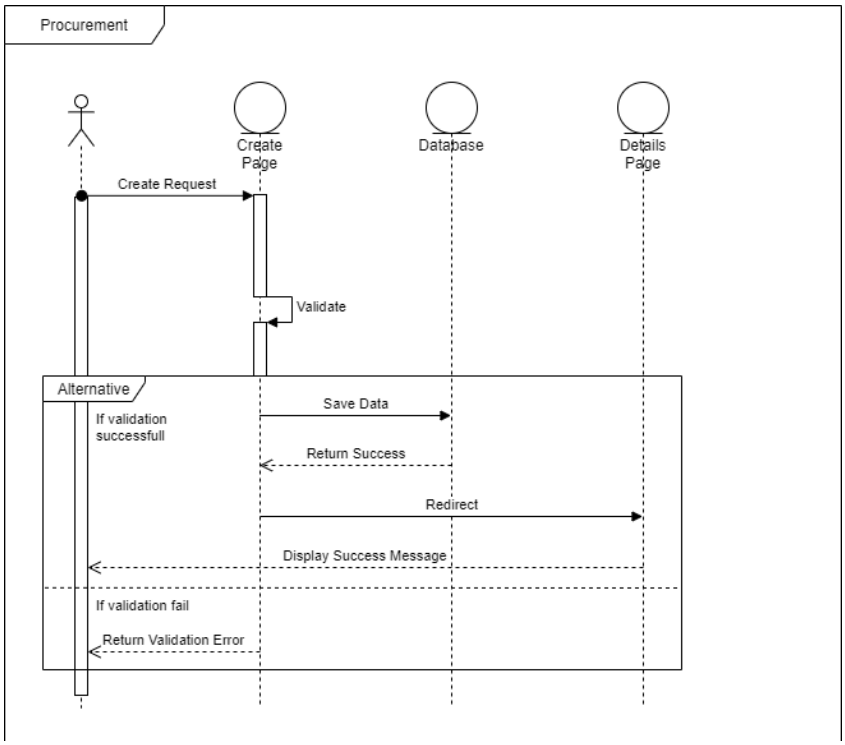


Figure 3.3: Sequence Diagram -Create Procurement Request

Figure 3.3 refers to the procurement request creation process of the product.

Once the create page controller receives the filled data with a create request(), the page controller will validate all filled data. If the page validation is successful, the page controller will pass data to the database and the saved successful message will be displayed on the page to the user. If the page is not validated, data will not be saved, and an error message will be on the page.

3.1.3.2 Scenario 2: Quotation calling process

Figure 3.4 refers to the quotation calling process of the proposed system. Once the message is passed to the controller, it will get related vendor data from the database to send the tender details. Once the quotation is created on DB, the user will pass the message to the controller page to print tender quotation letters, and also the controller will send notification emails to the vendor's email addresses. Once the controller job is completed, the successful message will display on the user screen.

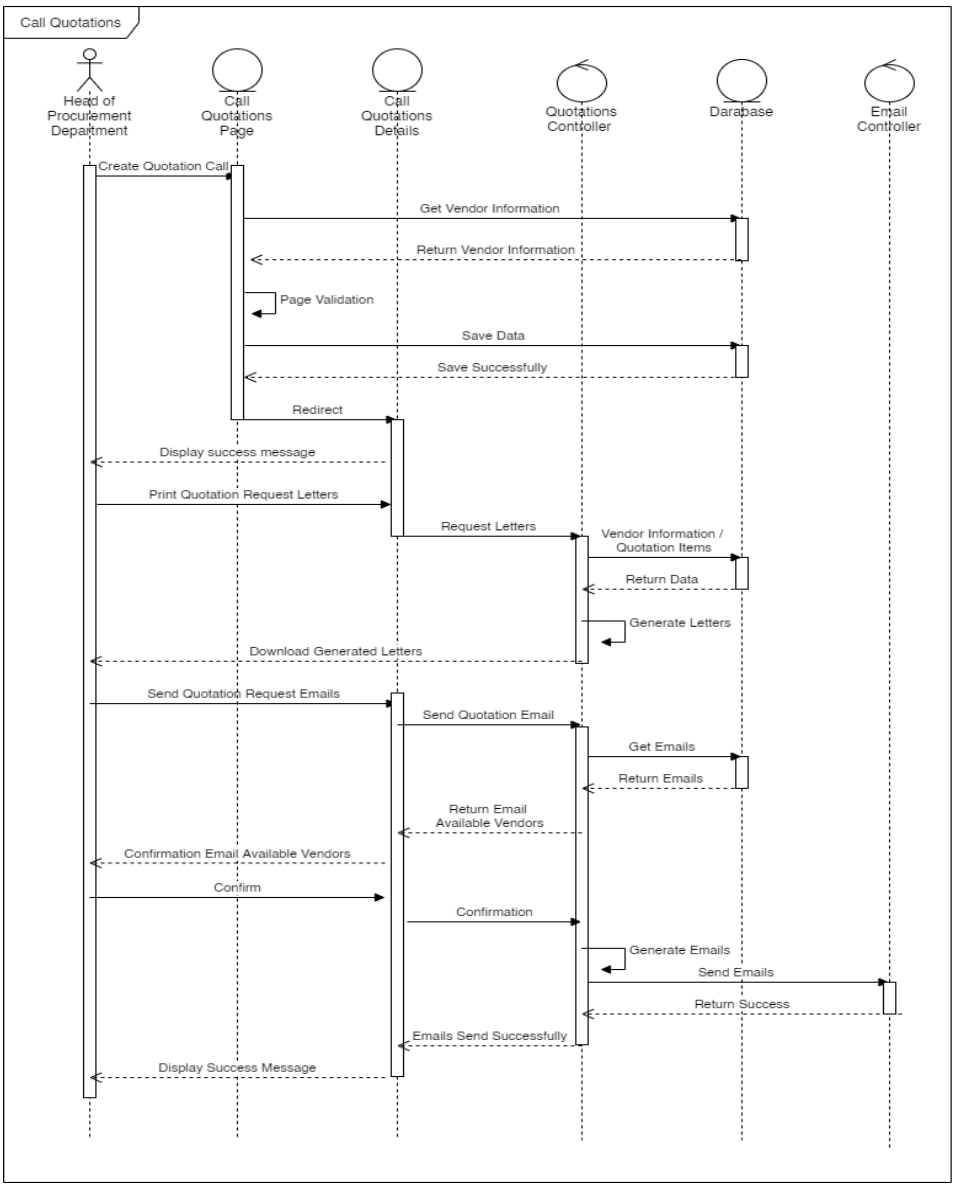


Figure 3.4: Sequence Diagram - Calling for quotation

3.1.3.3 Scenario 4: Appoint TEC

Figure 3.5 refers to the tender procurement of the department. To begin the tender process, the HOD of the procurement department has to appoint a TEC. In TEC appointing, the user should get employees from the controller, and once data is received from DB, the controller should save selected employees as TEC members and if it is saved successfully, the controller will pass the successful message.

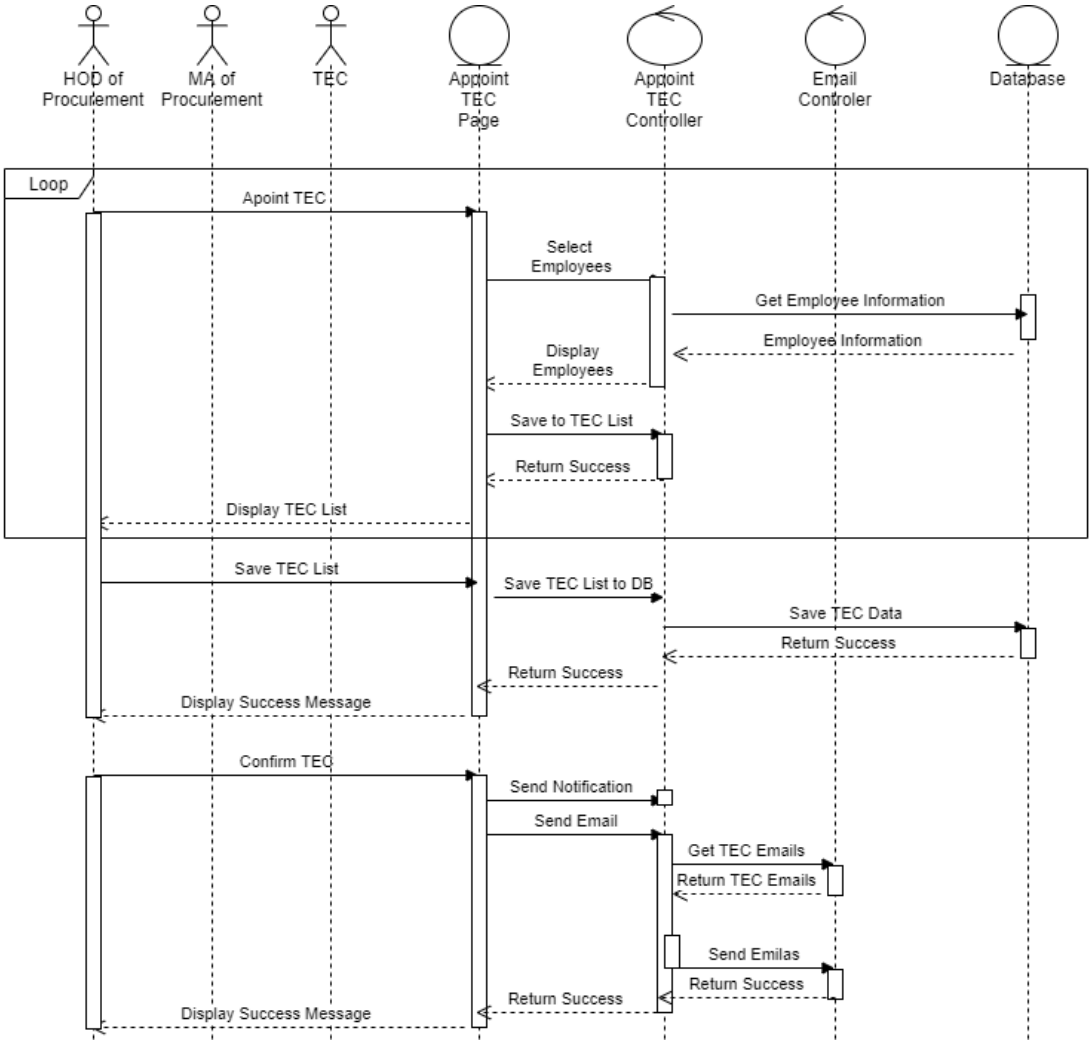


Figure 3.5: Sequence Diagram - Appoint TEC

3.1.3.4 Scenario 5: TEC recommendation

Figure 3.6 refers to the TEC recommendation submission to the Procurement department. Once the TEC selected a vendor, it will update the system upload an approval report. The controller will handle the message passing process to the DB and once the DB sends the successful message, it will pass to the user by the controller.

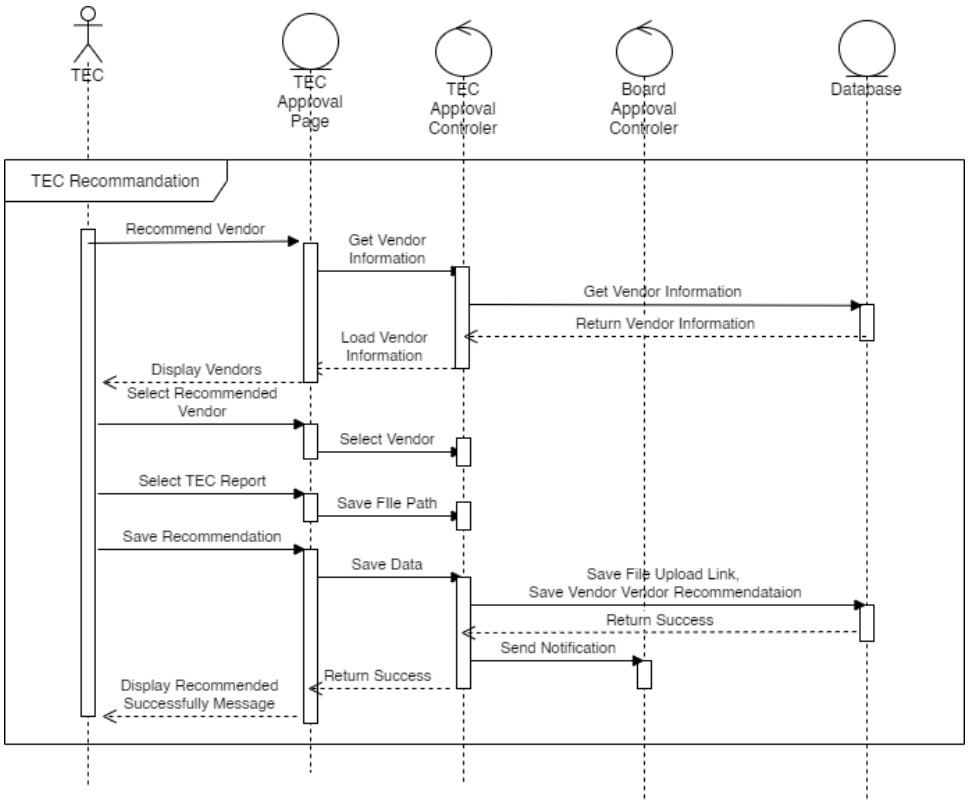


Figure 3.6: Sequence Diagram of TEC recommendation submission

3.1.4 Class Diagram of the proposed system

The class diagram shown in Figure 3.7 describes that objects related to the process with their attributes and operations.

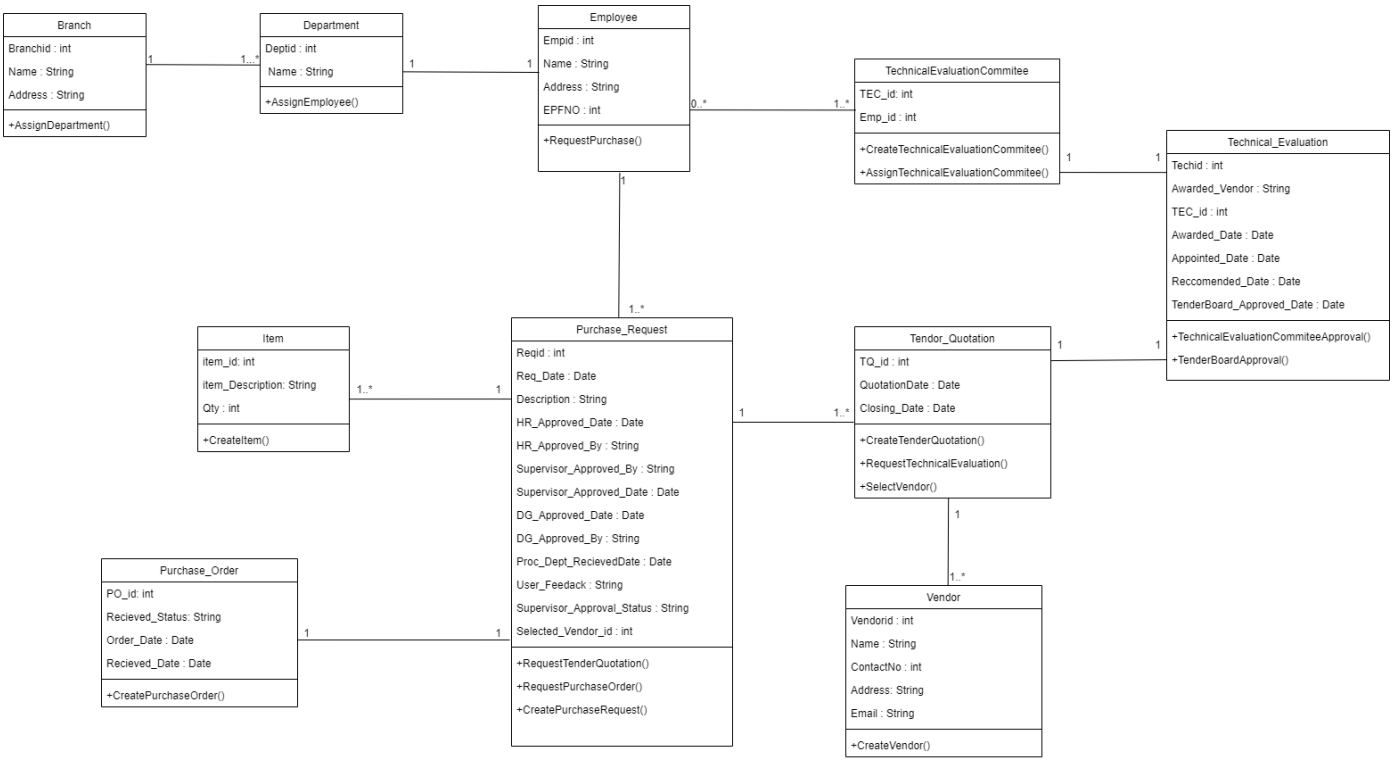


Figure 3.7: Class Diagram of the Proposed System

3.1.5 Database Design for the proposed system

Figure 3.8 refers to the database design of the proposed system.

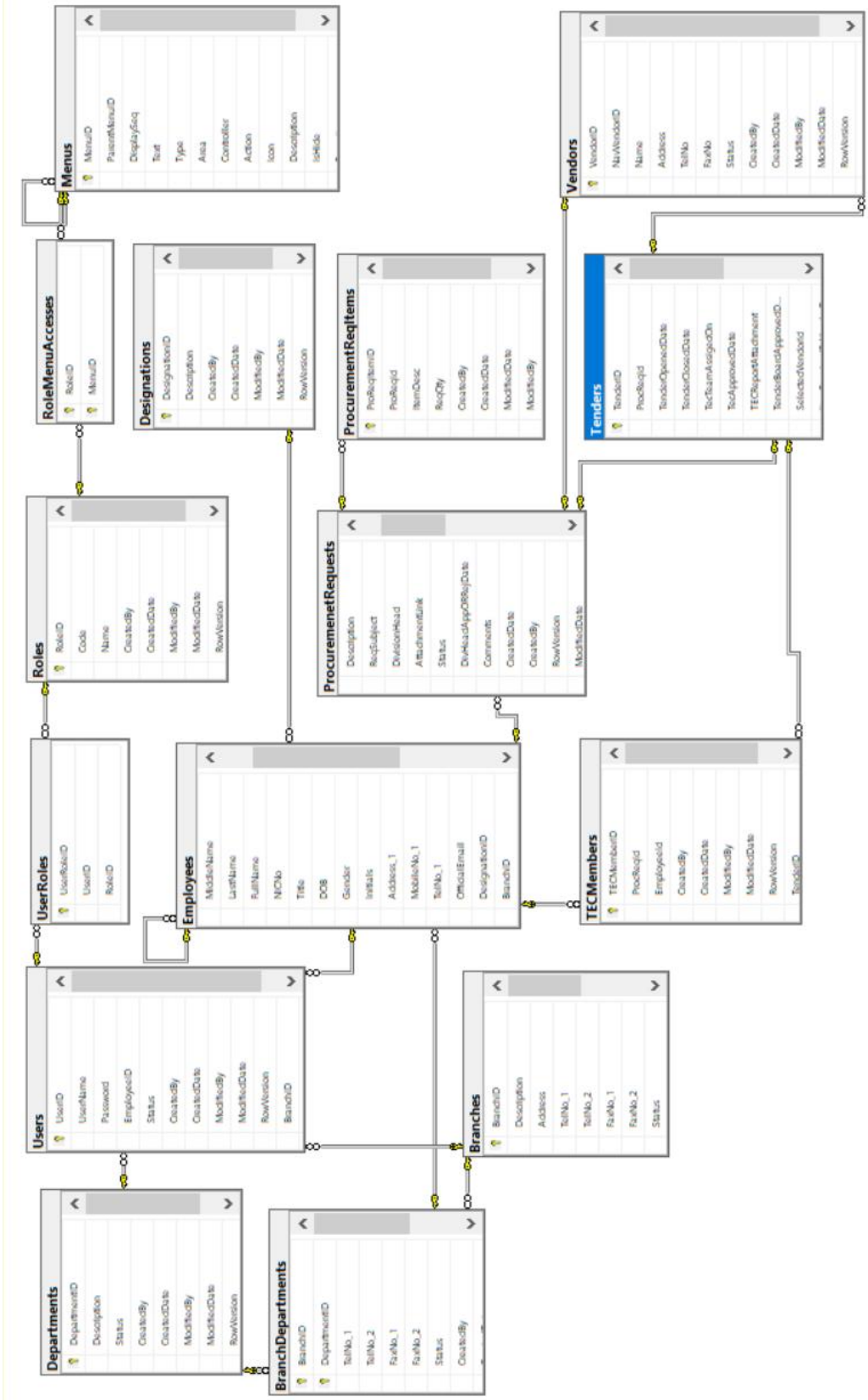


Figure 3.8: DB Diagram

3.2 Prototype Design

The main source of interaction between the user and the system is the user interface. Following are some GUI designs related to the proposed system.

3.2.1 Login Page:

The user will be redirected to the following login page shown in Figure 3.9 through the URL hosted. By using a valid username and password the user will be able to redirect to the home page of the system successfully.

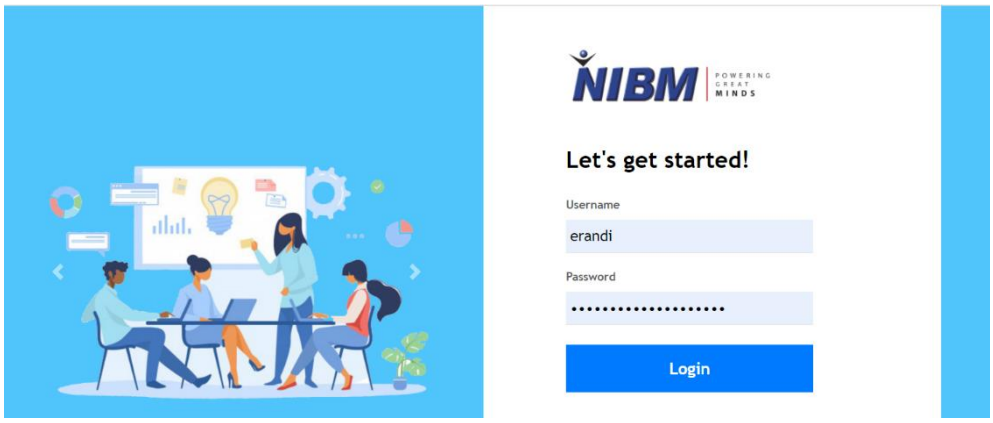


Figure 3.9 :UI – Sign-in page

3.2.2 Create Request Page:

Figure 3.10 allows the user to create a new procurement request with its subject, specification attachment, and its related items list with quantities.

According to the logged-in user and the system date.” Requested By” and the “Request Date” will be automatically filled.

The Immediate supervisor also filled automatically according to logged-in user details, but the user can select any authorizing party using the popup window shown in Figure 4.5.

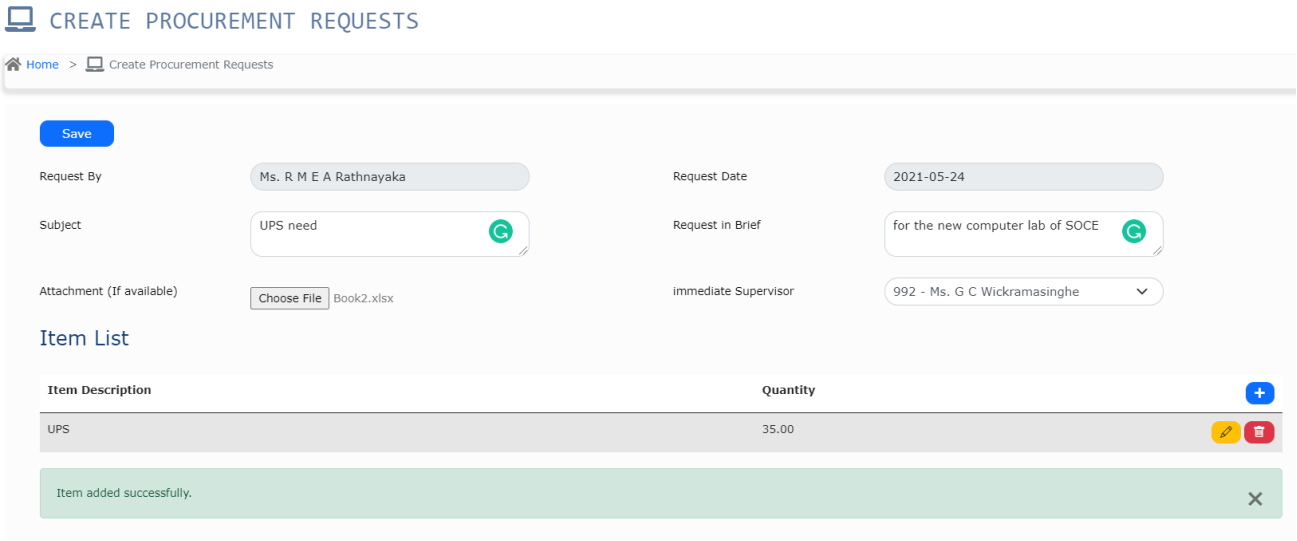


Figure 3.10: UI - Create procurement request

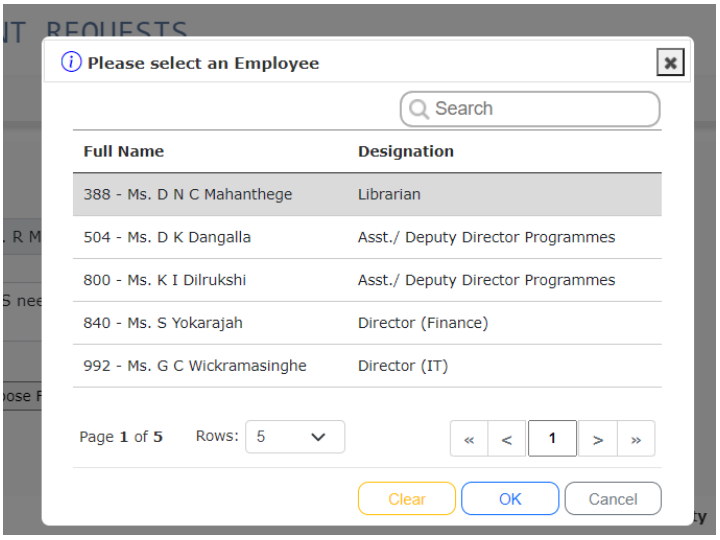


Figure 3.11: UI - Popup window of selecting a supervisor

3.2.3 Approval by the immediate supervisor:

Figure 3.12 refers to the approval UI of the immediate supervisor.

The Supervisor can select all at once and add comments to each when approving as in Figure 3.12.

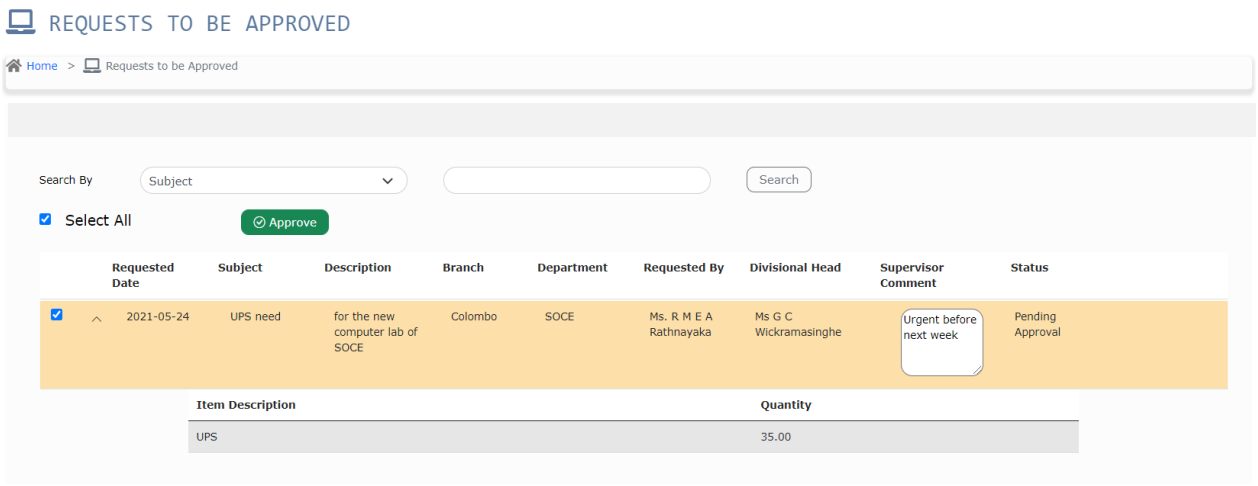


Figure 3.12: UI - Approve with a comment

As in Figure 3.13, the immediate supervisor is also able to reject any request using the "Reject" button. At the rejection also user able to add a comment for future use.

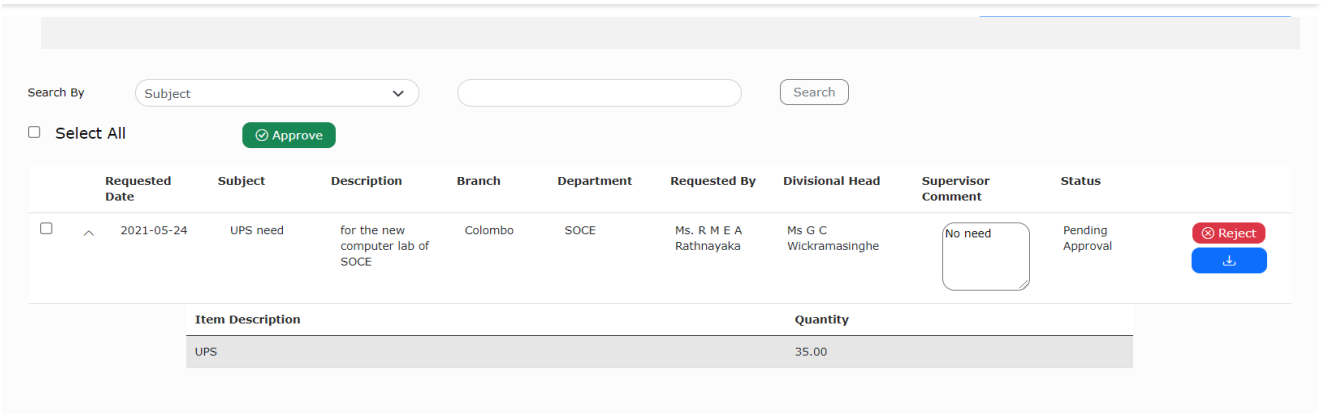


Figure 3.13: UI - Reject with a comment

3.2.4 Notification page for Procurement Department:

The UI shown in Figure 3.14 will be accessible only to the staff of the procurement department.

It will notify newly received requests by the "Open to process" tab, approved but still pending completion by the "Approved and pending completion" tab, the requests still waiting for approvals by "Pending approvals by other parties" and completed requests by "completed requests" tab.

The user can also get a printout of the request by clicking on the button if needed.

Also considering more user-friendliness, UI is designed to select more than one request to update the status by multiple selection options using "Select All".

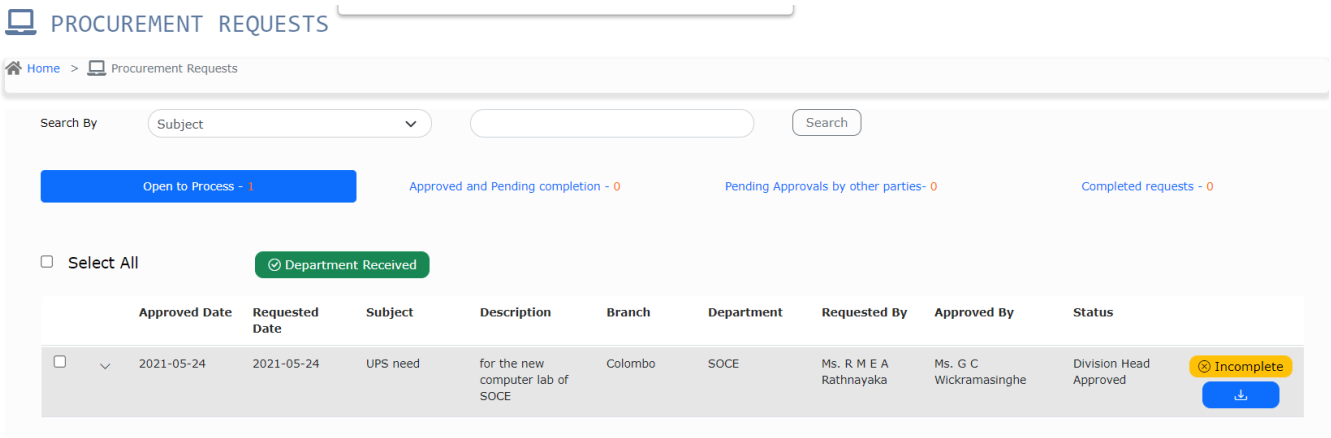


Figure 3.14: UI - Notification page for Procurement Department

When the procurement department user clicks Department Received the button the following confirmation box of Figure 3.15 will be open to getting the confirmation.

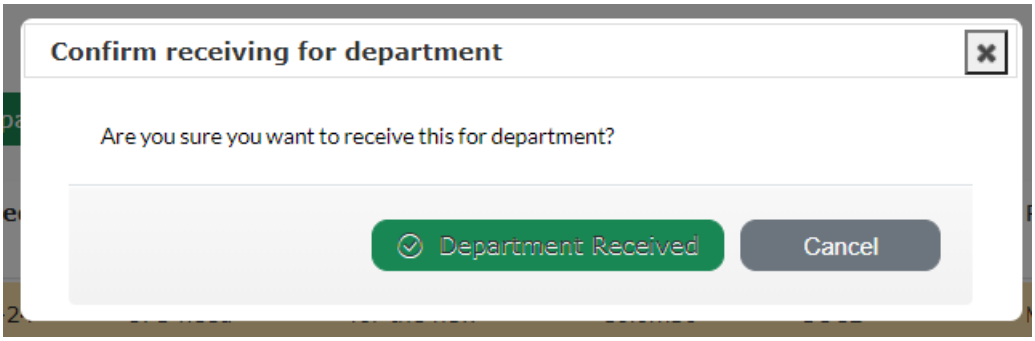


Figure 3.15: UI - Confirmation dialog box

3.3 Summary

Chapter 3 focused on the design architecture of the proposed solution. It refers to the high-level architecture, UML diagrams, and prototype designs of the solution.

4 CHAPTER – DEVELOPMENT & IMPLEMENTATION

This chapter describes the implementation methodology of the proposed system. This chapter includes the module interaction of the system, database, and major codes of the project used to develop the system. Also, the chapter describes the environment need to implement the project for client use.

4.1 Related Technologies

The proposed procurement system for NIBM was developed as a web-based application using ASP.net MVC (Svirca, 2020) technologies as shown in Figure 4.1. Since NIBM includes many branches and all staff will act as requesters in the system, this requires a web-enabled technology. Also, data need to be managed in real-time on a centralized server.

The front-end side is implemented using HTML (Hypertext Markup Language) and JavaScript while the back-end side in .Net technologies using MVC architecture to manage development easily using visual studio 2019 combined with C#, JavaScript, and Bootstrap 5. SQL Server technologies are used to manage database management.

Unit testing is performed during the development stage and system testing is performed at the end of the development stage using manual testing methods. After completing the integration testing, UAT is completed by the staff of the procurement department.

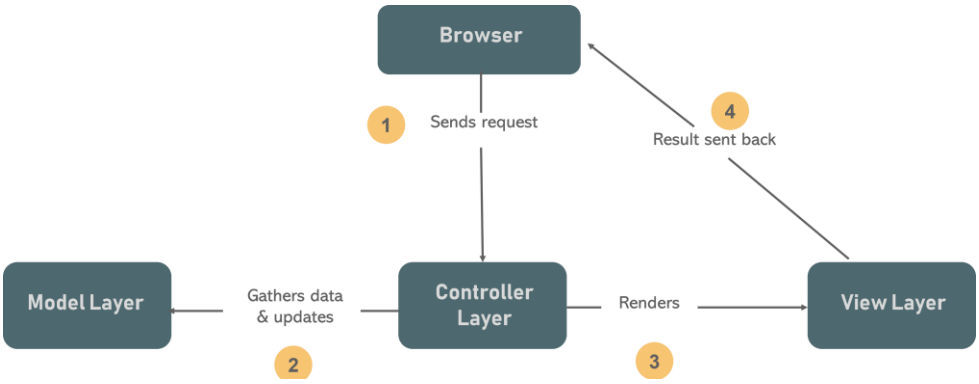


Figure 4.1: MVC Architecture

4.2 System Architecture

A system architecture is a conceptual model that defines the structure, behaviour, and views of a system.

The high-level architecture of the system describes as follows in Figure 4.2.

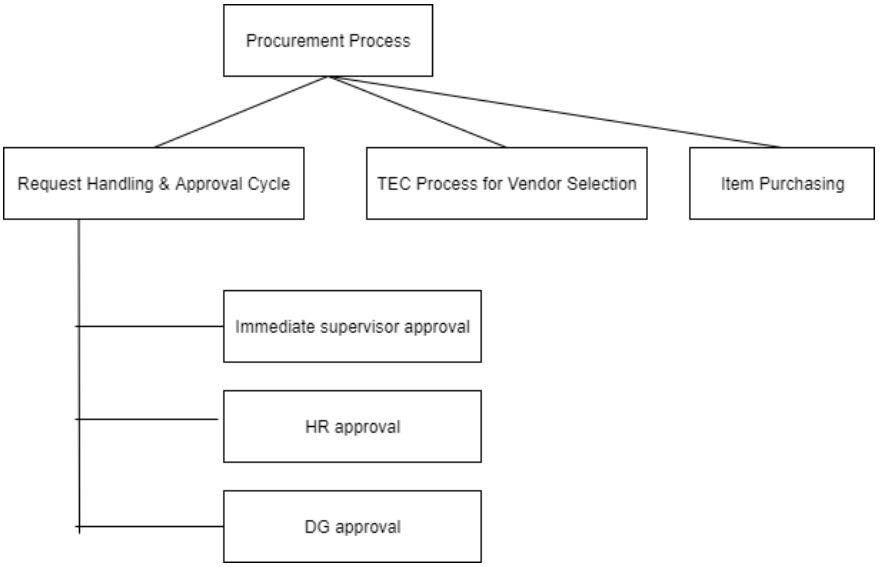


Figure 4.2 : High-level system architecture

Based on the architectural design of the system, system development is split into three phases. The procurement request handling and approval process was completed and implemented as the first phase. Development and implementation of Technical Evaluation module go to the second phase of the project and development and implementation of Item purchasing and dashboard analyzing, and monitoring process handles as the final stage.

Iterative waterfall methodology (Sharma, 2020) selected as the major requirements of the whole system was gathered at the beginning and were able to define clearly.

As the goal is to deliver the software systems on time and budget, while adjusting for changing requirements along the development process, the iterative waterfall method was selected (Figure 4.3).

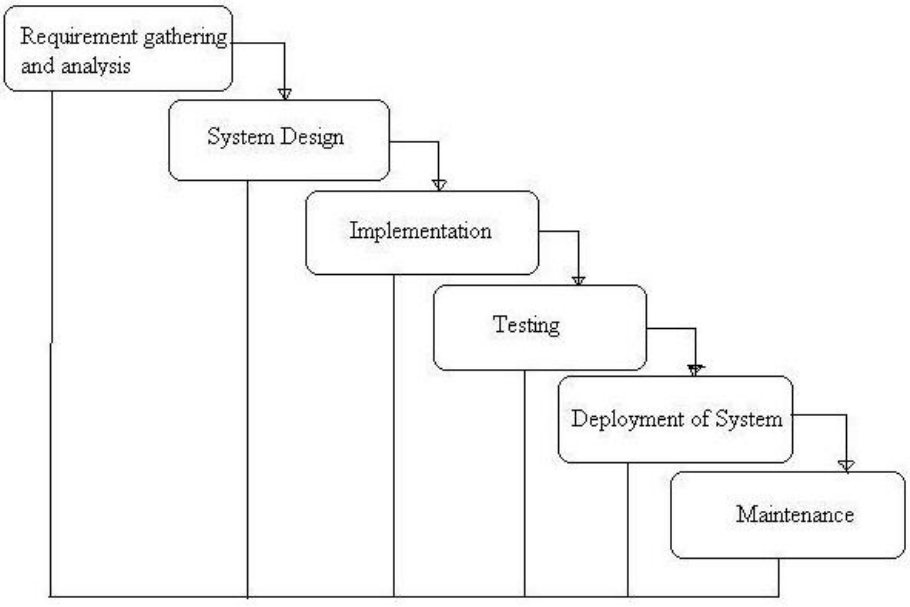


Figure 4.3: Iterative waterfall method

4.3 Modules of the system

The procurement handling process of NIBM is mainly categorized into the following four modules as in Figure 4.4.

- User Request and Approval Module
- Tender Processing Module
- Notification Module
- Report Generation Module

Inter-operability of these modules is essential when the system accomplishes the required functionality.

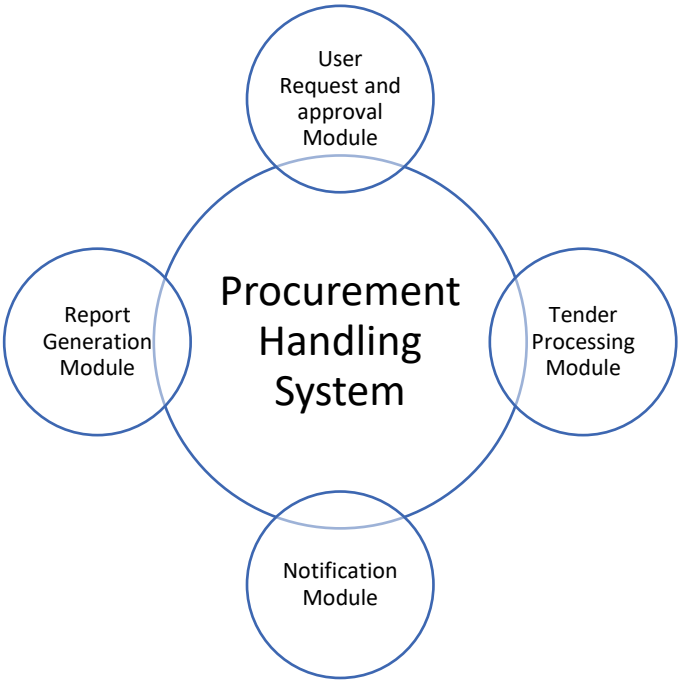


Figure 4.4: Module interaction of the system

4.4 Major Code Segment

Figure 4.5 refers to the file structure in the solution of visual studio 2019. As the MVC design pattern is used to develop the system the file structure has three main folders as “Controllers”, “Models”, and “Views”.

The “Reports” folder contains an HTML view of report generation UIs.

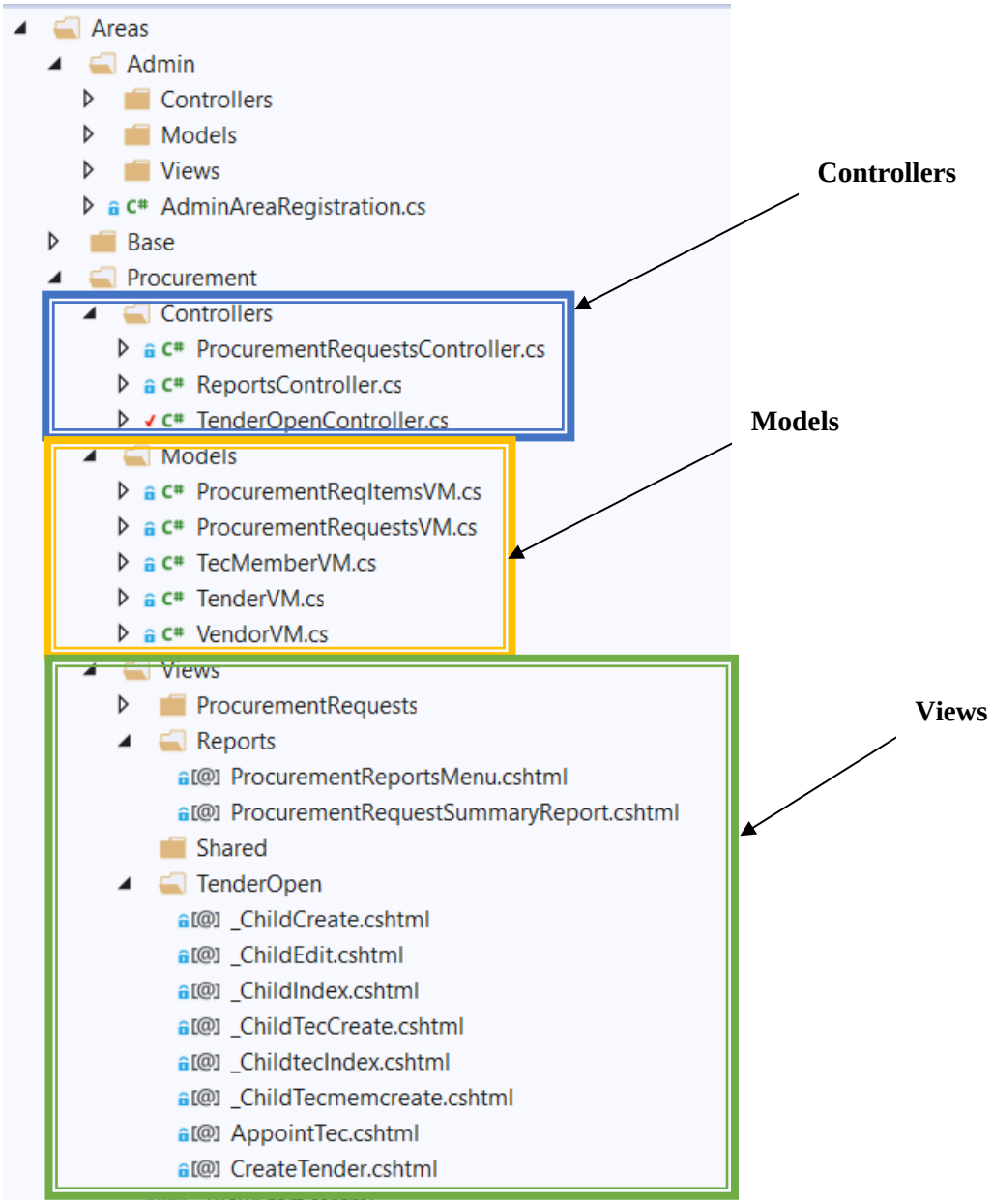


Figure 4.5: File structure of the solution

4.4.1 Save Procurement Request

Figure 4.6 refers to the code segment of data saving on DB related to the procurement request. The save function executes once after validations are checked, only if no errors occurred. If any validation returns true, the function is blocked, and the error messages will show on the page for a better user experience.

When executing the save function, data will save on "ProcurementRequests" and "ProcurementReqItems" tables. Once the action completes user redirects to its detail page with a proper success message as "Procurement request created successfully".

```
if (procuremenetRequest.ReqSubject == null)
{ ModelState.AddModelError("ReqSubject", "Subject is required."); }
if (procuremenetRequest.Description == null)
{ ModelState.AddModelError("Description", "Description is required."); }
if (obj.FileName != null && procuremenetRequest.ReqSubject == null || obj.FileName != null && procuremenetRequest.Description == null)
{ ModelState.AddModelError("", "Please select file again."); }
if (obj.ProcumentReqItemsDetails.Count() == 0 && file == null)
{ ModelState.AddModelError("", "Attachment or item list is required to make the request."); }
ModelState["UserFeedback"].Errors.Clear();

if (ModelState.IsValid)
{
    var empID = db.Users.Find(CurUserID).EmployeeID;
    procuremenetRequest.CreatedBy = this.GetCurrUser();
    procuremenetRequest.CreatedDate = DateTime.Now;
    procuremenetRequest.ReqBy = (int)empID;
    var objprocurement = db.ProcuremenetRequests.Add(procuremenetRequest.GetEntity()).Entity;

    if (!obj.Base64FileContent.IsBlank())
    {
        byte[] binData = Convert.FromBase64String(obj.Base64FileContent);
        var filePath = $"{obj.ProReqID}-{obj.FileName}";

        GraphApiHelper.SaveProcurementAttachment(binData, obj.ProReqID, filePath);
        objprocurement.AttachmentLink = GraphApiHelper.GetProcurementAttachment(obj.ProReqID, filePath);
    }

    db.SaveChanges();

    foreach (var det in obj.ProcumentReqItemsDetails)
    {
        det.ProReqId = objprocurement.ProReqID;
        det.CreatedBy = this.GetCurrUser();
        det.CreatedDate = DateTime.Now;
        objprocurement.ProcurementReqItems.Add(det.GetEntity());
    }
    db.SaveChanges();
    dbTransaction.Commit();
    Session.Remove(sskCrtdObj);
    AddAlert(NIBM.Procurement.Common.AlertStyles.success, "Procurement Requests created successfully.");
    return RedirectToAction("Details", new { id = objprocurement.ProReqID, TempNo = 0, tile = false });
```

Figure 4.6: Save Procurement Request

4.4.2 Retrieve data from the DB

Figure 4.7 refers to the data retrieval of the DB of the project. Data is retrieving by using its unique Id and if any data mappings are related to the execution, the project used LINQ to map data with other tables in the project.

```
public ActionResult Details(int? id, int TempNo, bool tile = false)
{
    if (id == null)
    {
        return new HttpStatusCodeResult(HttpStatusCode.BadRequest);
    }
    ProcuremenetRequest ProcuremenetRequests = db.ProcuremenetRequests.Find(id);
    if (ProcuremenetRequests == null)
    {
        return HttpNotFound();
    }

    var obj = new ProcuremenetRequestVM(ProcuremenetRequests);
    var ReqByID = (int)obj.ReqBy;
    var Emp = db.Employees.AsQueryable();
    obj.RequestBY = Emp.Where(x => x.EmployeeID == ReqByID).Select(y => y.Title.ToString() + ". " + y.Initials.Trim() + " " + y.LastName).FirstOrDefault();
    obj.HrRejectedName = Emp.Where(x => x.EmployeeID == 14).Select(x => x.Title.ToEnumChar("") + ". " + x.Initials.Trim() + " " + x.LastName).FirstOrDefault();
    obj.DGInitials = Emp.Where(x => x.EmployeeID == 115).Select(x => x.Title.ToEnumChar("") + ". " + x.Initials.Trim() + " " + x.LastName).FirstOrDefault();
    obj.ApprovedOrRejectByName = (obj.DivHead.Title.ToString() + ". " + obj.DivHead.Initials.Trim() + " " + obj.DivHead.LastName);
    obj.DivisionalHead = obj.DivHeadName;
    obj.IsTile = tile;
    obj.TempNo = TempNo;
    obj.CompletedDate = obj.CompletedDate != null ? obj.CompletedDate.Value.Date : DateTime.Now;
    Session.SetObject(obj);
    return View(obj);
}
```

Figure 4.7: Data Retrieval of DB

4.4.3 Update DB values

Figure 4.8 refers to the data update of the "ProcurementRequests" table when the approval party tries to reject the request. To update the record, the code finds the record using its unique Id. The execution includes only updating the values of the DB record. Once the execution success the user will redirect to another page.

```
public ActionResult Reject(ProcuremenetRequestVM procuremenetRequestVM)
{
    try
    {
        var obj = db.ProcuremenetRequests.Find(procuremenetRequestVM.ProReqID);
        if (obj == null)
        { throw new DbUpdateConcurrencyException(""); }

        if (obj.Status == ProcurementReqStatus.HRRecommended)
        {
            obj.Status = ProcurementReqStatus.DGRejected;
            obj.DGAppORRejDate = DateTime.Now;
        }

        else if (obj.Status == ProcurementReqStatus.ProcurementDeptReceived)
        {
            obj.Status = ProcurementReqStatus.HRRejected;
            obj.HRAppRecommendORRejDate = DateTime.Now;
        }

        else
        {
            obj.Status = ProcurementReqStatus.DivisionHeadRejected;
            obj.DivHeadAppORRejDate = DateTime.Now;
        }

        obj.ModifiedBy = this.GetCurrUser();
        obj.SupervisorComment = procuremenetRequestVM.SupervisorComment;
        obj.ModifiedDate = DateTime.Now;
        db.SaveChanges();

        AddAlert(NIBM.Procurement.Common.AlertStyles.danger, "Request rejected successfully.");
        return RedirectToAction("Requests");
    }
    catch (DbUpdateConcurrencyException ex)
    {
        this.ShowConcurrencyErrors(ex, true);
        if (ex.Message == "")
        { return RedirectToAction("ApproveIndex"); }
    }
    catch (Exception ex)
    {
        AddAlert(NIBM.Procurement.Common.AlertStyles.danger, ex.GetInnerException().Message);
    }
    return RedirectToAction("ApproveDetails", new { id = procuremenetRequestVM.ProReqID });
}
```

Figure 4.8: Update DB values

4.5 Implementation Environment

4.5.1 Hardware Environment

Following specifications of the hardware environment were used to develop the proposed system.

- Operating System: Windows 10
- Processor: Intel CORE i5
- RAM: 8GB
- Hard disk: 1TB

4.5.2 Software and Technologies

The development phase of the system involves a diverse set of tools and software. The tools and software listed below were used in the development phase of this system.

- Visual Studio 2019 (.Net framework)
  This IDE can use to edit, debug, and build code, and then publish an app. It is a feature-rich program that can be used for many aspects of software development. Over and above the standard editor and debugger that most IDEs provide, Visual Studio includes compilers, code completion tools, graphical designers, and many more features to ease the software development process.

- IIS 10
  IIS is used to host the application locally. This includes built-in authentication options such as Basic, ASP.NET, and Windows auth.

- SQL Server 2014
  Microsoft SQL Server is a relational database management system developed by Microsoft. This is used to store and retrieve the data of the application.

- Entity Framework 5
  Entity Framework is an open-source object-relational mapping (ORM) framework developed for ADO.NET by Microsoft. This is used in the application to automate all database-related activities such as open connection, fetch data, create data set within the framework of .net.

- LINQ Query
  As the application used EF, it used LINQ queries for the querying of DB.

- HTML 5
  This is the markup language used for structuring and presenting the content of the project's web pages.

- CSS 3
  This is the style sheet language used to enable the separation of presentation and content, including layout, colours, and fonts of the application.

- Bootstrap 5
  Bootstrap is a free and open-source CSS framework directed at responsive, mobile-first front-end web development. This is used to develop application forms with responsive UI components such as buttons, navigations, dives and, etc.

- jQuery 3.5.1
  jQuery is a lightweight JavaScript library that we can use in webpage development. Using jQuery makes it much easier to use JavaScript in the application.

- SSRS
  SSRS is a server-based report generating software system from Microsoft. This is used to produce formatted reports with tables in the form of data, graphs, images, and charts in the application.

4.6 Summary

This chapter refers to the implementation methodology of the proposed system. It includes the module interaction of the system, database design, and some of the major codes including the CURD operation of the project which used to develop the system.

5 CHAPTER – TESTING AND EVALUATION

This chapter describes the testing and evaluation plan for the developed web-based system for NIBM. Testing begins from the beginning of the project life cycle, and it will end up with user acceptance. This chapter will focus on user testing strategies and the test plan of the testing process.

5.1 Related Testing Types

As testing of the project started initially, various kinds of testing types were used to test the project. At the development stage, it used the types of testing such as unit testing, integration testing, and system testing. (Aebersold, 2018)

5.1.1 Unit Testing

The individual component of each UI is tested to complete the unit testing of the project. This was completed during the development phase of the project by the developer. Unit testing is carried out during the development phase to identify the correctness of each component placed in each UI of the project. This was helped to find out errors of an individual component of each UI.

5.1.2 Integration Testing

The system is tested module-wise during the development phase after completing the unit testing. Integration testing is carried out to find functional issues of the developed module. Each module needs to test individually to come up with functional changes as solutions.

5.1.3 System Testing

The last testing type which can conduct by the developer's end is system testing. The entire system was tested as the final stage of testing to identify functional and non-functional issues of the system. Mainly this was focused on finding out whether the requirement of the procurement department of NIBM is satisfied or not. If the system testing is passed the system will be able to achieve all objectives mentioned.

5.1.4 User Acceptance Testing

Users at the procurement department of NIBM have tested the developed system at their premises. Testing with real data in the real environment helps out to identify whether the system is suitable for the client.

All the above testing methods were carried out to make an error-free system for the client.

5.2 Test Cases

Following table 5.1 refers to some of the test cases tested in the project. (McMullin, 2021)

Test Case ID	Area	Description	Sample Input Values	Expected Outcome
1	User Login	Login By a correct username and correct password	Un: Erandi, Pw:1	Correctly login and redirect to the home page
2		The username should be a character-based text field and the password field should be a password type text field	Un: Erandi, Pw: 123	Username values appear to the user when typing but password values are not readable to the user
3		Login without username or password	-	Error message: Username and password required
4		Login with an incorrect username	Un: abcd, Pw:1	Error message: Incorrect username
5		Login with a correct username but an incorrect password	Un: Erandi, Pw:11	Error message: Incorrect password
6	Branches	Show all created branch records in the main index page of "Branches"	Save a new record	Saved data on the data grid of the page
7		The view, edit button is shown on each record of the data grid of the index page. When clicking on the view button redirects to the detail page of the record. When clicking on the edit button redirects to the edit page of the record.	Save a new record	View and Edit button of each row. Clicks view->redirects to the detail page. Clicks edit -> redirects to the edit page.
8		Search by a branch name on the index page.	Type "Kandy" on the search and enter or click search	Retrieve records that have "Kandy" for the branch name
9		Click on create button.	Click	Redirect to a new page of branches
10		Click the save button without any data	Click on save, but no data	All required fields should be highlighted at once.
11		Use an Invalid no to "Tel No"	Sada12656	Error message: Invalid Tel No
12		Save the record with data filled only to required fields	Description: a text	The record should save and the status of the branch should be active

			Address: a text Tel No: valid no	
		Save a duplicate record	Branch Name: Kandy	Validation Error: Branch name already available
13		On the detail page, recorded data should need to fill correctly	Last added records	Data on text fields but not editable.
14		Delete an existing record	Add a record	Should be deleted after confirmation and the successful message should display
15	Departments	Show all created department records on the main index page of "Departments"	Save a new record	Saved data on the data grid of the page
16		View, edit buttons show on each record of the data grid of the index page. When clicking on the view button redirects to the detail page of the record. When clicking on the edit button redirects to the edit page of the record.	Save a new record	View and Edit button of each row. Clicks view->redirects to the detail page. Clicks edit -> redirects to the edit page.
17		Search by a department name on the index page.	Type "HR" on the search and enter or click search	Retrieve records that have "HR" for the branch name
18		Click on create button.	Click	Redirect to a new page of departments
19		Click the save button without any data	Click on save, but no data	All required fields should be highlighted at once.
20		Save a duplicate department	Department Name: HR	Validation error: Department already available
21		On the detail page, recorded data should need to fill correctly	Last added records	Data on text fields but not editable.
22		Delete an existing record	Add a record	Should be deleted after confirmation and the successful message should display
23	Employee	Show all created employee records on the main index page of "Employees"	Save a new record	Saved data on the data grid of the page
24		View, edit buttons show on each record of the data grid of the index page. When clicking on the view button redirects to the detail page of the record. When clicking on the edit button redirects to the edit page of the record.	Save a new record	View and Edit button of each row. Clicks view->redirects to the detail page. Clicks edit -> redirects to the edit page.
25		Search by an employee name or EPF no on the index page.	Type "Erandi" on the search and enter or click search	Retrieve records that have "Erandi" for the branch name
26		Click on create button.	Click	Redirect to a new page of Employee
27		Click the save button without any data	Click on save, but no data	All required fields should be highlighted at once.

28		Save a duplicate employee	EPF No: 1584	Validation error: Employee already available
29		When type full name -> Initials and last name should be automatically filled	Full Name: Rannalu Lakmali Zoyza	Initials: R L Last name: Zoyza
30		When type a valid NIC-> DOB, Gender, Title should be automatically changed	NIC No: 885312322V	DOB: 198-01-31 Gender: F Title: Ms
31		Mobile no and Telephone No should be a valid no	Type invalid no	Validation message: Invalid No
32		Mobile no and Telephone No should be a valid no	Type a valid no	No validation message
33		Accordions should be collapse and expand	Collapse and expand	If data is available data should not disappear when collapse and expand
34		On the detail page, recorded data should need to fill correctly	Last added records	Data on text fields but not editable.
35		Delete an existing record	Add a record	Should be deleted after confirmation and the successful message should display
36	User	Add a user without an employee select	Username: Milan Employee: Null	Validation message: Employee is required
37	Procurement Request	Show all requests of only the logged-in user requested	User: Erandi	All records filter using Requests created by: Erandi
38		Colour indicator of the status column of the index page	All records	Drafted: Grey pending approval: yellow recommended: Orange DGApproved: Blue DivisionHeadRejected: red DGRejected: red Ontender process: green
39		Edit button should disable after sending for approval	Add a record->send for approval	Edit button of drafted or rejected records should be enabled to change it and for others should not be able to change
40		Request By, Request date should not be able to change when on a new page	Add a record	Mentioned fields should be disabled and username should auto-fill according to logged in user and the date should be the current date
41		When saving attachment or the item list is required	Click save button	Validation message: Attachment or list items are required
42		Immediate supervisor should automatically load	Open a new page	The attached immediate supervisor of Employee information should be loaded for the logged-in user.
43		“Send to approve” After saved	Save a new record	Show the successful message and redirect to the view page. The button should be available.

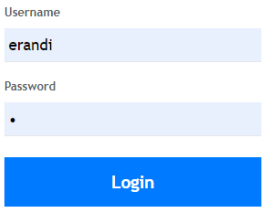
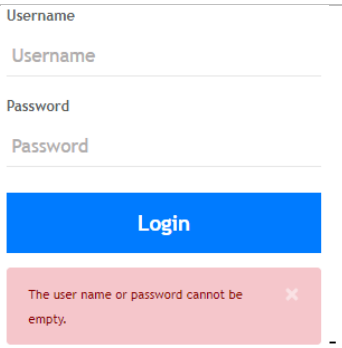
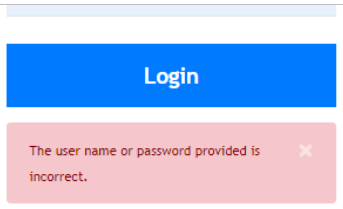
44		The user should be able to edit the request until it sends to get approval.	Click the edit button on the view page	Edit button should be available on view page if in draft status
45		The user should be able to edit the request until it sends to get approval.	Click the edit button on the view page	Edit button should not be available on view page if in "sent to approve" status
46	Approval Process	Visibility of the request to the procurement department. Without getting approval from the supervisor, check by the Proc. Dept user view.	Click send to approve button of a record.	Should be under the "Approval" tab. no buttons to proceed.
47		Get approval from the immediate supervisor	Click the Approve button	A confirmation box should appear and once successful, the successful message should display.
48		Supervisor Reject	Click the reject button	Should be able to provide a comment. A confirmation box should appear and once the action success, a successful message should appear.
49		Supervisor visibility of the item list and attachment	Click the down arrow button to get the list of records. Click the download button to get a view of the attachment.	The list should appear on the same page. Should be able to collapse. The PDF file should appear on the webpage.
50		Once the supervisor approved, Show it to the proc. dept to receive.	Login by Proc.Dept user	On the approval tab, with buttons to "Incomplete" or "Dept. Received" Only one action can proceed. Both buttons should appear on the record.
51		only "Proc. Dept received" records should appear to HR dept to approve.	Login by HR Dept user	Approve or reject buttons with the comment box should appear to the HR dept.
52		HR dept user should be able to "Recommend" or "Approve"	Login by HR Dept user	Both buttons should display.
53		IF HR "Recommended" -> DG should be able to approve it.	Login by DG user	Approve and reject buttons should appear.
54				Select all options that should be available to DG users.
55				If any are rejected, they should disappear from the list to approve.
56				If the record is selected to approve, the reject button should disappear from the record.
57				For approval or rejection, DG should be able to put a comment
58		When approve or reject, a confirmation should be asking.		A confirmation dialogue should popup

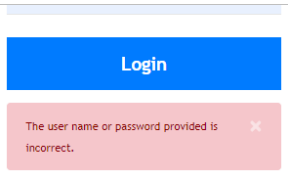
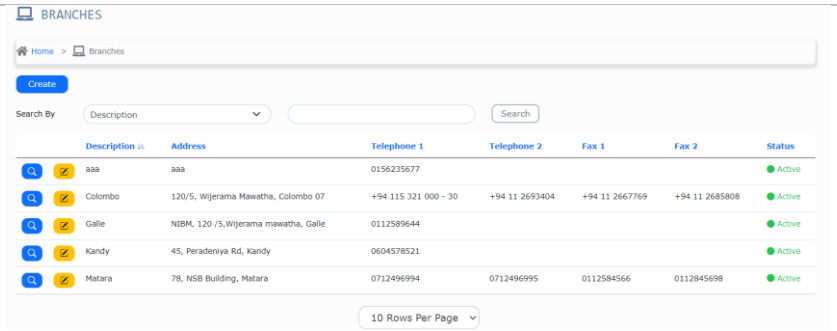
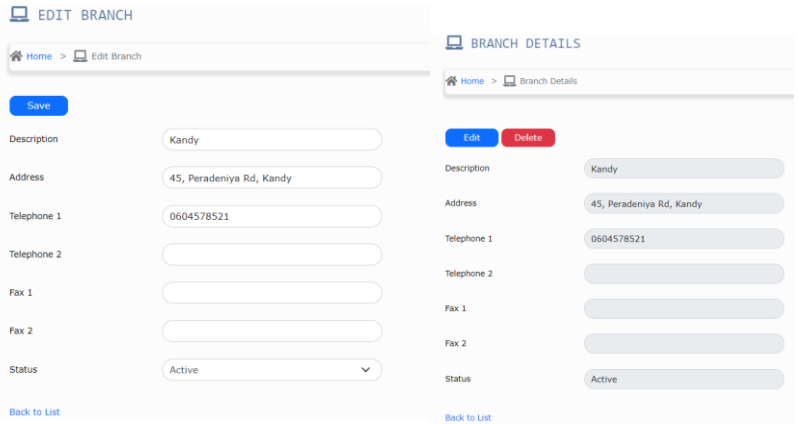
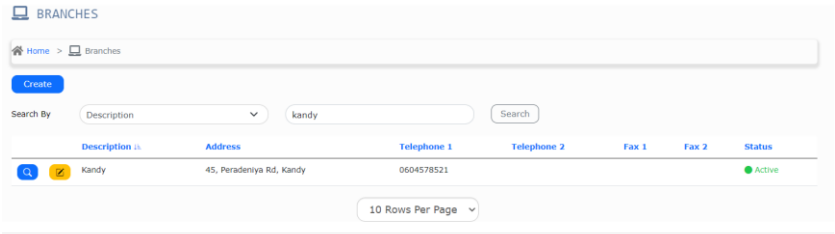
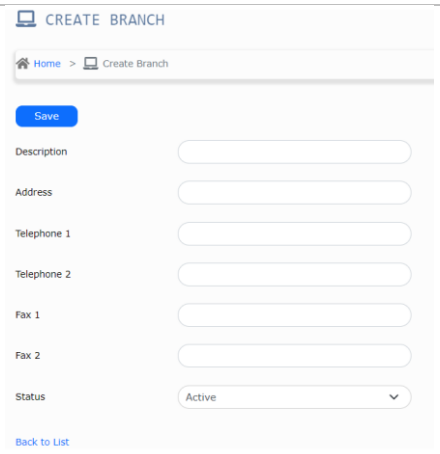
59		The user should be able to get the status update of his request.	Log in as the requester	The status of each record in the list of requests should update each time.
60	Request for Specification	Once DG or HR-approved, Record should be able to update its specification.	Login as Proc.Dept user	Spec request from, request date should be updated. All active employees should load to request from the field.

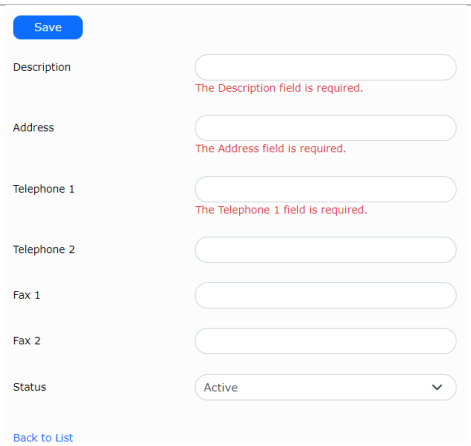
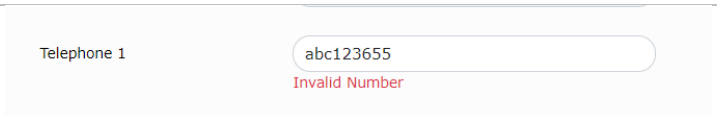
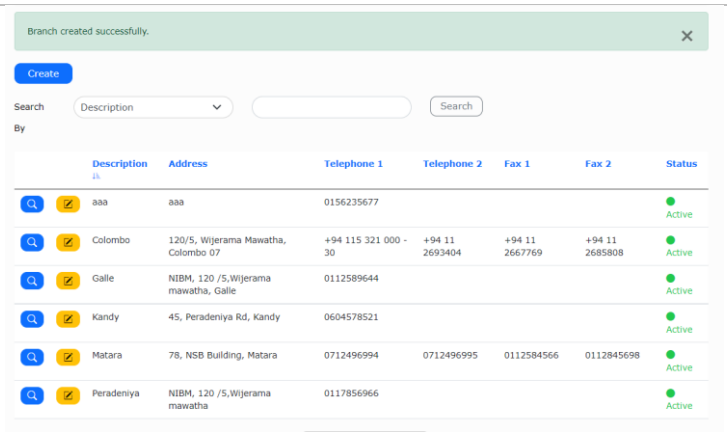
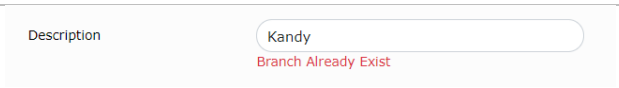
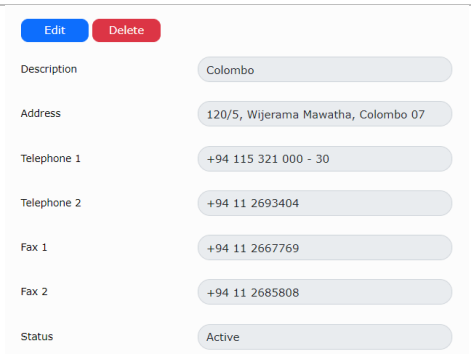
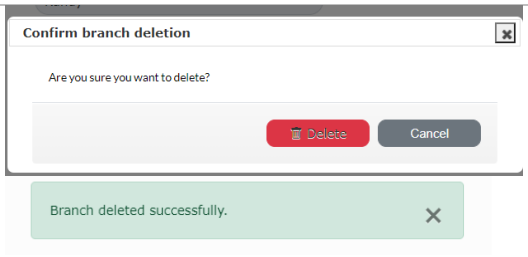
Table 5.1:Test cases

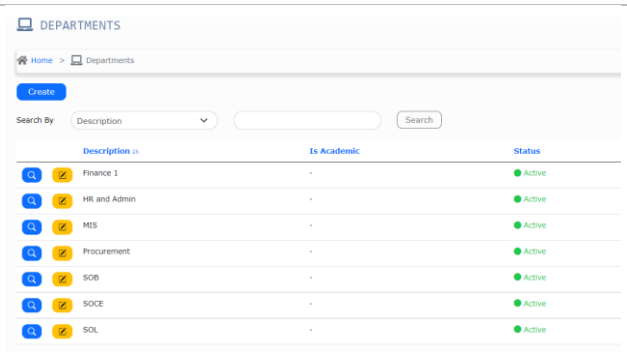
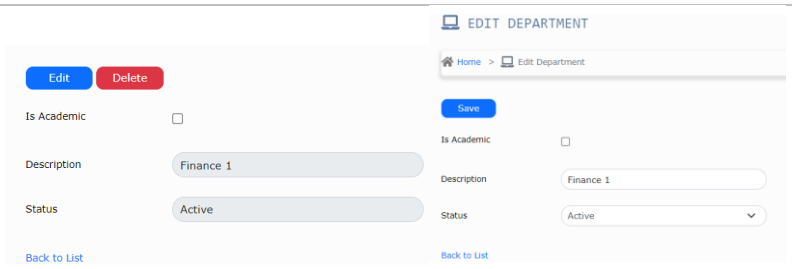
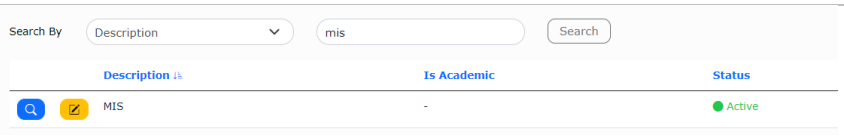
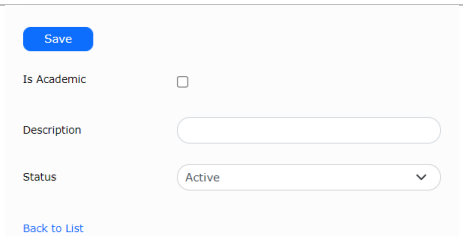
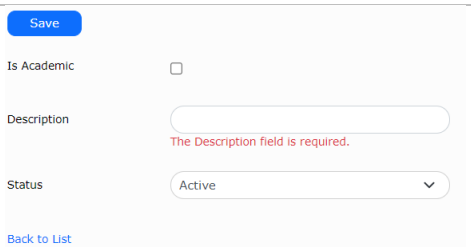
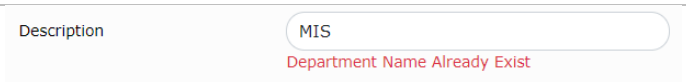
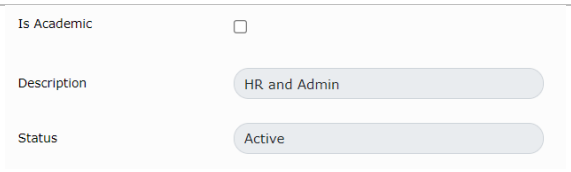
5.3 Test Results

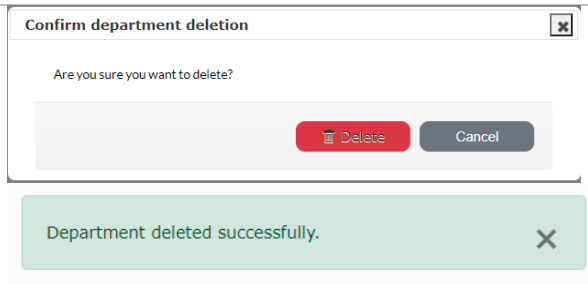
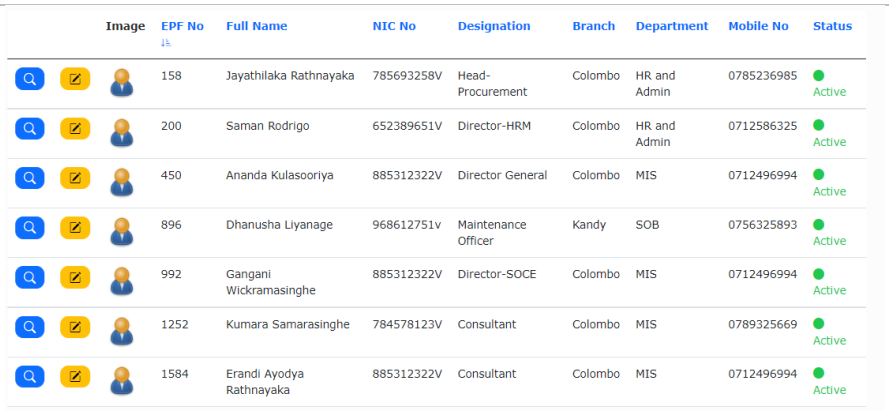
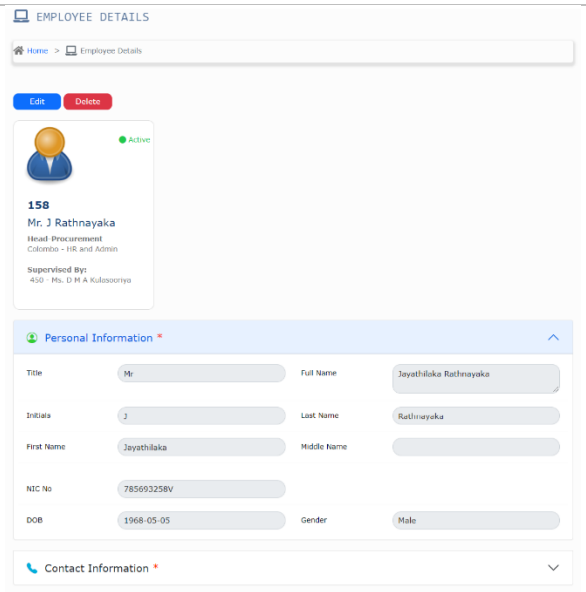
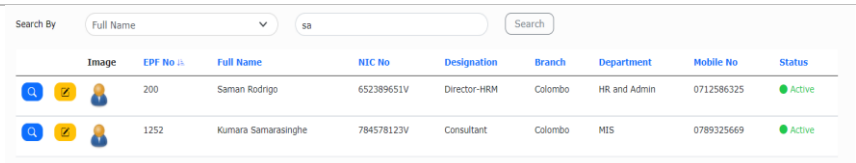
Table 5.2 refers to the actual test results with error messages and success messages of the above test cases. Additional test results of the developed system are attached in Appendix D.

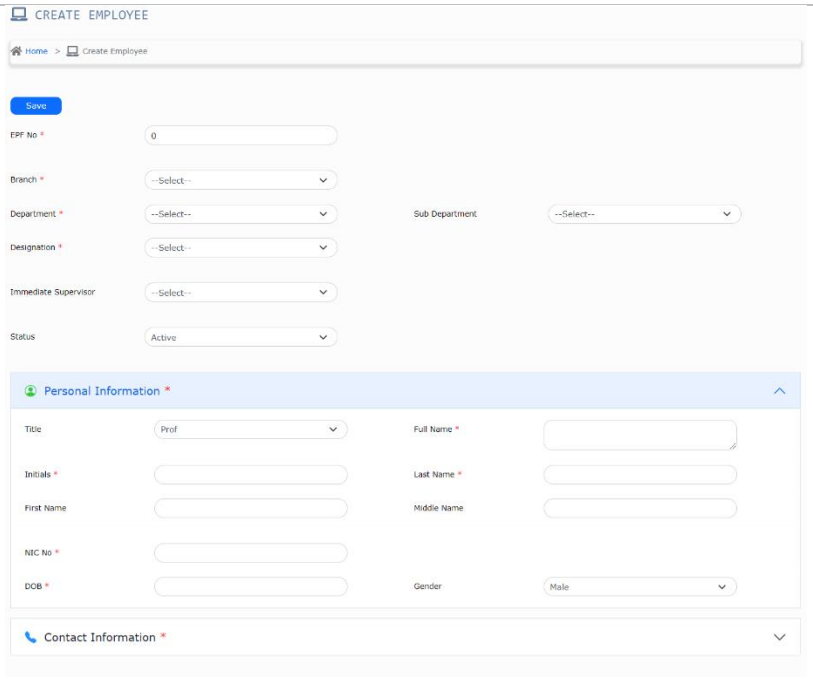
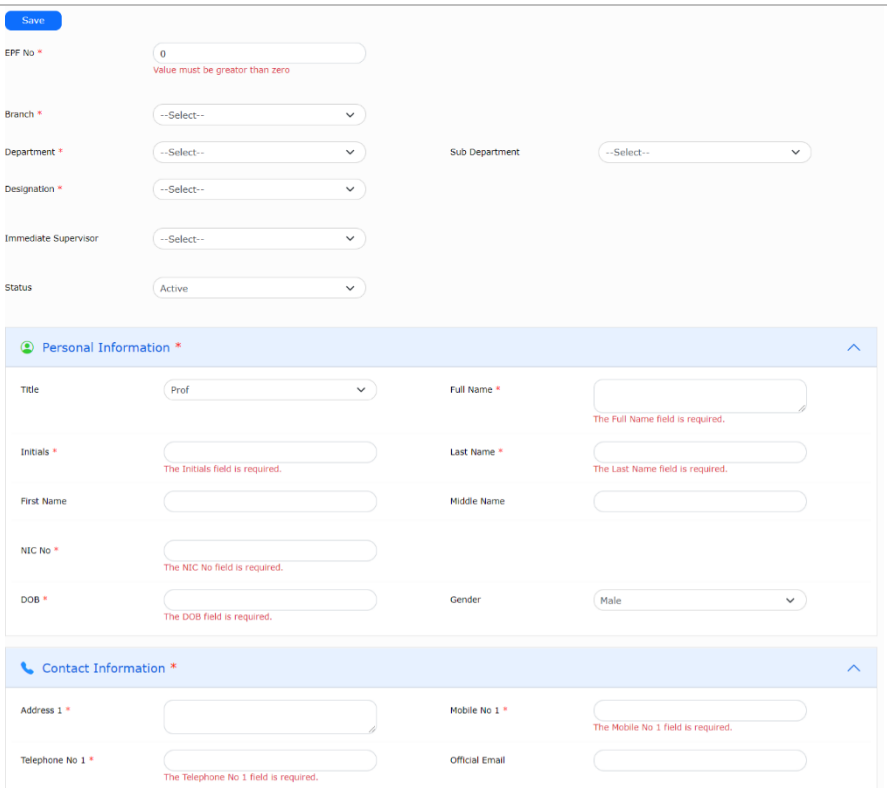
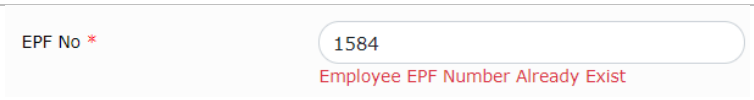
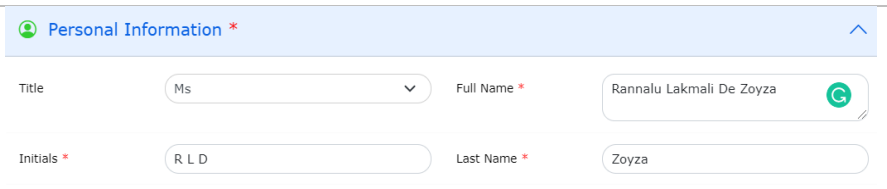
Test Case ID	Area	Description	Results
1	User Login	Login By a correct username and correct password	Un: Erandi, Pw:1
2		The username should be a character-based text field and the password field should be a password type text field	
3		Login without username or password	
4		Login with an incorrect username	

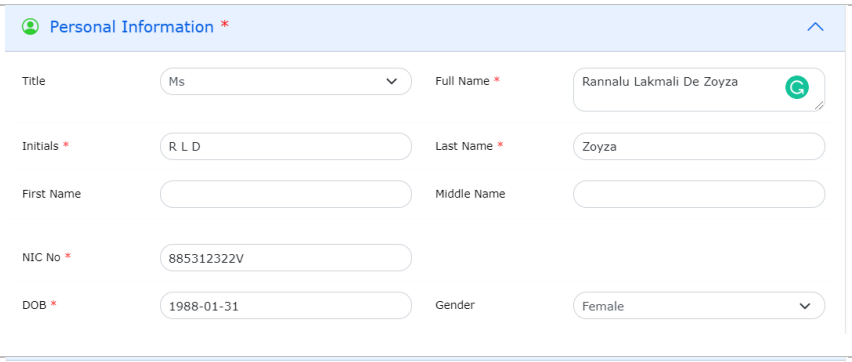
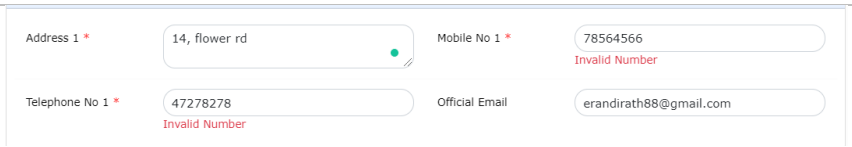
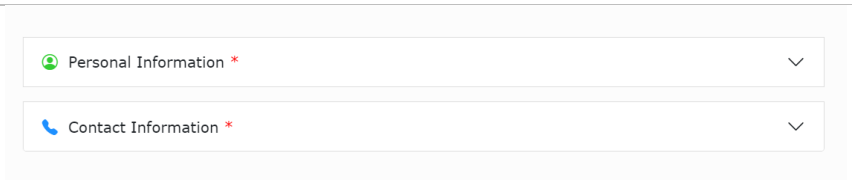
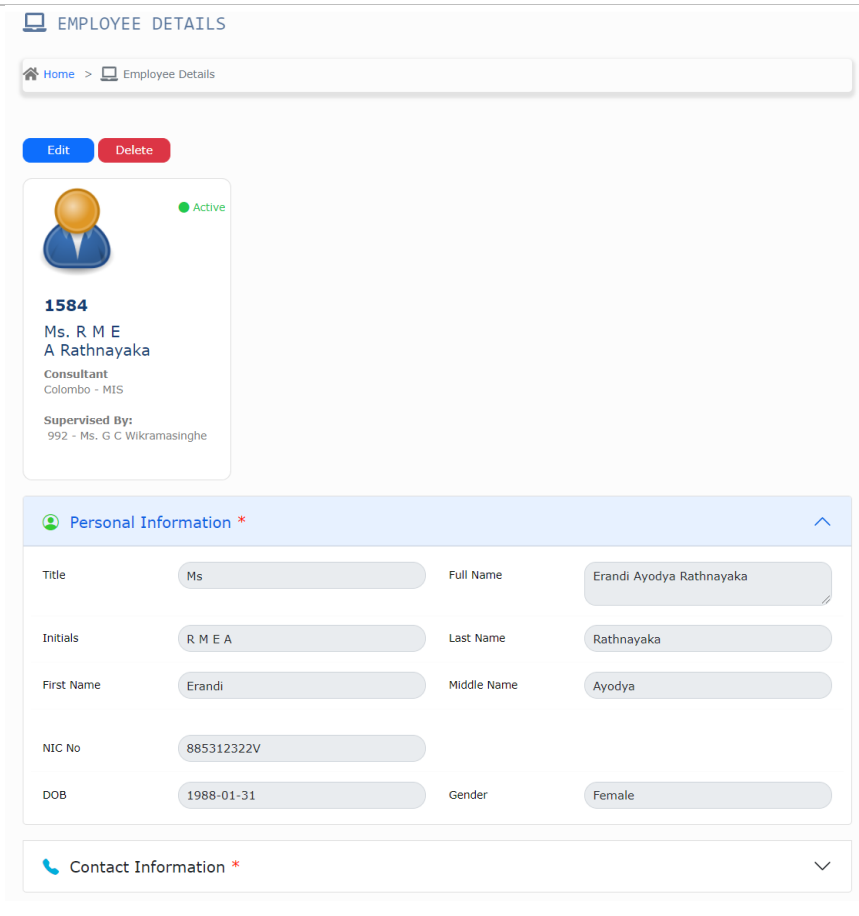
5		Login with a correct username but an incorrect password	
6	Branches	Show all created branch records in the main index page of "Branches"	
7		The view, edit button is shown on each record of the data grid of the index page. When clicking on the view button redirects to the detail page of the record. When clicking on the edit button redirects to the edit page of the record.	
8		Search by a branch name on the index page.	
9		Click on create button.	

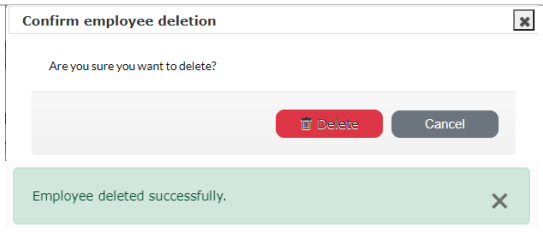
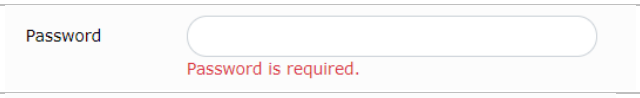
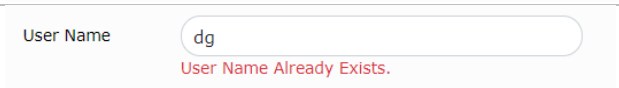
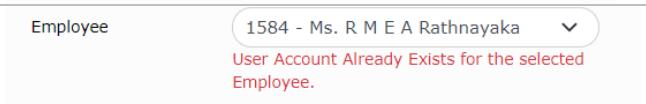
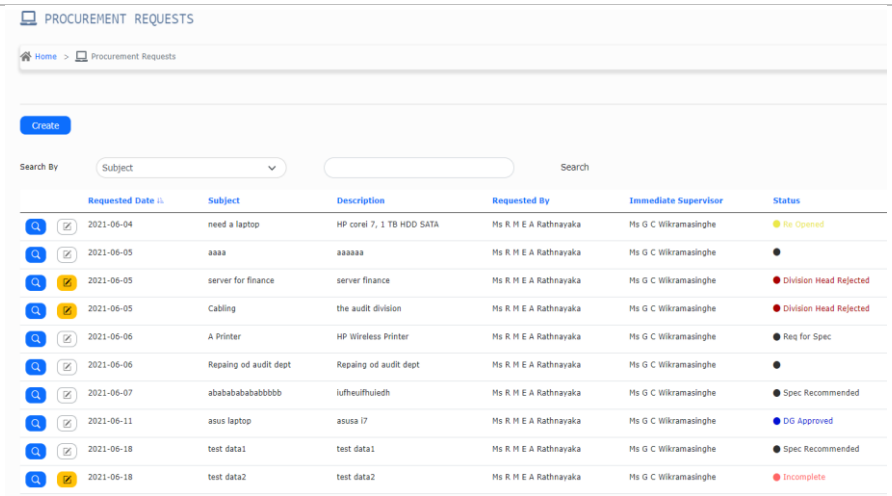
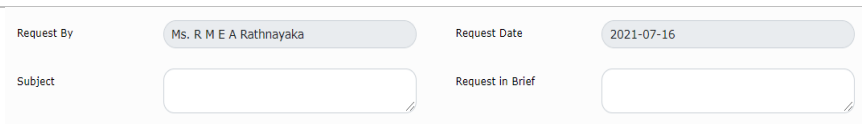
10		Click the save button without any data	
11		Use an Invalid no to “Tel No”	
12		Save the record with data filled only to required fields	
		Save a duplicate record	
13		On the detail page, recorded data should need to fill correctly	
14		Delete an existing record	

15		Show all created department records on the main index page of "Departments"	
16		View, edit buttons show on each record of the data grid of the index page. When clicking on the view button redirects to the detail page of the record. When clicking on the edit button redirects to the edit page of the record.	
17	Departments	Search by a department name on the index page.	
18		Click on create button.	
19		Click the save button without any data	
20		Save a duplicate department	
21		On the detail page, recorded data should need to fill correctly	

22		Delete an existing record	
23	Employee	Show all created employee records on the main index page of "Employees"	
24		View, edit buttons show on each record of the data grid of the index page. When clicking on the view button redirects to the detail page of the record. When clicking on the edit button redirects to the edit page of the record.	
25		Search by an employee name or EPF no on the index page.	

26		Click on create button.	
27		Click the save button without any data	
28		Save a duplicate employee	
29		When type full name -> Initials and last name should be automatically filled	

30		When type a valid NIC-> DOB, Gender, Title should be automatically changed	
31		Mobile no and Telephone No should be a valid no	
33		Accordions should be collapse and expand	
34		On the detail page, recorded data should need to fill correctly	

35		Delete an existing record	
36	User	Add a user without a password	
37		Add an existing username	
38		Add another username for an existing account hold employee	
39	Procurement Request	Show all requests of only the logged-in user requested	
40		Colour indicator of the status column of the index page	
42		Edit button should disable after sending for approval	
43		Request By, Request date should not be able to change when on a new page	

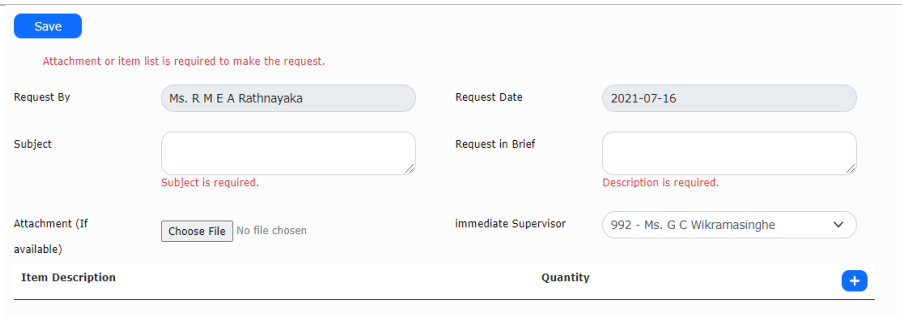
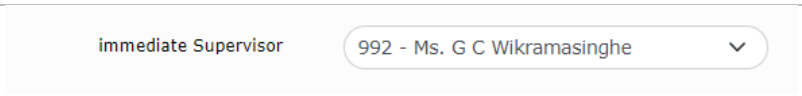
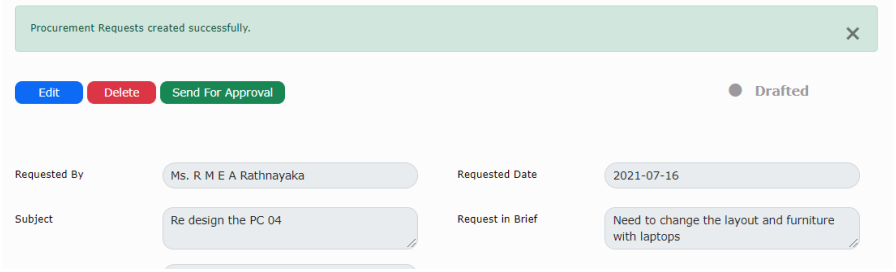
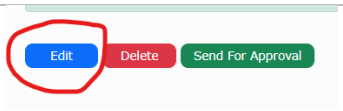
44		When saving attachment or the item list is required	
45		Immediate supervisor should automatically load	
46		"Send to approve" After saved	
47		The user should be able to edit the request until it sends to get approval.	

Table 5.2: Test Results

5.4 User Evaluation

User evaluation is conducted to determine if the requirement of the specification is met by the developed system. Main actors of the process were selected as users after the User Acceptance Testing (UAT) for the questionary process through google form survey.

Following employees of the NIBM participated in the evaluation. Employees were selected all over the NIBM to cover all departments and all campuses.

- The Head of the Procurement Department – As the Department head
- Management Assistant of the Procurement Department – As the MA of the department
- Director HR and Admin – As the Dir. HR
- The secretary of the Director-General – As the Dir. General
- Employees – As Immediate Supervisors (from different branches)
- 4 Employees – As requesters (from different branches and departments)

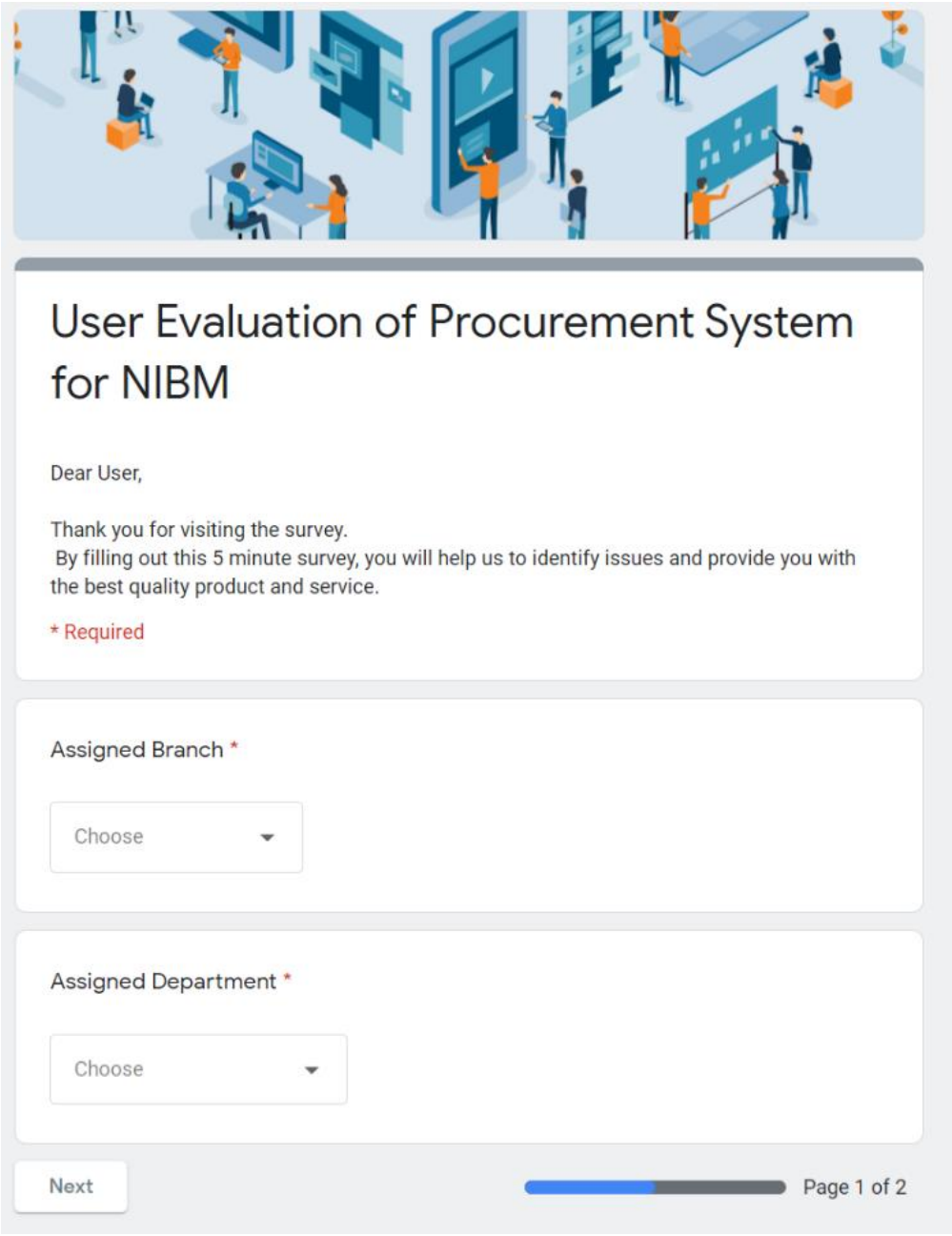


Figure 5.1: User Evaluation Form -Step 1

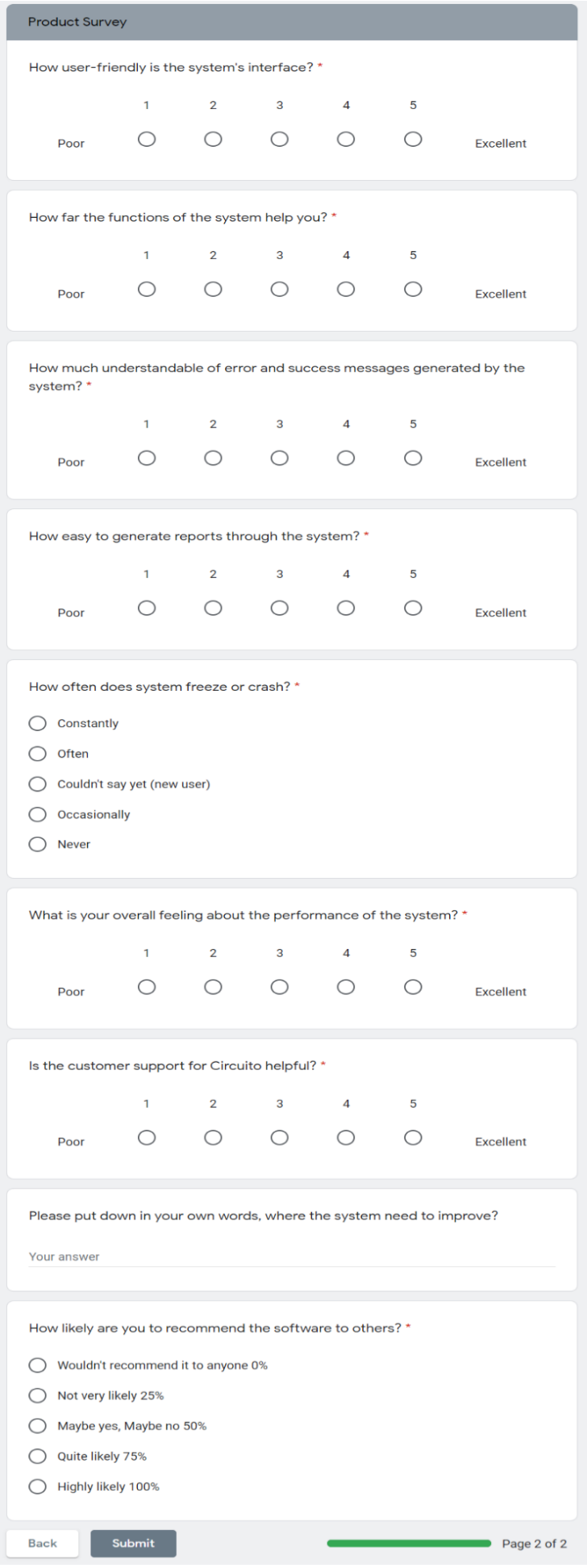


Figure 5.2: User Evaluation Form -Step 2

Figures 5.1 and 5.2 refer to evaluation forms send to users to collect their feedback regarding the developed system.

Results of the User Acceptance Testing

The survey was executed among some directly involving NIBM employees including several branches and several departments. Out of 14 responses, the received survey feedback is attached to figure 5.3-5.6.

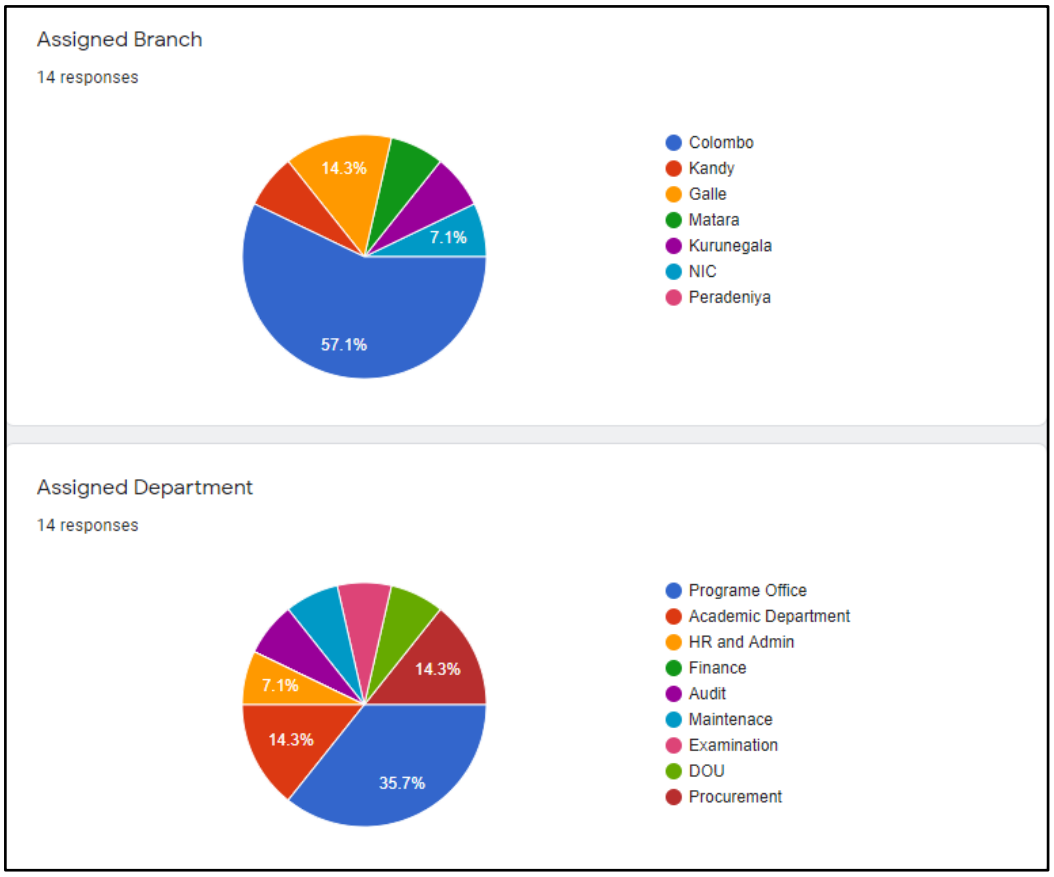


Figure 5.3: Response 1

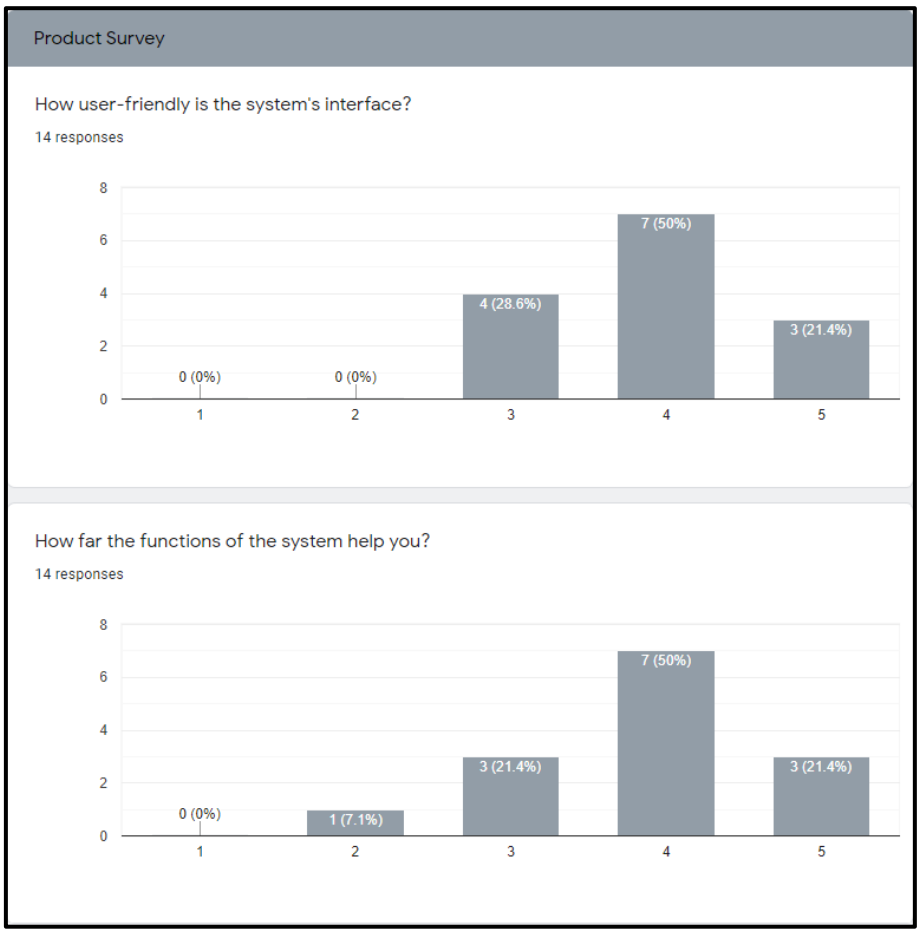


Figure 5.4: Survey feedback 2

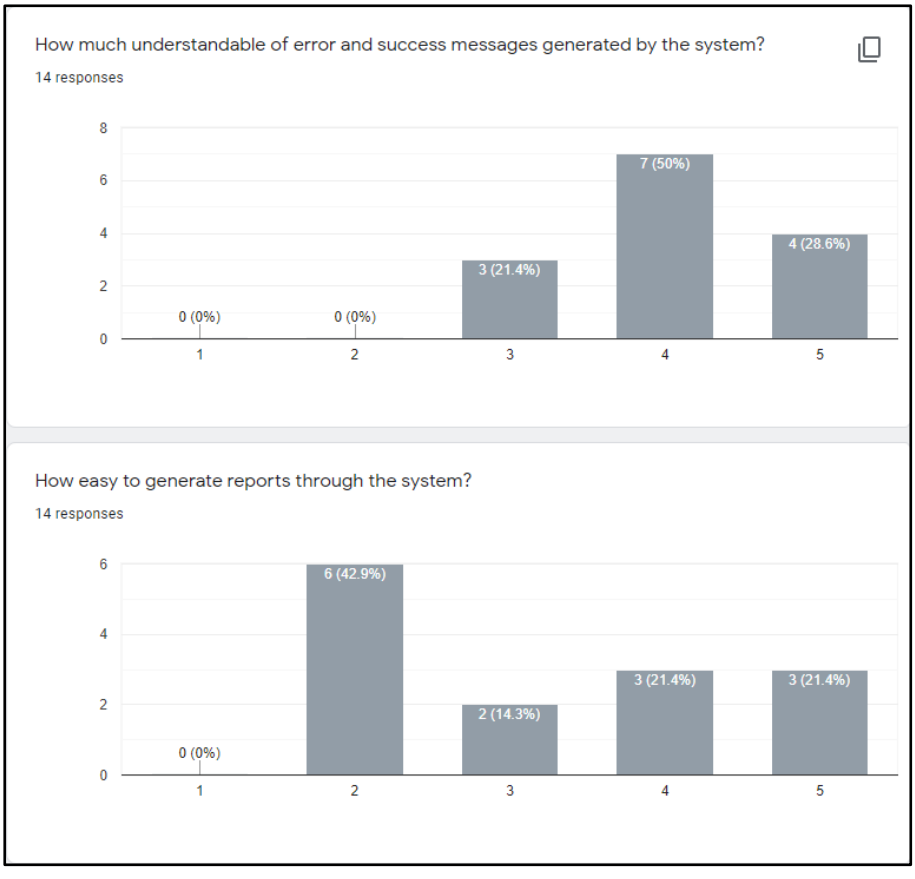


Figure 5.5: Survey feedback 3

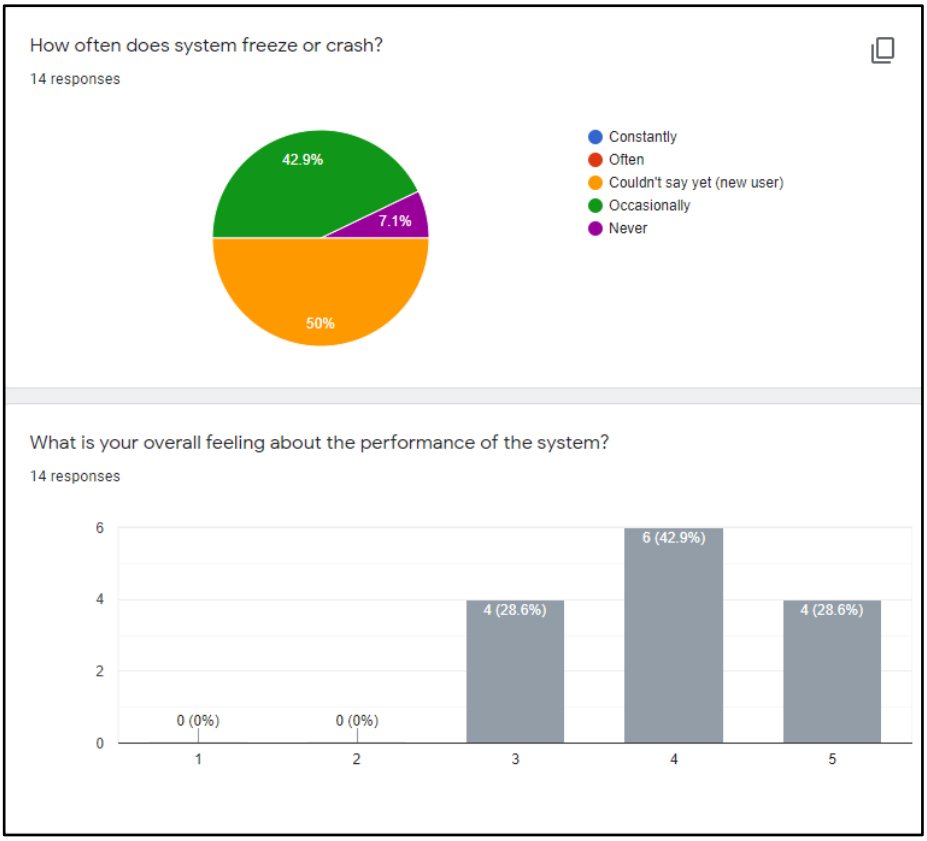


Figure 5.7:Survey feedback 4

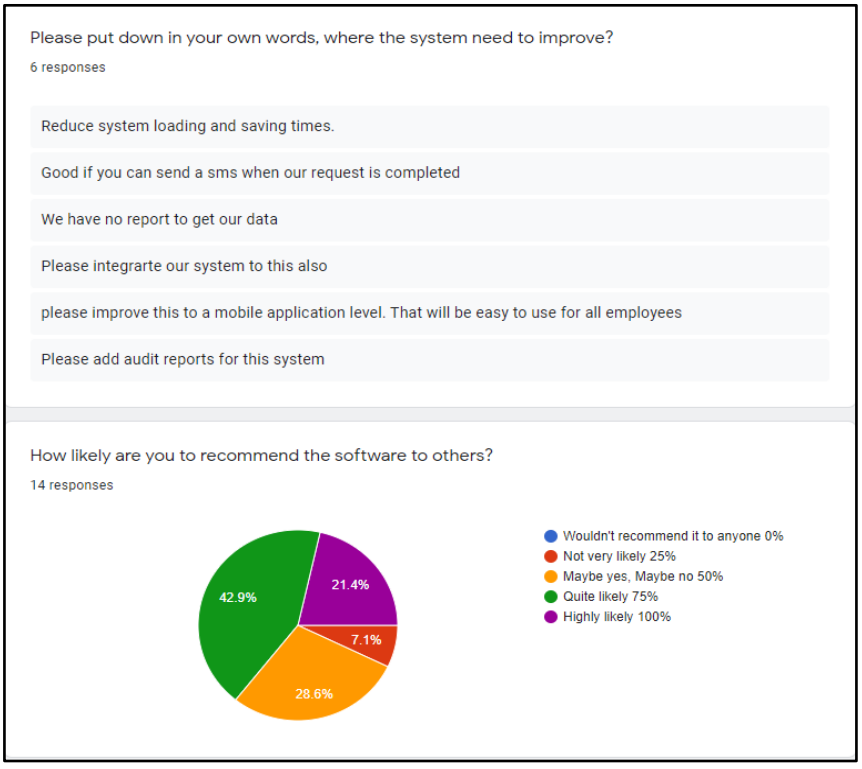


Figure 5.6:Survey feedback 5

5.5 Summary

This chapter was assigned to discuss the evaluation process of the entire development process. The evaluation process is a good measuring rod to determine the development success according to the user request and right business process.

Moreover, the chapter discussed the techniques used for the evaluation and the results of the evaluation according to user feedback. The next chapter will give the future work and the brief on the entire project.

6 CHAPTER – CONCLUSION

This chapter defines the conclusion of the entire project. This is mainly focused on the finding and how those findings apply to different situations. Moreover, this includes the lessons learned, project practices, project results, and future enhancement.

6.1 Overview of the developed System

The procurement department of NIBM is playing a major role in the company to support its main business of academic services by supplying equipment and all necessary company items through following government purchasing guidelines. As the department is currently following a manual process, the people who work under the division are not in a position to manage their workload to serve the company efficiently. Most of the time the procurement process takes much more time than the requester expected as they are following all a manual manner. As the tender process is manual, employees working at the department have so many difficulties keeping reminders, keeping track of vendor details, and managing the manual file system. Also, as NIBM has 7 campuses, including the head office, the department head is in trouble of managing all 7-branch information with a limited no of employees.

To overcome the above issues, the head of the department need to implement a computerized system which can manage all information in one place. The digitalization platform of the department needs to be centralized and web-based as per the head's requirement.

The project started with requirement gathering having conducted several interviews and discussions with the employees, the head of the department, and some of the employees of the NIBM by covering all campuses and all departments to get all of their aspects. The project used the incremental waterfall method as the SDLC methodology.

As per the requirement of the head of the DOU, the final product needs to be hosted on the Azure cloud. So as .Net technologies are pretty much suitable in Azure technologies, the product used .Net technologies and SQL as DB services in the implementation. Once the implementation was completed and the completion of developer tests, UAT was done by the department employees.

A survey was conducted among the employees involved in the requirement gathering stage via google forms, and results were found with several enhancements. However, according to their feedback, the system was at a satisfactory level and the department head accepted it with gratitude.

6.2 Lessons Learnt

This was a great opportunity for me to apply the previously learned lessons to a practical environment. As the domain area was familiar for me, it helped to gather business requirements easily. It broadened my horizons into understanding how to map related business processes into a computerized system.

In addition, this gave me an exceptional experience of being in a complete software development life cycle, starting from feasibility studies to the conclusion of the project. This project allowed getting extensive knowledge on several technical tools of every phase of the SDLC.

6.3 Future Improvement

The following features are planning to add to the newly built system as further improvements.

- Enhance the system to synchronize with the NIBM Inventory Management System and Finance System.
    - New procurement will execute if only the inventory is running out of the requested product. Therefore, once the inventory and finance systems are integrated into the procurement system the whole process will be streamlined and it can function with fewer errors and faster than the present.
- Add the email facility integrated with official email as notifications to all users.
    - Notifications will make users easy in accessing and it will help to increase the usability of the system.
- Enhance the system to use to collect tenders online from vendors.
    - The tender collection needs to be centralized to increase the efficiency and ease of using the system.

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APPENDIX A – SYSTEM DOCUMENTATION

The system documentation can be referred to if there are any changes or enhancements to be made in the application. This documentation includes steps that need to follow to configure the environment of implementation by the system administrator.

To develop the system locally below software is required to install.

- Visual Studio 2019 Community Edition
- SQL Server Express 2019

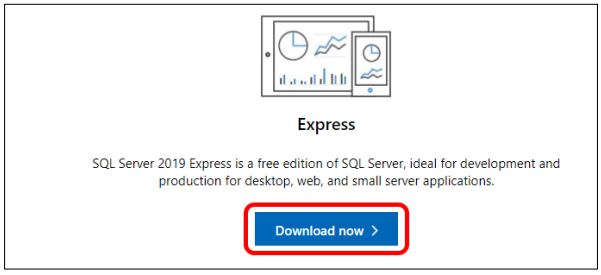
Minimum requirements of hardware and software for the installation are as follows.

Supported Operating Systems	Visual Studio 2019 & SQL Server 2019 will install and run on the following operating systems (64 bit recommended; ARM is not supported): ▪ Windows 10 version 1703 or higher: Home, Professional, Education, and Enterprise (LTSC and S are not supported) ▪ Windows Server 2019: Standard and Datacenter ▪ Windows Server 2016: Standard and Datacenter ▪ Windows 8.1 (with Update 2919355): Core, Professional, and Enterprise ▪ Windows Server 2012 R2 (with Update 2919355): Essentials, Standard, Datacenter ▪ Windows 7 SP1 (with latest Windows Updates): Home Premium, Professional, Enterprise, Ultimate
Hardware	▪ 1.8 GHz or faster processor. Quad-core or better recommended ▪ 2 GB of RAM; 8 GB of RAM recommended (2.5 GB minimum if running on a virtual machine) ▪ Hard disk space: Minimum of 800MB up to 210 GB of available space, depending on features installed; typical installations require 20-50 GB of free space. ▪ Hard disk speed: to improve performance, install Windows and Visual Studio on a solid-state drive (SSD). ▪ A video card that supports a minimum display resolution of 720p (1280 by 720); Visual Studio will work best at a resolution of WXGA (1366 by 768) or higher.
Additional Requirements	▪ Administrator rights are required to install Visual Studio. ▪ .NET Framework 4.5.2 or above is required to install Visual Studio. Visual Studio requires .NET Framework 4.7.2 to run, and this will be installed during setup. ▪ Internet Explorer 11 or Edge is required for internet-related scenarios. Some features might not work unless these, or a later version, are installed. ▪ Running Visual Studio 2019 (Professional, Community, and Enterprise) in Windows containers is not supported.

A 1: Minimum Hardware Requirements

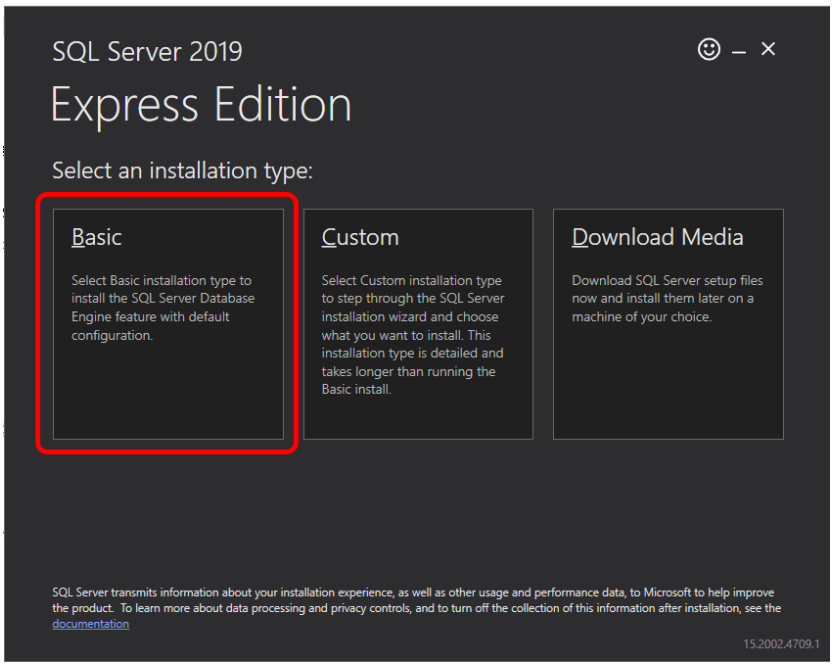
Install SQL Server Express 2019

Step 1: Download the SQL Server setup from https://www.microsoft.com/en-us/sql-server/sql-server-downloads. Select the "Express" edition.



A 2: Download SQL setup

Step 2: Double-click on the downloaded setup. Administrator rights are required to install.
Step 3: When the below screen appeared select "Basic" installation type.

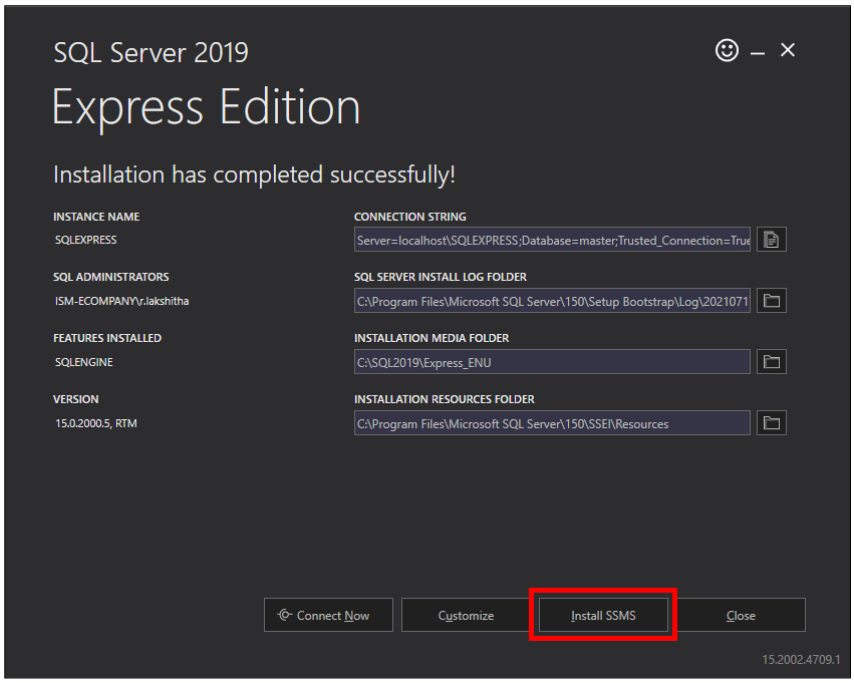


A 3: SQL Installation-Step 3

Step 4: Select the installation folder.

Step 5: Once the installation is completed, the below screen will be displayed. Click on "Install SSMS" to install the SQL Server Management Studio.

**Note: Note down or copy the connection string as it needs to use later.*



A 4: SQL Installation-Step 4

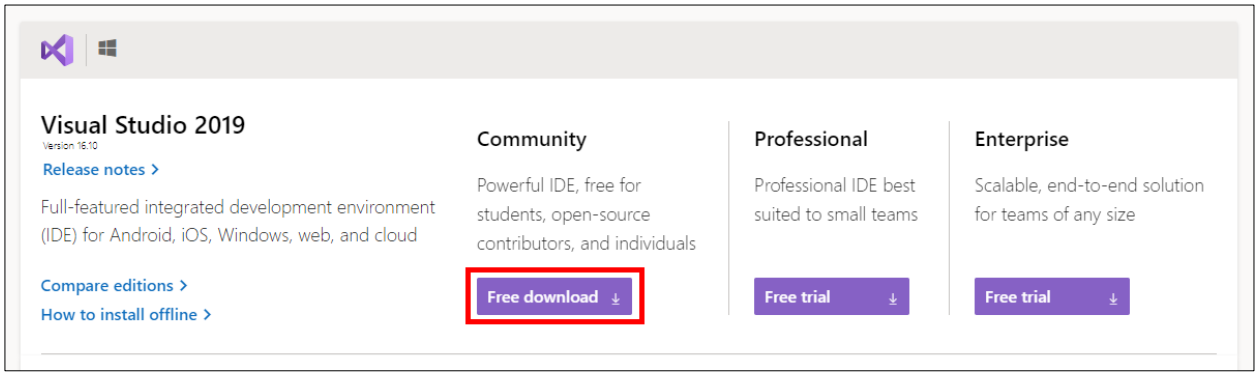
Step 6: Click Next and Finish to complete the installation.

Install Visual Studio 2019

Follow the below steps to install visual studio to use as the development framework.

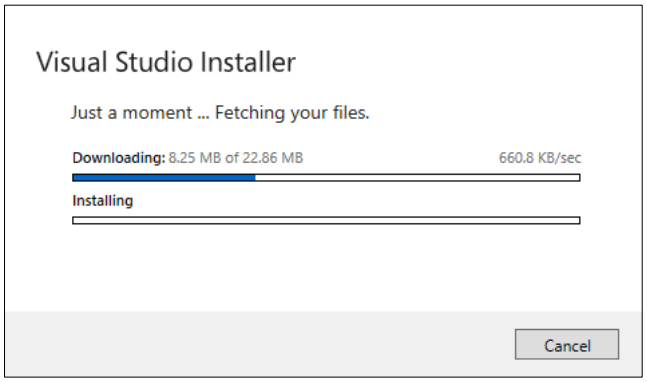
Step 1: Download the Visual Studio setup from https://visualstudio.microsoft.com/downloads/.

Step 2: Select the "Community" edition for free or if the license is available select the "Enterprise" edition.



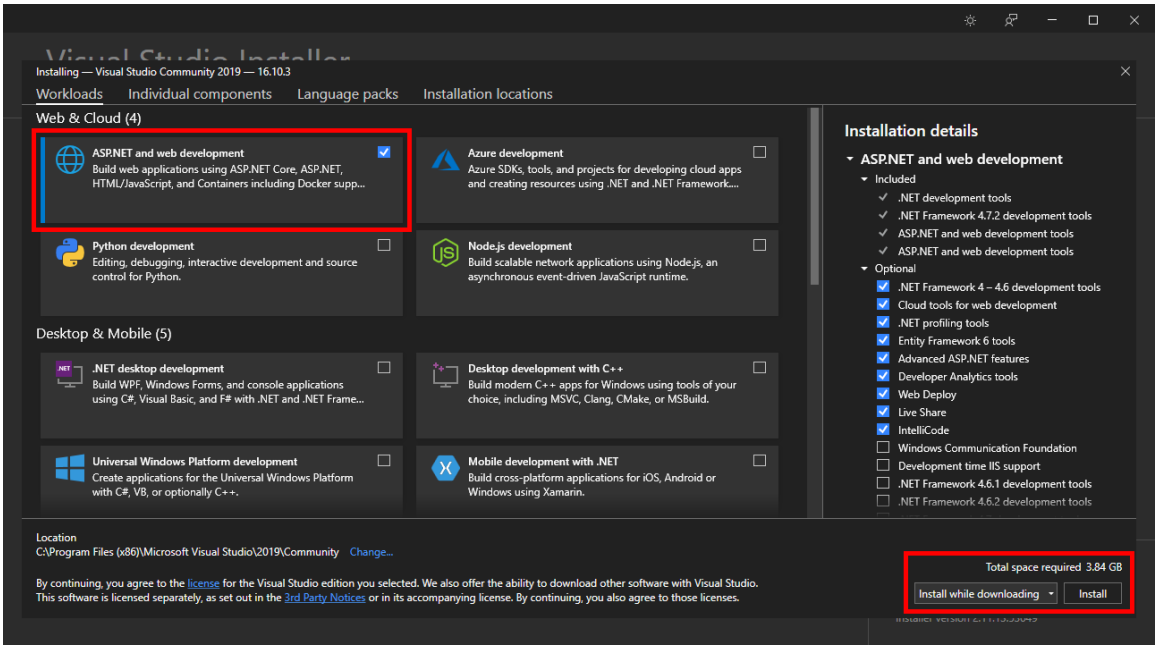
A 5: VS installation-Step 1

Step 3: Double-click on the downloaded setup. Administrator rights are required to install. This will automatically download and start the visual studio installer.



A 6: VS installation-Step 2

Step 4: Select "ASP.Net and Web Development" and select "Install while Downloading".

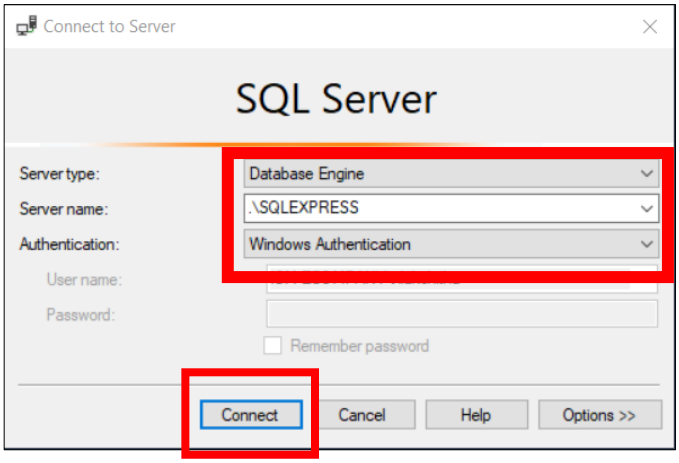


A 7: VS installation-Step 3

Setup the Development Environment

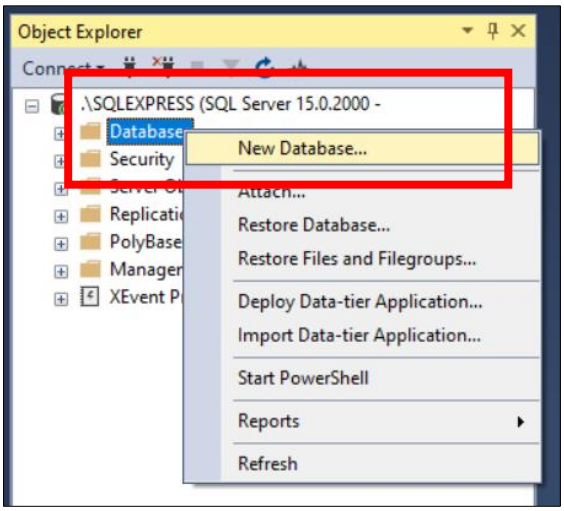
Follow the below steps to set up the development environment once the visual studio and SQL server download completes.

Step 1: Double click on “SQL Server Management Studio”
Step 2: Use “Windows Authentication” to connect to the database engine.



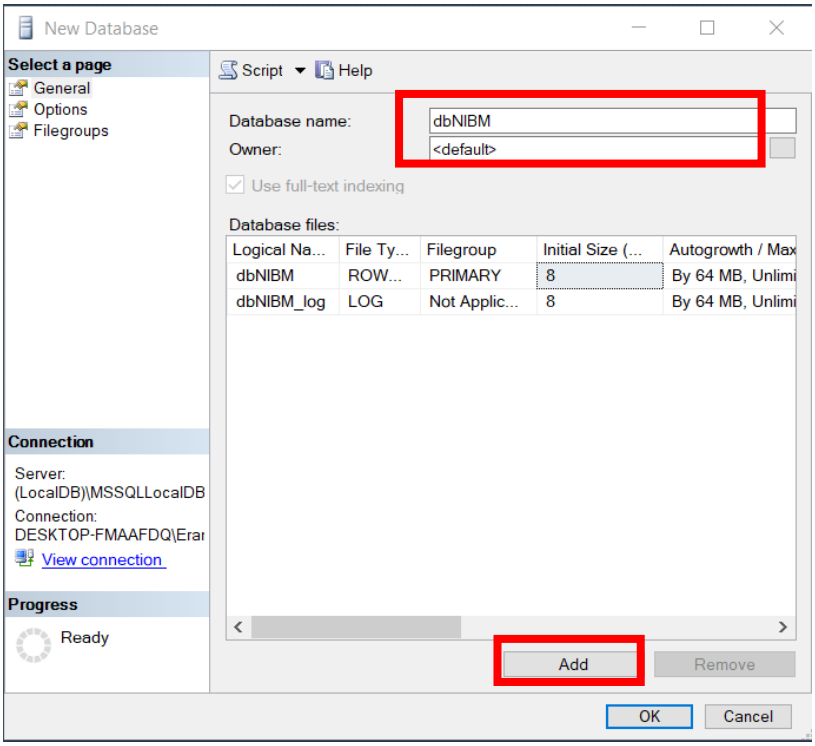
A 8: Setup environment-Step 1

Step 3: Get the “Object Explorer” view and right-click on Databases -> Select “New Database”



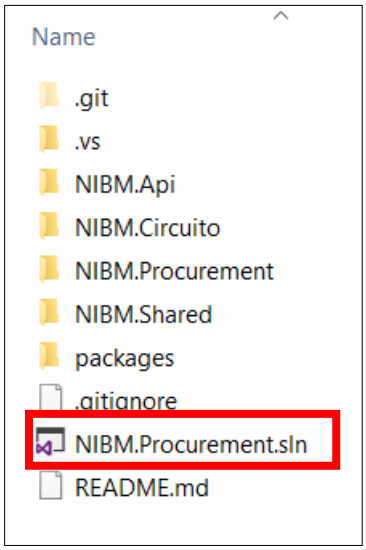
A 9: Setup environment-Step 2

Step 4: Provide the DataBase name as “dbNIBM” and click ok.



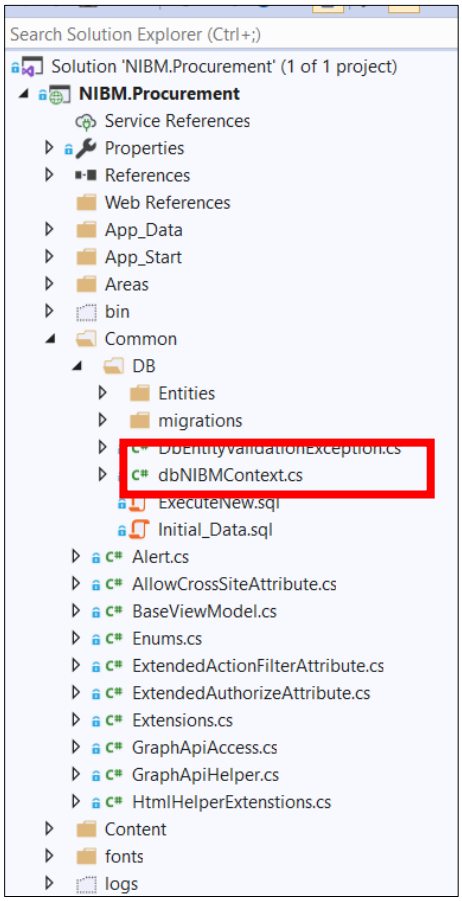
A 10: Setup environment-Step 3

Step 5: Double click on the project source file and find the solution file named “NIBM.Procurement.sln”.



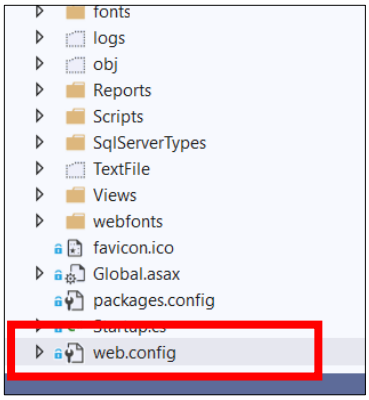
A 11: Setup environment-Step 4

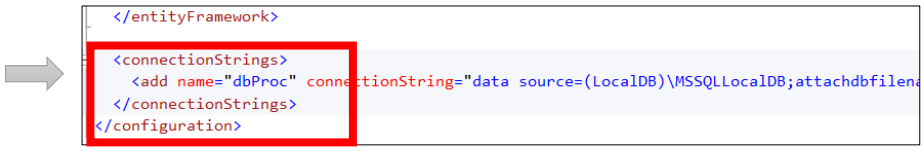
Step 6: In the “Solution Explorer” and double click on the “dbNIBMContext.cs” file.



A 12: Setup environment-Step 5

Step 7: Open the "Web. config" file and find the connection string name given in the application.





A 13: Setup environment-Step 7

A 14: Setup environment-Step 6

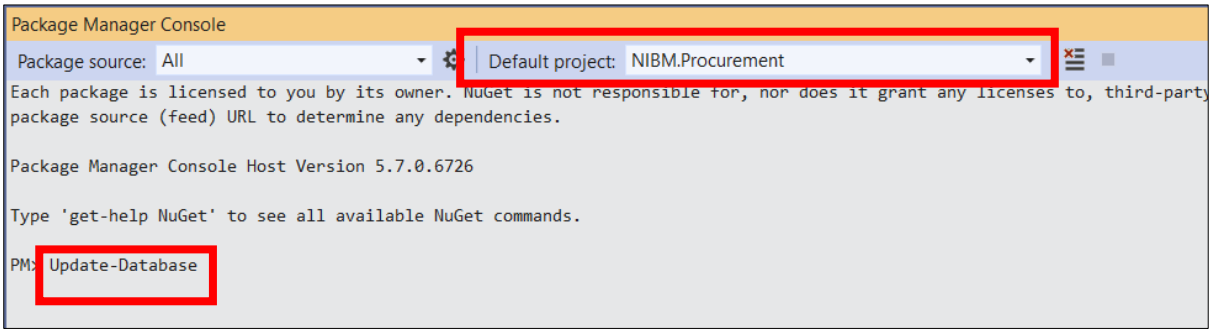
Step 8: Change the connection string name of the "dbNIBMContext.cs" as the name of the "Web. config" file.

```
14 references | Erandi Ayodya, 37 days ago | 2 authors, 2 changes
public dbNIBMContext()
{
    ConnectionString = ConfigurationManager.ConnectionStrings["dbProc"].ConnectionString;
}
```

A 15: Setup environment-Step 8

Step 9: Open "Package Manager Console" of "Visual Studio using Tools -> Nuget Package Manager- > Package Manager Console".

Step 10: Type "Update-Database" on the Package Manager Console and enter.



A 16: Setup environment-Step 9

Step 11: Run the application using the  button on the toolbar.

APPENDIX B – USER DOCUMENTATION

User Document of the application will be helping the procurement department users and all NIBM users in their first time use to identify steps need to follow.

User Guide for all NIBM users:

Login

Step 1: Log in to the system by using the provided username and password.

Figure B 1 refers to the steps of the login process.

B 1: Login

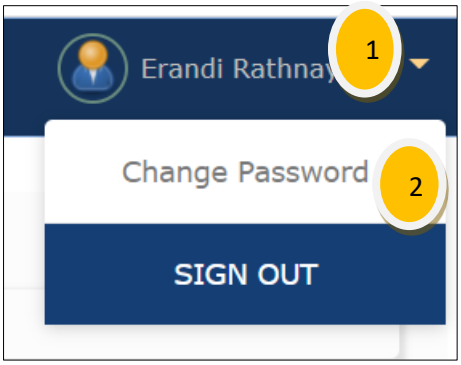
Change password

Step 1: Click on the greeting message on the top of the screen.

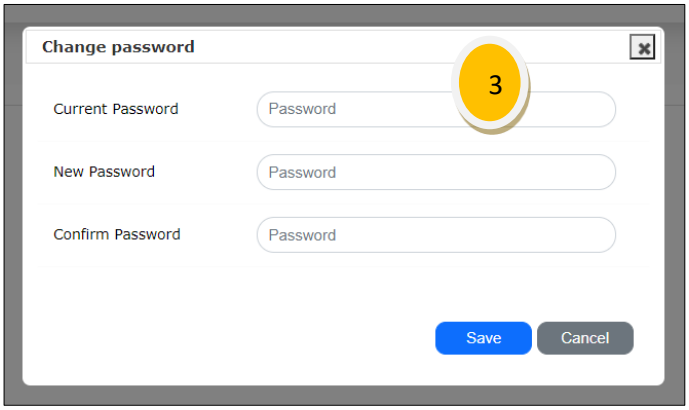
Step 2: Select "Change password".

Step 3: Provide necessary data and "Save".

Figure B2, B3 refers to the steps of the change password procedure.



B 2: Change password- step 1



B 3: Change password- step 2

New Request

Step 1: Select "New Request" through the menu or select the "New Request" tile from the dashboard.

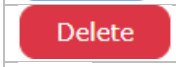
Step 2: Click on the "Create" button.

Step 3: Fill in data and click on the "Save" button.

Step 4: Click on the "Send for Approval" button to get approval.

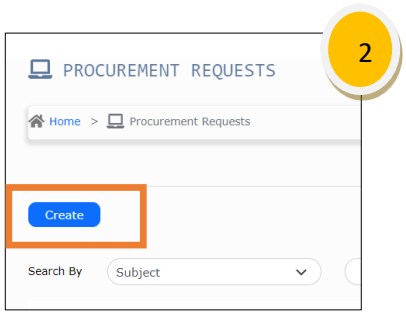
**Note:*

- *Once the request is "Sent for Approval" you are not able to make any modification to the request.*
- *If the request got "Rejected" you will be able to modify the record.*

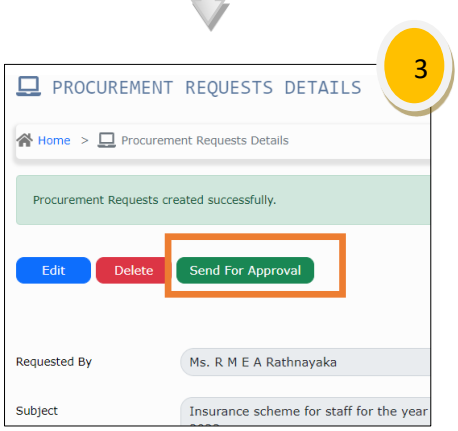
	Click the button to get a view of the request.
	Click the button to edit the request.
	Not authorized to modify the request.
	Click the button to pass the request to the approval cycle.
	Click the button to edit the request.
	Click the button to delete the request.
	Click the button to add list items.
	Click the button to edit the added list item.
	Click the button to delete the added list item.

Figures B4, B5, and B6 refer to the steps of creating a new request and send it for approval.

B 5: New request-step 1



B 6: New request-step 2



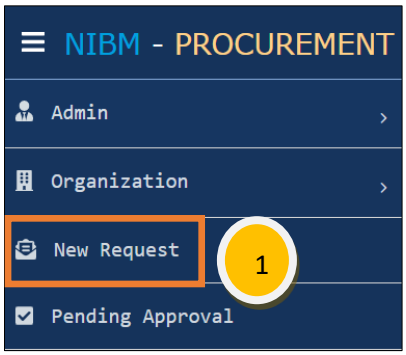
B 4: New request-step 3

Search for Request and find its status

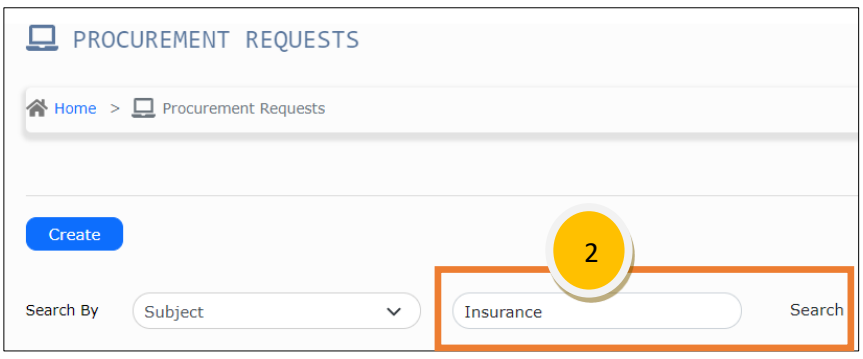
Step 1: Select "New Request" through the menu or select the "New Request" tile from the dashboard.

Step 2: Type the searching keyword on the highlighted text area and click on the "Search" button.

Figures B7 and B8 refer to the steps of the process of searching a request and its status.



B 7: Search Request-Step 1



B 8: Search Request-Step 2

Approve or Reject the Request

Step 1: Click on the "Pending Approval" button on the home page or select "Pending Approval" from the menu.

Step 2: Click on the "Approve" button.

**Note: Approver can add a comment when approving or rejecting the request.*

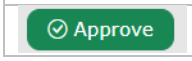
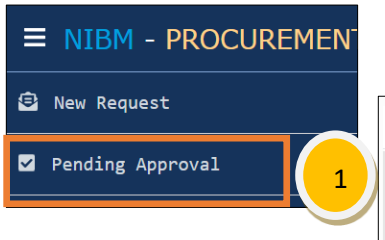
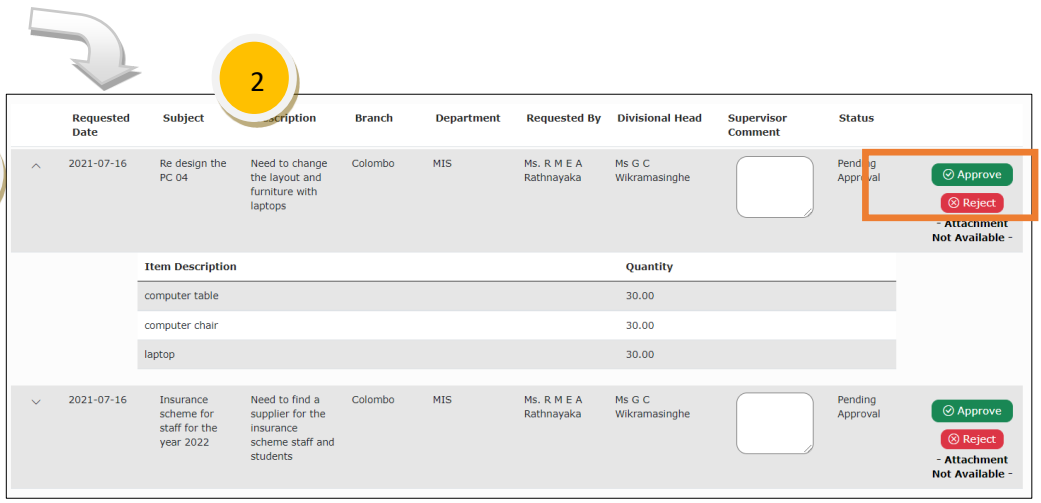
	Click the button to get a view of the attached specifications. The button will available only if any attachments are available for the request.
	Click the button to get the list of items requested with their quantity.
	Click the button to reject the request.
	Click the button to approve the request.

Figure B9 and B10 refer to the steps of approval or rejection process need to be complete by the immediate supervisor and the Director HR.



B 10: Pending Approval-Step 1



B 9: Pending Approval-Step 2

Approve or Reject the Request: By DG

Step 1: Click on the “Pending Approval” button on the home page or select “Pending Approval” from the menu.

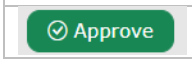
Step 2: Select records that need to be approved. (Select all can be used to select all records of the list at once)

Step 3: Click on the “Approve” button.

**Note:*

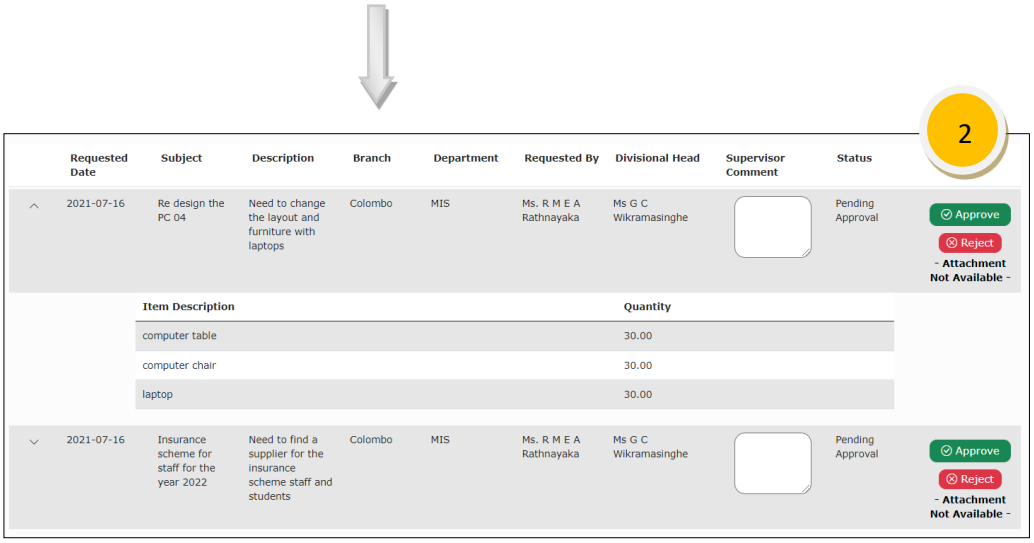
DG can add a comment when approving or rejecting the request.

Multiple selections when approving is enabled for the DG.

	Click the button to get a view of the attached specifications. The button will available only if any attachments are available for the request.
	Click the button to get the list of items requested with their quantity.
	Click the button to reject the request.
	Click the button to approve the request.

Figures B11 and B12 refer to the steps of the approval or rejection process of DG.

B 11: DG approval-Step 1



B 12: DG approval-Step 2

User Guide for Procurement Department users:

Following features are only accessible by the procurement department users.

Login

Step 1: Log in to the system by using the provided username and password.

Figure B 1 refers to the steps of the login process.

B 13: Login

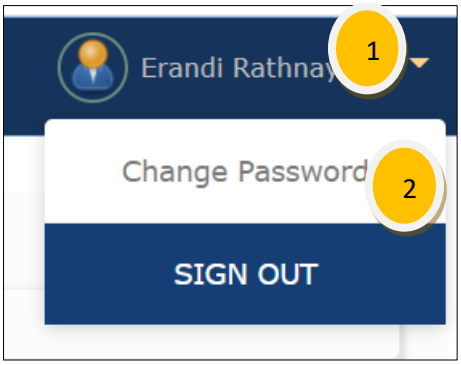
Change password

Step 1: Click on the greeting message on the top of the screen.

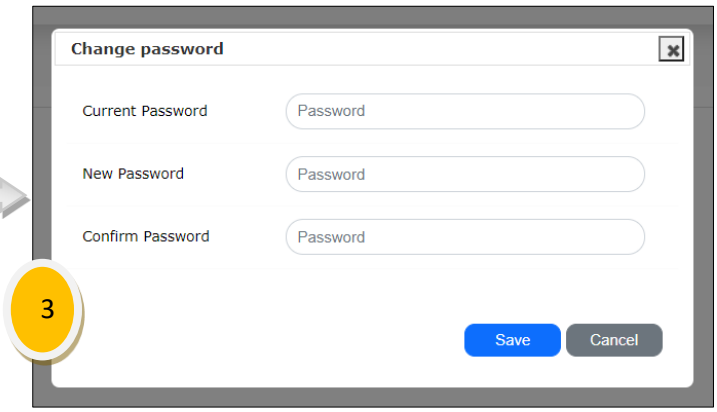
Step 2: Select “Change password”.

Step 3: Provide necessary data and “Save”.

Figure B14, B15 refers to the steps of change password procedure.



B 14: Change password- step 1



B 15: Change password- step 1

Start Department Process

Step 1: Select "Procurement Department Process" through the menu.

Step 2: Select the "Approval" tab.

Step 3: Click on "Department Received" to start the process or if the request is incomplete, the user can "incomplete" using the button for Division head approved records.

**Note:*

- *The tab includes all HR director recommended requests to make them "DG approved" to the procurement department user.*
- *All requests which are still on the approval process are shown on the "Approval" tab.*

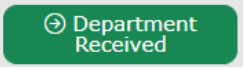
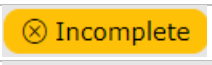
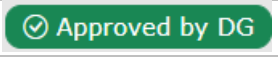
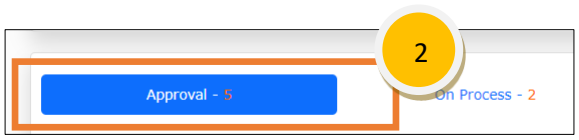
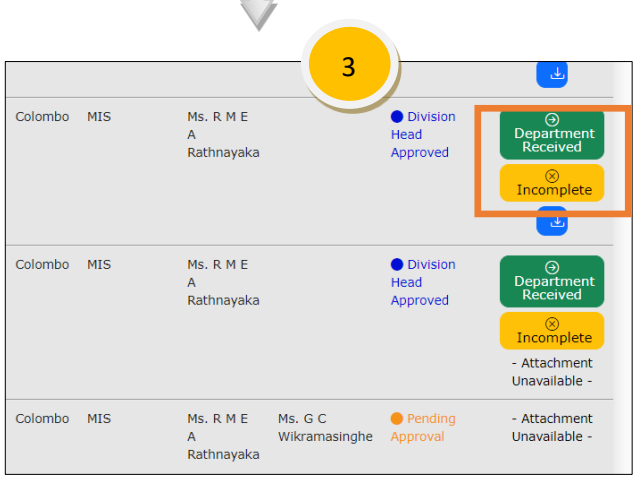
	Click the button to get a view of the attached specifications. The button will available only if any attachments are available for the request.
	Click the button to get the list of items requested with their quantity.
	Click the button to start the department process.
	Click the button to incomplete the request.
	Click the button to make the record as "DG Approved".

Figure B16, B17, B18 refers to the steps of procurement department process start. These processes only can be accessible by the procurement department users.

B 17: Proc Dept Process-Step 1



B 16: Proc Dept Process-Step 2



B 18: Proc Dept Process-Step 3

Collect Specification

Step 1: Select "Procurement Department Process" through the menu.

Step 2: Select the "On Process" tab.

Step 3: Click on the "Request for Spec" button to request a spec from the relevant party.

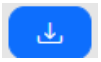
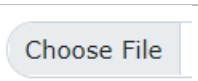
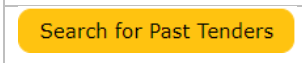
Step 4: Select the employee for "Spec Requesting from" of the page and click on the "Request for Spec" button.

Step 5: Click on the "Spec Received" button or if the request to collect has already been sent and the procurement department has collected it from the relevant party.

Step 6: attach the specification and select the process type using the dropdown list.

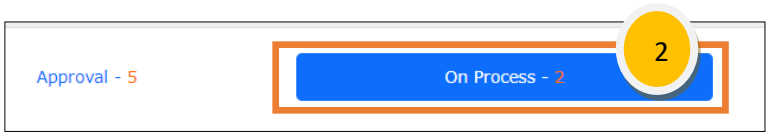
Step 7: If the user is trying to the find last 3-month tenders to proceed with the request, the user can click on "Search for past tenders"

**Note: If the user selected a past tender to proceed or if the process type is selected as "Completed by advance" or "Completed by petty Cash", the record will not be accessible on the tender process.*

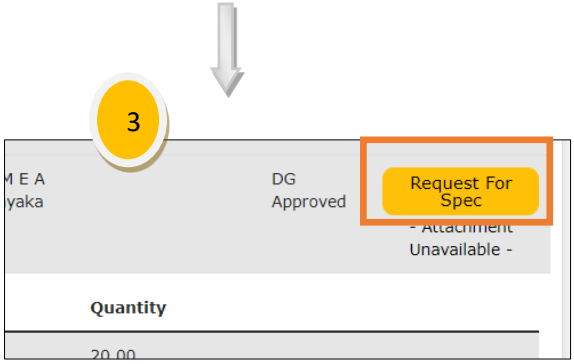
	Click the button to get a view of the attached specifications. The button will available only if any attachments are available for the request.
	Click the button to get the list of items requested with their quantity.
	Click the button to request a specification from the relevant party.
	Click the button to update the received specification details.
	Click the button to upload the specification.
	Click the button to check the past 3 months' tender details.

Figures B19, B20, B21, B22, B23 refer to the steps of specification collection from relevant parties according to a received request by the procurement department.

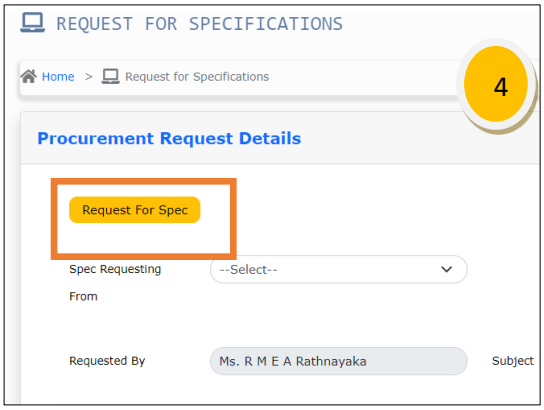
B 20: Collect Specification-Step 1



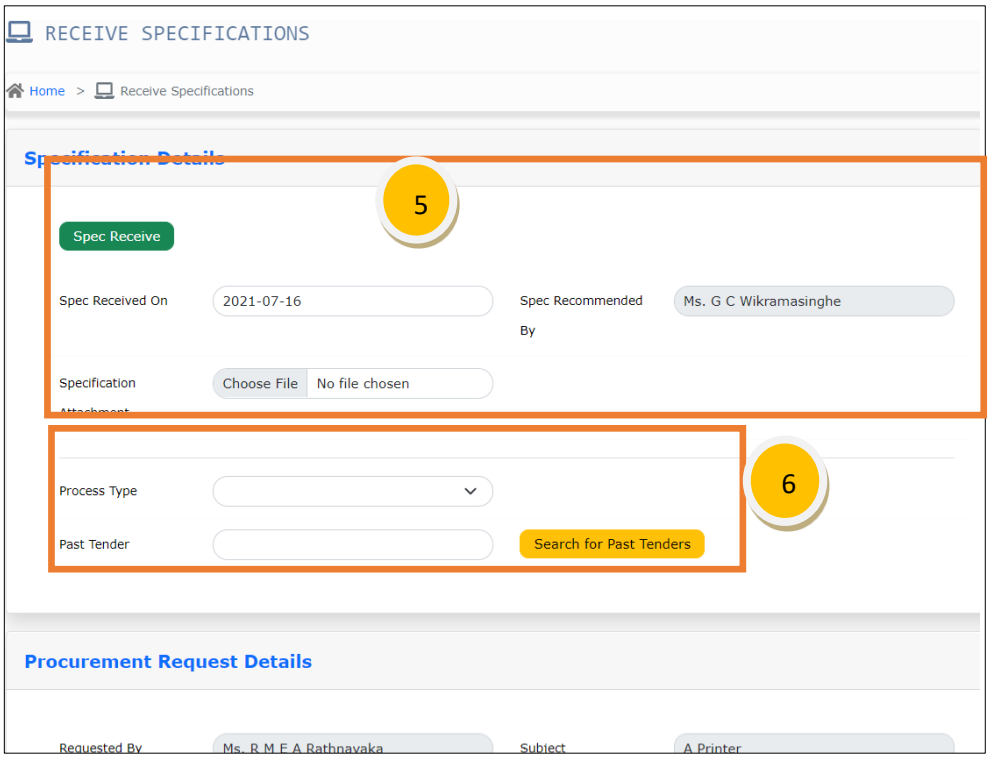
B 19: Collect Specification-Step 2



B 21: Collect Specification-Step 3



B 22: Collect Specification-Step 4



B 23: Collect Specification-Step 5

Tender Open

Step 1: Select "Procurement Department Process" through the menu.

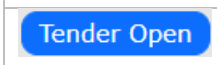
Step 2: Select the "Tender" tab.

Step 3: To open tender, click on the "Open Tender" button of the record.

Step 4: Select the tender open date and close date.

Step 5: Select vendors need to inform regarding the quotation.

Step 6: Click on the "Save" button to save the record details.

	Click the button to download the specification recommended by the relevant party for items that need to purchase.
	Click the button to print the request with attachments requested by the requester.
	Click the button to get the list of items requested with their quantity.
	Click the button to open the tender.

Appoint TEC	Click the button to appoint TEC members.
+	Click the button to add list items.
✎	Click the button to edit the added list item.
🗑	Click the button to delete the added list item.

Figure B24, B25, B26, B27 refers to the steps of the tender open process.

B 27: Tender Open-Step 1

B 26 : Tender Open-Step 2

B 25 : Tender Open-Step 3

B 24: Tender Open-Step 4

Appoint TEC Members

Step 1: Select “Procurement Department Process” through the menu.

Step 2: Select the “Tender” tab.

Step 3: Click on the “Appoint TEC” button.

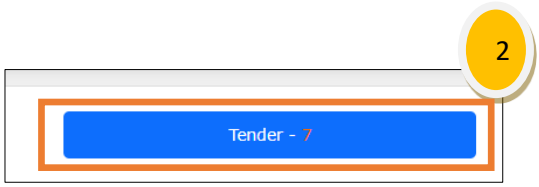
Step 4: Click the “Add” button to add members to the list

Step 5: Select an employee from the popup window and save it to the list.

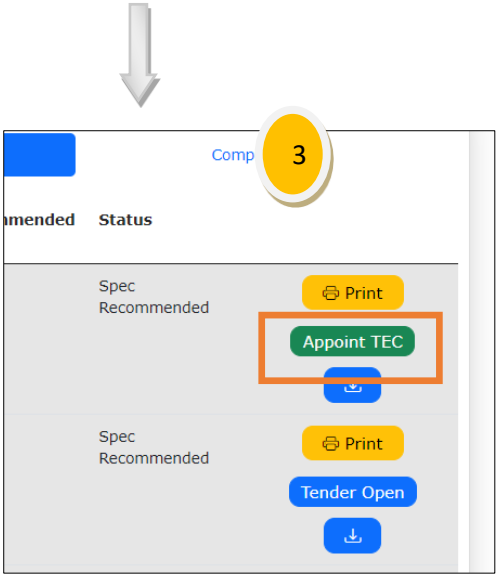
Step 6: Click on the “Save” button to save the record.

Figures B28, B29, B30, B31, B32 refer to the steps of the TEC member appointment process.

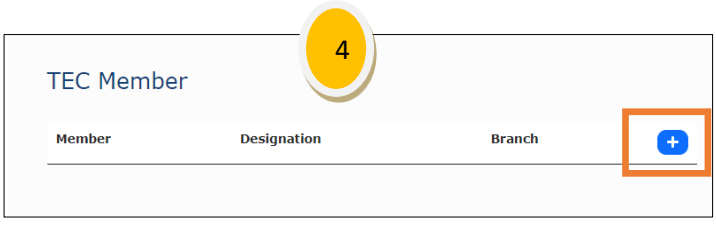
B 29: Appoint TEC members-Step 1



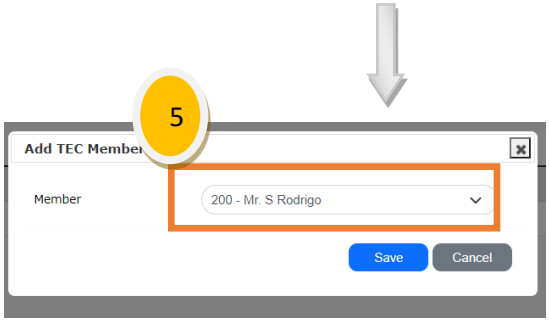
B 28: Appoint TEC members-Step 2



B 30: Appoint TEC members-Step 3



B 31: Appoint TEC members-Step 4



B 32: Appoint TEC members-Step 5

Request Completion

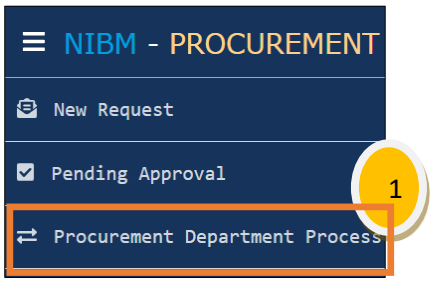
Step 1: Select “Procurement Department Process” through the menu.

Step 2: Select the “Completion” tab.

Step 3: Click on the “Items Received” button.

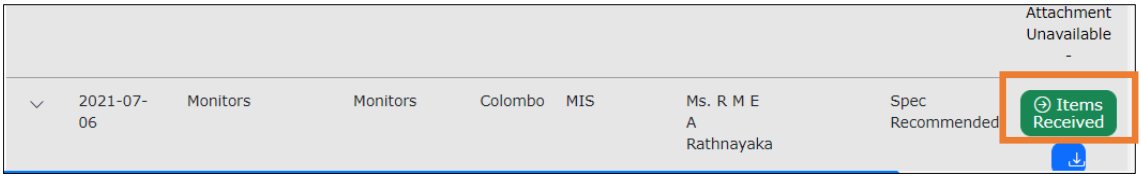
Step 4: Confirm the message.

Figures B refer to the steps of the complete process of the procurement request.

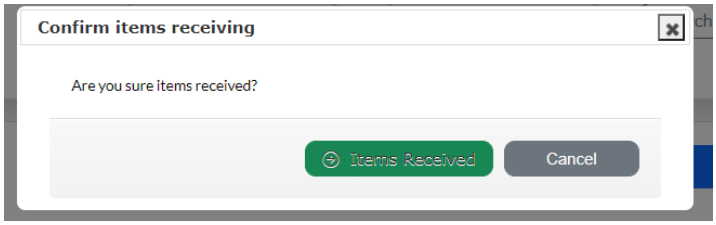


B 33: Completion Process-Step 1

B 34: Completion Process-Step 2



B 35: Completion Process-Step 3



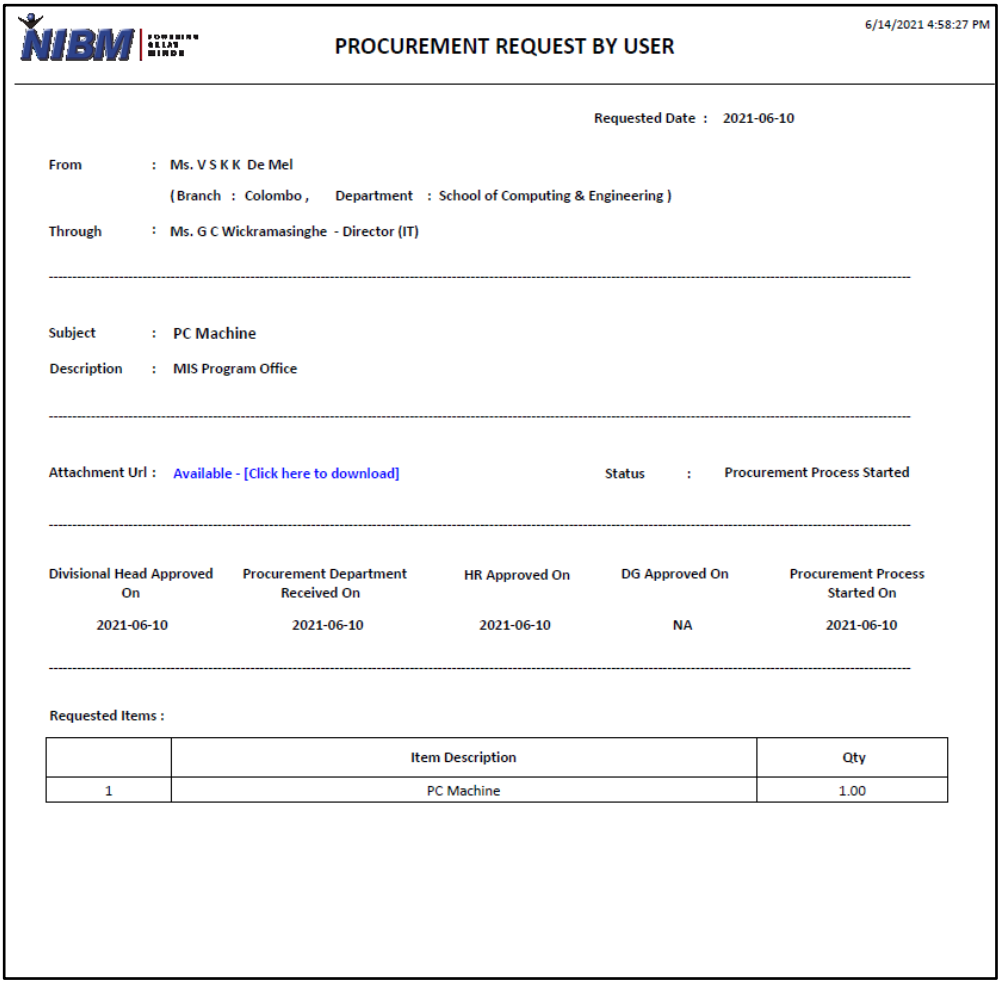
B 36: Completion Process-Step 4

APPENDIX C – MANAGEMENT REPORTS

All managerial reports were designed according to the user's request for their decision-making purposes in PDF format. The Head of the procurement department and the Director-General of NIBM can generate reports through the system.

Procurement Request by User

Figure C.1 refers to each report of a procurement request. This report can be generated by the head or MA of the Procurement Department. The report contains all information related to a selected request.



NIBM

6/14/2021 4:58:27 PM

PROCUREMENT REQUEST BY USER

Requested Date : 2021-06-10

From : Ms. V S K K De Mel

(Branch : Colombo , Department : School of Computing & Engineering)

Through : Ms. G C Wickramasinghe - Director (IT)

Subject : PC Machine

Description : MIS Program Office

Attachment Url : Available - [Click here to download] Status : Procurement Process Started

---

Divisional Head Approved On	Procurement Department Received On	HR Approved On	DG Approved On	Procurement Process Started On
2021-06-10	2021-06-10	2021-06-10	NA	2021-06-10

Requested Items :

	Item Description	Qty
1	PC Machine	1.00

C. 1: Procurement Request

Figure C.2 refers to the Progress Report of the process. The report can be generated by both DG and the head of the procurement department. The monthly progress report can be executed for a selected date period, and the report will contain all processed procurement requests summary during the selected period by the procurement department.

The report indicated the processed days in each record as the head of the procurement department need to clarify delay reasons to audit.

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9/15/2021 2:45:52 PM

PROCUREMENT PROGRESS REPORT

The report covers procurement requests handled during the period of 2021-05-01 to 2021-09-15

Completed Requests:

No.	Req Date	Req By	Branch	Request Subject	DGApproved On	Process Type	Completed On	Process Days
1	2021-05-07	R M E A Rathnayaka	Colombo	abababababbbbb		Completed By PettyCash	2021-06-18	42
2	2021-05-07	R M E A Rathnayaka	Colombo	abababababbbbb		Completed By PettyCash	2021-07-10	64
3	2021-05-21	R M E A Rathnayaka	Colombo	abababababbbbb		Completed By PettyCash	2021-06-30	40
4	2021-06-06	R M E A Rathnayaka	Colombo	A Printer	2021-07-05	Going through Procurement Process	2021-09-10	97
5	2021-06-07	R M E A Rathnayaka	Colombo	abababababbbbb		Completed By PettyCash	2021-07-18	41
6	2021-06-20	R M E A Rathnayaka	Colombo	abababababbbbb		Completed By PettyCash	2021-07-15	25
7	2021-07-21	K Narangoda	Kandy	Laptop		Going through Procurement Process	2021-07-26	6

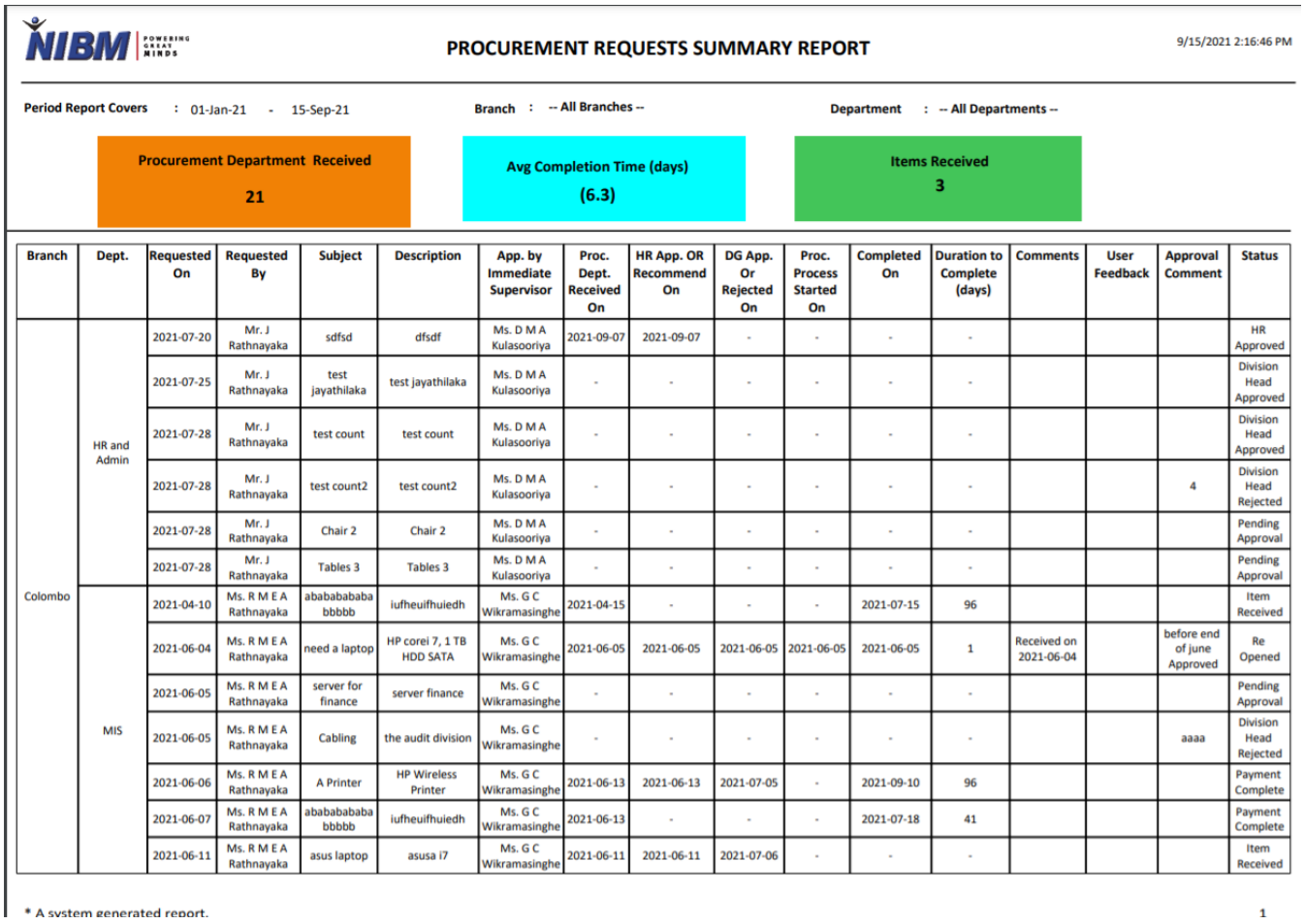
Requests Onprocess:

No.	Req Date	Req By	Branch	Request Subject	DGApproved On	Process Type	Status	Process Days
1	2021-06-04	R M E A Rathnayaka	Colombo	need a laptop	2021-06-05		Re Opened	103
2	2021-06-05	R M E A Rathnayaka	Colombo	server for finance			Pending Approval	102
3	2021-06-05	R M E A Rathnayaka	Colombo	Cabling			Division Head Rejected	102
4	2021-06-11	R M E A Rathnayaka	Colombo	asus laptop	2021-07-06	Going through Procurement Process	Item Received	96
5	2021-06-18	R M E A Rathnayaka	Colombo	test data1		Last 3 month process	Spec Recommended	89
6	2021-06-18	R M E A Rathnayaka	Colombo	test data2			Incomplete	89
7	2021-06-18	R M E A Rathnayaka	Colombo	test data3			Req for Spec	89

C. 2: Monthly Progress Report

Figure C.3 refers to the summary report of the procurement request. The PDF report is accessible to the procurement department staff via the report's menu. The report can be generated for a selected date period, and the report will contain all requests created and proceeded during the period.

The branch and department filter options are available if need to filter by branch or department. The report executes by grouping data by branch and department for easy reading to the user.



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PROCUREMENT REQUESTS SUMMARY REPORT

9/15/2021 2:16:46 PM

Period Report Covers : 01-Jan-21 - 15-Sep-21 **Branch** : -- All Branches -- **Department** : -- All Departments --

Procurement Department Received	Avg Completion Time (days)	Items Received
21	(6.3)	3

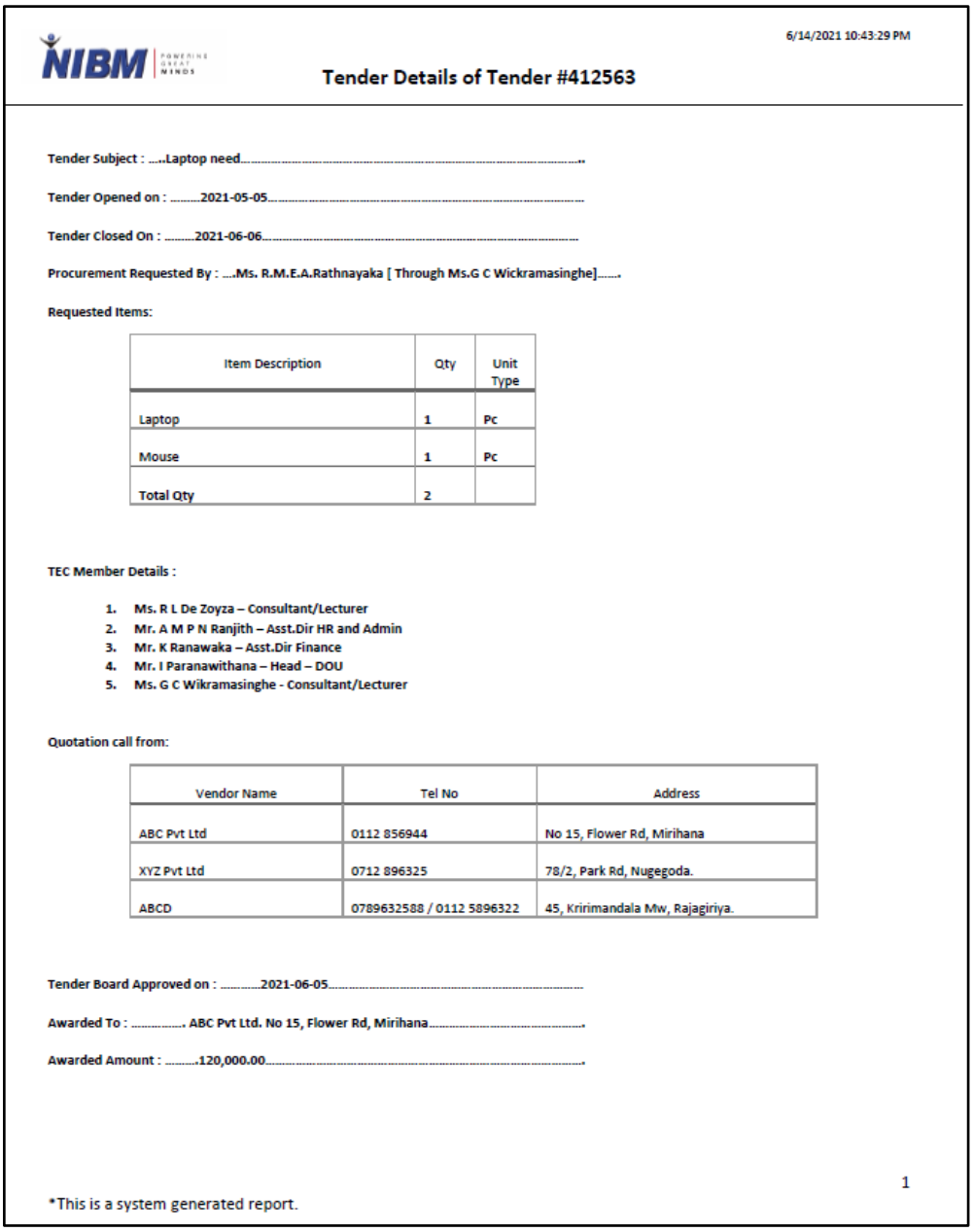
Branch	Dept.	Requested On	Requested By	Subject	Description	App. by Immediate Supervisor	Proc. Dept. Received On	HR App. OR Recommend On	DG App. Or Rejected On	Proc. Process Started On	Completed On	Duration to Complete (days)	Comments	User Feedback	Approval Comment	Status
Colombo	HR and Admin	2021-07-20	Mr. J Rathnayaka	sdfsd	dfsdf	Ms. D M A Kulasooriya	2021-09-07	2021-09-07	-	-	-	-				HR Approved
		2021-07-25	Mr. J Rathnayaka	test jayathilaka	test jayathilaka	Ms. D M A Kulasooriya	-	-	-	-	-	-				Division Head Approved
		2021-07-28	Mr. J Rathnayaka	test count	test count	Ms. D M A Kulasooriya	-	-	-	-	-	-				Division Head Approved
		2021-07-28	Mr. J Rathnayaka	test count2	test count2	Ms. D M A Kulasooriya	-	-	-	-	-	-			4	Division Head Rejected
		2021-07-28	Mr. J Rathnayaka	Chair 2	Chair 2	Ms. D M A Kulasooriya	-	-	-	-	-	-				Pending Approval
		2021-07-28	Mr. J Rathnayaka	Tables 3	Tables 3	Ms. D M A Kulasooriya	-	-	-	-	-	-				Pending Approval
	MIS	2021-04-10	Ms. R M E A Rathnayaka	abababababa bbbbb	iufheuifhuiedh	Ms. G C Wikramasinghe	2021-04-15	-	-	-	2021-07-15	96				Item Received
		2021-06-04	Ms. R M E A Rathnayaka	need a laptop	HP corei 7, 1 TB HDD SATA	Ms. G C Wikramasinghe	2021-06-05	2021-06-05	2021-06-05	2021-06-05	2021-06-05	1	Received on 2021-06-04		before end of june Approved	Re Opened
		2021-06-05	Ms. R M E A Rathnayaka	server for finance	server finance	Ms. G C Wikramasinghe	-	-	-	-	-	-				Pending Approval
		2021-06-05	Ms. R M E A Rathnayaka	Cabling	the audit division	Ms. G C Wikramasinghe	-	-	-	-	-	-			aaaa	Division Head Rejected
		2021-06-06	Ms. R M E A Rathnayaka	A Printer	HP Wireless Printer	Ms. G C Wikramasinghe	2021-06-13	2021-06-13	2021-07-05	-	2021-09-10	96				Payment Complete
		2021-06-07	Ms. R M E A Rathnayaka	abababababa bbbbb	iufheuifhuiedh	Ms. G C Wikramasinghe	2021-06-13	-	-	-	2021-07-18	41				Payment Complete
		2021-06-11	Ms. R M E A Rathnayaka	asus laptop	asusa i7	Ms. G C Wikramasinghe	2021-06-11	2021-06-11	2021-07-06	-	-	-				Item Received

* A system generated report. 1

C. 3: Procurement Request Summary Report

Figure C.4 refers to the tender details report of the project. The report can be generated for each tender. The PDF formatted report is accessible to the staff of the procurement department.

The report contains tender-related details including TEC-related information.



6/14/2021 10:43:29 PM

NIBM

Tender Details of Tender #412563

Tender Subject : .....Laptop need.....

Tender Opened on : .....2021-05-05.....

Tender Closed On : .....2021-06-06.....

Procurement Requested By : ....Ms. R.M.E.A.Rathnayaka [Through Ms.G C Wickramasinghe].....

Requested Items:

Item Description	Qty	Unit Type
Laptop	1	Pc
Mouse	1	Pc
Total Qty	2	

TEC Member Details :

1. Ms. R L De Zoyza – Consultant/Lecturer
2. Mr. A M P N Ranjith – Asst.Dir HR and Admin
3. Mr. K Ranawaka – Asst.Dir Finance
4. Mr. I Paranawithana – Head – DOU
5. Ms. G C Wikramasinghe - Consultant/Lecturer

Quotation call from:

Vendor Name	Tel No	Address
ABC Pvt Ltd	0112 856944	No 15, Flower Rd, Mirihana
XYZ Pvt Ltd	0712 896325	78/2, Park Rd, Nugegoda.
ABCD	0789632588 / 0112 5896322	45, Kirimandala Mw, Rajagiriya.

Tender Board Approved on : .....2021-06-05.....

Awarded To : ..... ABC Pvt Ltd. No 15, Flower Rd, Mirihana.....

Awarded Amount : .....120,000.00.....

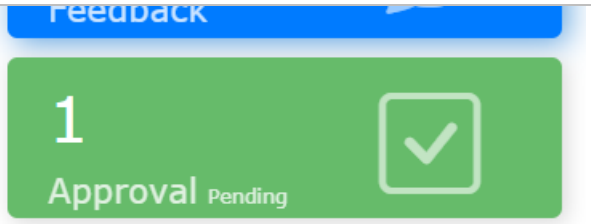
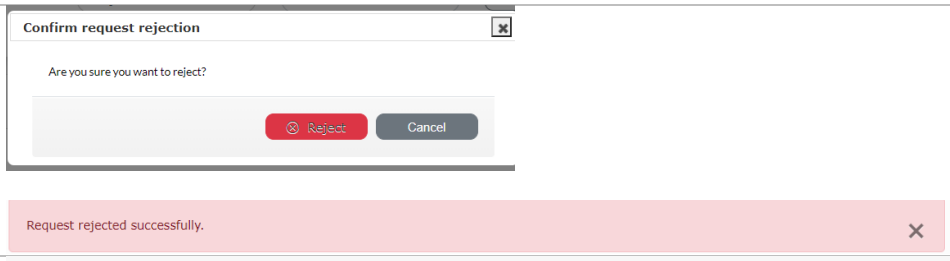
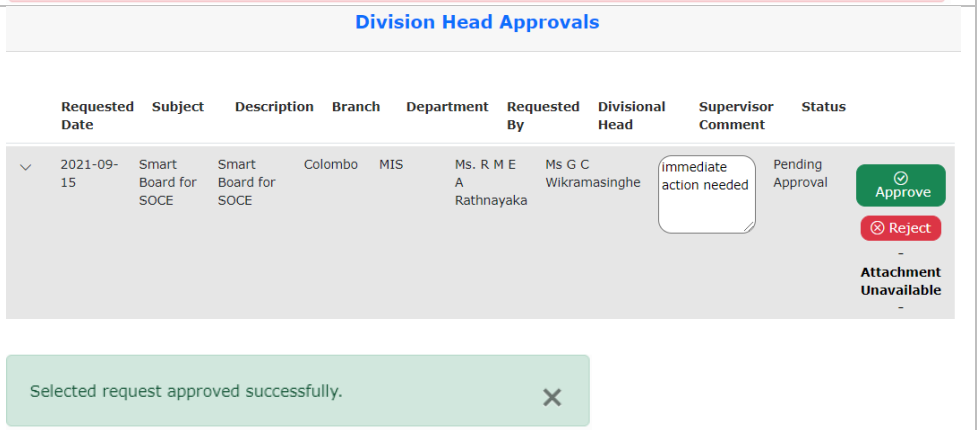
1

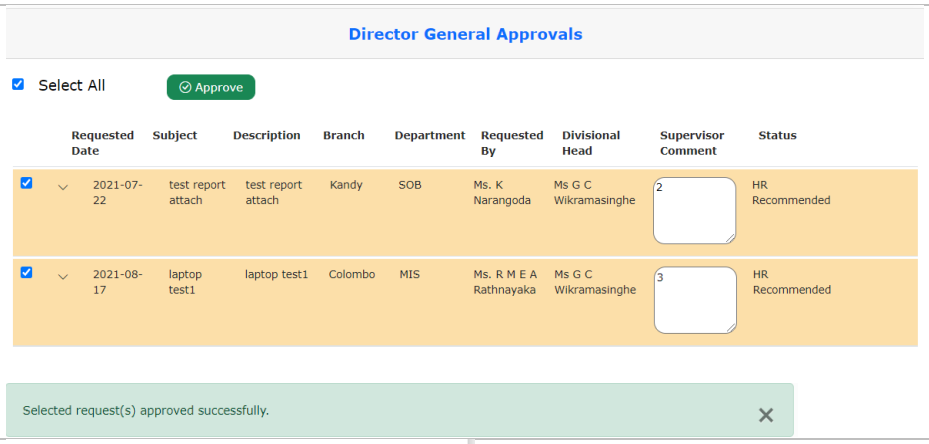
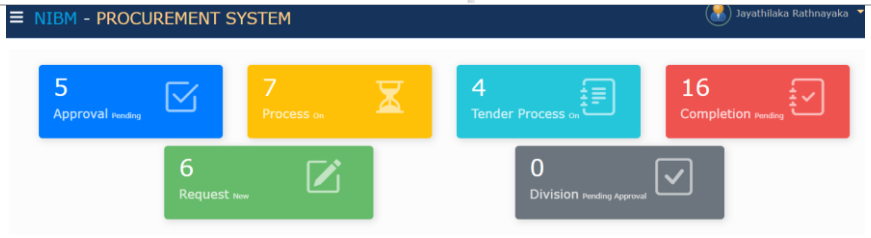
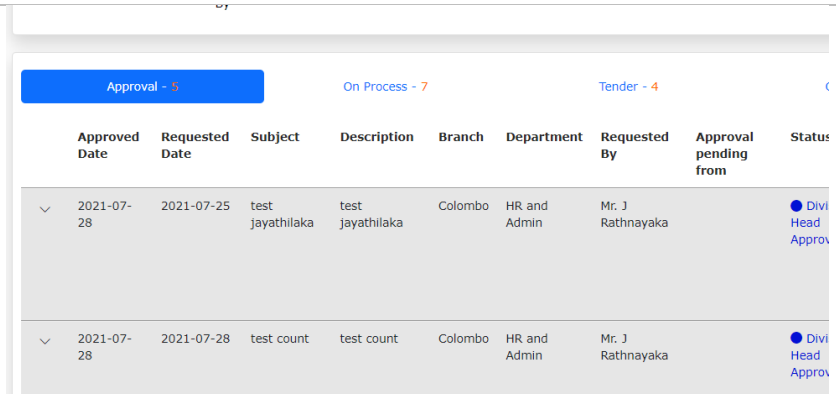
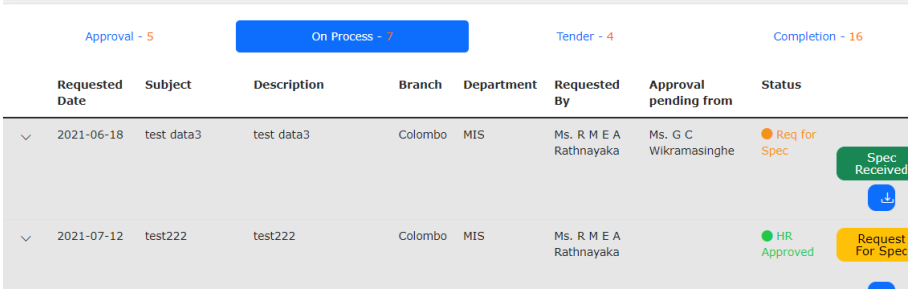
*This is a system generated report.

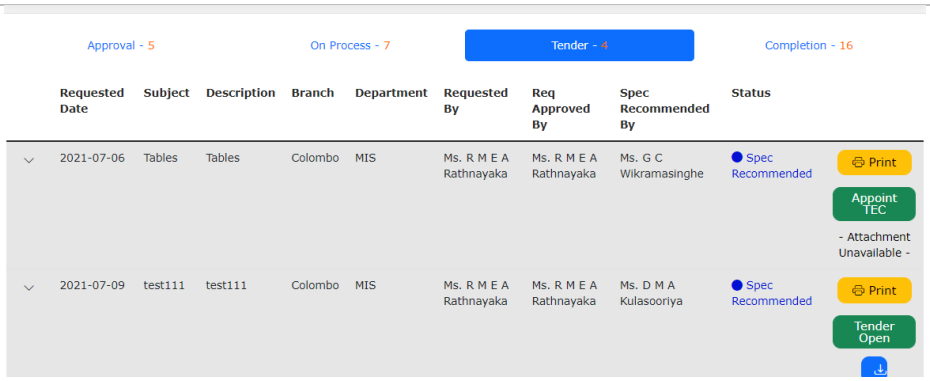
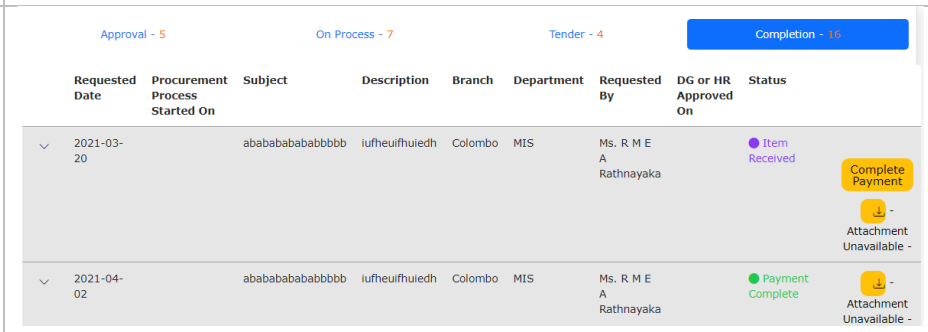
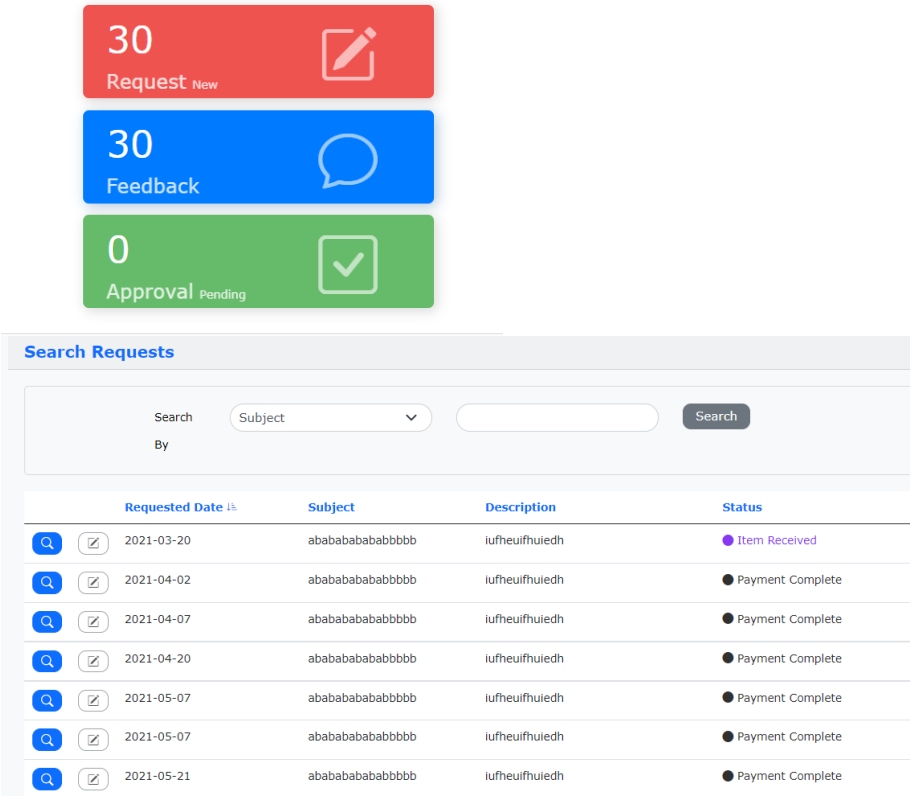
C. 4: Tender Detail Report

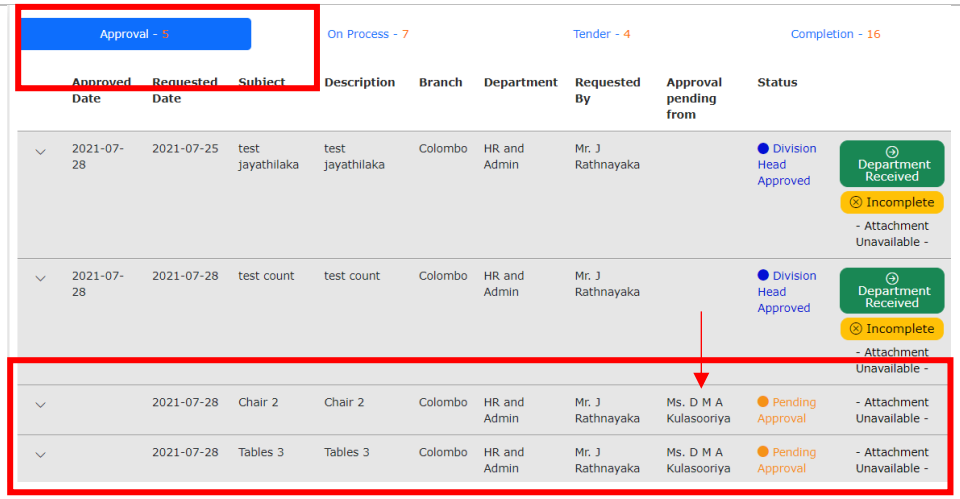
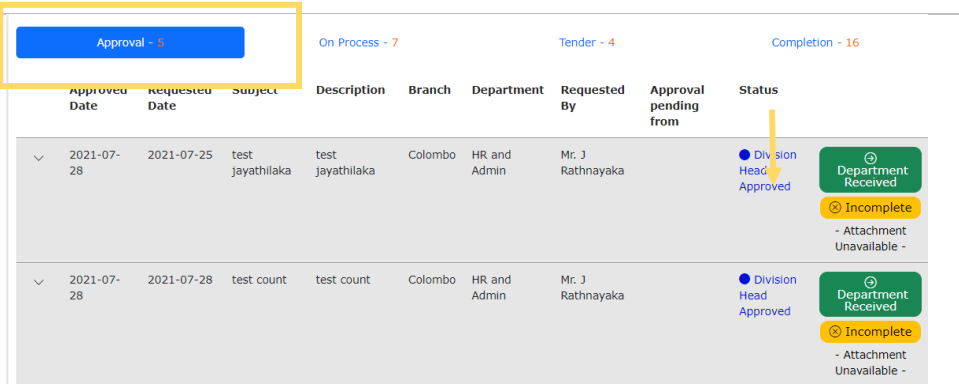
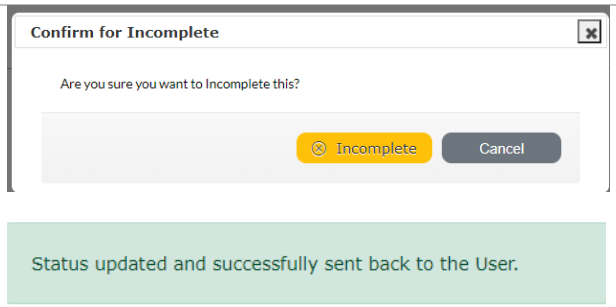
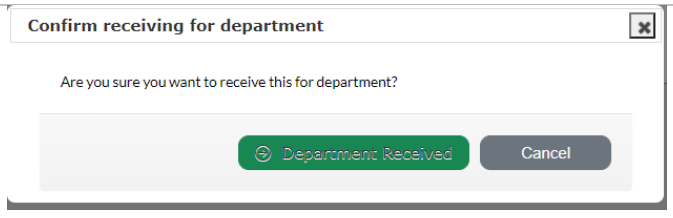
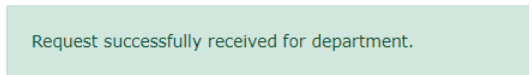
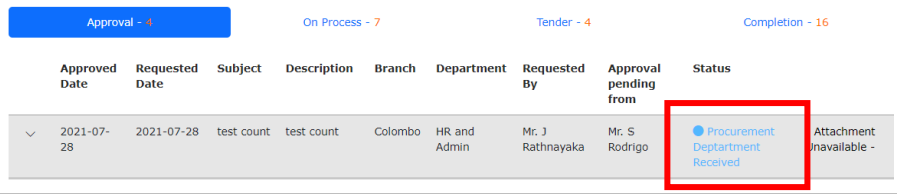
APPENDIX D – TEST RESULTS

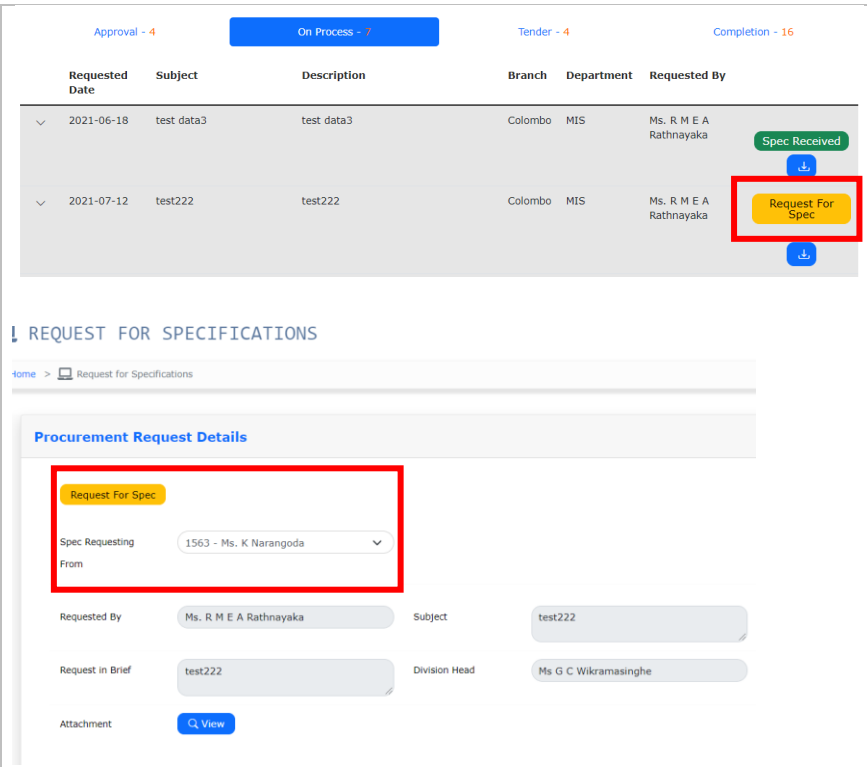
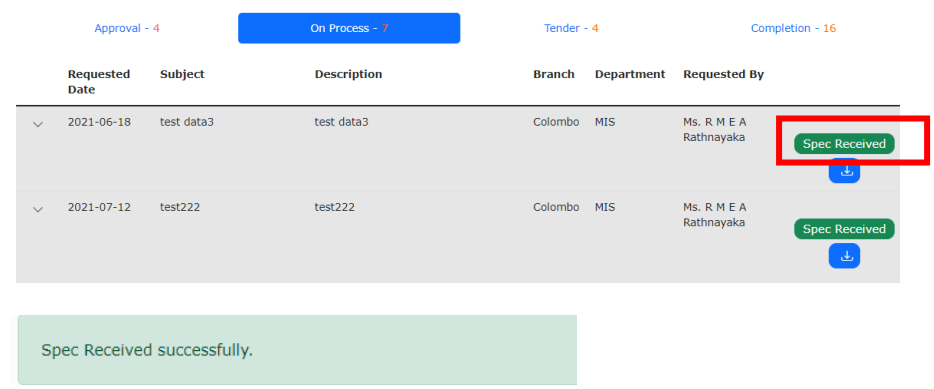
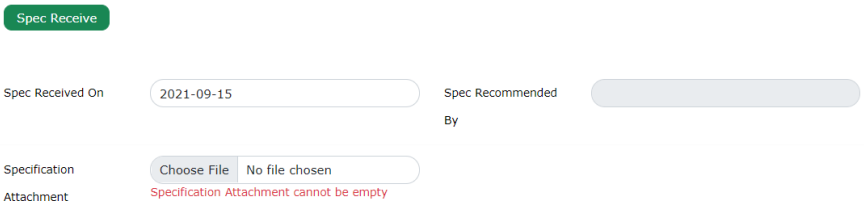
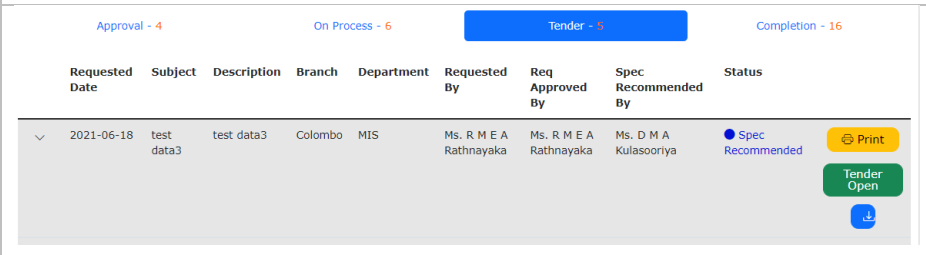
Table D.1 refers to the test results with evidence for additional test cases of the developed system.

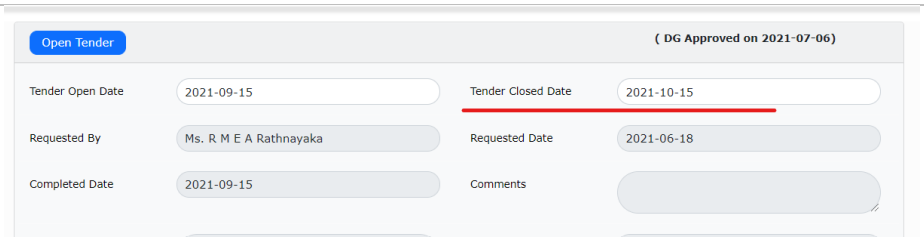
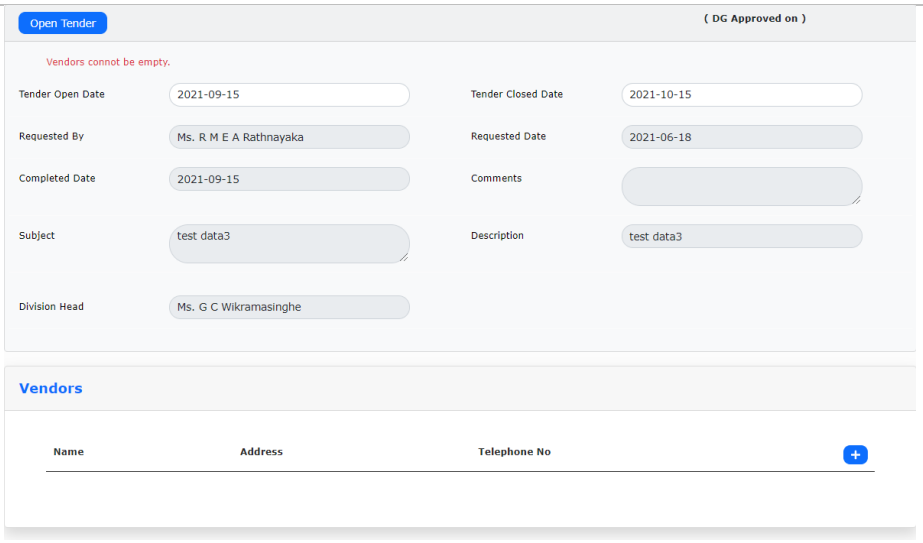
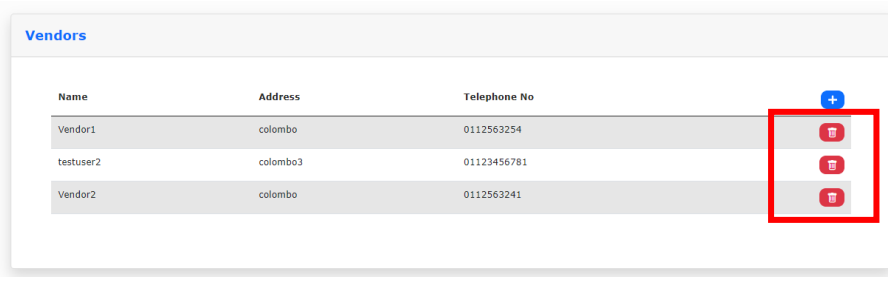
Test Case ID	Area	Description	Results
1	Approval Cycle	Login By an immediate supervisor and check for pending approval card.	
2		For the same supervisor: click on the "Approval" notification card.	
3		Click on the "Reject" Button	
4		When approving, add a comment and approve.	

5		Login by DG and bulk approve.	
6		Show added supervisor comments in the approval cycle to the next approving level.	
7	Procurement department dashboard	Dashboard for the procurement department.	
8		Click on the “Pending Approval” card.	
9		Click on the “Process On” card.	

10		Click on the “Tender Process On” card.	
11		Click on the “Completion Pending” Card.	
12	Requester Dashboard	Login by a normal user and navigate to the dashboard.	

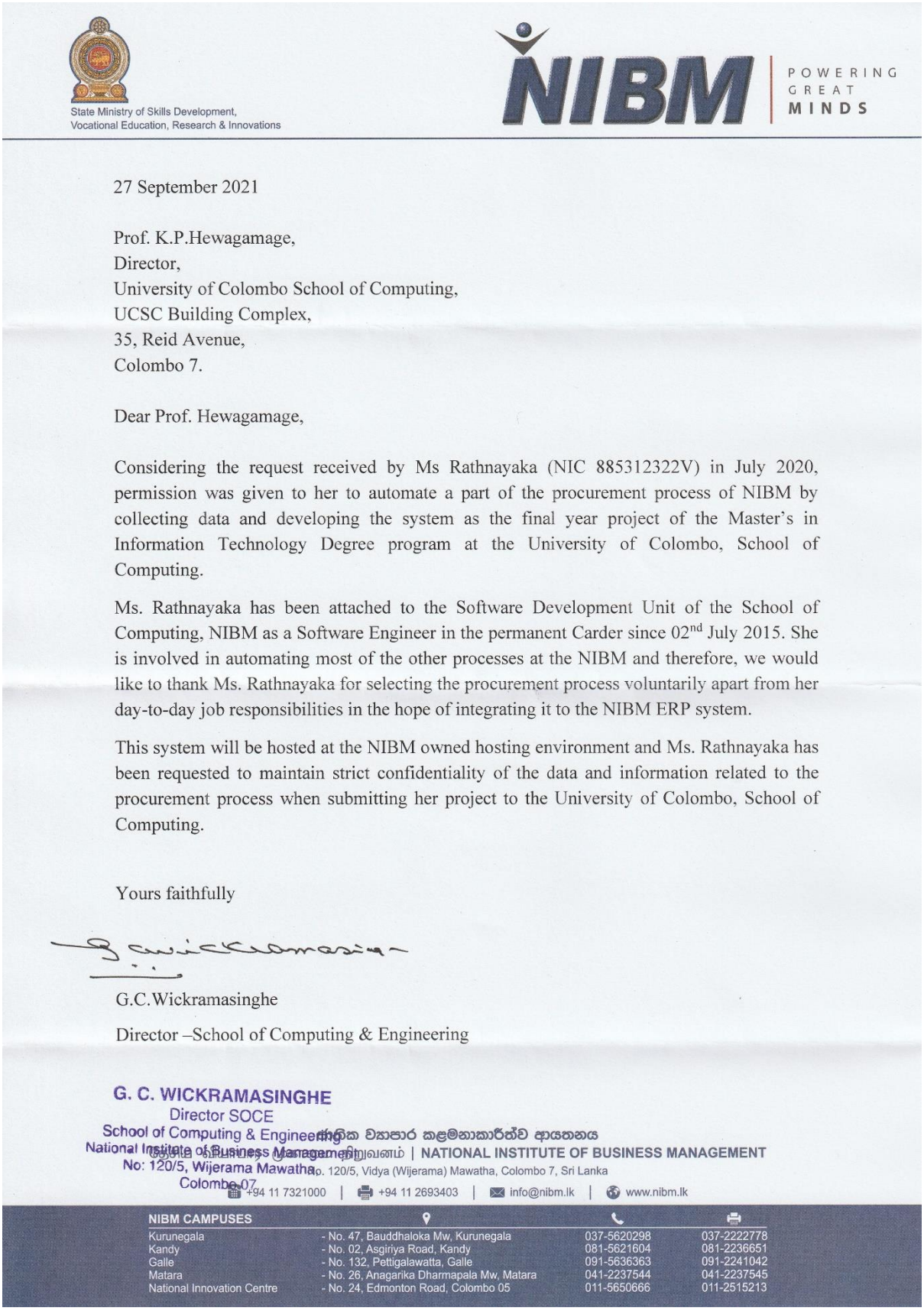
13	Procurement department process	If the approval pending from the immediate supervisor or HR Dir/DG.	
14		If the approval cycle is completed and pending to receive it from the proc.dept's end.	
15		When the request is incomplete, make it incomplete.	
16		When all information is correct, and department needs to receive it to proceed.	  

17		Request for a spec from the appropriate party to proceed with the procurement.	
18		Once the spec is received, update the status with the spec.	
19		If the received spec is not attached.	
20	Tender Process	When the spec is recommended and the process selected as “tender”, the record should be visible on the tender tab.	

21		When open the tender, the Tender closing date should be set as the next month.	
22		When opening the tender, the Vendor list needs to be filled.	
23		Added vendors should be able to remove before it is saved.	

D 1: Test results of additional test cases

APPENDIX E – COMPANY APPROVAL LETTER



State Ministry of Skills Development,
Vocational Education, Research & Innovations

NIBM POWERING GREAT MINDS

27 September 2021

Prof. K.P.Hewagamage,
Director,
University of Colombo School of Computing,
UCSC Building Complex,
35, Reid Avenue,
Colombo 7.

Dear Prof. Hewagamage,

Considering the request received by Ms Rathnayaka (NIC 885312322V) in July 2020, permission was given to her to automate a part of the procurement process of NIBM by collecting data and developing the system as the final year project of the Master's in Information Technology Degree program at the University of Colombo, School of Computing.

Ms. Rathnayaka has been attached to the Software Development Unit of the School of Computing, NIBM as a Software Engineer in the permanent Carder since 02nd July 2015. She is involved in automating most of the other processes at the NIBM and therefore, we would like to thank Ms. Rathnayaka for selecting the procurement process voluntarily apart from her day-to-day job responsibilities in the hope of integrating it to the NIBM ERP system.

This system will be hosted at the NIBM owned hosting environment and Ms. Rathnayaka has been requested to maintain strict confidentiality of the data and information related to the procurement process when submitting her project to the University of Colombo, School of Computing.

Yours faithfully

G.C.Wickramasinghe

Director –School of Computing & Engineering

G. C. WICKRAMASINGHE
Director SOCE
School of Computing & Engineering
National Institute of Business Management
No: 120/5, Wijerama Mawatha
Colombo 07

ජාතික ව්‍යාපාර කළමනාකාරිත්ව ආයතනය | NATIONAL INSTITUTE OF BUSINESS MANAGEMENT
No. 120/5, Vidya (Wijerama) Mawatha, Colombo 7, Sri Lanka
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NIBM CAMPUSES			
Kurunegala	- No. 47, Bauddhaloka Mw, Kurunegala	037-5620298	037-2222778
Kandy	- No. 02, Asgiriya Road, Kandy	081-5621604	081-2236651
Galle	- No. 132, Pettigalawatta, Galle	091-5636363	091-2241042
Matara	- No. 26, Anagarika Dharmapala Mw, Matara	041-2237544	041-2237545
National Innovation Centre	- No. 24, Edmonton Road, Colombo 05	011-5650666	011-2515213

Figure 43 : Approval letter from NIBM