

A Project Report
on
Procurement Tracking Management System
in the course
Software Engineering
(IT350)

Submitted by

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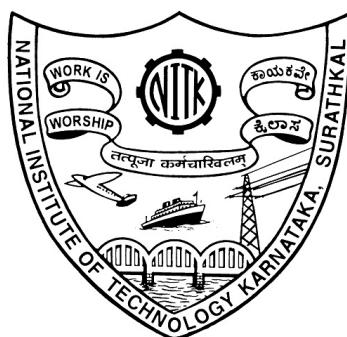
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BACHELOR OF TECHNOLOGY

In

INFORMATION TECHNOLOGY

At



Department of Information Technology
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CERTIFICATE

This is to certify that the project entitled “Procurement Tracking Management System” is a bonafide work carried out under my guidance for the course IT350, Software Engineering, by Neha B, Prerana K R, S S Karan, students of VI Sem. B.Tech (IT) at the Department of Information Technology, National Institute of Technology Karnataka, Surathkal, during the academic year 2016-17, in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Information Technology, at NITK Surathkal.

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Abstract

The aim of this project is to develop a Procurement tracking system for an organization. As there are number of activities involved in the procurement encompassing many departments, the status of Purchase Requisition changes dynamically. In order to expedite the priority purchase requisitions and to estimate the time of material receipt, an information system to track the dynamic status of Purchase Requisitions is essential. The present project aims at tracking the dynamic status of Purchase Requisitions in a procurement department.

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1 Introduction

1.1 Problem Statement

The aim of this project is to develop tracking system for procurement activities in an organization. Procurement system helps in supply chain management function of organizations. Many organizations manage their ERP functions on SAP platform. SAP system helps in tracking purchasing functions from indent (requirement) generation, tendering, purchase order generation, inspection and receipt and usage. However, in any typical public procurement setup, where the system is not fully paperless due to audit/record requirements, there are many activities which are not captured in SAP system e.g., which purchase officer is dealing with the indent, when the file is sent to Technical department for evaluation, when the file is sent to finance department for concurrence etc. This limitation leads to opacity in procurement functions carried out in organization. The present Procurement Tracking Management System (PTMS) exactly addresses these gaps and fulfils the transparency requirement and also enhances efficiency.

1.2 Scope of the Work

Procurement system helps in supply chain management function of organizations. Many organizations manage their ERP functions on SAP platform. SAP system helps in tracking purchasing functions from indent (requirement) generation, tendering, purchase order generation, inspection and receipt and usage. However, in any typical public procurement setup, where the system is not fully paperless due to audit/record requirements, there are many activities which are not captured in SAP system e.g., which purchase officer is dealing with the indent, when is the file sent to the technical department for evaluation, when is the file sent to the finance department for concurrence etc. This limitation leads to opacity in procurement functions carried out in the organization. The present proposed system exactly addresses these gaps and fulfils the transparency requirement and also enhances efficiency. This helps SMT groups to track the various activities being carried out by procurement department and will help in planning their maintenance functions. The scope of the project covers all activities which are carried out on papers outside the ERP system.

1.3 Usage Scenarios

Normally all public sector companies use some platform of ERP like SAP/JD Edwards etc. Major procurement milestones like PR generation date, Tender floating date and issue of Purchase order are available in ERP system. However, there are many inter and intra departmental activities like assigning Dealing officer for each PR, sending the offers for technical evaluations, receipt, sending the file for obtaining permission for opening of Price bids, receipt, obtaining approval for issuing Purchase order etc are still not tracked on ERP system. The project can be developed in existing ERP system itself so that the gaps in information can be bridged and a completely transparent procurement system can be made available to all users in the Organization.

There are three types of users that interact with the system: a Procurement head, Bid dealing officers and service/maintenance/technical(SMT) groups (Mechanical, Electrical, IT, Finance etc.) i.e. indentors. Each of these three types of users has different use of the system so each of them has their own requirements. Procurement department receives indent (request for procurement) from various maintenance groups like mechanical, Instrumentation, civil, electrical, Safety etc. Maintenance users are required to login to view the state of their indent. The procurement head assigns the Purchase requisition (indent) to one of the dealing officers in procurement department to process the case depending on the current number of cases being handled by the DO (Dealing Officer). Dealing officer floats a tender for the PR and updates status of the bid in the database. At any point of time, SMT users will be able to check the status of their PR and would be notified in case of change of status. Subsequent activities like receipt of offers from vendors, file being sent to SMT group for technical evaluation, receipt after evaluation, status of approval for priced offer, concurrence of finance, placement of Purchase order is tracked in the system. This helps SMT groups to track the various activities being carried out by procurement department and will help in planning their maintenance functions.

The following report deals with the initial stages like requirement analysis and system design which are involved in the development of any software system. The report is divided into the following sections.

The second section is the SRS (Software Requirement Specification) of the software system which in detail explains about the functional requirements, non-functional requirements, use case scenarios and limitations of the software system being developed.

The third section is the SDS (Software Design Specification) of the software system which provides description about the system architecture and design goals and detailed design methodologies.

The fourth section gives a brief description about the results of the requirements analysis and design phase and the development environment chosen for the implementation of the project. Finally the fifth section gives a brief description about the proposed work plan of the project.

2 Requirement Analysis

2.1 Functional Requirements

The functional requirements provided by the system are as follows:

2.1.1 User Login

Each user of this system will be required to provide correct log-in credentials to be able to use this system. This feature of high priority as only authorised users must be able to view and edit data handled by this system.

2.1.2 View Purchase Requisition

When an authorised indentor logs in to the system, he/she will be able to view all the purchase requisitions put forward by him/her. This feature is of medium priority as the indentor must be aware of the progress of his/her purchase requisitions.

2.1.3 Add Purchase Requisition

When an authorised indentor logs in to the system, he/she will be able to add new purchase requisitions. This feature is of high priority as it the first step to the entire procurement process.

2.1.4 Update Tender Evaluation Report

When an authorised indentor logs in to the system, he/she will be able to update the status of a tender for a given purchase requisition. Once the tenders are evaluated by the respective departments, the indentor must indicate this by updating the status for each tender that was evaluated. This feature is of high priority as purchase orders can be placed only if tenders for a given purchase requisition are evaluated by the respective department.

2.1.5 View Pending Purchase Requisitions

When an authorised dealing officer logs in, he/she will be able to view all the purchase requisitions that have not yet been completed. This feature is of medium priority as the dealing officer will need to know what the current status of each incomplete purchase requisitions is, from which he/she can decide what actions are to be taken in order to complete them.

2.1.6 View Completed Purchase Requisitions

When an authorised dealing officer logs in, he/she will be able to view all the purchase requisitions that have been successfully completed by him/her. It include only those purchase requisitions for which a purchase order has been placed. This feature if of low priority.

2.1.7 Float Tenders

When an authorised dealing officer logs in, he/she will be able to float tenders for any purchase requisition that has been assigned to him/her by the procurement head. This feature is of high priority as, floating tenders lets suppliers know that there is a demand for the item mentioned in the tender so that suppliers can send in samples of the item they can provide.

2.1.8 Add Extension Date

When an authorised dealing officer logs in, he/she will be able to extend the last date by when suppliers have to send in their samples. Normally, a dealing officer can provide only two such extensions. This feature is of medium priority.

2.1.9 Change Tender Status

When an authorised dealing officer logs in, he/she will be able to update the status of a tender as and when sub processes of the procurement process are completed. This feature is of high priority as maintaining status of the tenders helps the dealing officer decide what action is to be performed next for each tender.

2.1.10 Select Final Tender

When an authorised dealing officer logs in, he/she will be able to select the tender to be finalised for a given purchase requisition assigned to him/her. This feature is of high priority as finalizing a tender will ultimately lead to the creation of a purchase order.

2.1.11 View Unassigned Requests

On logging in, the procurement head will be able to view all the requests from every department that have not been assigned to a dealing officer yet. This feature is of high priority as it helps the procurement head to ensure that no request goes unassigned.

2.1.12 View Assigned Purchase Requisitions

On logging in, the procurement head will be able to view all the purchase requisitions that have been assigned to a dealing officer. This feature is of low priority.

2.1.13 Assign Requests to Dealing Officer

On logging in, the procurement head will be able to assign the unassigned requests to dealing officers based on the number of requests already being handled by them. This feature is of high priority as it helps the procurement to evenly distribute the work load among the dealing officers.

2.2 Non-Functional Requirements

2.2.1 Performance Requirements

The response time of the software system should be minimum. A user can undo his action any point of time.

2.2.2 Safety Requirements

Since the procurement management software built is used by only authorised personnel within the organisation, with appropriate login credentials and the information handles pertains to only inventory that is private to the organisation, there is no possible loss, damage, or harm that could result from the use of the product. Nonetheless, the database may get crashed at any certain time due to virus or operating system failure. Therefore, it is required to take the database backup so that the database is not lost. Proper UPS/inverter facility should be there in case of power supply failure.

2.2.3 Security Requirements

The data stored by the system must not be accessible to unauthorised users for viewing or editing to ensure correct functioning of the system.

2.2.4 Business Rules

A business rule is anything that captures and implements business policies and practices. A rule can enforce business policy, make a decision, or infer new data from existing data. This includes the rules and regulations that the System users should abide by. This includes the cost of the project and the discount offers provided. The users should avoid illegal rules and protocols. Neither admin nor member should cross the rules and regulations.

2.2.5 Availability

All the information that the user requires will be readily available and accessible. The software system is also independent of the user's location. The software system will be available to the users anytime they wish to use it irrespective of the time and location.

2.2.6 Usability

The software system has a very simple and user friendly user interface. Any new user can easily use the software system. Every screen has self-explanatory buttons and explanations that avoids any confusion for the user. The layout of the user interface is consistent throughout the software system. The software system supports English language.

2.2.7 Documentation

Software Requirements Specification is provided for the users as well as the developers and System Design Description is provided for the developers and the maintenance engineers.

2.3 Use Case Scenario

UML Use Case Diagrams are usually referred to as behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors).

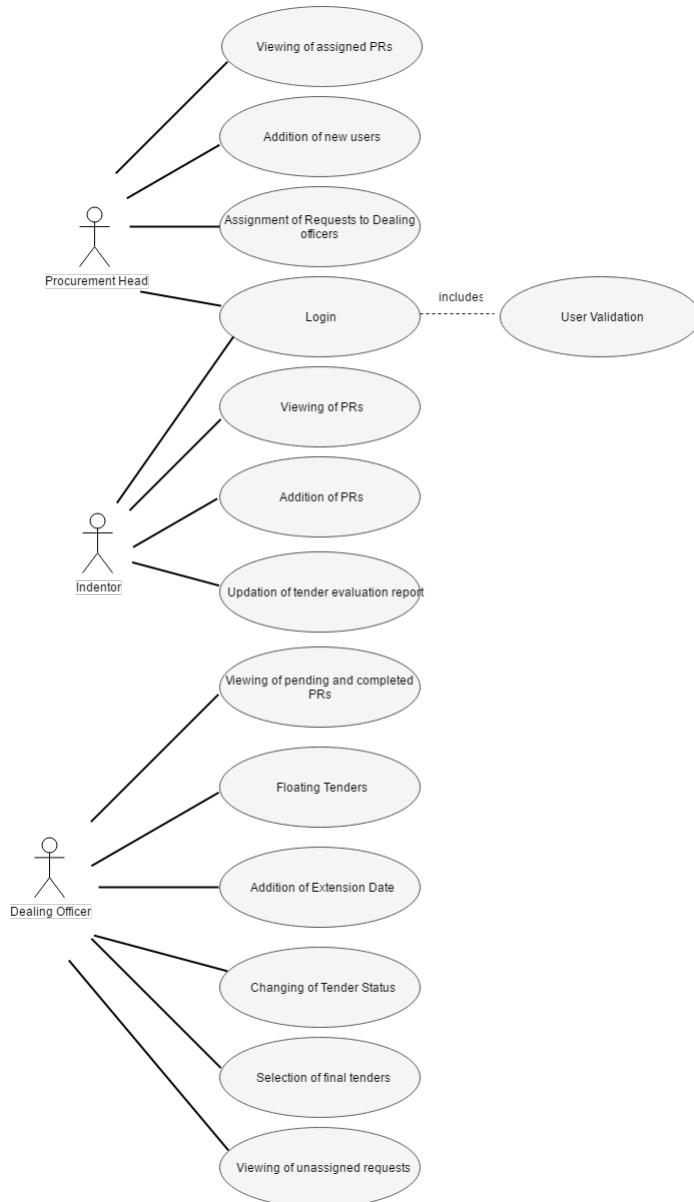


Figure 1: Usecase Diagram

Figure 1 shows the use case diagram for the PTMS. As the diagram illustrates, there are 3 different actors, who interact with the system, Indentor, Dealing Officer and Procurement Head. Each user has his own use cases, using which the interaction takes place. The draw.io online tool was used to create the use case diagram.

3 System Design

3.1 Design Goals

The software system comprises of many features and hence the system is divided into various components. The main objective of this section is to elaborate the system design and to give an overview of the various components of the software system including their interfaces. It also provides information about the relationship between the various components and the different data elements used by each of the components. It also explains the overall system design. The software system has a client-server architecture with the software system running on the client side and the files residing on the server side with which the user interacts through the software system.

The following sections contains class diagram, sequence diagram and activity diagrams representing the various components and their interactions and also the detailed description of each of the components.

3.2 System Architecture

The overall system architecture is as shown below in Figure 2

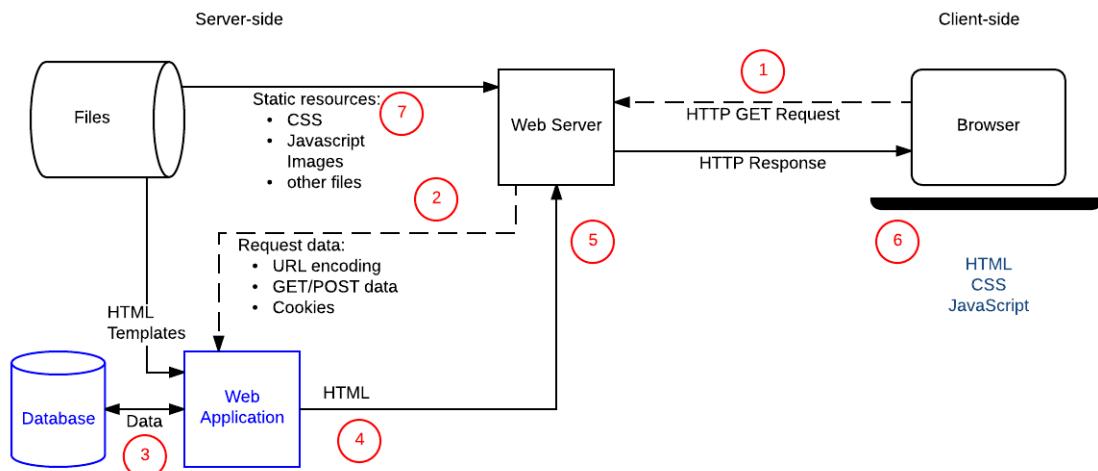


Figure 2: Overall System Architecture

3.3 Entity-Relationship Diagram

The web page is developed using HTML, CSS for front end and PHP and MySQL for back end. The data involved in the entire process is stored in a relational database.

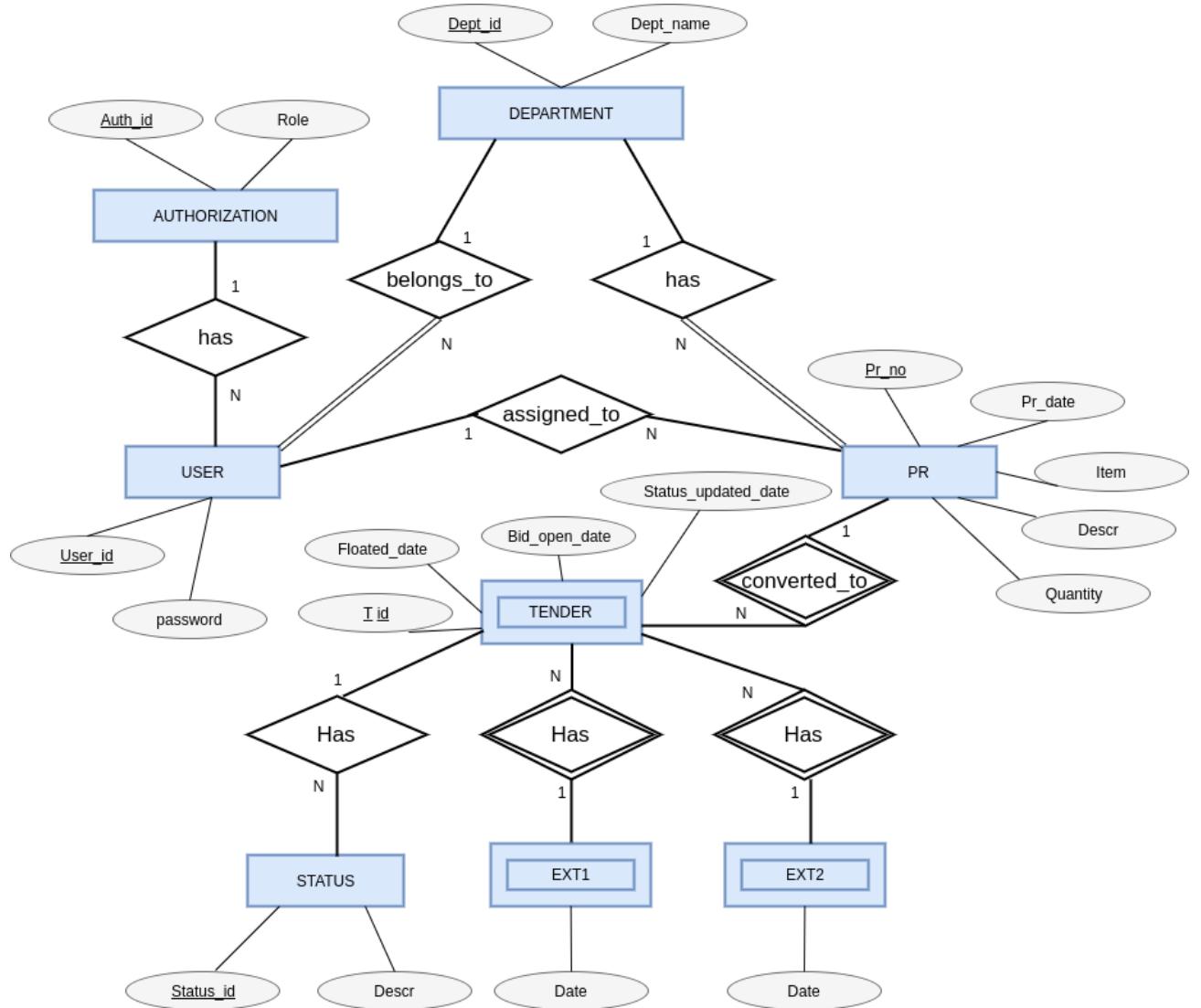


Figure 3: Entity-Relationship Diagram

Figure 3 shows a detailed Entity-Relationship diagram. There are 7 tables in the database. The relationships that exist between these tables, their attributes are clearly depicted in this diagram.

3.4 Navigation Diagrams

A navigation diagram (a.k.a., site map) is a low-level architecture diagram work product that documents how to navigate around the presentation components of an application, usually a Web application.

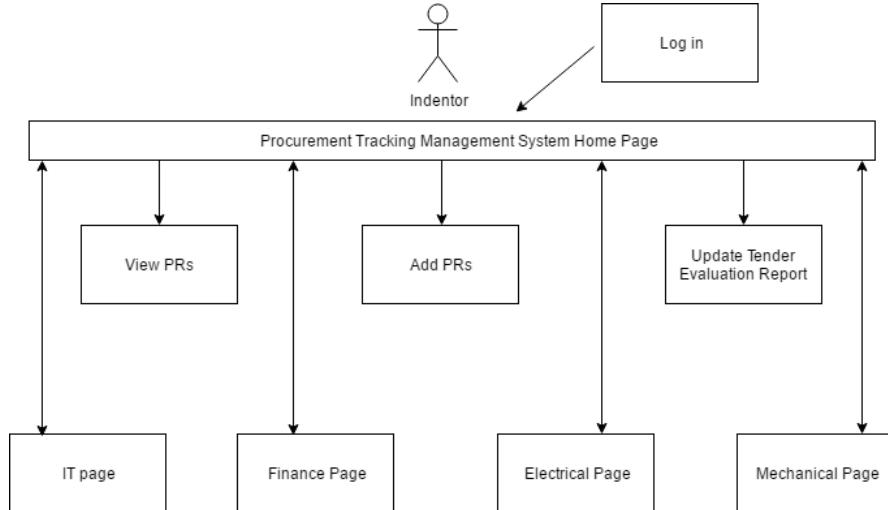


Figure 4: Navigation Diagram for User, Indentor

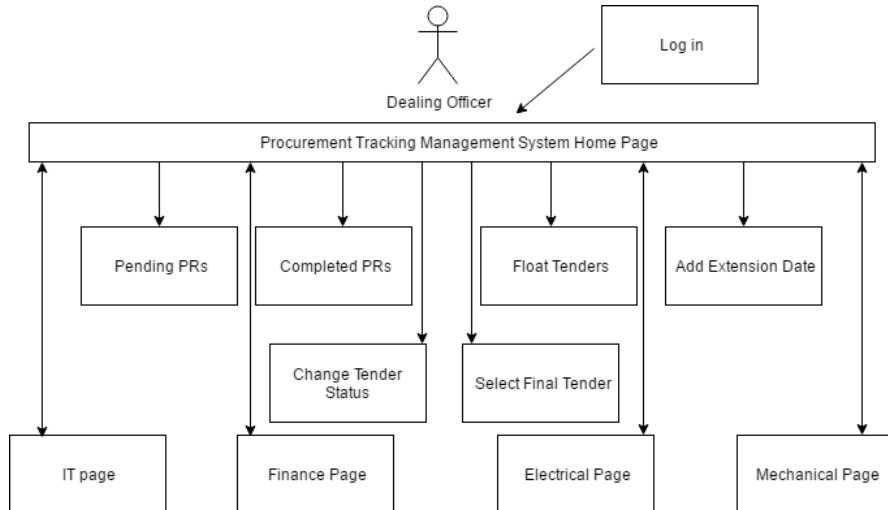


Figure 5: Navigation Diagram for User, Dealing Officer

Figures 4,5,6 show the navigation diagrams with respect to the 3 different users who will be interacting with the system. The flow of control, between the web pages based on the options/buttons/menu items selected is shown in these diagrams. Once logged in as an authorised user, the user is directed to respective pages from which he can proceed to the required page by choosing relevant options, as shown here.

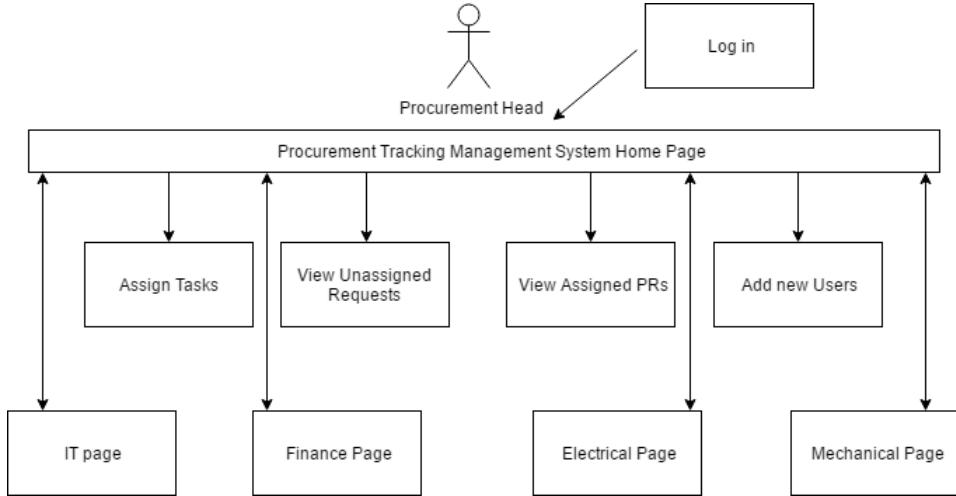


Figure 6: Navigation Diagram for User, Procurement Head

3.5 Interaction Diagrams

The high level sequence of steps involved in successful procurement of required items can be seen below in Figure 7. The following swim lane diagram, shows which responsibilities are to be carried out by which actor in the system. The procurement process begins with the indentor putting forward a purchase requisition and after its successful assignment to a dealing officer, the dealing officer carries out various responsibilities and the process ends with him/her placing a purchase order for the required item.

Before any actor can perform their respective actions, they are required to login to the system to ensure only authorised employees can make changes to and view data in the system. The login page requires the user to enter login credentials like username and password. These credentials are verified by the login checker and the user is then directed to his/her respective page if the credentials entered are valid, else they are directed to a login failure page. The flow of this can be observed in the Figure 8.

Once an indentor logs in, he/she can add new purchase requisitions (approved indents) to the system to initiate the procurement process for the required item. Further he/she can view the current status of the PR and also who has been assigned their PR among other details. Once the bids for a tender have been opened, the indentors will be required to evaluate each bid with respect to their requirements. The steps involved can be viewed in Figure 9.

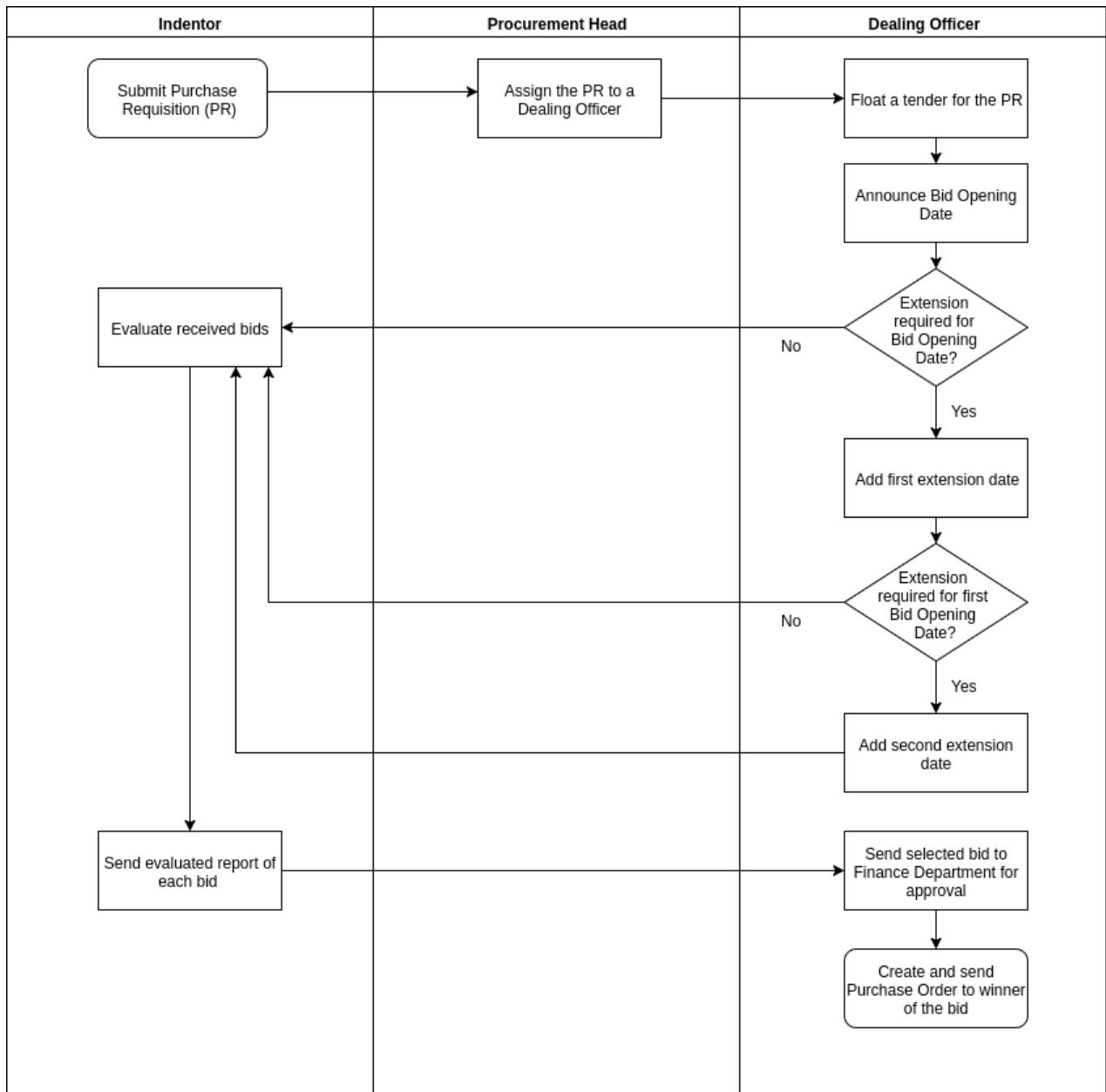


Figure 7: Swim Lane Diagram showing division of responsibilities

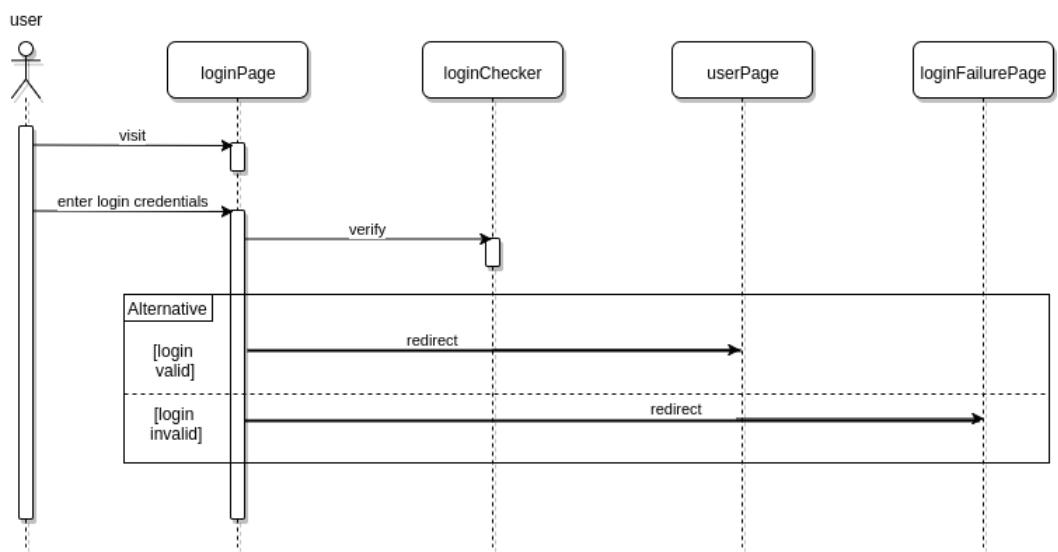


Figure 8: Sequence Diagram for User login

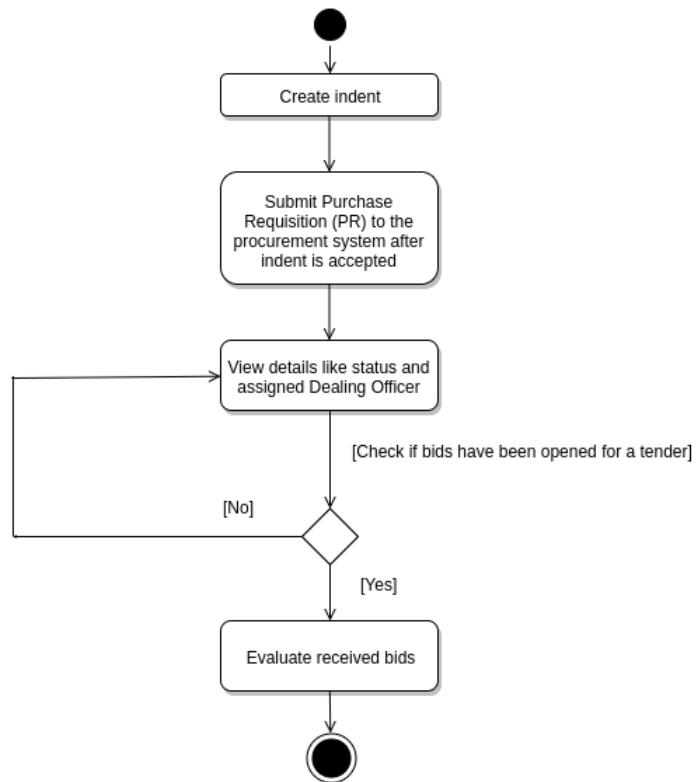


Figure 9: Activity Diagram for an Indentor's work flow

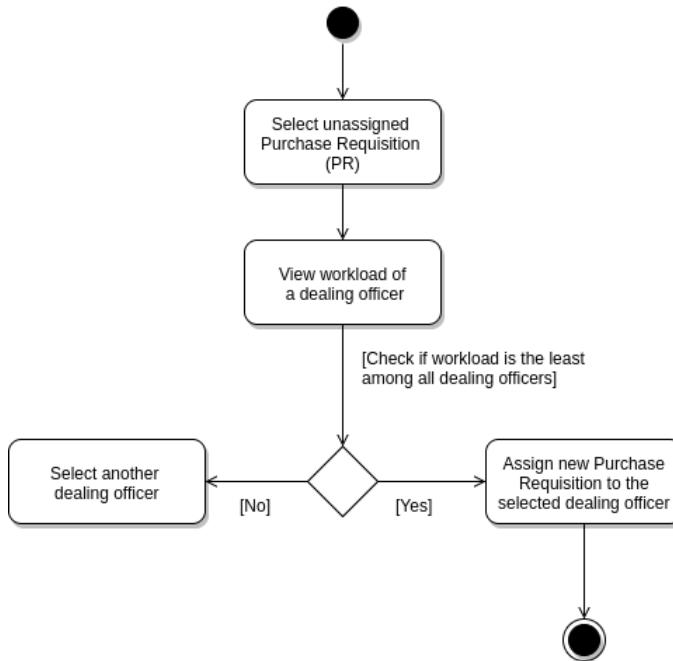


Figure 10: Activity Diagram for a Procurement Head's work flow

When a new PR has been added, it is the procurement head's duty to check which dealing officer has the least load and accordingly assigning the new PR to him/her to be processed further. This working of this can be observed in Figure 10.

Once a PR has been assigned to the dealing officer, he/she floats a tender for the same and the announces a bid opening date at the same time. If required, the bid opening date is extended a maximum of two times. Once the deadline is reached, the bids are opened and are sent to the respective indentor for evaluation. Once an evaluation report is received, he/she send the selected bid to the finance department for the final approval, receiving which a purchase order is created and sent to the winning bidders organisation. The entire work flow can be observed in Figure 11.

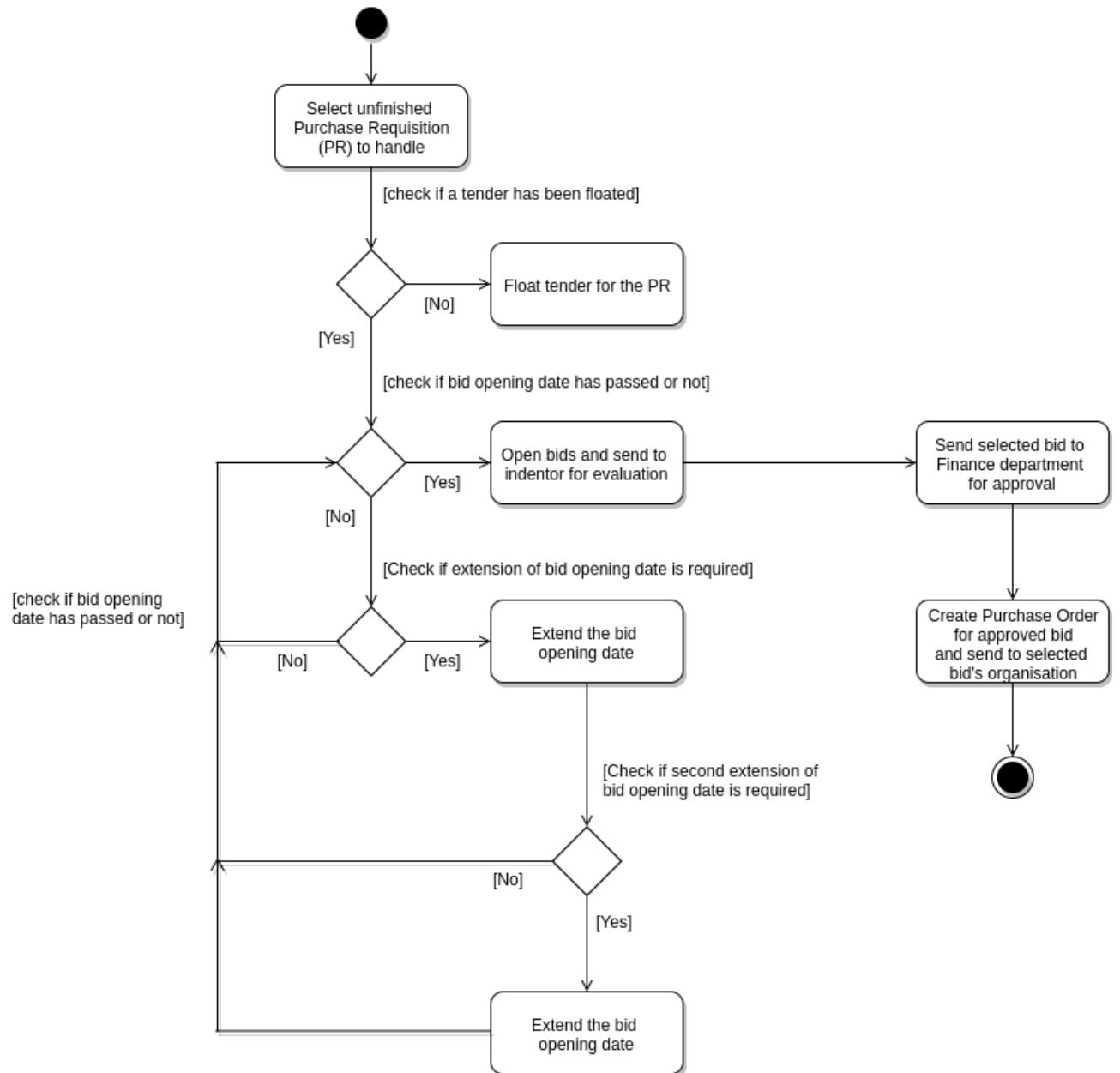


Figure 11: Activity Diagram for a Dealing Officer's work flow

3.6 Detailed Design Methodologies

3.6.1 Detailed Description of the User Interface

The first page visible to the users of this system is the login page. It contains a navigation bar on the top that has the following buttons

- IT: Takes the user to the information page of the IT department.
- Finance: Takes the user to the information page of the Finance department.
- Electrical: Takes the user to the information page of the Electrical department.
- Mechanical: Takes the user to the information page of the Mechanical department.
- Login: Clicking on this button shows a dropdown card where the user can enter his/her login credentials as shown in Figure 12

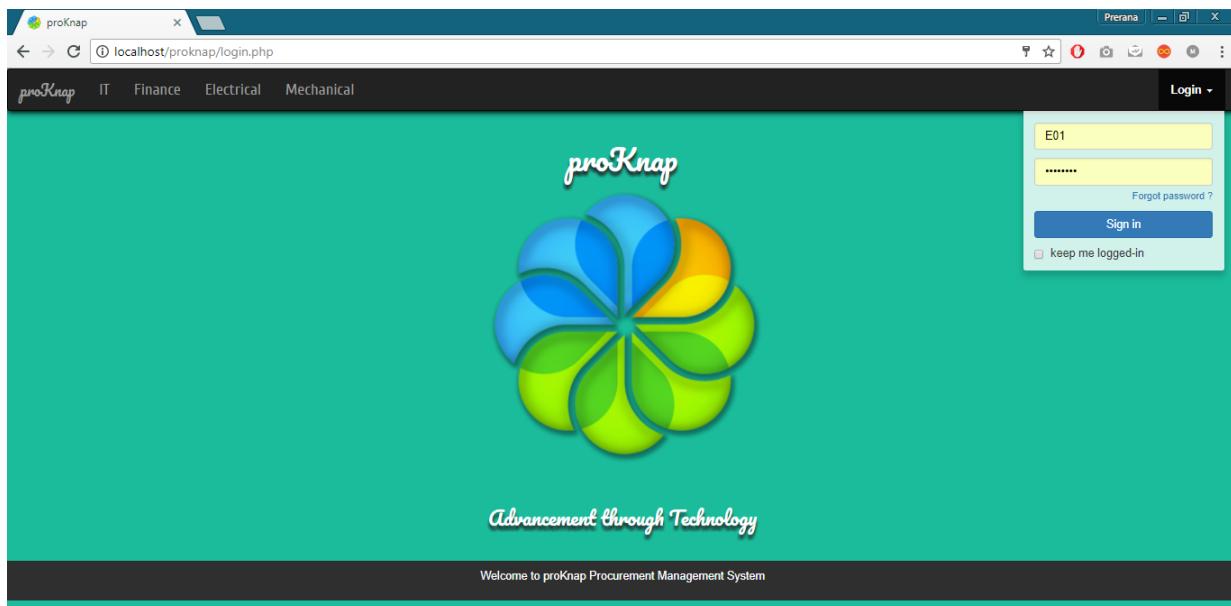


Figure 12: Login Page

When an indentor logs into the system, the page as shown in Figure 13 will be displayed. The page has the following functionalities:

- View PRs : On clicking this button, a card on the right hand side will appear showing the indentor the PRs put forward by him/her that are yet to be completed.
- Add PR: The indentor will be shown a card on the right hand side where he/she can enter details regarding a new PR like item, quantity required and a short description.
- Update Tender Evaluation Report: On clicking this button, a card on the right hand side will appear showing the indentor the PR's whose tenders have to be evaluated by him/her and then they can subsequently update the status to that of Tender evaluated.

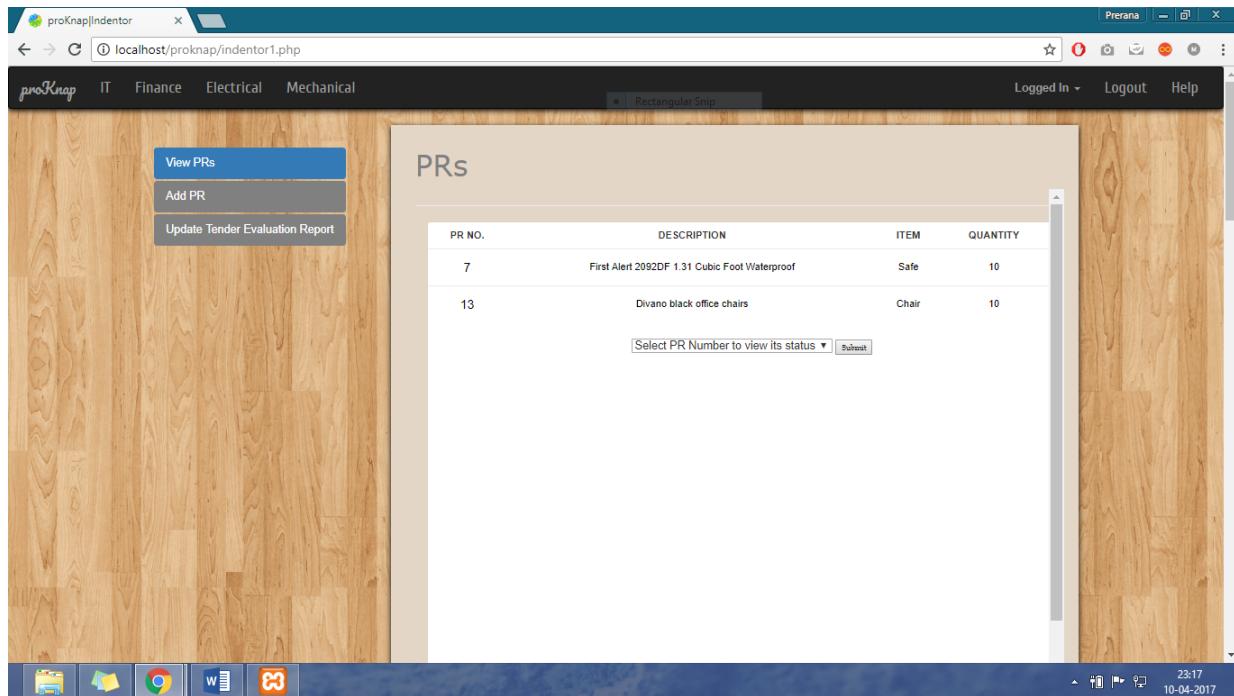


Figure 13: Indentor's Page

When a dealing officer logs into the system, the page as shown in Figure 14 will be displayed. The page has the following functionalities:

- Pending PRs : On clicking this button, a card on the right hand side will appear showing the authorised dealing officer all the purchase requisitions that have not yet been completed.
- Completed PRs: On clicking the 'Completed PRs' button, he/she will be able to view a list of purchase requisitions that have been successfully completed by him/her and its details.
- Float Tender : On clicking the 'Float Tender' button, he/she will be able to select a purchase requisition for which a tender has to be floated in a drop down menu present on a card on the right side of the page.
- Add Extension Date : The dealing officer will be shown a card on the right hand side where he/she will be able to extend the last date by when suppliers have to send in their samples. Normally, a dealing officer can provide only two such extensions.
- Change Tender Status : On clicking this button, a card on the right hand side will appear where the dealing officer will be able to update the status of a tender as and when sub processes of the procurement process are completed.
- Select Final Tender:On clicking this button, a card on the right hand side will appear where the authorised dealing officer will be able to select the tender to be finalised for a given purchase requisition assigned to him/her.n.

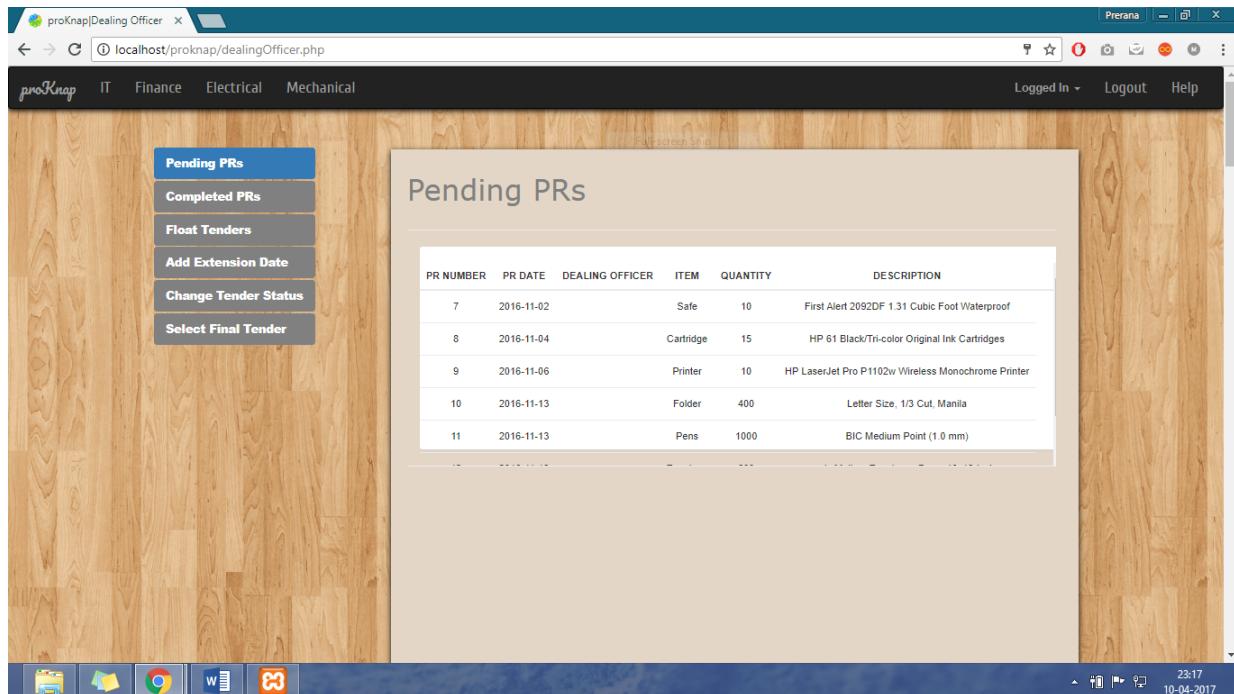


Figure 14: Dealing Officer's Page

When a Procurement Head logs into the system, the page as shown in Figure 15 will be displayed. The page has the following functionalities:

- View Unassigned Requests : On clicking the 'View Unassigned Requests' button, a card on the right side of the page will display all the requests that have not yet been assigned to any dealing officer.
- View Assigned Purchase Requisitions : On clicking the 'View Assigned Requests' button, a card on the right side of the page will display all the requests that have been assigned to a dealing officer.
- Assign Requests to Dealing Officer : On clicking the 'Assign Task' button, a card on the right side of the page will display two sub parts. The first sub part will display a list of dealing officers and the number of requests currently being handled by them. The second sub part will allow the procurement to select the unassigned request and a dealing officer to whom it must be assigned from drop down menus. On clicking the submit button, the system will update the database accordingly.

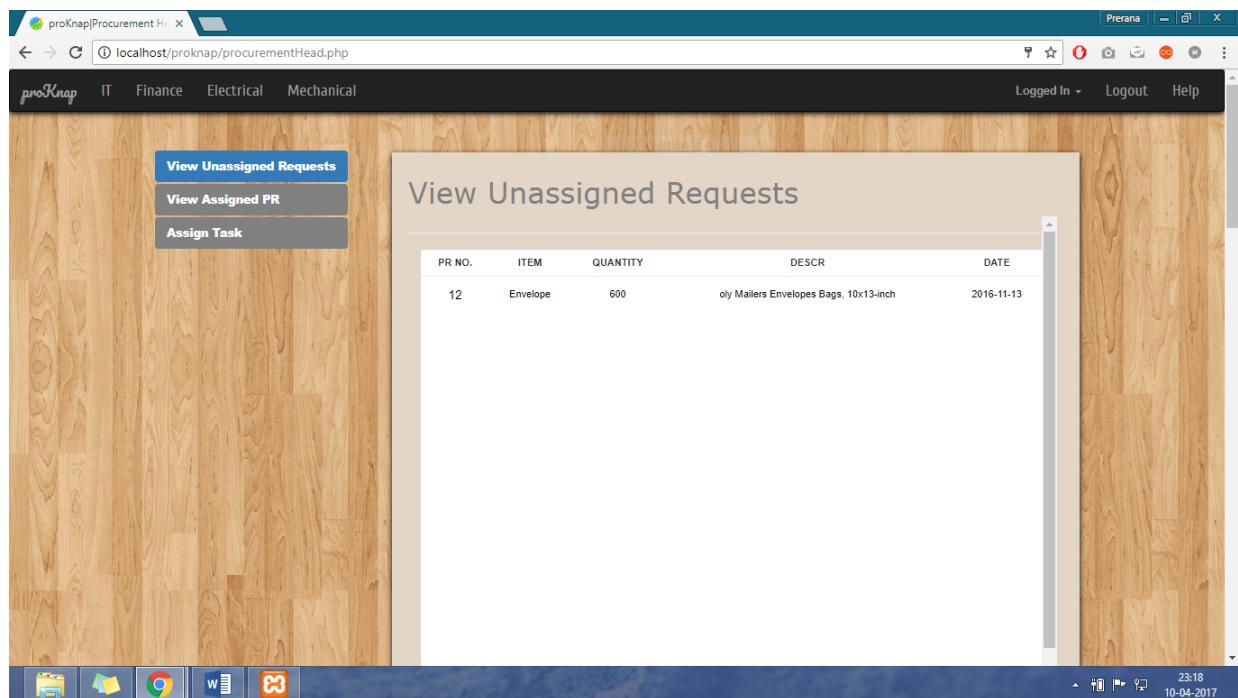


Figure 15: Procurement Head's Page

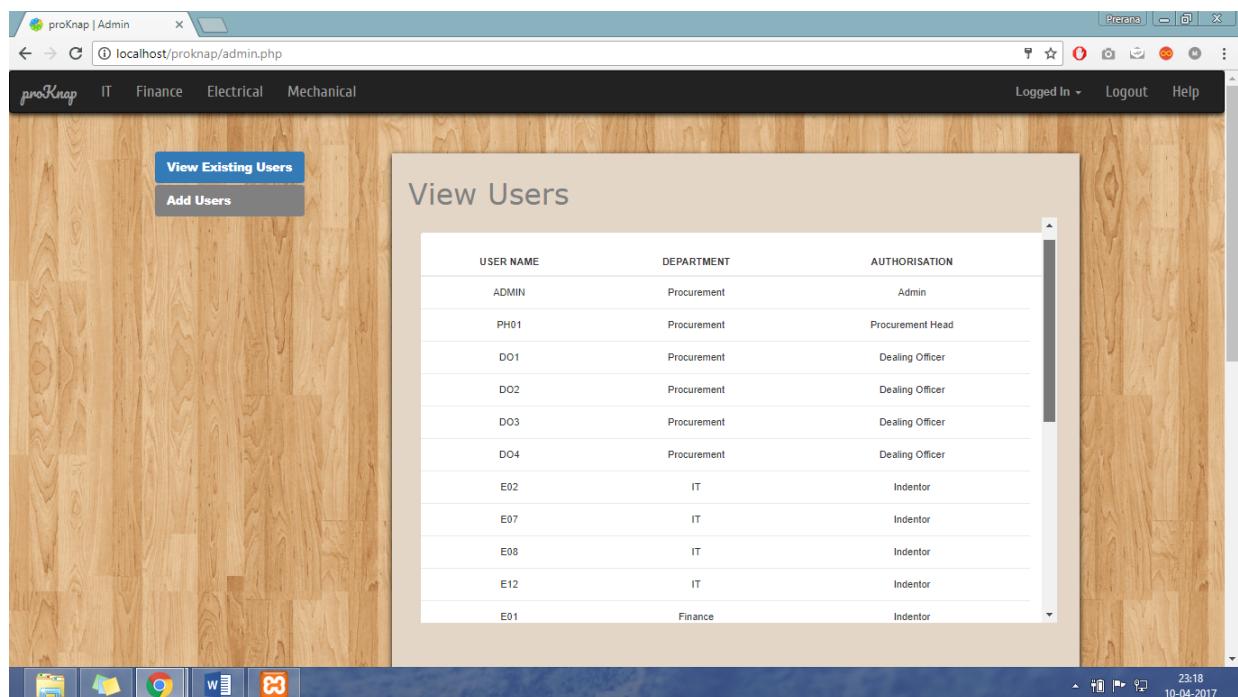


Figure 16: Administrator's Page

When an admin logs into the system, the page as shown in Figure 16 will be displayed. The page has the following functionalities:

- View Users : On clicking the 'View Users' button, a card on the right side of the page will display all authorised, registered userd of this system.
- Add Users : On clicking the 'Add Users' button, a card on the right side of the page will allow the admin to enter details like username, password and authorisation level of the new user.

4 Work Done

4.1 Development Environment

The web page is developed using HTML, CSS for front end and PHP and MySQL for back end. To ensure the user is given access to only functionalities coming under his area of work, unique employee ids and passwords are given, thereby making the system secure. The organization will be responsible for maintaining the delivered software, the Procurement head can add or delete users.

Currently the system consists of 4 departments, one procurement head, 4 dealing officers and 10 indentors. This number can be varied accordingly by the Procurement head as and when required. The backend database is queried using MySQL. The web page is best displayed on Mozilla Firefox/Google Chrome browser. Since the system is basically a webpage which can be hosted on any suitable server. It is Operating System and Hardware independent and can be run on any browser.

4.2 Testing

4.2.1 Black Box Testing

The Selenium tool was used to perform blackbox testing of the developed application taking various test cases, a couple of which have been listed here.

Test Case 1:

Input: Correct user name and password.

Output: Display page corresponding page to user with functionalities pertaining to their job titles only, as can be seen in Figure 17. (Indentor, Dealing officer, Procurement Head, Admin)

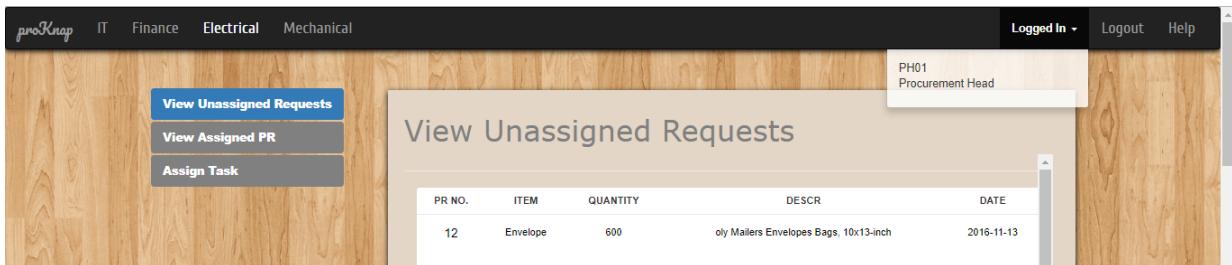


Figure 17: Procurement Head's Functions

Test Case 2:

Input: PR information to add new PR.

Output: Adds new entry to database. The corresponding changes are reflected on the view PRs section.

Figure 18: Adding new PR

Figure 19: Reflected changes in View PR

4.2.2 Unit Testing

In unit testing individual units of source code is tested to check it's working correctly. The goal of unit testing is to isolate each part of the program and show that the individual parts are correct. For unit testing, each activity is considered as a single unit and tested. Each activity is expected to display the buttons pertaining itself only and not those belonging to other activities. VBScript was used for performing unit testing of various individual parts(units).

	A	B	C
1	Username	Password	Test Result
2	ADMIN	wrongPassword	Failed
3	DO1	password	Successful
4	WrongName	WrongPassword	Failed
5	WrongName	password	Failed
6			

Figure 20: Unit Testing for Login

4.2.3 Integration Testing

For integration testing, the working of all the activities of the application was tested on the browser. It involved checking if upon pressing a button in one activity directs to the next intended activity. Basically it checks if the application runs as expected with the correct sequence of activities.

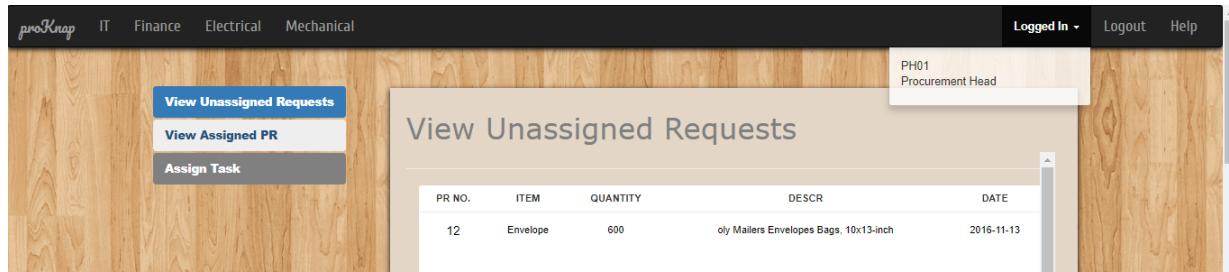


Figure 21: Click on View Assigned Pr



Figure 22: User taken to View Assigned PRs

4.2.4 System Testing

For system testing, the application is installed on various platforms like Ubuntu and Windows. Also it was run on multiple browsers and tested.

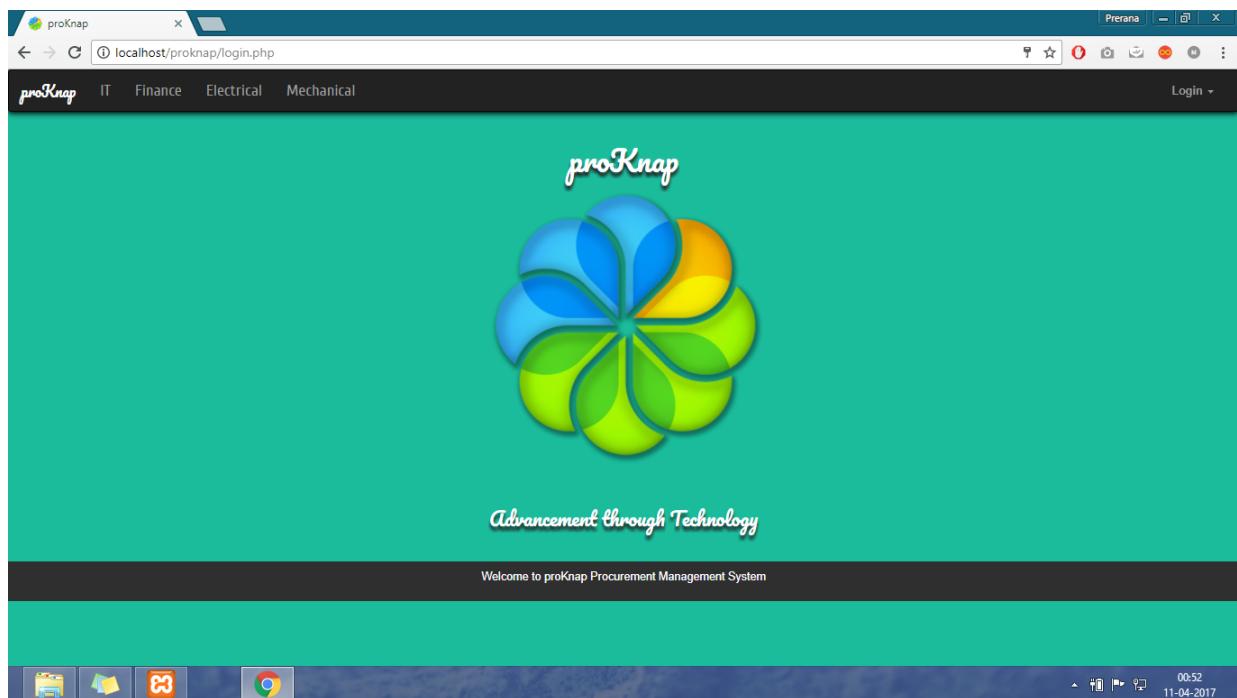


Figure 23: Using Chrome Browser

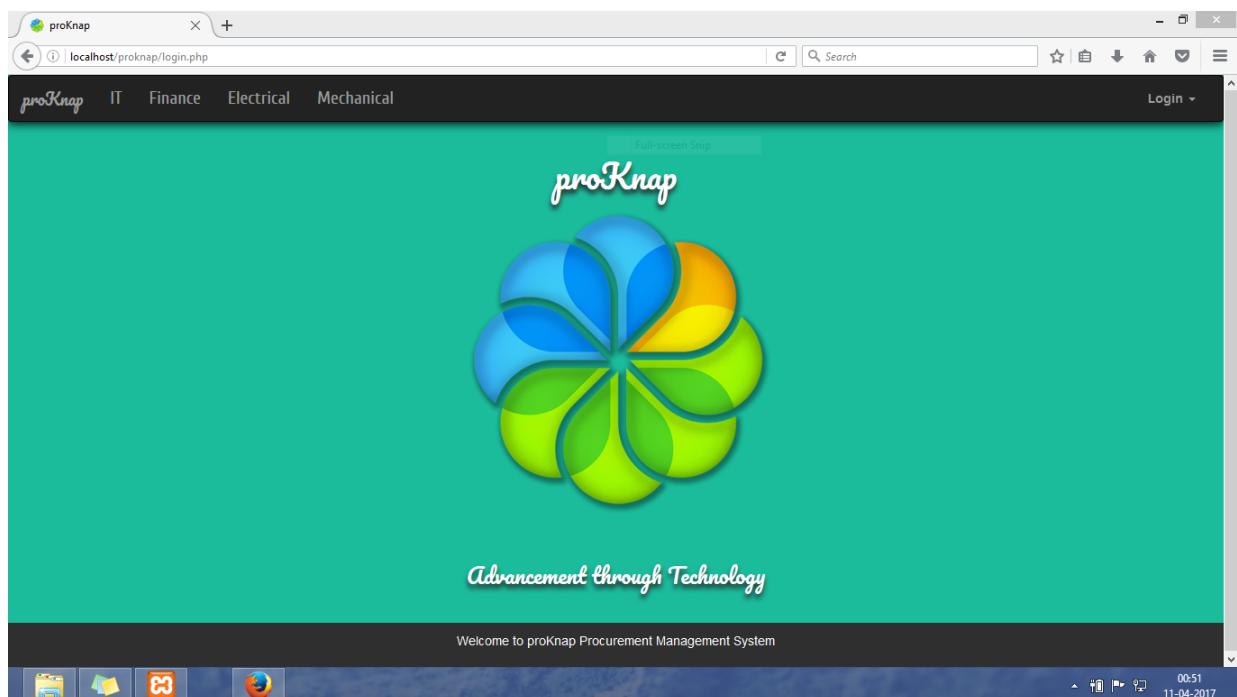


Figure 24: Using Firefox Browser

4.2.5 Expected Software Response

The application is expected to display results to the user based on his/her choices. For example:

Test Case 1 (Positive testing):

Input: Correct user name and password.

Output: Display page corresponding page to user with functionalities pertaining to their job titles only. (Indentor, Dealing officer, Procurement Head, Admin)

Input: DO's username and password.

Output: Display options pertaining to Dealing officer only.

Test Case 2 (Positive testing):

Input: Tender information to add new tender.

Output: Adds new entry to database. The corresponding changes are reflected on the view tenders section.

Input: View tenders.

Output: All tenders including the last one added is visible.

Test Case 3 (Negative testing):

Input: Hit Login (without internet connection)

Output: Web Page not available. Check your Internet connection.

4.3 Cost Estimation of the System

Cost Estimation of the App has been performed using COCOMO model. COCOMO applies to three classes of software projects:

- Organic projects - "small" teams with "good" experience working with "less than rigid" requirements
- Semi-detached projects - "medium" teams with mixed experience working with a mix of rigid and less than rigid requirements
- Embedded projects - developed within a set of "tight" constraints. It is also combination of organic and semi-detached projects.(hardware, software, operational, ...)

The System built here would fall into the category of organic projects.

KLOC: estimated number of delivered lines

For organic,

a = 2.4

b = 1.05

c = 2.5

d = 0.38

Effort Applied (E) = $a \times (KLOC)^b$ (man months)

Development Time (D) = $c \times (E)^d$ (months)

People required (P) = $E \div D$ (count)

6.157 (KLOC in thousands)

$E = 2.4 \times (6.157)^{1.05} = 16.18 = 16$ man months

$D = 2.5 \times 16^{0.38} = 7.17 = 7$ months

P = 3 people

5 Conclusion and Future Work

Procurement system helps in supply chain management function of organizations. Many organizations manage their ERP functions on SAP platform. SAP system helps in tracking purchasing functions from indent (requirement) generation, tendering, purchase order generation, inspection and receipt and usage. However, in any typical public procurement setup, where the system is not fully paperless due to audit/record requirements, there are many activities which are not captured in SAP system e.g., which purchase officer is dealing with the indent, when the file is sent to Technical department for evaluation, when the file is sent to finance department for concurrence etc. This limitation leads to opacity in procurement functions carried out in organization. The present system exactly addresses these gaps and fulfils the transparency requirement and also enhances efficiency.

ProKNAP was successfully developed meeting all the functional and non-functional requirements that were identified in the initial phase of development. All the features were implemented and effectively retrieves the required information and displays it to the user based on the choices made by him/her. Users of this system include an administrator, Procurement head, Bid dealing officers and service/maintenance/technical (SMT) groups (Mechanical, Instrumentation, HR, IT etc.). Procurement department receives indent (request for procurement) from various maintenance groups like mechanical, Instrumentation, civil, electrical, Safety etc. Maintenance users are required to login to view the state of their indent. The procurement head assigns the Purchase requisition (indent) to one of the dealing officers in procurement department to process the case depending on the current number of cases being handled by the DO (Dealing Officer). Dealing officer floats a tender for the PR and updates status of the bid in the database. At any point of time, SMT users will be able to check the status of their PR and would be notified in case of change of status. Subsequent activities like receipt of offers from vendors, file being sent to SMT group for technical evaluation, receipt after evaluation, status of approval for priced offer, concurrence of finance, placement of Purchase order is tracked in the system. This helps SMT groups to track the various activities being carried out by procurement department and will help in planning their maintenance functions. All these information for all user groups are all easily accessible in a single place at one go.

As future work, the built system can be integrated with the existing SAP systems to overcome their drawbacks of opacity and existance of paper work.

References

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- [2] IEEE STANDARD 1016: Software Design Specification
- [3] <https://en.wikipedia.org/wiki/COCOMO>
- [4] <http://www.seleniumhq.org/docs/>