INTEGRATED SUPPLY CHAIN MANAGEMENT SYSTEM

By

Talha Arshad

Waqar Saleem

Mashood Tanveer

Submitted to the Faculty of Computer Software Engineering, Military College of Signals, National University of Sciences and Technology, Islamabad in partial fulfillment for the requirements of a B.E Degree in Software Engineering

JUNE 2013

CERTIFICATE

It is certified that the contents and form of project report entitled **"Integrated Supply Chain Management System"** submitted by 1) Talha Arshad, 2) Waqar Saleem, and 3) Mashood Tanveer have been found satisfactory for the requirement of the degree.

Supervisor: _____

Asst. Prof. Dr. Awais Majeed

ABSTRACT

Supply chain is an important area in any manufacturing or retail enterprise. The management of the supply chains is difficult and can greatly affect the performance of an organization. This project focuses on the development of Supply Chain Management System that can integrate the upstream and downstream supply chains. The project will focus on a general purpose, customizable solution that can cater for the needs of a variety of SMEs. The proposed project will focus on the development of a workflow-based system that will use the open-standards and technologies like Web services to integrate supply chains in a particular value chain for a particular organization especially SMEs. **The focus will be on order management, maintaining inventory levels for raw material, work-in-process inventory and finished goods.**

The system consists of a **web-based system** through which the administrator accesses the system and can perform a variety of tasks. The customers and suppliers of the supply chain access the functionality of this system transparently by using **web services** that call the appropriate functions on our system. The **advantage of this technique** is that the customers and suppliers don't need to visit our system and can place orders and view invoices from their system and the request is automatically forwarded to our system and so their and our database is updated with only one user request. Some of the **functions** of the system, apart from those mentioned, include report generation, user account management, invoice management, stock forecasting, sales statistics and customer/supplier management.

There is also an **android sub-system** through which a warehouse administrator can access the main database and update/order products by scanning product barcodes and entering information. Other functions can also be performed.

Table of Contents

List of Tables

List of Figures

This page has been intentionally left blank.

CHAPTER 1:

INTRODUCTION

1. Introduction

1.1 Introduction

This report is the culmination of the entire project. It describes all the activities that were conducted from the start of this project till the end. The main details that were included in each of the lifecycle of this project are all explained in this report. The main topics covered are the introduction, literature review, system requirements, system design, system implementation, testing and conclusion. This document was created to provide an easily understandable and a complete overview of the project.

1.2 Background

A supply chain includes all the activities and resources that lead to products or services being transferred from the supplier to the customer.
Unless these activities and resources are managed and monitored in an organization, it can lead to chaos and dysfunction. A Supply Chain Management (SCM) system is therefore required to manage and maintain a well-coordinated and operational supply chain. An SCM system includes financial management, material requirement management, sales management, order management among other activities that can be added according to an organization's needs.

Figure 1-1 shows the flow of a typical supply chain.

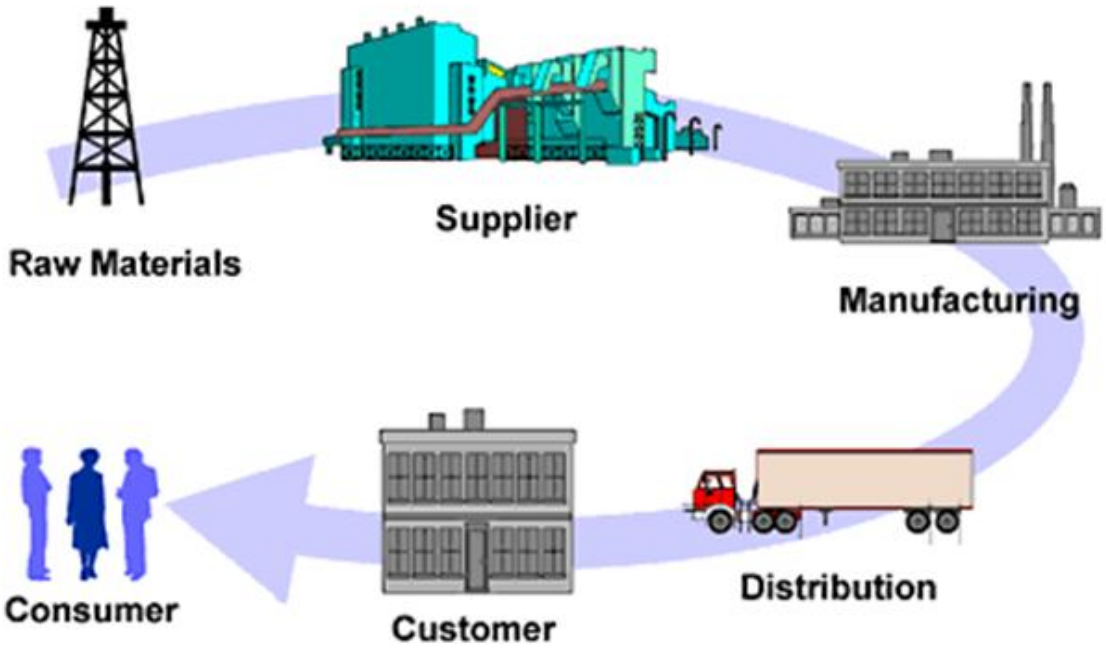


Figure 1-1 : Supply Chain

1.3 Problems Addressed

A system is required that will be able to integrate multiple supply chains by linking different modules of different supply chains. For example, order placement of different supply chains can be linked so that when an order is placed on an organization's website, it should be automatically uploaded to the supplier for order fulfillment. An order and inventory management system has to be developed that supports integration with other supply chains. Other modules such as user account management, supplier/customer management, sales management and stock forecasting also need to be implemented. An android system that performs some of the major functions, such as inventory and order management, also needs to be created.

1.4 Goals and Objectives

To learn about the basic theory and practice of supply chain management, **development of management information systems (MIS)** to support various organizational tasks/goals and the **development and integration of distributed**/Web services based applications. The proposed project will focus on the development of a workflow-based system that will use the open-standards and technologies like **Web services** to integrate supply chains in a particular value chain for a particular organization especially SMEs. We as students will also **learn** about web technologies such as **jsp/php** for server-side scripting, **javascript/ajax/jquery** for client side scripting and **MySQL** for database related operations.

Android usage and development will also be included to scan barcodes and place orders/manage inventory. The focus will be on **order management**, **maintaining inventory** levels for raw material, work-in-process inventory and finished goods. It will also integrate the supply chain of a particular enterprise with the upstream supply chains (suppliers of the enterprise) and the supply chains of the product/service customer (down-stream chain).

1.5 Deliverables

1.5.1 Document Deliverables

The document deliverables include the SRS (Software Requirements Specifications) and the system design document. It also includes the final thesis and the user manual along with it. Progress reports throughout the course of the project lifecycle are also a part of the deliverables.

1.5.2 **Software Deliverables**

The software deliverables involve two items. A **web-based system** to perform different supply chain management operations and an **android** based sub-system to scan product barcodes and perform required operations such as inventory management/order placement are included.

CHAPTER 2:

LITERATURE REVIEW

2. Literature Review

2.1 Introduction

Different supply chain management systems are available as commercial or open source solution as part of different ERP systems like SAP, PeoplesSoft, OpenBravo etc. In this section we will discuss some of the existing systems and their features.

First we will explain some common terms and concepts that are associated with this field.

2.2 Concepts Review

2.2.1 Enterprise Resource Planning Systems (ERPs)

ERPs[1] help organizations manage their information flow inside and outside their organization. The management includes the organization of finance, manufacturing, sales, customer relations and others. ERPs help automate this activity. Organizations rely heavily on these systems to help with their day-to-day operations and help with their transactions and productions.

2.2.2 Supply Chain Management Systems (SCMs)

SCMs[2] are a part of ERP systems and help organizations deal and communicate with their upstream and downstream supply chains. Upstream supply chains include all the companies who supply products or provide services to the target organization. The target organization is then responsible to compensate the upstream companies for their services.

Downstream supply chains include those firms who have requested for services and products from the target organization and are liable to reimburse it for the services. The management of all these corporations may prove to be an enormous task for the target organization and therefore SCMs were introduced to help out with this task.

The operations involved in SCMs include inventory, order, sales, HR, suppliers/customers management and so on.

2.2.3 **Web Services**

Web Services[3] are an ingenious technology. What web services actually do is help different types of systems communicate with each other regardless of the platforms, development language and operating environment of either systems. Messages can be exchanged using open-standards like SOAP and are translated according to each system's needs. For this reason, systems that may have been developed by different people and that involve different technologies are able to exchange information because of web services.

This communication can be automated in a way that the user doesn't explicitly have to make the call to a function, it could be transparently called by the backhand system. Web services are explained in detail and how they are used in our system in chapter five.

2.3 **OpenSource ERPs**

These are systems that have been developed and are available for commercial use with their source code and implementation details available for others to use and improve if needed.

2.3.1 **OpenBravo**

OpenBravo[4] is an open source web based ERP system that allows enterprises to manage their resources in an efficient and organized manner. Some of the features that it provides are production management, inventory management, financial management, among others.

Openbravo's **Java-based** architecture focuses on two development models namely model-driven development, in which developers describe the application in terms of models rather than code and model-view-controller, a well established design pattern in which the presentation logic and the business logic are kept isolated.

These two models allow for integration with other programs and for a simple interface. Because of the application of open standards, Openbravo ERP can be integrated with other open source applications like Magento webshop, Pentaho Business Intelligence, ProcessMaker BPM, Liferay Portal and SugarCRM.

2.3.2 **Ordoro**

Ordoro[5] is another web based system that allows users to manage products, orders and shipments. Ordoro has another feature that it allows integration with leading shopping carts and marketplaces, including BigCommerce, Shopify, Shopsite, 3dcart, eBay and Amazon Seller Central.In addition to inventory levels, Ordoro tracks the unit cost of every product to give you an accurate picture of your inventory costs. It also allows aisle/Bin Tracking for All Products. You can keep tabs on product locations and save time on order processing and packing.

2.3.3 **OpenErp**

OpenERP[6] is committed to Open Source Business Model. OpenERP is a comprehensive suite of business applications including Sales, CRM, Project management, Warehouse management, Manufacturing, Financial management and Human Resources just to name a few. OpenERP's unique modular approach allows customers to start with one application and add other modules later. Customers keep the benefits of an integrated software but avoid a “big bang” project.

OpenERP allows you to customize the user interface and manage your business processes in only a few clicks.

2.4 Proprietary/Commercial ERPs

Besides the above mentioned open source solutions, there are a number of commercial systems available. Since they are proprietary, they may be difficult for smaller organizations to afford since they require expensive licensing and setup costs. Some of these products are discussed below.

2.4.1 PeopleSoft

Oracle's PeopleSoft[7] Supply Chain Management (SCM) provides a cohesive yet flexible solution for the synchronized supply chain, driving efficiencies in cost savings over your entire supply chain—including your plan-to-produce and order-to-cash business processes.

Some of the features offered by PeopleSoft are Customer Order Management, Supply Chain Planning, Supply Chain Warehouse, Inventory and Fulfillment Management and Manufacturing Management.

2.4.2 SAP

SAP's[8] offers flexibility needed to quickly and affordably adapt to market changes, capitalize on new opportunities, and deliver stellar service – with their supply chain management (SCM) software for companies of any size. Recognized by key industry analysts as one of the market-leading SCM solutions, their software helps strengthen

relationships with suppliers, customers, and contract manufacturers around the globe.

The benefits of this system are faster responsiveness to changes in supply and demand, optimized inventory with greater forecast accuracy and market visibility, increased perfect order fulfillment with integrated planning and logistics, reduced operational expenses and transportation spend, improved warehouse efficiency with automated processes and tighter controls.

2.5 Summary

Many more systems exist. This was just a summary of some of them. Our system will include bar code scanning as one of the methods to place orders and manage inventory using android devices. Our system will also provide our functionalities as services so that they can be integrated into other systems.

CHAPTER 3:

SYSTEM REQUIREMENTS

3. System Requirements

3.1 Introduction

This product is a follow-on member of existing ERP systems, specifically SCM systems. Many similar systems exist but what this systems tries to focus on is adding functionality and features such as integration of different SCM systems by providing the functionality offered by different systems as web services and also implement different functionalities such as order management, inventory management and forecasting stock quantities.

3.2 Technological requirements

3.2.1 Hardware Requirements

1. An **android enabled device** to run/test the android based sub system with a 3+ MP camera, 500 MHz processor and 256 MB RAM and 512 MB free disk space.
2. A **windows 7 operated workstation** to develop and test the main web based system with 1 GHz CPU, 1 GB RAM and 1 GB free disk space.

3.2.2 Software Requirements

1. MySQL as the database system.
2. GlassFish server to deploy the web application on.
3. Apache tomcat server for the android application.
4. Android OS to develop and operate the sub-system on.

5. Netbeans IDE to develop the system.
6. JSP as the language to develop the system in.

3.3 System Features

3.3.1 View Sales Patterns

3.3.1.1 Description

The system should have the capability to display the highest/lowest product, sales /expenditures by product and total sales over time.

3.3.1.2 Stimulus/Response Sequences

System: The system displays the highest/lowest product, sales /expenditures by product and total sales over time on the main page to keep the user updated.

3.3.1.3 Functional Requirements

a) The system should interact with the database to retrieve the sales statistics and display them on the main page.

3.3.2 Place Sale/Purchase order

3.3.2.1 Description

One main feature of the system is Place Order. An interface is provided by the system to place order. This interface will take the information of the product whose order is to be placed.

3.3.2.2 Stimulus/Response Sequences

Actors: Admin, customers

Preconditions: The user has to be logged in the system.

User: The user accesses the place order page.

System: The system asks the user to select the product to be ordered and the quantity.

User: The user enters the required information and then presses submit.

System: The system places the order and updates the orders and products tables in the database.

3.3.2.3 Functional Requirements

a) The system should provide an interface to select the product and enter the quantity to be ordered.

b) The system should update the database after the order is placed.

3.3.3 **Generate Reports**

3.3.3.1 Description

The system has data about orders, inventory, sales and expenditures stored. So if the system user wants to generate any report it can be generated.

3.3.3.2 Stimulus/Response Sequences

Actors: Admin

Preconditions: The user has to be logged in the system.

User: The user accesses the generate report page.

System: The system asks the user to type of report that the user wants to generate.

User: The user selects the report and then presses submit.

System: The system retrieves the data from the database and displays the data appropriately.

- For order reports, the system generates the orders placed over a period of time specified by the user.
- For inventory reports, the system displays the products in stock
- For sales reports, the system generates the sales of different products over time
- For expenditure reports, the system generates the costs of different products/materials over time.

3.3.3.3 Functional Requirements

a) There will be a predefined format for the report and every report will take data from the database.

b) The appropriate data has to be available at the server.

3.3.4 **Stock Forecasting**

3.3.4.1 Description

We analyze past sales patterns and generate forecasted quantities of products to be ordered.

3.3.4.2 Stimulus/Response Sequences

Actors: Admin

Preconditions: The user has to be logged in the system.

User: The user accesses the forecast page.

System: The system asks the user to select the product whose quantity has to be forecasted or a list of products.

User: The user selects the required information and then presses submit.

System: The system calculates forecasted quantities and displays them. The system can take the average of past sales and display that value.

3.3.4.3 Functional Requirement

a) For Forecasting purpose main requirement is the previous data. So system should have previously stored data in the database in such form that it is easily accessible.

3.3.5 **Update inventory/Place order through mobile device**

3.3.5.1 Description

A user should be able to scan barcodes of products through mobile devices and update stock quantities when new orders are received or place orders when new products are needed.

3.3.5.2 Stimulus/Response Sequences for place order

Actors: Admin

Preconditions: The user has to be logged in the system through the mobile device.

User: The user accesses the place order page.

System: The system asks the user to scan the product's barcode to be ordered and the quantity.

User: The user scans the product and enters the required information and then presses submit.

System: The system places the order and updates the orders and products tables in the database.

3.3.5.3 Stimulus/Response Sequences for update inventory

Actors: Admin

Preconditions: The user has to be logged in the system through the mobile device.

User: The user accesses the update inventory page.

System: The system asks the user to scan the product's barcode to be updated and enter the quantity.

User: The user scans the product and enters the required information and then presses submit.

System: The system updates the products tables in the database.

4.6.3 Functional Requirements

a) The android enabled device should have the appropriate application installed.

b) The application should have the appropriate functionality and a connection with the database.

3.3.6 **Manage Inventory**

3.3.6.1 Description

The system provides a functionality to manage the inventory such as add, delete and modify operations on products.

3.3.6.2 Stimulus/Response Sequences

Actors: Admin

Preconditions: The user has to be logged in the system.

User: The user accesses the add/delete/modify product page.

System: The system asks the user to enter product details to add/modify/delete product

- To add product, the system asks the user to enter the new product details such as name, ID, price, quantity, sale quantity and purchase quantity.
- To delete product, the system asks the user to select the product to be deleted.
- To update product the system asks the users to select the product to modify and enter the updated product details.

User: The user enters the required information and then presses submit.

System: The system updates the products tables in the database.

3.3.6.3 Functional Requirements

a) The system should provide appropriate interfaces to add/update/delete products so that the user can enter/select the data accordingly.

b) The system must update the information at the server.

3.3.7 **Manage user accounts**

3.3.7.1 Description

The system provides a functionality to manage the user accounts such as add, delete and modify operations on users.

3.3.7.2 Stimulus/Response Sequences

Actors: Admin

Preconditions: The user has to be logged in the system.

User: The user accesses the add/delete/modify user page.

System: The system asks the user to enter user details to add/modify/delete product

- To add user, the system asks the user to enter the new user details such as username, password and type.
- To delete user, the system asks the user to select the user to be deleted.
- To update user the system asks the user to select the user to modify and enter the updated user details.

User: The user enters the required information and then presses submit.

System: The system updates the users tables in the database.

3.3.7.3 Functional Requirements

a) The system should provide appropriate interfaces to add/update/delete users so that the user can enter/select the data accordingly.

b) The system must update the information at the server.

3.3.8 **Track and view orders**

3.3.8.1 Description

The admin/customer can track and view orders they have placed over the system.

3.3.8.2 Stimulus/Response Sequences

Actors: Admin, customers

Preconditions: The user has to be logged in the system.

User: The user accesses the view orders page.

System: The system displays all the orders placed by that user if it is a customer otherwise displays all the orders if an admin is logged in.

User: The user can search for specific order by entering the order ID.

System: The system searches for the entered order and displays the result.

3.3.8.3 Functional Requirements

a) The system should provide a webpage through which the user can view and search for orders.

b) The system should communicate with the database to retrieve the data required and display all the data that is related to that order.

3.3.9 **Manage Customer/Suppliers details**

3.3.9.1 Description

The system provides a functionality to manage the customer/supplier details such as providing the add, delete and modify operations on customers/suppliers.

3.3.9.2 Stimulus/Response Sequences

Actors: Admin

Preconditions: The admin has to be logged in the system.

User: The user accesses the add/delete/modify customers/suppliers page.

System: The system asks the user to enter customers/suppliers details to add/modify/delete product

- To add customers/suppliers, the system asks the user to enter the new customers/suppliers details such as name, ID, phone, address and location.
- To delete customers/suppliers, the system asks the user to select the customers/suppliers to be deleted.
- To update customers/suppliers the system asks the user to select the customers/suppliers to modify and enter the updated customers/suppliers details.

User: The user enters the required information and then presses submit.

System: The system updates the customers/suppliers tables in the database.

3.3.9.3 Functional Requirements

a) The system should provide appropriate interfaces to add/update/delete customers/suppliers so that the user can enter/select the data accordingly.

b) The system must update the information at the server.

3.4 Non-functional Requirements

3.4.1 Performance Requirements

- Since the system is web based, there shouldn't be much delay in processing and responding to the user's requests. The requests should be responded at most 5 seconds.

- The system is designed to integrate multiple supply chains, therefore there maybe a lot of users who would use the system. Therefore the web based system should be hosted on a server that is capable of handling at least a 100 requests at a time.

3.4.2 Safety Requirements

N/A

3.4.3 Security Requirements

- The system should not be accessed by any unauthorized user.
- The database should also only be allowed to be manipulated by valid users.
- The application on the mobile device should also be secured.

3.4.4 **Software Quality Attributes**

This system should be reliable and provide accurate data without errors. Since it is a web based system, the system is highly portable and can be accessed from anywhere with an internet connection. The system is easily extendible since we can add functionalities through web services. The benefit of web services is to make the functionalities reusable by other systems.

3.5 Use Case Diagrams

This section shows some the use case diagrams of our system. Two partial and one complete but simplified diagrams are shown.

3.5.1 Place Order

Figure 3-1 shows the use case diagram for placing an order. When placing an order, we have two options, either a sale or a purchase order can be placed. After an order, an invoice is generated.

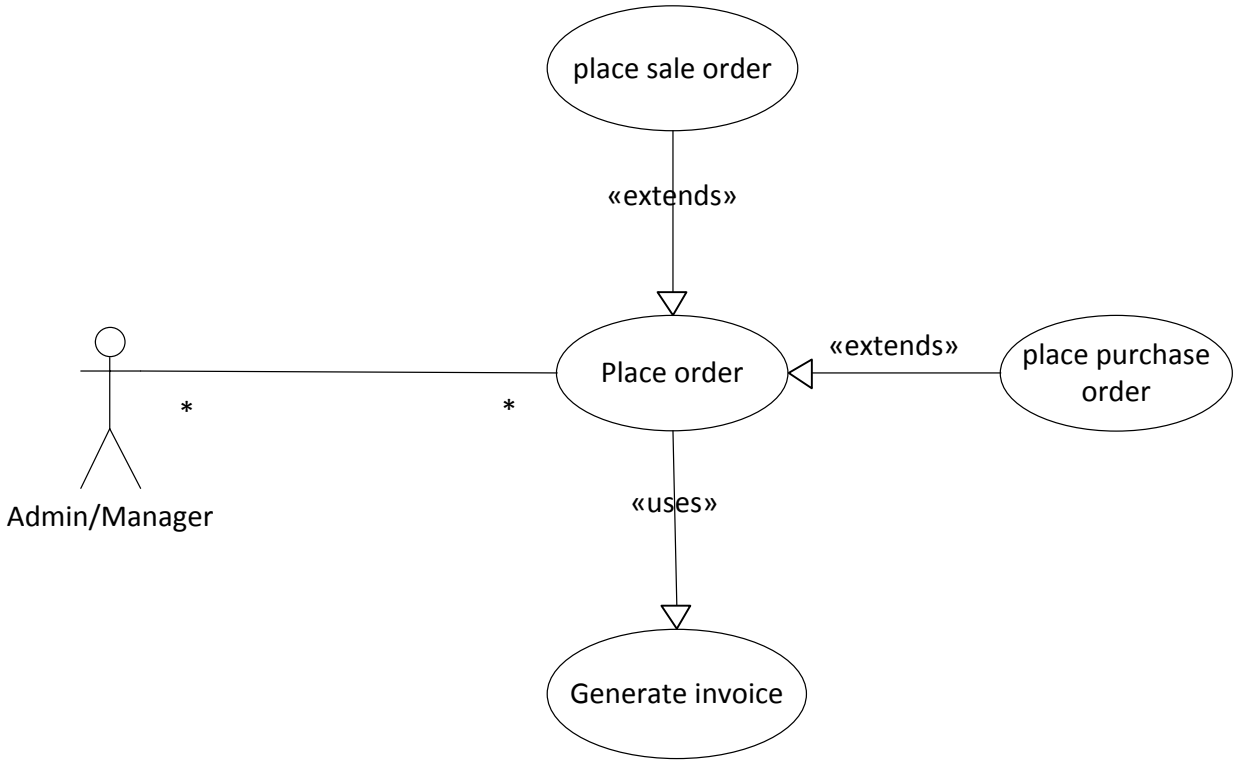


Figure 3-1 : Use Case Diagram : Place Order

3.5.2 **Manage Inventory**

We have three operations that can be performed when managing an inventory namely, add, modify and delete. Figure 3-2 shows the use case diagram.

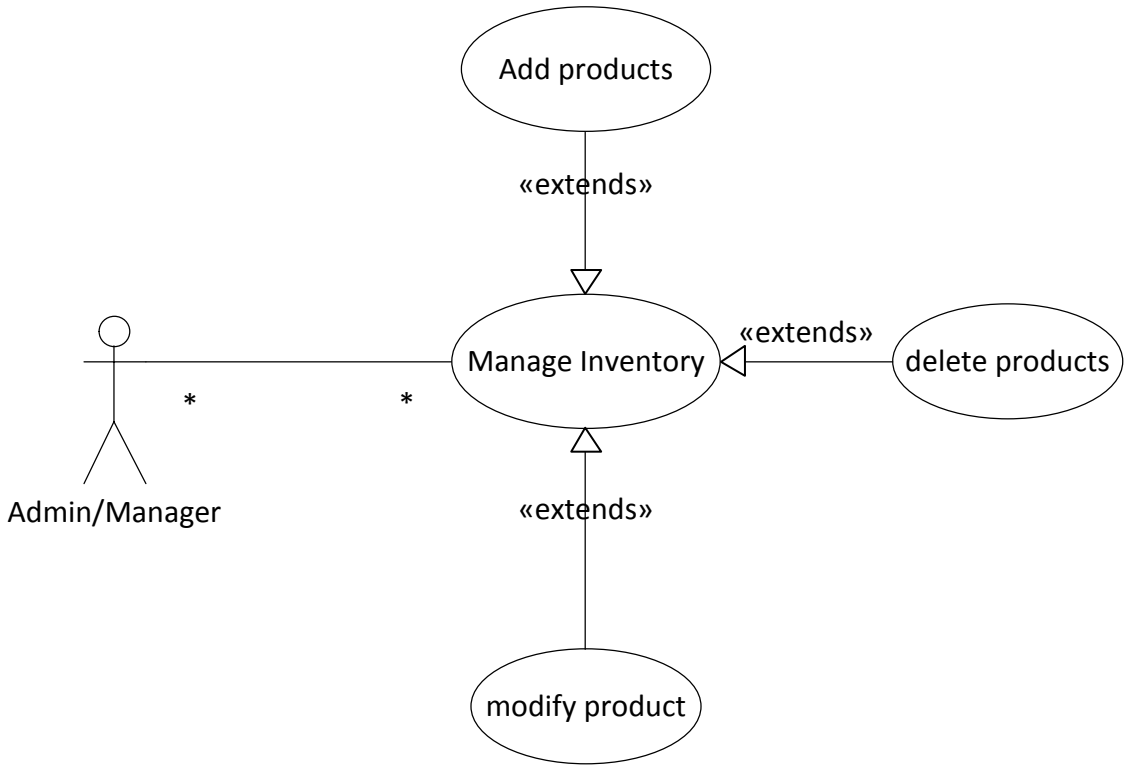


Figure 3-2 : Use Case Diagram : Manage Inventory

3.5.3 **Complete Use Case Diagram (Simplified)**

Figure 3-3 shows the complete use case diagram of our system without the extended functionality due to page space issues.

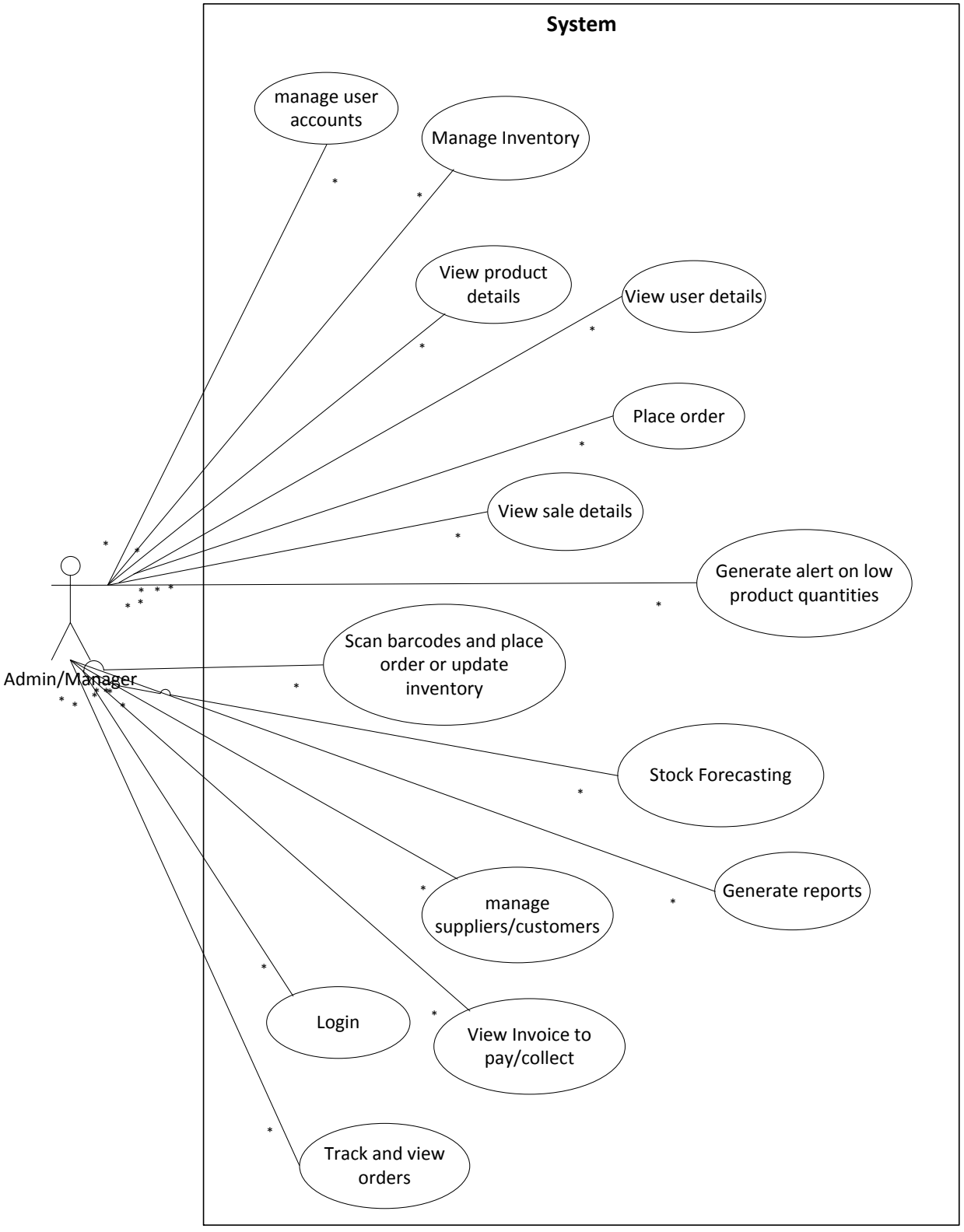


Figure 3-3 : Complete Use Case Diagram (Simplified)

CHAPTER 4:

SYSTEM DESIGN

4. System Design

4.1 Introduction

This section deals with the detailed design of our system. We will start of by describing the chosen architecture for the web and android systems and its benefits. We will then proceed and show and explain the design diagrams associated with our system.

4.2 System Architecture of Web System

The system architecture follows a **layered approach**[9]. The layers consist of a database, server and client layer. The architecture shows the systems of the customer, supplier and our organization. Each system has a database, a web server and client workstations. These three entities form the 3 layers. The web servers of each organization can communicate with each other using web services.

Figure 4-1 demonstrates the design of the web system.

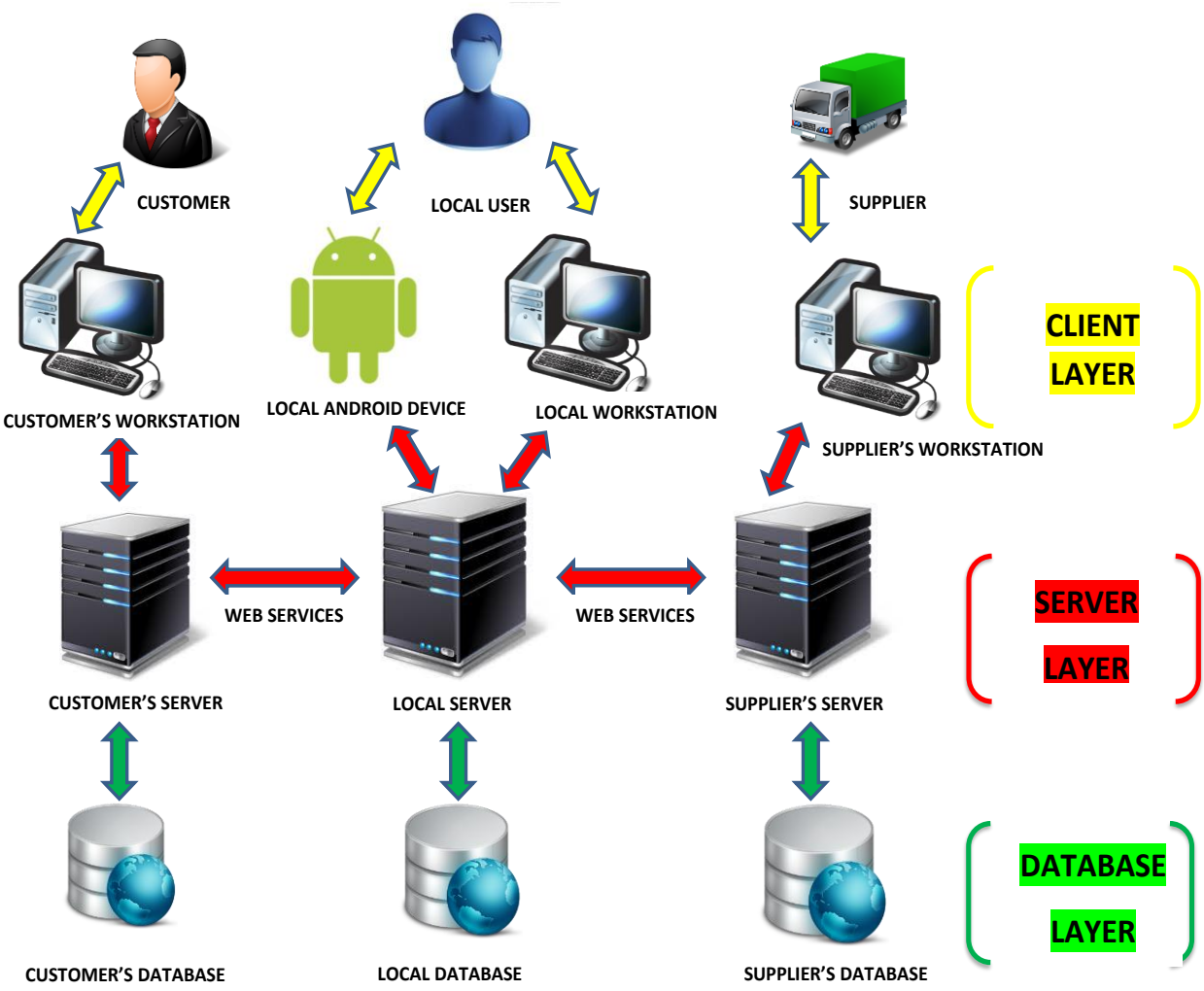


Figure 4-1 : System Architecture

4.2.1 **Benefits of chosen architecture**

This architectural style has many benefits[10]. One of the benefits is **independence**. We have divided our system into 3 parts. Now when we want to make changes to one part, the others remain unaffected and the change is isolated only in one part. This also reduces the complexity as compared to if there were no division.

Now the complexity only lies within the 3 individual parts and the interdependence within the 3 divisions is kept to a minimum.

This architectural style also makes our system more **manageable**. Because complexity is reduced, now we can identify any potential errors easily and can also fix and enhance any functionality without worrying about the effects it will have on the other parts. This also improves **scalability**. If we want to increase the database to cater for more users we can do that without having to rework the whole system. **Reusability** is also a factor that comes along with this architecture. Since each of our three parts can exist independently, each one of them can be used later on in other projects without a lot of change. The internal logic can remain the same and the external connections may only need to be changed.

Lastly, **Testing** can be much easier and efficient. Now that we can test each part separately from the others, we can reduce testing time, since testing one part won't be dependent on the other parts and if any fault is found, it will be easier to locate and fix it.

4.3 Architecture of the Android Application

The android system also follows **MVC**[11] style. Whenever the user makes a request, the controller recognizes it and updates the model if required. The model then triggers the view that it needs to be changed and that the old view has expired. The view is then redrawn and displayed to the user. Figure 4-2 shows the architecture of the android app.

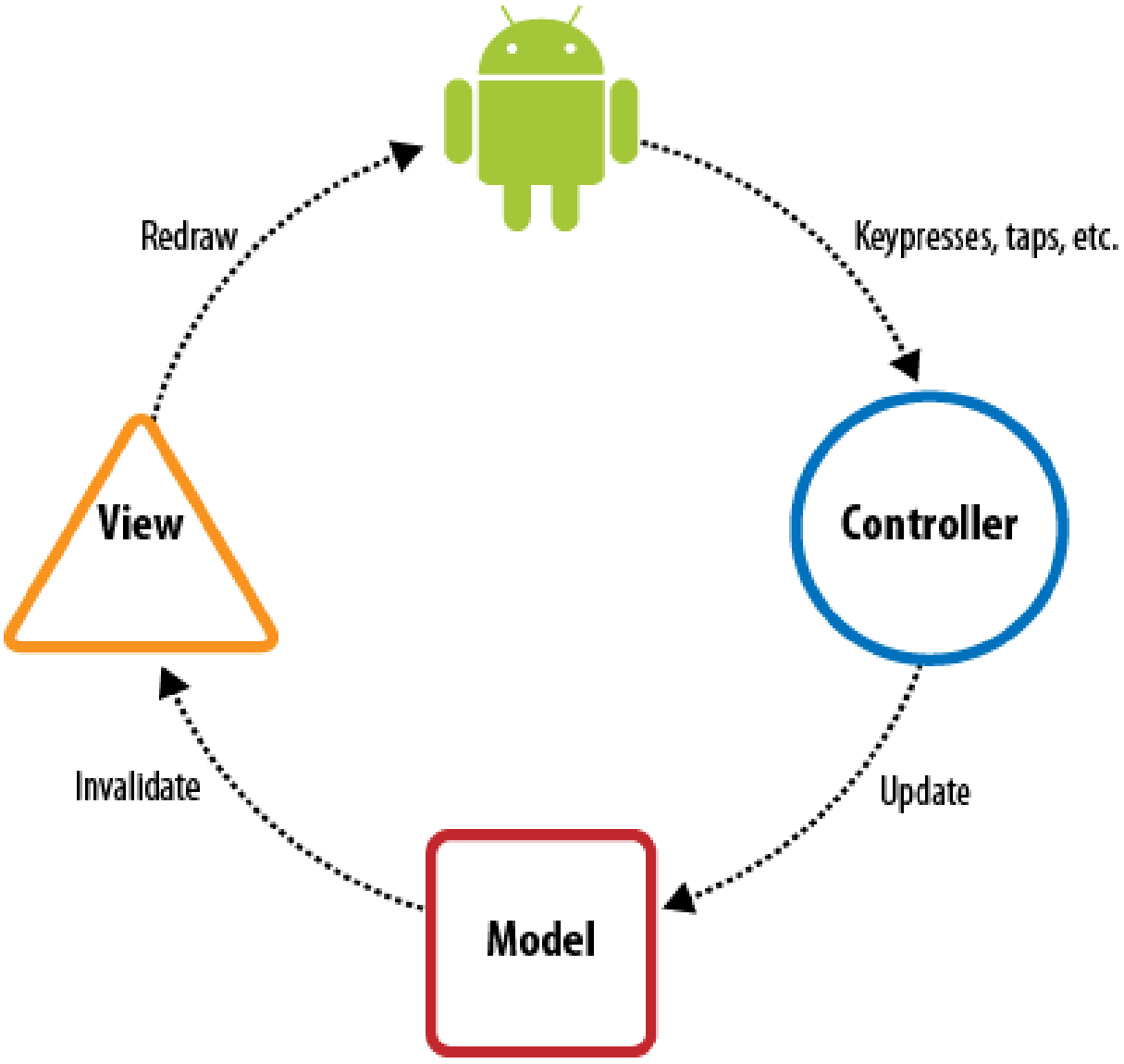


Figure 4-2 : Android Architecture

4.4 Class Diagram

The class diagram consists of classes such as **order** that stores all the orders made by users of the system. The **sale order** and the **purchase order** classes inherit the order class. This is just to differentiate between sale orders, which are made to suppliers, and purchase orders, which are made by customers. The **products_ordered** class stores the details of the products ordered in each order. The **invoices_to_pay** and **invoices_to_recieve** classes contain the invoices that are generated against each order. The invoices are visible to those users who made the order with the exception of the admin who can view all the invoices in the system.

The **user** class contains the data of all the users that are registered on the system. The types of users include **admins**, **suppliers** and **customers**. The admin has many functions he could perform but the supplier only has the view_orders function which he could use to view the invoices made against the orders to that supplier. The customer has the view_order and the place_order function. The **product** class contains the information of all the products that are available. The **report** class is inherited by **sales_report**, **expenditure_report**, **inventory_report** and **order report** classes. These classes are used to generate the different types of reports that can be generated by the system. The **system** class links all the classes together and represents the functions that are performed by the system without triggers from the user.

Figure 4-3 shows the class diagram.

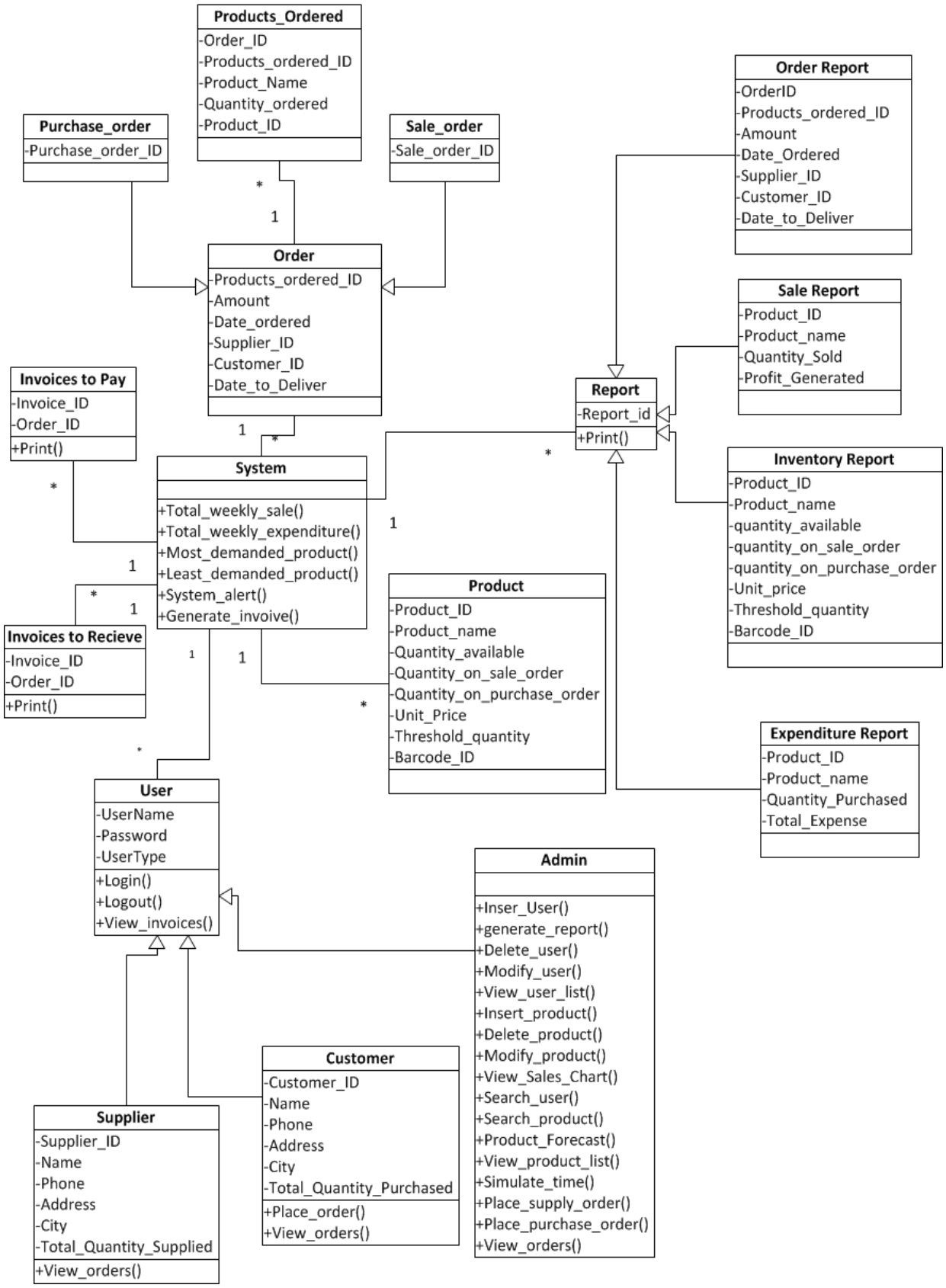


Figure 4-3 : Class Diagram

4.5 Database Model

The database model describes the different tables that are included in the database. These tables are similar to the classes mentioned in the class diagram. The fields are also mapped to the attributes in the class diagram. The database also identifies the primary keys of each table that uniquely identifies each record in that table.

Figure 4-4 shows the database model.

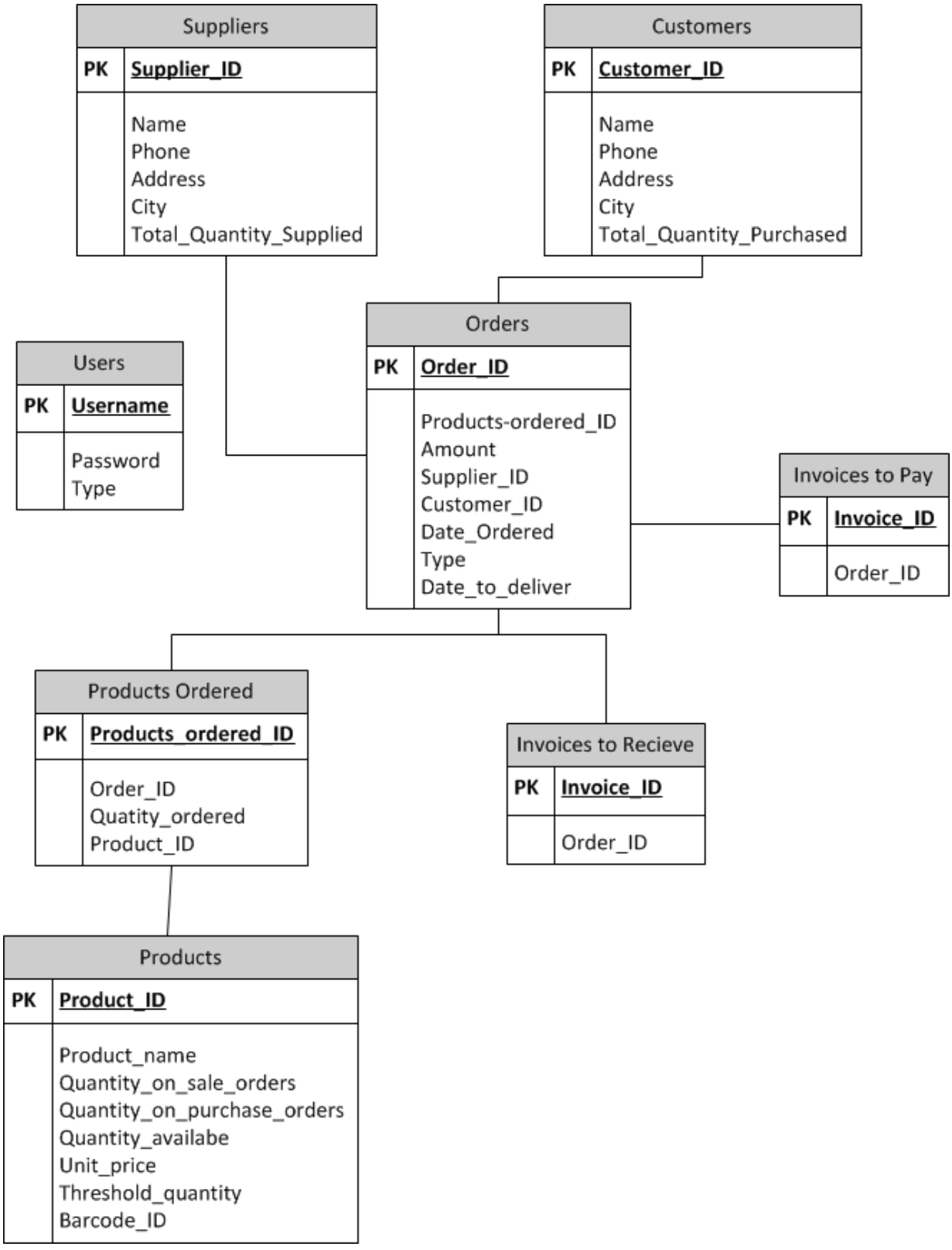


Figure 4-4 : Database Model

4.6 Activity Diagrams

This section demonstrates different activities that can be performed using our system. Major process workflows are modeled and presented in this section.

4.6.1 Place Order

When placing an order, the admin accesses the place order page and selects the product and enters the quantity that needs to be ordered and then submits the page.

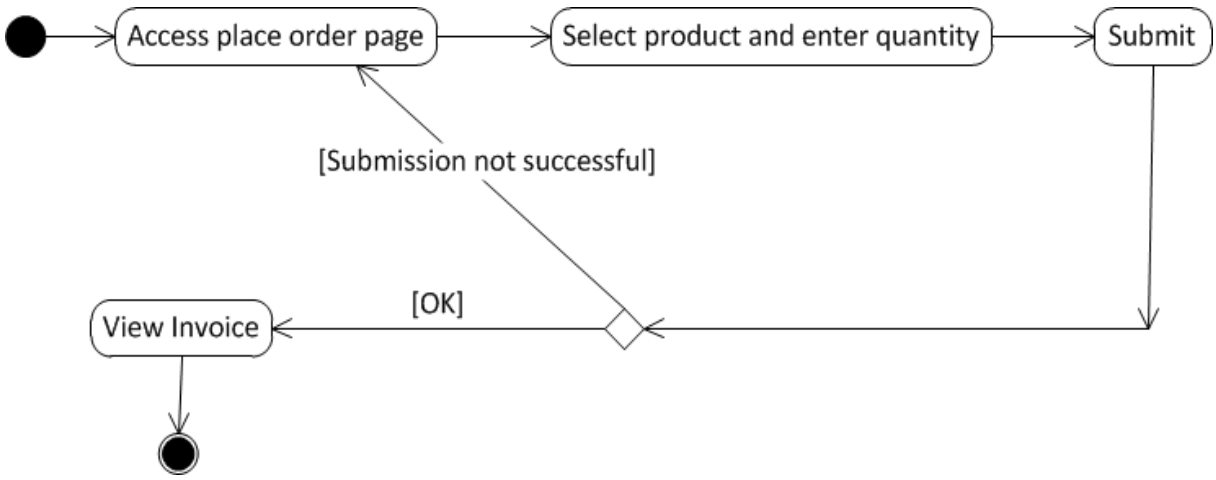


Figure 4-5 : Activity Diagram : Place Order

4.6.2 **Update Inventory through Android**

To update the inventory using android, the admin goes to the required page and scans the product barcode using the phone. That barcode provides the product ID and then the admin enters the quantity and places the order.

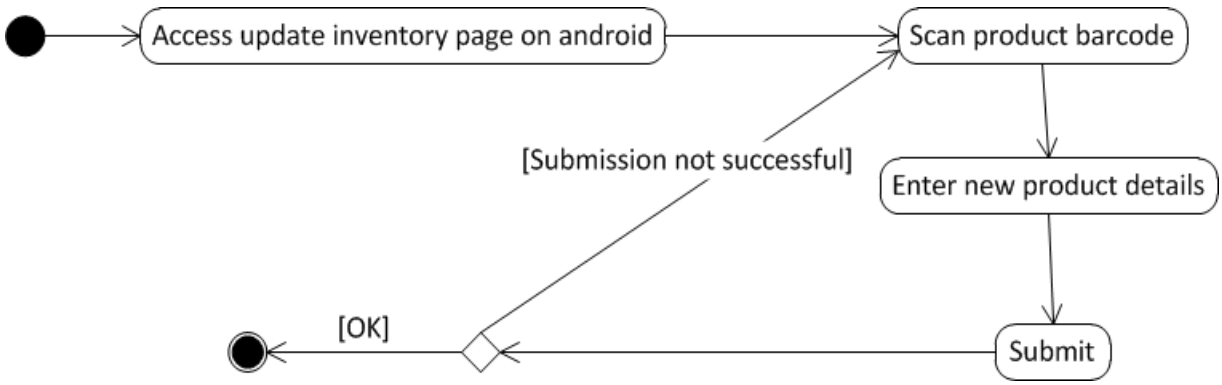


Figure 4-6 : Activity Diagram : Update Inventory (Android)

4.7 **Sequence Diagrams**

This section describes the sequence that is associated with each Use Case.

4.7.1 **Place Order**

The place order sequence involves the user selecting the product name and entering the quantity and then submitting the order. The place order page sends the new order details to the system and the system further forwards the details to the database. The database updates itself and returns the confirmation. Then the system sends the new order to the supplier and then at the end, the system generates an invoice and displays it to the user.

Figure 4-7 shows the place order sequence diagram.

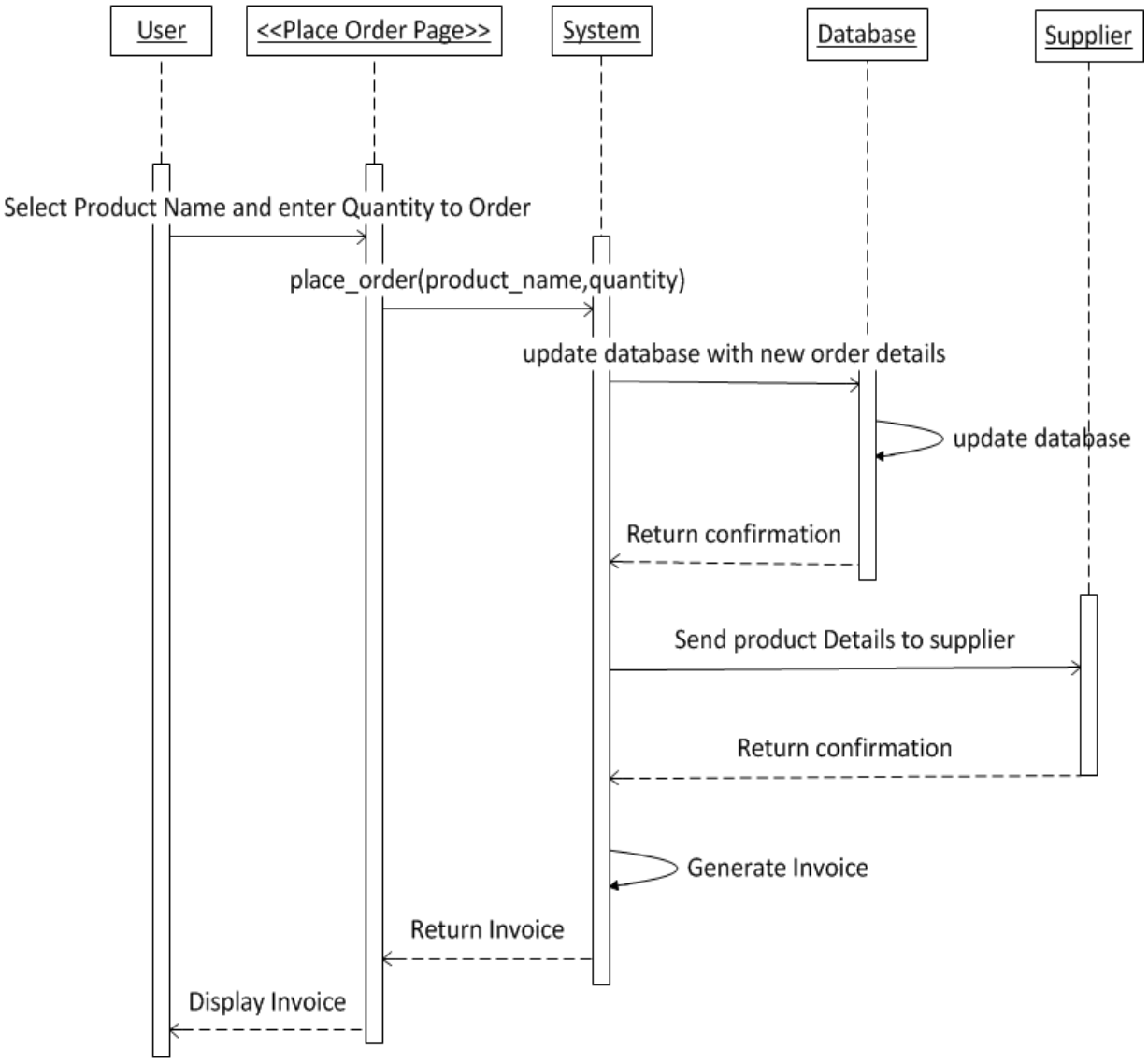


Figure 4-7 : Sequence Diagram : Place Order

4.7.2 **Update Inventory through Android**

To update the inventory through an Android phone, the admin enters the new inventory details and then scans the barcode of the product that needs to be updated and then the system recognizes the product id and sends the information to the database to store it. The confirmation is displayed to the user.

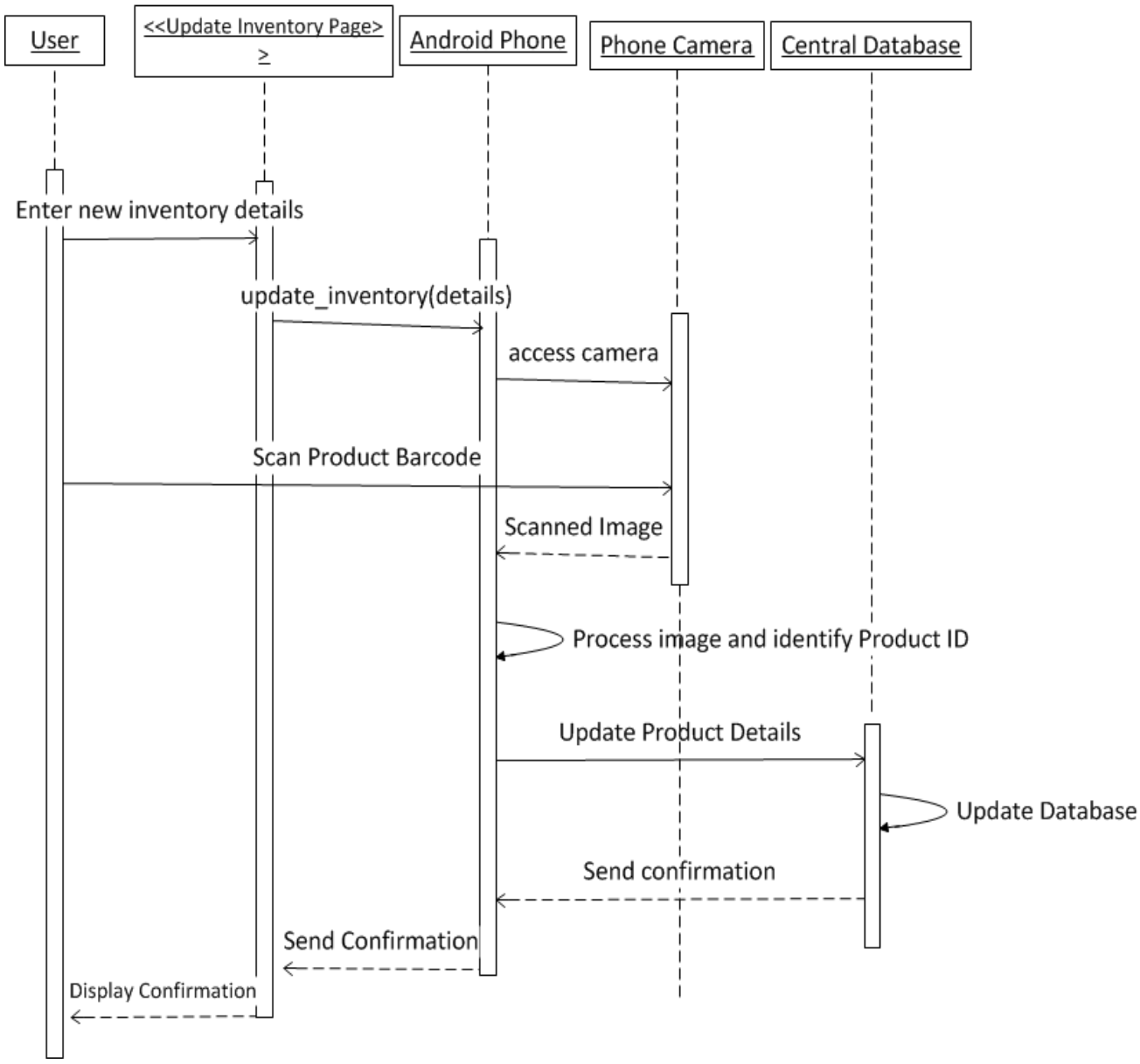


Figure 4-8 : Sequence Diagram : Update Inventory (Android)

4.7.3 **Generate Reports**

When the admin needs to generate a certain type of report, he goes to the generate report page and selects which type of report needs to be created. The system queries the database for the appropriate information. When the database responds, the system calculates the necessary details and creates the report. The system then sends the report to the user.

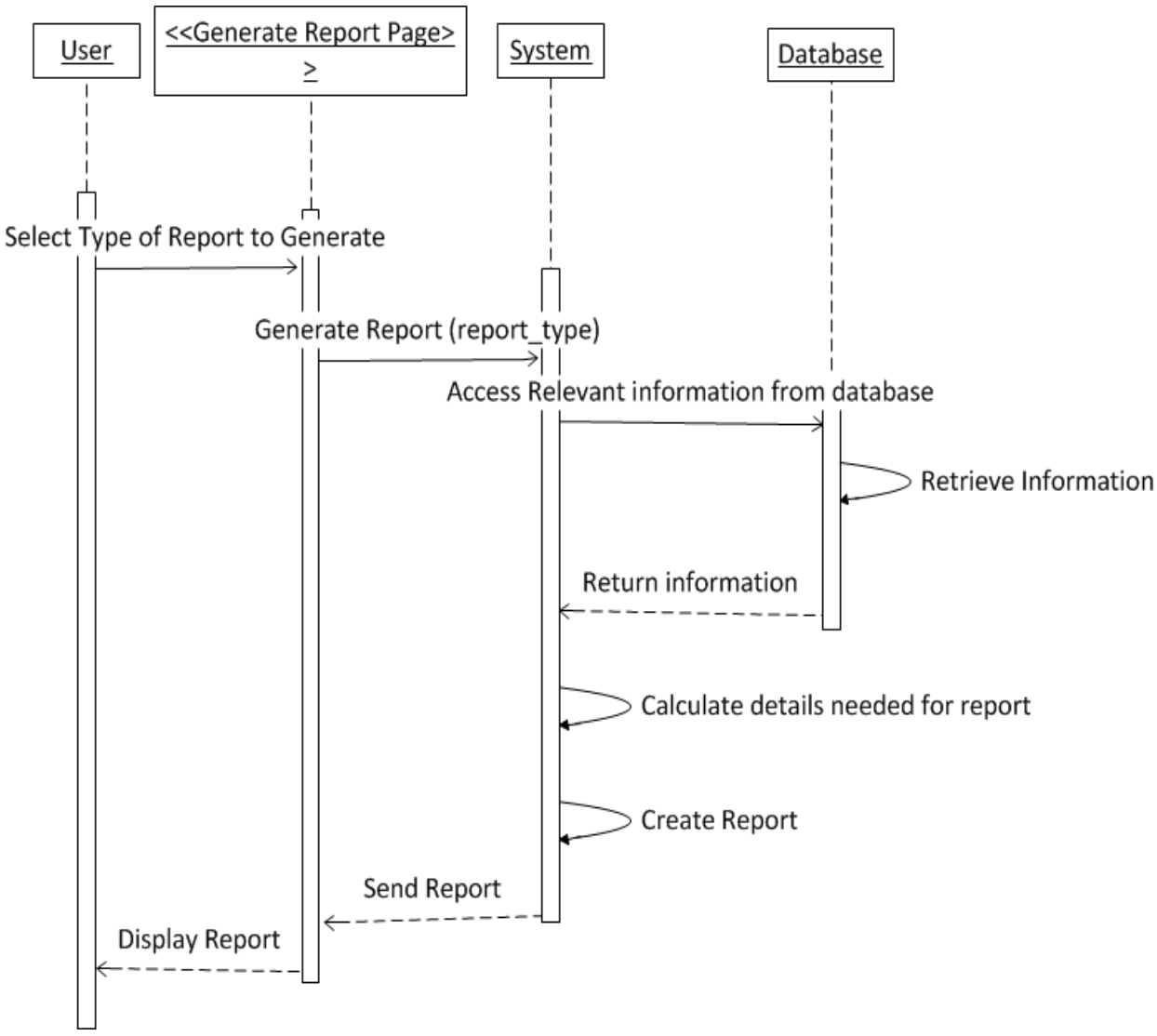


Figure 4-9 : Sequence Diagram : Generate Reports

4.8 State Transition Diagrams

The state transition diagrams show the different states associated with each operation and how they transit.

4.8.1 Place Order

Initially there is no order. When the user starts to fill in an order details, the order is in process. When the user submits the order, the order is placed. The order is then saved in the database and sent to the supplier. Finally an invoice is generated.

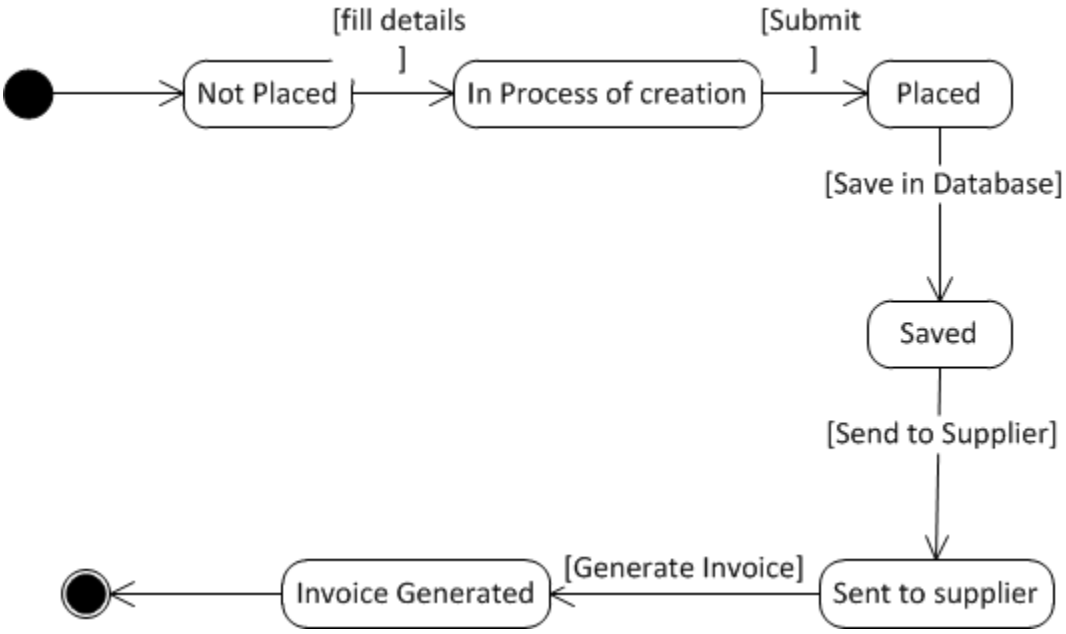


Figure 4-10 : State Transition : Place Order

4.8.2 **Update Inventory through Android**

When updating the inventory through android, first the barcode is scanned and then the new details are provided and then the inventory gets updated.

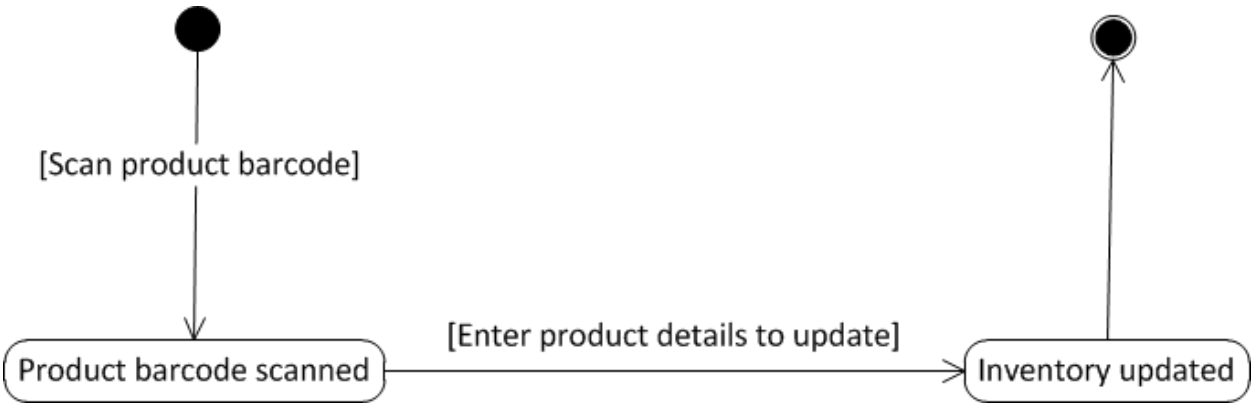


Figure 4-11 : State Transition : Update Inventory (Android)

4.8.3 **View Product List && Alarm on low Product Quantities && Report Generation && Login**

This diagram describes state diagrams of 4 operations. When the user requests the product list, the product list is generated. When reports are requested to be generated, the state changes to reports generated. The user is initially logged out but when he enters his login details, the state changes to user logged in. The alarm is off in normal conditions but when low product quantities are detected, the alarm is set off.

Figure 4-12 shows the state transition diagram.

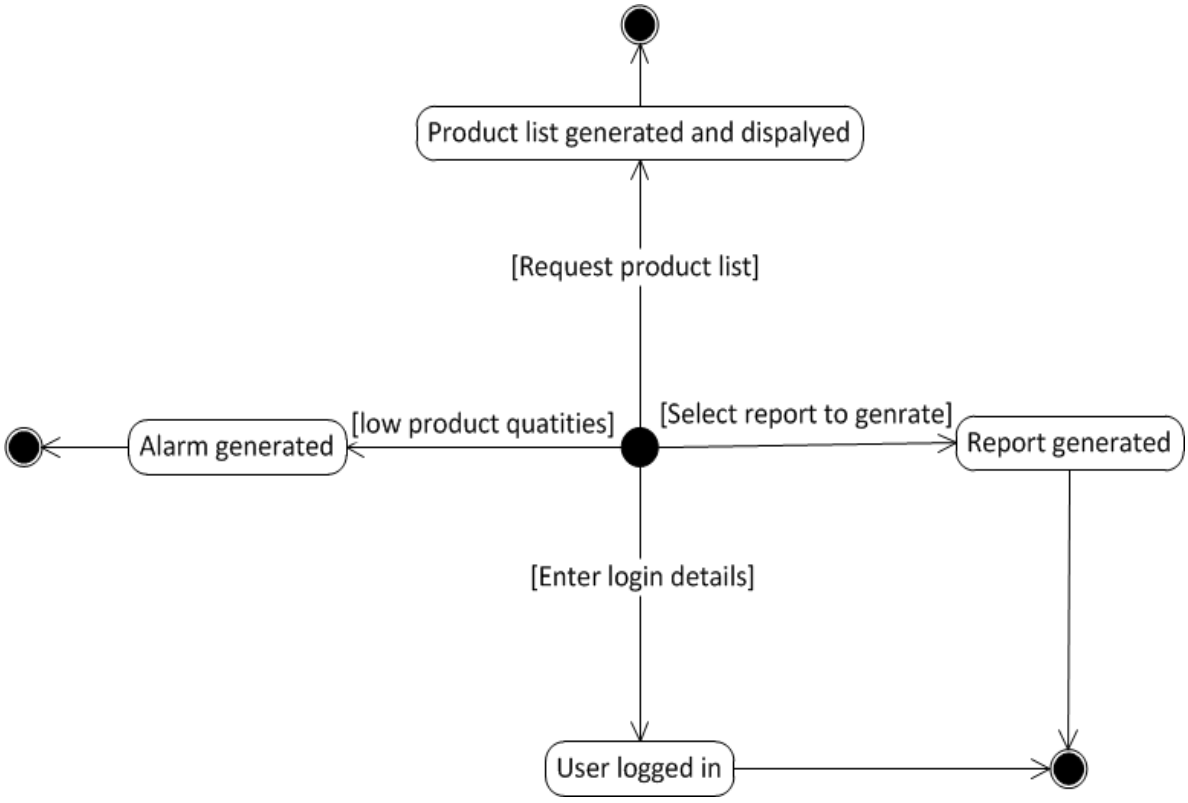


Figure 4-12 : State Transition : Multiple Operations

4.9 Presentation Model

4.9.1 Manage Inventory

The manage inventory page provides a set of links that lead to other pages such as add product, modify product and delete product. There is also a logout link and a link that leads to the main page.

Figure 4-13 shows the presentation model for manage inventory.

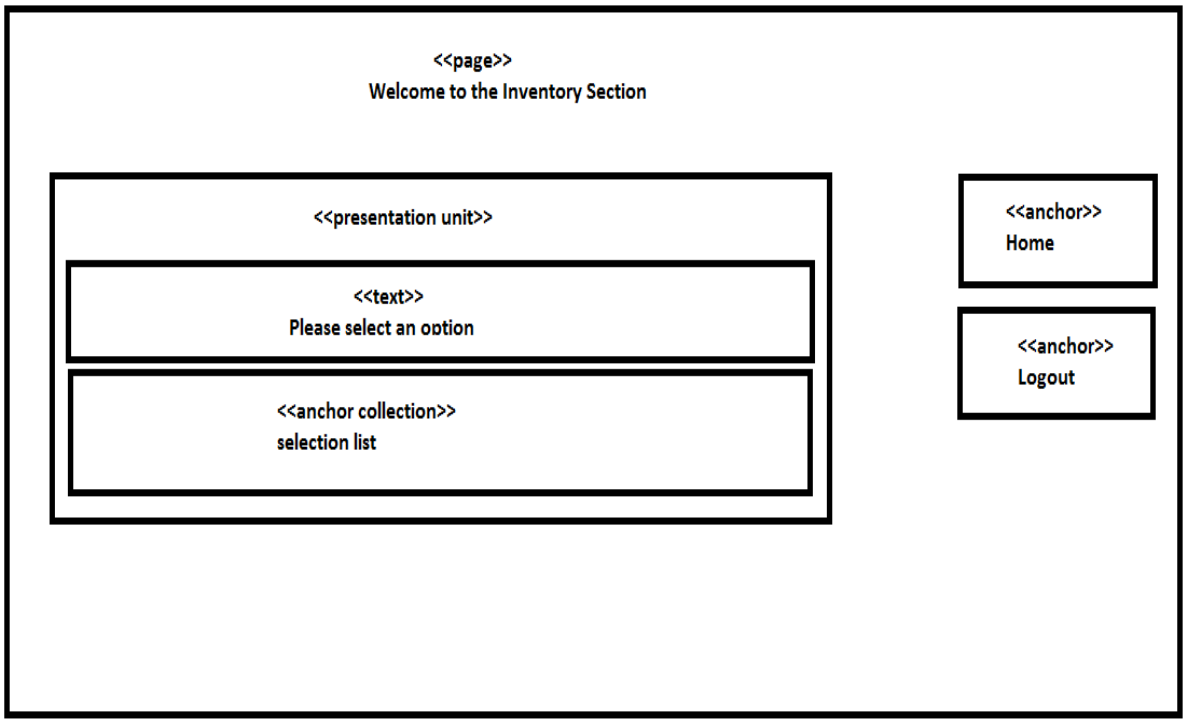


Figure 4-13 : Presentation Model : Manage Inventory

4.9.2 **Place Supply Order**

The supply order page allows the user to select a product through a drop down list and also allows the user to enter the quantity needed to order through a textbox. Then at the bottom there is a submit button that allows the user to place the order. As usual there is logout link and a link that leads to the homepage at the top right corner of the page.

Figure 4-14 shows the presentation model for place supply order.

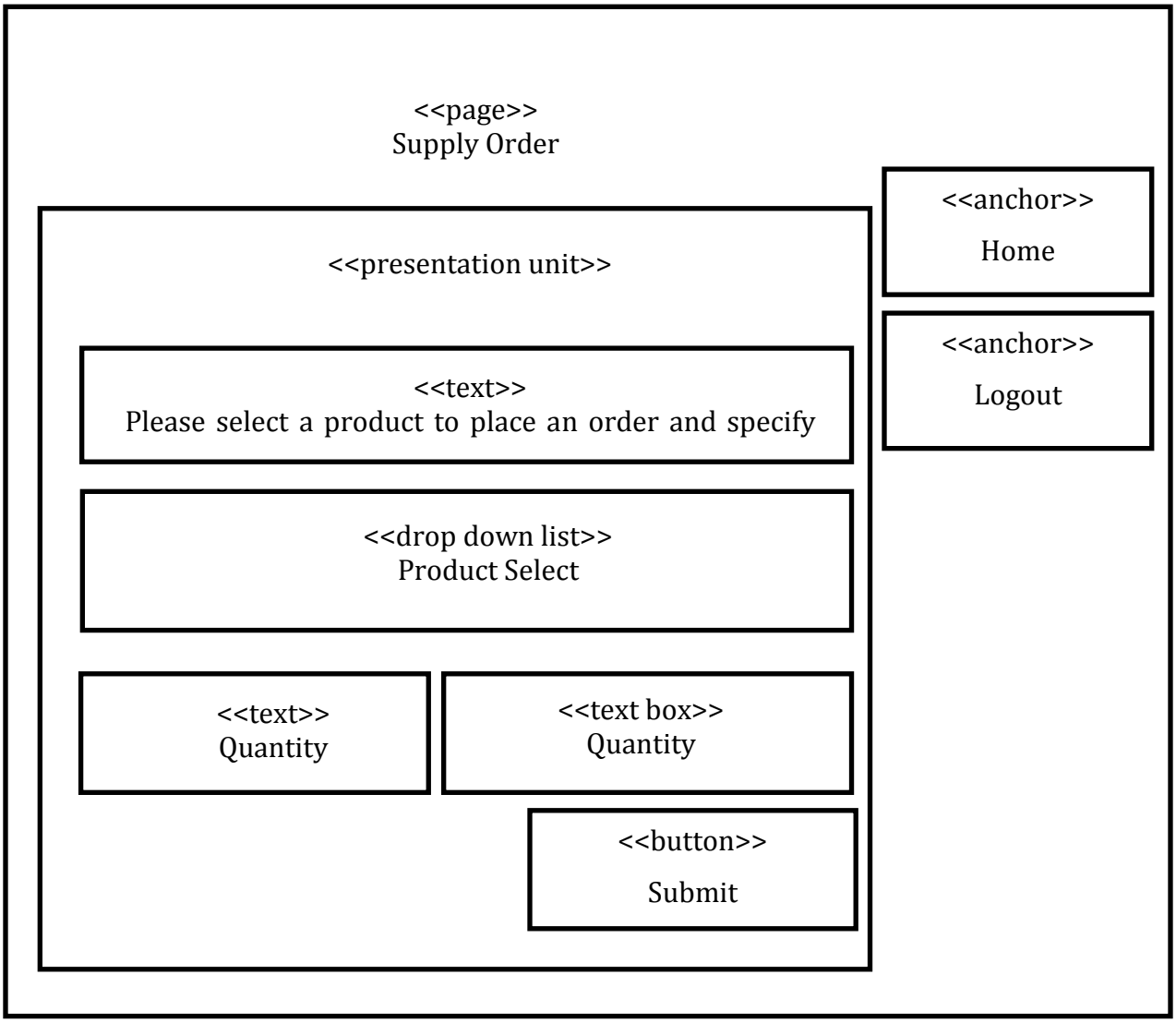


Figure 4-14 : Presentation Model : Place Order

4.9.3 **View product list**

This page initially shows the available products and their details in a tabular form. The user has the option to search for a certain product by entering its name in the textbox provided.

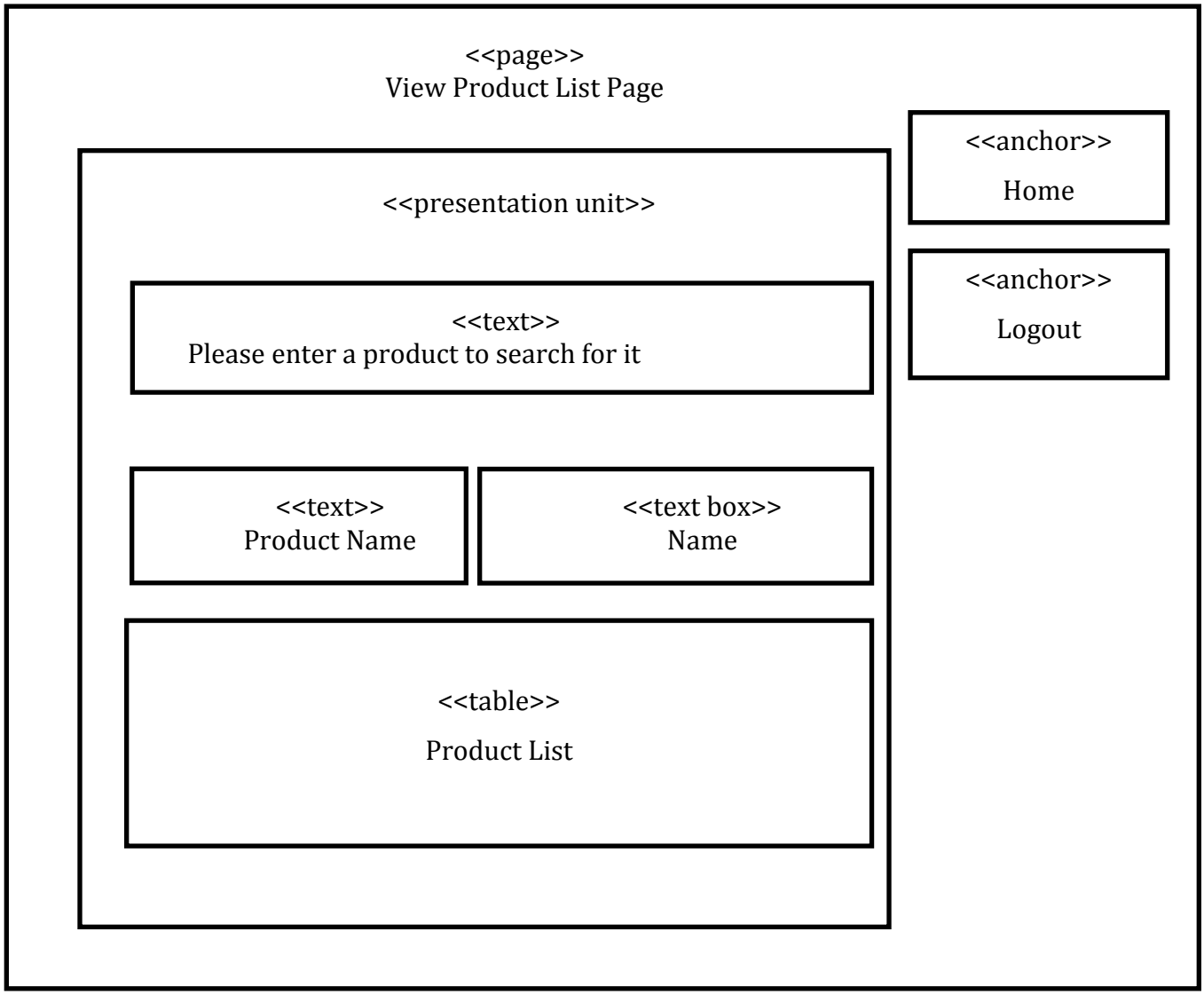


Figure 4-15 : Presentation Model : View Product List

4.10 Navigational Model

The navigational model shows the different paths available to the user when he is surfing on the website.

4.10.1 Hyperlink Model 1

The below hyperlink model shows the pages that can be visited from the main page that include the login page, the place order page, the product details page and so on. All the pages also lead back to the main page.

Figure 4-16 shows this model.

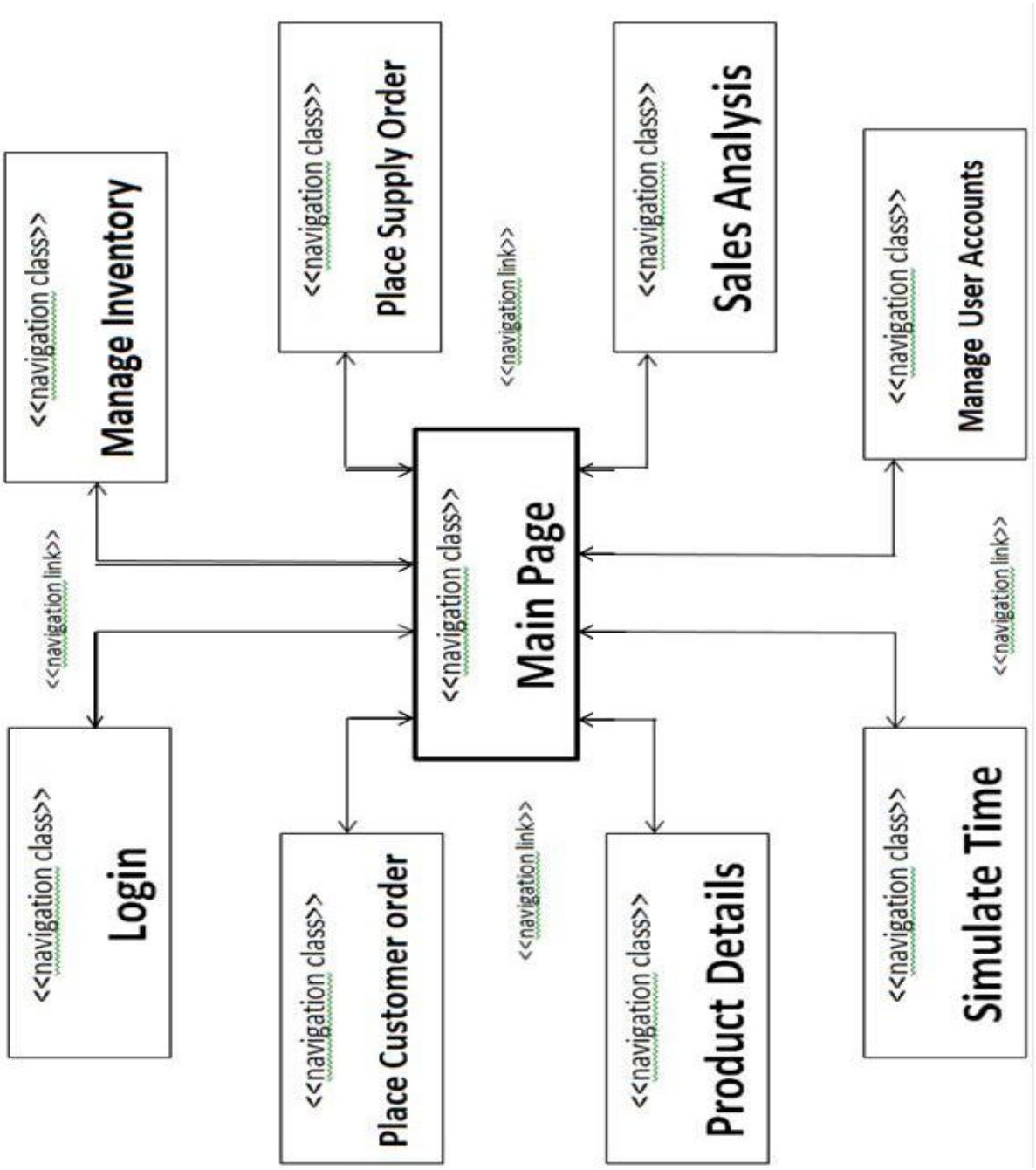


Figure 4-16 : Hyperlink Model 1

4.10.2 **Hyperlink Model 2**

This hyperlink model is a continuation of the first one and it shows the other pages that are linked to the main page and it also shows that we can go back to the main page from these pages. The pages include, generate reports, invoice details page and so on.

Figure 4-17 explains this model.

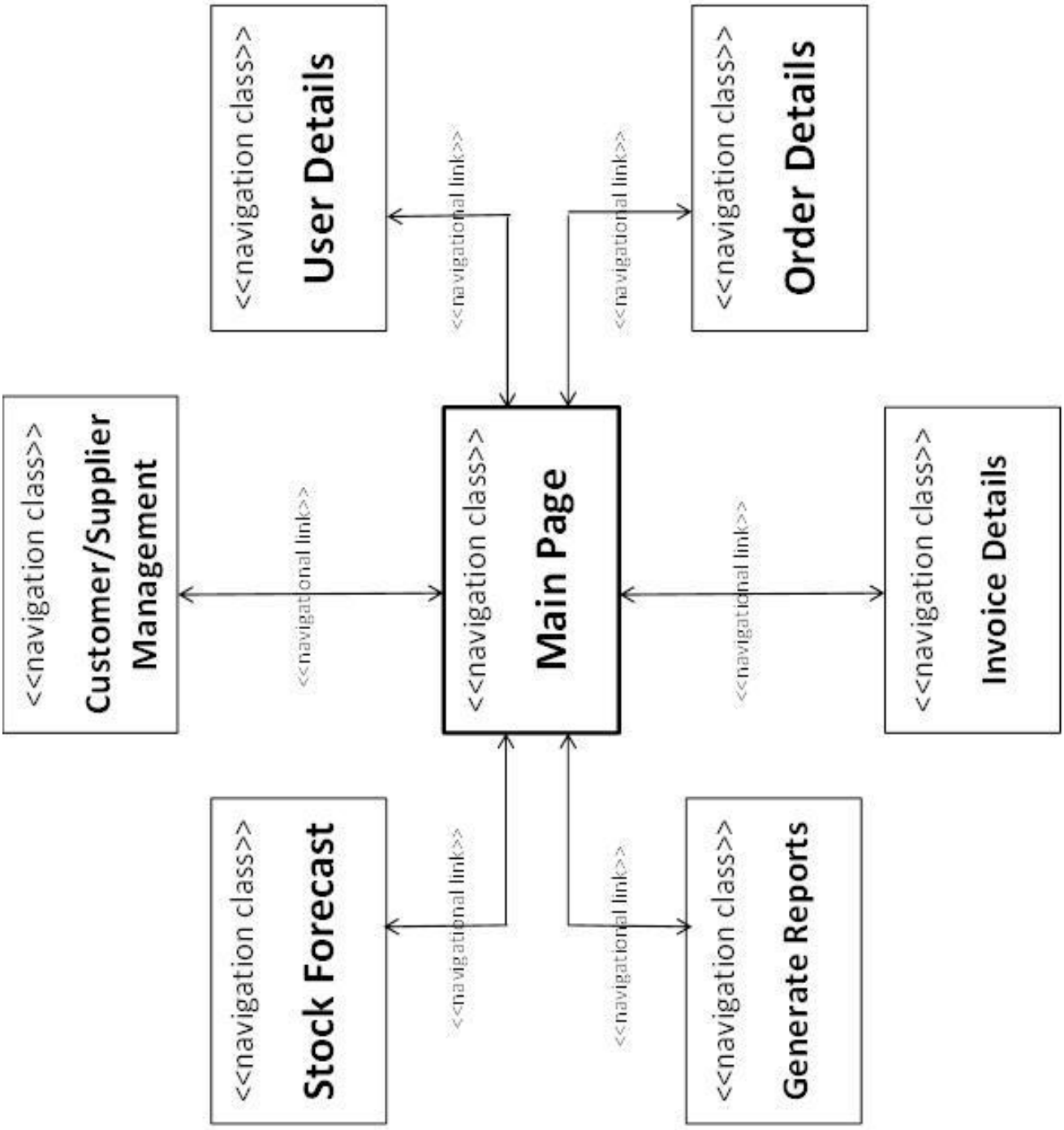


Figure 4-17 : Hyperlink Model 2

4.11 Summary

To conclude, this chapter described the system architecture and design of both the android and web-based system. Designs of major system activities were shown to give the reader a comprehensive overview of the entire system. The designs were made keeping in mind the best and most effective solution that was available at the time.

CHAPTER 5:

SYSTEM IMPLEMENTATION

5. System Implementation

5.1 Introduction

This chapter deals with the specific implementation details of our system. From technologies to system modules and system interfaces, all of these items are covered in this section. The use of web services in both the web and android system has been explained in detail and their advantages become more apparent. The usage of both the systems has been explained with the help of screenshots for better understanding. The implementation details that go along with each web page are explained along with the system usage.

5.2 Technologies Used

The technologies used include HTML[12] for web presentation, JavaScript[13] for client side logic, CSS[14] for web design, JSP[15] for server side logic, Android[16] for mobile application development. Glassfish[17] and Tomcat[18] servers are used for the Web and Android systems respectively. MySQL[19] was used as the database server and web services were used for inter-system communication.

5.3 Servers and Deployment

The Web-based system is developed in JSP and client side technologies, like JavaScript, and was deployed on Glassfish server. The Android based system is deployed on the Android device and uses Apache Tomcat to interact with web services. The benefit of using two different servers is that if one goes down, the

other is still available. The Android device communicates with the server through WIFI.

5.4 Database

We have used MySQL as our database and the Web and Android system of our organization communicate with the same database to keep the data consistent. The supplier and customer's organization each have their own databases and systems as well for that matter.

5.5 Web and Android Clients

To access the functionalities of our system, there are two options, one through any Web browser and the other through an Android device which has the Android application installed on it.

5.6 Modules of the Project

The system has been decomposed into a number of modules to help maintain the code and achieve modifiability. Details of some of the important modules is given as follows.

5.6.1 Inventory Management Module

The module helps in maintaining inventory level of raw materials and products. Also administrators can add/delete/modify and view product details.

5.6.2 **Order Management Module**

The module helps in generation of purchase orders of raw material from suppliers and sale order of finished products by customers. Users can also view sale and purchase orders. Orders can be tracked and updated as well as the status of ordered products.

5.6.3 **Reporting Generation Module**

The module helps in generating different types of reports such as order, inventory, sales and expenditure reports. These reports show the details about all the individual entities.

5.6.4 **Stock Forecasting Module**

The module gives the forecasted product quantities and amounts based on past data.

5.6.5 **Sales Pattern Identification**

This feature identifies different sales patterns over periods of time such as highest and lowest selling products as well as the total sales and expenditures.

5.6.6 **User accounts management Module**

This module allows the admin to add, modify and delete user accounts. Administrators can also view existing users and search for them.

5.6.7 **Mobile Inventory Management and Order Placement**

This feature allows administrators to scan mobile barcodes and update the inventory or place orders on the move among other important functions

5.6.8 **Invoice Management**

This module is responsible for generating invoices when orders are placed and users can view existing invoices using this feature as well.

5.6.9 **Customer/Supplier Management**

This module helps administrators in managing customers and suppliers and keep record of details relating to them.

5.7 Web Services Usage in the Web-based System

Web Services played a vital role in the integration of the operations of multiple supply chains. By using web services we efficiently and transparently communicated the requests between different organizations.

Figure 5-1 below explains how a web service operates:

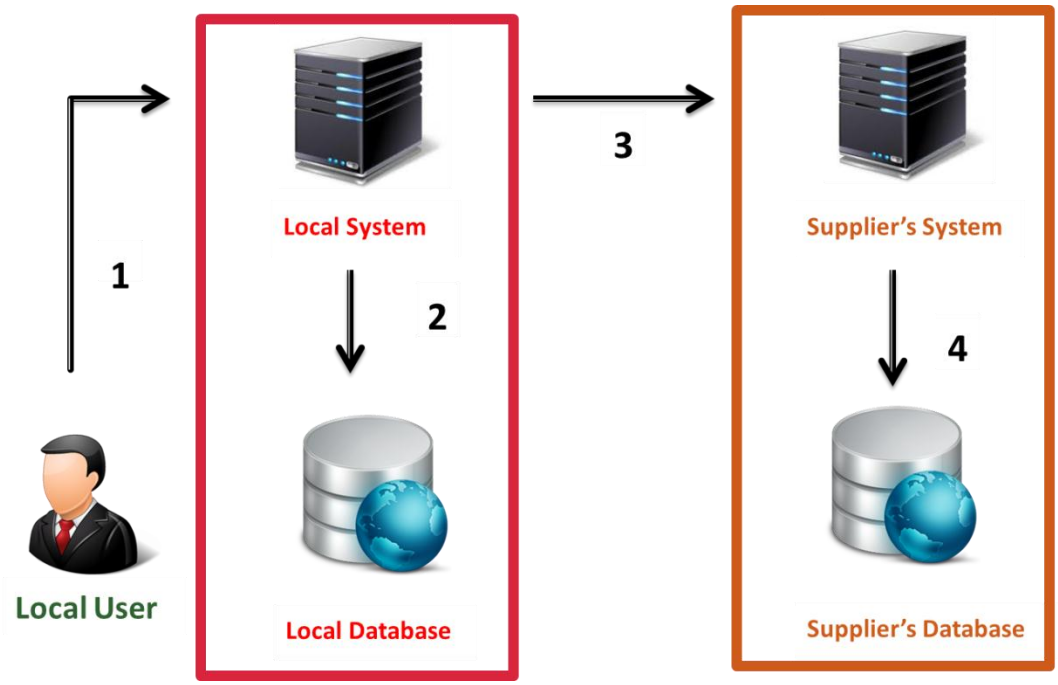


Figure 5-1 : Web Services Implementation

Figure 5-2 shows the different web services that have been used in our web-based system.

Figure 5-2 : Web Services Operations (Web-based)

The description of each of the web services deployed is given in the following sections.

5.7.1 **Place Order Web Service**

When a purchase order is placed in a customer's system, the order is automatically transferred to the supplier's system so both the customer's and supplier's systems are updated.

5.7.2 **Update Order Status Web service**

When the supplier updates a sale order's status, the customer's system is also updated of that change.

5.7.3 **Update Ordered Product Status Web Service**

When the supplier updates an ordered product's status, the customer's system is also updated of that change.

5.7.4 **Update Supplier Details Web Service**

When the supplier updates its company details, those details are transported to the customer transparently using web services.

5.7.5 **Manage Supplied Products Details Web Service**

When a supplier updates its inventory, its customer is also updated of that new change.

5.7.6 **Delete Order Web Service**

When a customer cancels a purchase order, the supplier's database is also updated of that change.

5.8 **Web Services Usage in the Android System**

In the android system, web services are used for a different purpose. Since android is unable to communicate with the database directly, it needs web services to store and retrieve data from the database. Web services also perform the functionality of different operations involved.

Figure 5-3 below shows how the data is transferred between the android device and the database:

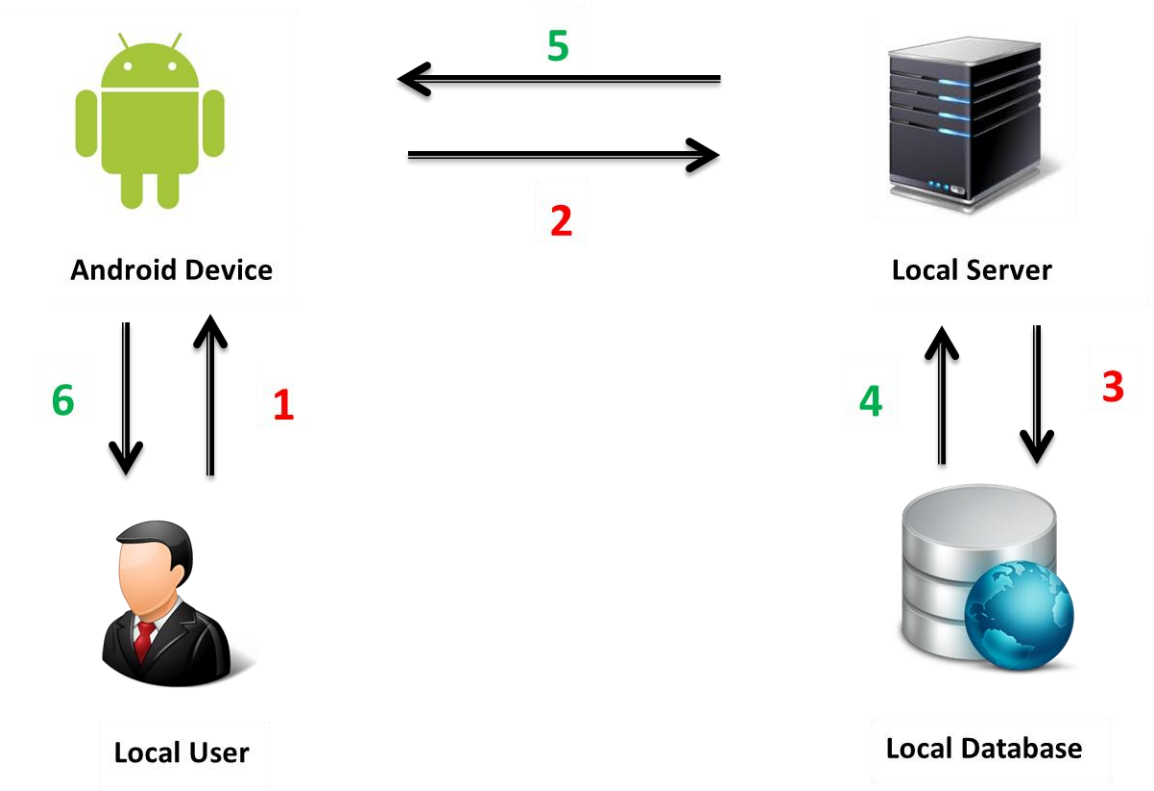


Figure 5-3 : Web Services Flow (Android)

Figure 5-4 shows the different operations that the android device performs that require database access:

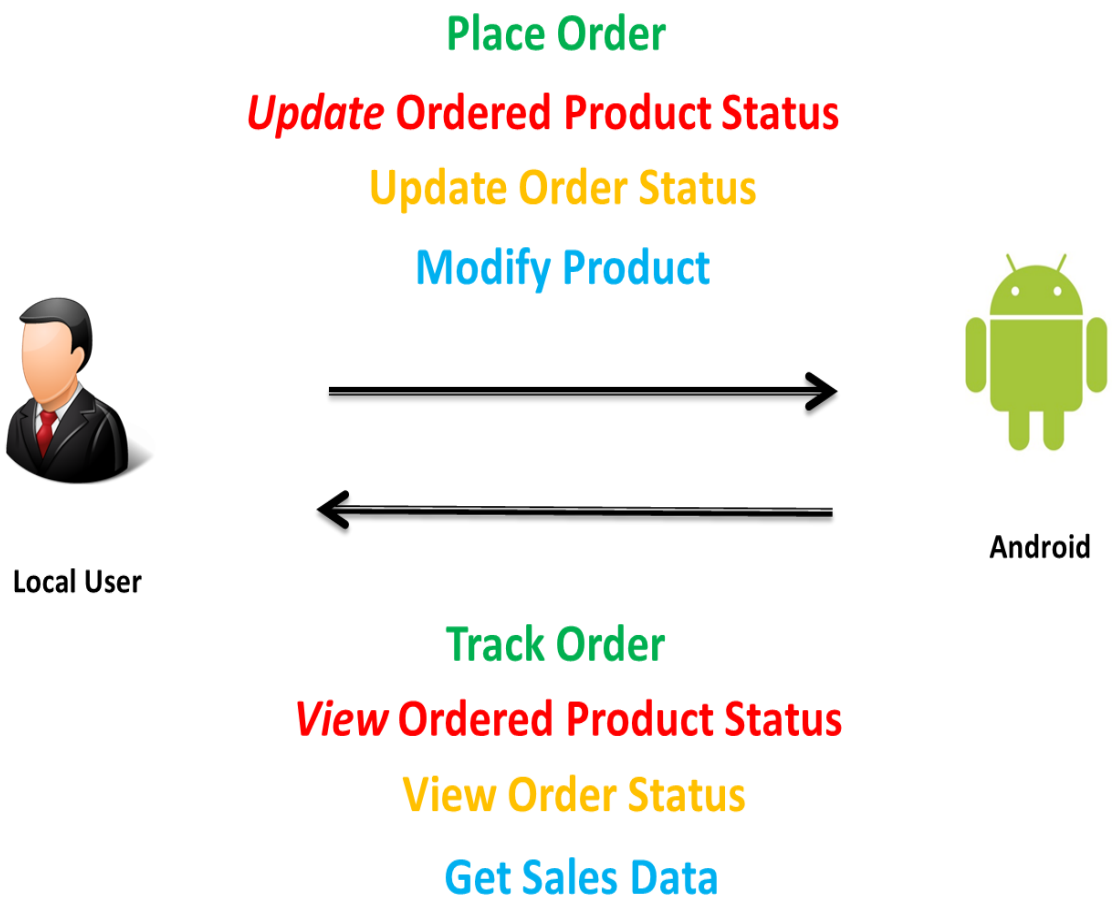


Figure 5-4 : Web Services Operations (Android)

5.9 Details of the Web-based System

To explain the system, we will follow a usage scenario and explain the system using screen shots. **Only some of the important operations are explained.**

5.9.1 User Roles

There are a few user roles that have been defined in our system. Each user role has been assigned its rights and can only perform the appropriate functionalities. The user roles include a SuperUser who has access to all the system operations and then we have a manager who can view orders, sales details and perform stock forecasting. Then we have an administrator who has the ability to manage inventories, users, supplier and customer details, company details. We also have a role of a normal user who can place orders and update order statuses and view sales details. The normal user can also perform stock forecasting.

The operations described below are given from the perspective of a SuperUser.

5.9.2 Navigation Bar

First of all, the navigation bar is showed below. This bar is displayed on all the web pages to navigate between different pages:

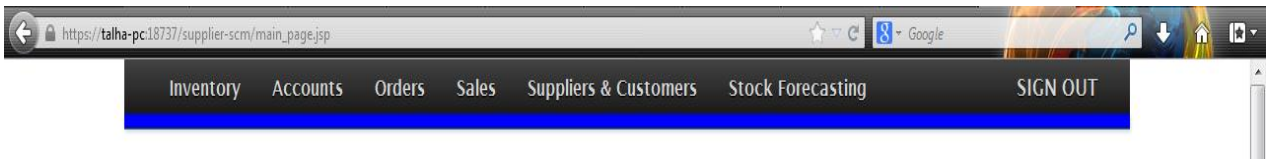


Figure 5-5 : Navigation Bar

Using this navigation bar we can visit the inventory, accounts, orders sections and so on.

5.9.3 **Login**

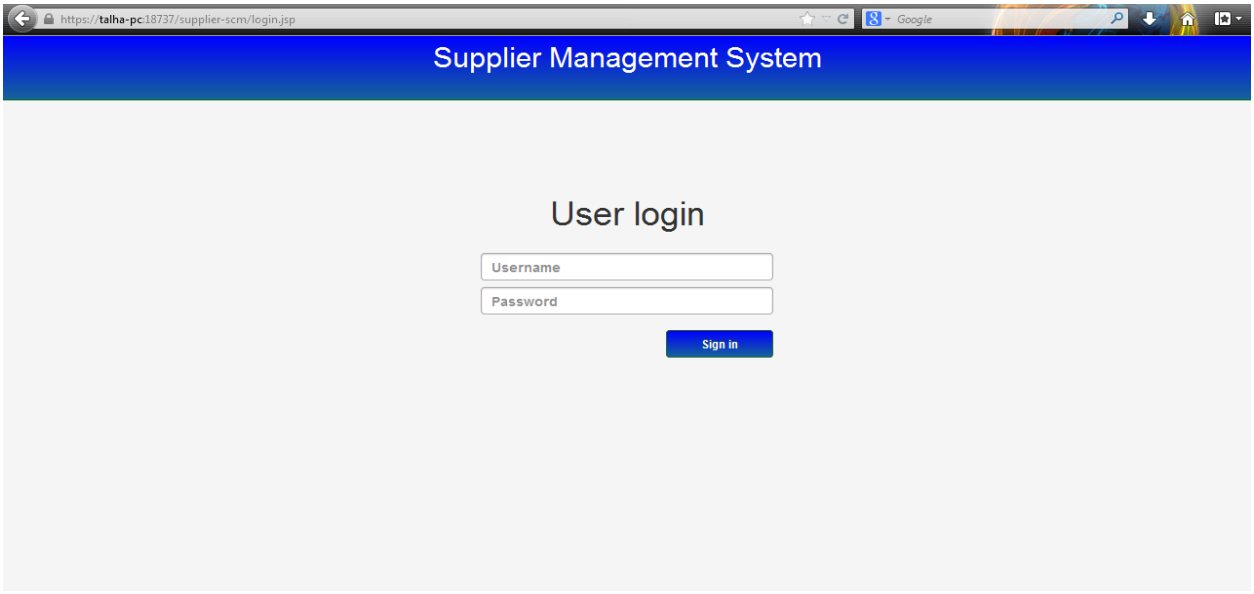
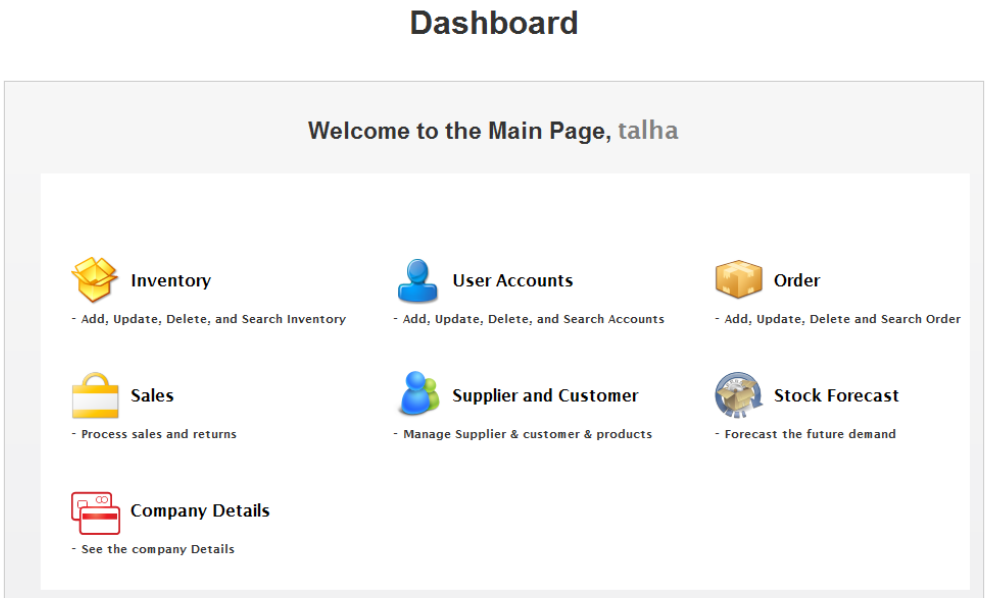


Figure 5-6 : Login Page (Web)

The login credentials are verified from the database upon login.

5.9.4 **The Dashboard**

On the main page we have icons through which we can navigate to different sections. These icons change according to the user logged in.



When we scroll down we get two blocks side by side, one showing any alerts, such as low product quantities (when any quantity reaches below the set threshold) and the other showing the latest orders and their statuses (the latest five order updates).

Figure 5-8 : Latest Orders

After this as we go further down, we have to charts displaying sales and expenditures amount of different months.(based on the orders placed in different months)

Figure 5-9 shows the charts.

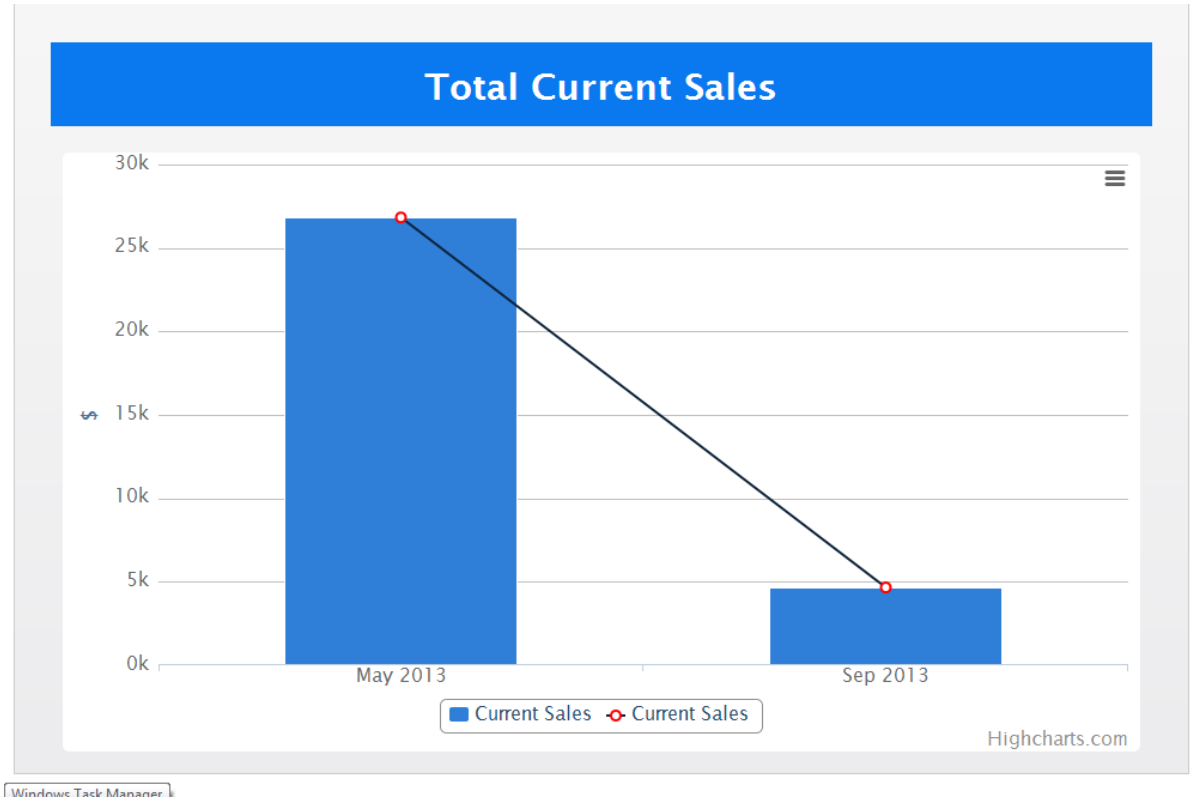


Figure 5-9 : Total Current Sales

Finally, the last thing on the main page is the latest sales details:

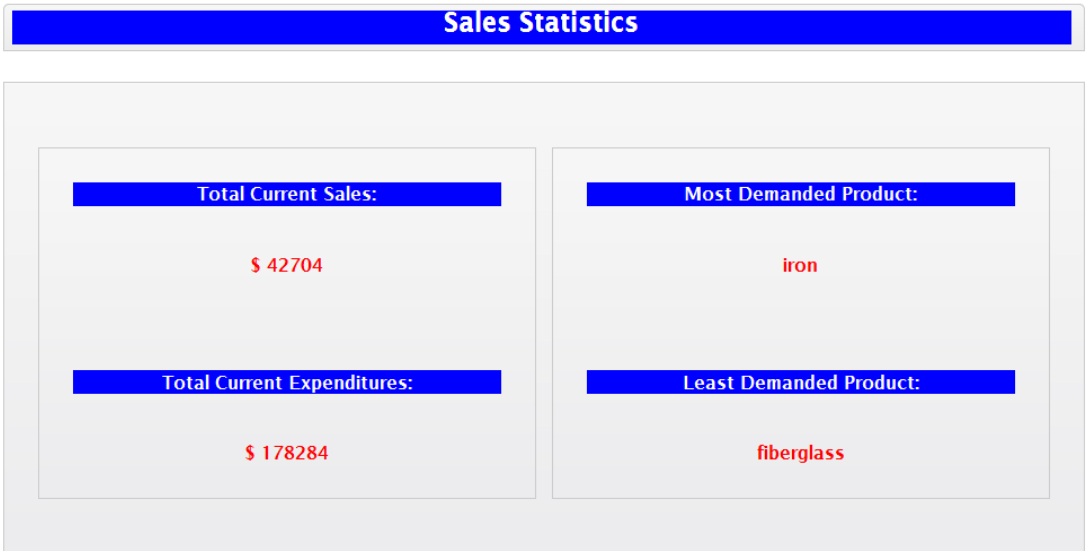


Figure 5-10 : Sales Statistics

The total sales and expenditures is found by adding the total product demand and product expenditures respectively. The most and least demanded product is found by checking which product has the highest and least demand quantity.

5.9.5 **Inventory Section**

When we visit the inventory section, we are shown the existing products in our database and as well as the options to add, edit, delete and search products.

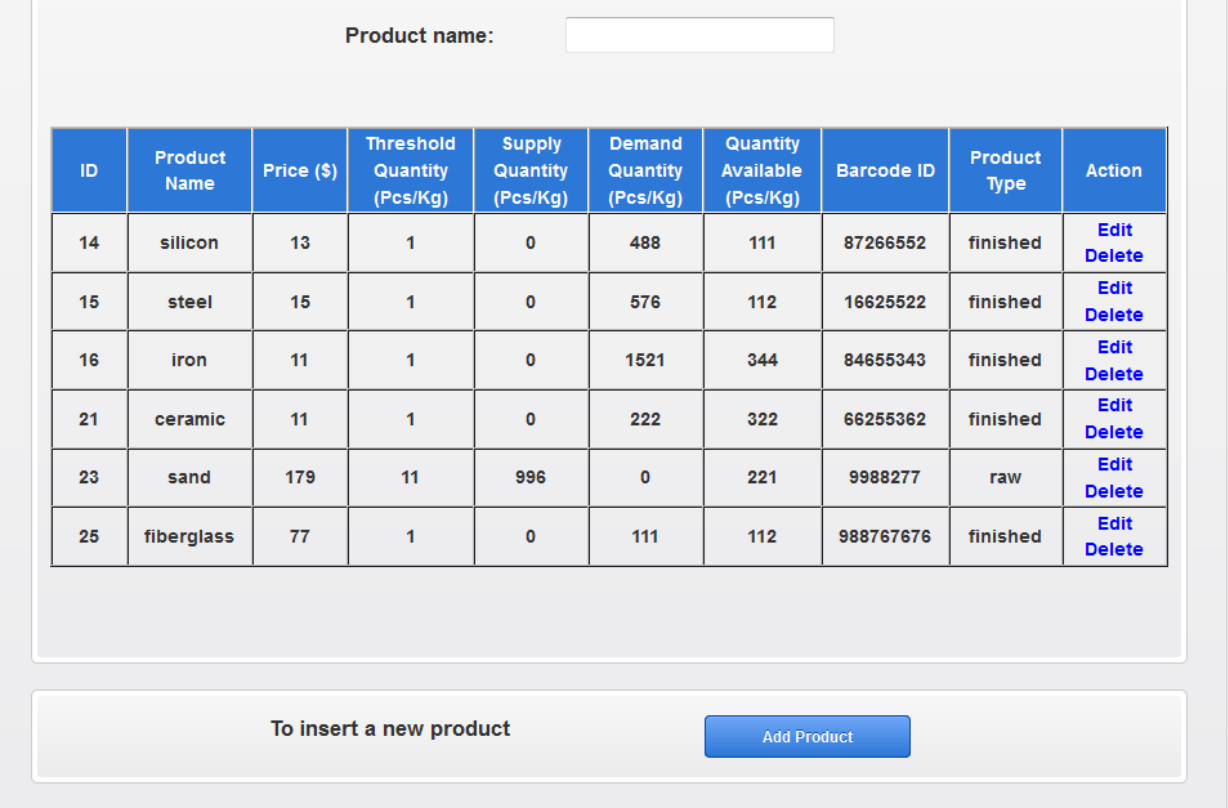


Figure 5-11 : Manage Inventory

We can also edit a product and the interface for that web page is:

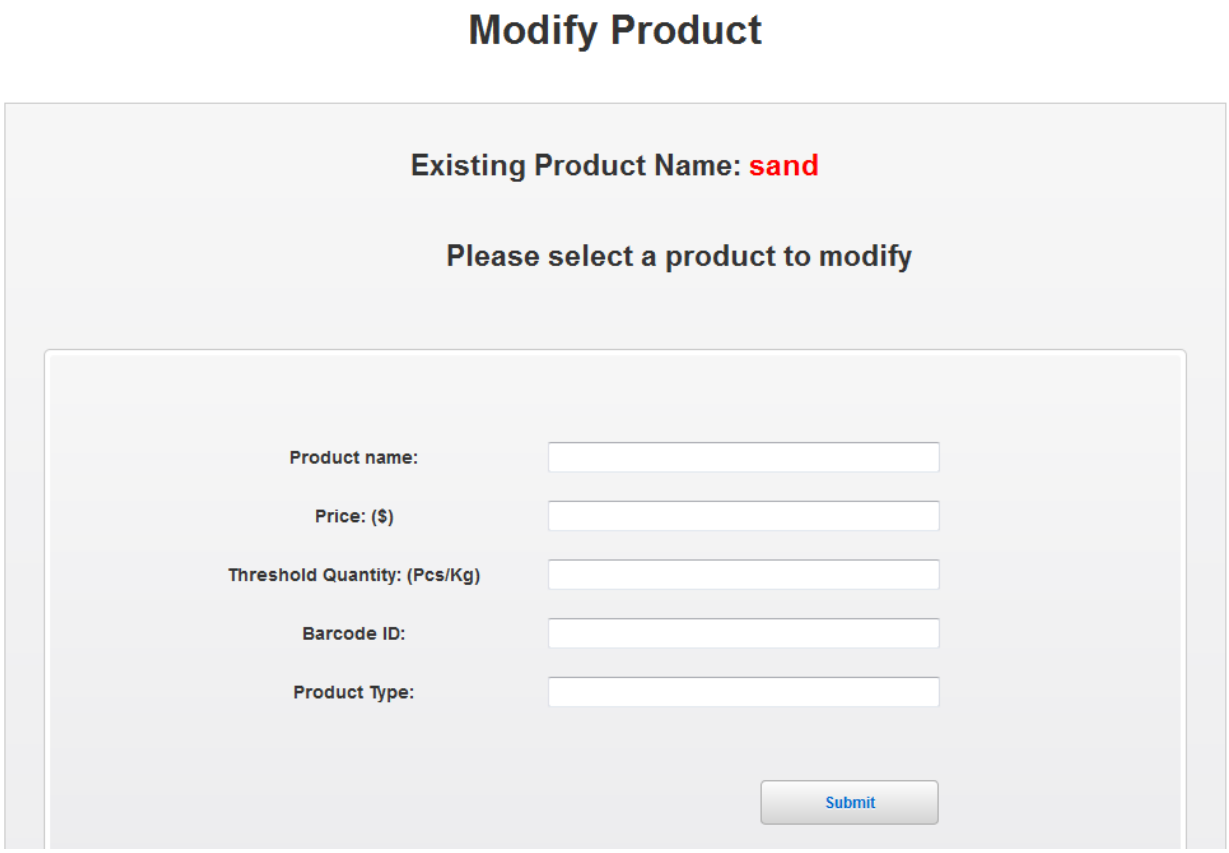


Figure 5-12 : Modify Product

Here you can enter new product details and submit to change those details.

5.9.6 **Orders Section**

When we visit the orders section, we are shown with a list of options that we are able to perform.

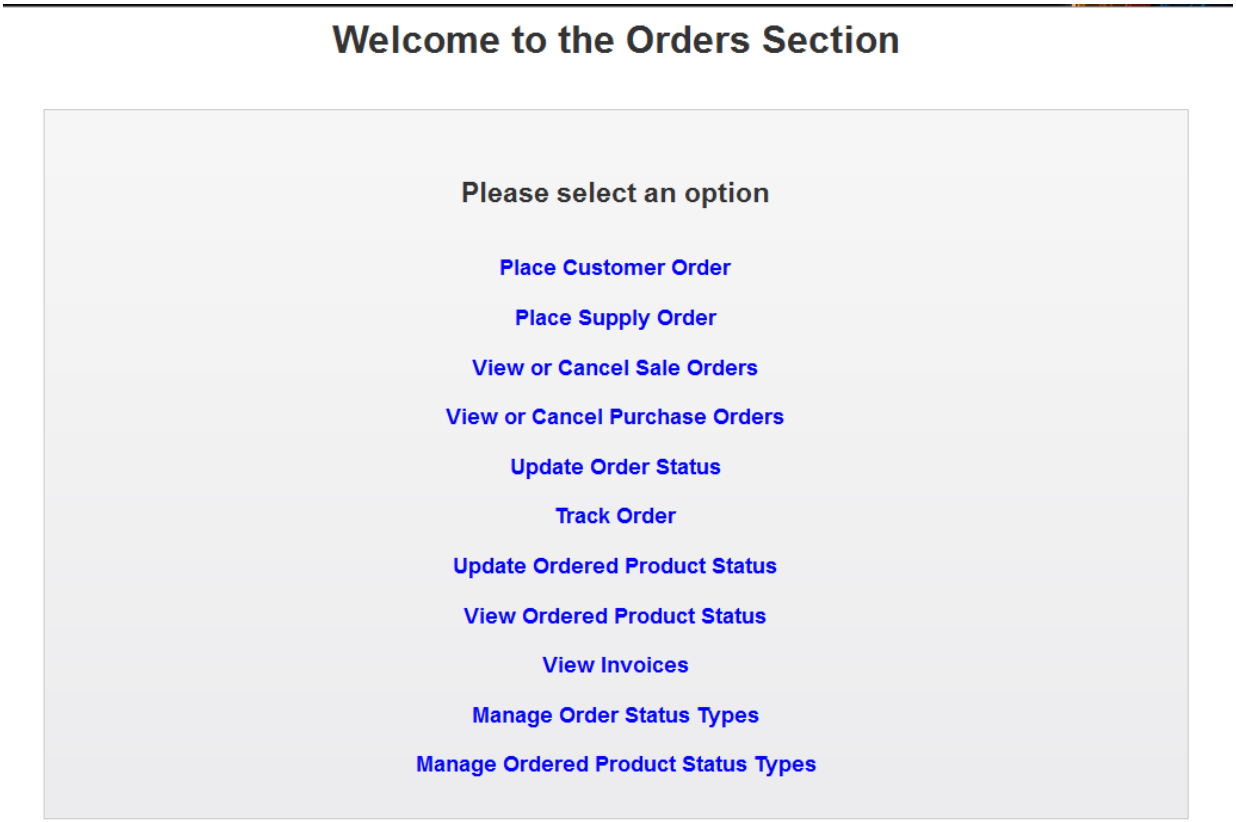


Figure 5-13 : Order Section

5.9.6.1 Place Order

To place an order we can visit the appropriate place order page.

Say we visit the Place Supply Order page:

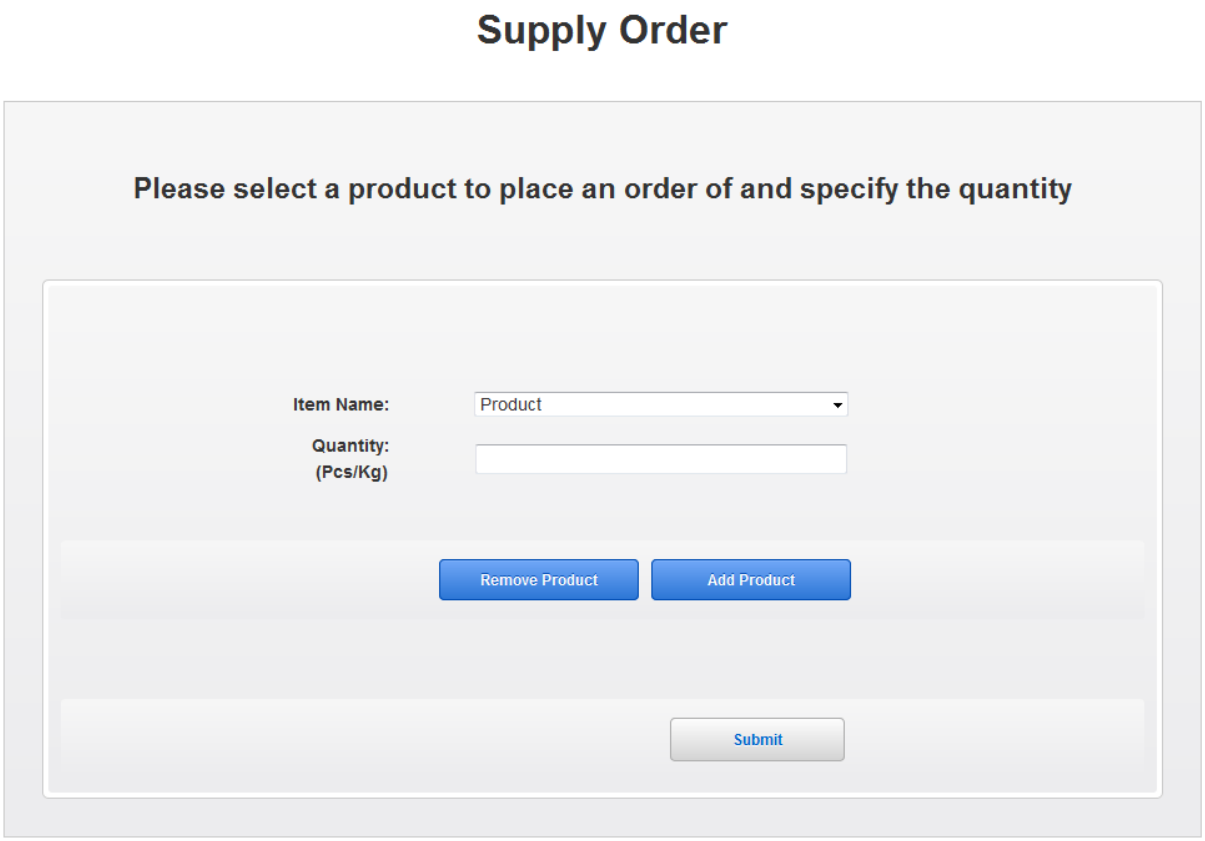


Figure 5-14 : Place Supply Order

Now here the user can choose the different products and their quantities that need to be ordered.

When he submits the order, the system automatically generates an order ID, as well as calculates the order amount and date to deliver. All the details are added to the appropriate databases and the supplier's system is updated of the new order as well as an email that is sent to him.

5.9.6.2 Update and Track Orders

A user can update the status of existing orders.

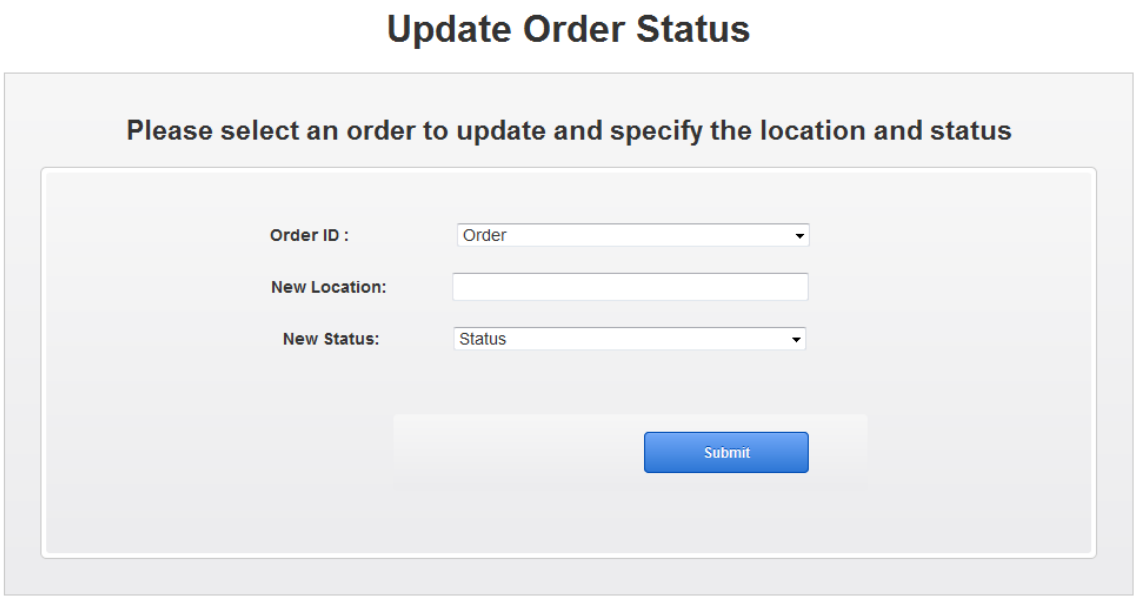


Figure 5-15 : Update Order Status

The user enters the new location and status of the existing order and the system performs the update.

To track an order:

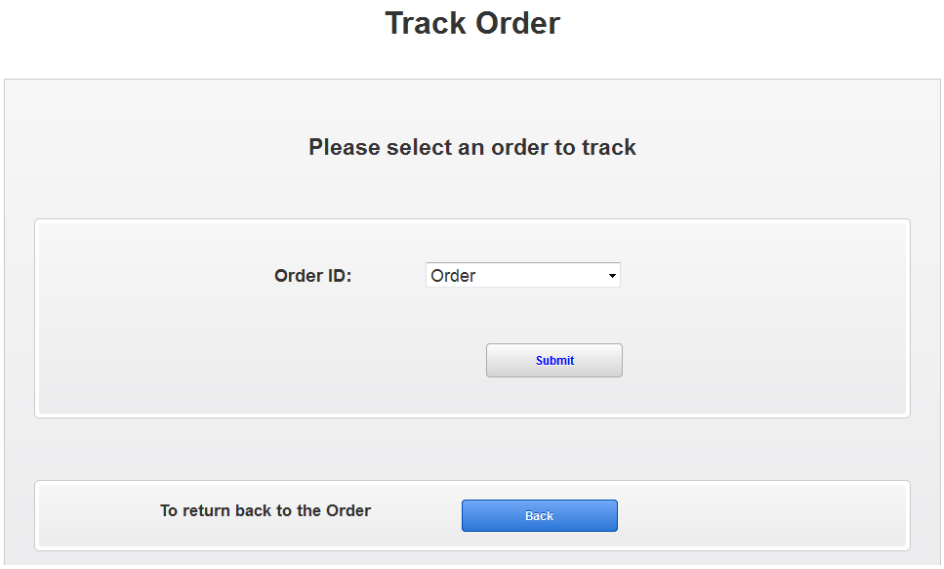


Figure 5-16 : Track Order

The user selects the required order ID and the system retrieves the Order Details:

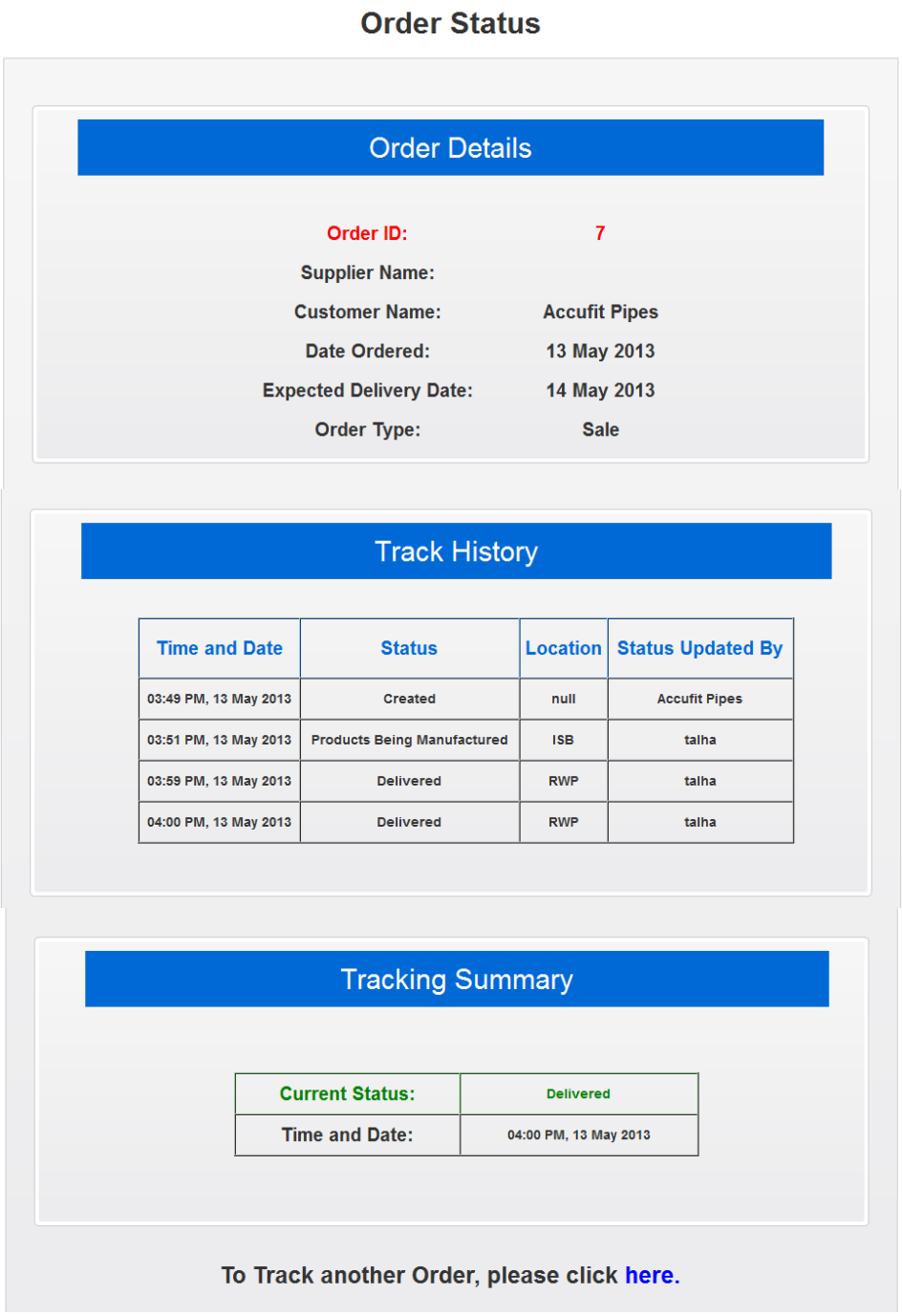


Figure 5-17 : Order Status

5.9.7 **Sales Section**

5.9.7.1 Product Sales and Expenditures

Product Sales and expenditures can be viewed in the form of graphs as well as reports.

Product Sales and expenditures Graphs:

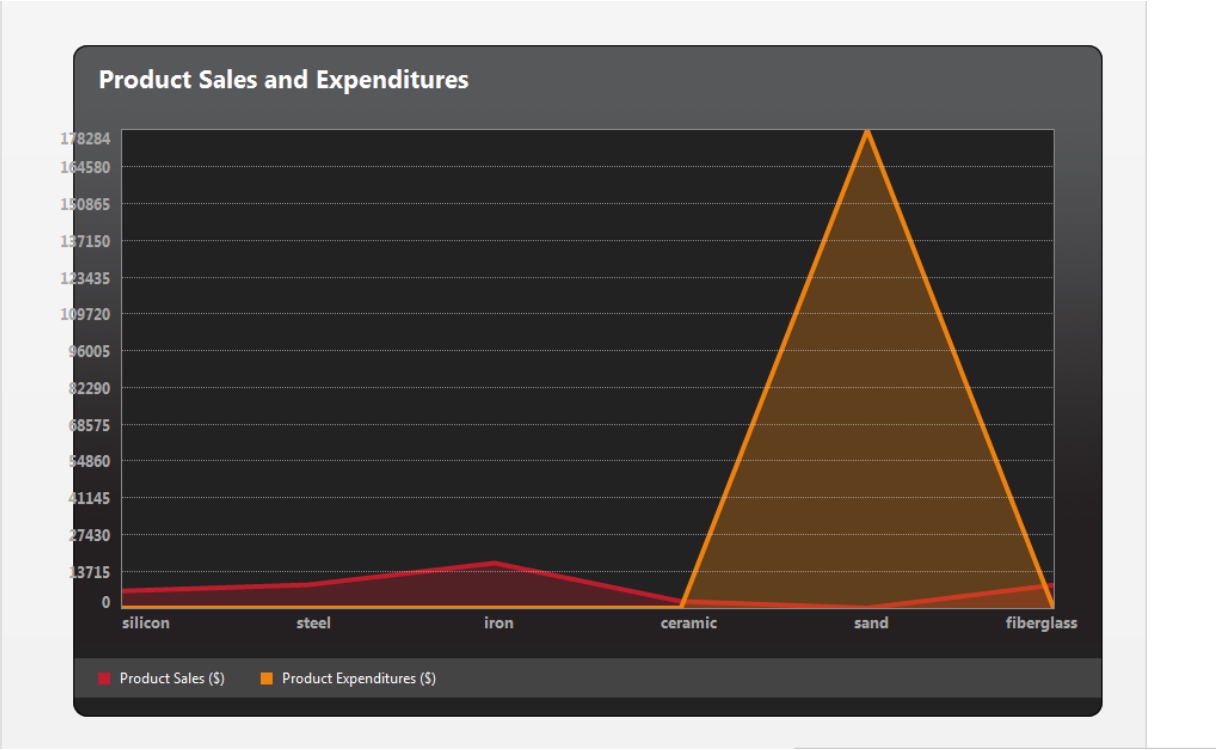


Figure 5-18 : Product Sales and Expenditures

This graph is generated by a JQuery Library called Visualize. The products sales and expenditure details are gathered from the database and passed on to this library's function to generate these charts.

5.9.8 **Stock Forecasting Section**

In this section, users are able to view a product's previous sale history and the system also generates a projected sales graph based on that past data.

When the user selects a product, the system creates a table that shows that product's sales in past months:

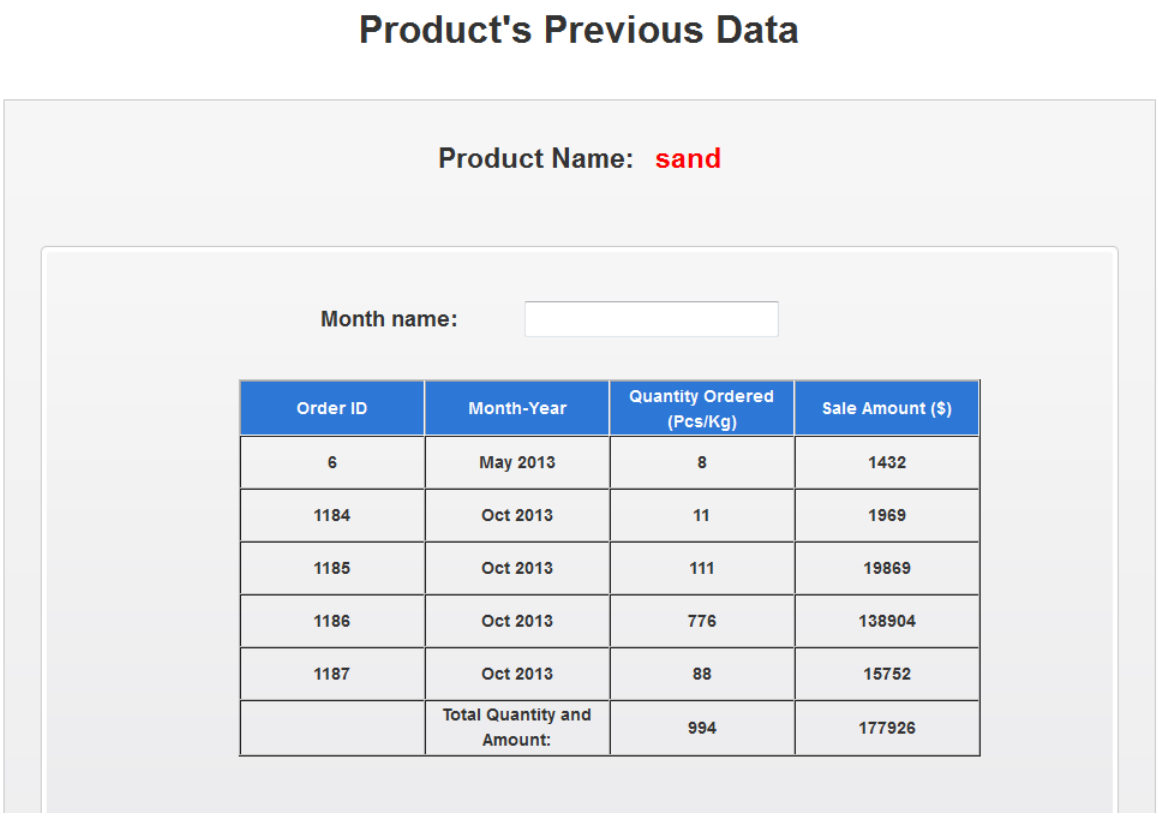


Figure 5-19 : Product Sale History

Then the user can choose an option to either view the future sale amount or quantity, say in this case he selects the projected quantity option:

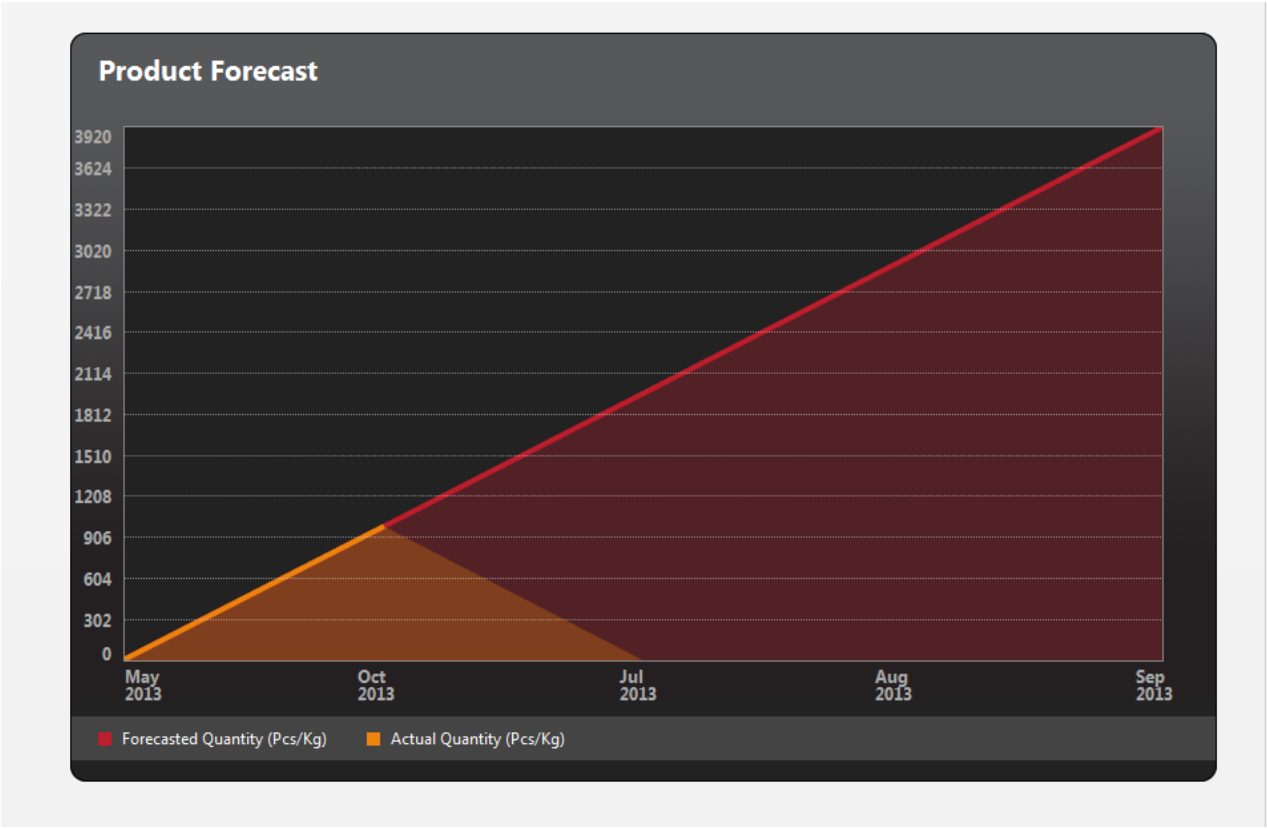


Figure 5-20 : Product Quantity Forecast

The forecast is generated by extending the graph of the sales of previous months and extrapolating it for the future months. The technique used is linear regression also known as finding the line of best fit[20].

Further usage details on both, the web and android, systems is available in the user manual located in appendix A of this document.

CHAPTER 6:

TESTING AND RESULTS ANALYSIS

6. Testing and Results Analysis

6.1 Introduction

Testing involves checking whether the system meets the requirements that were established in the beginning of this software's lifecycle.

In this section we will use functional testing[21] to check whether our system performs as expected.

6.2 Testing Technique

Functional testing typically involves five steps:

1. The identification of functions that the software is expected to perform.

2. The creation of input data based on the function's specifications.

3. The determination of output based on the function's specifications.

4. The execution of the test case.

5. The comparison of actual and expected outputs.

Functional Test Cases & Their Execution: The following test cases were created and executed against the application.

6.3 Login

Table 6-1 : Login Test Case

Input	Correct Username and Password.
Steps	1) Visit the login page. 2) Enter the username and password and submit the page.
Expected Output	Login should be successful.
Actual Output	Login is successful.
Test result	Pass.

6.4 Add Product

Table 6-2 : Add Product Test Case

Input	New Product Details (name, price, threshold quantity, product type, barcode ID).
Steps	1) Visit the inventory section. 2) Visit the add product page. 3) Enter the new product details and submit.
Expected Output	Update should be successful.
Actual Output	Update is successful.
Test result	Pass.

6.5 **Delete Product**

Table 6-3 : Delete Product Test Case

Input	N/A.
Steps	1) Visit the inventory section. 2) Visit the manage inventory page. 3) Select the product to delete.
Expected Output	Deletion should be successful.
Actual Output	Deletion is successful.
Test result	Pass.

6.6 View User Accounts

Table 6-4 : View User Accounts Test Case

Input	N/A.
Steps	1) Visit the Accounts section. 2) Visit the manage accounts page.
Expected Output	Accounts should be displayed.
Actual Output	Accounts are displayed.
Test result	Pass.

6.7 Place Supply Order

Table 6-5 : Place Supply Order Test Case

Input	Product Names and Quantities.
Steps	1) Visit the Orders section. 2) Visit the Place Supply Order page. 3) Select product names and enter quantities and submit.
Expected Output	Order should be successfully placed.
Actual Output	Order is successfully placed.
Test result	Pass.

6.8 View Sale Orders

Table 6-6 : View Sale Orders Test Case

Input	N/A.
Steps	1) Visit the Orders section. 2) Visit the View Sales Order page.
Expected Output	Orders should be displayed.
Actual Output	Orders are displayed.
Test result	Pass.

6.9 Update Order Status

Table 6-7 : Update Order Status Test Case

Input	Order ID, New Location, New Status.
Steps	1) Visit the Orders section. 2) Visit the Update Order Status page. 3) Select the Order ID and enter the new location and select the new status. 4) Enter Submit.
Expected Output	Order should be successfully updated.
Actual Output	Order is successfully updated.
Test result	Pass.

6.10 Track Order

Table 6-8 : Track Order Test Case

Input	Order ID.
Steps	1) Visit the Orders section. 2) Visit the Track Order page. 3) Select the order ID.
Expected Output	Order details should be displayed.
Actual Output	Order details are displayed.
Test result	Pass.

6.11 View Ordered Product Status

Table 6-9 : View Ordered Product Status Test Case

Input	Order ID.
Steps	1) Visit the Orders section. 2) Visit the view ordered product status page. 3) Select the order ID.
Expected Output	Ordered product statuses should be displayed.
Actual Output	Ordered product statuses are displayed.
Test result	Pass.

6.12 View Invoices

Table 6-10 : View Invoices Test Case

Input	N/A.
Steps	1) Visit the Orders section. 2) Visit the view invoices page. 3) Select the generate invoice link of the invoice that needs to be generated.
Expected Output	Invoice should be displayed.
Actual Output	Invoice is displayed.
Test result	Pass.

6.13 View Product Sales and Expenditures

Table 6-11 : View Product Sales Test Case

Input	N/A.
Steps	1) Visit the Sales section. 2) Visit the product sales and expenditures page.
Expected Output	Product sales and expenditures should be displayed in a graph form.
Actual Output	Product sales and expenditures are displayed in a graph form.
Test result	Pass.

6.14 Customer and Supplier Analysis

Table 6-12 : Customer & Supplier Analysis Test Case

Input	N/A.
Steps	1) Visit the Sales section. 2) Visit the customer and supplier analysis page.
Expected Output	Customer and supplier sales and expenditures should be displayed in a graph form.
Actual Output	Customer and supplier sales and expenditures are displayed in a graph form.
Test result	Pass.

6.15 Add Supplier

Table 6-13 : Add Supplier Test Case

Input	New Supplier Details (name, phone, email, address, city, delivery time).
Steps	1) Visit the Suppliers and Customer section. 2) Visit the manage suppliers page. 3) Click the add supplier button. 4) Enter new supplier's details.
Expected Output	Supplier should be successfully added.
Actual Output	Supplier is successfully added.
Test result	Pass.

6.16 Add a Supplier's Products

Table 6-14 : Add a Supplier's Products Test Case

Input	Supplier name and product names.
Steps	1) Visit the Supplier and Customer section. 2) Visit the Add a supplier's product page. 3) Select suppliers and the products that he supplies. 4) Click Submit.
Expected Output	Update should be successful.
Actual Output	Update is successful.
Test result	Pass.

6.17 Stock Forecasting

Table 6-15 : Stock Forecasting Test Case

Input	Product name.
Steps	1) Visit the Stock Forecasting section. 2) Select a product. 3) Select the future product quantities/amounts.
Expected Output	Future quantities/amounts should be displayed.
Actual Output	Future quantities/amounts are displayed.
Test result	Pass.

6.18 View Company Details

Table 6-16 : View Company Details Test Case

Input	N/A.
Steps	1) Visit the Company Details link on main page.
Expected Output	Company Details should be displayed.
Actual Output	Company Details are displayed.
Test result	Pass.

6.19 View Current Sales/Expenditures

Table 6-17 : View Current Sales Data Test Case

Input	N/A.
Steps	1) Visit the main page.
Expected Output	The current sales/expenditures graphs should be displayed.
Actual Output	The current sales/expenditures graphs are displayed.
Test result	Pass.

6.20 Summary

All the test results are positive and therefore our system is working as expected and all the requirements are met accordingly.

CHAPTER 7:

CONCLUSION AND FUTURE WORK

7. Conclusion and Future Work

7.1 Introduction

So far, important system requirements and features and important design decision related to development of an integrated supply chain management system have been discussed. Moreover, it has been shown how this system has been developed and its usage has been briefly explained. Testing techniques used and the result have also been shown in chapter 6. This chapter concludes this report by highlighting our reflections about this project and future work to improve this work.

7.2 Conclusion

There are many existing SCM systems which are much advanced than ours and which include many other functions and facilities that are offered. Our aim was to develop the basic functionalities of SCM systems and not only enhance them but also apply our own twist on them. We have used our own algorithms and our own techniques when developing the functions at the same time not deviating from the standard protocols.

This system has been implemented on multiple platforms and its scalability has been tested by developing mobile application on Android platform. This provided multiple accessibility modes to different types of users.

Another advantage of our system is that our functions update our database and our suppliers/customers database as well transparently without any additional

operations. This substantially reduces the time required to keep all the organizations synchronized and updated.

7.3 Future Work

Despite all these advantages, there are still a lot of opportunities to make this system better and expand it so it may be able to cater for other needs as well.

The system is divided into modules and therefore it is very easy to add a new module and integrate it with the existing features if needed. We can add further operations that can be called in between organizations via web services to automate more functions that are currently done manually.

Examples of further expansion include adding a new algorithm for generating future stock quantities and amounts, adding products in bulk through CSV or excel files could also be an added option, sending SMSs to suppliers/customers on order placement/delivery, automatically placing orders when product threshold reaches a certain amount. These are all examples of further enhancements to this system.

An HR management module can be added that manages employees and their salaries and attendances. A fingerprint reader could be installed that would obtain the attendances of the employees. Connections with banks could be established to automatically issue cheques and manage finances.

SCMs are a vast field of opportunities waiting to be pursued. The list can go on and on and enhancements can keep on going making supply chains as organized and profitable as possible.

REFERENCES

[1] Wikipedia. *Enterprise resource planning* [Online].

Available: http://en.wikipedia.org/wiki/Enterprise_resource_planning

[2] Wikipedia. *Supply Chain Management*

[Online]. Available: http://en.wikipedia.org/wiki/Supply_chain_management

[3] Wikipedia. *Web Service*

[Online]. Available: http://en.wikipedia.org/wiki/Web_service

[4] Openbravo. *Openbravo*

[Online]. Available: http://www.openbravo.com

[5] Ordoro. *Ordoro*

[Online]. Available: http://www.ordoro.com

[6] OpenERP. *OpenERP*

[Online]. Available: http://www.openerp.com

[7] Oracle. *Oracle PeopleSoft Applications* [Online].

Available: http://www.oracle.com/uk/products/applications/peoplesoft-enterprise/overview/index.html

[8] SAP. *SAP Supply Chain Management* [Online].

Available: www.sap.com/lines-of-business/scm/solutions-overview.epx

[9] Wikipedia. *Multitier Architecture*
[Online]. Available: http://en.wikipedia.org/wiki/multitier_architecture

[10] Remo Objects Software. *Why Multi-Tier?*
[Online]. Available: http://www.remobjects.com/da/why-multitier.aspx

[11] Wikipedia. *Model-view-controller*
[Online]. Available: http://en.wikipedia.org/wiki/model-view-controller

[12] Wikipedia. *HTML*
[Online]. Available: https://en.wikipedia.org/wiki/HTML

[13] Wikipedia. *JavaScript*
[Online]. Available: http://en.wikipedia.org/wiki/javascript

[14] Wikipedia. *Cascading Style Sheets*
[Online]. Available: https://en.wikipedia.org/wiki/Cascading_Style_Sheets

[15] Wikipedia. *JavaServer Pages*
[Online]. Available: http://en.wikipedia.org/wiki/javaserver_pages

[16] Wikipedia. *Android (Operating System)* [Online].
Available: https://en.wikipedia.org/wiki/Android_(operating_system)

[17] Wikipedia. *GlassFish*
[Online]. Available: http://en.wikipedia.org/wiki/GlassFish

[18] Wikipedia. *Apache Tomcat*

[Online]. Available: http://en.wikipedia.org/wiki/Apache_Tomcat

[19] MySQL. *MySQL*

[Online]. Available: http://www.mysql.com/

[20] Wikipedia. *Linear Regression*

[Online]. Available: http://en.wikipedia.org/wiki/Linear_regression

[21] Wikipedia. *Functional Testing*

[Online]. Available: http://en.wikipedia.org/wiki/Functional_testing

APPENDIX A:

USER MANUAL

Appendix A : User Manual

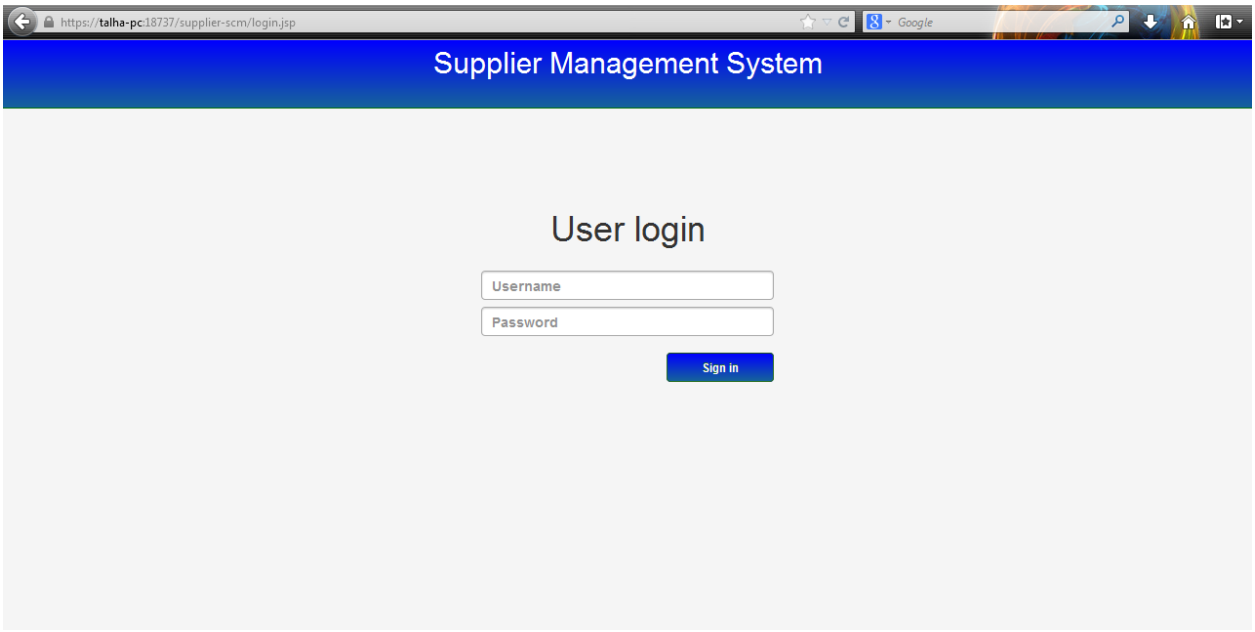
User Manual for the Web-based System

In this user manual, we will go step by step, exploring each option and helping you get around this software as easily and effectively as possible.

Lets get started.

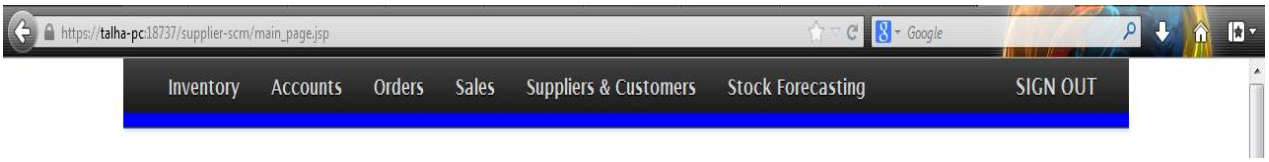
Now when you will deploy the application, the first thing you will need to do before anything else is logging in.

Login



When you provide the correct credentials, you will be successfully logged in and transferred to the dashboard.

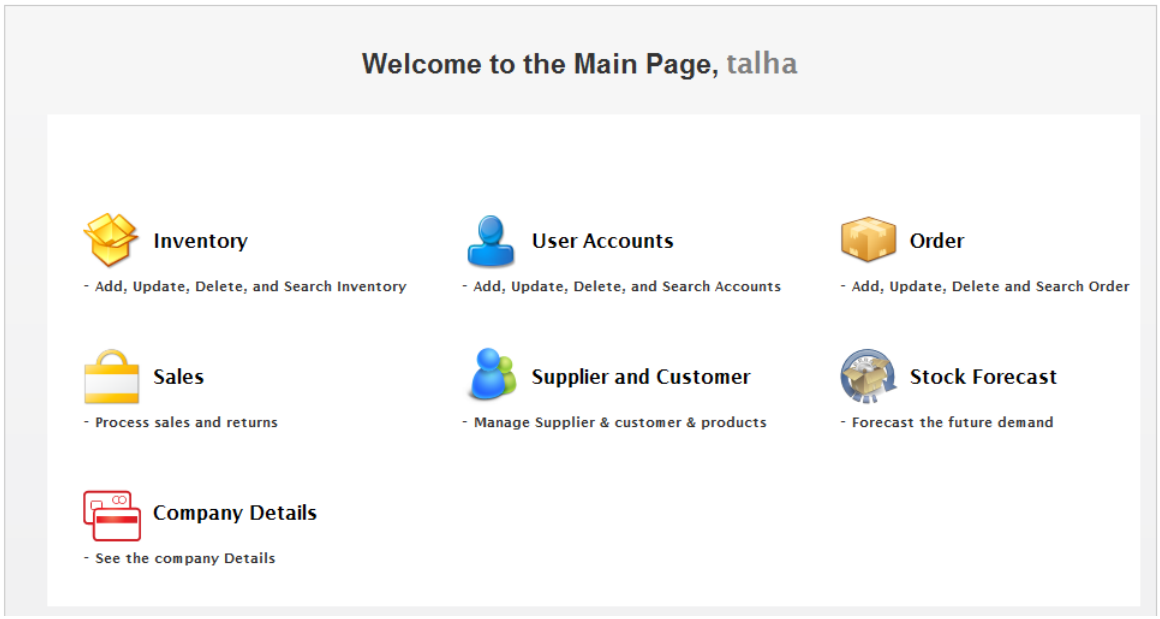
Now before we continue, let us explore the navigation bar which is showed below. This bar is displayed on all the web pages to navigate between different pages:



Using this navigation bar we can visit the inventory, accounts, orders sections and so on.

The Dashboard

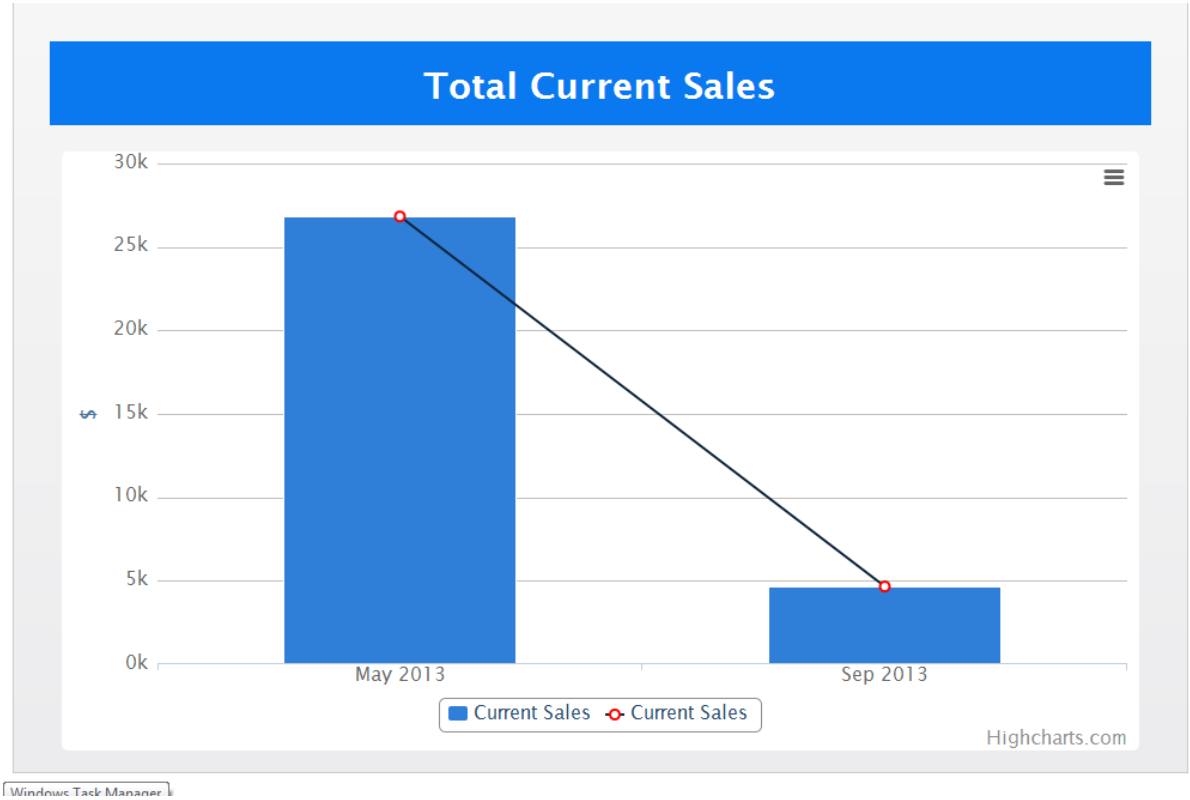
On the main page we have icons through which we can navigate to different sections. These icons change according to the user logged in.



When we scroll down we get two blocks side by side, one showing any alerts, such as low product quantities and the other showing the latest orders and their statuses.

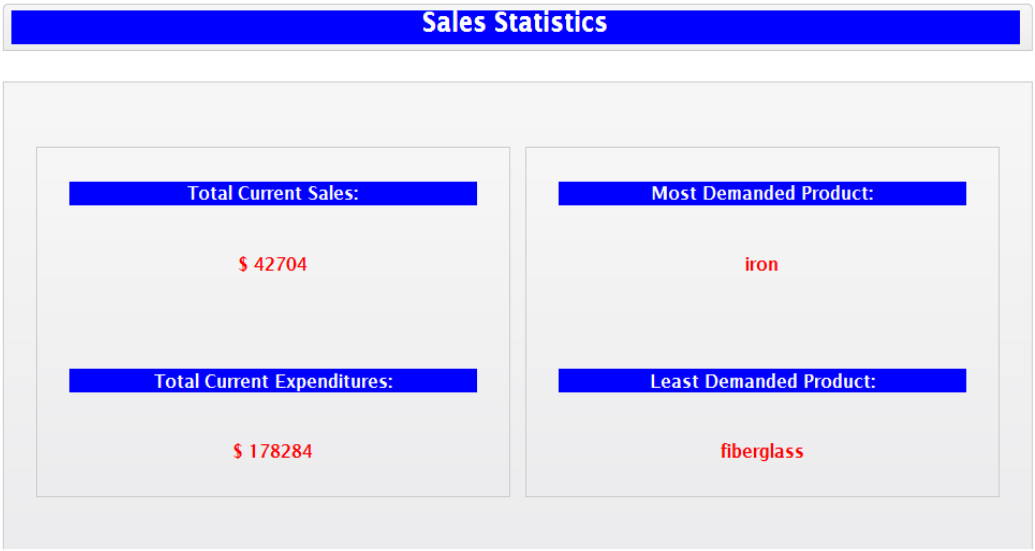
Latest Orders and Alerts

After this as we go further down, we have to charts displaying sales and expenditures amount of different months:



Total Current Sales

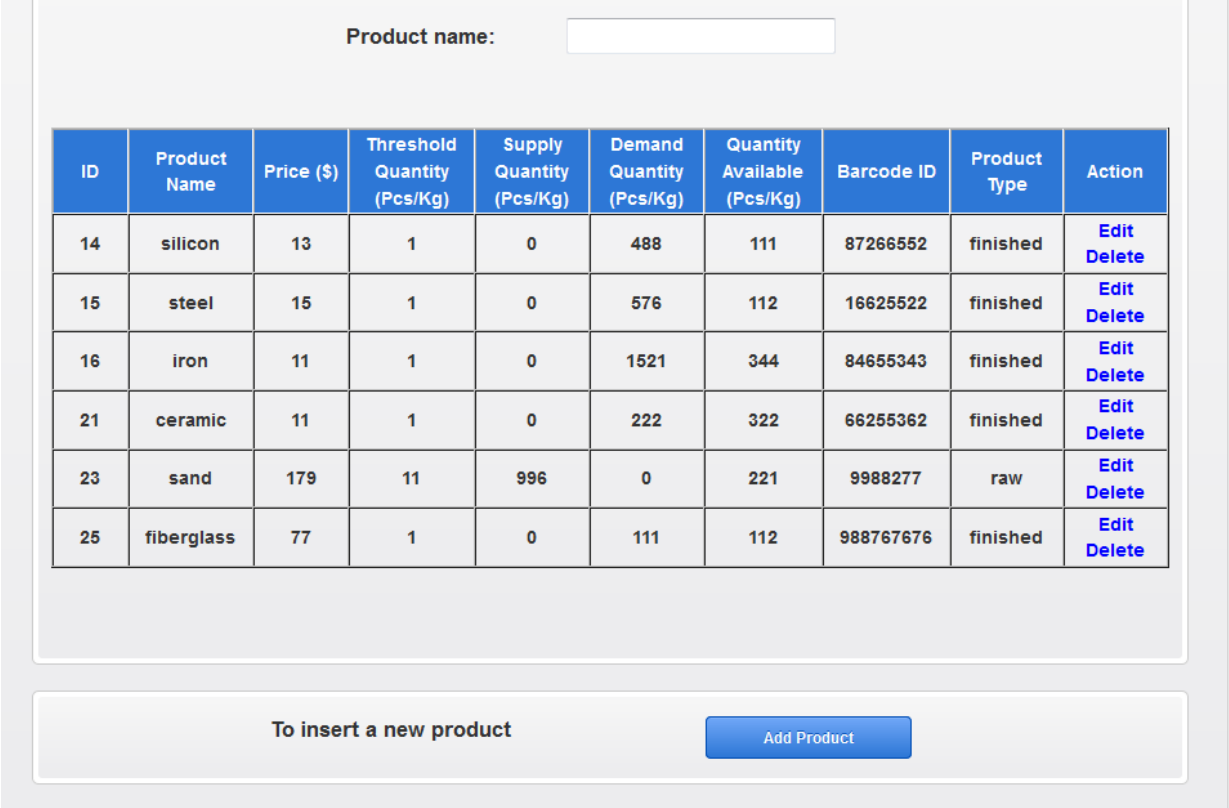
Finally, the last thing on the main page is the latest sales details:



Sales Statistics

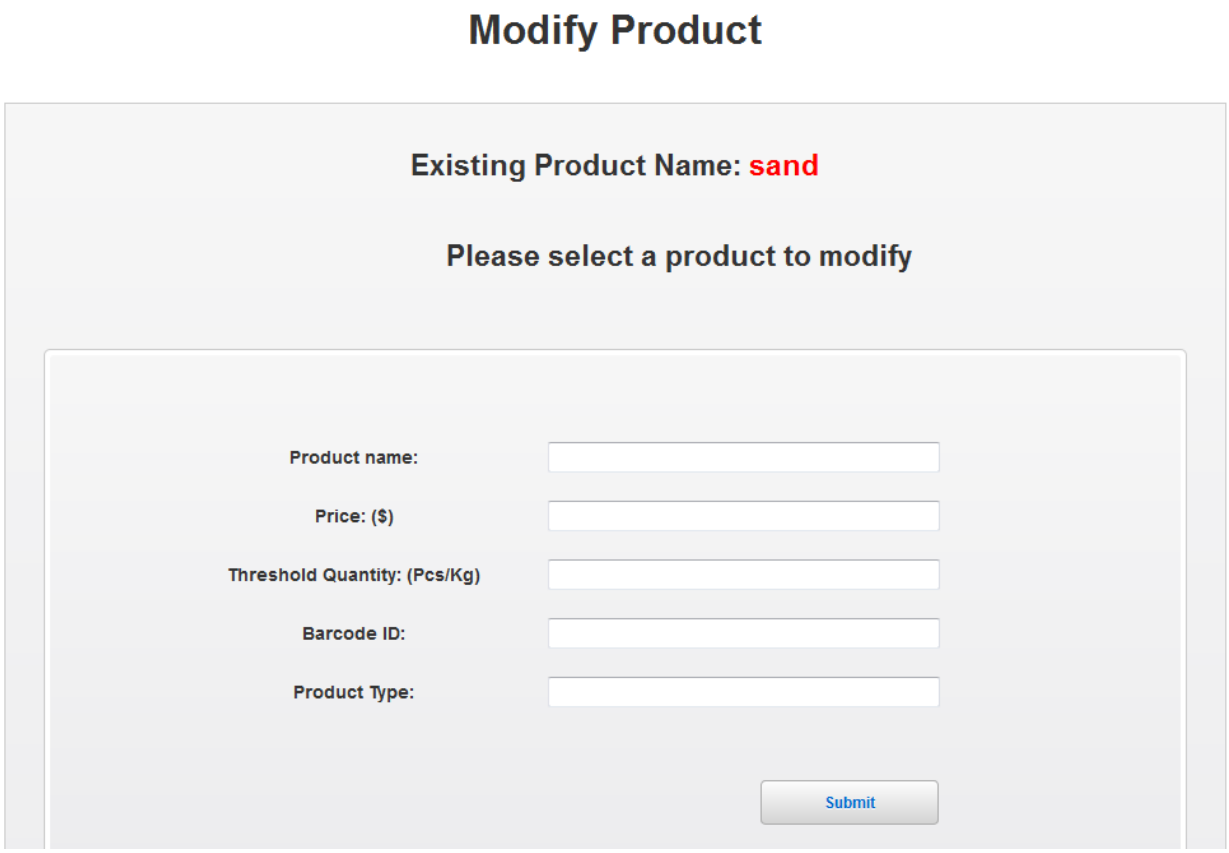
Inventory Section

When we visit the inventory section, we are shown the existing products in our database and as well as the options to add, edit, delete and search products.



Manage Inventory

We can also edit a product and the interface for that web page is:

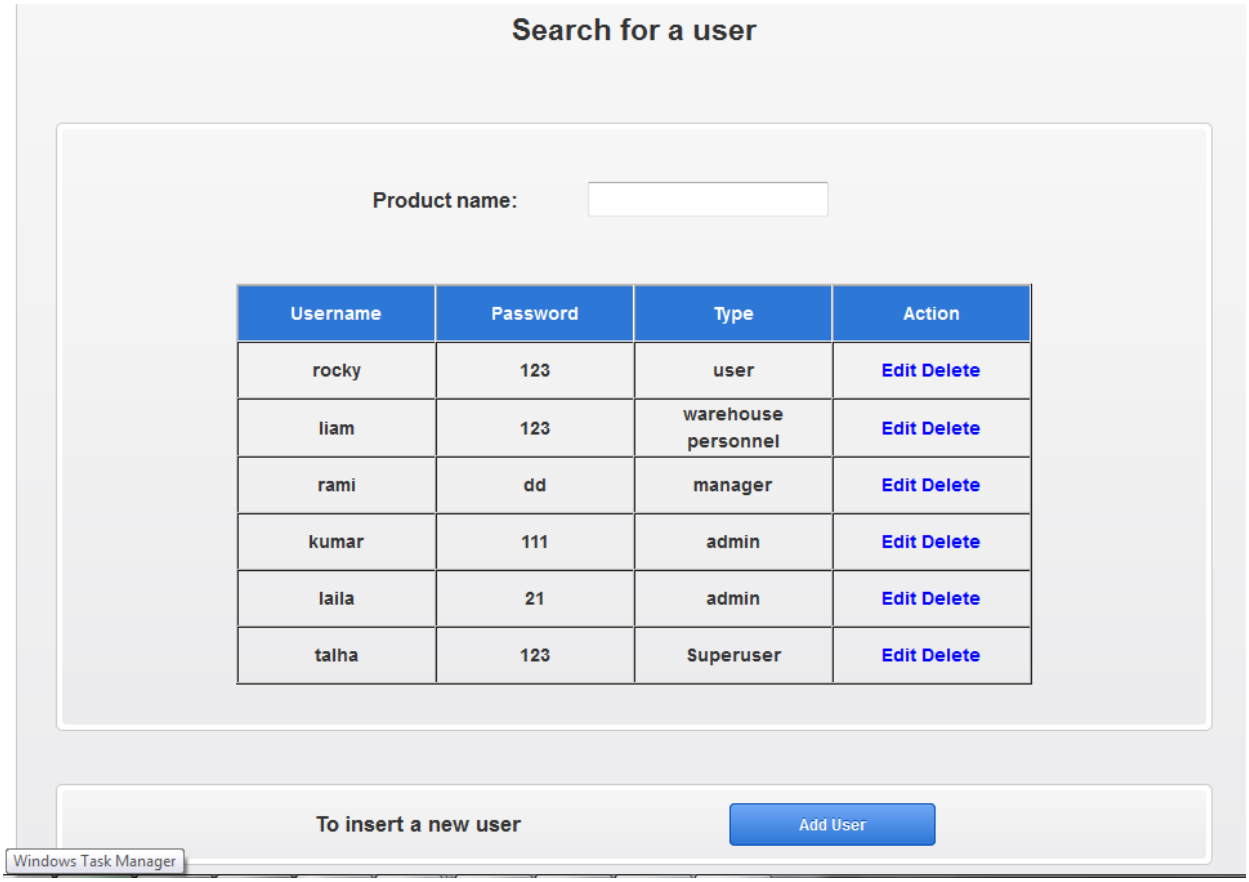


Modify Product

Here you can enter new product details and submit to change those details.

User Accounts Section

In this section we can add/edit/delete/search and view user account details.

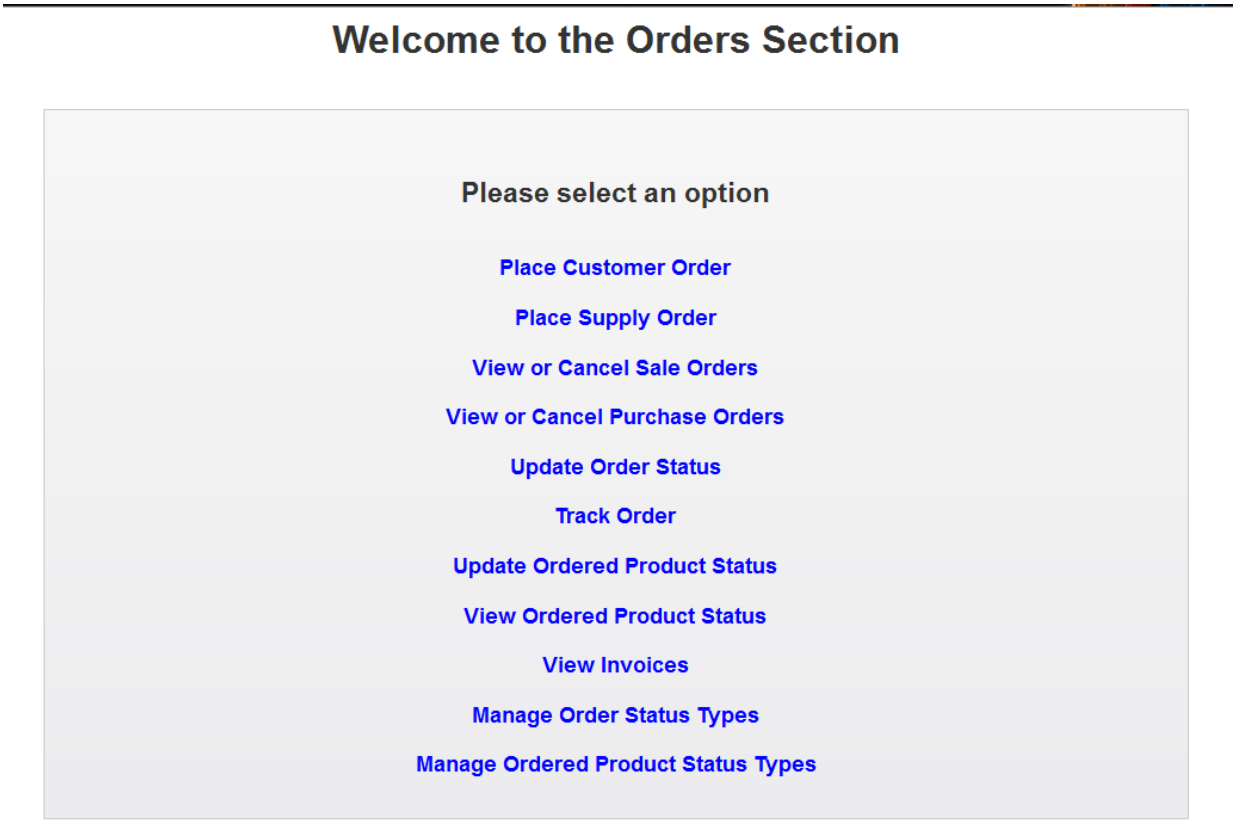


Manage Users

We can edit and add user details in a similar way as the inventory section.

Orders Section

When we visit the orders section, we are shown with a list of options that we are able to perform.

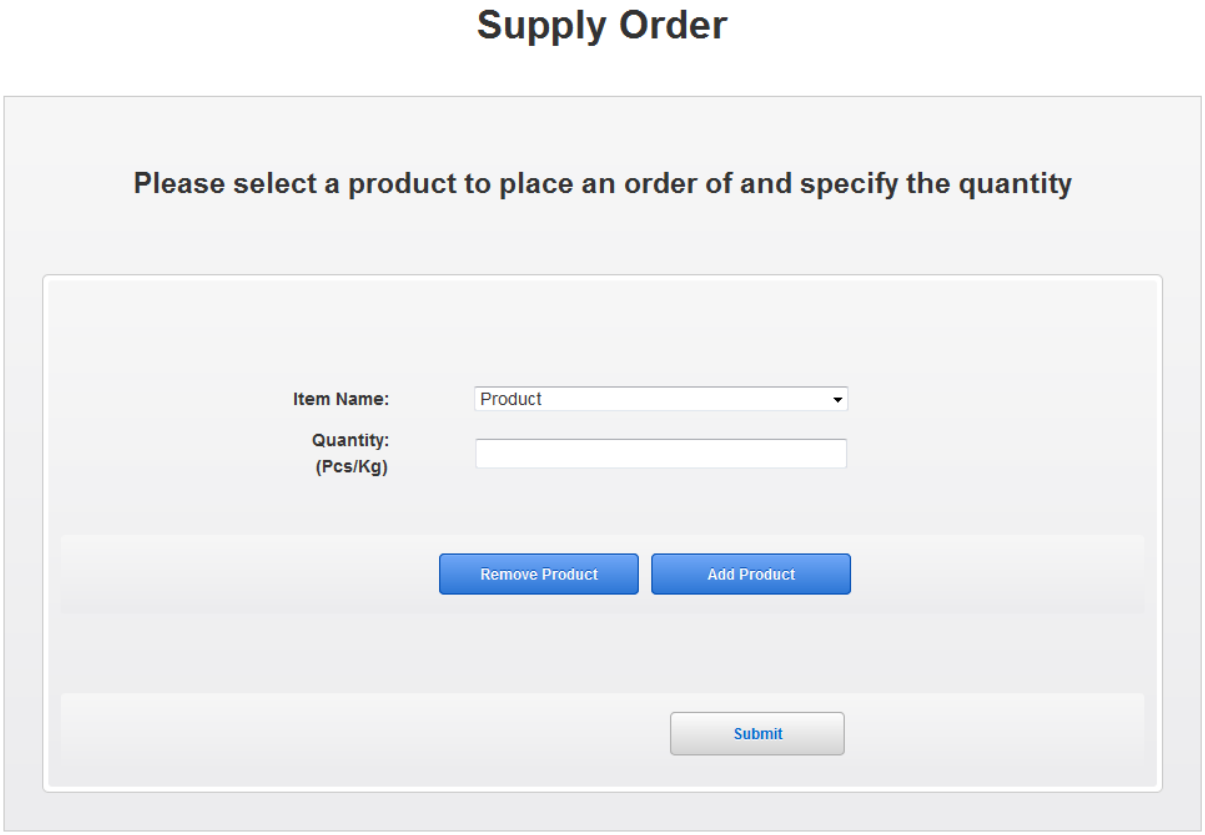


Order Section

Place Order

To place an order we can visit the appropriate place order page.

Say we visit the Place Supply Order page:

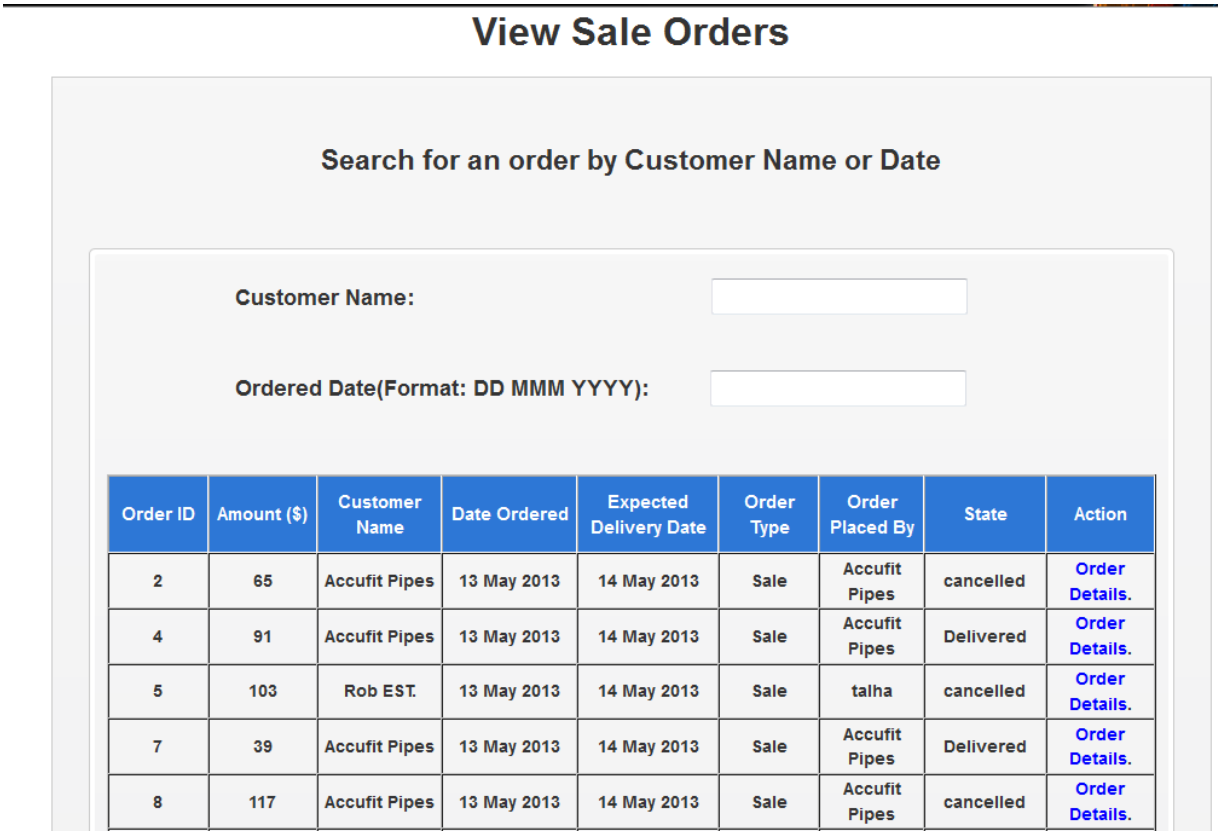


Place Supply Order

Now here the user can choose the different products and their quantities that need to be ordered.

View Orders

A user can also view sale and purchase orders by visiting the appropriate pages:

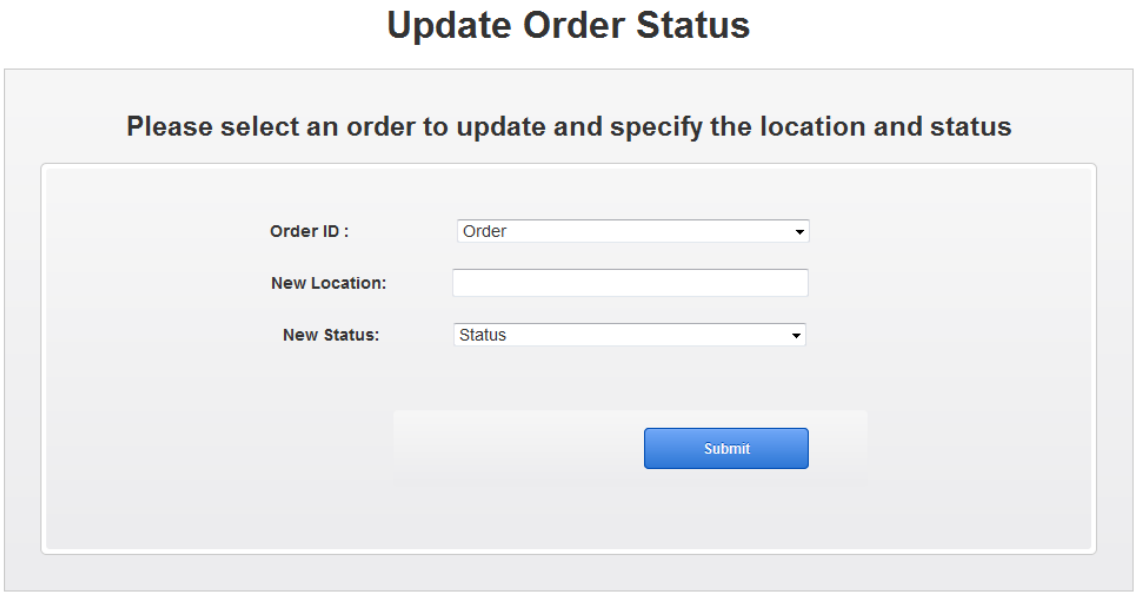


View Sale Orders

On this page the user has an ability to view order details in addition to those that are already displayed on the page.

Update and Track Orders

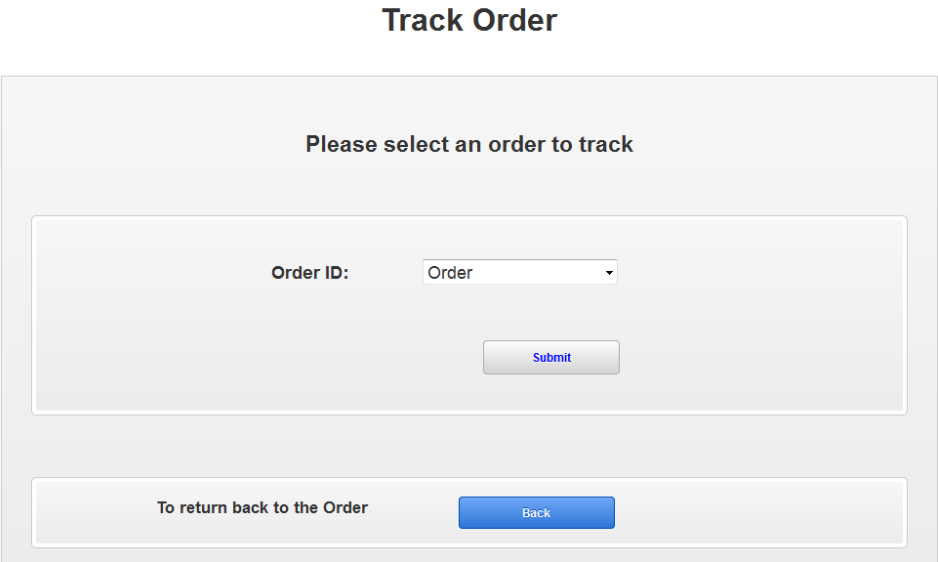
A user can update the status of existing orders.



Update Order Status

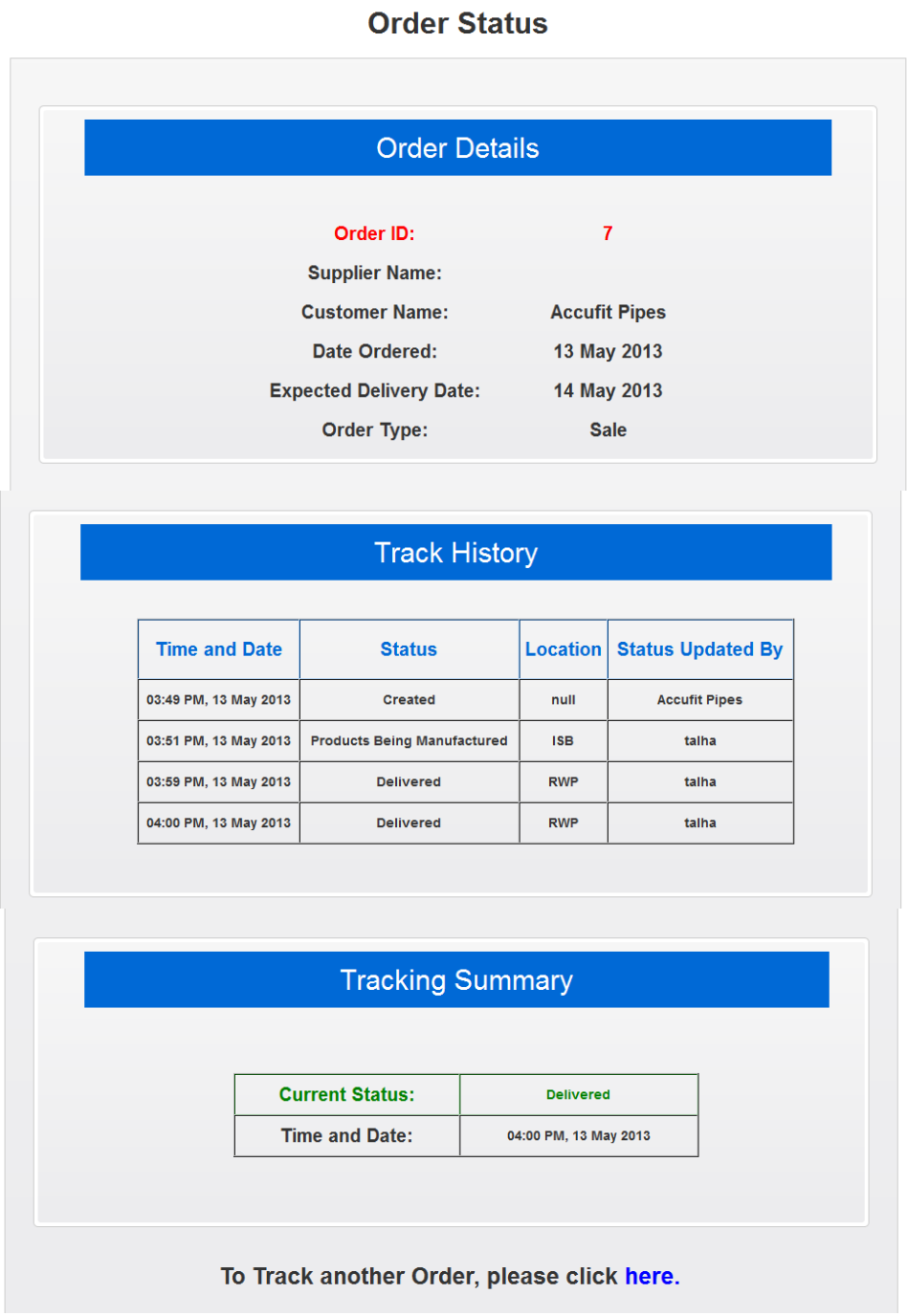
The user enters the new location and status of the existing order and the system performs the update.

To track an order:



Track Order

The user selects the required order ID and the system retrieves the Order Details:

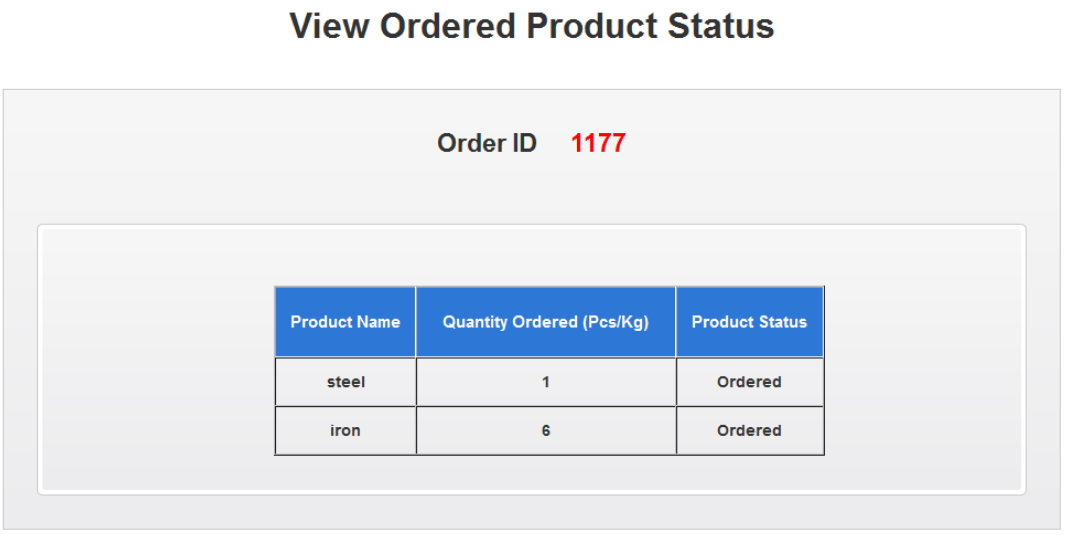


Order Status

7.3.1.1 Update and View Ordered Product Statuses

The User can update and view the statuses of products that have been ordered.

Now, to view the status of an ordered product, the user selects the order ID and then the details are shown to him:



View Ordered Product Status

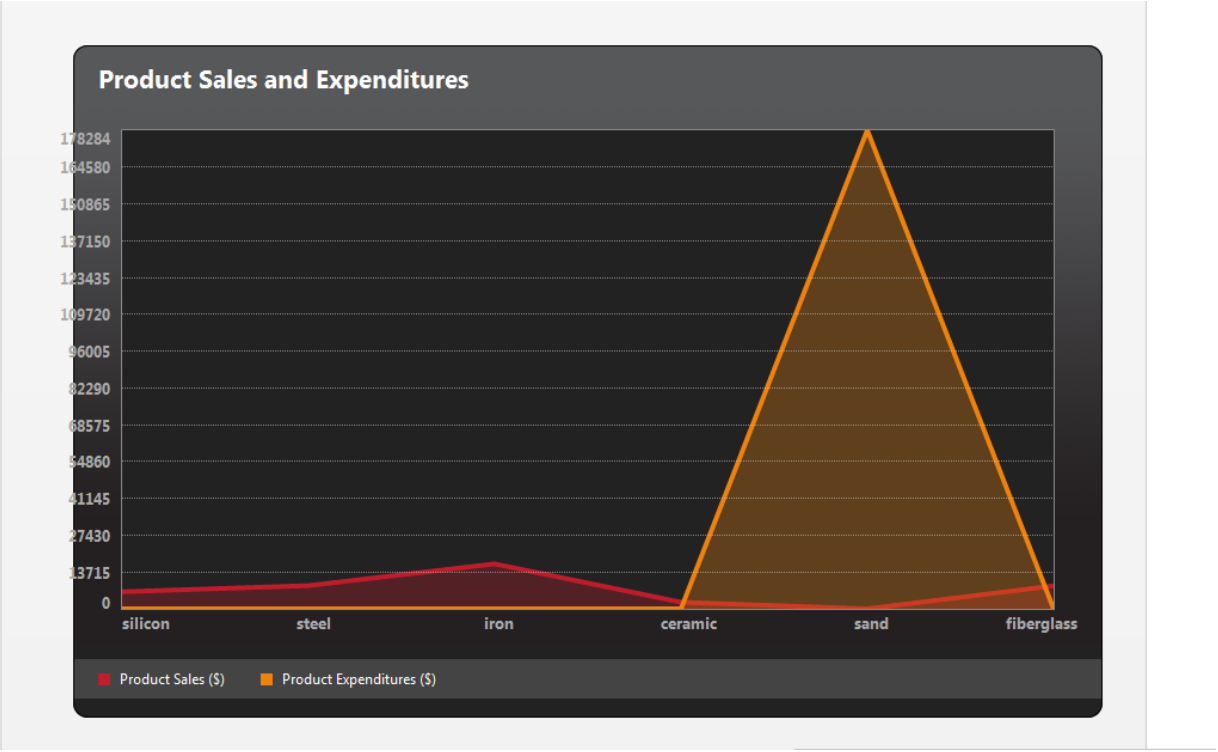
The user can similarly update the status of an ordered product by visiting the page and first entering the order ID of that ordered product and then entering the new status.

Sales Section

Product Sales and Expenditures

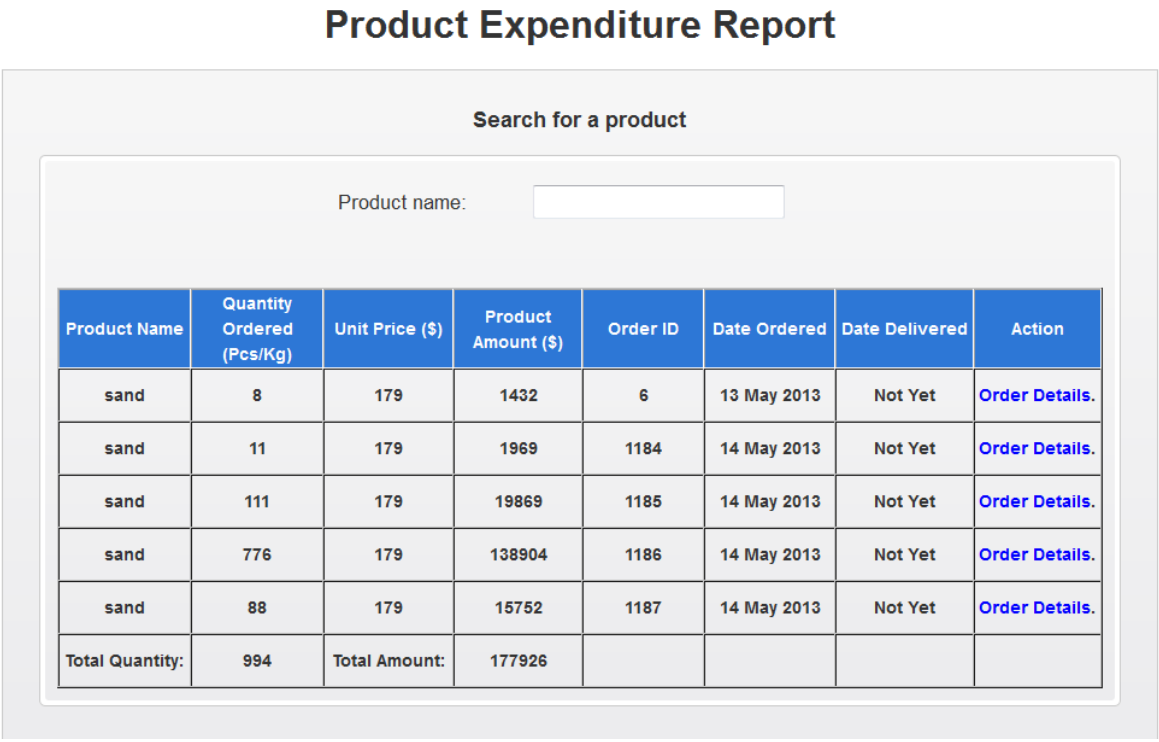
Product Sales and expenditures can be viewed in the form of graphs as well as reports.

Product Sales and expenditures Graphs:



Product Sales and Expenditures

Product Sales and Expenditures as Reports:



Product Expenditure Report

Search for a product

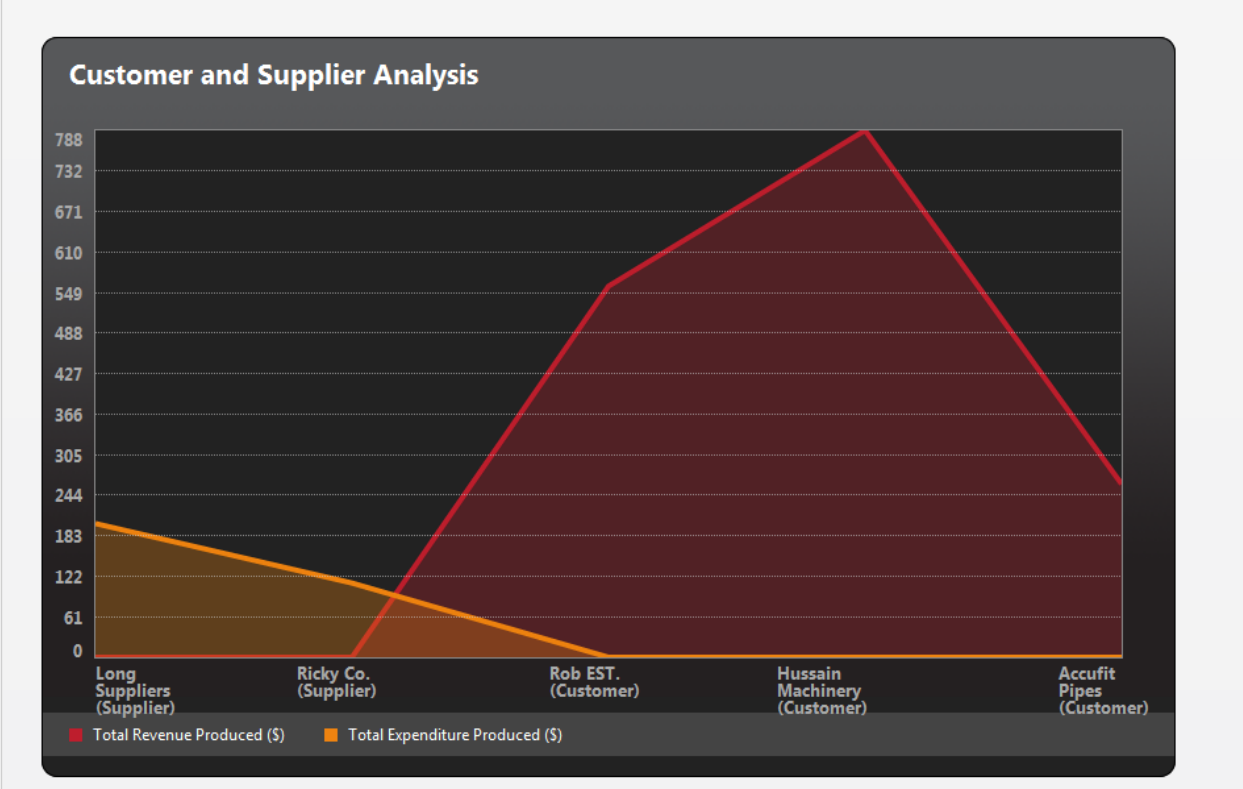
Product name:

Product Name	Quantity Ordered (Pcs/Kg)	Unit Price ($)	Product Amount ($)	Order ID	Date Ordered	Date Delivered	Action
sand	8	179	1432	6	13 May 2013	Not Yet	Order Details.
sand	11	179	1969	1184	14 May 2013	Not Yet	Order Details.
sand	111	179	19869	1185	14 May 2013	Not Yet	Order Details.
sand	776	179	138904	1186	14 May 2013	Not Yet	Order Details.
sand	88	179	15752	1187	14 May 2013	Not Yet	Order Details.
Total Quantity:	994	Total Amount:	177926				

Product Expenditure Report

Customer and Supplier Analysis

The details about the customers and suppliers such as how much sales has a customer generated and how much expenditure has supplier generated are represented as forms of graphs:



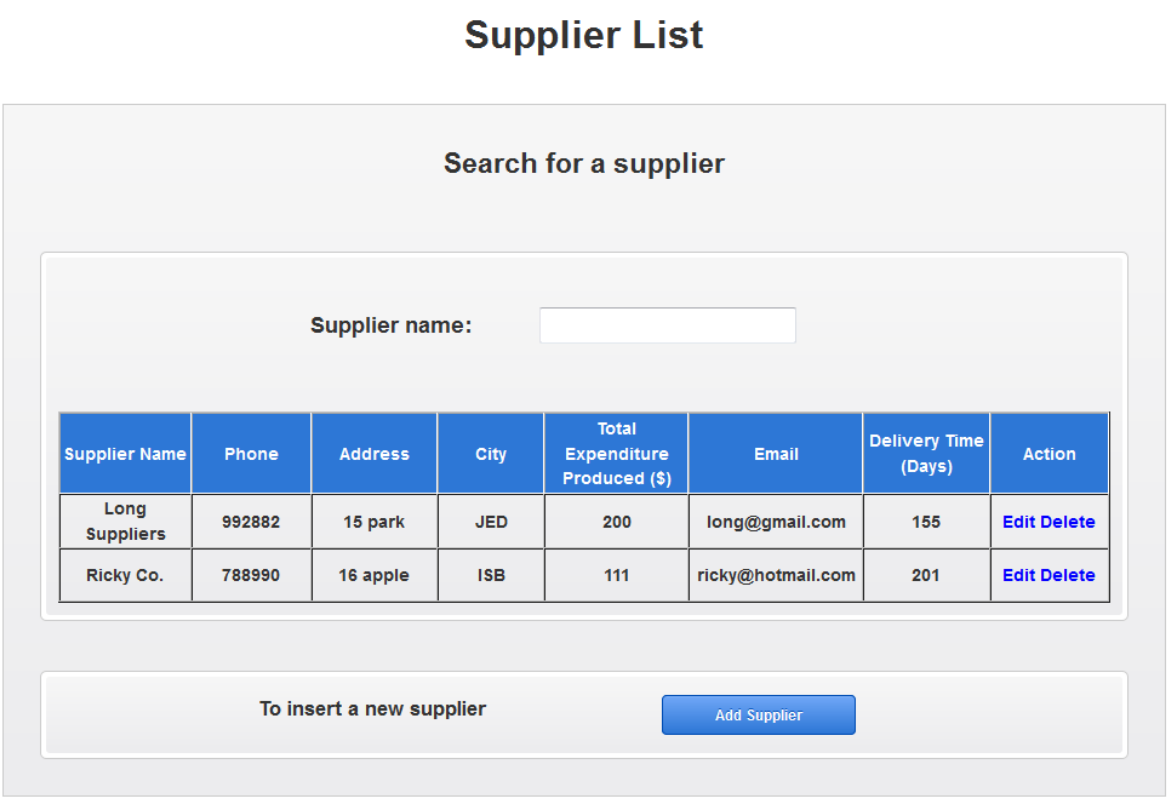
Customer and Supplier Analysis

Supplier and Customer Section

This section helps in managing our suppliers and customers as well as assigning suppliers different products that they supply.

The management of suppliers and customers include, adding/ modifying and deleting customers and suppliers.

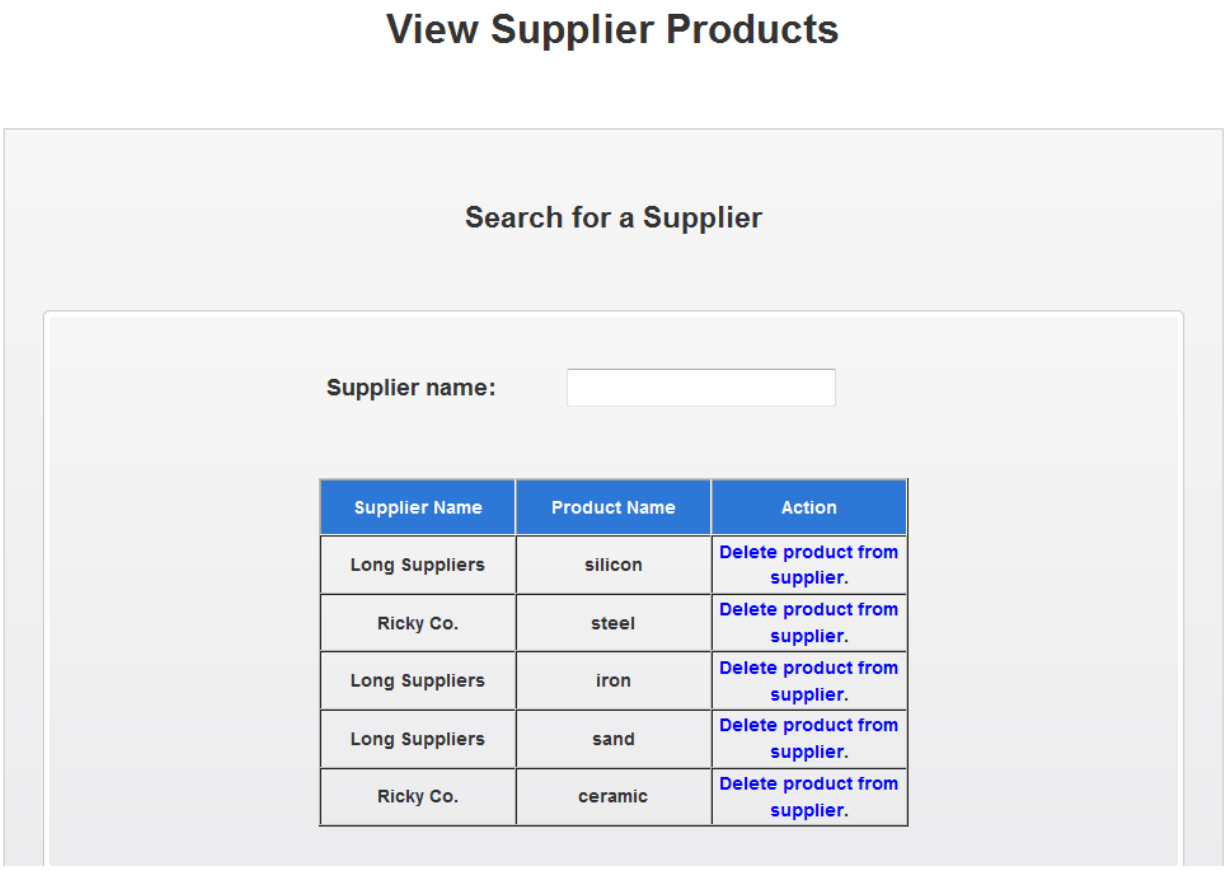
Supplier Management Page:



Supplier Management Page

From this a user can perform all the above mentioned operations by clicking the appropriate link.

We can view the products that different supplier's supply and delete them in the view supplier's products page:

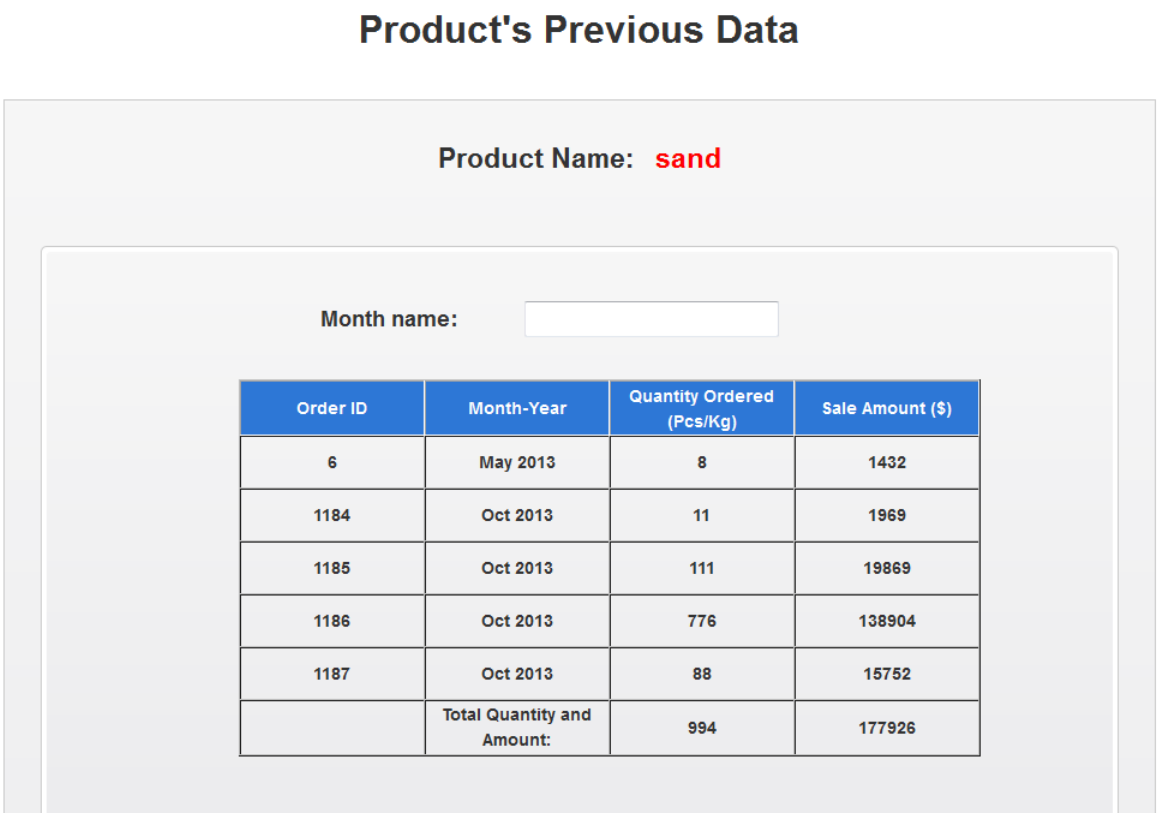


Supplier Products

Stock Forecasting Section

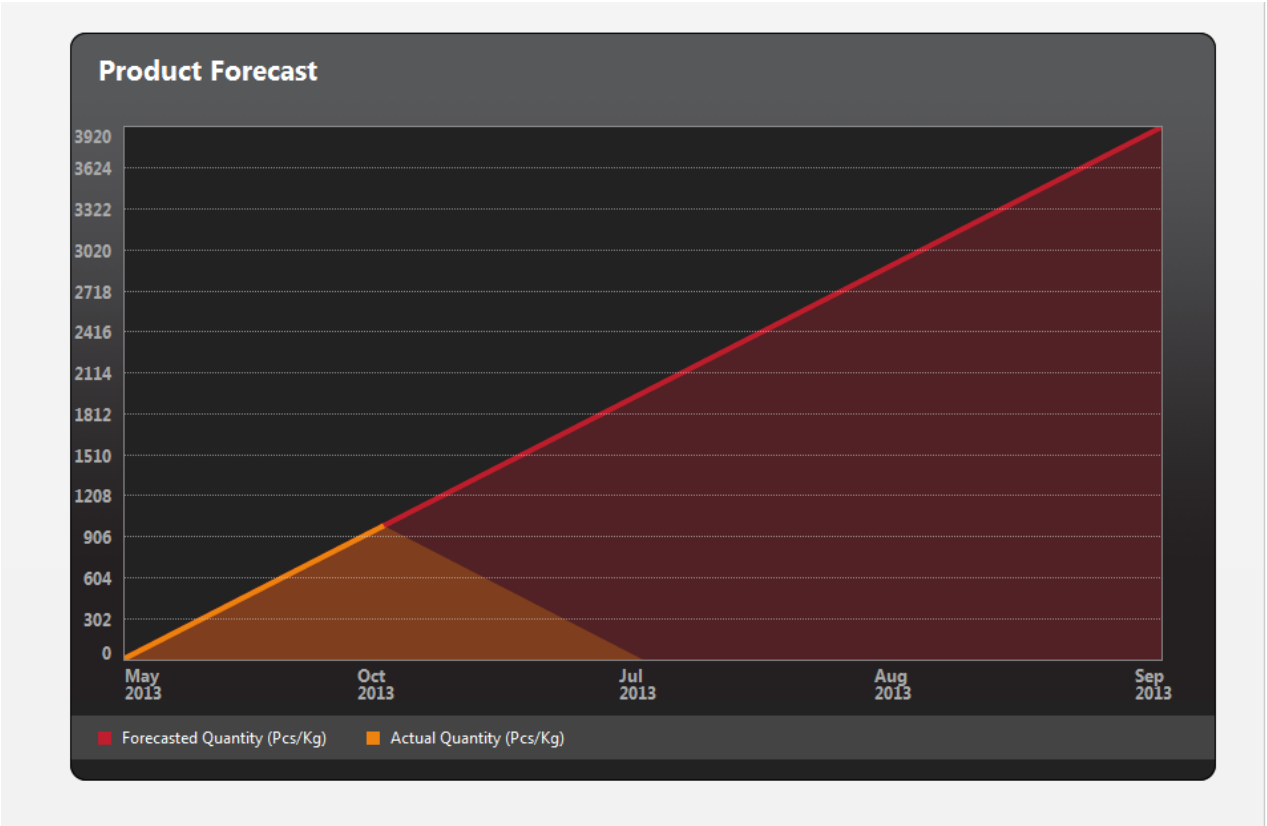
In this section, users are able to view a product's previous sale history and the system also generates a projected sales graph based on that past data.

When the user selects a product, the system creates a table that shows that product's sales in past months:



Product Sale History

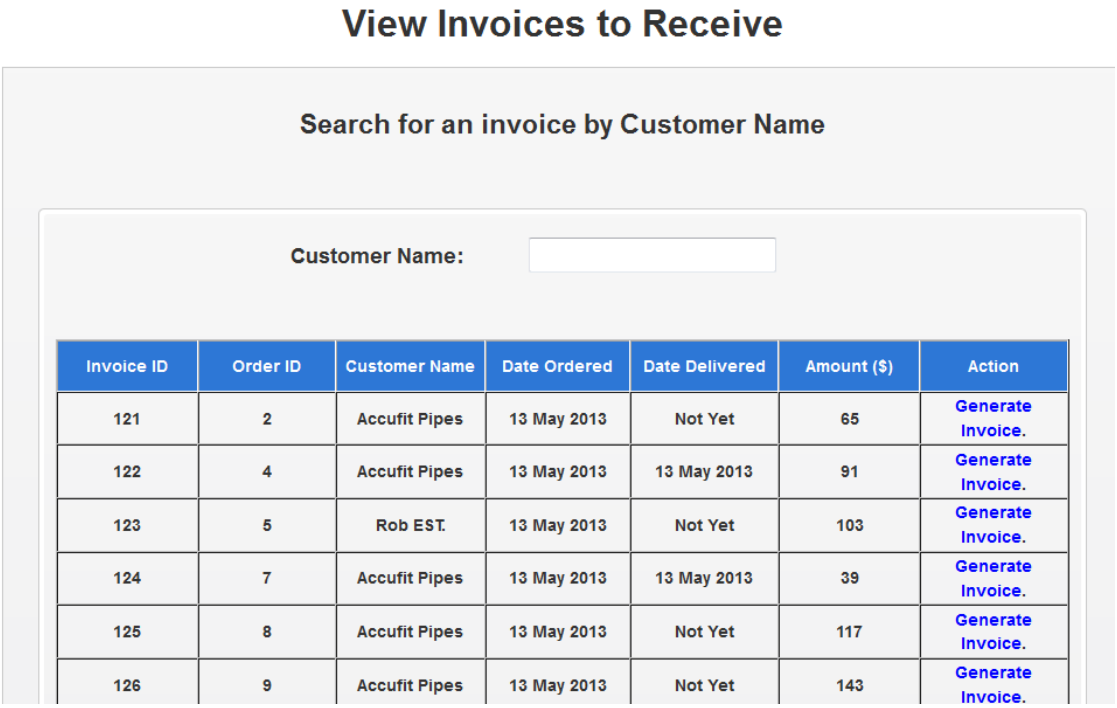
Then the user can choose an option to either view the future sale amount or quantity, say in this case he selects the projected quantity option:



Product Quantity Forecast

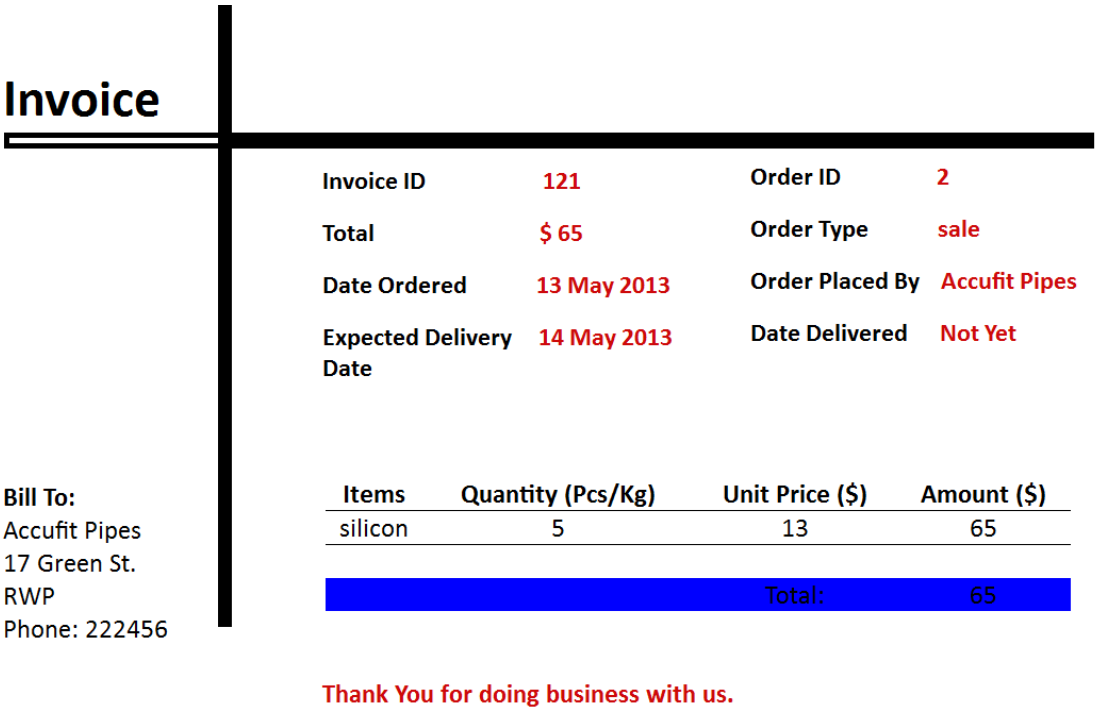
Invoice Management

Invoices can be viewed by visiting the view invoices link in the orders page:



View Invoices to Receive

To view the complete invoice, the user can select the generate invoice link where the complete invoice is generated:



Invoice

Invoice ID	121	**Order ID**	2
Total	$ 65	**Order Type**	sale
Date Ordered	13 May 2013	**Order Placed By**	Accufit Pipes
Expected Delivery Date	14 May 2013	**Date Delivered**	Not Yet

Bill To:
Accufit Pipes
17 Green St.
RWP
Phone: 222456

Items	Quantity (Pcs/Kg)	Unit Price ($)	Amount ($)
silicon	5	13	65
		Total:	65

Thank You for doing business with us.

Invoice

Company Details

A user can update the company's details and view them.

Company Details

User Manual of the Android-based System

Again here we also begin with login so that we can access further operations.

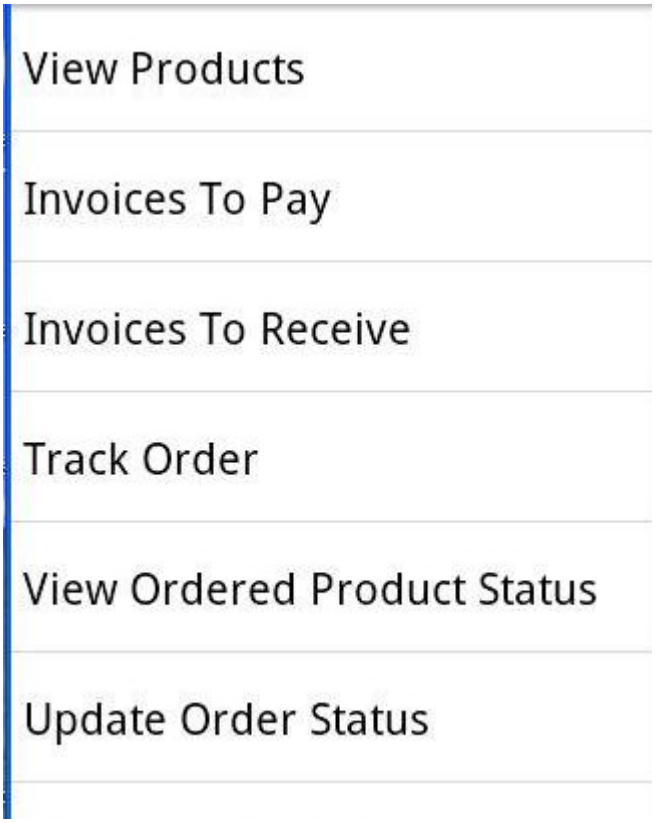
Login

The user has to log in before he can perform any operation.

Login (Android)

Option Selection Page

After the log in, the user is displayed with options from which a user can select the one he needs.



Options Selection (Android)

Place Supply Order

A user can place a supply order by providing the product name/barcode and the required quantity.

Place Supply Order (Android)

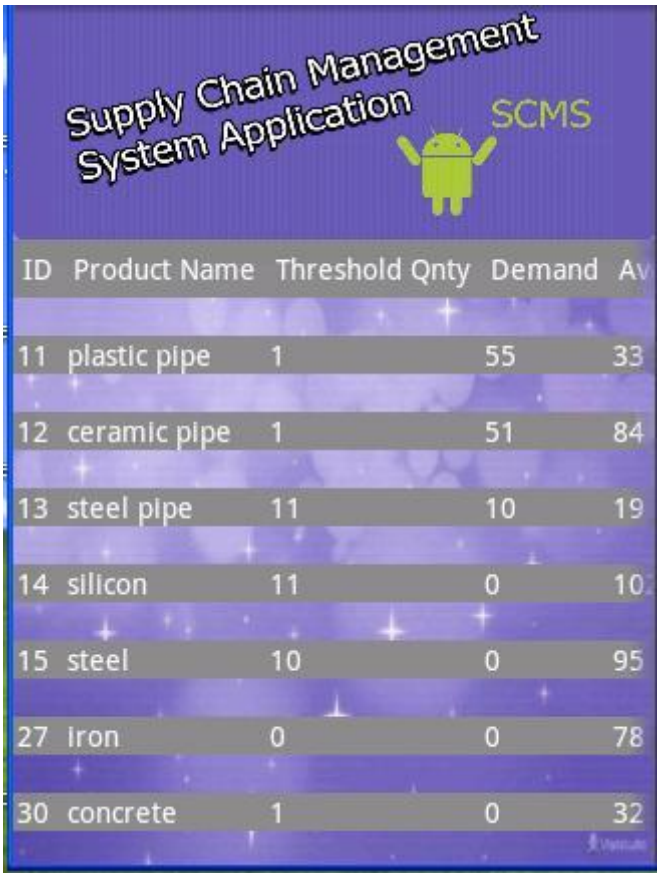
View Sales Data

The user can view Sales Data by selecting the appropriate option.

View Sales Data (Android)

View product details

The user can view details about different products in its inventory.



View Product Details (Android)

Track Order

The user can also track orders by selecting the appropriate order ID.

Track Order -1 (Android)

Track Order - 2 (Android)