Fast Moving Goods Distributing Management System (FMGDMS)

A dissertation submitted for the Degree of Master of Information Technology

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Declaration

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

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

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

Mr. M.F.A.H. Fuard

under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name: Dr. K. L. Jayaratne

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Signature: Date:

Abstract

This project is carried out to introduce a standalone database application for a FMG distribution business platform.

This is a proposed computerized system for a FMG distributors who have started their business in Ampara district in 2014, known as "Magbool Distributors". In early stage of their business, they did not have any difficulties in maintaining the business information using paper work since they had to deal with few FMG products from a single supplier.

As their business has grown up to a large scale by doing distribution for many FMG products from many suppliers, they face problems in maintaining and developing the same paper work. The manual paper work has become very complex since it has been developed during a process of a long period and understanding its format also identified very difficult. The total work depends only on the person who created the manual files and that creates more problems and restrictions especially when the management needs information from the business history. The management understand that this is not a good practice to create this sort of restriction to business information in future. This situation made the necessity of proposing a computerized database system for their current manual functions.

The primary concern was to migrate the business activity to a computerized platform by introducing a well standard system. All the requirements were properly collected form the client and a better proposal was submitted to introduce the FMGDMS system. With the approval from the client, the system has been implemented using MS Visual Studio C#/.NET framework and MS SQL database. The system has the MIS component and is fully compatible with Windows operating system environment.

The FMGDMS system provides an easy access to effectively manage the information. The management can directly get analysis from the business history so that the information is not restricted by system users. After the completion of the development phase the system was released to the client for a period of time for testing in the real work environment. User training and demonstrations also were covered during this testing period.

The computerized FMGDMS system has been released with the hope of changing the client business activity to a significant success stage.

Acknowledgement

First of all, I am grateful to the God for the good health and well-being that were necessary to start and do this project.

I take this opportunity to express my gratitude to my supervisor, Dr. K. L. Jayaratne, for being help full and for his guidance and motivation from the beginning of this project. Also I wish to thank my other lecturers who taught me other subjects such as database management and software engineering and also for other subject which helps me to do this project in a proper way.

I wish to extend my special thanks to my client Magbool Distributors who gave me this opportunity to start my research work at their business place.

My gratitude also goes to my parents and my family for their grate support in all the way including financial support.

Contents

List of Figures

List of Tables

List of Abbreviations

FMGDMS	-	Fast Moving Goods Distributing Management System
PC	-	Personal Computer
SQL	-	Structured Query Language
OS	-	Operating System
MS	-	Microsoft
DB	-	Database
GUI	-	Graphical User Interface
UML	-	Unified Modeling Language
GRN	-	Good Receive Note
VPN	-	Virtual Private Network
MIS	-	Management Information System

1. Introduction

This documentation describes the Fast Moving Goods Distributing Management System (FMGDMS) sufficiently to determine the feasibility and usability of proposed system. The core concept is to maintain daily sales functions including MIS component which helps to analysis the entire business history. The MIS component of the system covers many analysis of reports in order to help the management for improving their business. Standalone database model is followed to deal with this day-to-day sales functions.

This can be used for further expansion later while still supporting the targeted small businesses. The core features and final framework has been completed according to the requirement submitted to the office.

1.1 Project Title and Interpretation

TITLE: "Fast Moving Goods Distributing Management System / FMGDMS"

The title is selected to suit the client business function as they focus on distributing fast moving goods. The goal of this project is to identify, analyze, design and implement a standalone computerized system which has stock control and sales detail database to run a FMG products distribution business. The assumption notifies that the FMGDMS software product is a standalone system for the client based on their day to day sales functionality and requirements which includes MIS component as an important module.

Since it is not possible for a large software system to be developed in a short time window that could handle all of the details including accounting functionality which can be used for any business purpose, this system focuses on activities such as store, sales operations and report generation.

1.2 Objective of the Project

The objective is to provide a real time database application known as "FMG Distributing Management System" capable of managing small and medium type of distributing business. This can be used to track the inventory of a single store in an efficient way. However, the system merely records sales and stock data. The goal is to reduce the strain of tracking rather than handling the business manually.

1.3 Scope of the Project

The entire scope of the project is to convert the manual business function into a computerized system. The outcome of the scope can be divided into two main parts such as data store and management information system component. These two parts define the boundaries of the proposed standalone system. The data store includes recording all relevant data from creating stock to preparing bills. The management information component includes generating numeric view of reports and generating graphical analysis. There are many steps of functionalities exist between these two main boundaries. Even though this system has boundaries, there is no restriction in going for further modification in future.

The entire features are categorized into five main functionalities by considering user friendliness of the system. These five main functionalities are named as **Add New, Products, Stocks, Sales and Report**. There are twenty five sub features available in the system under the five main functionalities. Features like adding and editing records are enabled almost for all interfaces. But the features of deleting a record is tricky point since some records are dependent on some other records in different database table. So some user interface does not allow to delete records according to the business functions dependency. This feature is discussed in the Graphical User Interface section 3.2.9

Any products can be added under a selected category and then the product can be assigned for a selected supplier. Then only the system allows to create batches detail for added products. The system accepts the stock loading, if at least there is one product batch available for a selected product.

As well as the stock loading, stock adjustment also possible through the system. This is useful when any product needs an amendment in the stock quantity by product expiration deduction. Between the sales and the billing activity, the mobile store feature keeps track of what products are released for daily sales. This will enable feature expansion of online use of the system. So the sales representative can be directly add bills in the system from the mobile store feature without touching the main store database.

It is clearly focused that each user interface should contain only the relevant details according to the business operation. This has been accomplished by categorizing the business functions and avoiding conflicts between functions. Providing separate interfaces in such way will help the users to have a user friendly system.

2. Background and Literature Review

2.1 The Project Client and Background Business Function

"Magbool Distributors" is a FMG product distributors located in Ampara district of the country. They do distribution for many FMG products. They currently keep all records of stock and sales detail manually. Since all activities are kept manually they are not able to generate any reports from the sales history. Also they face difficulties in managing their large stock. They also end up with wrong analysis and wrong decisions often by the manual system.

A case study at "Magbool Distributors" cited issues regarding a basic day to day requirement list that has to be maintained manually by the user. To keep track of their stock levels they have to calculate a list of the items utilized during a course of time, calculate and analyze the requirements for the future, and place their next order to the vendors if needed. This process takes up a lot of time and human effort, and is also prone to human error.

2.2 Literature Review

When considering the functions of sales and distributing management process, each company or firm are unique and include many different features and limitations. Due to that reason, there is no standard solution found for this kind of requirements. Therefore there is a need for modelling a specific and effective method for distributing management function, based on the conditions and limitations.

There are many studies and researches found in terms of implementing stock or inventory control software. The point is that they are very common and people may find it difficult to customize according to their business needs. Business people are now interested in having customized software module for their business to reduce their work complexity. Because they believe that customized solution is always becomes user friendly as it is required very less technical knowledge to operate. This is the reason why the client is expecting this FMGDMS customized software module to be developed in a specific way which suits their day to day business operation.

As a research methodology, some existing similar solutions were initially identified. Then the differences between each identified system were studied. Also the strength of the each identified system was measured in terms of benefits. Finally, the entire framework was used to analyze to

draw a clear picture about how the FMGDMS system should be implemented to fulfill the requirement in an efficient way.

2.3 FMGDMS Software and Similar Applications

A computerized FMGDMS Software system makes everything from recording information to generating result easier. Doing a hand processes of inventory can take more time, but with this computerized system, the same processes can be done in a matter of minutes.

With a manual system, the data is only as accurate and up to date as the last hand count. With this computerized system, the management can pull a report and instantly track the business status.

There are several inventory systems and stock control systems available in the technology market. There also many online database system available these days. Below are some of the top example available in the online market.

1. Prim seller: This is one of the available cloud base inventory management software which can create stock transfer, generate purchase orders and manage inventory [1].

Figure 1: Primeseller Software Screenshot
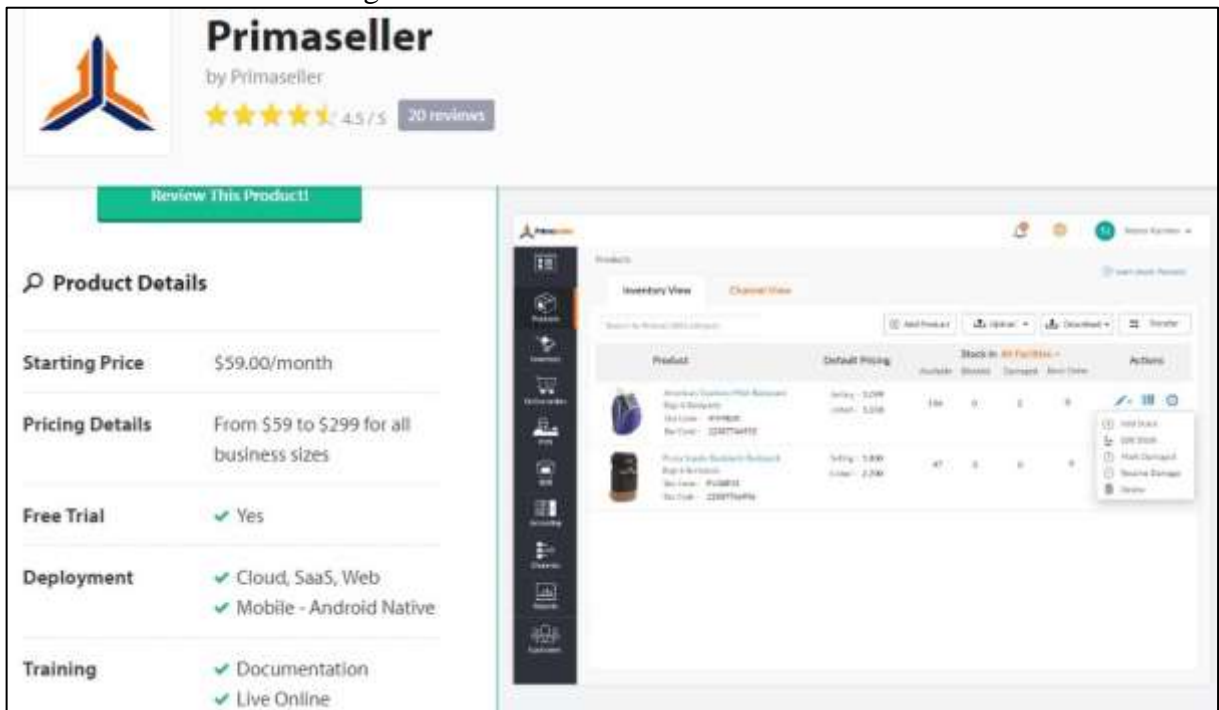
2. TapHunter: This is helpful for reducing the strain in manual spreadsheet works. [2].

Figure 2: TapHunter Software Screenshot
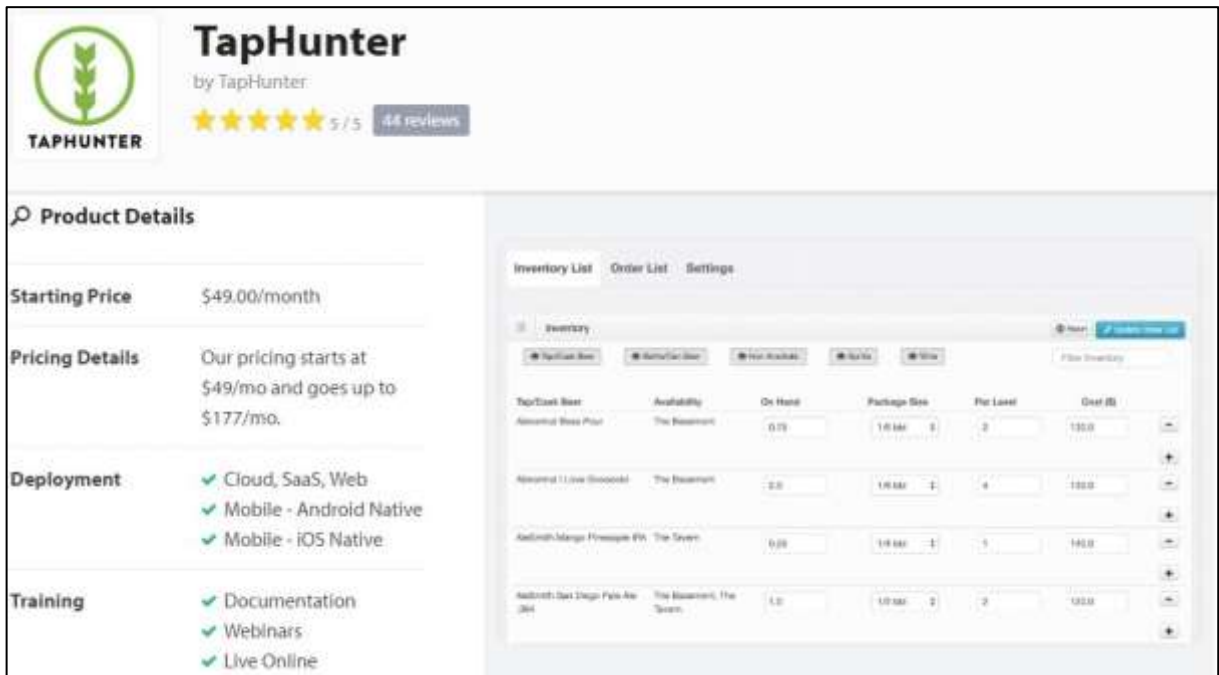
3. Windward System Five: one of the inventory management system which control inventory, tracking items and reducing paper work [3].

Figure 3: Windward Software Screenshot
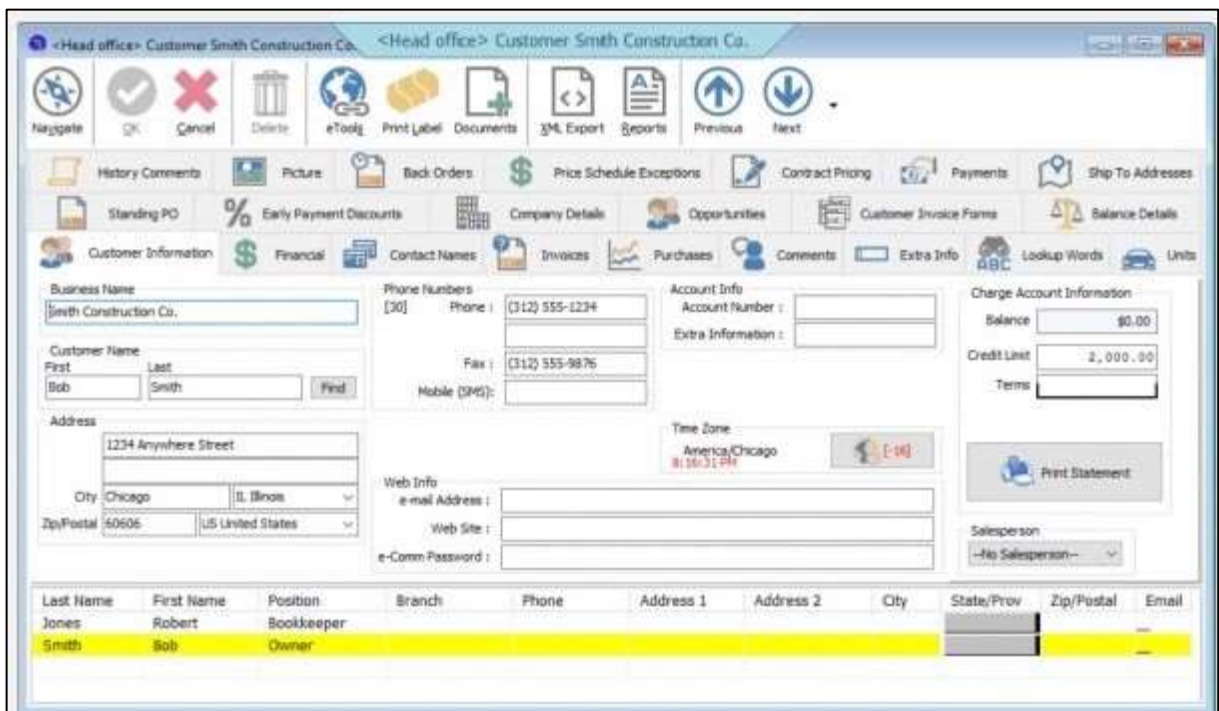
4. Zoho Inventory: This is an online application that enables you to manage orders and inventory. With multi-channel selling, shipping integrations and powerful inventory control, you can now optimize your inventory and order management, right from purchase to packing, to payments [4].

Even though there are many application solutions available, they are very common in terms of system features. Using a common system is definitely will only be a temporary solution for any real world situation. It may increase the complexity by unwanted features availability in the common system. Also it is not easy to get familiar with a common system when the features are not customized. Having a customized system will reduce all these practical issues.

3. Analysis and Design

3.1 Analysis

When working on any software project, it is important to recognize that project planning and structure have vital parts to play if the designer is to avoid ending up with unmanageable code and an unmaintainable software product.

3.1.1 Software Requirement Specification

This software project has been implemented using Microsoft Visual Studio 2013[5] and Microsoft SQL 2008 R2 [6] on a 64bit Windows 10 platform. The final product is fully compatible for 64 bit platform of Windows 7, 8, 8.1 and 10. SAP Crystal Report for Visual Studio has been used for report generation.

Software	Version
MS SQL	2008 R2
Windows OS	7,8 and 10 – 64 bit
MS Visual Studio	2013
SAP Crystal Report	10

Table 1: Software to be Installed in the Client PC

3.1.2 Hardware Requirement Specification

According to the development of the platform and expectation of the system performance, the client PC has a recommendation of below system requirements to run the final version of the product.

Component	Minimum requirement
Operating system	64 bit OS of Windows 7 or 8 or 10
Processor	64-bit, four-core, 2.5 GHz minimum per core (If the dataset size is significantly larger than the medium dataset, we recommend 8 core.)
RAM	8 GB (16 RAM will show more effective performance)
Hard disk	100 GB space should be available on C drive
UPS	A 650VA UPS is recommended in order to avoid any interruption during the power failure for the PC. Power failure during the database access may cause crashing any data.

Table 2: Hardware Requirement for Client PC

3.2 Design

3.2.1 Software Architecture

Software application design architecture is the process of defining a structured solution that meets all of the technical and operational requirements, while optimizing common quality attributes such as performance, security, and manageability. It involves a series of decisions based on a wide range of factors, and each of these decisions can have considerable impact on the quality, performance, maintainability, and overall success of the application.

This particular software product is built on a solid foundation and designed with consideration of the end user, the system (the IT infrastructure), and the business goals. For each of these areas, important quality attributes and key areas of satisfaction and dissatisfaction are identified during the requirement gathering process.

3.2.2 Front End

Figure 4: Front End of the System

```
C# / .NET
    ├── GUI Design
    ├── Control Design
    └── Database Connectivity
```
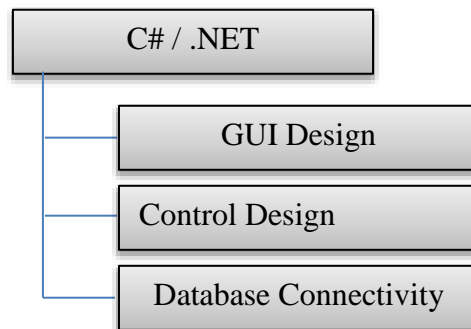
3.2.3 Back End

Figure 5: Back End of the System

```
            ┌── Form Design
SQL DB ─────┼── SQL Query and Coding
            └── Table Design
```
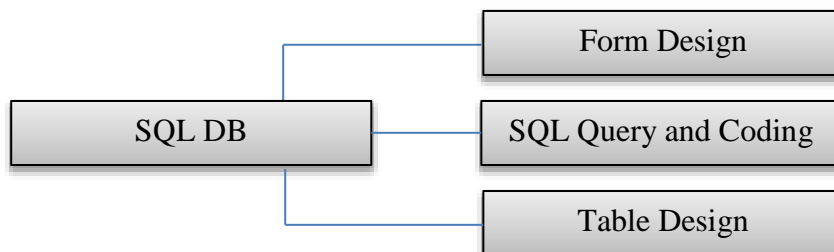
3.2.4 Entity Relationship Diagram

The below entity diagram shows the basic identified entities and the relationship used to develop the system database. Each entity have its unique primary key and its attributes in the real database.

Figure 6: Entity Relationship Diagram
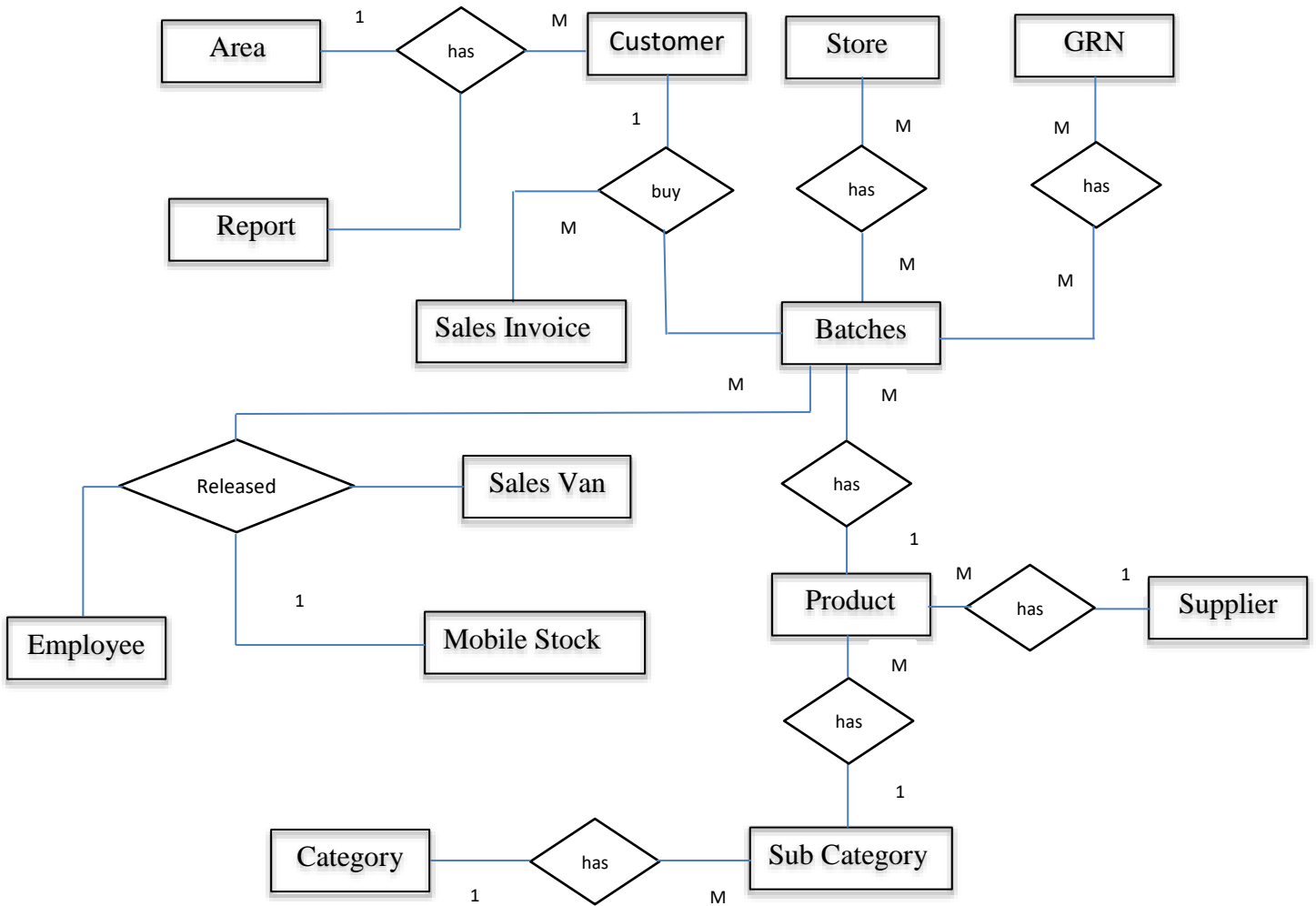
3.2.5 Use Case Diagram

Architecturally significant use cases have an impact on many aspects of design. These use cases are especially important in shaping the success of applications. They are important for the acceptance of the deployed application, and they must exercise enough of the design to be useful in evaluating the architecture. This diagram is drawn using an online UML tool[7].

This use case diagram shows the main activities of the proposed system.

Figure 7: Use Case Diagram
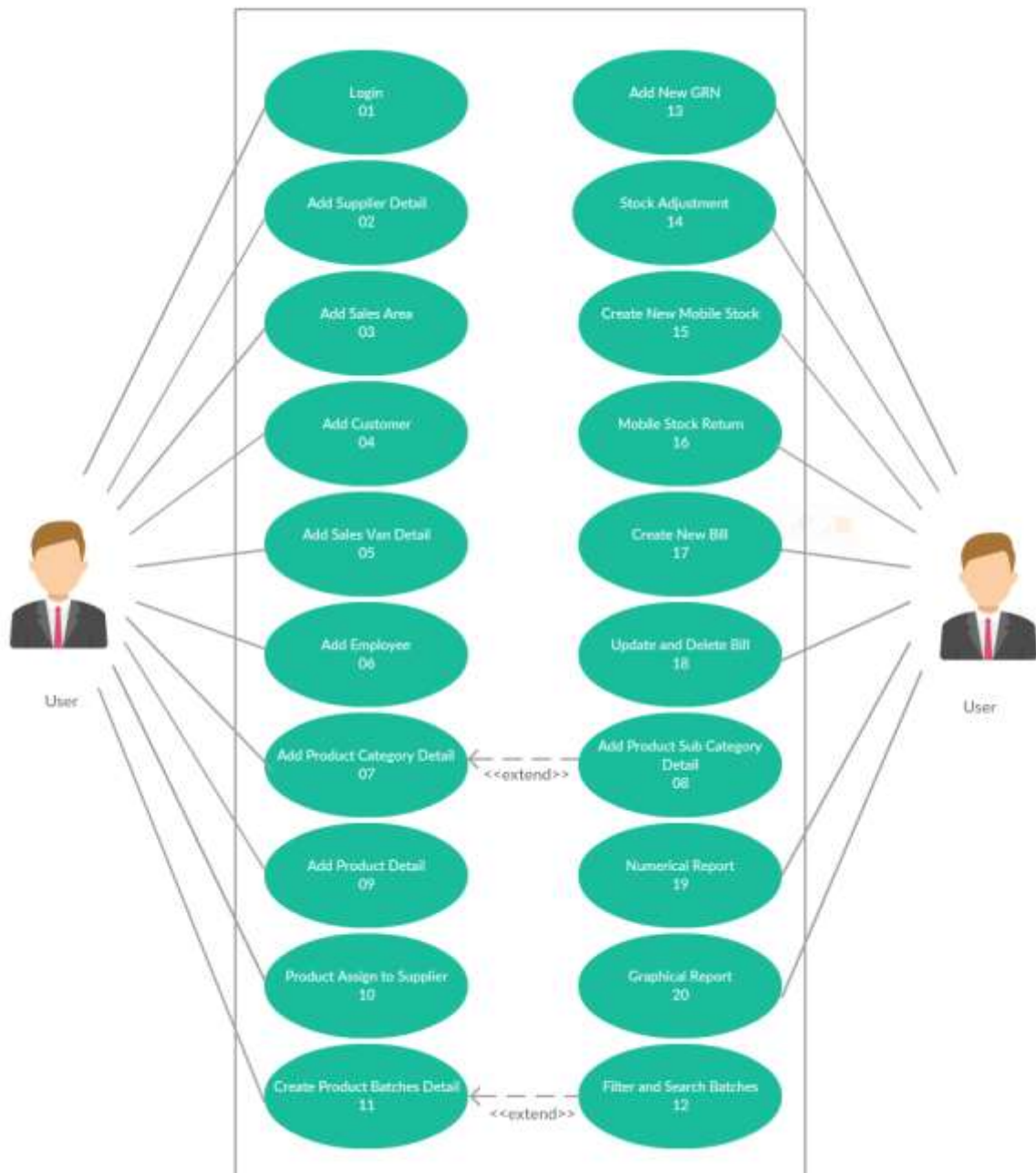
3.2.6 User of the System

The system currently has a single login credential. The system user is responsible for updating and maintaining the database frequently so that the system does not contains incorrect information loaded to the database. The system user is identified as the Accounts Person of the MAGBOOL distributors.

3.2.7 Use Case Activity
3.2.7.1 Use Case Activity 1: System Login

Use case number	01
Use case name	System Login
Actor	Accounts Person
Pre-condition	User must have login detail
Flow of activity	1. User enters user name 2. User enters the password 3. User clicks on login button in order to login to the system 4. User login attempt is successful and directed to the home page
Exceptions	1. a) User types incorrect user name 2. a) User types incorrect password 3. a) System shows error message for incorrect user name or incorrect password b) System stays back to the login page for re-entering the user name / password

Table 3: Use Case Activity 1: System Login

3.2.7.2 Use Case Activity 2: Add Supplier Detail

Use case number	02
Use case name	Add Supplier Detail
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User clicks on **Add** button 2. User enters distributor **Name** 3. User enters **Address**, **Contact No**, **E-Mail** and **Web** address 4. User clicks on **Save** option

	5. System internally generates **Supplier ID**
	6. System shows successful saved message
Exceptions	2. a) System shows error message for empty **Name** field
	3. a) System shows error message for incorrect **Contact No** field
	b) System shows error message for incorrect format of **E-Mail** field entry
	c) System shows error message for incorrect format of **Web** field entry
	d) User click on **OK** and enter or correct relevant field

Table 4: Use Case Activity 2: Add Supplier Detail

3.2.7.3 Use Case Activity 3: Add Sales Area

Use case number	03
Use case name	Add Sales Area
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User clicks on **Add** option
	2. User enters the name of **Area**
	3. Clicks on **Save** option
	4. System generates auto **ID** for area at the back end
	5. System shows the successful message
Exceptions	2. a) System shows an error message for empty **Area** field
	b) User click on **OK** and fill the **Area** field

Table 5: Use Case Activity 3: Add Sales Area

3.2.7.4 Use Case Activity 4: Add Customer

Use case number	04
Use case name	Add Customer
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User clicks on **Add** option
	2. User types the **Name** field
	3. User fills **Address** field
	4. User fills **Contact No** field
	5. User fills **E-Mail** field

	6. User selects the relevant **Area** for the shop
	7. User clicks on **Save** option
	8. System internally generates the **Customer ID**
	9. System shows a successful message
Exceptions	2. a) System prompts an error message for empty **Name** field
	4. a) System shows an error message for incorrect **Contact No field**
	5. a) System shows an error message for incorrect **E-Mail field**
	6. a) System shows an error message to select an **Area** before saving it
	e) User click on **OK** and re-enter the required field

Table 6: Use Case Activity 4: Add Customer

3.2.7.5 Use Case Activity 5: Add Sales Van Detail

Use case number	05
Use case name	Add Sales Van Detail
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User clicks on **Add** option
	2. User enters **Reg No** for the Vehicle
	3. Clicks on **Save**
	4. System internally generates the **ID** field
	5. System shows the success message
Exceptions	2. a) System shows an error message for empty **Reg No** field
	b) User clicks on **OK** to re-enter required **Reg No** field

Table 7: Use Case Activity 5: Add Sales Van Detail

3.2.7.6 Use Case Activity 6: Add Employee

Use case number	06
Use case name	Add Employee
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User clicks on **Add** option
	2. User fills the **NIC** field
	3. User fills the **Name** field
	4. User provides **Address** for the user
	5. User fills single entry or multiple entry for **Contact No** field

	6. User fills the **E-Mail** field
	7. User clicks on **Save**
	8. System internally generates **Employee ID**
	9. System shows a successful message
	10. User clicks on **OK**
Exceptions	2. a) System shows error message for empty or incorrect **NIC** field
	3. a) System shows error message for empty or incorrect **Name** field
	5. a) System shows error message for incorrect **Contact No** field
	6. a) System shows error message for incorrect entry for **E-Mail** field

Table 8: Use Case Activity 6: Add Employee

3.2.7.7 Use Case Activity 7: Product Category

Use case number	07
Use case name	Add Product Category Detail
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User clicks on **Add** option
	2. User fills the **Category** field
	3. User clicks on **Save**
	4. System internally generate **Category ID**
	5. System shows successful message
	6. User clicks on **OK**
Exceptions	2. a) System shows error message for empty **Category** field
	b) User clicks on **OK** and fill the **Category** field

Table 9: Use Case Activity 7: Product Category

3.2.7.8 Use Case Activity 8: Product Sub Category Detail

Use case number	08
Use case name	Add Product Sub Category Detail
Actor	Accounts Person
Pre-condition	User must login to the system,

	User must go to **Product Category and Sub Category Detail** interface
Flow of activity	1. User clicks on a Category from the list which already created 2. User clicks on **Add** 3. User provides **Sub Category** name 4. User clicks on **Save** 5. System internally generate Sub **Category ID** 6. System shows successful massage 7. User clicks on **OK**
Exceptions	3.a) System shows error message for empty for **Sub Category** field b) User clicks on **OK** and fill the **Sub Category** filed

Table 10: Use Case Activity 8: Product Sub Category Detail

3.2.7.9 Use Case Activity 9: Product Details

Use case number	09
Use case name	Add Product Detail
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User clicks on **Add** 2. User enters **Barcode** 3. User enters **Product Code** 4. User enters **Full Name** 5. User provides **Short Name** also 6. User clicks on **More Details** tab 7. User selects relevant **Category** 8. User selects relevant **Sub Category** 9. User provides some **Description** also 10. User click on **Save** 11. System internally generate **Product ID** 12. System shows successful message 13. User clicks on **OK**
Exceptions	4. a) System shows error message for empty **Full Name** field 7. a) System shows error message for not selecting a **Category**

	under **More Details** tab
	8. a) System shows error message for not selecting a **Sub Category** under **More Details** tab

Table 11: Use Case Activity 9: Product Details

3.2.7.10 Use Case Activity 10: Product Assign to Supplier

Use case number	10
Use case name	Products Assign to Supplier
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User selects a **Supplier** from the dropdown 2. User can Selects **Category** under **Unassigned Products** 3. User selects **Sub Category** under **Unassigned Products** 4. User select a product from the **Unassigned Products** list 5. User clicks on > option to assign the selected product 6. User can click >> option to assign all products from the **Unassigned Products list** 7. User can click on < option to unassigned product from **Assigned Products** 8. User can click on << option to unassigned all product from a **Assigned Products list**

Exceptions	1.a) System shows error message for not selecting a **Supplier**
	   b) User clicks on **OK** and select a Supplier
	2.a) System shows error message for not selecting a **Category**
	   b) User clicks on **OK** and select a Category
	3.a) System shows error message for not selecting a **Sub category**
	   b) User clicks on **OK** and select a Sub Category

Table 12: Use Case Activity 10: Product Assign to Supplier

3.2.7.11 Use Case Activity 11: Batches Details

Use case number	11
Use case name	Create Product Batches Detail
Actor	Accounts Person
Pre-condition	User must login to the system

Flow of activity	1. User clicks on **Add** 2. User selects a **Product** from the dropdown list 3. User enters **Batch Code** OR selects an **Expire Date** and then clicks on **Generate Batch Code** 4. User enters **Buy Price** 5. User enters **Sale Price** 6. User click on **Save** 7. System shows a successful message

Exceptions/Alternative Flows	2. a) System shows error message for not selected a **Product**
	3. a) System shows error message for not selected an **Expire Date**
	  b) System shows error message for empty **Batch Code** field
	  c) System shows error message to choose an **Expire Date**
	  d) System shows error message for same **Batch Code** for a particular product
	4. a) System shows error message for empty **Buy Price** field
	5. a) System shows error message for empty **Sale Price** field

Table 13: Use Case Activity 11: Batches Details

3.2.7.12 Use Case Activity 12: Filter and Search Batches

Use case number	12
Use case name	Filter and Search Batches
Actor	Accounts Person
Pre-condition	User must login to the system, User must go to the **Batches Details** interface
Flow of activity	1. User ticks the option **By Products** 2. User selects a product from the **By Product** dropdown 3. User clicks on **Filter and Search** option 4. System shows the relevant batches for selected products
Exceptions	1.a) System shows error message for not selecting **By Product** option 2. b) System shows error message for not selecting a product from the drop down list

Table 14: Use Case Activity 12: Filter and Search Batches

3.2.7.13 Use Case Activity 13: Add New GRN

Use case number	13
Use case name	Add New GRN
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User selects a **Supplier**
	2. User enters **Bill No**
	3. User selects the **Bill Date**
	4. User selects a **Product**
	5. System shows the **Batch** detail for selected product
	6. User selects a **Batch**
	7. User enters **Item QTY** for selected batch
	8. User clicks on **Add** to add the item to GRN list
	9. System shows the added **GRN Items** list
	10. System calculates and shows the **Sub Total**
	11. User enters **Discount Price** for total GRN
	12. System generates and shows **Total** for GRN
	13. User deletes any individual entry in **GRN Items** list
	14. System asks for confirmation to delete
	15. User clicks on **Yes** option to delete OR **No** option to cancel it again
	16. User clicks on **Cancel** in order to cancel the GRN
	17. User clicks on **Save**
	18. System Shows successful message
	19. User clicks on **OK**
Exceptions	1. a) System shows error message for not selected any **Supplier**
	2. a) System shows error message for empty **Bill No** field
	4. a) System shows error message for not selected any **Product**
	6. a) System shows error message for adding same **Batch** of a particular product currently available in the GRN list
	7. a) System shows error message for empty **Item Quantity** field

Table 15: Use Case Activity 13: Add New GRN

3.2.7.14 Use Case Activity 14: Stock Adjustment

Use case number	14
Use case name	Stock Adjustment
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User selects a **Product** to make an stock adjustment 2. System shows the **Batch** available for selected product 3. User selects a particular batch from the **Batch** list 4. System sows the **Available QTY** for selected batch 5. User enters the **Amend QTY** to be reduced from the **Available Quantity** 6. Users clicks on **Add** option to add it to the below list 7. System internally check the **Amend Quantity** with **Available Quantity** 8. System shows the list bellow 9. User deletes entry to cancel any Amendment 10. System asks for a confirmation to delete 11. User clicks on **Yes** to delete OR **No** to cancel the delete again 12. System makes the changes internally for stock 13. User clicks on **Save** to make the amendment in stock 14. System shows successful message 15. User clicks on **OK** finally
Exceptions	1. a) System shows error message for not selecting a product 5. a) System shows error message for empty field of **Amend QTY** b) System shows error message for exceeded quantity of **Amend QTY** with **Available QTY**

Table 16: Use Case Activity 14: Stock Adjustment

3.2.7.15 Use Case Activity 15: Create New Mobile Stock

Use case number	15
Use case name	Create New Mobile Stock
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User selects **Van**
	2. User selects **Supplier**
	3. User selects **Sales Rep**
	4. Users select **Product**
	5. System shows all batches for selected **Product**
	6. User selects a particular **Batch**
	7. User enters **Item QTY**
	8. User clicks on **Add** option to **create Stock Items**
	9. System shows the added list under **Stock Items**
	10. Users deletes an entry from added **Stock Items** to delete if needed
	11. System asks for confirmation to delete
	12. User clicks on **Yes** to delete or **No** not to delete
	13. User clicks on **Save** option
	14. System shows successful message
	15. User clicks on **OK** finally
Exceptions	1. a) System shows error message for empty **Van** field
	b) System shows error message for trying to create mobile stock for a vehicle which is already having a stock
	2. a) System shows error message for **Supplier** field
	3. a) System shows error message for **Sales Rep** filed
	4. a) System shows error message for empty **Product** field
	7. a) Systems shows error message for empty **Item QTY** field
	b) System shows error message if the **Item QTY** entered is greater than stock quantity
	8. a) System shows error message for not created **Stock Items** list

Table 17: Use Case Activity 15: Create New Mobile Stock

3.2.7.16 Use Case Activity 16: Mobile Stock Return

Use case number	16
Use case name	Mobile Stock Return
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User clicks on **Mobile Stock ID** 2. System shows relevant detail **Van, Supplier and Sales Rep** for the selected **Mobile Stock ID** 3. System also shows **Stock Items** detail 4. User selects an row to return 5. User clicks on **Save** option 6. System shows successful return message
Exceptions	1. a) Systems shows an error message for not selecting a **Mobile Stock ID**

Table 18: Use Case Activity 16: Mobile Stock Return

3.2.7.17 Use Case Activity 17: Create New Bill

Use case number	17
Use case name	Create New Bill
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User selects a **Mobile ID** from the drop down list 2. System shows the **Van** detail, **Supplier** detail and **Sales Rep** detail for the selected **Mobile ID** 3. System also shows the **Status** 4. User enter a **Receipt No** 5. User selects a **Product** from the drop down list 6. System shows the **Batch** detail available in the selected **Mobile ID** 7. User enters the **Item QTY** for billing 8. User clicks on **Add** button to add the item to **Bill Items** list 9. System shows the **Sub Total** and the **Total** 10. User clicks on **Delete** option from the **Bill Items** list if its required

	11. User enters a **Discount Price**
	12. User picks an Area from the drop down list
	13. User also picks an Customer from the drop down list
	14. User clicks on **Save**
	15. System shows successful message
Exceptions	1. a) System shows error message for empty **Mobile Stock ID**
	4. a) System shows error message for empty field of **Receipt No**
	5**.** a) System shows error message for **Product**
	7**.** a) System shows error message for empty field of **Item QTY**
	b) System shows error message for **Item QTY** larger than **STOCKED QTY**
	11. a) System shows error message for **Discount Price** larger than **Sub Total**
	12. a) System shows error message for empty field of **Area**
	13. a) System shows error message for empty field of **Customer**

Table 19: Use Case Activity 17: Create New Bill

3.2.7.18 Use Case Activity 18: Update and Delete Bill

Use case number	18
Use case name	Update and Delete Bill
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User selects the option **Select Bill or**
	2. User Selects the option **Select Customer**
	3. User picks an **Area** from the drop down for **Select Customer** option
	4. User also picks a Customer from the drop down for **Select Customer** option
	5. System shows all relevant **BILL NO** in the grid view
	6. User selects on a **BILL NO** to update the payment
	7. System shows all required detail for the selected **BILL NO**
	8. User enters the amount in **Update Payment** to update outstanding
	9. User clicks **Save**

	10. System updates the detail and shows successful message
Exceptions	6.a) System shows error message for not selecting a **BILL NO** from the list 8. a) System shows error message for empty field of **Update Payment** b) System shows error message for **Update Payment** value larger than **Outstanding** amount

<p align="center">Table 20: Use Case Activity 18: Update and Delete Bill</p>

3.2.7.19 Use Case Activity 19: Numerical Report

Use case number	19
Use case name	Numerical Report
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User selects an area from the **Area** drop down list or 2. User selects a customer shop **Customer** drop down list or 3. User provides a date range from the calendar 4. User clicks on **Print** option 5. System generates and shows the report
Exceptions	1.a) System shows error message for empty file of **Area** 2. a) System shows error message for empty file of **Customer** 3. a) System shows error message for not providing a date range

<p align="center">Table 21: Use Case Activity 19: Numerical Report</p>

3.2.7.20 Use Case Activity 20: Graphical Report

Use case number	20
Use case name	Graphical Report
Actor	Accounts Person
Pre-condition	User must login to the system
Flow of activity	1. User selects a desired option from **Area** or **Customer** or **Date Range** 2. User selects **Type of Analysis** 3. User selects **Type of History** 4. User provides other required details

	5. User clicks on **Print** option
	6. System generates and shows the report
Exceptions	1.a) System shows error message for empty file of **Area**
	b) System shows error message for empty file of **Customer**
	c) System shows error message for not providing a date range
	2. a) System shows error message for not selected **Type of**
	Analysis
	3.a) System shows error message for not selected **Type of**
	History

Table 22: Use Case Activity 20: Graphical Report

3.2.8 Class Diagram

The static view of the system module is shown here using class diagram. This diagram has been drawn using an online tool [7].

Figure 8: Class Diagram
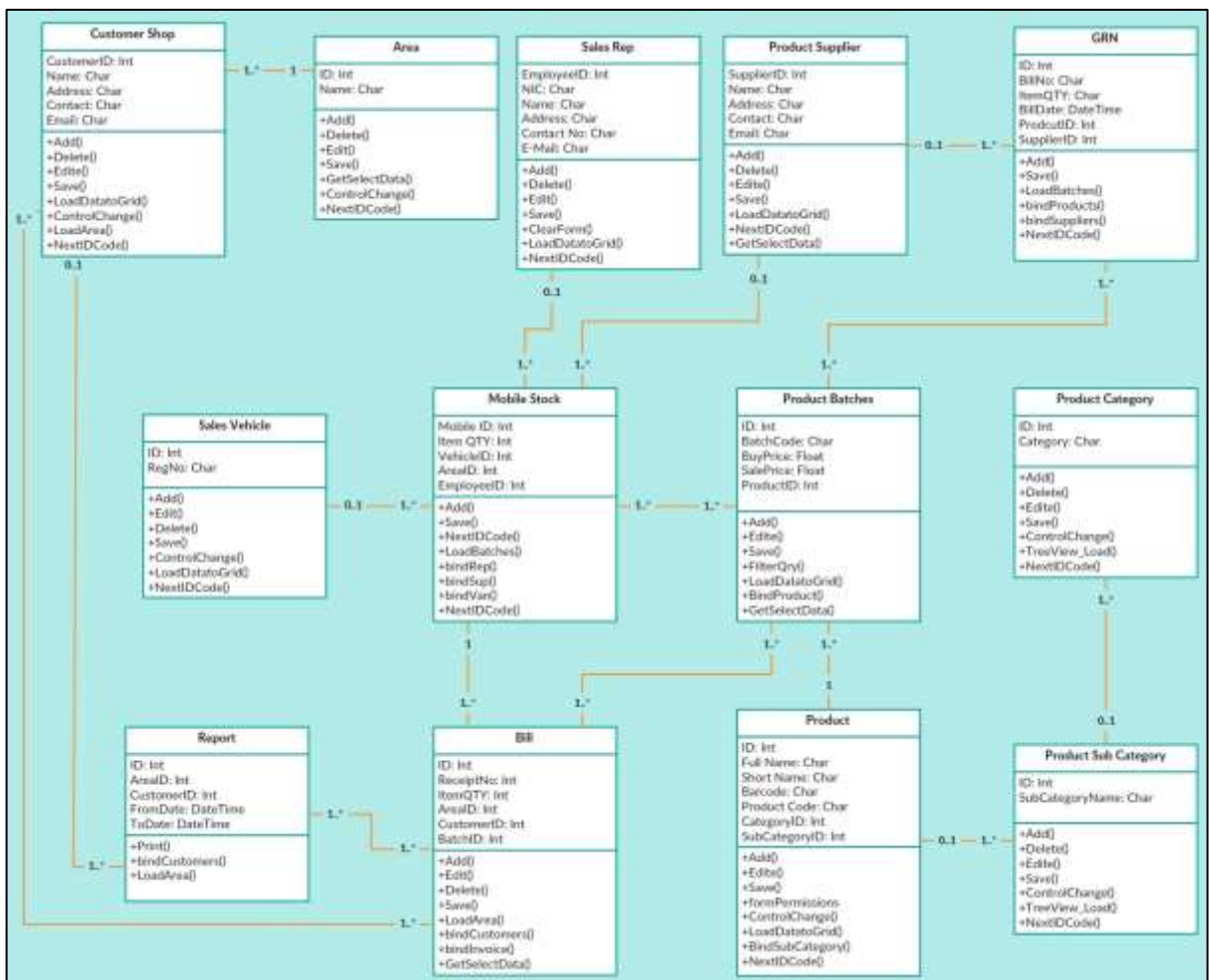
3.2.9 Graphical User Interface

The graphical user interface is an important feature for any computerized system. Because of the complex nature of the real world business functionalities, it is vitally important that the GUI should be easy to use and easy to understand. It is my experience that many current software available on the market are strong, but weak when it comes to a simple understandable interactive interface. User interface modelling for this system has been carried out by considering end user that he/she does not need to be a technical knowledge person.

Figure 9: Login Screen

This is the login interface of the system in which the user can type the user name and password in order to login. This interface contains the business client logo to represent that the system is belongs to the MAGBOOL business client. And by indicating the version number here, it is represented that modifying and releasing new version from this first version is possible in future.

Figure 10: Adding Supplier Detail

Add, Edit and **Delete** are the three active option in this interface. The **Name** field is necessary to save records. Other fields are optional. **Contact No** field allow the user to have multiple phone number having separated either by comma or space. **E-Mail** and **Web** field are validated using string patterns. Pressing the **Add** button will enable the fields to enter details in order to save records. **Supplier ID** is auto generating filed and user cannot type or edit this field.
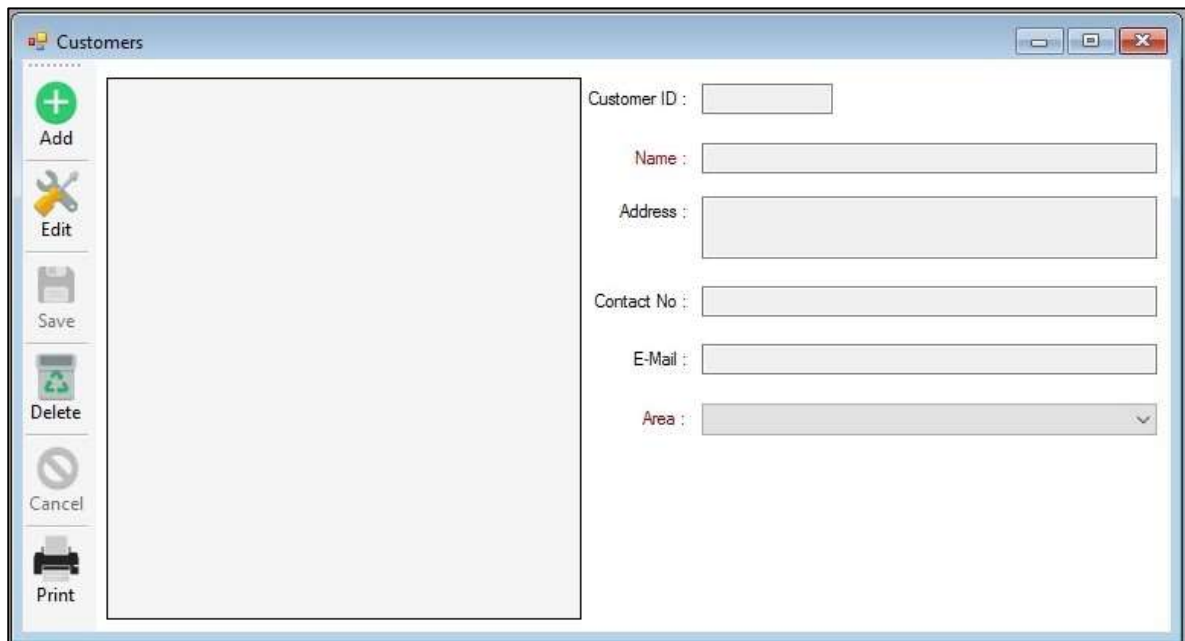
Figure 11: Adding Sales Area Detail

Add, **Edit and Delete** options are active here. **Area** field is necessary to save a record. **ID** is auto generating field which cannot be edited by user.
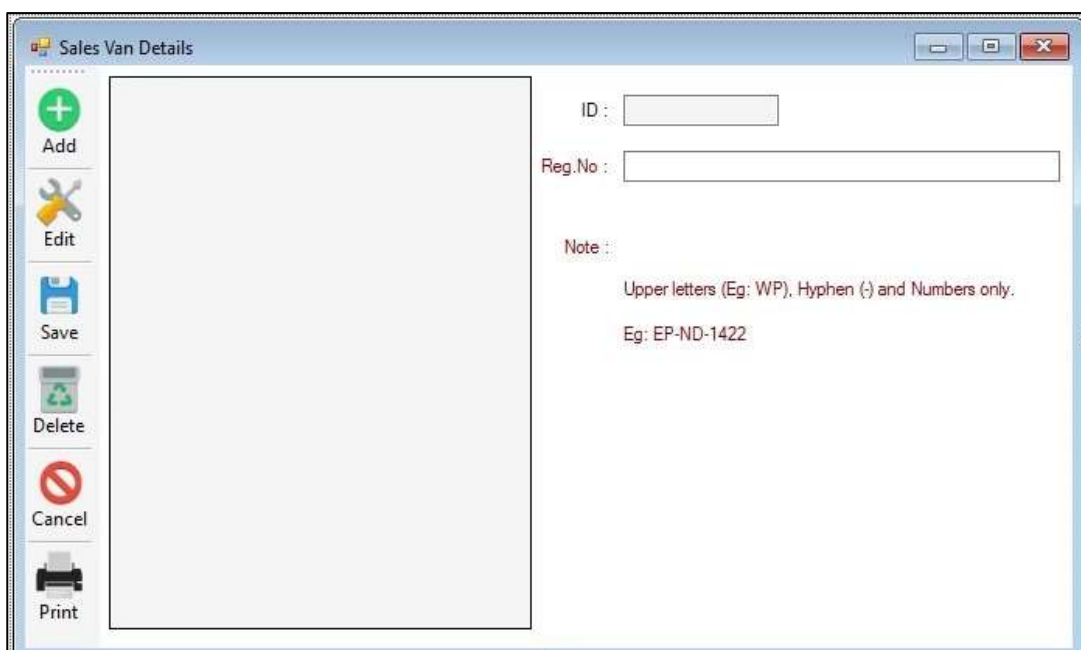
Figure 12: Adding Customer Shop Detail

Add, **Edit and Delete** are active in this interface. **Name** and **Area** fields are necessary to be filled to save a record. **Contact No** field allow the user to have multiple phone number having separated either by comma or space. **Customer ID** is auto generating field. Address is optional field. The E-Mail address field is also an optional field. But it is validated when inserting records.
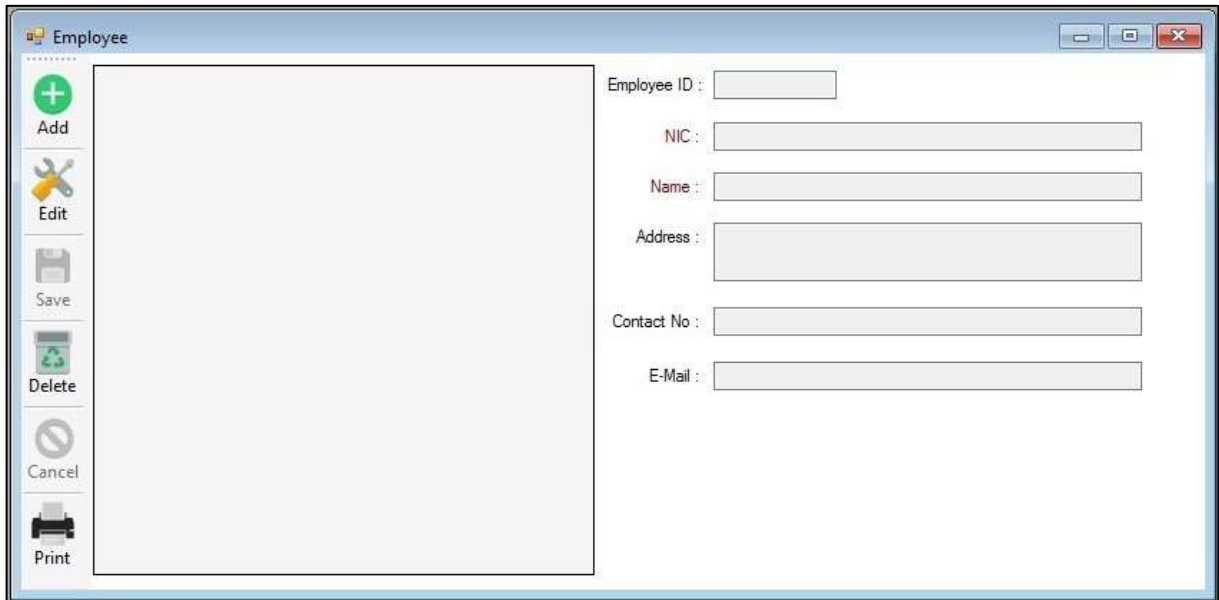
Figure 13: Adding Sales Van Detail

Reg. No is necessary here while the **ID** is generated automatically for new record. **Reg. No** field allows only upper letters, hyphen and numbers only. It is advised that the user has to follow the format provided in the **Note** section in this interface. **Add, Edit** and **Save** features are active in this interface.
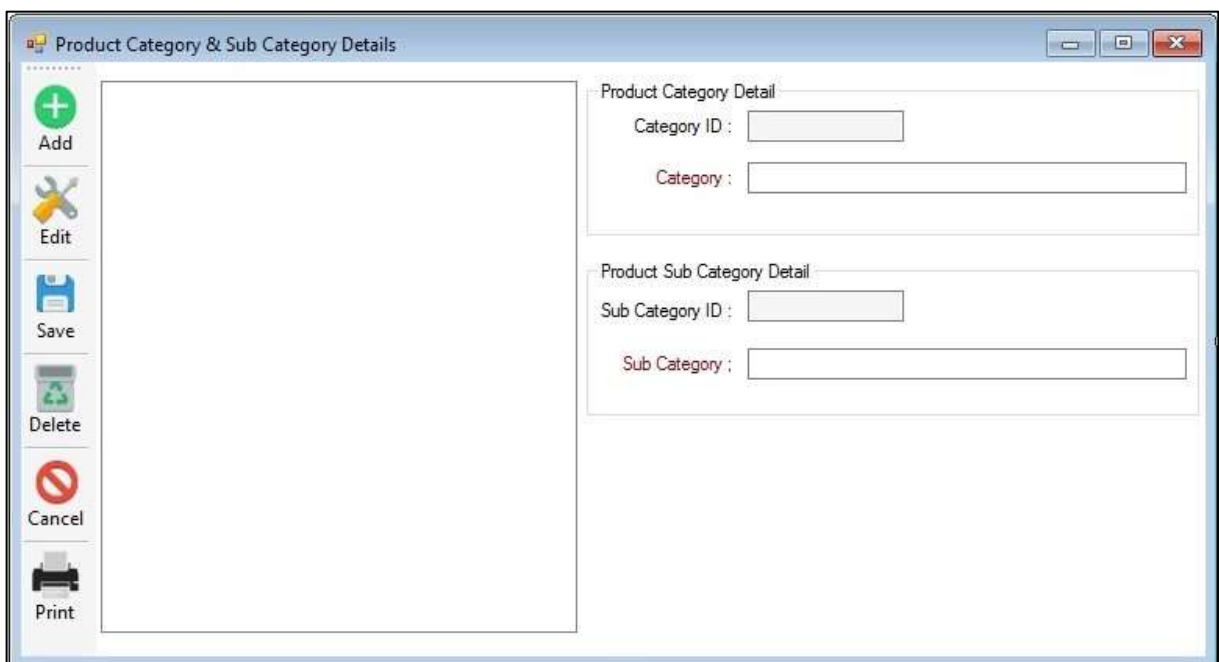
Figure 14: Adding Sales Person Detail

NIC and **Name** are necessary while other fields are optional here. Multiple contact numbers are allowed. **Add**, **Edit**, **Delete and Save** options are made active here.

Figure 15: Adding Category and Sub Category
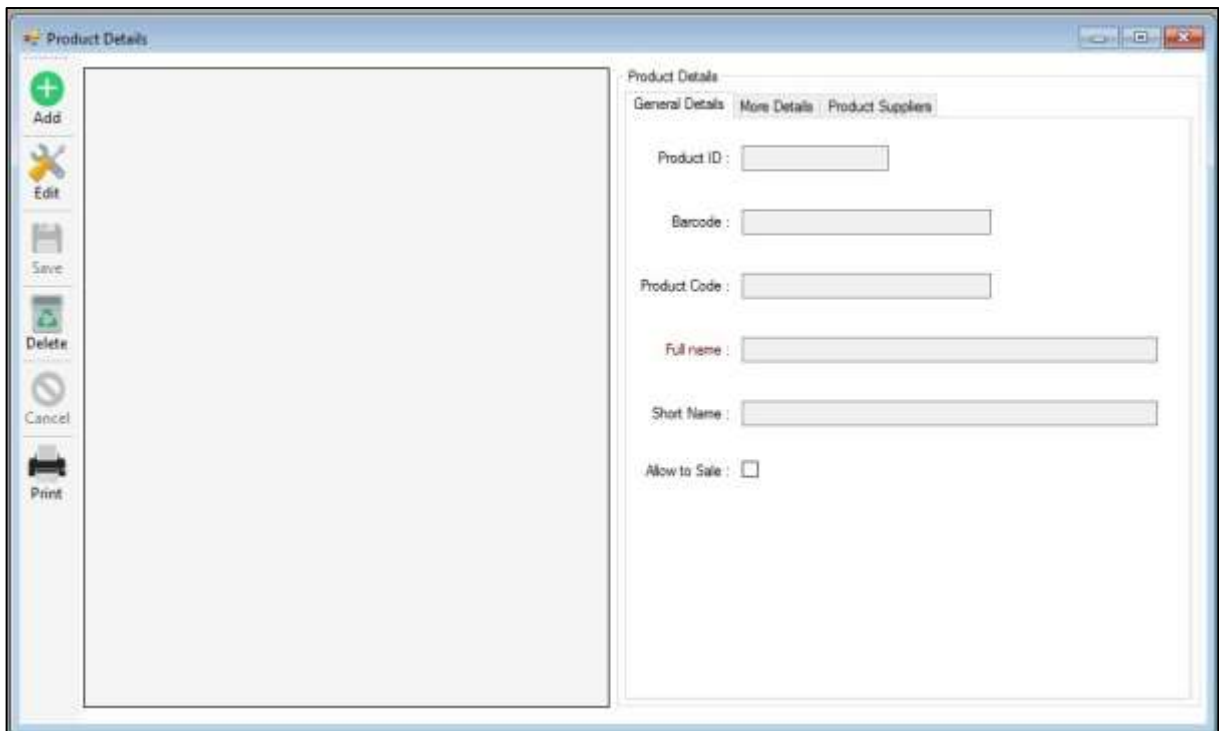
Category has to be created first by clicking the **Add** button. Then only **Sub Category** can be created for a selected category. Both the **Category** and the **Sub Category** cannot be blank for creating new record. **Add, Edit, Save** and **Delete** options are active in this interface. This interface shows the created categories and sub categories. So, for editing and deleting, user has to select relevant record from the interface display.

Figure 16: Adding Product Detail

This interface has three sub tabs which are **General Details, More Details** and **Product Suppliers**. **General Details, More Details** have fields which are to be filled by the user when creating new record while the Product Suppliers tabs shows the product supplier name for selected product from the list. Full Name in the **General Details and the Category and Sub Category** in the **More Details** are made as necessary. **Add** and **Edit** fields are active. Record from the grid view has to be selected in order to perform edit operation here. Selecting a product from the list and clicking on the **Print** options loads the stock level report for the selected product. The figure 17 and 18 shows the **More Details** and **Product Suppliers** sub tabs view of the figure 16.

Figure 17: Adding Product Detail - More Detail
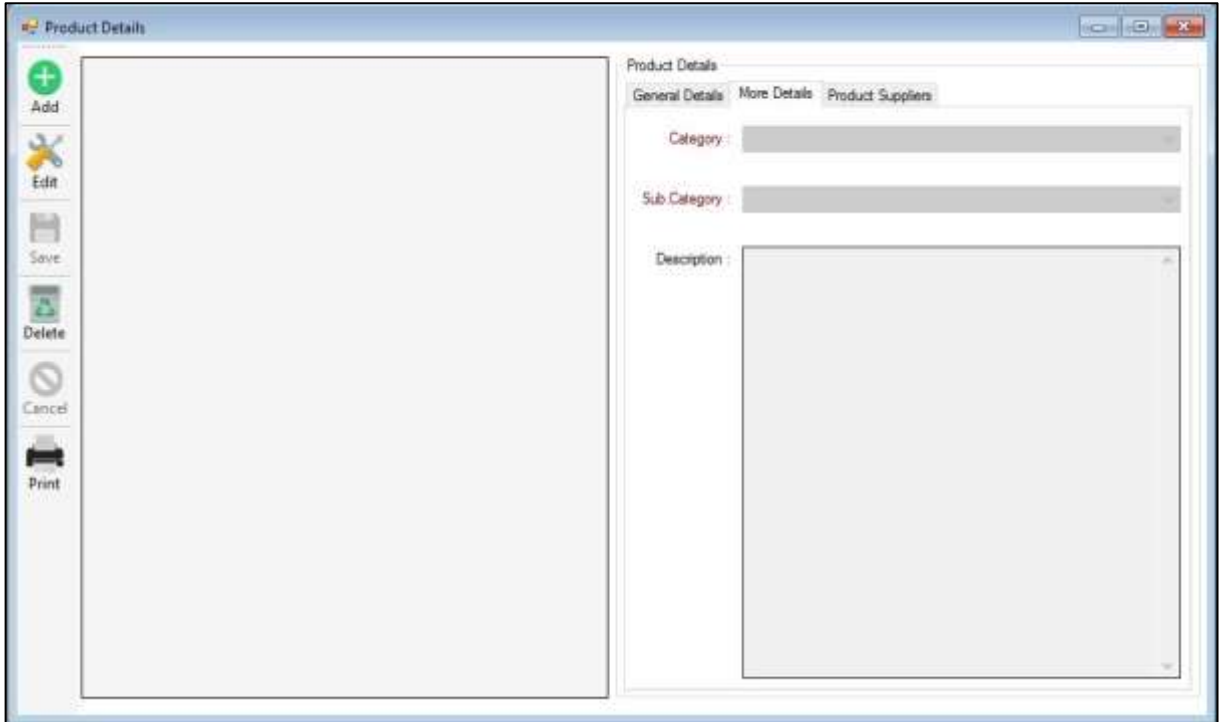
Figure 18: Adding Product Detail - Product Suppliers
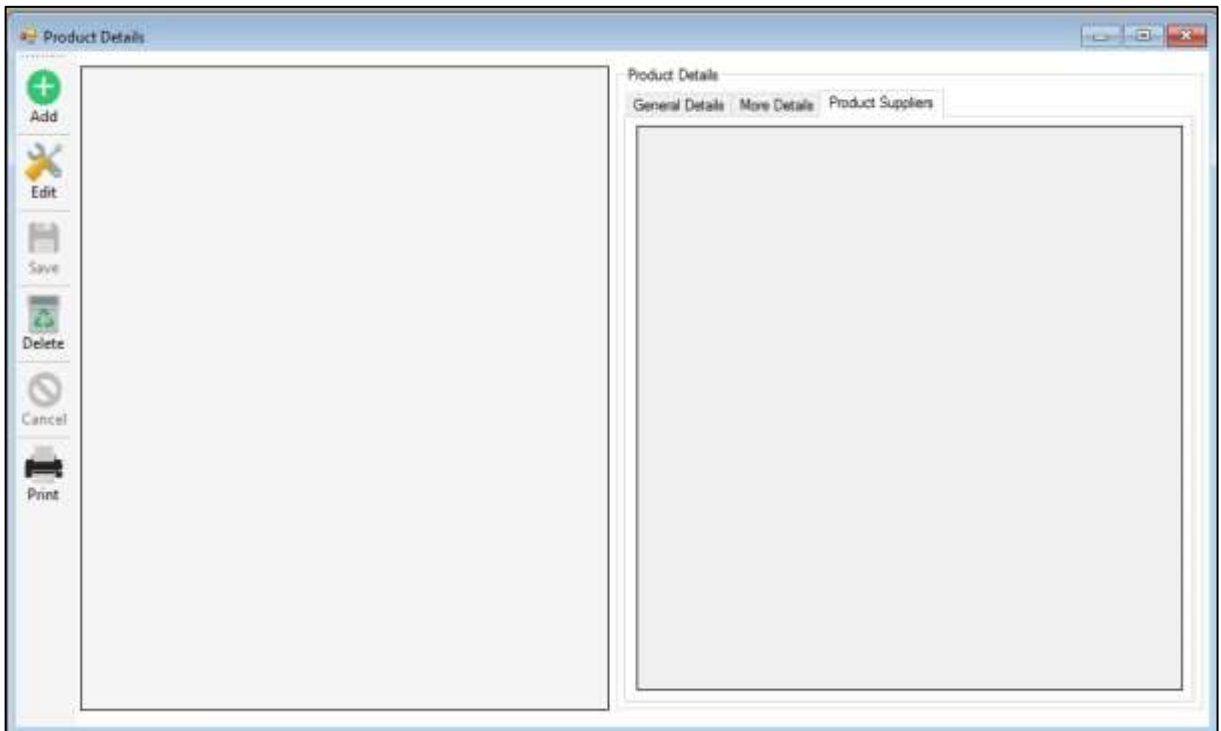
Figure 19: Assign Products to Supplier
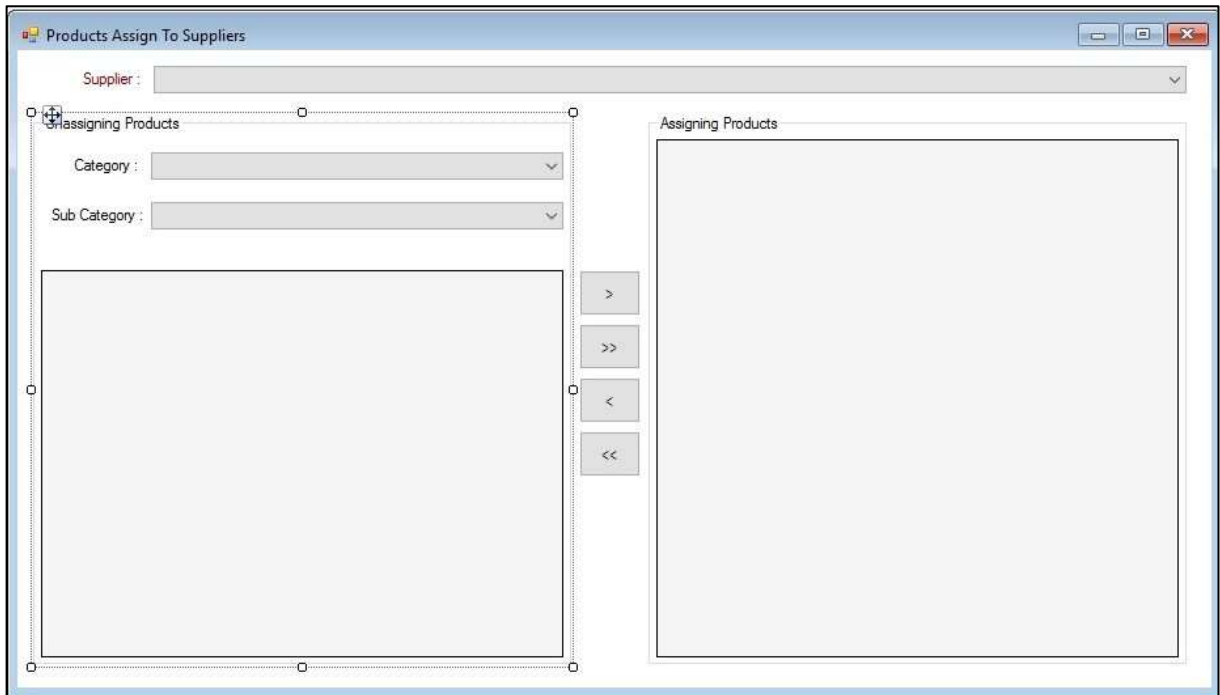
Supplier filed is necessary in order to assign a product here. Un-assigned products can be viewed by selecting the **Category** and **Sub Category** drop down. Then any selected product can be assigned as well as un-assigned for a selected supplier.

Figure 20: Adding Batches Detail
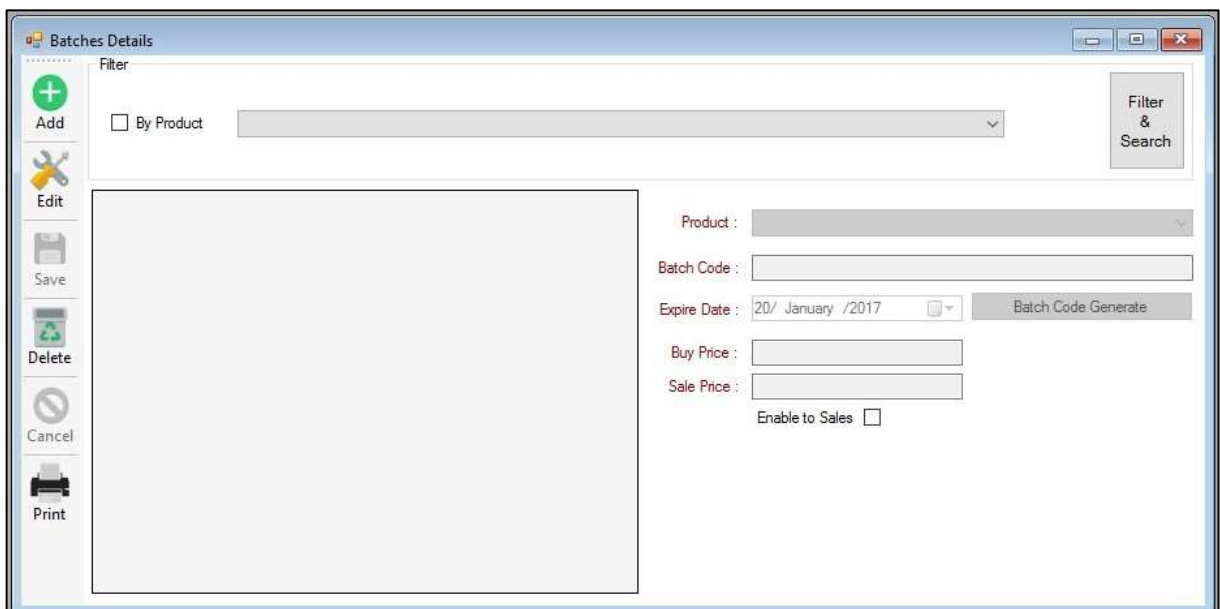
Selecting a product, generating or typing batch code by selecting an expiry date, filling **Buy Price** and **Selling Price** fields are mandatory for creating new record here. List of created batch detail is shown in the interface. To edit a record, user has to first select the particular record from the list in the interface. User can modify **Expire Date, Buy Price** and **Selling Price** in

31

this interface. **Add, Edit** and **Save** options are active in this interface. This interface has another features to search and see what are the batches already exist for a selected product. In order to search and filter result, it is mandatory to tick the option **By Product** and select a product from the drop down list.

Figure 21: Create New GRN

This interface is used to load products into the main store. **Supplier, Product** has to be selected from the drop down and **Item QTY** has to be provided in order to load products. **Add, Save** and **Cancel** options are active here. Successful save will increase the product quantity in the main store database.

Figure 22: Stock Adjustment
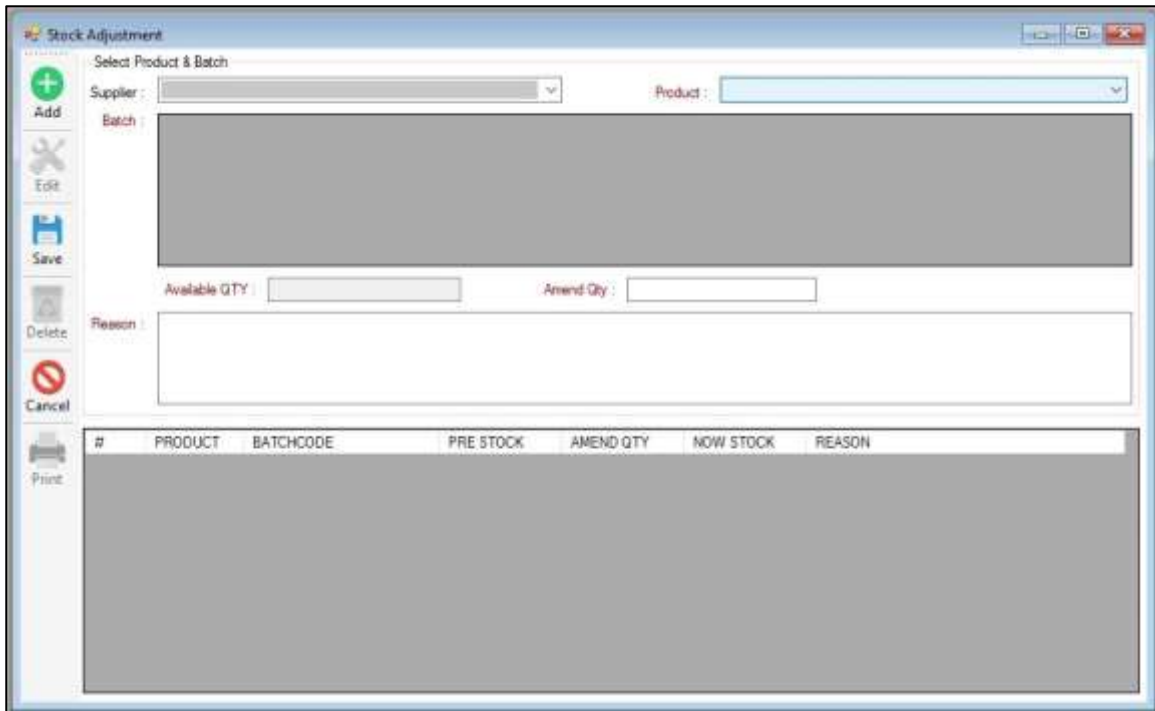
This interface is used to do amendment in the main stock database. When user select a supplier and a product from the drop down, the system will load the related batches in the grid view. Quantity availability of batches can be viewed here. Then the user has to provide **Item QTY** to make reduction in the main stock quantity and provide a reason for doing this amendment. By clicking the **Add** button user can add more than one batches in the second grid view and finally saving the result will do the reduction in the main stock database.

Figure 23: Create New Mobile Stock
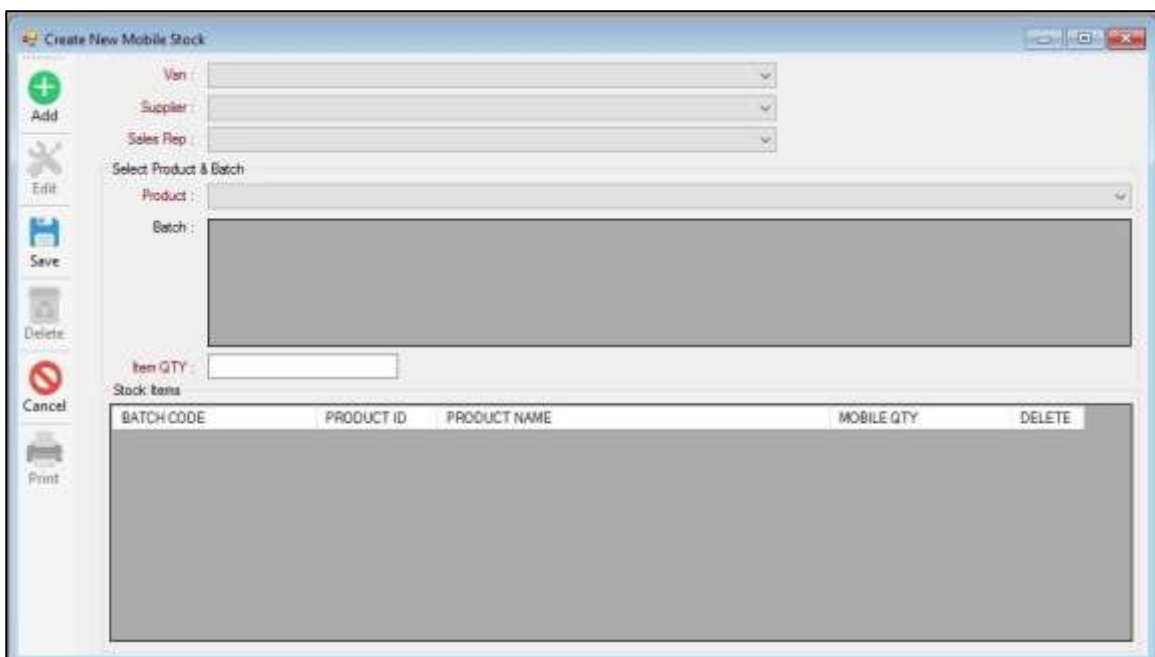
Basically user has to select a **Product** in order to create a mobile stock. For that user should select a **Supplier** from the drop down list. Then user should provide a quantity for selected product batches. This quantity should not exceeded to the main stock available quantity. User is able to add more than one item to the **Stock Item** list here. If the desires to delete any added list from the **Stock Item** list, then that is also possible here. After all list are added to the Stock Item list, then the **Van** field and the **Sales Rep** filed is necessary to be filled to save the mobile stock record.

Figure 24: Mobile Stock Return

Returning a mobile stock is required **Mobile Stock ID** to be selected first. This interface does not show all the mobile store created in the full history. It only shows the mobile stock ID which are not yet released to main stock. So it is important that all bills has to be created for a particular mobile stock before returning the mobile stock. If the user confirms that all bills are recorded, then it is very easy to compare the remaining quantity in the system mobile stock with physically available quantity in the sales van. This helps the user to easily check and see if any item is missing. If the remaining quantity in the system mobile stock is same as the physical quantity in the sales van, then it is clear that sales for that particular mobile stock has no incorrectness. This ensures that there is no way of preparing a fraud bills for unsold item by sales person. Also sales person has no way of hiding any item form he mobile stock. Even though this process was done manually earlier, it has been speedup by this computerized system. So this is one of the very impotent interface in the system business process.

Figure 25: New Bill

User has to first add items from the selected mobile stock to the Bill Items grid view. To do that there are three mandatory fields in this interface such as **Mobile Stock ID** drop down, **Product** drop down and **Item QTY** which have to be filled. Otherwise the user cannot add any product to the **Bill Item** grid view. Details like **Van, Supplier** and **Sales Rep** are shown for a selected **Mobile Stock ID.** This seems useful for the user to verify which mobile stock is selected. After added item or items to the **Bill Items** grid view, use can save the bill record. To save this, the other fields in this interface such as **Receipt No, Area** and **Customer** has to be filled. Use has an option to delete any **Bill Items** record view before saving the final record. User can provide advance payment and discount amount detail and see the total in this interface. **Add** and the **Save** options are the main active features in this interface.

Here, user is required to tick an option from **Select Bill** and **Select Customer**. If user select the option **Select Bill**, then it is allowed to select any of the **BILL NO** from the list. When the user tick the option **Select Customer**, then there is a requirement to select an **Area** and a **Customer** from the drop down. Then only the user is allowed to select any of the **BILL NO** from the list. The main purpose of this interface is to update the payment detail by providing collection amount for the **Outstanding** in the **Update Payment** filed. Selecting a bill here, shows some important information from the database for the purpose of providing a good review to verify before update the payment. Deleting a bill also possible in this interface.

Figure 27: Sales Detail Report
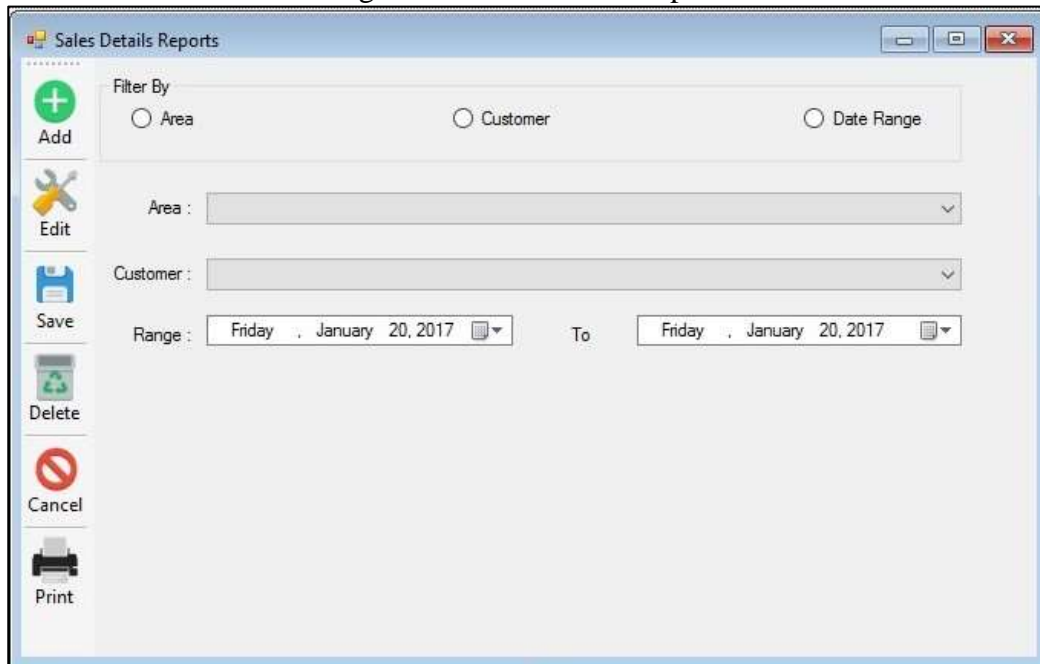
This is one important interface since it is generating reports for the whole process. Even though this is single interface, this actually provides three types of report view. One is area wise report, the second one is customer wise report and the last one is the date rand report. So user can tick an option to generate a report. User has the permission to provide date range when selecting report either area wise or customer wise. The **Print** button loads the report view for the selected option.

Figure 28: Daily Sales Analysis
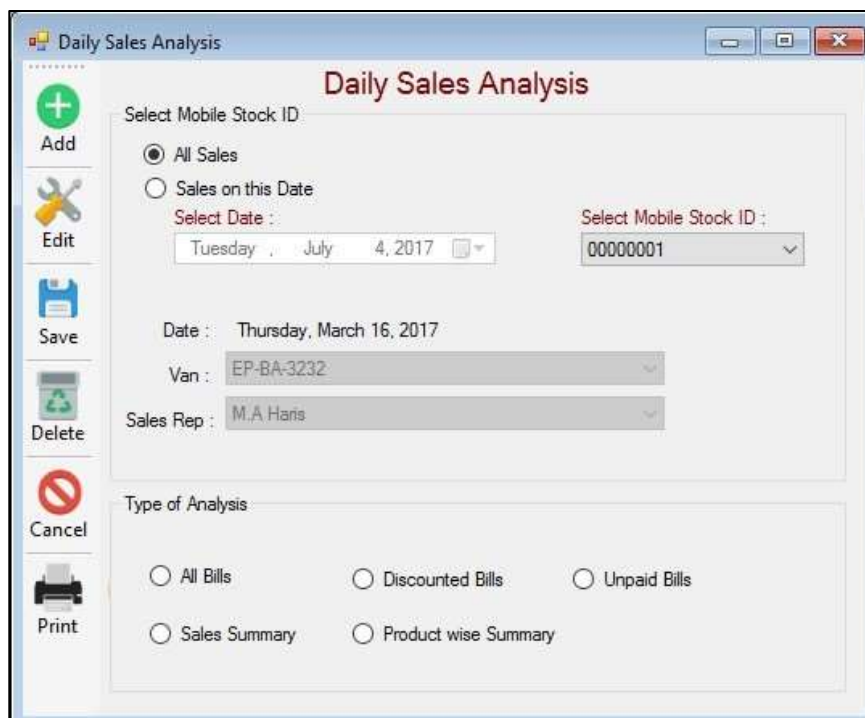
This user interface is used to generate analysis of daily sales separately. There are five types of analysis available for the user to pick one at a time. The output of this analysis will be graphical report view with relevant information. User has to select a **Mobile Stock ID** in order to generate do this analysis.

Figure 29: Supplier wise Analysis

This supplier wise analysis has six graphical report view. User has to select a supplier in order to generate do an analysis. The analysis can be generated based on the full history or for a date range history.

Figure 30: Product wise Analysis
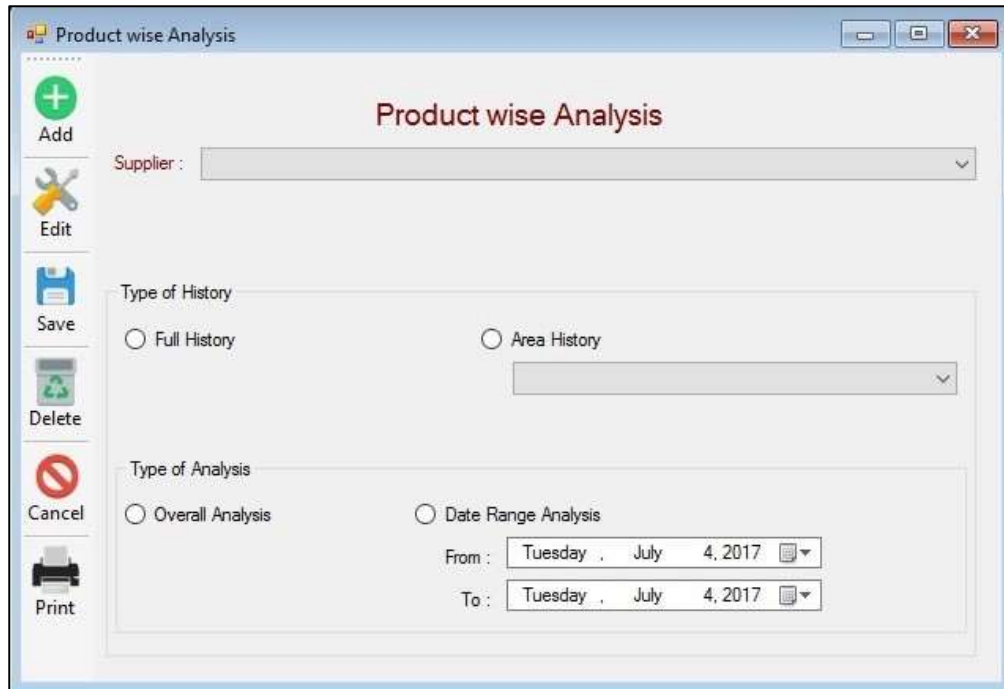
This user interface has a capability of generating four graphical view of product wise analysis. The analysis can be generated for full sales history or for a date range history. Also the output will represent the total sales area or a selected single sales area.

Figure 31: Area wise Analysis
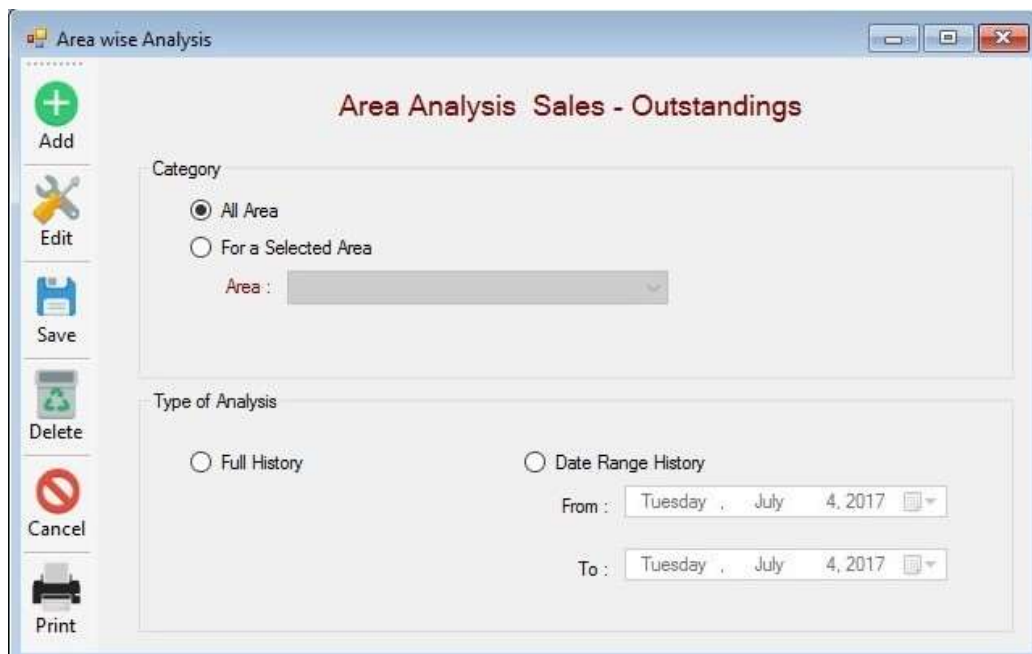
This area wise analysis interface is attached in the system for the purpose of doing analysis for sales and outstanding only. This can be either all area analysis or a single selected area analysis. Here also it is possible to do analysis for full history or for a selected single area.

Figure 32: Stock Analysis
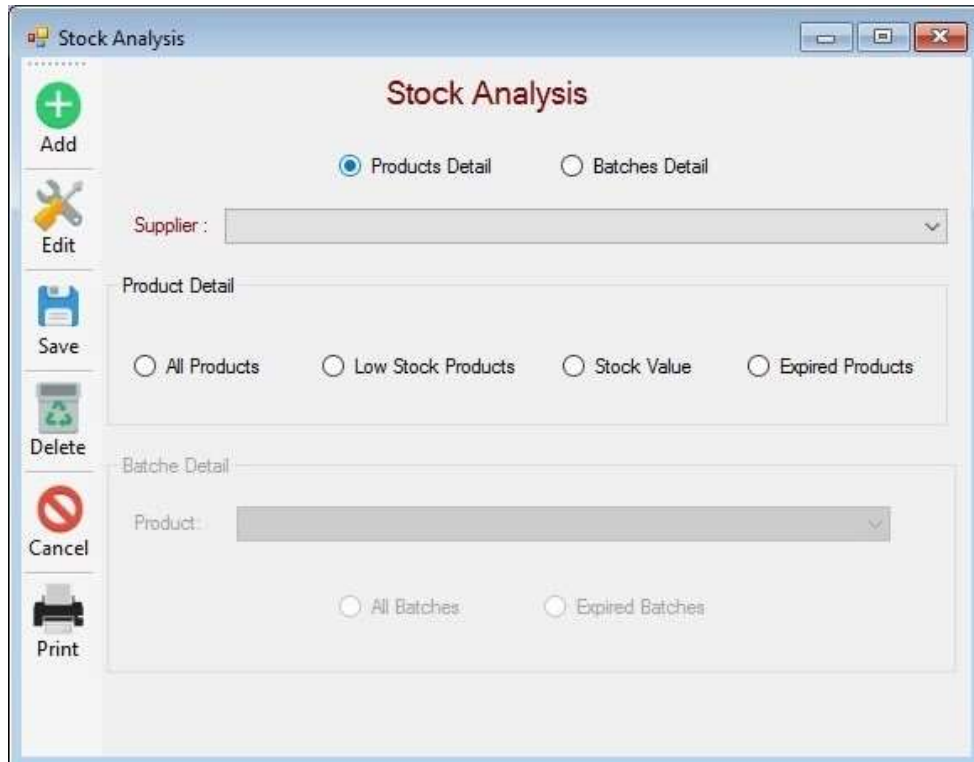
This user interface enables analysis for stock detail. There are six analysis available in the user interface. Stock analysis can be done for products or for batches in a selected product.

Figure 33: Profit Analysis
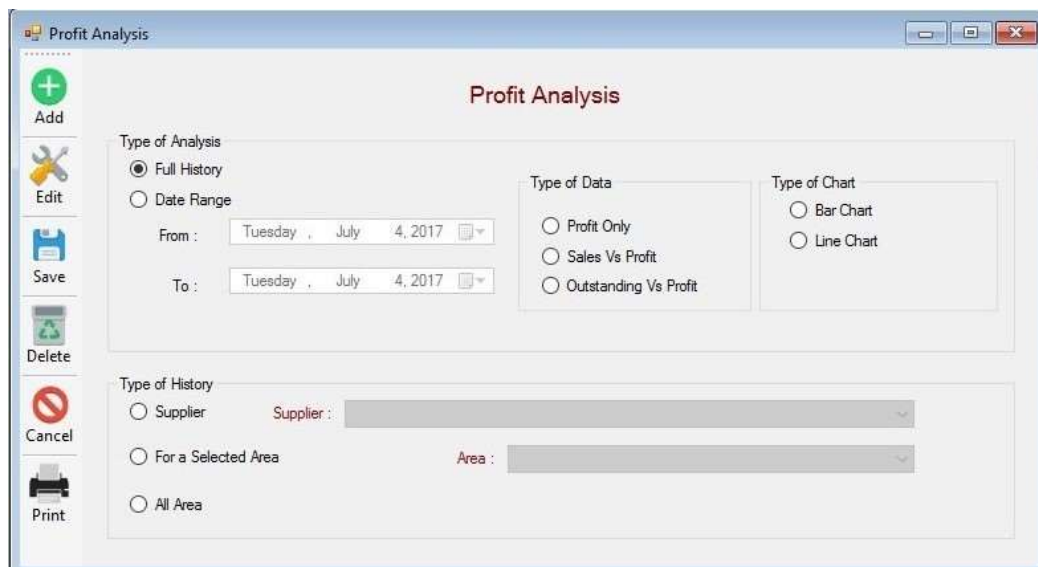
This is one of the most important user interface in the MIS component of the system. Doing profit analysis for full history or for a date range history with selecting type of information is enabled in this user interface. With having three history type, this interface has options to generate the graphical view either for bar chart or line chart. There are eighteen graphical view of different analysis available in two different type of graphs.

4. Implementation

The Waterfall Development model was followed to implement the project by considering the required amount of resources. The Waterfall model is the simplest method to implement a project and it requires a minimal amount of resources while it has high visibility.

4.1 Planning

Figure 34: Waterfall Development Model

```
┌─────────────────┐
│   Requirement   │
└─────────────────┘
      │
      └──▶┌─────────────────┐
          │     Design      │
          └─────────────────┘
                │
                └──▶┌─────────────────┐
                    │ Implementation  │
                    └─────────────────┘
                          │
                          └──▶┌─────────────────┐
                              │  Verification   │
                              └─────────────────┘
                                    │
                                    └──▶┌─────────────────┐
                                        │   Maintenance   │
                                        └─────────────────┘
```
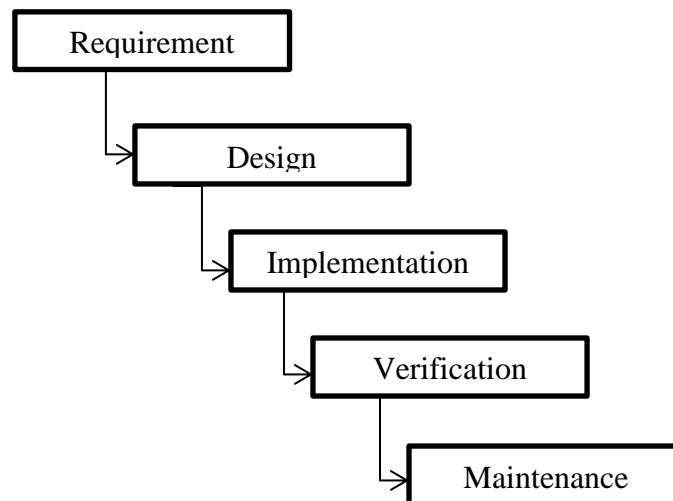
In software development task, planning plays a major role. Since the project is a small and medium solution, the suitable process model is the Waterfall Model. Waterfall Development Model is the basic model which is easy to understand and manage. Also the FMGDMS system is a short term project with clearly identified requirements. Each phase was processed and completed one at a time and the testing was started after the completion of the development.

The first aspect of the design stage was to break the initial aims and objectives down into a number of tasks and subtasks. These tasks were assigned start and finish times. Then a number of milestones were then identified by analyzing the project deliverables. An analysis was produced by listing a number possible problems and detailing proposed solutions. The combination of the each frequency and severity were considered when planning and scheduling the time frames for each individual task.

The task list was then used to produce a Gantt chart. This gave a clearer breakdown of the tasks and allowed to schedule easier. The Gantt chart played a crucial role in time keeping of the project and was often referred back to in order to ensure the tasks were completed on time and were deliverables meeting their deadlines.

4.2 Backup Management

A folder structure was maintained to keep backups of all development work including code and diagrams on an external hard disk until the final version is completed. Backup of the most recent changes of the application were also kept. This was done to minimize the impact of lost work. This was very helpful when some of the changes ended up with unresolvable errors. So going back to the very recent version and start doing modifications was the easiest solution when facing major errors which had no way of resolving.

4.3 Programming Languages

It would be possible to implement this project using huge number of programming languages and the choice for FMGDMS application is the C# with .NET framework since Microsoft Visual Studio is one of the widely used most reliable tool in programing world.

4.3.1 Why C#?

C# is pretty good language for developing business applications targeting a windows environment and most small to medium business which allow end user to retrieve and manipulate information from a data storage server easily and effectively. Also the C# and the .NET Framework has been designed to produce powerful, interoperable desktop applications quickly and efficiently.

The common language runtime and the .NET Framework provide many useful classes and services that enable developers to easily write secure code and enable system administrators to customize the permissions granted to code so that it can access protected resources. In addition, the .NET Framework provides useful classes and services that facilitate the use of security.

4.4 Database Design

MS SQL is used to create database tables for the system. The identified main entities are shown in the entity relationship diagram in the section 3.2.8

4.4.1 Why MS SQL?

SQL Server provides a security architecture that is designed to allow database administrators and developers to create secure database applications. Also each new version of SQL Server

has improved on previous versions of SQL Server in terms of introduction to new features and functionality.

The choice of MS product enables learning facilities very easy widely through online.

4.5 Report Sample

The FMGDMS system provides features to generate many reports, mainly categorized in two types. One type is known as numerical view and the other type is graphical view of analysis. The system is released with the capability of generating around seventy five useful reports with different types of information. A few of those reports are shown below in this section. It is also possible to modify the system to generate more reports in future if the business activity is extended more.

Figure 35: Sales Report - Numerical View

This numerical view of report shows Shops in a selected area which are having sales records in detail. This report shows the user bill amount, paid amount and the outstanding amount for each shop individually. At the end, the total amount of those three fields are also shown here for the selected area.

Figure 36: Daily Sales Analysis
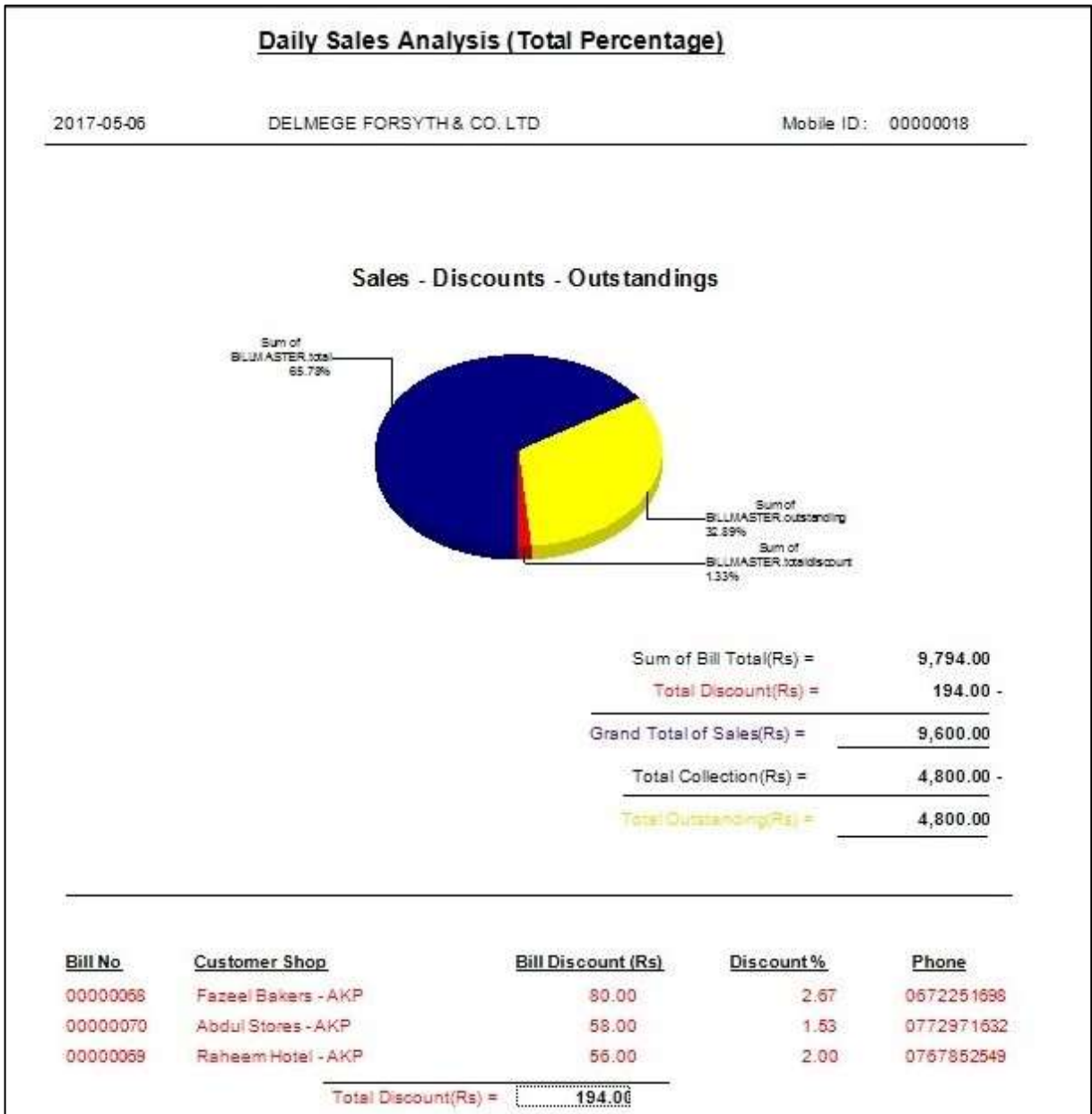
This is the overall analysis of daily sales for a selected supplier. This analysis has useful information such as sum of bill total, discount given, sum of grand total, total collection and the outstanding. Also the bottom detail view shows the customer detail for the relevant sales with discount rate for each customer. Bills given discount shown in red color in the bottom detail view.

Figure 37: Stock Analysis - Stock in Hand
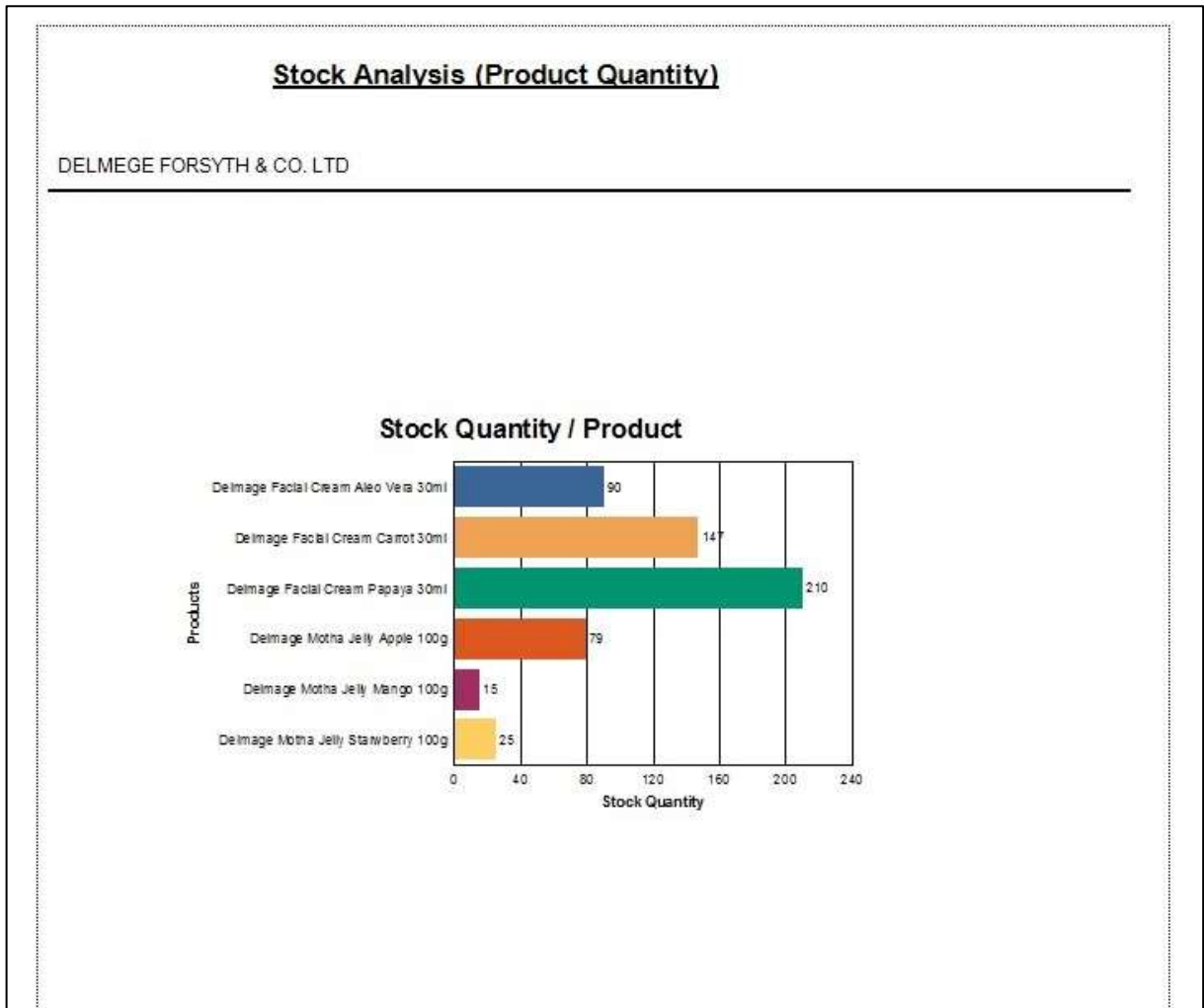
The stock in hand is shown in the above graphical analysis. All products for a selected supplier is mentioned in the analysis. It is possible to view stock availability of each batches for a selected product from above graph.

Figure 38: Stock Analysis - Stock Value
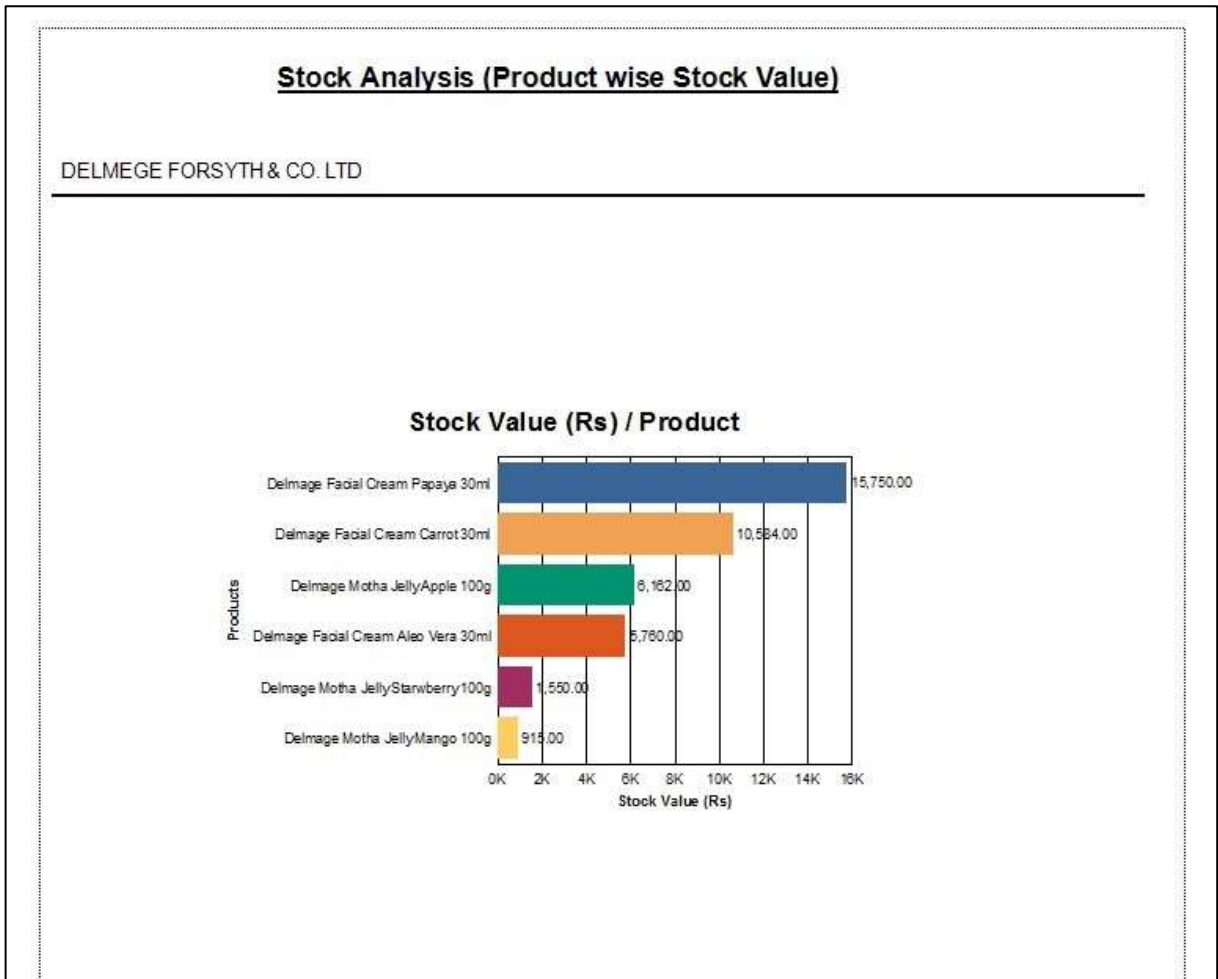
This particular analysis shows the stock value for each product of a selected supplier in an order.

Figure 39: Stock Analysis - Low Stock
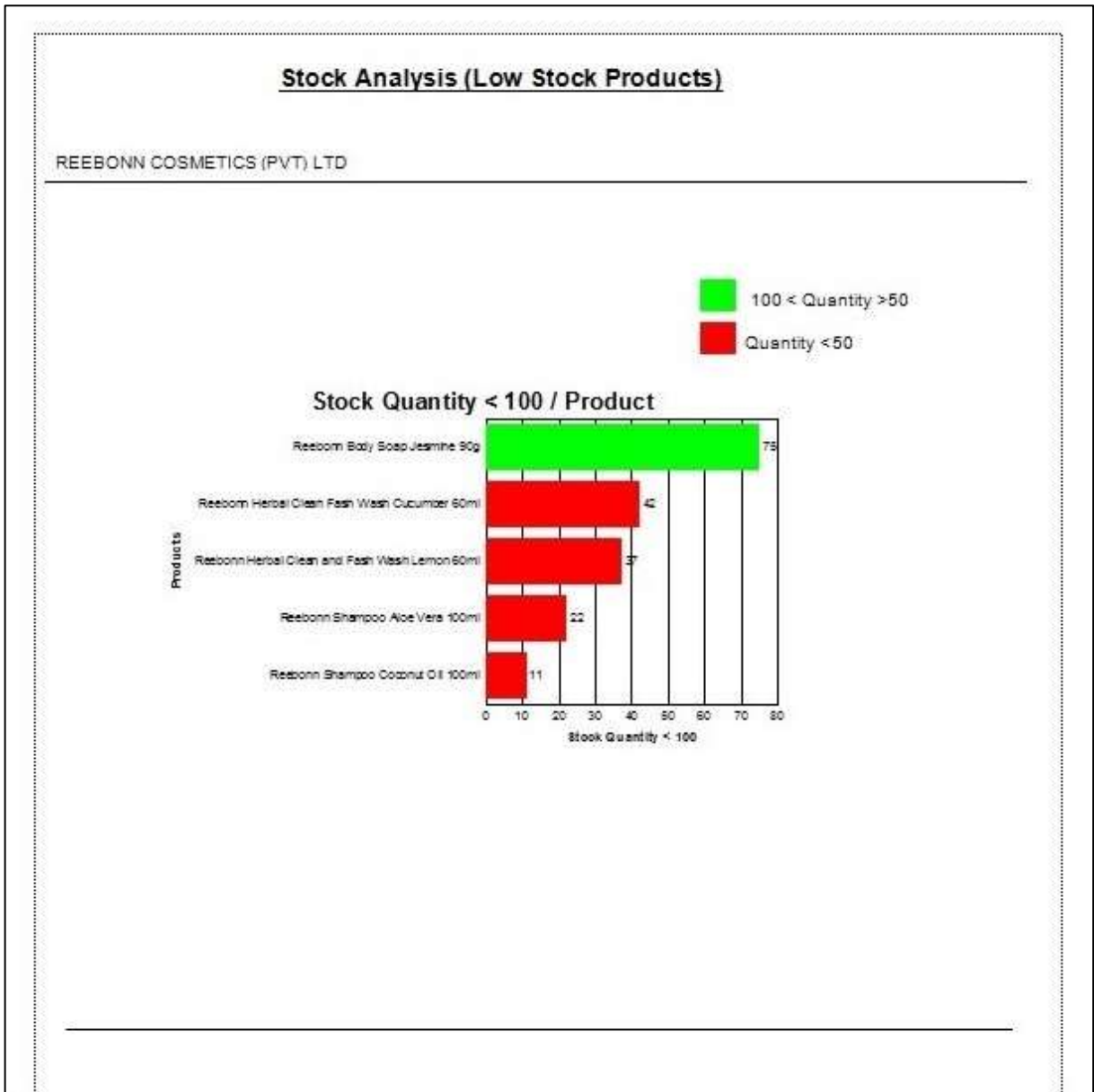
The purpose of this graphical view is to check the low stock product detail. The green colored bar products are low in stock while the red colored bars indicate very low in the stock. The minimum quantity in deciding the low stock here considered as less than hundred in stock and less than fifty are considered very low in stock.

Figure 40: Stock Analysis - Expired Products
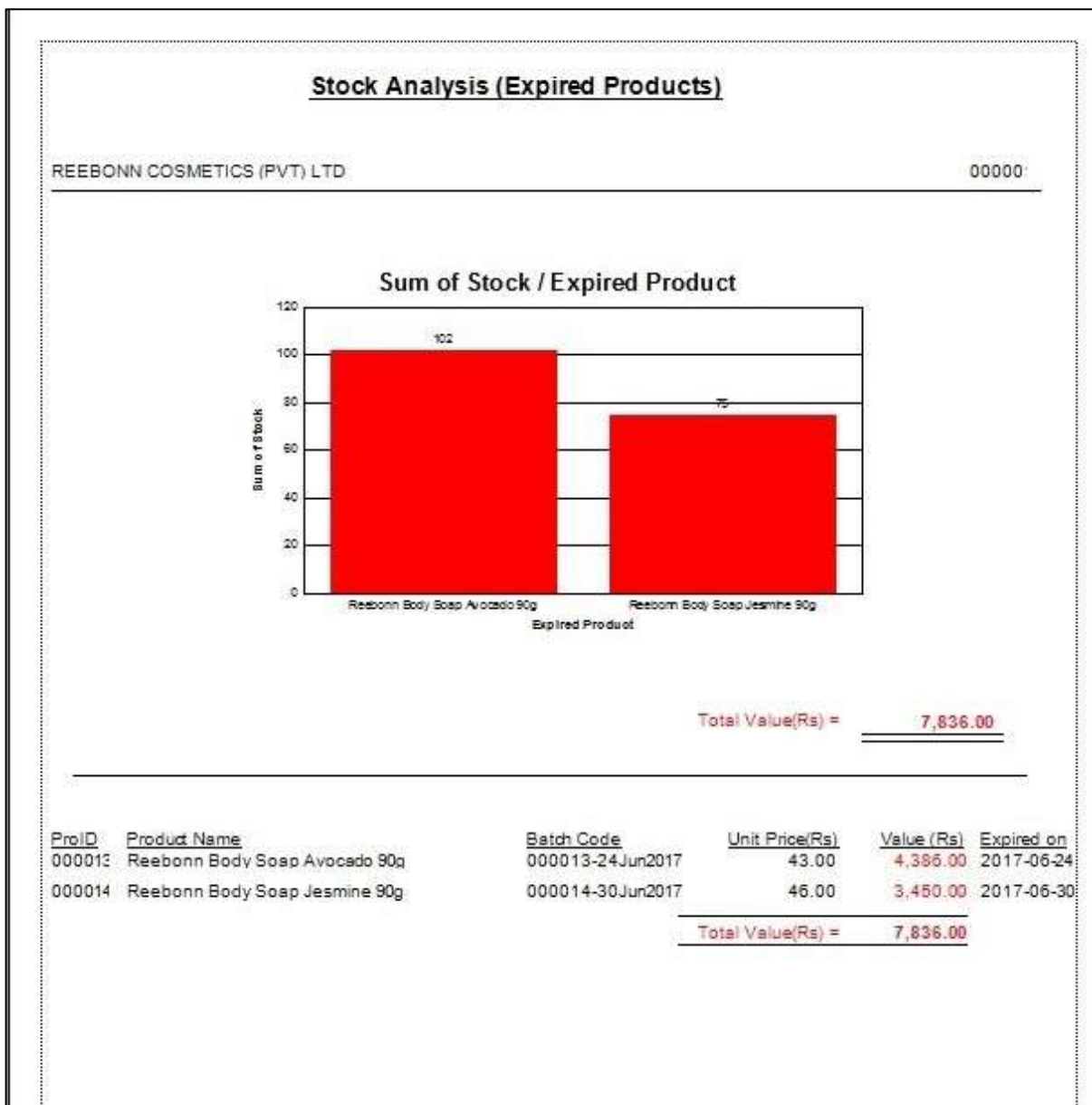
This report shows the expired product with quantity for a selected supplier. It is possible to view in detail such as product batch detail for a selected expired product.

Figure 41: Supplier wise Analysis - Sales and Outstanding
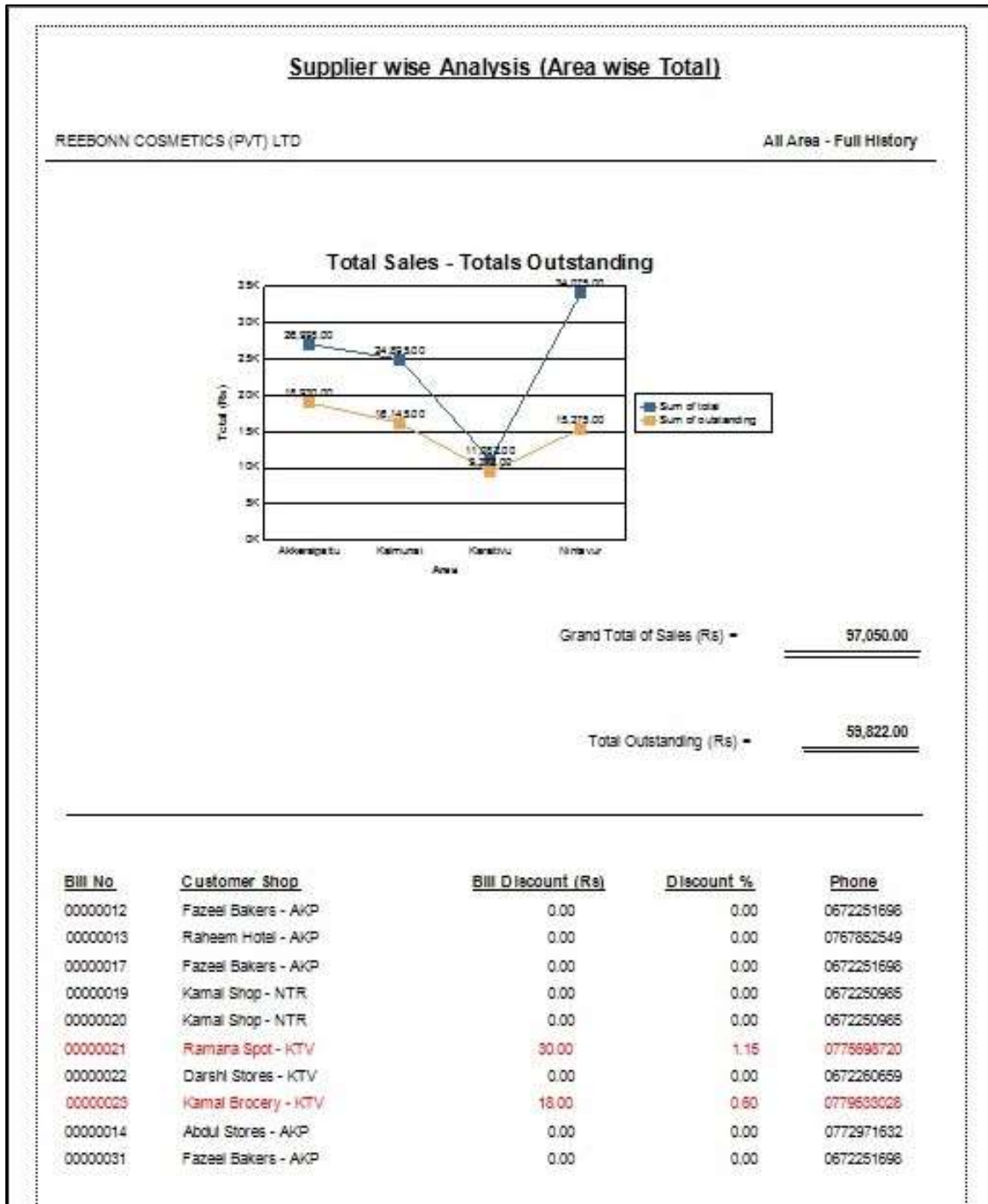
This report is to show total sales and total outstanding for a selected supplier in all area separately. The red colored bills are in the bottom detail view is to show those are discounted bills.

Figure 42: Supplier wise Analysis – Outstanding Bills
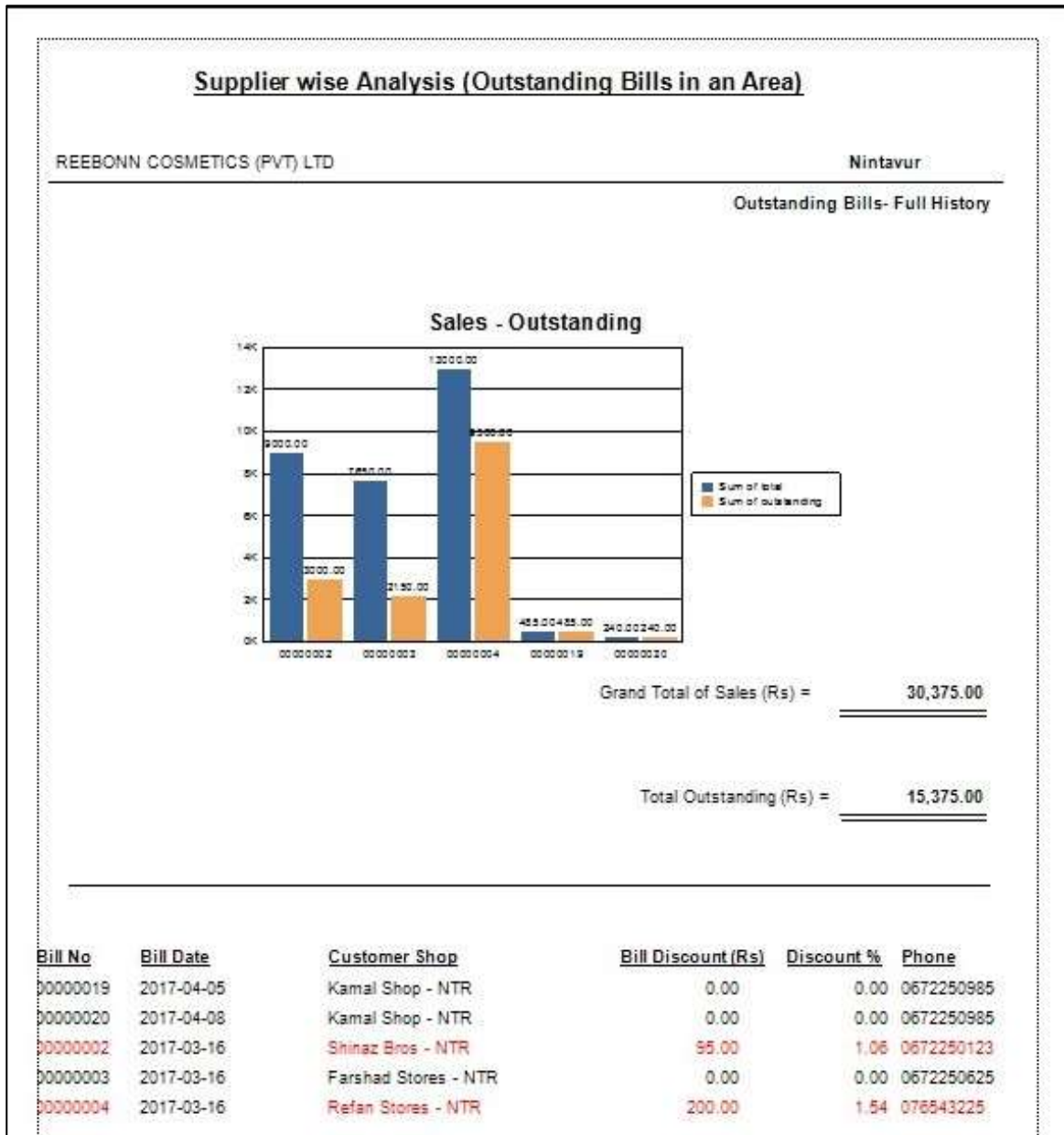
This particular report analysis shows all outstanding bills for a selected product supplier in a selected area. It is possible to generate this sort of report for unpaid bills, discounted bills and bills having higher total amount. These reports can be generated for different type of analysis such as area wise, product supplier wise and for all bills wise analysis. If any bill has been given a discount then it is indicated in red color in the bottom detail section.

Figure 43: Area wise Analysis - Sales and Outstanding
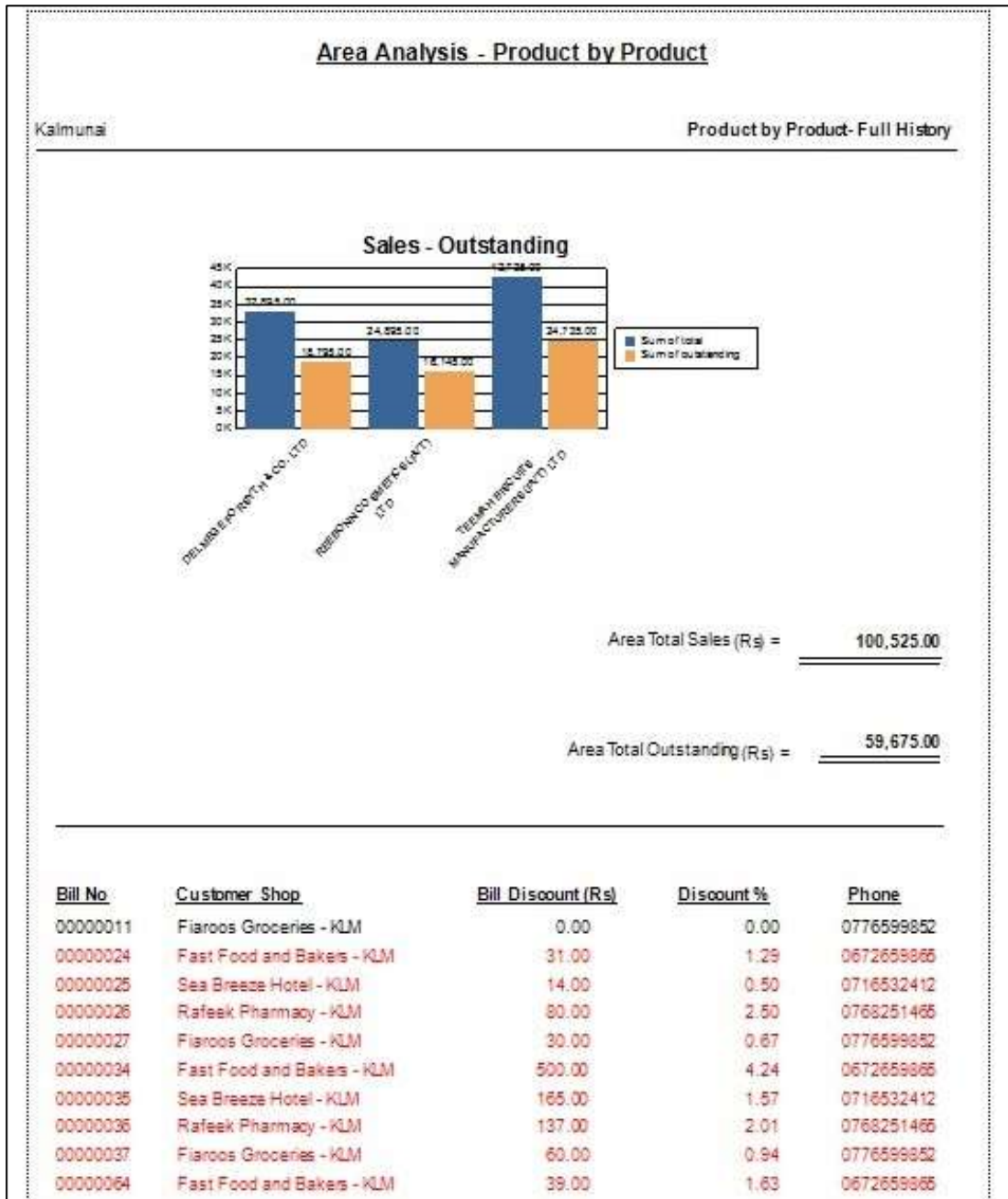
This area wise graphical analysis shows total sales with total outstanding for each supplier. It is possible to generate this type of report for a selected date range too. Red colored bill detail in the bottom detail views are discounted bills.

Figure 44: Product wise Analysis - Sales
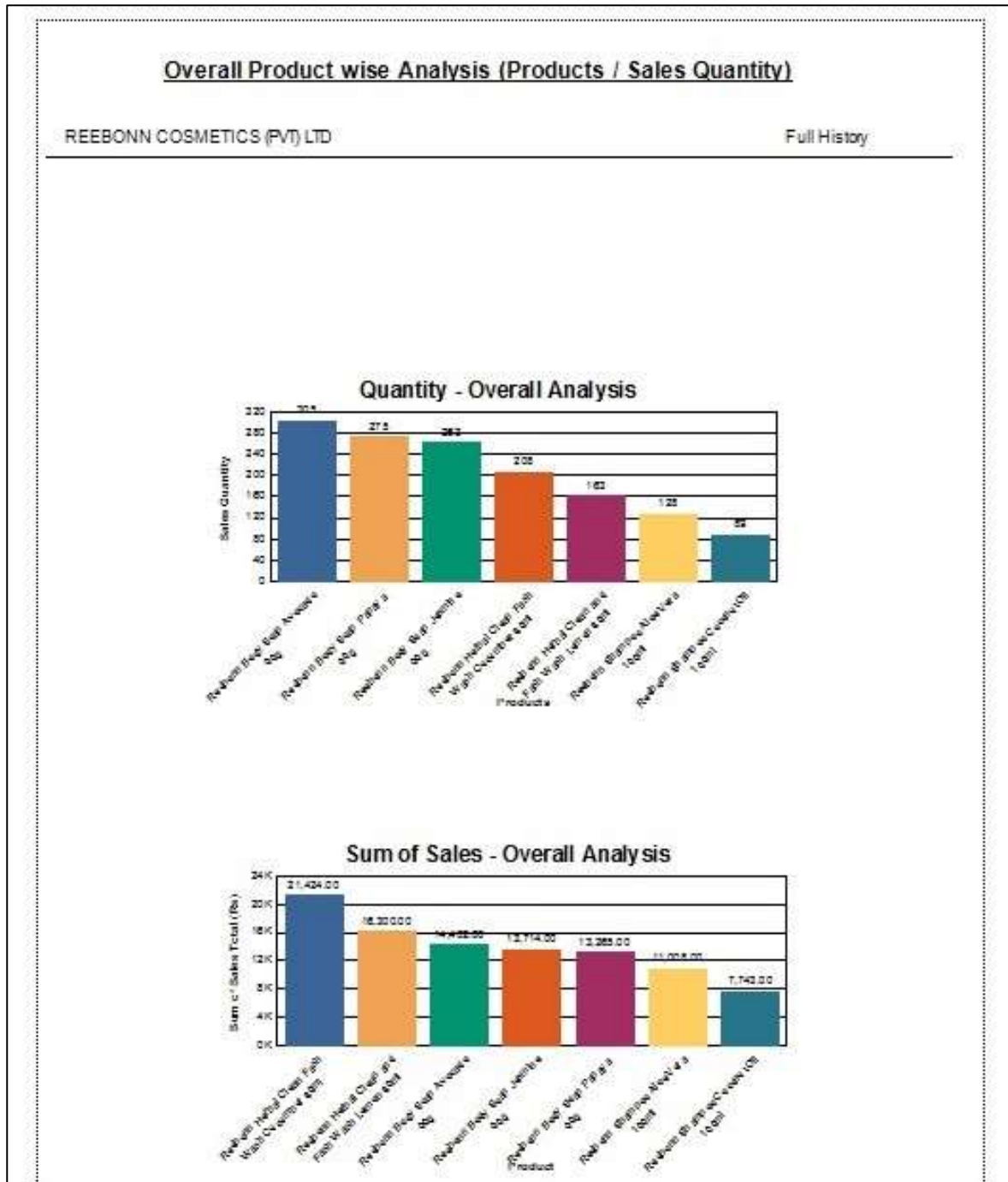
This is one of the product wise analysis for the full history of sales. This shows the product quantity and the value of the each product that have been sold from the beginning of the sales up to the current date. It is also possible to generate this report for a particular date range and for a single day of sales.

Figure 45: Profit Analysis - Supplier wise

Profit Analysis (Profit)

All Area   Full History

Sum of Profit / Supplier

Expected Total Sales(Rs) =	333,574.00
Total Discounts(Rs) =	4,319.00 -
Actual Total Sales(Rs) =	329,255.00
Total Cost of Sold Products(Rs) =	313,710.00 -
Total Profit(Rs) =	15,545.00
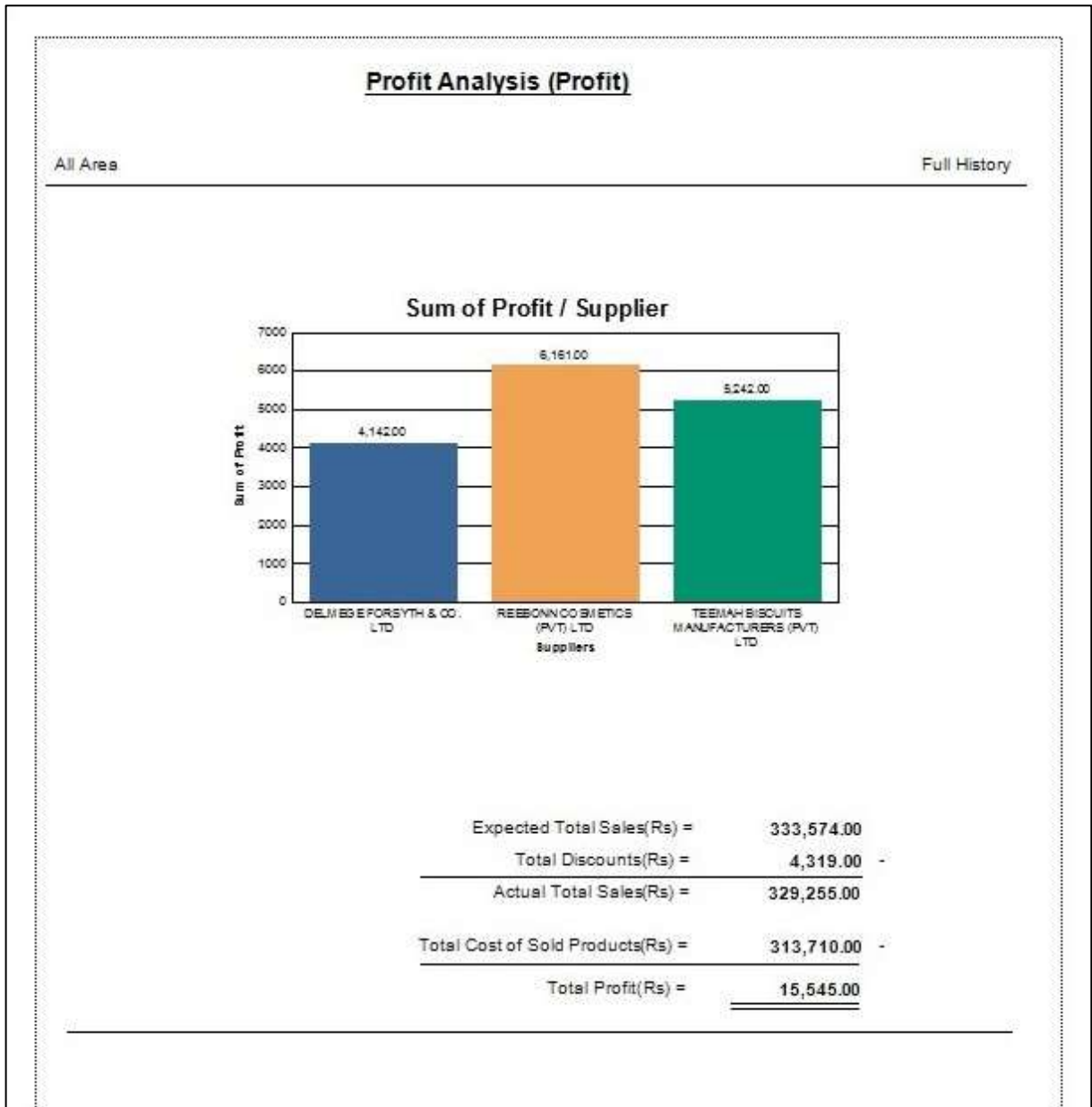
This is the profit analysis for the full history of sales. This contains the profit detail for each supplier separately covering all area. It is possible to generate this report for a date range, for a selected area only and for a selected supplier only. Also it is possible to choose a chart type from bar chart and line chart when generating profit analysis.

Figure 46: Profit Analysis – Area wise

Profit Analysis (Sales Vs Profit)

Nintavur   Full History

Expected Total Sales(Rs) =	86,052.00	
Total Discounts(Rs) =	1,455.00	-
Actual Total Sales (Rs) =	84,597.00	
Total Cost of Sold Products(Rs) =	80,705.00	-
Total Profit(Rs) =	3,892.00	
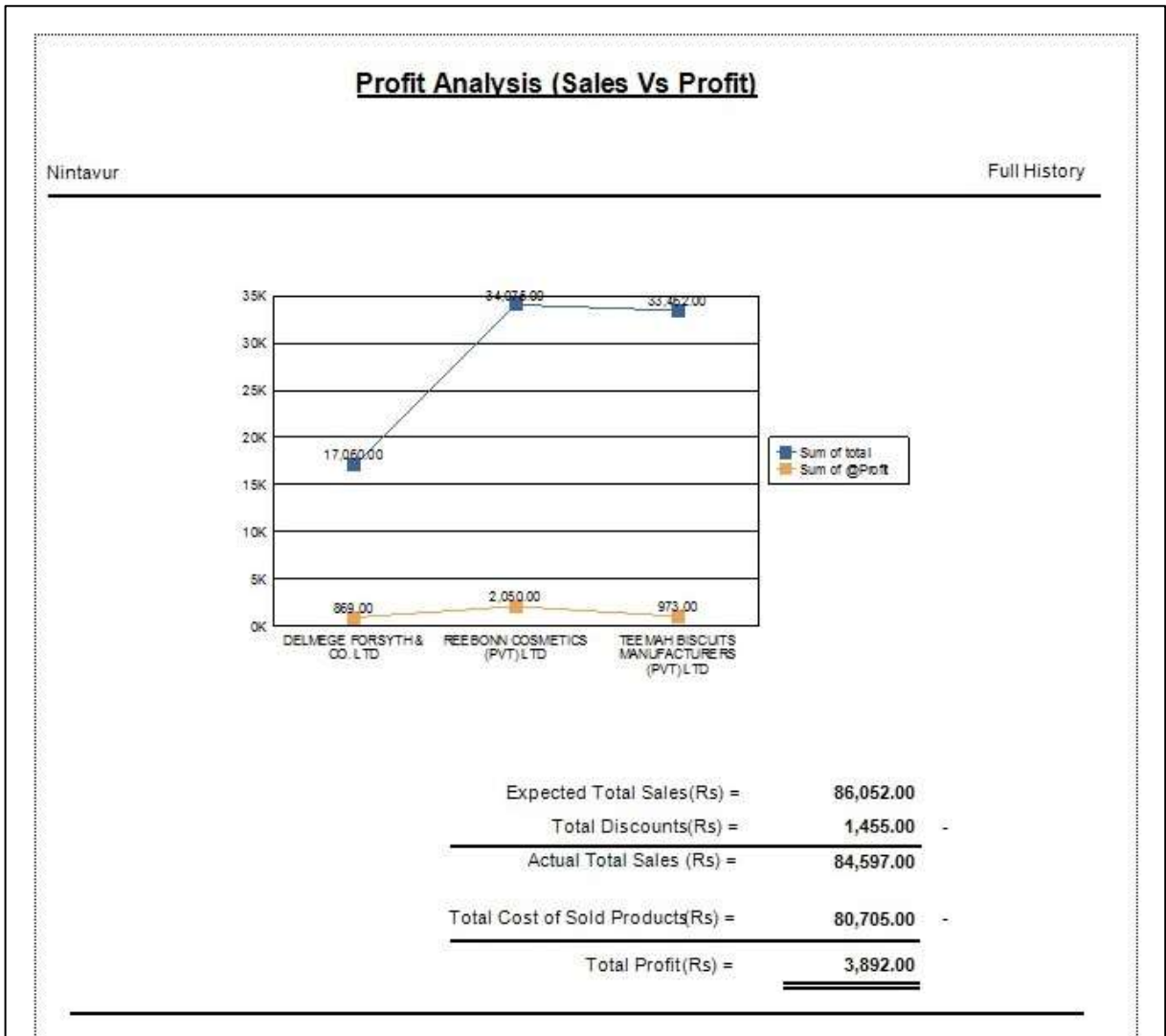
This analysis shows profit for each supplier in a selected area. This line chart shows the detail for the total sales and total profit for each supplier.

5. User Evolution and Testing

5.1 Features to be Tested

Below table lists the features that has been tested from the beginning to the end of the development process of the system.

Features	Test description
System Login	This test is basically to make sure that the system does not allow any invalid login attempt.
Product Supplier	This test is conducted for adding, editing and deleting supplier detail.
Sales Area	This test will check about recording, editing sales area detail
Customer Shop	This test checks for inserting a new customer shop. Then editing and deleting any selected customer shop from the database.
Sales Vehicle	This is to determine if the user is able to correctly enter detail of sales vehicle, edit or delete when it is needed.
Sales Person	Purpose of this test to show that this interface allows the user to enter, edit and delete user from the database.
Product Category and Sub Category Detail	This is to test that Category and the Sub Category field cannot be empty
Product Details	Here the test checks the necessary user input in the relevant interface
Product Assign to Suppliers	Testing to make sure that a Supplier has to be selected before assigning any product
Product Batches	This testing is to test user inputs when the user creates products batches.
New GRN	This testing also checks the user inputs when the user create a GRN for product batches.

Stock Adjustment	This testing ensures user is allowed to adjust the main stock by doing amendment.
Mobile Stock	This test checks the two mandatory field such as Product and Item QTY
Return Mobile Stock	Testing the mandatory filed Mobile ID should not be empty
Create Invoice	This tests about creating a new bill and save it to database.
Edit Invoice	Here the test make sure that user is able to correctly update payment detail and delete any bill.
Numerical Reports	This is to make sure that required field are selected in order to generate report
Graphical Analysis Report	This is to make sure that required field are selected in order to generate graphical veiw

Table 23: List of Features to be Tested

5.2 Usability Testing

Usability is a measure of interface quality that refers to the effectiveness, efficiency and satisfaction with which users. This concept was is carried out with three main points such as user-friendliness, performance of operons and specific features.

The user acceptance testing was initially taken place by interview with the client initially. Then finally a form of well-prepared questionnaire was issued to the client and feedback has been recorded. Information regarding questionnaire and its analysis report is mentioned in the appendices section 8.4 and 8.5 respectively.

The testing was created with four options such as "Extremely Satisfied", "Very Satisfied", "Somewhat Satisfied" and "Not Satisfied". User advised to pick out an option from the experience of using the system to show how successful the system is at the end of the project.

The option "Not Satisfied" is to be marked as modification needed, re-developed and again to be sent through the user evaluation testing.

5.3 Pass / Fail Criteria

The main objective of testing is to find how accurate the developed system. Defining Pass/Fail criteria for system components helps the developer to know which area of the system require more attention in order to obtain an error free system.

As a best practice, it is divided into two parts such as expected result and actual result. The expected result was defined before the testing and the actual result was obtained after the testing. Hence, a comparison between these two types of result was done for each testing to check whether the testing passes or fails. This is a very useful way to check whether the system fulfills the requirements or not.

If the both result are exactly same, then the components get pass status. Otherwise they get fail status. Components in the fail status were put back into code checking and verified using the same input criteria until they get pass status.

5.3 Test Cases

5.3.1 Test Case 1: System Login

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 1.1	**User Name** field	1. Blank **User Name** field input.	System shows an error message for blank input	Passed
		2. Blank **User Name** field input.	System shows an error message for invalid input	
Case 1.2	**Password** field	1. Blank **User Name** field input.	System shows an error message for blank input	Passed
		2. Blank **User Name** field input.		

Test Case	Test Item	Input Specifications	Output specifications	Test result
			System shows an error message for invalid input	

Table 24: Test Case Specifications for Test Case 1: System Login

5.3.2 Test Case 2: Add Supplier Detail Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 2.1	**Name** field	1. Allow users for upper /lower letters, space and full stop only.	System does not allow the user to type any other characters or symbols	Passed
Case 2.2	**Contact No** field	1. Allowing for digits, space and comma only.	System has restriction for typing any other input	Passed
Case 2.3	**E-Mail** field	1. At least one valid local-part character at the beginning 2. Full stop is not allowed at the begging 3. Any number of group which starts with a single period and has at least one valid local-part character after the period 4. Then the @ character 5. At least one group of at least one valid word character or hyphen followed by a period 6. Any two or four valid top level domain characters Local-part characters:	System shows error message for incorrect input.	Passed

58

Test Case	Test Item	Input Specifications	Output specifications	Test result
		(a-z, A-Z, 0-9,!, #, $, %, &, ', *, +, -, /, =, ?, ^, _ , {, |, } ,`, ~**)**		
Case 2.4	**Web** field	1. Matching the pattern : ^(http|https|ftp|)\://|[a-zA-Z0-9\-\.]+\.[a-zA-Z](:[a-zA-Z0-9]*)?/?([a-zA-Z0-9\-\._\?\,\'/\\\+&%\$#\=~])*[^\.\,\)\](\s]$"	System shows error message for un matched input	Passed

<div align="center">Table 25: Test Case Specifications for Test Case 2: Add Supplier Detail</div>

5.3.3 Test Case 3: Add Sales Area Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 3.1	**Area** field	1. Blank **Area** field input for new record.	System shows an error message for blank input	Passed
		2. Blank **Area** field input for editing.	System shows an error message for invalid input	Passed

<div align="center">Table 26: Test Case Specifications for Test Case 3: Add Sales Area Detail</div>

5.3.4 Test Case 4: Add Customer Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 4.1	**Name** field	1. Allow users only for upper /lower letters, space and full stop.	System does not allow the user to type any other characters or symbols	Passed
Case 4.2	**Contact No** field	1. Allowing only for digits, space and comma.	System has restriction for	

		2. This is to allow having more than one numbers having separated by either space or comma	typing any other input	
Case 4.3	**E-Mail** field	1. At least one valid local-part character at the beginning 2. Full stop is not allowed at the begging 3. Any number of group which starts with a single period and has at least one valid local-part character after the period 4. Then the @ character 5. At least one group of at least one valid word character or hyphen followed by a period 6. Any two or four valid top level domain characters Local-part: (**a-z**, **A-Z**, **0-9**,!, #, $, %, &, ', *, +, -, /, =, ?, ^, _ , {, |, } ,`, ~)**	System shows error message for incorrect input.	Passed

Table 27: Test Case Specifications for Test Case 4: Add Customer

5.3.5 Test Case 5: Add Sales Van Details Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 5.1	**Reg. No** field	1. Allow only upper letters, hyphen and numbers only under KeyPress event	System does not allow the user to type any other characters or symbols	Passed

Table 28: Test Case Specifications for Test Case 5: Add Sales Van Details

5.3.6 Test Case 6: Add Employee Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 6.1	**NIC** field	1. Allow only for letters and digits under KeyPress event 2. Allowing for any digits nine times and a letter at the end. The letter should be either upper or lower of X or V **^\d{9}(X|x|V|v)$**	System does not allow the user to type any other characters or symbols	Passed
Case 6.2	**Name** field	1. Allow users only for upper /lower letters, space and full stop.	System does not allow the user to type any other characters or symbols	Passed
Case 6.3	**Contact No** field	1. Allowing only for digits, space and comma. 2. This is to allow having more than one numbers having separated by either space or comma	System has restriction for typing any other input	Passed
Case 6.4	**E-Mail** field	1. At least one valid local-part character at the beginning 2. Full stop is not allowed at the begging 3. Any number of group which starts with a single period and has at least one valid local-part character after the period 4. Then the @ character	System shows error message for incorrect input.	Passed

61

		5. At least one group of at least one valid word character or hyphen followed by a period 6. Any two or four valid top level domain characters Local-part: (**a-z**, **A-Z**, **0-9**,!, #, $, %, &, ', *, +, -, /, =, ?, ^, _ , {, |, } ,`, ~)		

Table 29: Test Case Specifications for Test Case 6: Add Employee

5.3.7 Test Case 7: Product Category and Sub Category Detail Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 7.1	**Category** field	1. This field is necessary to be selected before save	System shows error message for not selecting this field	Passed
Case 7.1	**Sub Category**	1. This field is necessary to be selected before save. This is dependent on **Category** field	System shows error message for not selecting this field	Passed

Table 30: Test Case Specifications for Test Case 7: Product Category and Sub Category

5.3.8 Test Case 8: Product Details Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 8.1	**Full Name** field	1. This field is necessary to be selected before save	System shows error message for being empty	Passed
Case 8.2	**Category** field	1. This field is necessary to be selected before save	System shows error message for not selecting this field	Passed

Case 8.3	**Sub Category**	1. This field is necessary to be selected before save. This is dependent on **Category** field	System shows error message for not selecting this field	Passed

Table 31: Test Case Specifications for Test Case 8: Product Details

5.3.9 Test Case 9: Product Assign to Suppliers Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 9.1	**Supplier** field	1. This field is necessary to be selected in order to assign a product	System shows error message is this field is not selected	Passed

Table 32: Test Case Specifications for Test Case 9: Product Assign to Suppliers

5.3.10 Test Case 10: Batches Details Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 10.1	**Buy Price** field	1. Allow numbers and full stop only	System does not allow the user to type any other characters or symbols	Passed
Case 10.2	**Selling Price** field	1. Allow numbers and full stop only	System does not allow the user to type any other characters or symbols	Passed

Table 33: Test Case Specifications for Test Case 10: Batches Details

5.3.11 Test Case 11: Add New GRN Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 11.1	**Item QTY** field	1. Allow numbers input only under KeyPress event	System does not allow the user to type any other characters or symbols	Passed

Table 34: Test Case Specifications for Test Case 11: Add New GRN

5.3.12 Test Case 12: Stock Adjustment Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 12.1	**Amend QTY** field	1. Allow numbers only in KeyPress event	System does not allow the user to type any other characters or symbols	Passed
		2. Amend QTY cannot be exceeded than Available QTY	System shows an error message for exceeded value in Amend QTY	Passed

Table 35: Test Case Specifications for Test Case 12: Add Adjustment

5.3.13 Test Case 13: Create New Mobile Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 13.1	**Product** drop down	1. Product should be selected to create mobile store.	Empty field of this Product provide error message	Passed

| Case 13.2 | **Item QTY** field | 1. Allow numbers only in KeyPress event | System does not allow the user to type any other characters or symbols | Passed |
| | | 2. Item QTY cannot exceed than the main stock quantity | System shows an error message | Passed |

Table 36: Test Case Specifications for Test Case 13: Create New Mobile

5.3.14 Test Case 14: Mobile Stock Return Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 14.1	**Mobile Stock ID** drop down	1. A mobile ID should be selected to return stock.	Empty field of this mobile ID provide error message	Passed

Table 37: Test Case Specifications for Test Case 14: Mobile Stock Return

5.3.15 Test Case 15: Create New Bill Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 15.1	**Item QTY** field	1. Allow numbers only in KeyPress event	System does not allow the user to type any other characters	Passed
		2. Item QTY cannot exceed than the mobile stock quantity	System shows an error message	Passed

Table 38: Test Case Specifications for Test Case 15: Create New Bill

5.3.16 Test Case 16: Update and Delete Bill Interface

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 16.1	**Update Payment** field	1. Allow numbers only in KeyPress event	System does not allow the user to type any other characters or symbols	Passed
		2. **Update Payment** cannot exceed than the **Outstanding** value	System shows an error message	Passed

Table 39: Test Case Specifications for Test Case 16: Update and Delete Bill

5.3.17 Test Case 17: Numerical Report

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 17.1	**Area** field	1. An area should be selected from the drop down	System shows error message for empty Area drop down field	Passed
Case 17.2	**Customer** field	1. A customer should be selected from the drop down	System shows error message for empty Customer drop down field	Passed
Case 17.3	**Date Range** field	1. Date range should be provided from the calendar option	System shows error message for not selecting a date range	Passed

Table 40: Test Case Specifications for Test Case 17: Numerical Report

5.3.18 Test Case 18: Graphical Report

Test Case	Test Item	Input Specifications	Output specifications	Test result
Case 18.1	**Area** field	1. An area should be selected from the drop down	System shows error message for empty Area drop down field	Passed
Case 18.2	**Customer** field	1. A customer should be selected from the drop down	System shows error message for empty Customer drop down field.	Passed
Case 18.3	**Date Range** field	1. Date range should be provided from the calendar option	System shows error message for empty date.	Passed

Table 41: Test Case Specifications for Test Case 18: Graphical Report

6. Conclusion and Future Work

6.1 Problem Encountered, Lesson Learnt and Limitations of the System

The project "Fast Moving Goods Distribution Management System" mainly as the name suggests deals with distribution sales operations for an accurate process for a specific client who are related to the subject of fast moving goods distribution. This system enables stock maintenance and the sales detail at a basic level while the second level contains MIS component.
This system accurately maintains stock level, mobile store detail, sales billing detail and linked with many back end operations having relations to many database tables. Purpose of performing a completed process, the system database contains record such as area detail, customer shop detail, supplier detail, products detail, and product batches detail.

As the main part of the consideration, the system ensures user friendliness by collecting a feedback from the client.

As it has been proposed at the begging, this is a stand-alone computerized database application define a limitations with its functionalities considering its initial step of the development.

As per the requirement identified form the client, with related to the main stock, the FMGDMS system begins its process from entering the GRN item to database. This is practically happens when the products are physically arrived to the store. From that point only, the stock is created. In this way the current system does not have functions related to purchase order process.

Also the current system doesn't provide options for system user creation and role assignment. Since this is the very initial step of moving a business platform to a computerized system, the system has a limitation in providing this option to end user administrator.

The FMGDMS system is expected to be run only on Windows environment since the client prefers having only windows computers at their work station. This another limitation for working environment of this system.

This complete project helped me to learn the whole process of providing a computerized solution for a manual real world problem. This knowledge is gathered from the very basic steps such as gathering requirements and proposing a suitable solution to end up with a successful system.

6.2 Critical Evaluation of the Project

This section provides a comparison summary between the developed FMGDMS system and some selected similar systems available in online market.

As the section 2.3 highlights about some similar systems available, the base functionalities of developing this kind of system may be constructed from almost a same implementation idea. But the main difference with this FMGDMS system is focusing the day to day sales operation. This mainly includes creating a mobile store between the two main functions such as stock and sales. So, this mobile store creation is such unique function available in this FMGDMS system.

Considering the sales point of view, the FMGDMS system has a unique way of recording the billing detail based on customer shops. Entering billing part is based on the mobile store. So the user will not be able to create bills for any products which were not released to the relevant mobile store for the daily sales. The mobile store detail can be kept in the system until the user checks the remaining items in the vehicle to make sure that the remaining items in the vehicle is balanced with the remaining items in the system. Only after this checking is done, the remaining items are released to the main store in the system. This is one of the main specific functionality available in the FMGDMS system.

Also the MIS component attached to the system has the capability of doing analysis by generating reports in numerical view and graphical view.

The FMGDMS application does not require a long term training process for users since it is basically developed for a specific customer with their acceptance. This is the important concern comparing with the other common applications available in the online market since those common applications require a well long term training after the deployment.

6.3 Direction for Future Research

This FMGDMS system is designed and developed in a way that it is possible to extend its functions to have an online based system in future. In the concept of having an online sales control system, this current stand-alone software easily can be developed by having more options such as online bill entering.

By hosting the system in a web host server, the system can be accessible from outside at any time. This has two options; one is to host the system in a public web host in any service provider

in an outside location. And create connection like we can access websites. This option will require purchasing a sub level domain which will enable URL access for the online system.

Second is to have an own server internally, host the system and make it for outside access. For this the intranet access has to be configured internally with the help of any internet service providers. Intranet access from outside can be obtained through Virtual Private Network (VPN) configuration.

Purchasing of a web server, having continues internet connection, ensuring the security for VPN access are important considerations for the second option of future online migration of this stand-alone system. This online migration will enable multi-location handling, barcoding facility, purchase order management.

The current system can be expanded by adding more modules in future. For this purpose of future direction of this stand-alone system, comments are left with the coding as it is required at the back end. This explanation of coding will make any developer to easily understand and make any changes for future needs. Also the coding has been carried out in an easy way to reduce its complexity for future use.

7. References

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[5] Microsoft Visual Studio 2013, https://msdn.microsoft.com/en-us/library/dd831853(v=vs.120).aspx

[6] Microsoft SQL 2008, https://www.microsoft.com/en-us/download/details.aspx?id=30438

[7] Online UML diagram drawing too, https://creately.com

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8. Appendices

8.1 Test Plane and Test Cases

Points such as testing item, input specifications and output specifications were carefully considered when the test plane was developed since developing a test plane plays an important role in developing a software product.

Functional testing, Error handling testing, GUI testing, Compatibility testing, Performance testing, Installation testing were done successfully and results from each testing also were obtained from the test plane.

Testing	Pre-condition	Validation	Result
GUI testing	System user participation is must	User friendliness was verified by having user meetings to have direct feedback. Changes made according to the comments from the user side.	User interfaces were verified as practically user friendly
Compatibility testing	Minimum software and hardware requirements should be satisfied.	System was installed in the prepared windows computer and tested	Windows compatibility is verified
Functional testing	Collection of sample / real data set is required.	A collection of sample data and real data set was used to test.	Test was success
Performance testing	Minimum software and hardware requirements should be satisfied.	By accessing the more than one user interface at a single time, the	There were no slowness or stuck and showed out a good performance.

|		performance was checked.	
Installation testing	Minimum software and hardware requirements should be satisfied.	System was installed in the prepared computer	Test was success
Error handling testing	Valid and invalid user inputs should be used	Sample valid and invalid inputs were used to see what error message is produced	Error messages obtained for invalid inputs

Table 42: List of Testing Plane

Unite testing is a smallest testable part which was carried out for each single function in each interface. This was done by considering the internal coding part and functionality and cane be identified as White Box testing.

Integration testing was carried out at the time of designing and developing the application. Integration testing was done to expose any defect in the interfaces and interaction between components. User interfaces were checked for individual functions until obtain a fine work.

System testing was taken place to check the behaviour of the completed software product. This was started after the completion of the coding phase. The main focus of this testing was to evaluate Business / Functional / End-user requirements. This was done step by step. A sample data set was entered first. And then each and every user interfaces were checked by the recorded data. This was the first stage of system testing.

In order to test the system for acceptability the user acceptance testing was planned. This testing scheduled to be done at the client work station in the real practical environment. This can be considered as a type of Black Box testing since the system user does not care or does not worry about the internal function. System user should consider front end data entering for this testing. The system was installed in the client computer and the user was given initial instructions to start this testing. A set of real data collection used to perform this testing. The final acceptance test used to make sure the system status of the working condition.

Figure 47: Software Testing Life Cycle
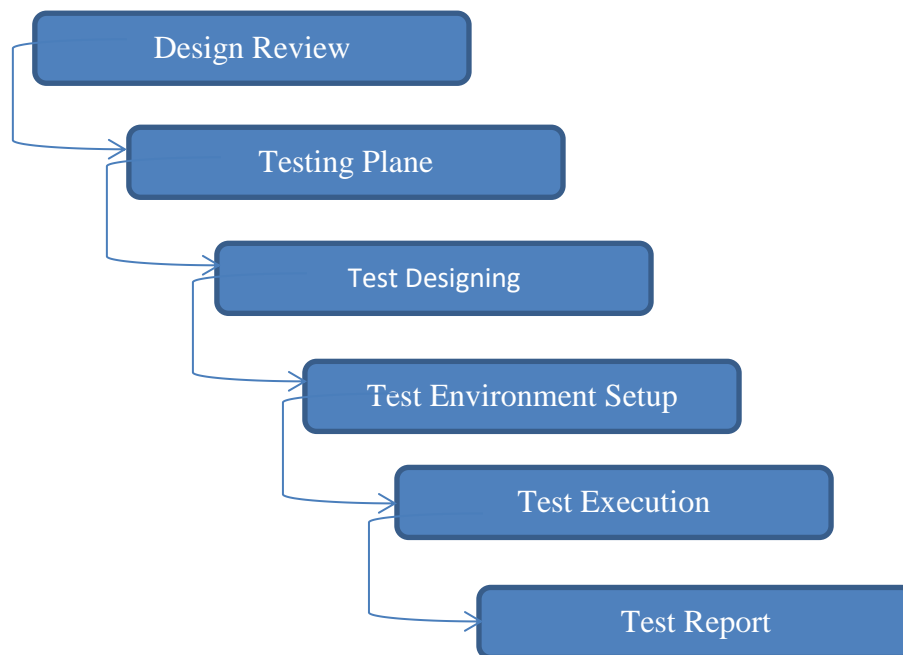

8.2 Non Functional Requirements

➢ The system must be easy to use such that the user does not need any user manual once after the initial training.

➢ The system must be quickly accessible by user.

➢ The system must be simple that it displays all relevant data and relationships.

➢ The system must provide a password enabled login to the user to make sure security of the system.

➢ The system should not update the data in any database for any failed processes.

➢ System should not allow the user to delete any record if the record is already in use with any of the system other records.

➢ The system must be compatible to run on the Windows platform as it's mentioned in the document.

➢ All the functions of the system must be available every time the system is turned on.

8.3 User Manual

A new user can easily read this manual to start to use the FMGDMS system without an initial practical training. Users are advised to carefully follow the order of the functions as it is explained in this user manual.
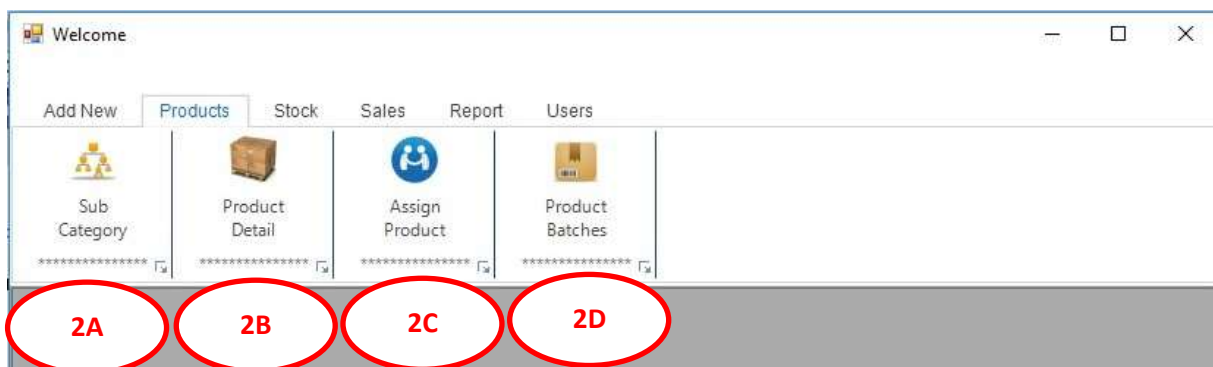
1. **Add New** tab is the first tab option in which user should start entering data such as **Product Supplier (1A), Sales Area (1B), Customer Shop (1C), Sales Vehicle (1D) and Sales Person (1E).**

Figure 48: User Manual Step 1: Add New Tab Option of the Home Page
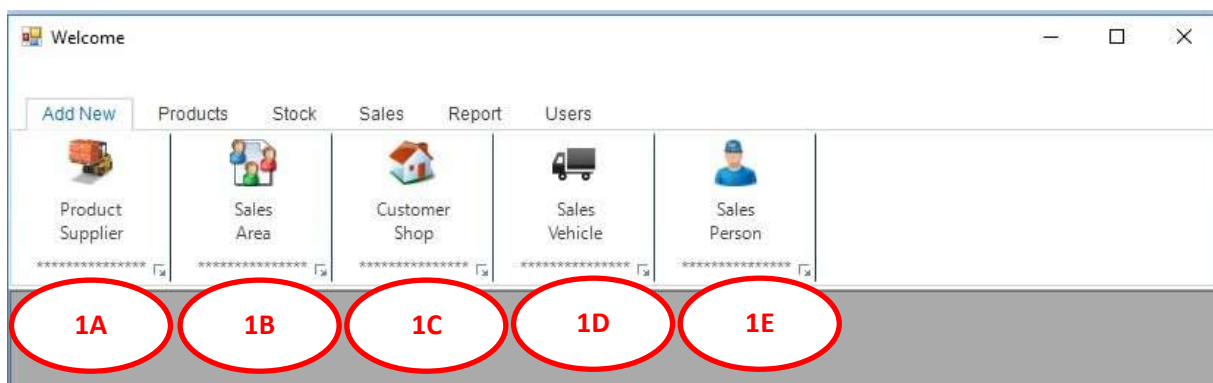
2. Then the second tab option **Products** is to be accessed.

Figure 49: User Manual Step 2: Product Tab Option of the Home Page

    a. In that tab option, first category and sub category of products should be created using the sub tab **Sub Category (2A).**

    b. Then the real product should be created using the sub tab **Product Detail (2B)**.

   c. Then the created product should be assigned to relevant supplier using the sub tab **Assign Product (2C).**

d. Finally the batches for products should be created using the sub tab **Product Batches (2E).**

3. Now the stock can be loaded by created batch items to the database by using the third main tab **Stock**.

Figure 50: User Manual Step 3: Stock Tab Option of the Home Page
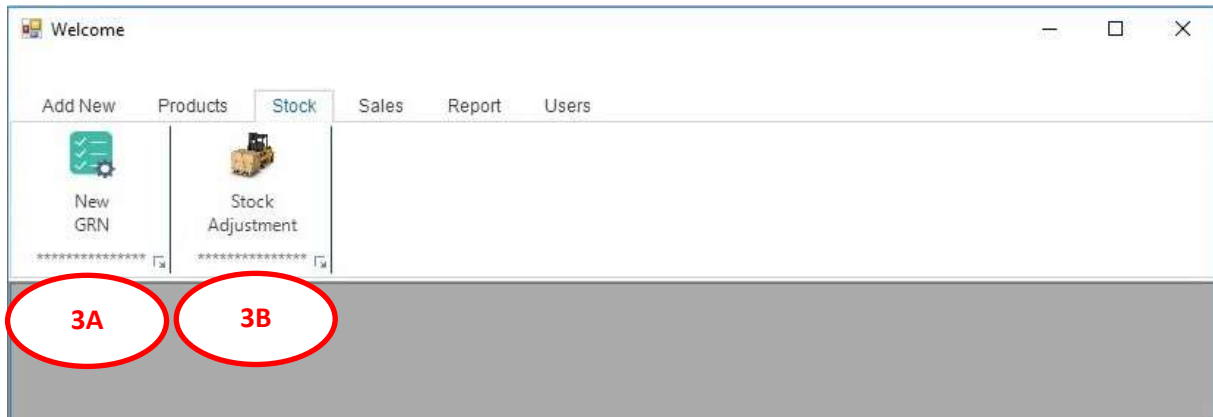
a. Stock can be loaded for product batches using **NEW GRN (3A)** sub tab.

4. The next step is to release stock to mobile store using the main tab **Sales**.

Figure 51: User Manual Step 4: Sales Tab Option of the Home Page
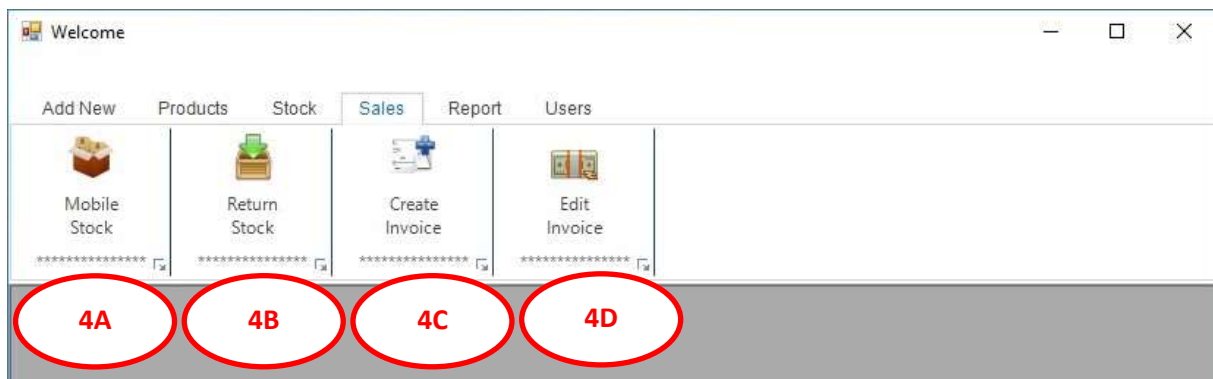

a. By filling the relevant detail in the sub tab **Mobile Stock (4A),** sales stock can be prepared and released to vehicle.

b. After the sales vehicle is return from the day sales, it's time to enter invoice detail. This can be accomplished using the sub tab **Create Invoice (4C).**

c. After entering all the sales detail by creating invoices, then the remaining item in the mobile store can be released to the main store. This can be done using the sub tab **Return Stock (4B).** At this point the current day's sales detail entering functions are completed.

d. Now the sub tab **Edit Invoice (4D)** is used to update collection detail for old invoices.

5. This long process may show any expired item remaining in the main stock. So, the distributor can physically return those items to relevant suppliers. At this point, the stock detail should be updated using the sub tab **Stock Adjustment (3B).**

Figure 52: User Manual Step 5: Stock Tab Option of the Home Page
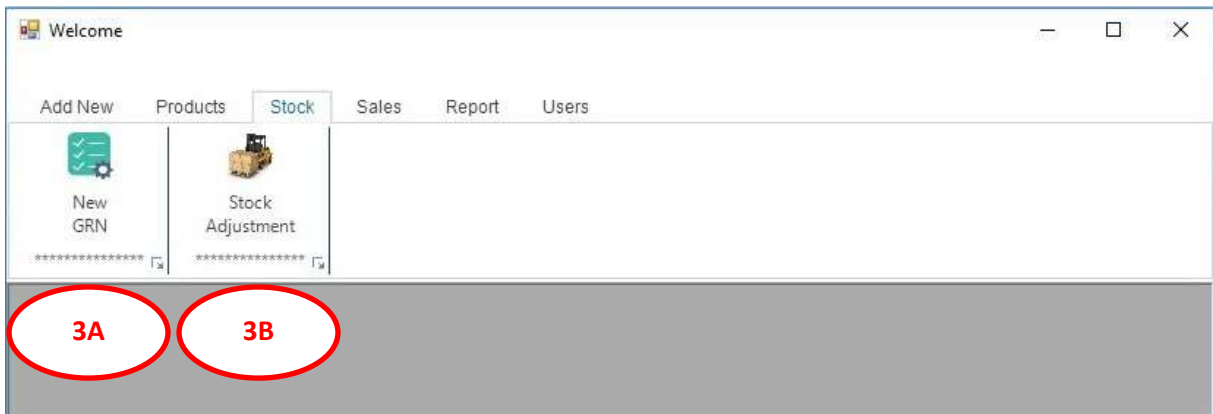
6. Finally the fifth main tab **Reports** can be used to generate numeric reports and graphical view of analysis. **5A, 5B** and **5C** are options to generate numerical reports and **5D, 5E, 5F, 5G, 5H, 5I, 5J** are options to generate graphical view of analysis.

Figure 53: User Manual Step 6: Reports Tab Option of the Home Page

7. The last main tab **User** is not mentioned here since this is added to the current system for future modification.
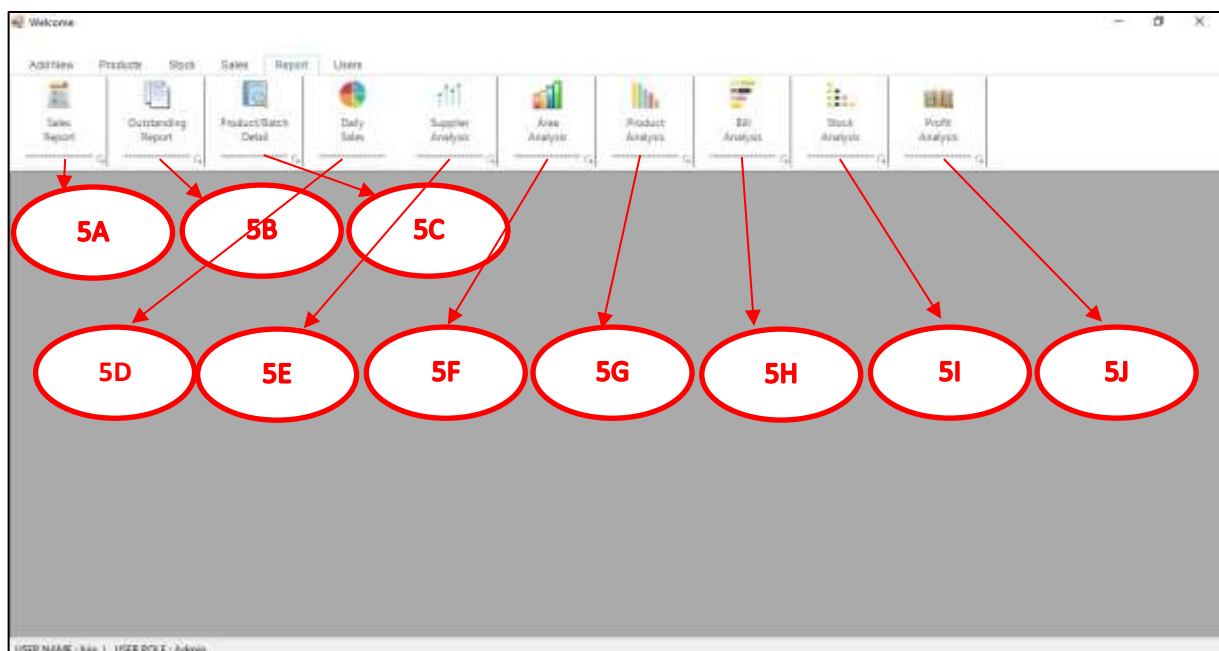
8.4 Questionnaire

This is the format of the questionnaire form which was used to collect user feedback after the system release.

Name of the user:

Designation:

Instruction: Please tick on one out of the four option for each questionnaire and provide the comments in the last option

	Extremely Satisfied	Very Satisfied	Somewhat Satisfied	Not Satisfied
1. The login interface is very cool.				
2. I am satisfied with the overall interface design.				
3. Font size and colors are very clear in each interface.				
4. Fields arrangement in the interfaces are user friendly.				
5. The system shows a proper arrangement of tab order in the home page.				
6. The mobile store creation interface has enough detail to do the day to day work.				
7. The system reports have enough detail for our day to day current work process.				
8. The invoice creation and update interfaces are good enough to record our billing process.				
9. The system is not showing any slowness.				
10. The overall system is very user friendly.				

11. The system is fully compatibility with our environment computer platform.				
12. The system has no conflict between each interfaces.				
13. I am able to efficiently complete the process using this system.				
14. I can recommend this system to others.				
15. This system is specific from other software application available in the online market.				

Table 43: User Questionnaire Test

16. Any comments for future expansion of the system

Table 44: User Comments

8.5 Analysis of the Questionnaire

The obtained user feedback results were used to generate bellow graphical analysis view
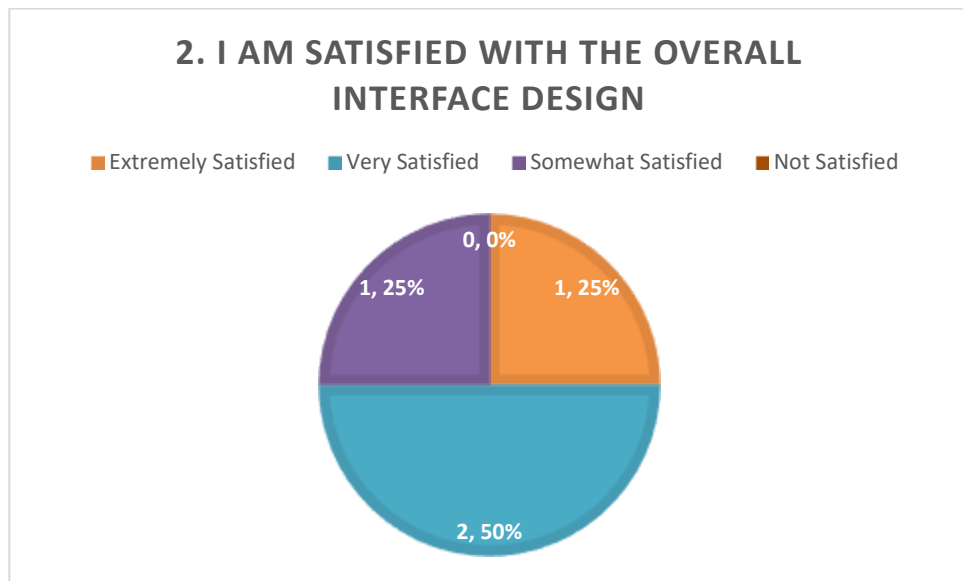
1. The login interface is very cool

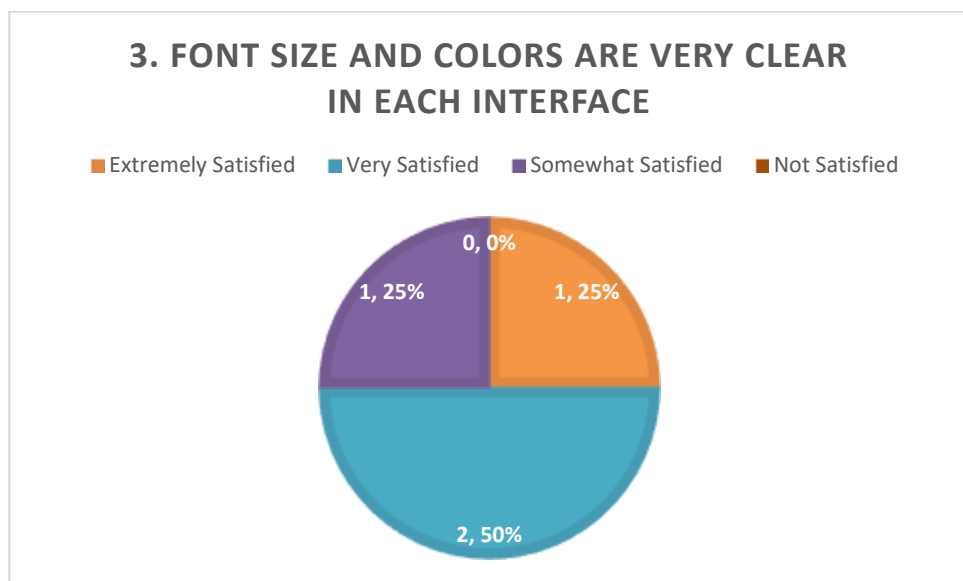Figure 54: Questionnaire Analysis Result 1
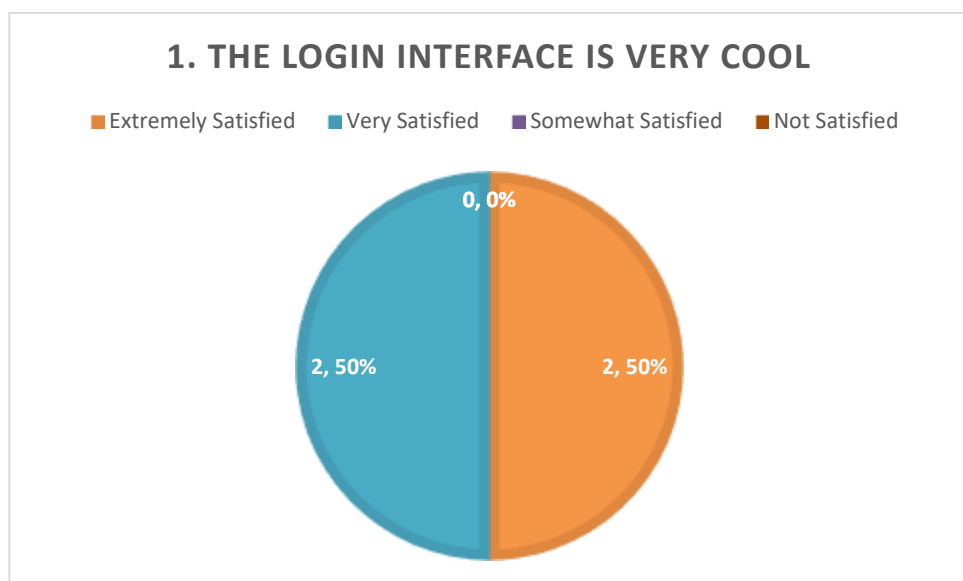
2. I am satisfied with the overall interface design.

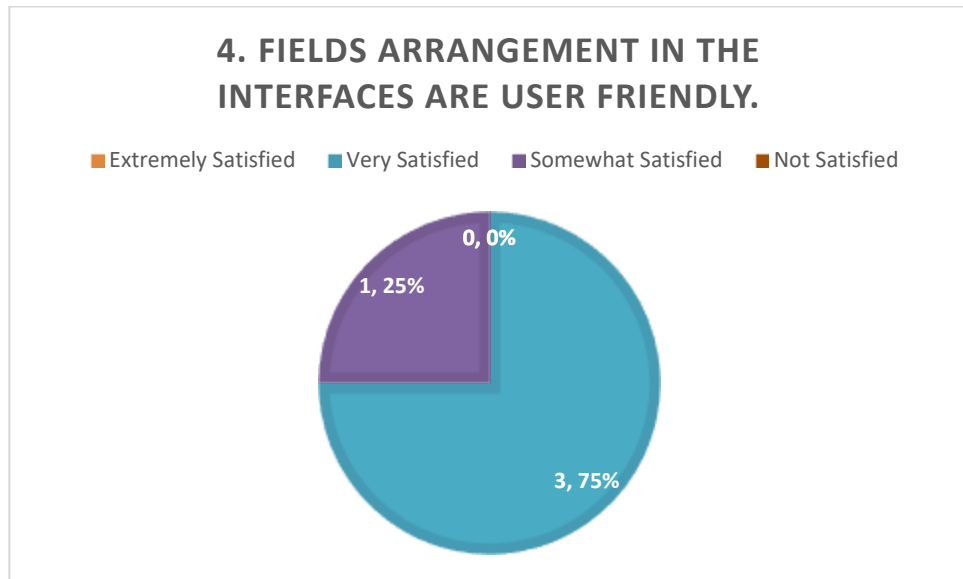Figure 55: Questionnaire Analysis Result 2

3. Font size and colors are very clear in each interface.

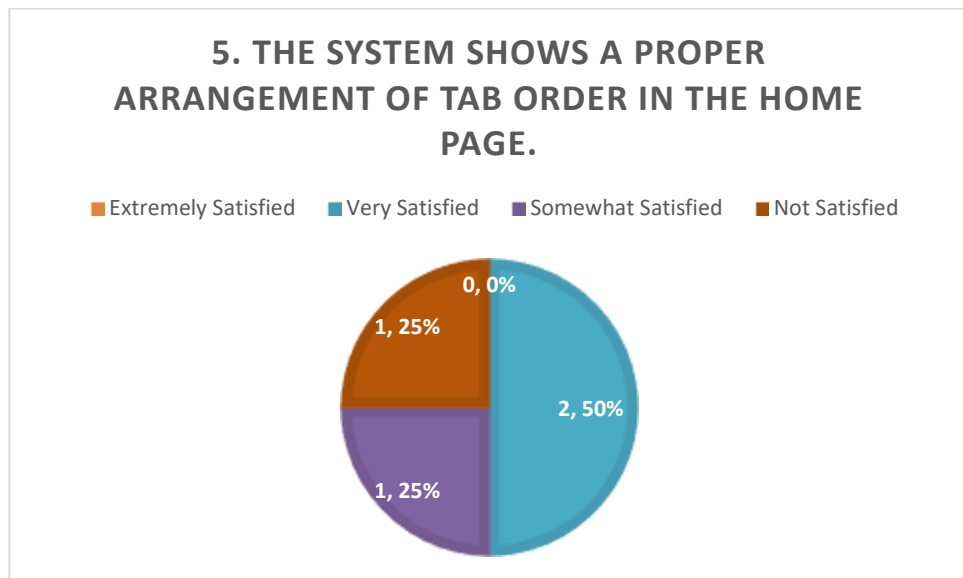Figure 56: Questionnaire Analysis Result 3

4. Fields arrangement in the interfaces are user friendly.
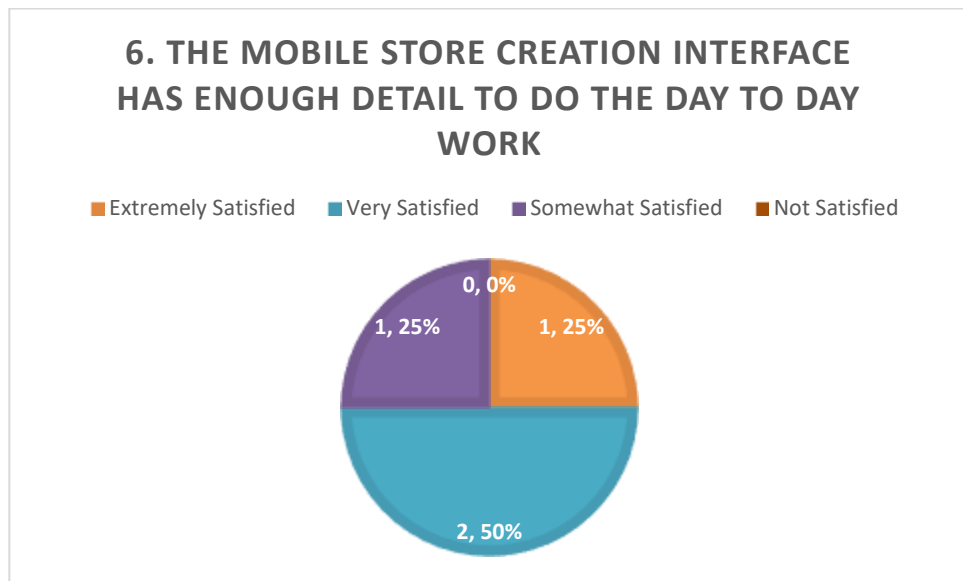
Figure 57: Questionnaire Analysis Result 4

5. The system shows a proper arrangement of tab order in the home page.

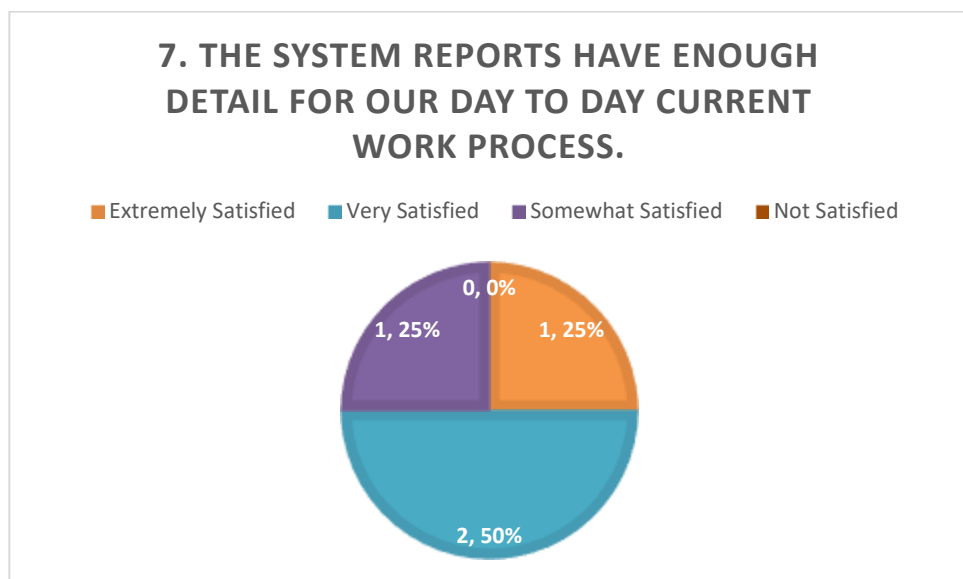Figure 58: Questionnaire Analysis Result 5

6. The mobile store creation interface has enough detail to do the day to day work.

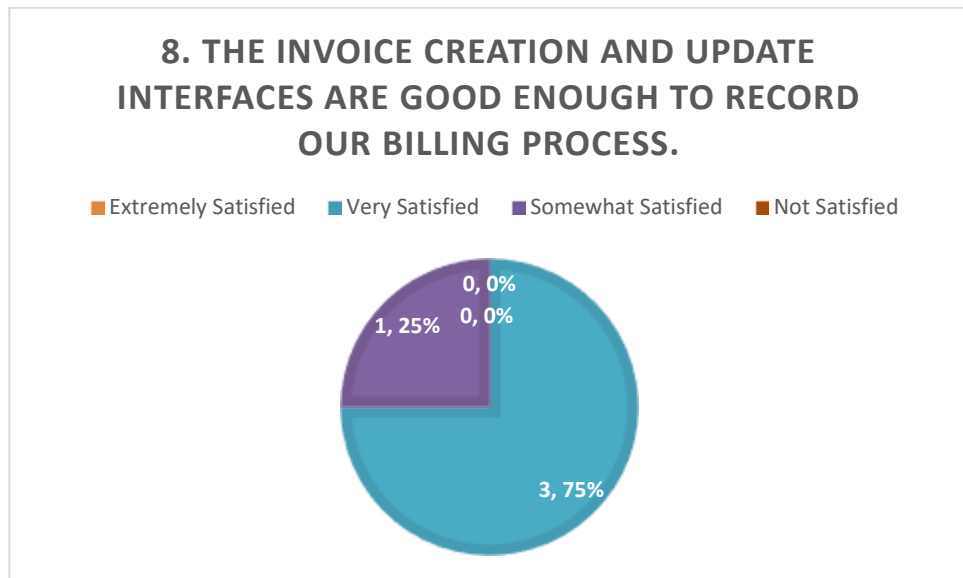Figure 59: Questionnaire Analysis Result 6

7. The system reports have enough detail for our day to day current work process.

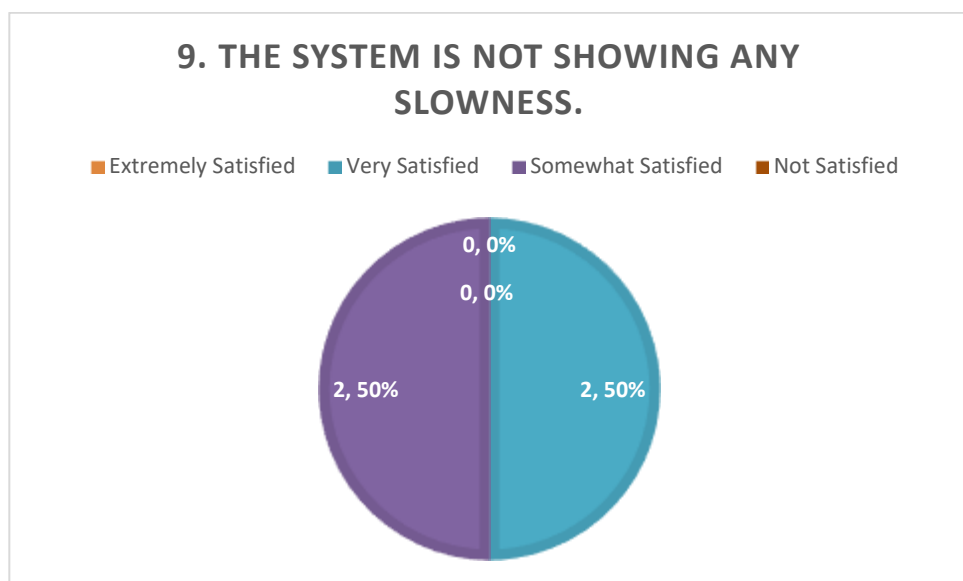Figure 60: Questionnaire Analysis Result 7

8. The invoice creation and update interfaces are good enough to record our billing process.

Figure 61: Questionnaire Analysis Result 8

8. THE INVOICE CREATION AND UPDATE INTERFACES ARE GOOD ENOUGH TO RECORD OUR BILLING PROCESS.

■ Extremely Satisfied ■ Very Satisfied ■ Somewhat Satisfied ■ Not Satisfied

0, 0%
0, 0%
1, 25%
3, 75%

9. The system is not showing any slowness.

Figure 62: Questionnaire Analysis Result 9

9. THE SYSTEM IS NOT SHOWING ANY SLOWNESS.

■ Extremely Satisfied ■ Very Satisfied ■ Somewhat Satisfied ■ Not Satisfied

0, 0%
0, 0%
2, 50%
2, 50%

10. The overall system is very user friendly.

Figure 63: Questionnaire Analysis Result 10

10. THE OVERALL SYSTEM IS VERY USER FRIENDLY.

■ Extremely Satisfied ■ Very Satisfied ■ Somewhat Satisfied ■ Not Satisfied

0, 0%
0, 0%
1, 25%
3, 75%
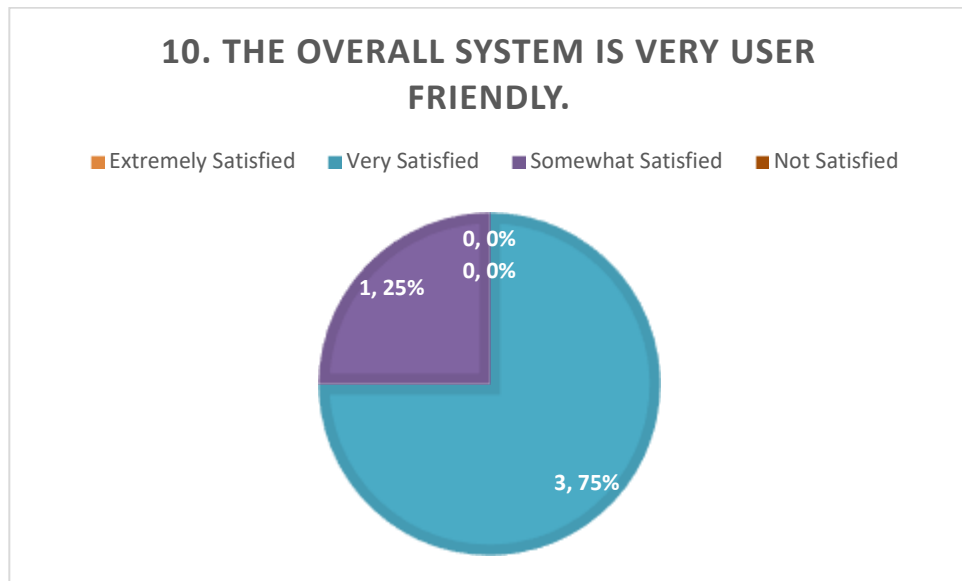
11. The system is fully compatibility with our environment computer platform.

Figure 64: Questionnaire Analysis Result 11

11. THE SYSTEM IS FULLY COMPATIBILITY WITH OUR ENVIRONMENT COMPUTER PLATFORM.

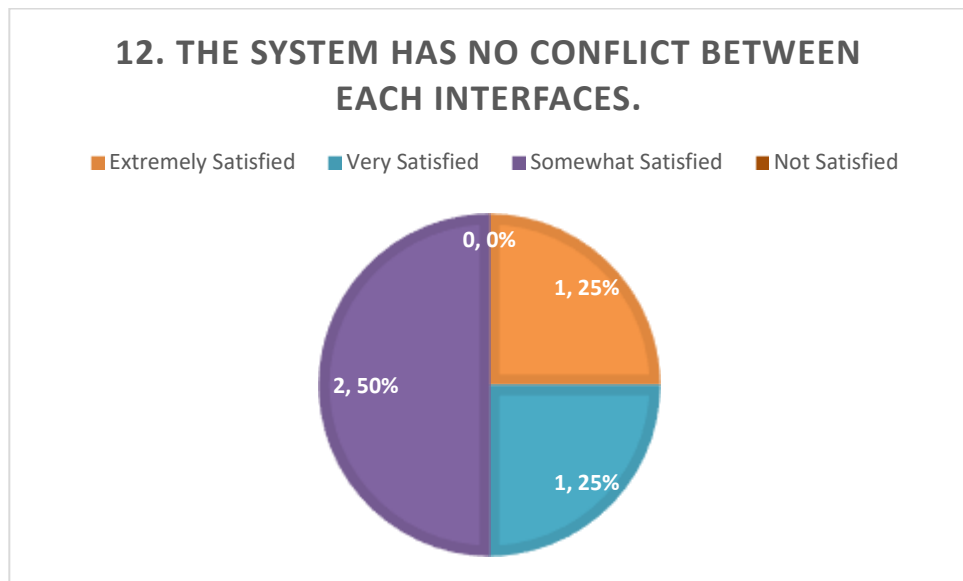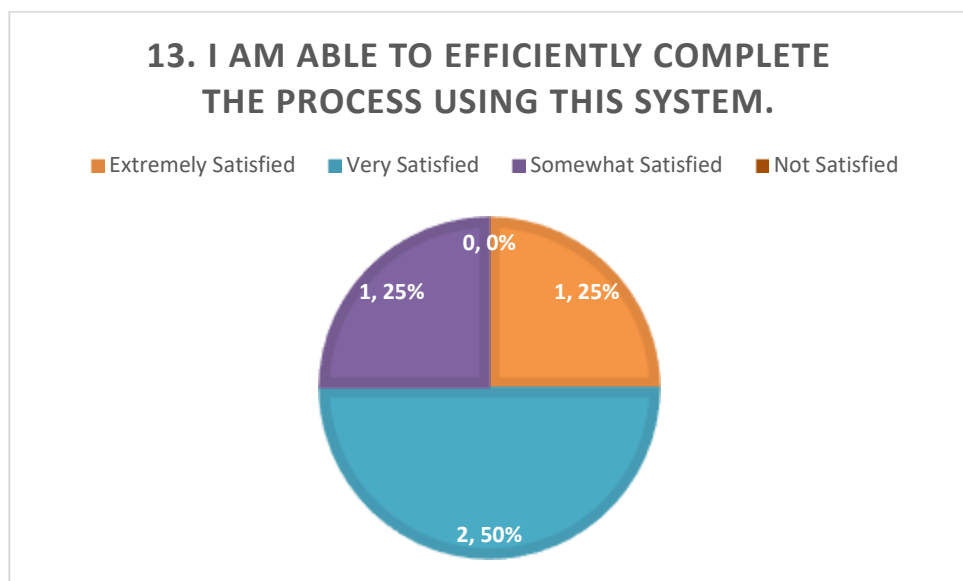■ Extremely Satisfied ■ Very Satisfied ■ Somewhat Satisfied ■ Not Satisfied

0, 0%
0, 0%
0, 0%
4, 100%
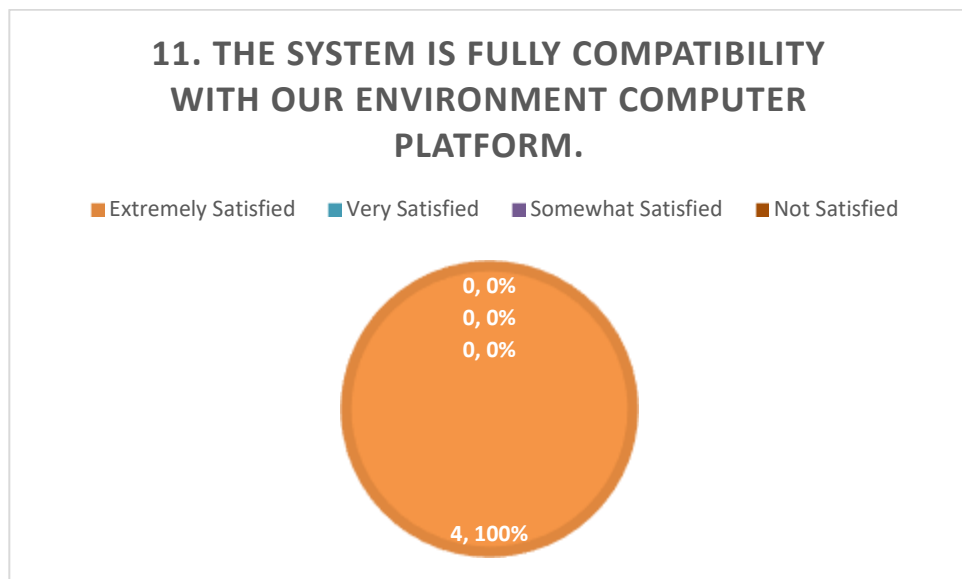
12. The system has no conflict between each interfaces.

Figure 65: Questionnaire Analysis Result 12

12. THE SYSTEM HAS NO CONFLICT BETWEEN EACH INTERFACES.

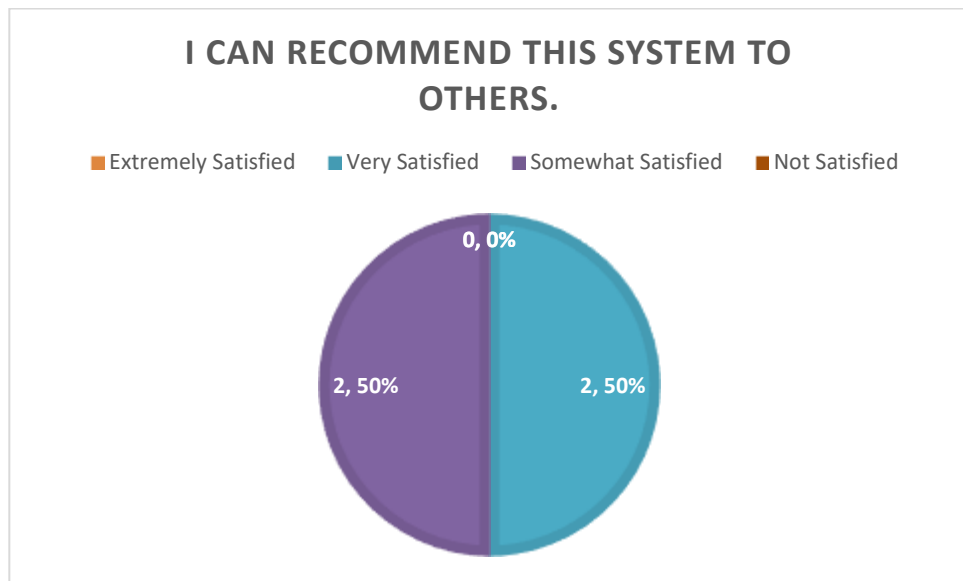■ Extremely Satisfied ■ Very Satisfied ■ Somewhat Satisfied ■ Not Satisfied

0, 0%
1, 25%
2, 50%
1, 25%

13. I am able to efficiently complete the process using this system.

Figure 66: Questionnaire Analysis Result 13

13. I AM ABLE TO EFFICIENTLY COMPLETE THE PROCESS USING THIS SYSTEM.

■ Extremely Satisfied ■ Very Satisfied ■ Somewhat Satisfied ■ Not Satisfied

0, 0%
1, 25%
1, 25%
2, 50%

14. I can recommend this system to others.

Figure 67: Questionnaire Analysis Result 14

15. This system is specific from other software application available in the online market.

Figure 68: Questionnaire Analysis Result 15