Tea Stock Warehouse Management System for
John Keels Warehouse

A dissertation submitted for the Degree of Master of Information Technology

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2019

UCSC

Abstract

Tea stock warehouse management system was designed successfully for the tea warehouse of John Keels PLC, which is a well-known tea brokering company in Sri Lanka. This system reduces most of the inefficient processes which was carried by earlier manual system. This is very user-friendly system.

A tea brokering company is an intermediary party which collects tea from different manufactures and sells to buyers. Management of the tea stocks are been handled through the warehouse. This system was developed to enhance the warehouse management process. Tea stocks received from different tea manufacturers were stored as Tea Bags in the warehouses. They sell those to tea buyers in local market. Therefore, it is essential for tea brokers to maintain details regarding tea manufactures from whom they buy tea, tea stocks details, and their buyer details. In addition to warehouse management, this system also provides the facility to handle tea brokering process.

The existing tea warehouse management system used by John Keels PLC is a standalone system and it involves considerable amount of paper-based processes. Only the broker can interact with the existing system and people who engaged in brokering process must enter details manually. The current partially automated manual processes are inefficient and very time consuming. Therefore, they have realized the need of developing an efficient and reliable solution to manage the warehouse process. The developed warehouse management system is web-based and hence all stakeholders such as manufacturers, brokers can also interact with the system. The current processes were automated to handle tea stock receiving, storing and issuing process in an efficient manner.

The cost of employees and cost for local servers were reduced and it was hosted in a cloud. The paper and stationery work were reduced using the developed system. Users can easily generate` reports using this system. Also, users can access to system from anywhere. So, this system has been very convenient for the users. The system was implemented using Visual studio (C# ASP.Net, IIS, MSSQL) technology and has been successfully deployed on-site. This can also be easily deployed in Tea Warehouses in other Brokers or tea Warehouse management companies.

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. A.G.J. Sarwapriya

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

Certified by:

Supervisor Name: Dr. L.N.C. De Silva

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Signature: Date: 23/10/2019

Acknowledgements

I would first like to thank my advisor Dr L. N.C De Silva at the University of Colombo school of computing. She consistently allowed this to be my own work and directed me in the right direction whenever required.

I would also like to thank all the staff and experts at John Keels PLC, who got involved in different surveys conducted from the beginning of the project. Also, I would like to acknowledge their valuable feedback received during the validation survey. Without their passionate participation and input, this project could not have been possible.

Finally, I must express my very profound gratitude to my parents for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of conducting this project and writing this thesis. This accomplishment would not have been possible without their support.

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1. Introduction

The implemented Tea stock and warehouse management system is for John Keells. It is a multinational company. One of their core business is tea brokering, including warehousing of these produce, whilst their Real Estate activities include the renting of office space. John Keells preeminent position as Sri Lanka's leading Tea and Rubber broker with the largest state-of-the-art warehousing complex is an effective leverage to the future.

JKH is widely perceived as a benchmark of the Sri Lankan economy and is also the single largest market-capitalized company on the Colombo Stock Exchange, a position they have enjoyed for the past five years. John Keells plantation service sector includes the operations of tea factories, tea and rubber broking and pre-auction produce warehousing. With over 140 years of experience in the tea trade, John Keells PLC is one of the leading tea brokers in the country and their warehousing facility is the largest for pre-auction produce in the country.

In John Keells PLC Tea Brokering and warehousing goes as two separate companies. The implemented system is for John Keells Holding's Warehousing. Tea warehouse of JKH is situated in Handala, Wattala. All the tea stocks taken from manufactures are been stored in this warehouse until it was taken from buyers.[1]

1.1 Problem Domain

Tea brokering is a process of collecting and selling of tea. Warehousing is done to store the tea stocks until it will be sold to buyers. Currently they are using a standalone system to handle warehouse related activities. Though warehousing and brokering are interconnected processes, currently these two have been handled separately because these two processes are managed by two in-house standalone systems [2].

Therefore, considerable man power was needed to handle those systems and to enter all details manually to system. Details entered from warehouse and details of brokering have separate databases. These two databases are not interconnected. Because of that transferring data from one database to another was not possible. It must be done manually. Therefore, to transfer details in database accurately, more man power was needed. This was a costly and time-consuming process. But the implemented system minimizes most of the manual work done by human and entering the same data twice is eliminated. So, the efficiency and accuracy of the whole tea brokering, and warehousing process can be increased.

John Keells has handled most of these processes and data entering manually. In addition to that their previous system was a standalone system which has limited capacity and limited functionalities such as manual data entering. when a stock has received, stock details were entered to generate a GRN (Goods Receive Note). Similarly, when a buyer bought a tea stock, manual data entering was done again to create a GIN (Good Issuing Note). There were times where the same detail was entered to system several times within this process. Data entering errors were high because users had to enter massive amount of data in to system repeatedly in several phases. So, by the use of this developed system data redundancy can eliminated.

There are seven other similar companies which handles tea brokering and warehousing in Sri Lanka. Those companies are, Asia Siyaka Commodities PLC, Bartleet Produce Marketing Ltd, Mercantile Produce Brokers (PVT) Ltd, Lanka Commodity Brokers Ltd, Ceylon Tea Brokers PLC, Forbes And Walker Tea Brokers (PVT) Ltd, Eastern Brokers (PVT) Ltd [2].

However, none of the systems which were used by above mention companies does not handle both brokering and warehouse management. Most of the systems are in-house standalone systems. Therefore, this system can be introduced to other companies which involves in tea brokering and warehousing.

1.2 **Motivation**

Existing systems were developed as two separate systems for brokering and warehousing. This system has been developed to connect the functionalities of two separate systems. Existing systems needed more human interactions because it had a manual process. Also, it was very time consuming. Therefore, there was need of a reliable solution for this process. So, to full fill that requirement this system was implemented. By using this system entering same data into the system can be eliminated.

1.3 **Objectives**

The main objective of this proposed solution is to enhance the tea brokering warehouse management process. The proposed solution will automate the entire warehouse management process. The proposed solution will introduce a barcode reader to automate the good receiving process as well as goods issuing process. The proposed system will facilitate users to generate reports easily and through that they can easily get the details regarding stocks, cost and income. To provide a comprehensive advantage to the management level users, system can facilitate relevant authorizations and authorization levels to manage through the system.

- Minimize manual work operations.

- Better control of information for decision making purposes

- Enhanced Quality and Efficiency

- Quick access to invoice details and stock details

- Increase Accuracy

- Eliminate data duplication and work repetition

- Secure and Reliable Backups

- Decrease overall costs

- Enables collaboration and automated workflow

- Enterprise Agility and Decision Support

1.4 Outline of Thesis

This part of the document contains business case documents and it focuses on the current business process and the critical functionalities. The preceding chapter also focuses on mentioned requirement specification which contains the functional and non-functional requirements for the developed system, which has been identified through primary and secondary investigations. The requirement specification section of this document is written primarily focused on the developers and describes in technical terms regarding the functionalities of the system.

Chapter 1 - Introduction

This chapter will contain the details about the client, problems of the existing method, motivation for the project.

Chapter 2 - Background / Literature Review

This chapter will contain the survey of existing similar systems. Issues related those systems and the solutions that would provide proposed system. Also contains the technologies that used for the design and development of the proposed system with the references related for this project.

Chapter 3 – Methodology

The major goal of systems Methodology is to be used to develop the system and what we are using technologies for it.

Chapter 4 – Requirement Analysis and Design

This chapter will include fact gathering techniques, current system explanation with a top-level use case diagram, similar system analysis, functional and non- functional requirements and methodologies. Design section include the methodology used for proposed system, alternative methods, model the system with various diagrams (use case, sequence diagrams), use case descriptions database design and main interface designs. In this scenario we gathering to the requirement of the system user.

Chapter 5 – Implementation

This chapter will include hardware and Software requirements, tools and technologies used, as well as existing codes.

Chapter 6 – User Evaluation and Testing

This chapter will describe the techniques, test plans, system as well as client evaluation.

Chapter 7 – Conclusion and Future Work

This chapter will describe the experience gained through the project along with areas for future reconditions.

2. Background

2.1 Overview of the Manual Process

The previous system used in John Keells PLC is a standalone system which handles only warehousing related functions. Though warehousing and brokering are interconnected, currently these two have been handled separately because these two are managed by two in-house standalone systems. Therefore, more man power was needed to handle those systems and to enter all details manually to system. This result in cost increase related to staff salaries. The implemented system minimizes most of the manual work done by man power and entering the same data twice to system is eliminated. So, the effectiveness of the whole tea brokering, and warehousing process can be increased.

2.2 Business Process Overview

The below diagram illustrates a blue print of a typical warehouse. As the main processes of warehouse Unloading and Issuing processes are carried out. The diagram is attached for reference when analyzing the above two process.
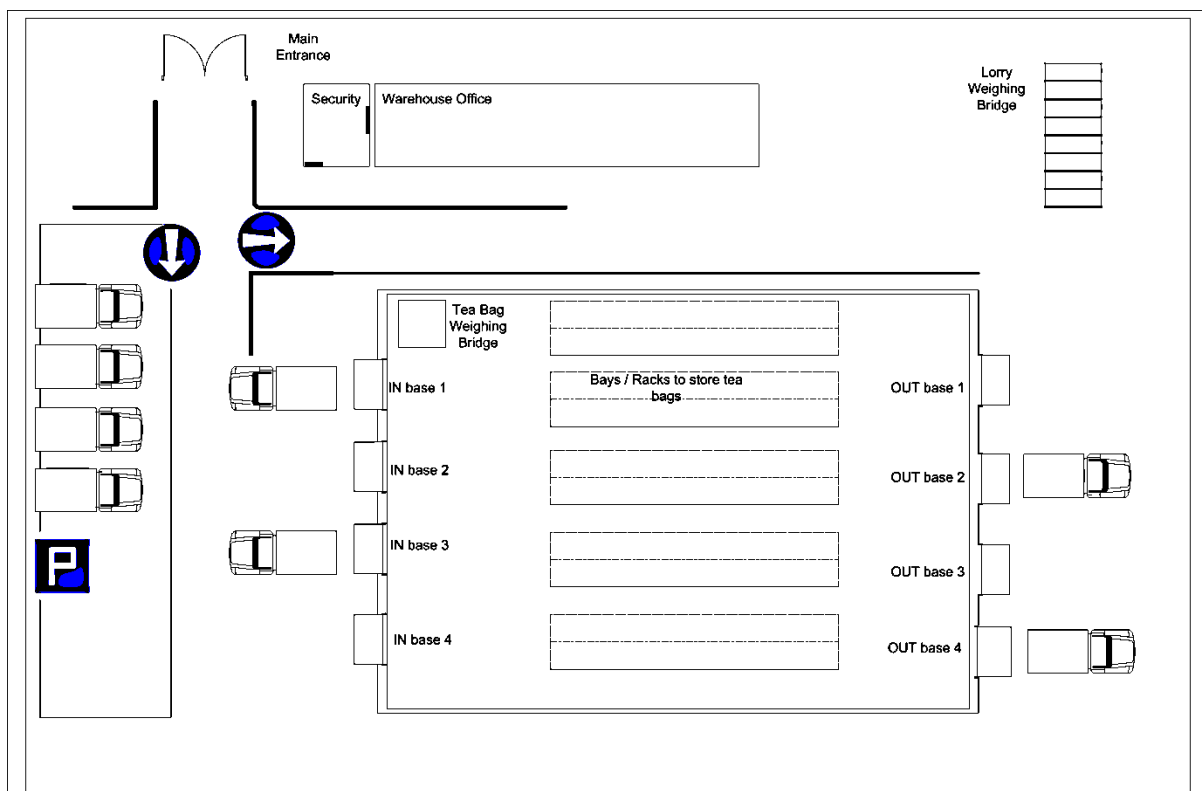

Figure 2-1 – Warehouse Blueprint

As illustrated in the above diagram, the two separated processes, Unloading Process and Issuing Process are handled by the store office and in two different sides at the store.

Before specifying the system features, the following processes were studied. The two diagrams illustrate a high-level process flow of the Warehouses for information and clarification. The Two processes are illustrated using BPML (Business Process Modeling Language) and its Notations.

2.2.1 GRN and GIN Process

Until now John Keells, handled most of these processes and data entering manually. In addition to that their previous system was a standalone system which had limited capabilities such as manual data entering. Once a stock was received, stock details were entered to generate a GRN (Goods Receive Note). Similarly, once a buyer buys a tea stock, manual data entering has done again to create a GIN (Good Issuing Note). There were times where that the same details were entered into the system several times within this process. Data entering errors were high because users must enter massive amount of data in to system repeatedly in several phases.

2.2.1.1 Unloading (GRN) Process
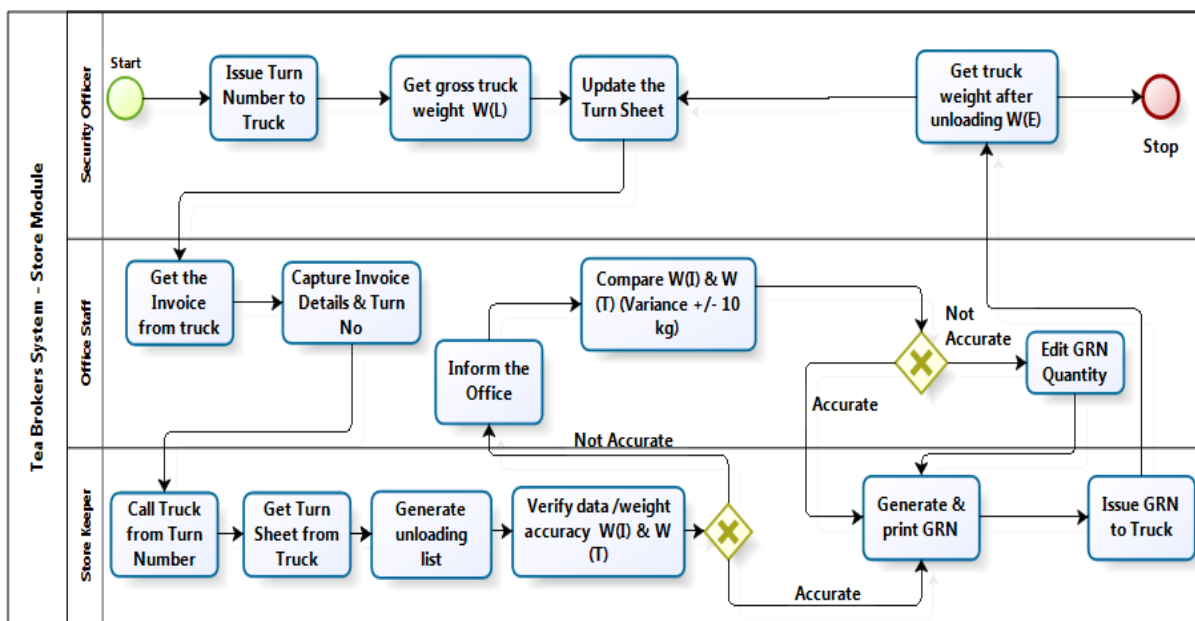
Figure 2-2 – Unloading Process - Store Module

The above diagram breaks down the process of receiving goods at the warehouse in to simple functions. These functions can be explained by the following steps.

- When a truck enters the warehouse premises, a Turn Number is issued by the security officer, Also the truck is taken to the Weighing bay to get the weight of the truck and the stocks inside it.
- Once the Gross weight is weighed, the turn sheet is updated respectively.

- The office then calls for the turn number and get the invoice from the truck. This invoice is then entered in to system.
- At the point of unloading, the truck will be called by the turn number to the vacant unloading bay. Based on the turn sheet received by the truck, the unloading list can be generated from the system. This list is handed over to the folk lift driver once unloaded to store the tea stock. The storage of these stocks is to be done according to the system assigned locations.
- Once the tea is unloaded the total weight of the stock is checked and verified from what is mentioned in the system.
- If there is a variance between the stated weight and the received weight, the office should be informed to modify the GRN. Else the GRN can be generated and issued.
- The process ends when the truck leaves the premises after weighing of the empty truck is done.

2.2.1.2 Issuing (GIN) Process
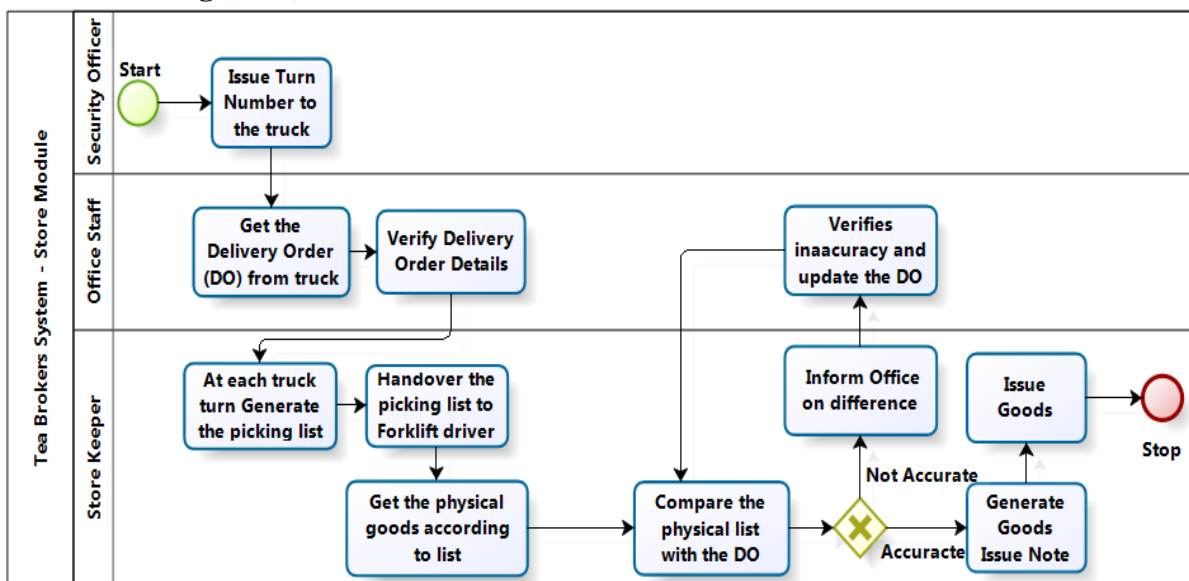
Figure 2-3 – Issuing Process - Store Modul

The Issuing process was triggered by several factors. Mainly the stocks were issued to a buyer once an auction sale or private sale has been made. However, issuing process was also carried out at an invoice withdrawal or rejection. Irrespective of the reason for issuance, a delivery order must be generated from the system. This will be then sent to the respective party.

The steps of the issuing process functions are as below;

- When a truck enters the warehouse premises, a Turn Number is issued by the security officer.

- The office then calls for the turn number and get the delivery order from the truck. This document is then cross checked with system.
- At the point issue, trucks are called to the issuing bay and the turn number is obtained. Based on this number the picking list is generated and handed over to the folk lift driver.
- The folk lift driver brings the physical goods from the stated location.
- The physical goods are then compared with the delivery order, and if there are any differences, the office is informed on it to update the Goods Issue Note. Else the Good Issue Note can be generated.
- The stocks are issued with the GIN note.

2.2.2 Storage Rent Calculation Process

Also, for tea bag storage, a rent is been charged by the corresponding tea manufacturers. After selling the goods to a buyer, after a specific time period an extra storage rent has been charged by the buyer. However, in the previous process these stores rent charges and extra storage rent charges where been calculated manually. So, this was very time-consuming process and, they have encountered huge number of calculation errors. Therefore, the previous process has reduced the efficiency and accuracy in buying and selling procedure of the warehouse.

2.3 Similar System

Currently there are other companies in Sri Lanka which is also handling tea brokering. Those companies are, Asia Siyaka Commodities PLC, Bartleet Produce Marketing Ltd, Mercantile Produce Brokers (PVT) Ltd, Lanka Commodity Brokers Ltd, Ceylon Tea Brokers PLC, Forbes And Walker Tea Brokers (PVT) Ltd, Eastern Brokers (PVT) Ltd.

But none of the systems which were used by above mention companies does not handle both brokering and warehouse management. Most of the systems are in-house standalone systems.

However, none of these systems consist with all facilities, which will be provided by the implemented WMS. Following 2 are examples for existing tea brokering systems.

1) WMS System (Warehouse management system) – Standalone system. John Keels previous system
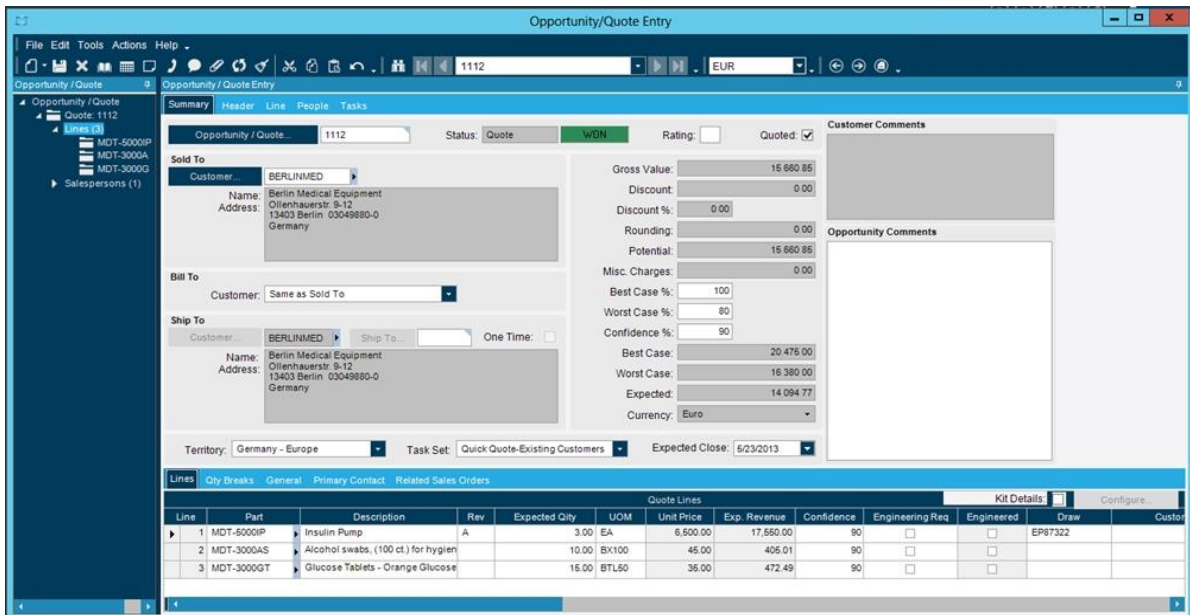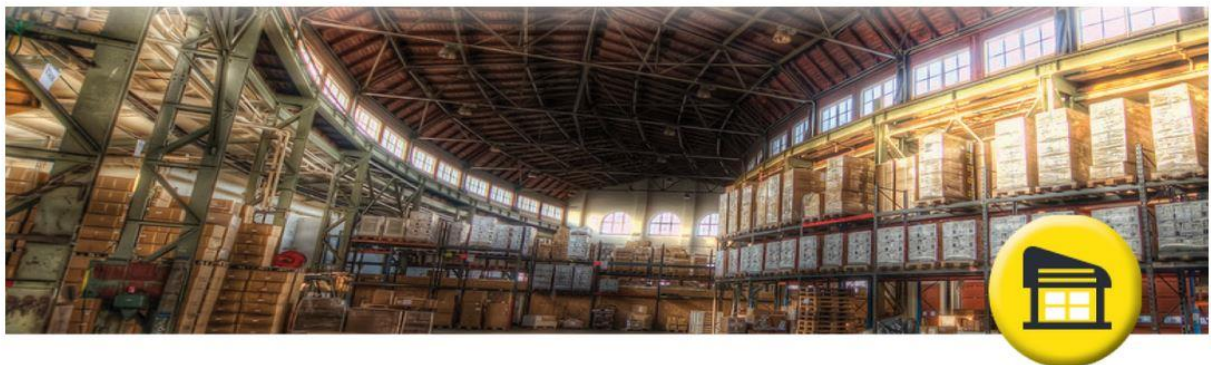2) Tea Stock Management System. (Current System in Mercantile Produce Brokers warehouse) [3]

Figure 2-4 – Tea Stock Management System

Figure 2-5 – Fishbowl Warehouse Management System[4]

Figure 2-6 – Softeon Warehouse Management [5]

2.4   **Review of System**

There are many systems that provides similar kind of functionalities such as the implemented system. Some of the websites can conduct administrative task online and can-do sales online. But the developed WMS web site has real time update with tea brokering module. This system has incorporated receiving and delivering factory tea's stocks.

3. Methodology

The major goal of system methodology is to be used to develop the system and what we are using technologies for it. In this scenario we gathering to the requirement of the system user.

3.1 Software Development Life Cycle

The implemented solution was developed based on the iterative development model in accordance to Agile Methodology. Agile methodology was used because it was important to get feed backs from client in each phase of development. In this method client feedbacks can be taken module wise. As an initial step the detailed requirement gathering was been performed based on the module wise and key requirements was prioritized based on the client need, to provide workable output at the end of each iteration in accordance to the client need.

In this project client's software and hardware requirements must not be high end, because this is a web-based system. This web site was hosted at one server, and needed server specifications are 16GB or above RAM, 500GB hard drive, 16mpbs network bandwidth. SQL Server 2012 or above, Windows server 2012 (OS should be supported .Net framework 4.5) or above, Crystal report run time XI are software requirements for this implementing system. Development environment for this project was visual studio 2013, and database side handled by SQL server 2012 Crystal report developer version XI

Development architecture for the system was 4 Tier based on MVC. System designing was done using bootstrap and JavaScript is used to validate user inputs.

Database backups are scheduled automatically for hourly, daily and weekly. Therefore, it was easy to take backup restoring point in case of emergency.
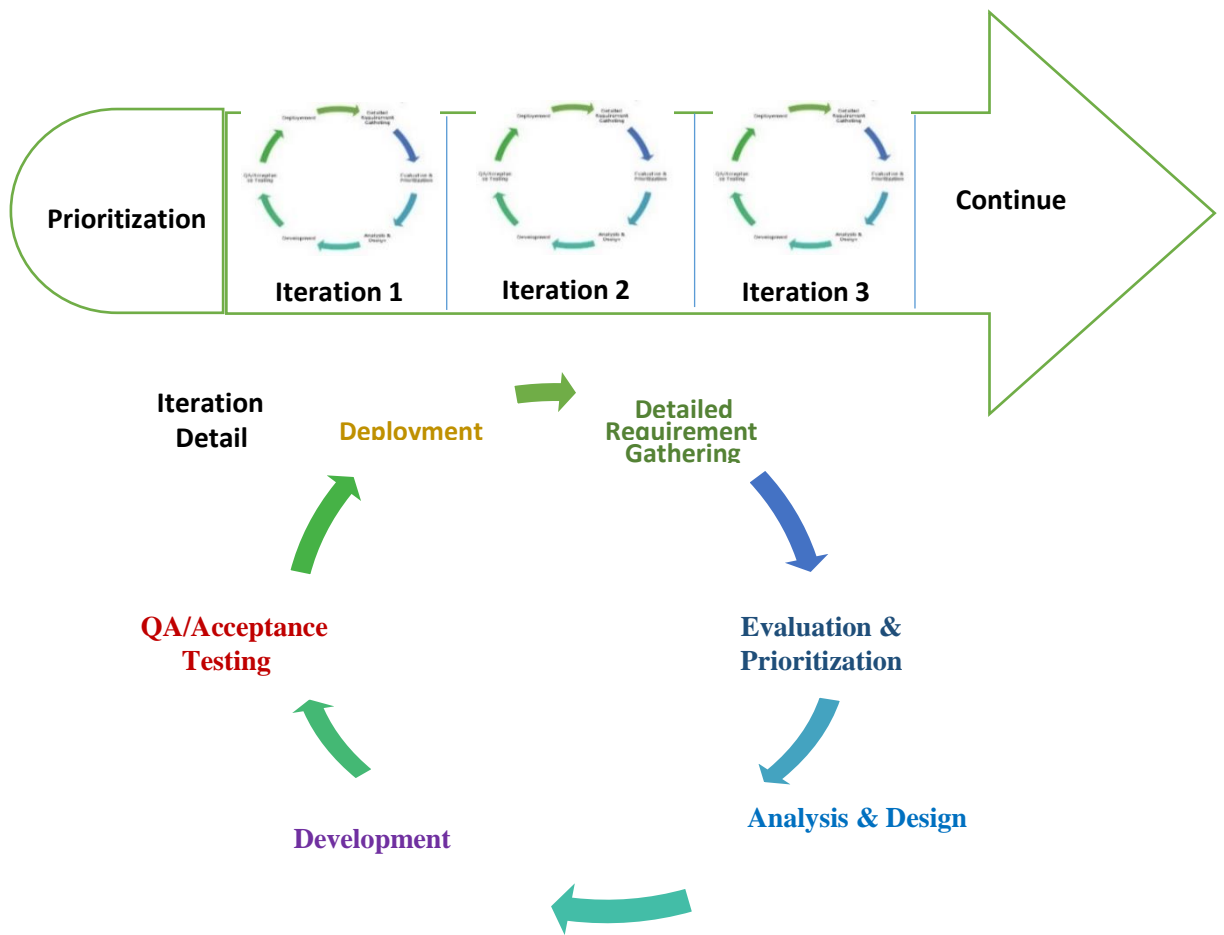
Figure 3-1 – Software Development Life Cycle

4. Requirement Analysis

4.1 Requirement Gathering

Requirement gathering was an essential part of any project management. Understanding fully what a project outcome was critical to its success. This may sound like common sense, but surprisingly it's an area that is often given for too little attention. The following methods were used to gather requirements.

- **Document Analysis**

  Stock books, purchased order format, sample Good issue note (GIN) and Good receive note (GRN) had been carefully examined to obtain proper knowledge about the manual process.

- **Interviews**

  Store keepers, Data entry operators and Managers had been interviewed to yield information about the current process. It was enabling to share different knowledge in different user point in view.

- **Prototype**

  prototype was a relatively modern technique for gathering requirements. Created prototype was shut down to the main system users (Store Keepers) and it had been developed in advances using Store Keeper's comments.

- **Questionnaires and surveys**

  A one sheet questionnaire was given data entry clerks, store keepers and managers, to study on how they find item types from item holes, how transactions are done, how item transfers take place, etc. (Refer Appendix C1 for the Questionnaire)

- **Surveys**

  Majority of information related to surveys were from internet related blogs, forums, etc. Had referred and analyzed for existing tea products of storing system to capture main valuable concept which all had.

- **Observation**

  This was study of user in their day to day activities and performance of assigned task and duties. By observing it was noted that process flows, awkward steps, pain points and opportunities for improvement. Also observed manual inventory users and assisted to gather valuable key points to be developed.

- **Supervisor Comments**

  Discussion with supervisor gave an idea regarding the requirements, from their point of view. Some valuable concepts which stated by supervisor were not included in the user information and not stated by user during the process of information gathering. With the assistance of the supervisor, added several key features to improve the quality of the final product.

- What is the process should be included?
- Which are the critical processors?
- Are inventory records reconciled?
- Are John Keells Warehouse maintain slandered format for GRN, GIN, DO? Describe
- Do branches compare quantities received against receiving reports?
- Does management need special reports?
- Are hoping to expand the WMS system in future?
- Will orders be sent to your warehouses automatically, or will this be a manual process for the sales team to do?
- How does the print, pick, pack process work in the software?
- Can picking routes be optimized by chosen product locations?
- Can shipping labels be automatically printed, and how are they integrated with carriers?
- How are tracking references dealt with in the system?
- How are inventory counts managed? Can they be assigned to a warehouse representative and easily split into cycle counts?

4.2 'SIPOC' Analysis

The SIPOC diagram is a tool that is used to outline the scope of a process improvement initiative. The diagrams name is an acronym for the elements that need to be identified and documented.

- S - Suppliers: Who supplies the inputs to the process under consideration
- I - Inputs: What are the inputs to the process
- P – Process: What are the steps of the process that is being improved upon
- O – Outputs: What are the outputs of the process
- C – Customers: Who are the customers or beneficiaries of the outputs of the process

Table 4-1 – SIPOC Analysis for Store Module

Supplier(s)	Inputs	Process	Outputs	Customers
• Tea Suppliers • Delivery person • Security Guard • Office staff • Weighting Officer • Customer	• Supplier Invoice • Turn number information sheet • Weight records • Store keeper's verbal confirmation • Delivery Order	• Create invoices • Update Invoice Details • Generate GRNs • Update GRNs • Update store location status • Assign location details • Calculate the efficiency rate of unloading • Update stocks at issue	• Invoice • GRN • Unloading list • Unloading efficiency rate • GIN	• Delivery Person • Store Keeper • Security Guard • Tea Suppliers • Customers

4.3 Functional Requirements

Table 4-2 – Module Components

	Unloading Process	Issuing Process	Other
Features	Invoice Entry	Picking List Generation	Store Location Management
	Unloading List Generation	GIN Generation	Efficiency Calculation
	Store location identification		Report Generation
	GRN Generation		

4.4 Non - Functional Requirements

- **User friendliness and learnability** – User Interfaces are easy to understand and navigate

- **Response time –** Faster loading and refresh times

- **Robustness –** Maximum level of how well it can handle the errors without failures

- **Compatibility -** Proposed application must be compatible with all the latest hardware & software that the company has.

- **Reliability** – Mean time between failures & mean time to recovery must be low.

- **Security** - System must include a user authorization and authentication mechanism.
- **Maintain backups** – System must be capable enough to take backups whenever needed
- **Accuracy** – Results should be accurate & system must not lead employees to any kind of confusions

5. Design and Implementation.

5.1 System Design

5.1.1 UML Diagrams

The unified modeling language (UML) is a slandered visual modeling language intended to be used for

- Modeling business and similar processes.
- Analysis, design, and implementation of software- based systems

UML is a common language used to describe, specified, design, and document existing or new business process, structure and behavior of artifacts of software systems.

In world of information technology there are so many commercial versions to create UML diagrams. I have selected Edraw MAX. Edraw max is a 2D business technical diagramming software which helps to create flowcharts, organizational charts, mind map, network, floor plans, workflow diagrams, business charts, and engineering diagrams.

5.1.2 Class Diagram

Class Diagrams are the backbone of almost every object-oriented method including UML. Class diagram describes the static structure of a system. Class diagrams can be used for data modeling. Classes represent an abstract of entities with common characteristics. Associations represent and abstract relationship between classes.

5.1.3 Use Case Diagrams
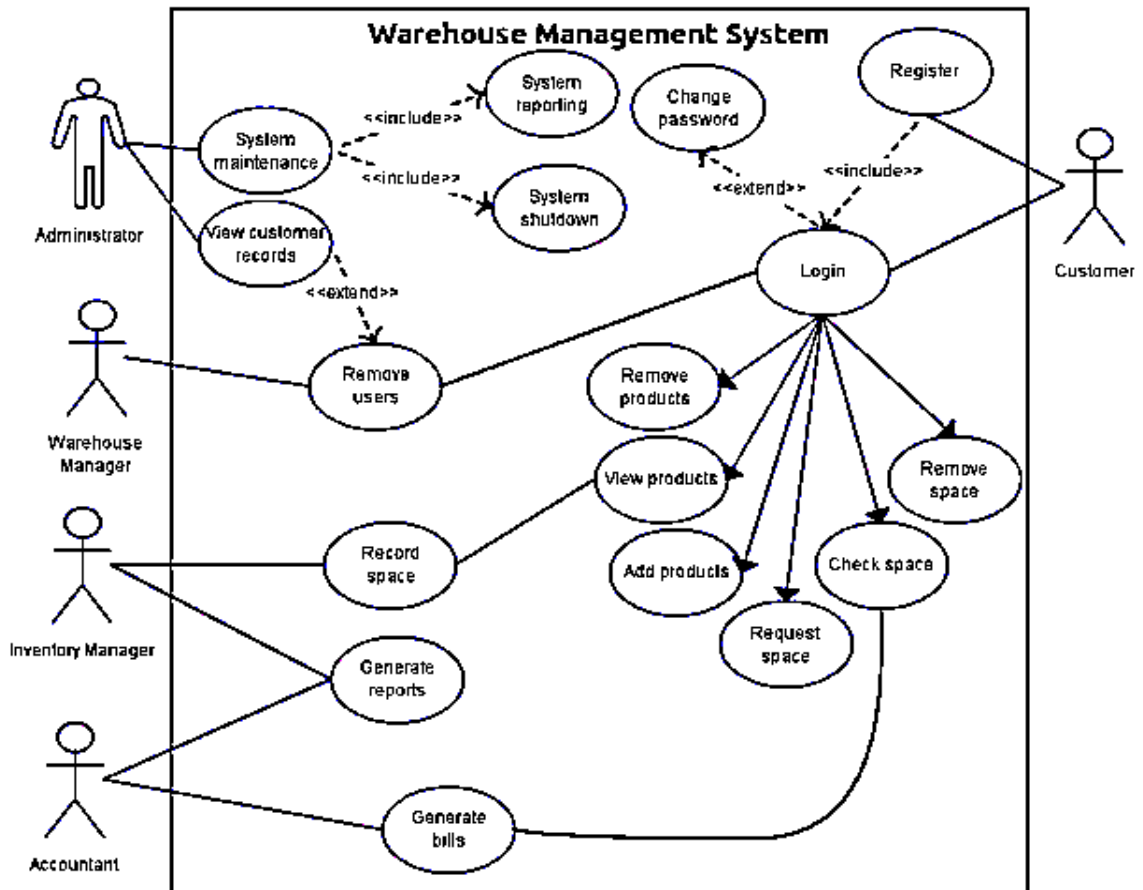
Figure 5-1 – Use Case Diagram Example
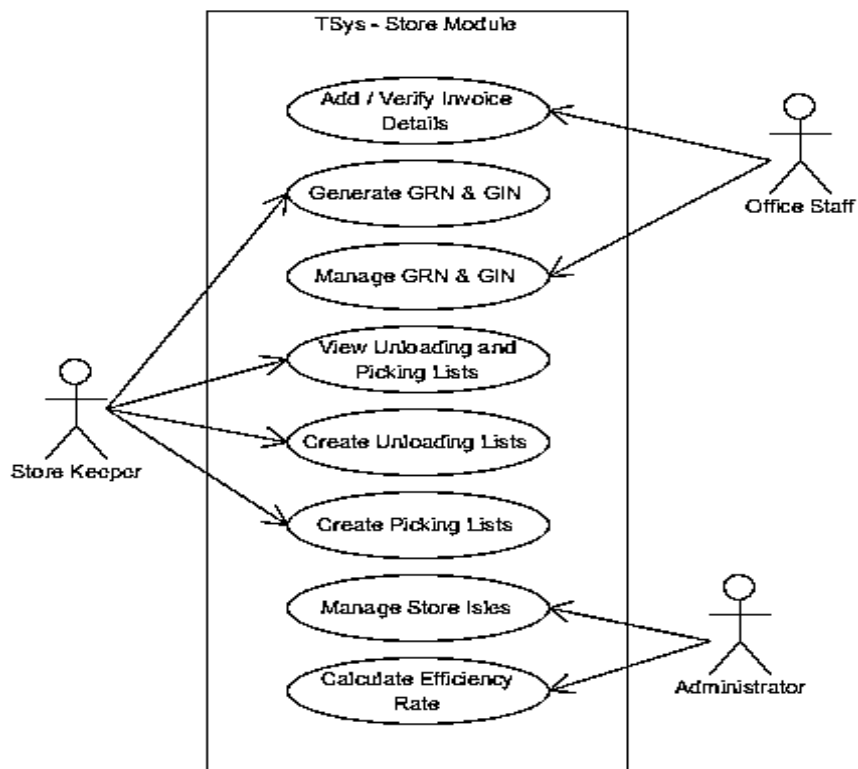
Figure 5-2 – Use Case Diagram

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5.1.4 Use Case Narrative

Use case Narrative is a textual representation of the course of events encounters when an actor is interacting with the system. There can be several use cases associated with a system, each of which describes the in a functional or behavioral point of view.

5.1.5 Sequence Diagram

A sequence diagram is an interaction diagram that shows how processes operate with one another and in what order. It is a construct of a message sequence chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchange between the objects needed to carry out the functionalization's in the logical view of the system under development.

5.1.6 Flow Charts
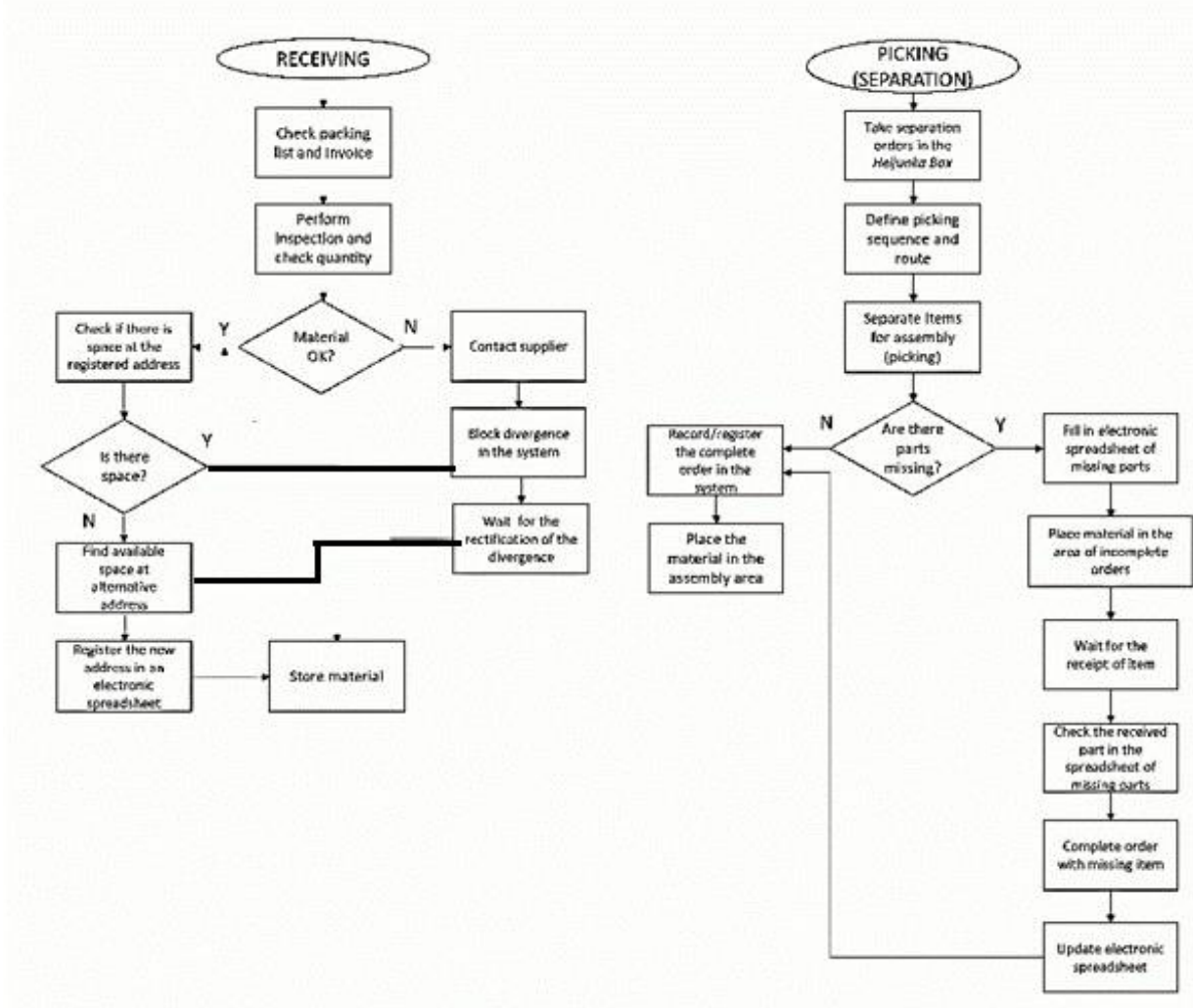
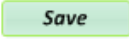*Figure 5-3 – Flow Chart Diagram – Warehouse Process*

5.1.7 **Invoice Entry**

Figure 5-4 – Flow Chart Diagram – Invoice Entry

Table 5-1 – Office Employee -Invoice Entering

Business Case Users
Office Employee -Invoice Entering
Business Case ID: 1.0
Business Requirements
• Tea stocks are sent by the Estate with the invoice containing the product details.
Pre-conditions
• Valid Estate, Grades, Mark, Chest Type and Chest Numbers should be in the invoice.

	The number of active in-bays should be defined by the administrator.

Business Rules

- Grade and the Estates should be selected by the existing list. If it's a new Grade or a new Estate, it should be created through the system administrator.

- By default, the location to be stored will be identified by the product Mark, Quantity, Invoice Number and the Grade. The default location can be changed through the system if necessary.

- The invoice information, the truck details and the location should be added to the unloading list which is to be generated at the store receiving point.

Main Event List / Flow of Events

On initial display

UI opens when the user clicks on the "Invoice Entry (Add New/Edit)" form in the menu structure

On User Interaction	1. Once Mark details are entered it should be validated and "Selling Mark" should display on the Screen.
	2. By clicking on `Enter` the form header details will be locked and unless the screen is reset, the details cannot be changed.
	3. Enter invoice details and click on `Add to Grid` button to add the details. The added invoices can be edited by clicking on ✏️ in the grid, deleted by clicking on 🗑️ button and sets can be segmented by clicking on ✂️ set break.
	4. The system should be able to calculate the gross weight, which would be carried forward to the GRN generated.
	5. Once details are entered and added to the grid, relevant location should be allocated, and the location details should be able to be viewed and edited separately.
	6. Click on `Save` to save newly added invoice or `Update` invoice through editing mode.

On user exit

N/A

On user terminate business case

Close window with user confirmation

Post Conditions			
When all the mandatory fields are filled and saved, the details should add to the unloading list. Once save Last entered line details should be displayed.			
Messages			
Ref #	Event	Message	Post Message
1	Erroneous "Mark", Validation is failed	"Please enter valid Mark Details"	Focus to "Mark" field.

5.1.8 Inquiry

The interface of inquiry is to be remained in the same structure. This interface is for information for the user to inquire on the stocks, GRNs and GINs. The user can specify the information to be inquired by the Invoice Year, Invoice Number, Grade, Mark or by GRN/GIN number. The user should also be able to sort the columns or group data by a column or columns.

Table 5-2 – Store Keeper / Office Employee – Inquiry

Business Case Users	
Store Keeper / Office Employee – Inquiry	
Business Case ID: 5.0	
Business Requirements	
• The authenticated users can inquire on details through this screen	
Pre – Conditions	
N/A	
Business Rules	
N/A	
Main Event List / Flow of Events	
On Initial Display UI opens when the user clicks on the "Information Inquiry" form in the menu structure.	
On User Interaction	1. Enter either one or more of the text fields, Year Invoice No, Grade, Mark, GRN Number or GIN Number. 2. If applicable tick the other broker check box. 3. Click on 'Search' button to retrieve the data.

	4. The user can view the information by clicking on the tabs and sort and group the information according to columns.
On User Exit	N/A

On User Terminate Business Case
Close window with user confirmation

Post Conditions
N/A

5.1.9 **Store Location Management**

The location inquiry screen allows the user to search for the location where each of the invoice stock is stored. The user can inquire for locations either by location details or by the invoice details.

Table 5-3 – Store Keeper / Office Employee – Location Inquiry

Business Case Users
Store Keeper / Office Employee – Location Inquiry

Business Case ID: 6.0

Business Requirements
• The authenticated users can inquire on details through this screen

Pre – Conditions
N/A

Business Rules
N/A

Main Event List / Flow of Events

On initial display
UI opens when the user clicks on the "Location Inquiry" form in the menu structure.

On User Interaction	1. Select the search criteria by clicking on either the Invoice details or the location details. 2. Once the load button is clicked the information will be displayed. 3. To free a location manually through the system, the user can select the line from the grid, tick the free location check box .

On User Exit N/A	
On User Terminate Business Case	
Close window with user confirmation	
Post Conditions	
N/A	

Every tea stock which will be received at each warehouse needs to be stored in the racks, in a specific way where it can be recognized, where it is safe, and the rack can accommodate it. This chapter discusses on how these store locations can be managed in an easier manner.

The below image is an overview of a typical warehouse.
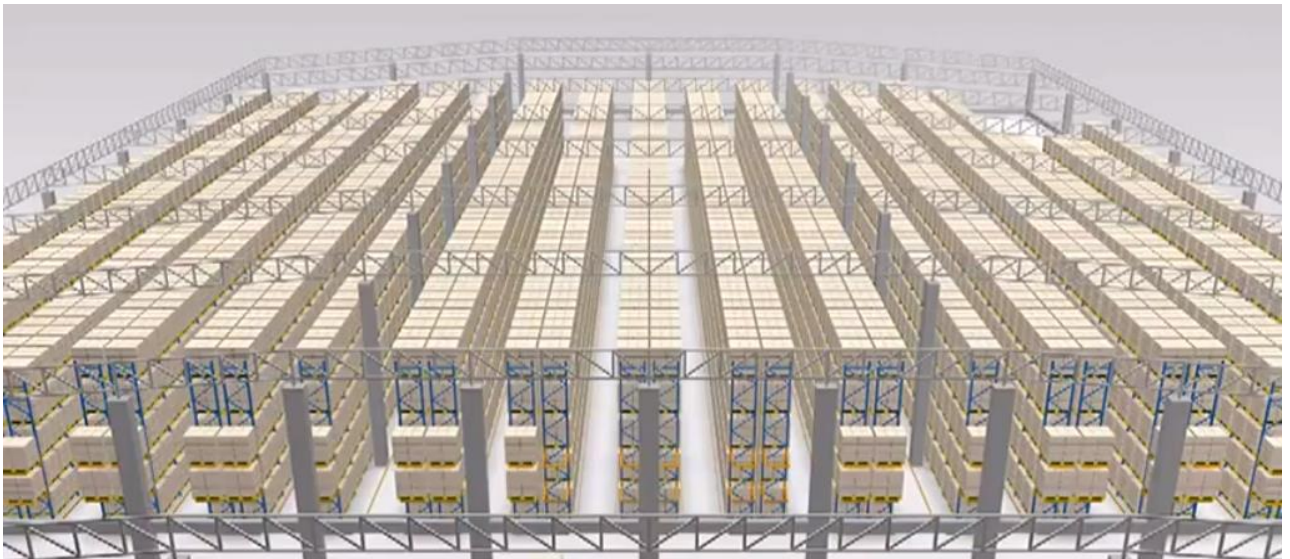
Figure 5-5 - Warehouse Overview

As per the above diagram the racks are been kept and arranged, where there is an ile between two racks, so that the folk lift can be driven through the space. In most cases, the iles are also used as store locations.

Store allocation which looks as a sub function is involves in logical comparison and decision making. Also, all locations should be defined in the system and should be able to change its status when required.

The management of the location will be based on user authentication. The basic functions of this management are as below;

1. Add/ Edit Locations
2. Change Status of Rack / Shelf / Compartment

3. Allocate locations to stocks (Systemized function)
4. Modify allocated locations
5. Inquire on location details

Each of the above functions, are described below, with an interface design to demonstrate the requirements and functions in a more clearly.
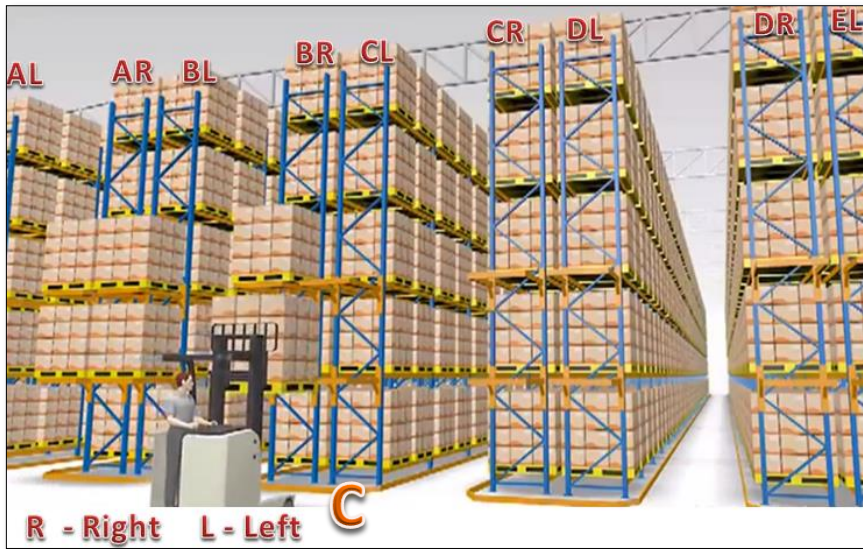
Figure 5-6 – Warehouse Rack Identity

For identification purpose, each store location was named based on the following analysis. The Figure 20 illustrates how racks are named in the warehouse. Each Ile is named alphabetically; the rack on the right side of the lie is named with the letter and R for right side and on left side with L. For example: The space between the two racks (lie) is named as "C" and the racks on either side are called "CL" and "CR".

Figure 5-7 – Warehouse Rack Shelf Identity
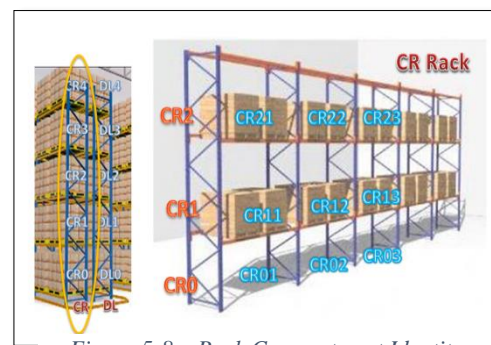
Figure 5-8 – Rack Compartment Identity

The Figure 21 details as to how each of the above labeled racks can be further labeled based on the shelf. The ground shelf is zero and towards up the number increases. This is important, because the shelf determines the type of chests that can be stored. Higher the shelf is lower the chest weight should be, and the ground level can handle the bulk. Each shelf's compartment is identified accordingly. The ground Shelf of rack CR is CR0, and compartments of rack CR0 are CR01, CR02, and CR03 etc.

Figure 5-9 – Other Location Identity

In addition to the above naming conventions for the racks and compartments, Certain stocks can be stocked near racks or in front of the racks as well. In this case, it can be suggested that these locations to be named with the closest rack and on direction.

For example: The arrow pointed stock location can be named as "BL0F"

For BL is the closest rack, '0' is for the ground shelf and 'F' to say in front of the rack. This can be applied in a similar manner as required. According to the need and to the availability of space the locations can be named when they were added to the system. The above indicated location identification can be changed based on the user preference.

The four criteria to determine the store location are;

- Factory Name / Selling Mark
- Grade
- Packing Type

- Quantity

Based on each of these criteria and the shelf level in the rack, at the point when the invoice was saved, the location for the stock was allocated. This will be indicated in the unloading list. Once the GRN is generated, the allocated location was marked as "occupied".

Similarly, when a Delivery Order was issued, the occupied location was marked as "Available Soon" and at the point of issuing goods, these locations was indicated in the picking list. Once the GIN was generated, the locations of the GIN stock was marked as "Free"

5.2 Security Scheme Design
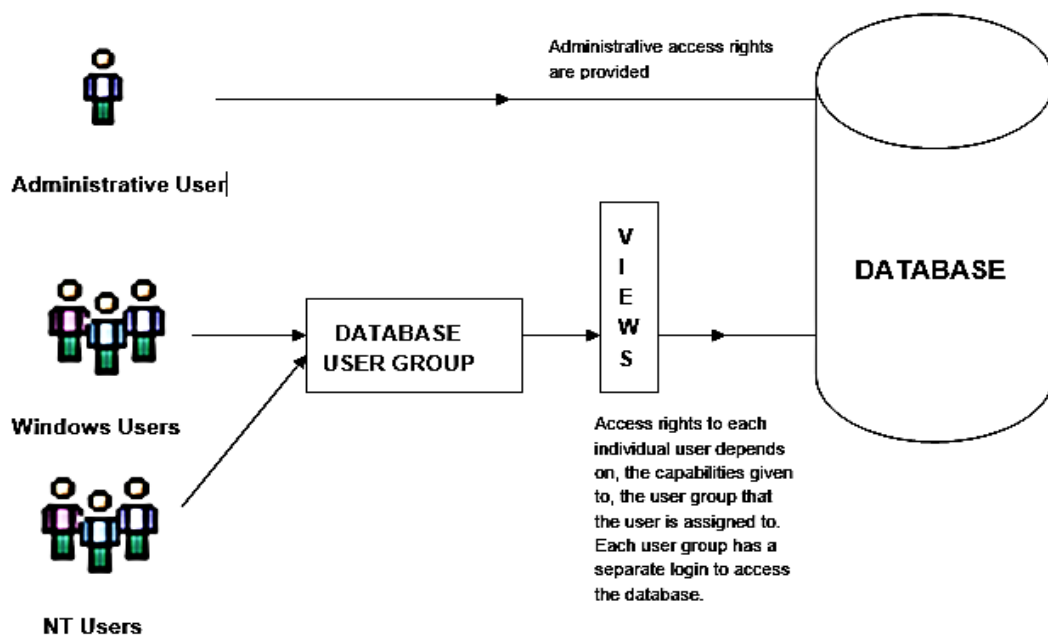
Figure 5-10 – Security Scheme Design

5.2.1 Administrative User
The administrative user accesses the database with the rights provided for an administrator.

5.2.2 Individual User
Users was categorized into different user groups and each user group was given a set of limitations and instructions to access the database. Each user group has a separate login to access the database.

5.3 server architecture
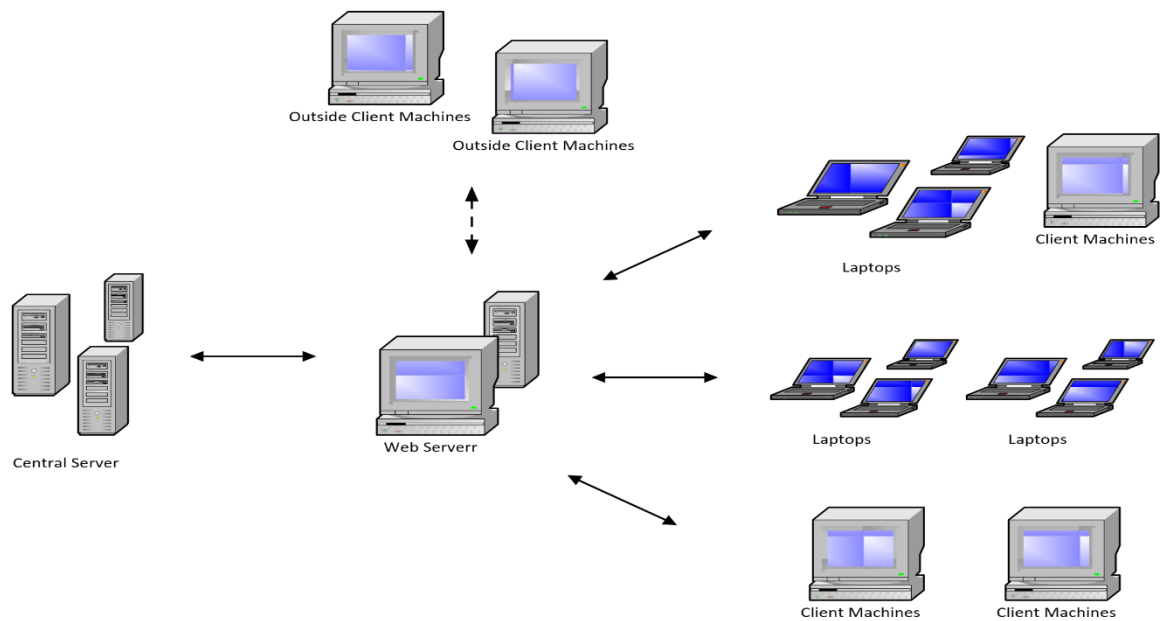
Figure 5-11 – Web Server Architecture

In the web server architecture;

- The system was located on the central server.

- Required functions were carried out in each location by accessing the system via the web server.

- Access to the system was be granted depending on the username / password passed to the web server

- Based on this, the functions and pages viewed were different and the functions respective to that location (if any) only will be accessible.

- The system can be accessed from any outside machine due to the solution being web based

5.4 System Development

5.4.1 Getting Started

The user can login to the system by entering his / her user credentials. Based on the given user credentials, the system function and module accessibility are defined.
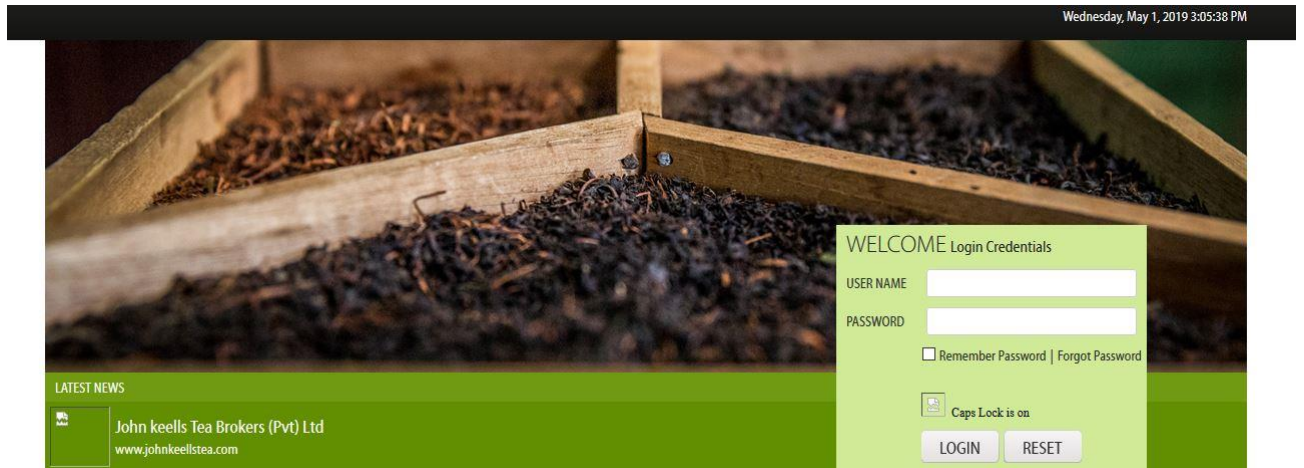
Figure 5-12 – Login Page

- **Enter** the USER NAME and the PASSWORD and click on [LOGIN] to access the system.
- **Click** on [RESET] to renter the username and password.
- To **reset password**, click on "**Forgot Password**", and a pop up was displayed to send the password reset link.
- For the system to save the password for the user in the PC used to log in to the system, **check** the checkbox, **"Remember Password".**

5.4.2 System Logout

Figure 5-13 – System Logout Page

- At the click of "Forget Password" the figure 3 on the left is popped up.

- The user can enter the User Name and the email address and click on Button.

- Then the system verifies if the user name and email address matched with the database and send the password recovery link to the entered email address. Then the user can reset their password through the link.

- **Click [Reset Detail]** on the home page or Logout on the right top corner of every page.

5.4.3 Warehouse Management System Home Page
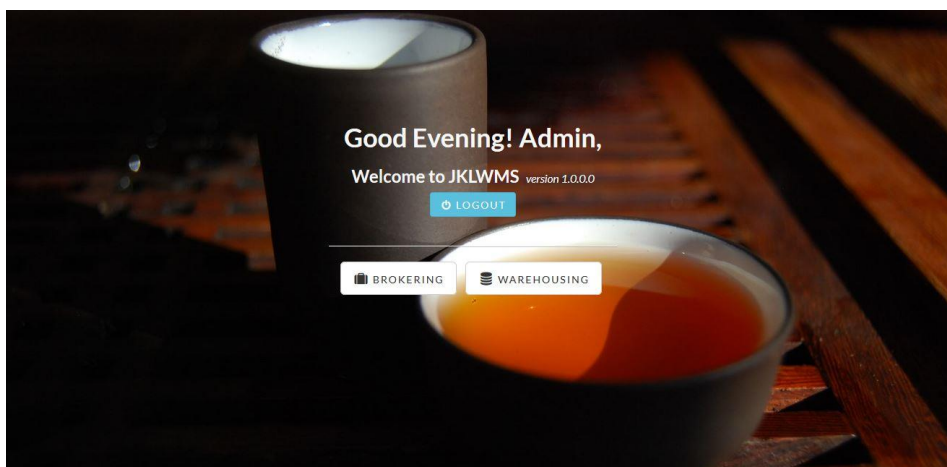
Figure 5-14 – Warehouse Management System – Home Page

- Once the user logged in to the system, the user was directed to the home page.

- **Select** the relevant module to access from this page. The accessibility of each of the module depends from one user to another.

- **Click** on either,

- Brokering Module

- Warehouse Module

5.4.4 Store Module Home Page

The landing page of the store module is as follows;

The user can view the module menu on the right-hand corner, where Bin Operation functions, reports, inquiry and store master could be accessed.

Click on, HOME to return back to the home page.

Figure 5-15 – Bin Operation Menu

- To view the menu, **click** on "Bin Operation".

- User can access to add / edit invoices, Add GRN and GIN and Chest Location Details.

- User can also be directed to GRN/ Unloading List and GIN/Picking list prints.
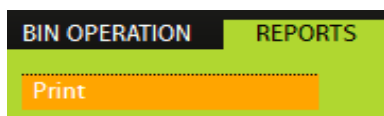
Figure 5-16 – Store Module Report Menu

The reports menu allows the user to use the report navigator tool to generate warehouse related reports
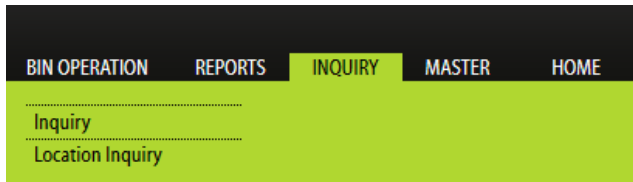
Figure 5-17 – Store Module Inquiry Menu

The store inquiry page can be accesses to view all the data of tea stocks in the specific store.
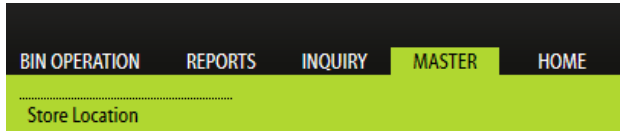
Figure 5-18 – Store Master Menu

The store master allows the user to access store location and location allocation functions of the module.

5.4.5 Bin Operation – Invoice Add New

Figure 5-19 – Add New Invoice Page

Allows the user to enter invoices received and turn details issued for receiving tea. Turn No will be issue from security point and invoice entry will be enter against turn no and turn date.

Step1.   Input the sale type at the top of the page

Step2.   If user select Broker, dropdown should be viewing the buyer list else, dropdown should be load broker list.

Step3.   Input the broker and store details (for store module users, the store maybe fixed).

Step4.   Input lorry details such as select turn date and turn No. (Invoice date and turn no should be kept same), lorry No, driver name and driver NIC No.

Step5. Select Mark from the dropdown list. (Selected marks, selling mark and elevation should be auto loaded to the specific fields).

Step6. Click enter, Specific invoice no (number) parent detail will be saved.

Step7. Input invoice No (Invoice No can't duplicate). if user select RA check box (Selected invoice No should be considered as "Rainforest" certified invoice).

Step8. Select grade, Chest type (type of bags) from the dropdown list.

Step9. Input no of chest and net weight value for each chest.

Step10. Select packing type from the dropdown list and select manufacture date from calendar.

Step11. User allows option to select "Sample Drawn", "Reprint", "Exportable" and "Colour Separator" fields by tick the specific check box.

Step12. Click [Location Allocate] to view the allocated rack details.

Step13. Select rack no from dropdown list. Selected racks uncatalogued, catalogued, sold, inactive, currently allocated location should be show as following screen.
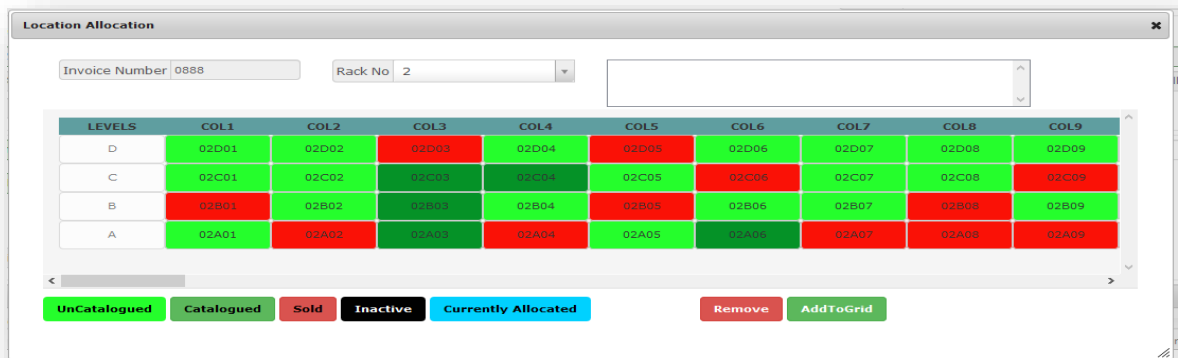
Figure 5-20 – Location Allocation Grid Screen

Step14. To remove the location from the rack, click "Remove", C**lick Add to grid**, to add more lines repeat the step.
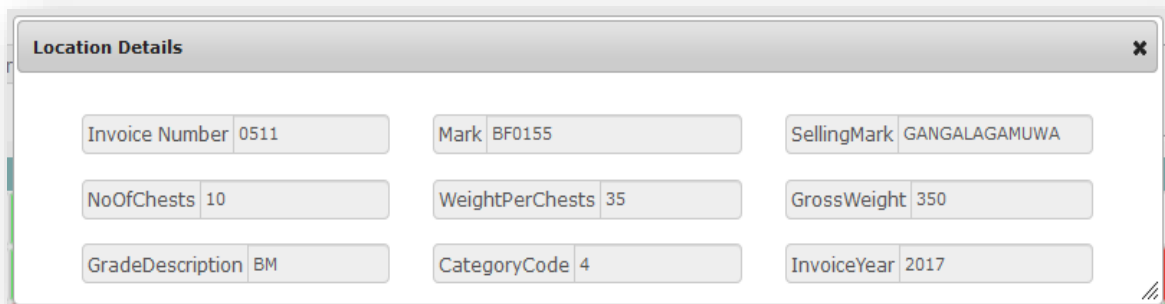
Figure 5-21 – Location Details Grid Screen

Step15. Once select a specific location from the grid above location details pop-up should be display.

Step16. Once all the lines are added, **click Save Details** to save the added information to the same. Once saved, the last added line will be displayed under "Last Saved" at the bottom of the page, and all text fields will be refreshed.

Step17. To clear all the information input before saving, **click Reset Form.**

All fields are mandatory

5.4.6 Invoice Entry Details Grid

As stated in Step 02 above, once the invoices are added to the grid, the grid will be displayed As below.

Invoice Number	No. of Chests	Chest Weight	Total Quantity	Grade	Chest Type	Packing Type	MFD Date	Rainforest Certified	Exp.Right	Colour Separated	Sample	Reprint	Location	Sets	Edit	Delete
0003	2	55	110	BOPF	B	MW-P/S – MW	10/31/2017	✔	✔	✔	✔	✔	🏢	✂	✎	🗑

Figure 5-22 – Invoice Entry Grid View

At invoice entry, users could edit or delete the lines added to the grid before saving the invoice. To edit or delete after saving, user should go to "Invoice Edit" Page.

1. **Select** the respective line in the grid, **click Edit** icon on the grid, the information on the line to be displayed on the invoice details section. Edit the required information and **click** on **Update**.

2. **Select** the respective line in the grid, **click Delete** icon on the grid, to delete the line from the grid and invoice.

3. **Select** a line and **click** Sets icon in the grid, the following pop up will display.

Figure 5-23 – Invoice Set Break Pop Up

The selected line details will be displayed on the first section, the user can break the line in to sets, by entering Chest quantity and weight per chest.

Click **Add to grid** to add sets to the grid or **click Clear t**o clear input data. If the set entered is more than the give quantity, the below message is to be displayed;

If clicked **Cancel** Cancellation verification as below is to be displayed.
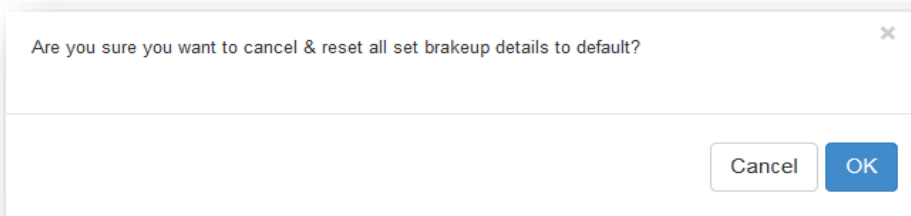
Figure 5-24 – Set Break Cancel Verification Message

5.4.7   Invoice Edit

Figure 5-25 – Edit Invoice Page

Allows the user to edit and update saved invoice details and set breaks.

Step 1:   **Select** Broker / Buyer (the Broker maybe fixed for some users), **Enter** Invoice year and Mark and **click Enter**, the header of the invoice will then be locked.

Step 2:   Input invoice number required to be edited and **click Load Invoice Details**.

> **NOTE** :If the invoice is already deleted or withdrawn or sold or catalogued the line cannot be edited.

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Step 3:   Once the line is loaded, **click Edit** icon on the grid, the information on the line to be displayed on the invoice details section. Edit the required information and **click** on **Load Invoice Details** button.

Step 4:   Set Breaks can also be edited by **clicking** on the **Sets** icon in the grid.

Step 4:   **Click** on **Save** or to clear all the information input before saving, **click Reset Form.**

5.4.8   Add GRN

Figure 5-26 - Add GRN Page

The above user interface allows the user to enter the details of the goods received physically. Details will be load against turn date and short weight, balance bags and remove lines functions will be handle through above GRN screen.

Step 1:   **Select** Store (the store maybe fixed for some users), **Enter** turn date, turn number**,** select broker, input mark and click **Load**, the header of the invoice will then be locked. Or check amalgamation check box, to enter invoice year and invoice number and click **Load**

Step 2:   If the input invoice / turn number related invoice available, it will be displayed in the grid below, else will display error message.

Step 3:   Once the line is loaded, **click Edit** icon on the grid, the information on the line to be displayed on the invoice details section. Edit the required information and **click** on **Update.** Set Breaks can also be edited by **clicking** on the **Sets** icon in the grid.

Step 4:   **Click** on **Save** or to clear all the information input before saving, **click Reset Form.**

(Once save entered GRN details GRN No will be generate against turn and mark)

> **NOTE**
> - *If the invoice is already deleted or withdrawn or sold or catalogued the line cannot be edited.*
> - *A message would display stating the same and the invoice will not load.*
> - *User can save the invoice as a "phone Input" by checking the check box on the left top corner of the Invoice Page.*
> - *Users allows to edit already added GRN details before printing.*
> - *Printed GRN line can't be edit*

5.4.9 Edit GRN

Figure 5-27 – Edit GRN Page

An already generated GRN can be edited through this screen.

Step 1: **Select** Store (the store maybe fixed for some users), Enter turn date, GRN number and **Click Load**, the header of the invoice will then be locked. Or check amalgamation check box, to enter invoice year and invoice number and click **Load.**

Step 2: If the input invoice / turn number related invoice available, it will be displayed in the grid below, else will display error message.

Step 3: Once the line is loaded, **Click Edit** icon on the grid, the information on the line to be displayed on the invoice details section. Edit the required information and **click** on **Update.** Set Breaks can also be edited by **Clicking** on the **Sets** icon in the grid.

Step 4:   **Click** on **Save** or to clear all the information input before saving, **Click Reset Form.**

5.4.10 GRN – Print/Unloading List

Figure 5-28 – Print/Unloading List

Step 1:   **Tick** other broker & Arrivals slip reprint check boxes. Select date from the date time picker. **Select** Store (the store maybe fixed for some users), Toggle and click **Load**.

Step 2:   **Click Select All** to select all the selected stores unloading turn details or to clear all
the unloading details **Click Clear All**. Required details will displayed in the Unloading Turn Information grid. **Click** Required Check box. (**According to the Date and Store**) user allows to view Arrival slip by Clicking **View Arrival Slip.**

Step 3:   **Click Send Email** to send a mail about unloading turn information to Warehouse Operators, particular Seller for that mark & to the Broker. Required details will displayed in the Unloading Turn Information grid. After that select particular turns and **Click Send Email**. End of the email sending process if successfully mails sent check box in the is email sent field will filled out.

Step 4: (**According to the Date and Store**) user allows to **View fresh arrival** and can **clear** the unloading reports.

5.4.11 Add/Edit GRN

Figure 5-29 – Add/Edit GRN

5.4.12 Chest Location Details

Figure 5-30 – Store Location Management Page

When chests came to the store. User allows to select a location to store the chests.

Step 1:   **Select** store (the store maybe fixed for some users), Broker, GRN Date, Sequence No and GRN No.

Step 2:   User allows to **select** invoice **one by one** by clicking required check box. **Enter** Invoice Year, Invoice No, Mark, GRN No and Selling Mark. Relevant details will have added to the GRN Details grid.

Step 3:   **Select** GRN Details from the grid or **Enter** Invoice No, Grade, Number of Chests, Chest Type, Packing Type, Total Received and Received Date.

Step 4:   **Enter** Location, Number of Chests and Remarks. **Check** the Sample check box as Required. Entered Location, Quantity and Sample will display on the grid. **Click** To add the entered details to Allocated Locations grid. **Click** To remove the Details from the grid.

Step 5:   **Click Save** to save the Store Location Details. Or to clear all the information input Before saving, **Click Clear Screen**.

Figure 5-31 – Allocation Location grid

Above interface function same as INVOICE ENTRY location allocation.

5.4.13 Add GIN

Figure 5-32 – Invoice Chest Issuing Page

Allows the user to record the goods issued as per the delivery order. The goods will be issued based on the delivery order details and the picking list that is generated.

Step 1:   **Select store** (the store maybe fixed for some users), Turn Date and **Enter** Turn Number, Collection Person NIC, Name and Vehicle No.

Step 2:   **Select Broker** and Sale Type. (According to the Broker and Sale Type) User allows to Select Radio buttons. Enter Barcode, Year, Do No, Sale Year, Sale No, Invoice Year, Invoice No, Mark, Selling Mark and Grade. Check the required check box and **Click Load**.

Figure 5-33 – Location and DO Information grid

Step 3: **Enter** Buyer Code, Buyer Name, No of Chests, Net weight each, Issued Quantity, Issue Date and Remarks. **Click Add to Grid**. (According to the entered details) Location and No of Chest will added to the **Location Information** grid.

Step 4: **DO In formation** will displayed in the grid. Users allows to delete a line by **clicking Delete.**

Step 5: **Click Save,** or to clear all the information input before saving, **Click Clear Screen.**

5.4.14 Edit GIN

Figure 5-34 – Invoice Chest Issuing edit

Allows the user to edit recorded issued goods as per the delivery order. The goods will be issued based on the delivery order details and the picking list that is generated.

Step1. If invoice is other broker invoice tick "other broker" check box.

Step2. Select store from dropdown list, turn date and enter GIN Number.

Step3. According to the above selection, required details should be loaded to the DO Information grid.

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Step4.   User allows option to delete invoice lines form Do information grid, or to clear the details click **clear** screen or to save the edited detail click **Save.**

5.4.15 Loading report Printing

Figure 5-35 – Picking List Print Screen

Step1.   **Select** store (the store maybe fixed for some users), Enter date and **Click** Load, The Header of the invoice will then be locked. Or Check other Broker, or Car chit reprint and **Click Load.**

Step2.   **Click Select All** to select all the picking list loading turn details or to clear all the line details **Click Clear All**. Required details will displayed in the Loading turn Information grid.

Step3.   **Click** Required Check box. (**According to the Date and Store**) user allows to view car chit & group car chit by clicking required buttons. **Unloading** List by Clicking **View Arrival Slip** to clear the unloading line details click **Clear**.

5.4.16 GIN Print

Figure 5-36 – GIN Print Screen

Step1. **Select** store (the store maybe fixed for some users), Enter date and **Click** Load, The Header of the invoice will then be locked. Or Check another Broker, or Gate pass reprint and **Click Load.**

Step2. **Click Select All** to select all the GRN list details or to clear all the line details **Click Clear All**. Required details will be displayed in the GRN information grid.

Step3. **Click** Required Check box. (**According to the Date and Store**) user allows to view gate pass by clicking **View gate pass** buttons and click **Clear**.

5.4.17 Reports Print
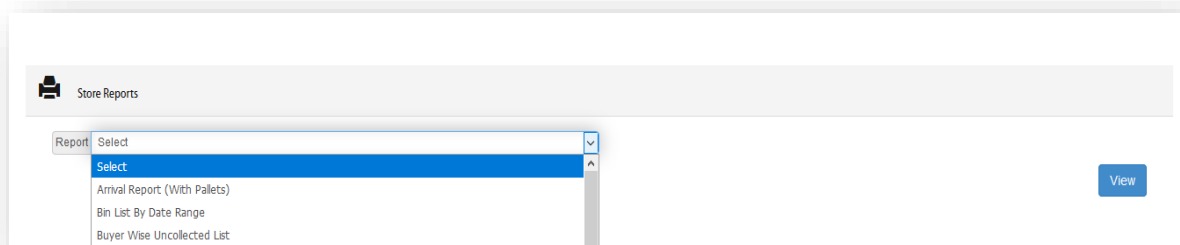
Figure 5-37 – Store Report Page

User allows to select store reports and able to view reports.

Step 1: **Select** Store reports and **Click View** to view the required reports.

5.4.18 Inquiry
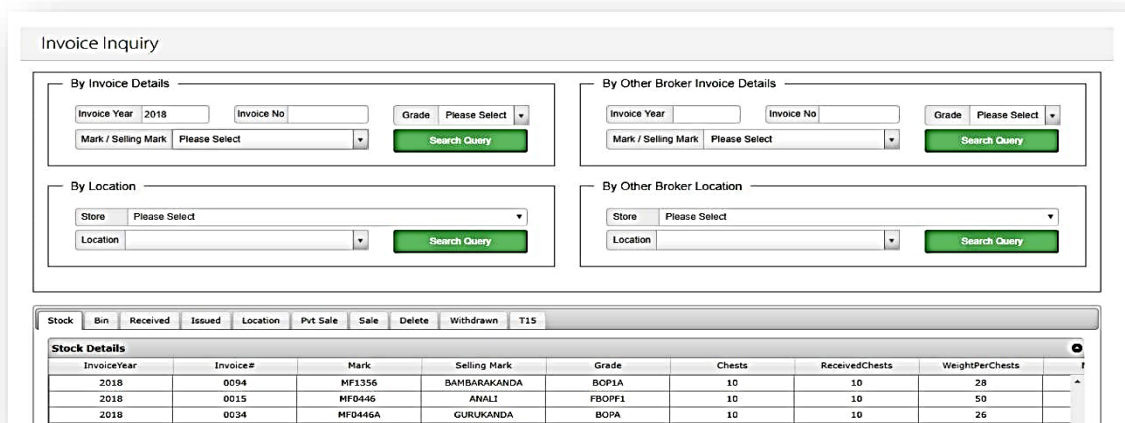
Figure 5-38 – Invoice Inquiry page

The store inquiry page can be accesses to view all the data of tea stocks in the specific store. User allows to view Stock, Bin, Pvt Sale, Sale, Delete, Withdrawn, T15, Received and Issued

invoices by Invoice Details, By Other Broker Invoice Details, By Location & by Other Broker Location.

Step 1: **Enter** Invoice year, Invoice No, Sale Year, Sale No user allows to Search Grade and Lot No. **Enter** Grade and Lot No **Click** **Search Query** required data will Display in the grid.

Step 2: **Select** Stock, Bin, Pvt Sale, Delete, Withdrawn, T15, Received and Issued as required. Selected invoice details will display in the grid.

5.4.19 Location Inquiry
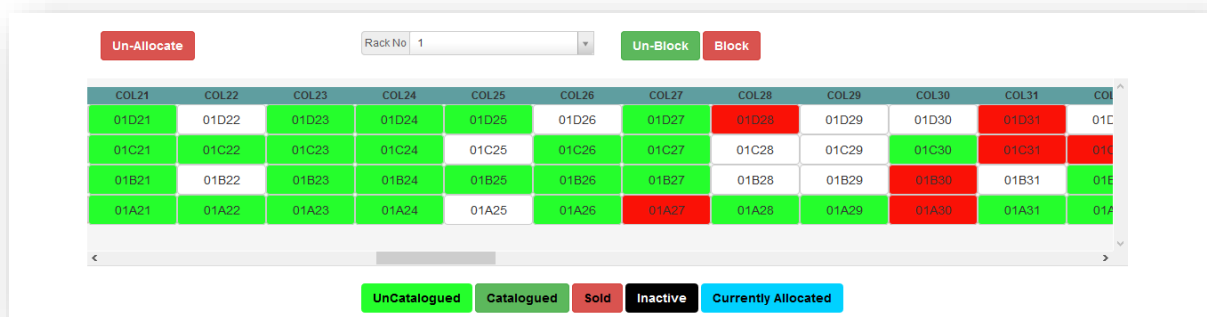
Figure 5-39 – Location Inquiry Screen

The above interface allows user to view location inquires through the system.
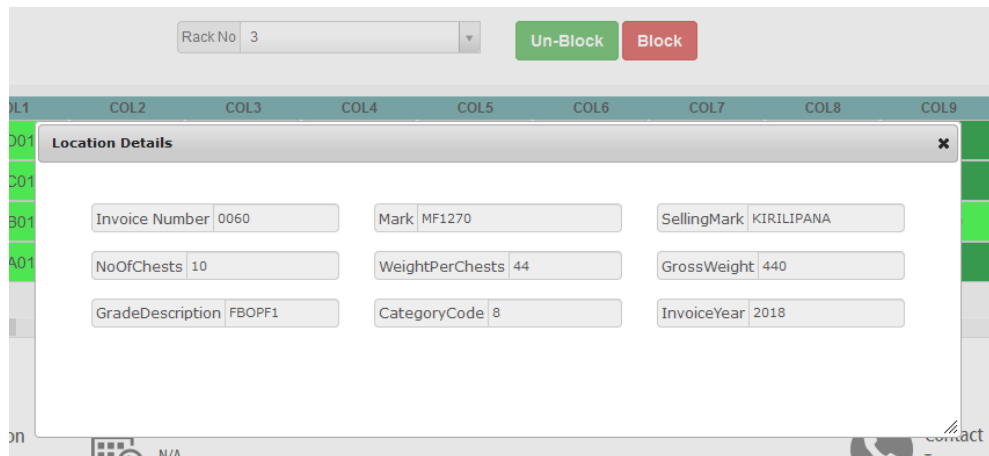
Figure 5-40 – Location details pop-up

Step1. Select rack No from drop down list (Selected rack number's allocated location details to be show as above interface).

Step2. Once user selects a location from the grid, above screen should be pop-up with selected location details.

5.4.20 Add Bay

Figure 5-41 – Store Location Management Page

The above screen enables the user to add store locations in to the system and edit the locations when required.

Step 1:   **Select** Store, Code, and description. **Select** Issuing and Status and required. **Click Save Bay** for save the bay details.

5.4.21 Update Existing Bay

Figure 5-42 – Updating Exiting Bay Page

User allows to edit Bay details and able to update the edited details.

Step 1:   **Enter** required bay and **Click Search** to search the required bay to edit. Select Store, Code, Description, Issuing and Status. **Click Update Bay** to update the existing bay.

5.4.22 Rack Details

Figure 5-43 – Rack Details Page

In adding the racks, the number of shelves, compartments and the height of a compartment need to be recorded and when adding a new floor space, the space width, length, Area should be recorded.

Step 1:   Click Add New, Select Store and Bay from the dropdown list. Select Letter of rack and side of the rack, according to the selected store and bay code should be load automatically. Enter Number of Shelves, Number of Compartments, height of a Compartment and If you required Enter comments.

Step 2:   Click Save Rack Details to save the entered rack details.

5.4.22.1 Update Existing
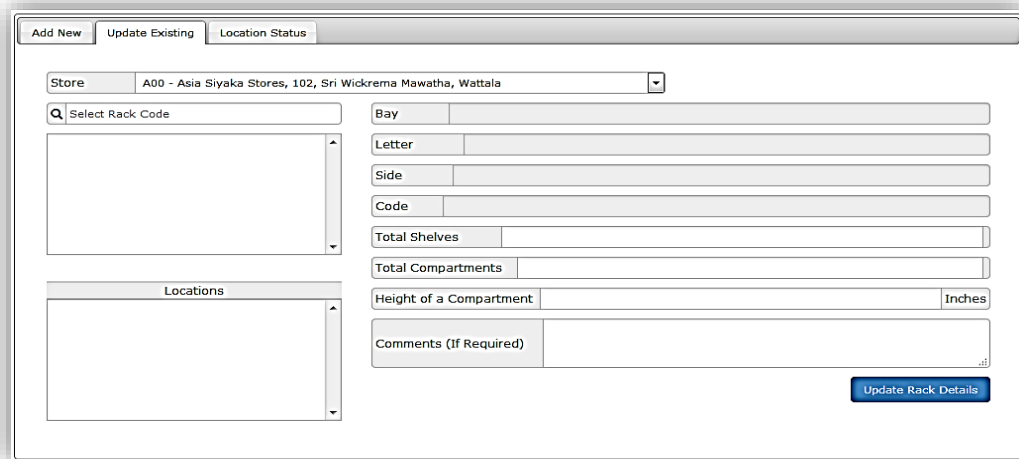
Figure 5-44 – Update Existing Rack Details page

User allows to edit rack details and allows to update the rack details.

Step 1:   Select Store, Enter Rack code and click Search. Required location will display in the grid. User allows to Edit Bay, Letter, Side, Code, Total Shelves, Total Compartments, height of a Compartment and Comments.

Step 2:   To update the entered details, Click Update Rack Details.

Step 3:   Click Location status and Select rack code.

5.4.22.2 Add New
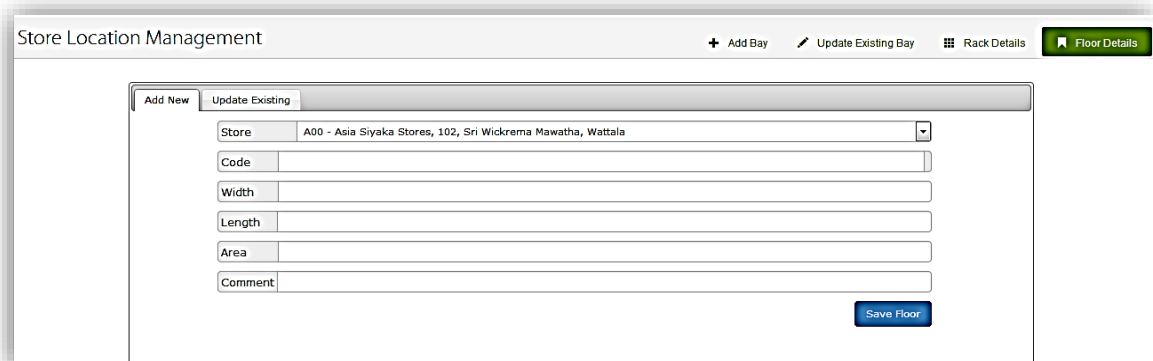
Figure 5-45 – Floor Details Page

The racks and the spaces maybe temporary unavailable to store stocks. In that case the user should be

Able to inactivate those spaces temporary where when allocating locations for the received stocks, the inactive locations will not be allocated against.

> Step 1: **Click Add New, Select** Store (for store module users the store maybe fixed), Code, width, Length, Area and User allows to add Comment as required. **Click Save Floor** to save the entered floor details.

5.4.22.3 **Update Existing**
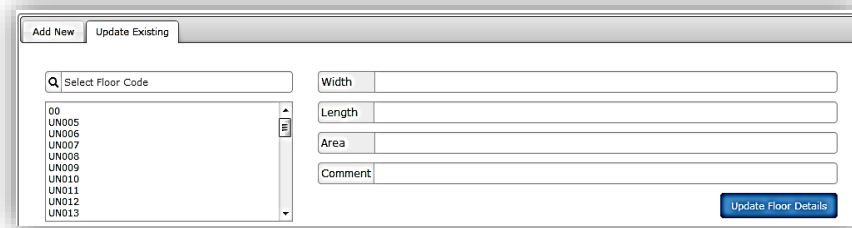
Figure 5-46 – Update existing Floor details page

User allows to edit the floor details and Update.

> Step 2: **Click Update Existing** and enter floor code and **Click Search**. (Required code details Will displayed in the grid). User allows to **Edit** Width, Length, Area and Comments. **Click Update floor Details** to save the edited details.

5.5 **Brokering Module Home Page**

The landing page of the Brokering module is as follows;
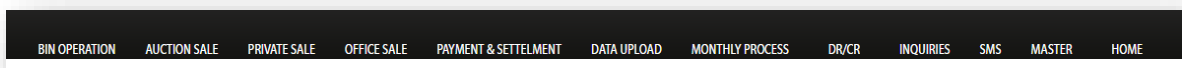
Figure 5-47 – Brokering Module Home page

The user can view the module menu on the right-hand corner, where Bin Operation functions, auction sales, other brokers, inquiries and master could be accessed.

5.5.1 Add New

Figure 5-48 – Invoice Add Screen

Allows the user editing an already added invoice in to the system and cataloguing department user allows to access to this screen.

Step 1:   **Input** the broker details, store (for store module users the store maybe fixed), turn details, invoice year, MF and **Click Enter**, the header of the invoice will then be locked.

Step 2:   **Input** invoice line details, check the relevant check boxes and **Click Add to grid**, to add more lines repeat the step.

Step 3:   Once all the lines are added, **Click Save Details** to save the added information to the same. Once saved, the last added line will be displayed under "Last Saved" at the bottom of the page, and all text fields will be refreshed.

Step 4:   To clear all the information input before saving, **Click Reset Form.**

NOTE: *User can save the invoice as a "phone Input" by checking the check box on the left top corner of the Invoice Page.*

5.5.2 Invoice Inquiry

Figure 5-49 – Invoice Inquiry page

Allows users to inquire invoice details of a particular tea line. User allows to view All, Bin, Pvt Sale, Sale, Delete, Withdrawn, T15, Received and Issued invoices.

Step 2: **Enter** Invoice year, Invoice No, Sale Year, Sale No user allows to Search Grade And Lot No. **Enter** Grade and Lot No **Click Search Query** required data will Display in the grid.

Step 3: **Select** All, Bin, Pvt Sale, Delete, Withdrawn, T15, Received and Issued as required.

Selected invoice details will display in the grid.

5.5.3 Master
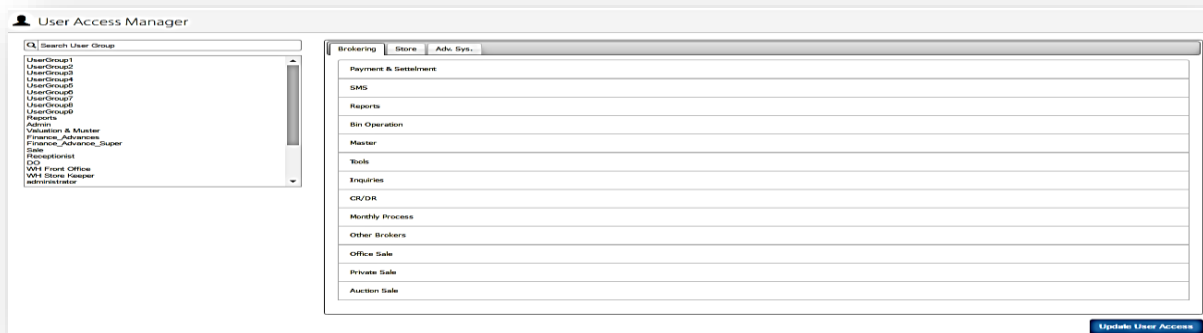
Figure 5-50 – User Account Manager

Allows the user to view the authorized access for each group and responsible person.

Step 1: Select the user group, and then select the module type.
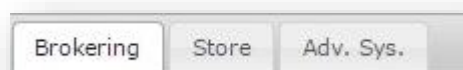
Figure 5-51 – Module Menu

Step 2: Select the access control type from the module menu and each typesfor each access controls will be displayed.

🍃 The user can update the access control units by selecting the Check boxes and select **Update User Access**
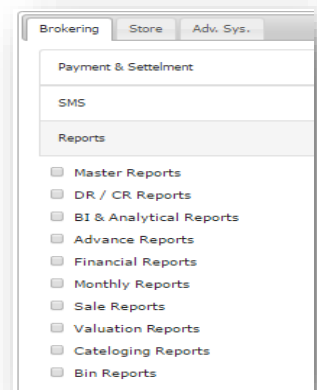
Figure 5-52 – Account Control Type

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5.5.4 User Account

Figure 5-53 – User Management

Step 1:   Input the User name, password, the details of the user, other required fields and
            select   and **click on** Save User. The user can remove the store by
            selecting

            Remove Store. The user can edit and change a saved store by selecting **Update**

            Existing button.

Figure 5-54 – Update User

5.5.5 User Group

Figure 5-55 – User Group Management

Step 1: Input the Group Name, a description about the user and select the User Group Status and select Save **User Group**.

> If the user wants to edit a saved user group, Select **Update Existing** button and change the details.

Figure 5-56 – Update User Group

5.6 Quality Assurance Process

Table 5-4 - Test Cases for User Evaluation

Scenario	Description	Expected Results	Actual Results	Status
Admin User				
Login	Login with correct username and password.	Admin should be navigated to the admin home page.	Admin is navigated to the admin home page.	Pass
	Login with wrong User ID/ password for more than 3 times.	Admin should be given with an error message.	Admin is given with an error message	Pass
	Login with an Admin User	Admin User should be able to perform admin user functionalities.	Admin user performed admin user functionalities.	
	Login with Store keeper account	Store should be able to perform stock Management functionalities	Store keeper performed stock management functionalities	
	Login with incorrect username	Username is validated	Validated Username	Pass
	Login with incorrect password	password is validated	Validated password	Pass
	Login with an incorrect account	User account is validated	Validated the user account	Pass

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Master Data Management	Admin has access to all the functionalities in this.	Admin should see all the icons under this.	Admin is able to see all the icons that has access to.	Pass
	Admin click 'Insert Invoices' to add an Invoices.	Admin should be able to add Invoices.	Admin is able to add invoices.	Pass
	Admin click 'Manage Invoices Details' to change any Invoice's property or delete an item.	Admin should be able to change any Locations or Invoice's stuffs	Admin is able to modify item descriptions or delete items	Pass
Issuing Management	Add GIN to the system	Admin should be able to add GIN	Admin should be able to add GIN	Pass
	View GIN	Admin should be able to view GIN	Admin should be able to view GIN	Pass
	Manage GIN	Admin should be able to update or delete GIN	Admin should be able to update or delete GIN	Pass
	Retrieve GIN History	Admin should be able to retrieve GIN history	Admin should be able to retrieve GIN history	Pass
Stock Management	Add Invoices Stock	Admin should be able to add invoices stock when receive stocks.	Admin is able to add item stocks	Pass
	View Invoices In stocks	Admin should be able to view Invoices in stocks	Admin is able to view Invoices stocks	Pass
	Manage invoice stocks	Admin should be able to any change to invoices stocks if mistake has occurred.	Admin should be able to any change to invoices stocks if mistake has occurred.	Pass
Report Management	GRN Reports	Admin should be able to retrieve the invoice Receiving reports as per given criteria.	Admin should be able to retrieve the invoice Receiving reports as per given criteria.	Pass
	GIN Reports	Admin should be able to retrieve the invoice Issuing reports as per given criteria. As per time period, for a particular customer, particular date, etc.	Admin should be able to retrieve the invoice Issuing reports as per given criteria. As per time period, for a particular customer, particular date, etc.	Pass

		Current stock reports	Admin should be able to retrieve the current stock report.	Admin should be able to retrieve the current stock report.	Pass
System Administrator		Add users to the system	Admin should be able to add user to the system.	Admin should be able to add user to the system.	Pass
		Manage Users	Admin should be able to modify or delete user details.	Admin should be able to modify or delete user details.	Pass
		Change Password	Admin should be able to change username or password.	Admin should be able to change username or password.	Pass
Store Keeper					
Login		Enter Correct User Name Password	Store keeper should be navigated to the stock management page.	Store keeper should be navigated to the stock management page.	Pass
		Enter Incorrect username password	System should display an error message.	System should display an error message.	Pass
Stock management		Add Invoices to stock	Store keeper should be able to add Invoices when receive Invoices	Store keeper should be able to add Invoices when receive Invoices	Pass
		View Invoices stocks	Store keeper should be able to view Invoices to the stocks.	Store keeper should be able to view Invoices to the stocks.	Pass
		Manage Item Stock	Store keeper should be able to view Invoices to the stock	Store keeper should be able to view Invoices to the stock	Pass

5.7 Implementation Process

5.7.1 Software Requirements

Table 5-5 – Implementation Process – Software Requirements

Database Server	
Operating System	Microsoft windows 2003/2000 Server (Standard Edition)
Database system	MS SQL Server 2000/2005 (standard Edition)
Application Server	
Operating System	Microsoft windows 2003/2000 Server (Standard Edition)
Application Server	IIS version 5.5 or above
.Net Framework	Version 1.1 and 2.0 and 3.5
Other 3rd party software	Internet Explorer 6.0 or Above, Acrobat Reader 8.0

5.7.2 Hardware Requirements

Table 5-6 – Implementation Process – Hardware Requirements

Database Server	
CPU	Intel 3 GHz or higher Processor
Memory	4 GB RAM
Network	LAN Adapter
Internal Storage	500 GB hard drive
CD/DVD drive	Standard CD/DVD drive needed to install software from CD/DVD
Backup Device	Tape drive preferred
Application Server (MS SQL)	
CPU	Intel 3 GHz or higher Processor

Memory	4 GB RAM
Network	LAN Adapter
CD/DVD drive	Standard CD/DVD drive needed to install software from CD/DVD
Internal Storage	200 GB hard drive

6. Evaluation

Once the Tea Stock and Warehouse Management System is deployed, it was given for users (Refer Appendix (A) for the User Guide) to test it and got the feedback and accordingly, the changes were done with both party's contributions. The developed system fulfills most of the requirements of the client. When developing the system difficult part was combining the databases of warehouse management system and brokering system. In some situations, there can be a mismatch of processes which was carried by two parties (Eg. When weight of tea bag in a warehouse & weight of tea bag client request to buy is different, then the quantity mismatch can occur). Also due to the mis-communication of brokering and warehouse staff, data misusing can occur. Therefore, to avoid those errors in data entering many validation techniques had been used.

Also, in previous system, when editing or changing the details of a database due to the weakness of communication proper data updating won't happen. Therefore, in the previous system a separate e-mail or a message must be passed within two parties regarding the updating. But in the developed system probability for these types of errors are been eliminated. When transferring data from the previous system to newly implemented system, transferred data was not 100% accurate. The accuracy of the transferred data was around 80%. Therefore, at the initial stage of the development, some of the reports generated from the system has given mis-leading information. So, there was parallel run of two systems (previous system and newly implemented system) for a period around 2-3 months.

In the period of training the staff to new systems, data entering have been done in to both previous and newly implemented system. So, the workload was high for staff for some period and it has created dis-satisfaction for staff. Also, financial cost has been increased during the period of information due to parallel run. Therefore, time allocation given for parallel run was limited. But after the implementation it has made so much easier for staff to carry out the process.

Some of the issues of developed system was identified in the period of parallel run, when comparing the information of two system. So, rectifying of errors were done during while client support.

The evaluation for the tea stock warehouse management system has been done using several steps.
The evaluation steps are as following.

1. Ask questions
2. Obtain responses.
3. Analyses, reflect and judge the evidence.
4. Make required changes

6.1 Sample Set of Selection Criteria

To evaluate the project outcome, from this system, the following system users were selected.

1. Data Entry Clerk
2. Managers
3. Software Quality Assurance Engineer

User tested each of these functions and the output of each test scenario was recorded. When evaluating comments, priority was given to QA Engineer's comments to enhance the system in IT security point of view since they have related expertise in IT industry. Also, priority was given to managers, store keepers and data entry operator to reduce complexity of the system and increase user friendliness of the system as they are the system users and they have lack of IT knowledge. Table 3 illustrates the test cases used for user evaluation.

6.2 Evaluation Methodology

To evaluate the system, online questions were given. While the implemented system was running parallel, new modifications were added to system. Needed modifications were identified by giving a questionnaire and taking feedback through those questionnaires. Those Type of questions were closed type questions and based on the user's feedback, critical modifications of the system have been done.

6.3 Modification Done Based on the Feedback

Based on the QA Engineer's feedback, some functionalities had been changed.

- Reduce the complexity of the system.
  version released.
- Remove the user id blocking process
  Password policy and password complexity had implemented in the system where if the user tries more than 3 attempts using wrong user id/ password, the system automatically block the user and he has to contact the admin to release. Users didn't agree with it since they are non-IT people. IT division also agreed since it's an internal

system and not required security controls such as external system. Considering all aspects removed user id blocking process.

- Eliminate one by one data entry

  System has enhanced to provide the facility enter details as bulks.

- Enter only one factory's invoices for a turn

  Provide facility to enter multiple invoices for a turn from different factories.

- Time consumes for total process

  System has enhanced to minimize the time taken for whole process.

7. Conclusion and Future Works

The conclusion of the projects is that the brokering and warehouse management processes are inter-related, and they can be handled using one system which provides con-current access to several people who works at multiple places. The concept of the project was taken considering the requirements of an actual customer, which was John Keels PLC tea warehouse in Handala, Wattala. Each phase of this project was conducted following all the stages of software development life cycle. With the help of the John Keels PLC, requirement gathering from staff, (Store keepers and data entry operators) analysis design, development and the testing was easier to be done. Each task and activities were not gone beyond the scope of the project.

7.1 Critical Evaluation of the Work & Achievements

The task in hand was to build a web-based warehouse management system for John Keels. This web-based system was built while keeping in mind regarding the business goals and to make the receiving and issuing process easier for customers (Tea Factories and Tea buyers). The main objective of the system was reducing their manual work of staff, provide product details to customers online, while providing quick service to the customers and maintain a complete and accurate database regarding tea stocks, and sales details. All the requirements mentioned in the user specification were met at the end of the project. The user evaluation test results showed the user satisfaction regarding the system functionalities. This was the main achievement of the project. Since C# ASP .Net, MSSQL, JavaScript and HTML were the technologies used to develop this web-based system, skills on those technologies were improved and better understanding of the software development life cycle was gained. Also, technical skills and soft skills such as effective communication and creativity was improved through this project. During the implementation several challenges and issue have been arise. It was very problematic to retrieve data from there database and to manage user session. First user session did not work properly. The user interfaces and designs were changed several times to gain the total client satisfaction. At the end of the project all functions which was required by the user were successfully implemented. The user testing has been carried out and user evaluation was successful. Although the functions were all implemented, certain other improvements that can be made were identified at the end. It is discussed in the next session.

7.2 Implemented New System

The implemented system is a web-based system. It was developed as a web-based system because it gives access from anywhere. It provides con-current access. Access to system has given for both manufactures and tea brokers. This will link manufactures and brokers related with warehouse. In this implemented system separate logins and access permissions were granted to manufactures and brokers to carry out their work. This has reduced the workload for warehouse management staff.

In this scenario manufactures would enter the tea stock details (Invoices) in to system and they will use a barcode for each invoice separately. When the stock arrived at warehouse stock entering and creation of GRN was done using a barcode reader to update stocks. Also, when issuing stocks generating the GIN was done by using the barcode reader. This method is more efficient than the previously used method. Brokers can login to system and check the status of available stocks.

The proposed web-based system consists of different modules. One of the modules is the store module which operates at the warehouse management end. The store module was created to facilitate the in-house office operations.

The components which consists of each module were as following;

- ✓ Unloading Process
  - Invoice Entry
  - Unloading List Generation
  - Store location identification and assignment
  - GRN Generation
- ✓ Issuing Process
  - Picking List Generation
  - GIN Generation
- ✓ Other Processes
  - Store Location Management
  - Efficiency Calculation
  - Report Generation

The implemented web-based solution was designed as an upgrade for the existing system and to maximize the productivity of the total warehouse process. This system has automated some

critical process in warehouse management which includes sensitive data. The features of the previous system also been incorporated with enhancements and eliminations where necessary. By reducing the total process time, the system had assisted the company to improve customer satisfaction by serving its suppliers and customers faster than earlier.

7.3 **Future Work**

No system is perfect at the very first iteration. There can be hidden requirements from the customers. There can still be new features with the technological changes and future changes will go on. This is where the change request come to play. In future this web-based warehouse management system can be link overall brokering and warehouse managing process Also it can facilitate to directly connect with brokering module. Another improvement is, it can sync with other brokers. Therefore, we can merge all brokering. So, no need to join other third parties. At the end security features and overall appearance of the web-based system can be improved.

References

[1] Johnkeellstea.com. (2019). *History of JKL*. [online] Available at: http://www.johnkeellstea.com/html/historyJKL.htm [Accessed 30 May 2019].

[2] Ceylon Tea. (2019). *Ceylon Tea - World's Finest Tea from Sri Lanka Official Site*. [online] Available at: https://www.pureceylontea.com/ [Accessed 30 May 2019].

[3] Mercantile Produce Brokers. (2019). *Tea Warehouse Sri Lanka | Secure Storage Facilities*. [online] Available at: http://www.merctea.lk/services/warehousing.html [Accessed 30 May 2019].

[4] Fishbowlinventory.com. (2019). *QuickBooks Inventory Management Software By Fishbowl*. [online] Available at: https://www.fishbowlinventory.com/ [Accessed 30 May 2019].

[5] Softeon. (2019). *Softeon Warehouse Management Software | WMS*. [online] Available at: https://www.softeon.com/our-solutions/product-solutions/warehouse-management [Accessed 30 May 2019].

Appendix A

User Guide

Daily Process / Close Catalogue
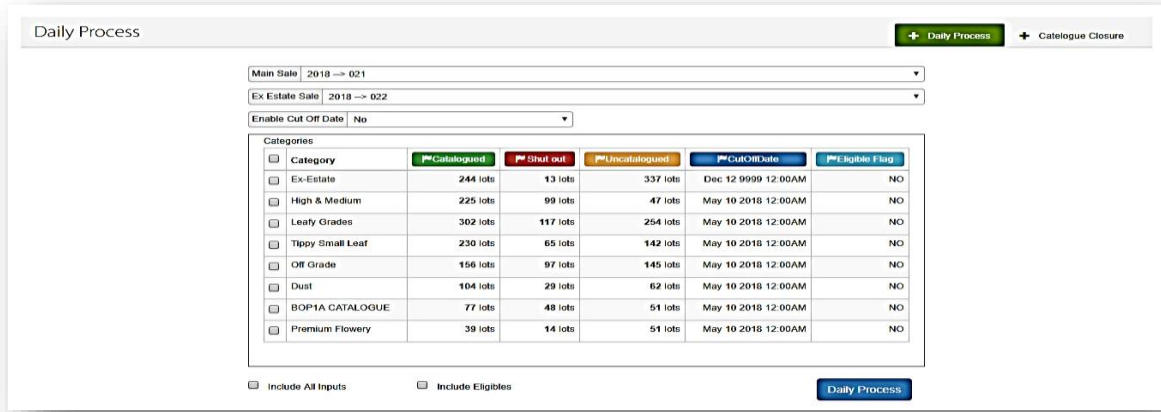
Daily Process Page

This screen allows the user to select the tea lots that are suitable to be catalogued.

  Step 1:   **Click Daily Process** and Input main Sale, Ex Estate Sale, Enable cutoff date and Cutoff Date.

  Step 2:   **Check** the required category check boxes and relevant tea category **Catalogued, shout out, uncatalogued, cutoff date & eligible flag** lots will be display in the grid as above figure.

  Step 3:   **Check** the relevant check box to include all the inputs. And **Click Daily Process.**

Catalogue Closure
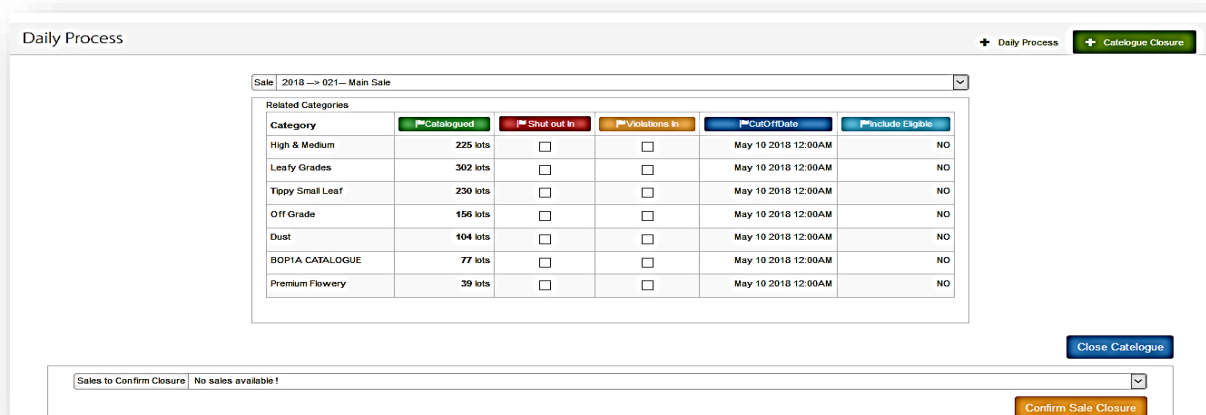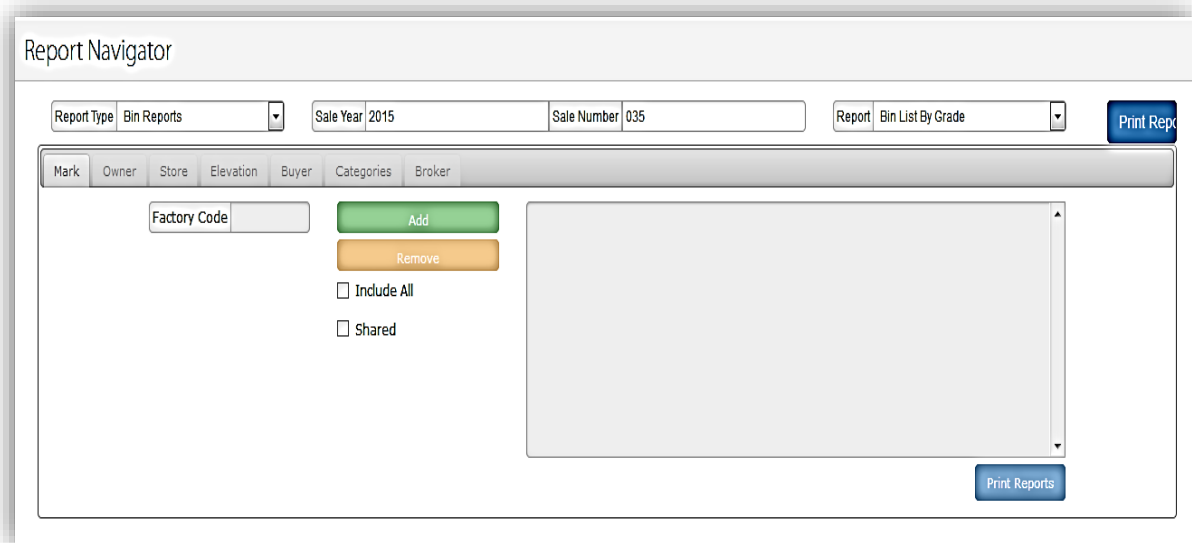
Catalogue Closure

Step 4: **Click** Catalogue closure and Select Store (the store maybe fixed for some users). Related category and catalogue amounts will be display as above figure.

Step 5: **Check** relevant **shout out** and **Violation In** check boxes for close catalogue and **Click** Close Catalogue. (Temporarily sale closure).

Step 6: **Select** sales to confirm closure and **Click** Confirm sale closure.

Report Navigation

Report Navigator page
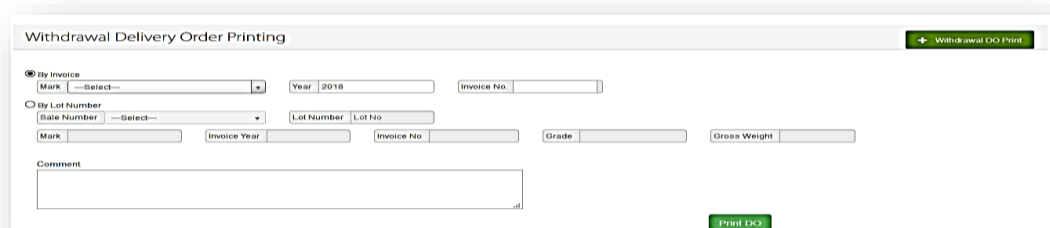
Allows the user to view reports and print reports.

Step 1: Input Report type, Sales year, Sales number, Report and **Click** Print Report.

> **NOTE** : _According to the report type, report navigator page will be differ. User allows to print the report by check once the check box. Or user can click select all to print all the reports._

Withdrawal DO Printing

Withdrawal DO Printing Screen

The above screen illustrates user to print withdrawal deliver order through the system.

Step1.   User allows to print DO by invoice or lot number. (Not selected options should turn to disable)

Step2.   If user select "Invoice" select mark, enter year and invoice number

Step3.   If user select "Lot Number" option, select sale & enter lot number.
(Selected lot number's mark, invoice number, invoice no, grade and gross weight should be load automatically)

Step4.   Enter comments *(Not mandatory field)* and Click "Print" option to print the DO for specific withdrawal line.

Control Files

Requests

Request page

Step 1:   **Enter** Sales Number from the dropdown.

Click Enter requests the following pop up will display.

Request Shortcut keys

Step 2:   **Enter** Sale number, Mark and **Click Load.** All the allocated Locations Mark, year, Invoice number, Grade, category, Status, new status details will be display in the Grid.

Step 3:   User can save the allocation locations entered by clicking on **Save**. Or user can **Cancel** The entered details.

Request page

Step 4:   **Enter** selling mark, Invoice number, Invoice year, Grade and Select Status from the Grid. Click **Load,** the information on the line to be displayed on the Entered requests Section.

Step 5:   **Select** the respective line in the grid, **Click Remove** to remove the line from the entered request grid.

Control File> Sale Cataloguing Rules

Sale Cataloguing Rules - Category Rule

Sale Cataloging Rules Page

Allows user to enter sale cataloging rules, grade rules and able to save all the rules.

Control File - Grade Rules

Grade Rules Page

Allows user to enter **Grade Rules** and able to update all the rules.

Step 1:   **Input** Category and user able to check the relevant available grade check boxes. **Enter** Minimum, Maximum chest ranges and Number of lots.

Step 2:   **Edit** the required information and **click** on **Update.** All the Updated details will Displayed in the **Cataloging rules details** grid. To clear all the information input before saving, **Click Clear Form.**

Categorizing Rules

Category Rules Page

The user should be able to add and modify the categorizing rules through the screen. User allows to enter sample amount and chest Density.

Step 1:   **Input** Category and check the relevant elevation check boxes. **Enter** grade and **click**

Search to search the required grade.

Step 2:   **Enter** fresh and resale for Sample Amounts. **Enter** Minimum and maximum number of half and Full bags for **chest density**. **Click Add** to add the entered details to the grid.
(To add more lines, repeat the steps)

Categorizing Rules Grid

(Entered details will added to the Categorizing rules grid).

Step 3:   **Click** on **Save** to save the information. Or to clear all the information input before   Saving, **click Clear.** When clicked **Save,** a verification as below is to be displayed.

Tea Buyer Management – Add New

Tea Buyer Management Page

At Tea buyer management, users could enter buyer details. To edit or delete after saving, user should go to "Update Existing" Page.

Step 1:   Input the broker details and select the type of the sale and **click Save Buyer**, The header of the invoice will then be locked.

Tea Buyer Management – Update Existing

Step 1:   Select the buyer from the left corner search box and enter the buyer details and select the type of the sale and **click Update Buyer**.

Category Management – Add New

Category Menu Page

At Category management, the user can add new tea categories with a brief description of the new category along with a short name.

Step 1:   Enter the new category details along with the code, description and the short name and **click Save**.

Step 2:   **Click Update existing** tab to edit and update the category management details.

Factory Management

Factory Management - Create Factory

Step 1:   Input the Factory details, telephone number, fax number and the capacity

Step 2:   Attach the registration copy by selecting **Choose file.**

Step 3:   Input the other required fields and select **Add Factory Certificates**.

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Factory Certificate

- The user can select the certificate for each certificate number and select the brokers to create the factory.

Add or Remove Broker

- The user can select the brokers from the left corner box and add it to the right corner box b selecting **Add** button. If the user wants to remove the brokers before saving, Can select the broker from the right corner box and select **Remove**.
- Select **Save Factory** to save all the details and create the factory.

Factory Management Menu

- The user can edit the factory details by selecting the **Edit Factory** at the right top corner.
- The user must select the Factory that has to be edited.
- The details of the selected factory will be displayed as follows.

Edit Factory Page

- The user can edit the details of the factory and select **Update Factory** button. Then all the edited details of the factory will be saved.

Create Estate

Create Factory

Step 1:   Select the factory name, Mark flag (estates for the factory), Mark, Selling Mark, Estate State and select **Save Details**.

Step 2:   The user can edit the Estate details by selecting **Edit Estate**.

Catalogue Sequence

Create Sequence

At Category Sequence page, the user can create the sequence of the types of tea and to add new estates.

Tea Grade Management

Tea Grade Management

Step 1:   Input the Code, Description, select the Grade Type and Grade State, input SLTB Grade and Sort Order. Then select **Save Grade**.

Step 2:   The user can edit the saved grades, by selecting the **Add New** button at the right top corner.

Step 3:   **Click Update existing** to edit the already added tea grade management details and update to the system.

Create Owner

Owner Management Page

Step 1:   Input Owner details, Business details, contact details and select the owner state. Then select **Save Owner**.

Step 2:   Select Choose File to upload the Business Registration Copy and the VAT registration Copy.

Step 2:   The user can edit the saved owner details by selecting **Edit Owner**.

Ownership Management

Ownership Management

At the ownership page, the user can change an owner of a tea factory. Once the user adds a new owner, the previous owner will be inactive. The history of the users for the factory will be displayed as follows.

Ownership Information

Step 1:   Select the Owner, start date and the end date, and the user can upload the Agreement Copy By   selecting and select Ownership status. Then select **Add Ownership**.

Owner Type

Owner Type - 1

Step 1:   At Owner Management page, the user can add new owner types by entering owner type and select **Add** button.

Step 2:   The user can edit the owner type by selecting the owner type from the left corner box, edit the owner type field and select **Update**.

Owner Type

Owner Type

Step 1:   At Owner Bank Details page, the user can add new bank.

And select **Add Bank** button.

Packing Type Management

Packing Type Management

In this page the user can specify a packing type for tea and describe the particular type and also to edit the added packing types.

Step 1:   **Enter** packing type and description of the packing type management.

Step 2:   **Click** save to save the entered packing type management details.

Step 3:   **Click** Update existing to edit the already entered details and update the edited detail   **Click** update.

Sales Catalogue Rules

Sales Catalogue Rules

Step 1:   Select the Category and input the minimum and the maximum Chest range. Then user can enter the number of lots and Select **Add to Grid.** Then the details will be displayed in a Grid.

Step 2:   To clear all the information input before saving, **click Clear Form**

Step 3:   The user can save all the sale catalogue rules by selecting **save all Rules**.

NOTE: User can edit the saved details in the grid by selecting the details which has to be changed and select update.

Update Rules

Grade Rule

Grade Rules

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Step 1:   The user has to select the Category and check the Grades that are available for that category.

Step 2:   Input the chest range as minimum and maximum and input the required number of lots, select **Save Rule**.

Step 3:   To clear all the information input before saving, **click Clear Form.**

- If the entered rule is an existing rule, a message will pop up.

User can edit the saved details in the grid by selecting the details which has to be changed and Select update.

Store

Store Management

Step 1:   Input the Store details and the other required fields and select **Save Store**.

Step 2:   To edit the saved details, click on the Update Existing button, select the store that must be changed, change the details and select **Update Store**.

Update Store

Auction Sales - Pricing

Auction Sales Pricing Page

Only the current sale can be processed. The user should be able to enter the sale details of the current sale.

Step 1:   **Select** Sale No and category. (All the auction sale details will be display in the Appointment grid).

Step 2:   **Enter** Lot No or user can select Lot number from Appointment grid. **Enter** Price, Buyer Code, and Number of Chests. If required to add more than one buyer check the Relevant check box.

Step 3:   **Click Add** to add the entered details to the grid Or to clear all the information input Before saving, **click Delete.**

When click **Add**, added details will display in the **Invoice entry details** grid. **Click Save** to save the added details.
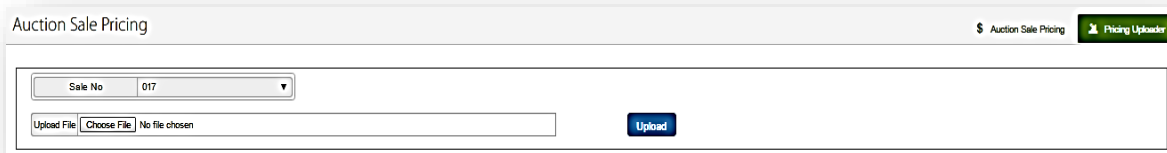

Invoice Entry Details

Step 1: **Click Print Advance DO's.** (If buyer assign to pay advance for delivery order, user can print Advance DO's for buyer).

Step 2: **Input** buyer and check the required check box and **Click** Print to print the **Advance Delivery Order**. Or to close the information input before saving, **click Close.** Allows User to view and verify reports by clicking **View Report**.
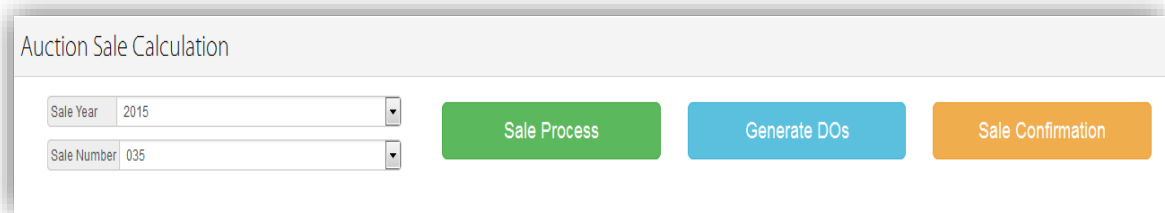
Pricing Uploader

Pricing Uploader Page

Step 3: **Select** Sale No and **Click Browser** and **select** generated pricing text file or excel file. **Click upload** to upload the selected generated pricing file.

Calculation

Auction Sale Calculation page

The user should be able to complete Buyers and Seller contract calculations.

Step 7: **Select** Sale Year and Sale Number. **Click Sale Process**. User allows to make calculation for Sellers, Buyer's procedure.

Step 8: **Select** Sale Year and Sale Number**. Click Generate Dos**. After complete the Sellers, Buyer's procedure user allows to generate Dos Calculations.

Step 9: **Select** Sale year and Sale Number. It's the final stage of the calculation. After completing the calculation, user allows to make confirm by clicking **Sale Confirmation**.

Out Lots Back to Bin

Out Lots back to Bin Page

All the unsold lots to be transferred back to the bin to be catalogued again. All the unsold tea lots of the current sale will be appeared on the grid.

Step 1:   **Input** Sale number and **Click Back to Bin** for send Out Lots to Bin Process. When click **Back to Bin**, a Successful message will display.

Process

Sharing Process

The above interface allows user to verify the violated sharing process lines.

Step 1:   **Select** require file type and **select** sale no from the drop-down list.

Step 2:   **Click Process Sharing** button to share the selected file type and selected sale numbered violated data lines. (After clicking the process sharing button violated lines will be added to the violate details grid).

(Catalogue lines can be removed from the remove option button)

Auction Sale

Auction Sale

Step 1:   Input the Sale Year, Month, Number and the Code. Then enter the 1st and the 2nd sales dates. Prompt dates with regard to the Buyer and the Seller.

Step 2:   Select the sales date from the right top corner and **enter** the number of sales durations.

Step 3:   Input the closing dates of the auction sale and select the Advance Date and **click** on **Add.**

The details will be displayed in a grid as follows.

Auction Sale grid

If the user wants to remove an Auction sale, **click** on the **Remove** button and select the line that has to be removed and then **Click on** the **Save** button.