

# **E-Osu Sala**

A web-based pharmacy system to provide quality assured pharmaceuticals at an affordable price to patients

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2021



# **E-Osu Sala**

**A dissertation submitted for the Degree of Master of  
Information Technology**

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**University of Colombo School of Computing**

**2021**



# Declaration

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

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

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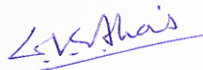
This is to certify that this thesis is based on the work of

Mr. H.U. Kuruppu

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

Certified by:

Supervisor Name: Professor G.K.A. Dias



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# Abstract

In the current market context pharmaceuticals have been part and parcel of the human day to day life as the other essentials such as food, clothes etc. This is due to the current lifestyle and the environment context which has being highly polluted. Nevertheless, from poorest to the richest people in the Sri Lankan context is requiring at least one of the drugs continuously to continue their day-to-day life. This cost that each day they need to bear is inevitable and pharmaceuticals has increased their prices and currently even moving towards marketing their brands to doctors which makes this cost for the buyer even higher at present.

When evaluate and see properly people pay higher amounts than they should pay for their medicines due to how the current pharmaceutical industry is ran from the prescriber, product owner to the reseller. Mostly they are running behind the money rather than caring about the patient by providing lesser valued pharmaceuticals at the highest quality.

The built system provides functions such as automating the quality assurance process and identification of the lowest priced suppliers for a given generic product in the market. These will help in catering the poor and middle-income people who doesn't have a choice in choosing the pharmaceuticals but to take prescribed product from the doctors or a product directed by the pharmacist. The built system then displays the chosen pharmaceuticals on the e-commerce product catalogue. Also, system has created an environment to see the current low-priced product per a generic pharmaceutical with the same quality as in a higher priced pharmaceutical available for the same generic. Further information on the functions is provided through the Design Architecture Chapter.

In order to deliver such service or drive such business scenario via a web system author has used a Layered architecture to facilitate the functions of the proposed system. So layered architecture will support to identify the user interface, business logic and the database of the system as separate components. If needed a separate layer will be facilitated for the shared components. System logic has been completed using the pure PHP language as the core language and the user interface using the HTML, CSS, JS combined Bootstrap framework. Author has done an in-depth elaboration about the technologies used under the Design Architecture Chapter.

So, from the proposed system author would like to give the upper hand to the vast majority of the poor or middle-income range of the patients by providing quality assured, low priced product rather than a brand.

The differentiation between a branded pharmaceutical and a generic product is done in the “Review of similar systems” chapter as well. The proposed system will evaluate the products for the quality with the support of NMRA quality assured supplier database support and further it’ll be supplying a product with the lowest priced in an efficient manner.

The developed system is unique from the currently available e-commerce systems for pharmacies as this is an all-in-one package to cover the total supply chain of a pharmacy which wants to provide quality products at a lower price.

# Acknowledgement

I do hereby like to take this opportunity to acknowledge and express my sincere gratitude to my project supervisor Prof. G.K.A. Dias, for the guidance, corporation and feedback offered to me throughout this project.

I would also like to thank numerous colleagues who work in the IT Industry of who supported and shared their product and platform knowledge concerning platform knowledge & knowledge in PHP, Laravel framework & other front-end technologies I have used in this project.

I also take this opportunity to thank pharmaceutical professionals who co-operated with me throughout the literature survey and evaluation by sharing their knowledge, experience and opinion on the pharmaceutical domain and the developed application.

Last but not the least, I would like to extend my appreciation towards my parents for the support and courage given to me throughout the entire project period in many ways.

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# List of Abbreviations

IaaS     Infrastructure as a Service

NMRA National Medicines Regulatory Authority

PaaS     Platform as a Service

SaaS     Software as a Service

SPC     State Pharmaceuticals Corporation

# 1 Introduction Chapter

## 1.1 Project Overview

Currently, in Sri Lanka, there is a huge competition over the branded pharmaceuticals which are manufactured to cure a particular disease. Even though normal consumer goods economists say the competition is good in terms of getting the benefits to the customer, but it's not the case when it comes to pharmaceuticals. Currently, the pharmaceutical industry is having unhealthy competition. The reason for this competition is mainly consumer unawareness of the relationship between generic products and the branded products.

Hence using this to their advantage of the pharmaceutical companies or the pharmaceutical dealers have manipulated the price of their branded pharmaceuticals. This has gone to the extent where they give incentives to doctors for prescribing respective pharmaceutical companies branded products. So, considering all these issues eventually the patient/consumer is the one who suffers the most due to the high-priced pharmaceutical products.

In the Sri Lankan context, people used to think the effectiveness of pharmaceutical products tends to differ with the brand name. This is not the reality. There could be many pharmaceuticals registered under the same generic name on the NMRA (National Medicines Regulation Authority) Sri Lanka. All these registered brand names do address a particular disease that is there to be addressed similarly. So, without knowing the absolute truth the patient's/consumer's mentality is structured in a manner to buy the brand prescribed by the doctor. To explain this further take the example of distribution in vehicle oil(gasoline). Three main entities sell oil. They are Lanka Petroleum Corporation franchises, IOC franchises & Laughs stations. So, does people pump the petrol or diesel considering the brand name of these products? In the general context, people only used to think about the quality of the product as in whether it's octane 95, octane 92, etc. This is because that they knew all of them are selling the same product and hence, people could buy the least valued oil product considering all the prices for a particular quality (octane 95, octane 92, etc.). So, is it impossible to implement the same for pharmaceuticals?

The reason is that patient is not aware of the information & they don't have the power to compare the branded products & then buy the lowest products when purchasing a pharmaceutical for a disease. The decider will be either the Doctor or the Pharmacist. Doctors need to decide the medicine diagnosing the

patient, but he/she shouldn't decide the brand which patient should buy. So, Doctor needs to prescribe the pharmaceutical by generic name. In this way, the patient would be able to request the least priced product from pharmacies. But still, there's a problem that exists. Even Doctor prescribes the generic product some pharmacist blindfolds the patient/customer and provides the highest priced product.

So, it was designed this system in terms of avoiding all of the above problems and providing the quality assured, the least priced product. Briefly, this system will be the point of access to the least priced, quality assured products at a given time which could be accessed by any place in Sri Lanka.

## 1.2 Motivation

The motivation of the author is to derive a software solution, to address the above problems exploiting the advantages of available web systems in place to purchase and deliver the medicines in an efficient manner.

In the event of a distributed system is available, parties at a pharmacy, handling different tasks of the process can collaborate online during various stages in purchasing pharmaceuticals and delivering them to the customers, thereby reducing the time spent, avoiding re-work and discrepancies. Customers will have the facility to look for the least priced quality assured product with this system to fulfill their medicinal needs without paying high margins on branded products where they are always in a position to take medicines at a considerably lower price.

Existing systems that handle such processes mostly do not consider how the quality of the product provided or not trying to provide the least priced product to customers. This can be improved in terms of allowing a patient to choose among branded products having a lesser price, in a scenario where the doctor prescribes a medicine.

As stated, earlier patients aren't aware of segregation between branded products and generic products. The other is that they are aware that there are branded products, but they are not able to compare all the branded products available in the market for one generic pharmaceutical due to the impracticality. Hence this vacuum is been covered from this system to deliver them the most reliable lowest priced product available within a market.

Most of the current sites available are commercial, which tries to sell the products available with them in the physical store. Unlike that, created system breaks that restriction and making this web platform available

for all the patients of any economic status, island-wide by providing the lowest priced pharmaceuticals. Also making the system in such a manner invites more suppliers having pharmaceuticals and hence it'll eventually lead to a more competitively priced pharmaceutical product available for the customer/patient.

## 1.3 Aim & Objectives

### 1.3.1 Main Aim

As the **main aim** of the proposed system, an attempt is made to make the customer aware of a substitute generic available for a particular brand prescribed by a doctor. This gives an opportunity for the patient to purchase an equally good, quality assured medicine at more competitive price. Since the patient has access to the options available in this web-based system.

#### **Workflow of the proposed system:**

Workflow of the proposed system is shown by figure 1.1 on next page to provide you an understanding of the system before moving on to the project objectives.

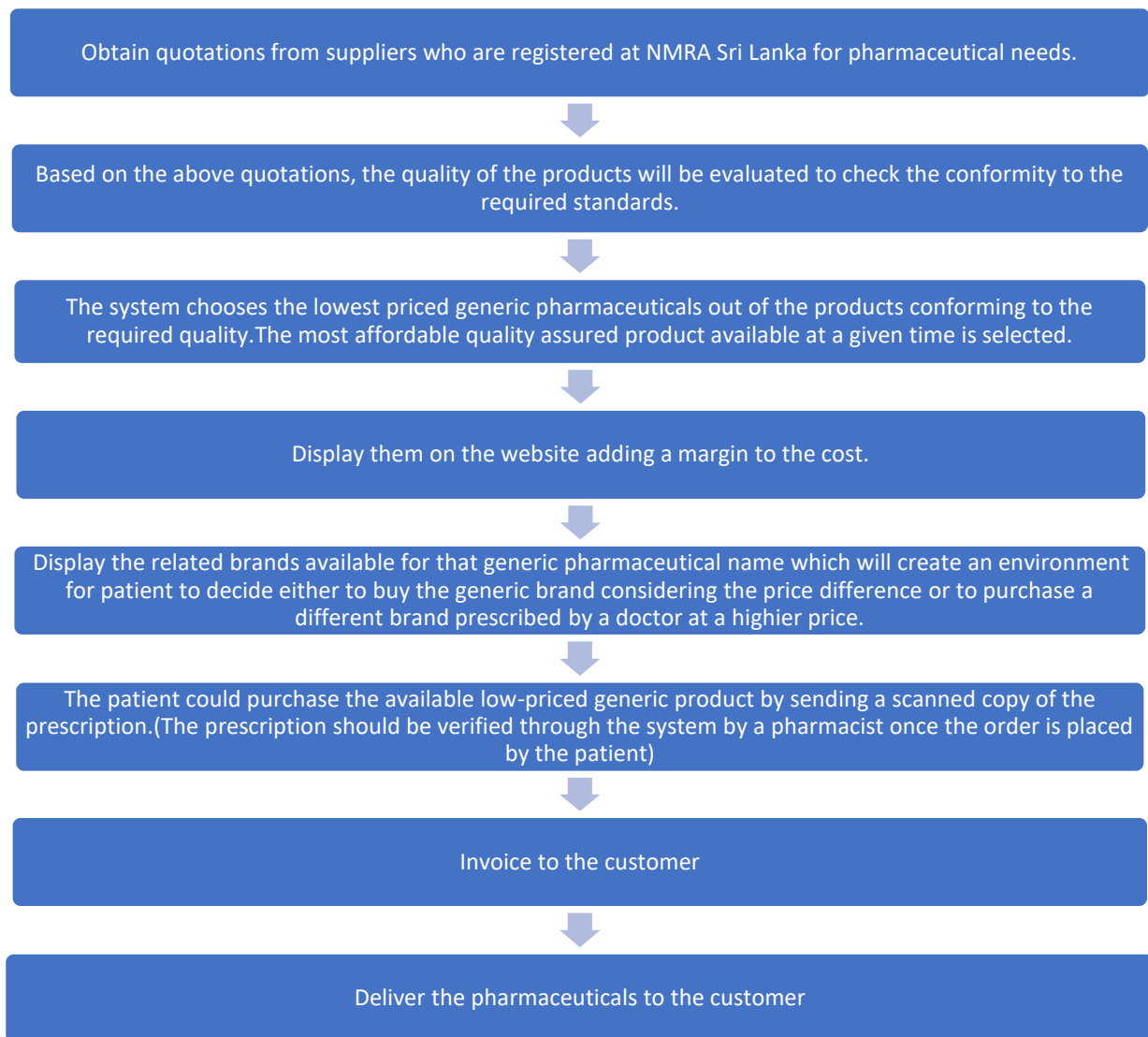


Figure 1. 1 Workflow of the proposed system

### 1.3.2 Objectives of the proposed system

- **To reduce the time taken to evaluate the pharmaceutical products through the government tender procedure.**

*This would reduce immensely by avoiding the hierarchical approval structure in the government tender procedure which is currently used by S.P.C. As mentioned below based on the following online functionalities (as shown on figure 1.2), the Pharmacist/Admin could do the evaluation in a smaller time phase.*

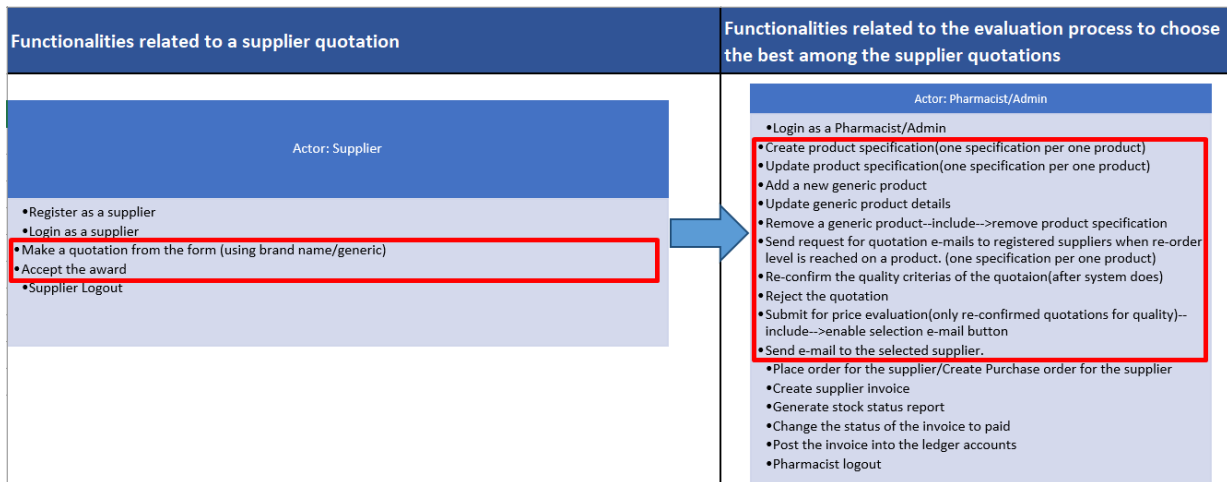


Figure 1. 2 Functionalities related to the evaluating pharmaceuticals

- **Reduce the out-of-stock situation which could affect the patients at critical situations.**

*At government pharmaceutical purchasing there are instances where out of stock situations arise. Due to these patients are prevented from getting their pharmaceutical needs. This system gives an opportunity to the patient to get such out of stock products since it consists of an efficient “Inventory Management System”. Functionalities of the system to facilitate the main system is given below figure 1.3.*

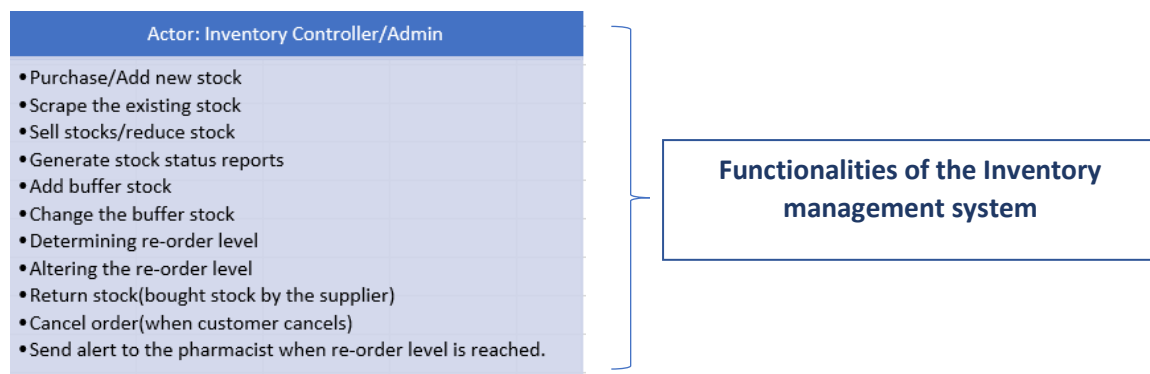


Figure 1. 3 Functionalities for Inventory System

- **To make available quality products at a lower price to the Sri Lankan market by increasing the reachability since this is a website.**

*This to be a success, anyone can register as a customer and he/she is capable of doing the below functionalities/operations (as shown on Table 1.4) through the website.*

- **Providing the patient/customer the decision-making power to choose low priced brands.**

*Also, from the below depicted search functionality consumer can search the pharmaceutical name from its brand & get the least valued product under the currently in stock. This makes the patient the decision maker by giving them a chance to compare the currently available lowest product in the generic pharmaceutical with the doctor prescribed brand name. (please refer table 1.4 for related functions)*

- **To stop the manipulations done at the pharmacies by promoting brand names for the prescribed generic medicine by the doctors.**

*Since from the below shown customer's functionalities (refer figure 1.4), he/she has the ability to see themselves what's the least valued product, it will reduce the price manipulations done by pharmacy owners.*

Actor: Customer			
• Register as a Customer			
• Login as a customer			
• Search for items			
• Add item to shopping cart			
• Flag item			
• Submit the prescription			
• Review items in the cart			
• Remove item from cart			
• Place the order			
• Cancel the order			
• View the Invoice			
• Download the invoice			
• Pay for the order using credit card			
• Customer Logout			

**Functionalities for the Customer**

Figure 1. 4 Customer's functions

- **To fulfill the medicinal needs of the patients without restricting it to a certain region.**

*Patients can order from any area and delivery is arranged using a courier service or the post. So, the customer needs to register & then when through the use of following sequence of functionalities (refer figure 1.5), he can get the product delivered. After the payment is made pharmacist needs to manually arrange the delivery to the mentioned address via a courier service.*

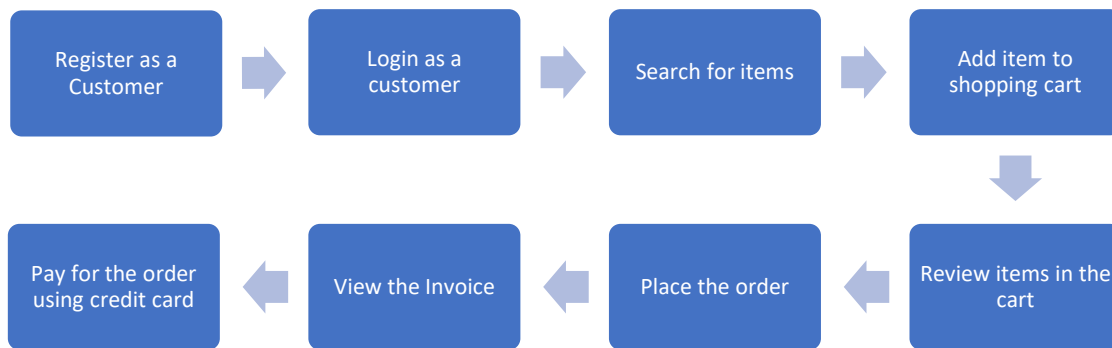


Figure 1. 5 Simplified ordering procedure for customers

- **To promote generic name of pharmaceutical product name rather than the branded pharmaceutical products** (by making available related brands to the generic products).

*Functions related to choosing the least priced quality adhered generic product is highlighted below using the figure 1.7.*

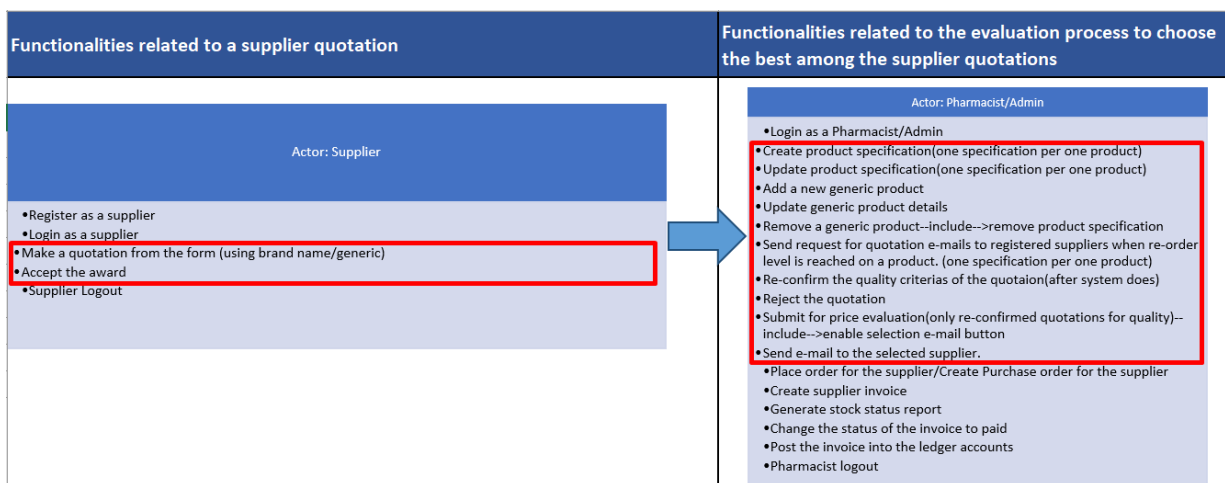


Figure 1. 6 functionalities related to the evaluating pharmaceuticals



## 1.4 Background Study of the issue

### 1.4.1 Sri Lankan pharma industry

The “National Medicines Regulatory Authority Bill”, said to be based on Prof. Senaka Bibile’s Essential Medicines Concept, was passed with amendments in parliament with a majority of 67 votes in the 1970’s. Apart from other objectives, the focus has been on giving prominence to drugs in their generic name rather than the brand name (WikiVisually, 2012).

By generic names, the medicines are considered in their medical substances included rather than the brands in which they exist. These have the same dosage, planned use, properties, side effects, protection, and strength and they are the main commonalities between all the brands which available in the market with different names.

Nevertheless, many tend to purchase branded drugs which are in high price due to the brand they carry but this is not what the patient needs in most of the times. They take these drugs since the doctors prescribe those or due to the influence of the pharmacists.

According to the stats present, 50% of all prescriptions in Sri Lanka are prescribed with brand names, the cost of which cannot be borne by an average citizen. It is good if the doctors are asked to prescribe the drugs with the generic name which is not practically happening at present (WikiVisually, 2012).

In the proposed system a platform is created to sell pharmaceutical products in their generic name by selecting the lowest priced product available in the market giving the same quality as other branded products.

## 1.4.2 Current context of the industry

### Necessity of the automated system:

(WikiVisually, 2012) At present more than 15,000 drugs under different brand names are available in the market. However, according to Prof. Bibile, out of the above only around 1000 could be considered as essential (in their generic name). Several such examples for the clarification is provided via the Table 1.1.

Eg:

Generic Name of the Pharmaceutical	Brand Names Related to it
<i>Paracetamol</i>	<i>Panadol, Paramol, Paracetol etc.</i>
<i>Amoxicillin/clavulanate potassium</i>	<i>Augmentin, Enhancin, Curam etc.</i>
<i>Metformin</i>	<i>Glucophage, Glycomet, Wallaphage</i>

Table 1. 1 Generic to brand name pharmaceuticals mapping

### Currently available manual system using physical pharmacies:

Currently Rajya Osu Sala does have a manual system to align with the concept/system which is created, and they also do have a manual quotation system. Distribution is done via 44 Rajya Osu Sala outlets. (State Pharmaceutical Corporation, 1999).

N.M.R.A. (National Medicines Regulatory Authority) issues a certificate for registration for the product's supplied by global companies. This ensures the suitability of a product to be imported to Sri Lanka for the use of patients (National Medicines Regulatory Authority, 2020).

The Table 1.3 is a comparison between how SPC sells a pharmaceutical product by promoting the generic name & in general how the other private pharmacies sell pharmaceutical products by promoting the brand name (National Medicines Regulatory Authority, 2020).

Generic Name of the Pharmaceutical	How it's sold by S.P.C.	How drugs sold by other pharmacies
<i>Paracetamol</i>	<i>Paracetamol</i>	<i>Panadol, Paramol, Paracetol etc.</i>
<i>Amoxicillin/clavulanate potassium</i>	<i>Amoxicillin</i>	<i>Augmentin, Enhancin, Curam etc.</i>
<i>Metformin</i>	<i>Metformin</i>	<i>Glucophage, Glycomet, Wallaphage</i>

Table 1. 2 Generic to brand name pharmaceuticals mapping

### **Currently available e-pharmacy systems in the market:**

In contrast to the manual systems there are several online systems in the market which majorly focuses on the urban or suburb market segments in Sri Lanka. They are more profit oriented and consist a wide range of branded products. It's good to have more products in any other consumer product category but it's not the same for pharmaceuticals. The reason behind that in pharmaceuticals consumer doesn't have the knowledge to chose among products as mentioned on the earlier stages.

One such pharmacy is Unique pharmacy system which allows consumer to online shop. As mentioned by them, the online pharmacy store intends to provide pharmaceuticals to the people around Negombo with there range of pharmaceutical brands. It's a hybrid system where physical pharmacy store and online store both exist. (Unique Pharmacy, 2020)

The other online store which was taken into consideration was Healthguard online store which is another pharmacy runs in with the hybrid model keeping both online and physical stores. These stores do not only cater the pharmaceuticals but also the wellness and beauty products in a way that a grocery store operates. Their core strategy is differentiation in order to compete with other similar ventures in the market. (Healthguard, 2021)

In conclusion it's observed most of the e-pharmacy systems sell the branded pharmaceuticals with high prices as prescribed by the doctors. A further detailed analysis on the current systems in operations is available on the background chapter.

## **1.5 Scope of the study**

The proposed system is created to promote high quality products at an affordable price to the patients.

Normally as the main users of the system the customer, supplier & the admin, or the pharmacist is identified, who are involved in operating the E-Osu Sala system.

The customers & suppliers are provided with their own portals to get registered into the online system. The suppliers are able to bid for the available requirements of the medicines according to the inventory system deployed. These are gone through an evaluation process in order to satisfy the quality and to select the lowest price among the market wide suppliers.

Above selected products are made available to the consumer in order to choose. Consumer would be mostly the patient who has got the medicines prescribed by a doctor. Mostly the doctors to prescribe the medicines in their brand name. Hence this platform enables the customer to search the medicines from the prescribed brand name or in generic name too. Then the lowest available products are displayed to the customer. He/she would be able to purchase it if they are willing to proceed for the check out.

Also the pharmacist will have the opportunity to generate Management Information System reports in the on dimensions Purchases, Sales, and Inventory.

A more detailed elaboration on the functionalities is done in the under the “Requirement Analysis” section at the Background chapter.

Following are the constraints of the project:

- All the branded products won't be available since the site caters to a market segment that looks for a quality conformed product at an affordable price to cure their diseases. This only shows the lowest-priced generic product at a given time.
- Unable to make a platform to quote all the suppliers worldwide (who aren't registered at NMRA) since it considers only quality conformed products at NMRA registered supplier list.
- Accounting transactions will not be maintained with the proposed system but could be taken as an advancement.
- Payment gateway could be implemented to facilitate the customer payments at the time of a go live. Normally payment is required to be made at the delivery. Supplier payment will not be handled in the first version of the system.

## 1.6 Feasibility Study

The feasibility study is done using several aspects such as Legal, Economic, Cultural & Political, Technical, Schedule.

### **1.6.1 Economic Feasibility**

This refers to the benefits users are deriving from the product as compared to the total cost spent for developing the system. If benefits more or less the same as the older system, then it is not feasible to develop the product.

The proposed system to derives the following benefits:

- Reduces the pharmacy processing time at the point of selling and tendering.
- Reduces the number of employees needed to complete the processes since even one pharmacist could complete it.
- Can monitor the orders, purchases, and inventory could be managed efficiently.

### **1.6.2 Operational Feasibility**

This refers to the feasibility of the product to be in operation. Some systems might be designed in the best possible manner but when it is put into use, it might not be the best system in use due to its lack of operationally feasible.

When it comes to the use, this system needs to be operated & it's advised to be operated by a Pharmacist considering the knowledge, he/she has about the pharmaceuticals and also considering the regulations which a vendor need to maintain at a pharmacy, to issue medicines. So, it's operationally feasible when the user(admin) adheres to the above requirement.

When it comes to the customer and supply it's easy to use and is an efficient system which provides the lowest priced products taking competitive bids from suppliers, compared to the normal pharmacy system.

### **1.6.3 Technical Feasibility**

The system guides the user in new functionalities and the other functionalities will be deployed in the interface in a user-friendly manner. So, most of the operations are provided as in a normal e-commerce

system for the customers. Hence much technical knowledge is in need to use the system. However, general IT literacy is needed for browsing the web and using the e-commerce system.

In terms of suppliers and the internal staff member who operates is also required to have less technical knowledge to operate the system since the interface and structure itself, guides them to move forward in an operation.

# 2 Background Chapter

## 2.1 Introduction

When you take the current market context it could be identified mainly two related groups exists in delivering or selling pharmaceutical products. One party is who sells pharmaceuticals using an online platform or an e-commerce system. The other party is the pharmacies who do manually runs the processes such as buying the pharmaceutical products and then selling them confirming the prescriptions are provided for those customer buying's.

So, from this chapter, author intend to compare the available two types of systems in the current market context and then elaborate on how the proposed system could override those problems with the current systems in the market.

## 2.2 Requirement Analysis

The author initially derives functional and non-functional requirements and then the design requirements of the solution based on the identified functional and non-functional requirements. Below indicated are the core functions in a high-level view of the proposed system and related use cases for them to achieve the core functions.

### 2.2.1 Functional Requirements

Understanding of the current systems functional requirements is provided below by structuring them based on the objectives that needs to be fulfilled from the proposed E-Osu Sala system.

Obtain quotations from suppliers who have registered on the site. Based on the product registration at NMRA the quality is evaluated through the system.

Use cases:

- Make a quotation from the form
- Accept the award

The system chooses the lowest-priced generic pharmaceuticals out of the products conforming to the required quality. The most affordable quality assured product available at a given time is selected.

Then the supplier supplies the product, and the invoice is created. The inventory system is also getting affected at this moment.

Then the system displays them on the website adding a margin to the cost.

Display the lowest brands available for a generic pharmaceutical name which allows the patient to decide either to buy the lowest generic brand considering the price difference or to purchase a different brand prescribed by a doctor at a higher price.

Use cases:

- Send request for quotation e-mails to the registered suppliers when the re-order level is reached on a product.
- Reject the quotation
- Submit for price evaluation (only re-confirmed quotations for quality) --include-->enable selection e-mail button
- Send an e-mail to the selected supplier.
- Place order for the supplier/Create Purchase order for the supplier
- Create supplier invoice

The patient could purchase the available low-priced generic product by sending a scanned copy of the prescription. (The prescription should be verified through the system by a pharmacist once the order is placed by the patient)

The payment can be done using the credit card and the cash on the delivery options. Then the invoice will be created, and the customer profile will get updated accordingly. Following are the related use cases for the above process.



- Search for items
- Add item to shopping cart
- Submit the prescription
- Review items in the cart
- Remove item from cart
- Place the order
- Pay for the order using a credit card
- Pay by cash
- Invoice to the customer
- Show the state of the order

The inventory system is created to control the stocks by adding the re-order levels and EOQ stock controlling techniques. Use cases related to it are provided below.

- Purchase/Add new stock
- Scrap the existing stock
- Sell stocks/reduce stock
- Generate stock status reports
- Create new stock item--include-->create buffer stock and other details for the product
- Change the buffer stock
- Determining re-order level
- Altering the re-order level
- Indicate to the pharmacist when the re-order level is reached (Enable calling for quotations).
- Change the status of the invoice to pay

Use cases related to details of the generic product or the specifications for those products, which needs to be added or altered according to changes required to the product range or at a removal of the products are

provided below. In addition, the general use cases related to pharmacist, customer and supplier which required for the functional flow are given below.

- Create product specification- Product Catalog & specification update
- Update product specification
- Add a new generic product
- Update generic product details
- Remove a generic product--include-->remove product specification
- Registration & login use cases
- Register as a Customer
- Login as a customer
- Customer Logout
- Log in as a Pharmacist/Admin- Registering and Login
- Pharmacist logout
- Register as a supplier
- Log in as a supplier
- Supplier Logout

### **2.2.2 Nonfunctional requirements**

In a system, nonfunctional requirements do take a larger part in creating a better system. The nonfunctional requirements of the E-Osu Sala are given below.

- The pharmacist needs to be the person who handles the orders placed by the customers.
- Authority levels and permissions differ for each user such as supplier, customer, the pharmacist. Based on that the user interface will be loaded with different sets of data and views.
- Available to large market since it's a website which is hosted in the cloud.

- Creating a responsive website. Hence the website could be loaded and used without any issue on any device.
- Code reusability is promoted which reduces the code components that repeatedly appearing at the code.

## 2.3 Review of similar systems

As stated earlier currently in the current Sri Lankan market majority of the pharmaceuticals are distributed via pharmacies that physically exist. Even though that's how the traditional distribution of pharmaceuticals distribution has been, there's an upcoming trend of allowing the customer to order the products via an e-commerce platform.

Hence from the physical pharmaceuticals which currently operate in the market, author has identified Rajya Osu Sala as a concept that could be closely related to the scenario which is tried to implement on this online e-commerce platform. So, these government pharmacy outlets are operated by State Pharmaceuticals Corporation and they are identifying the lowest pharmaceutical product by calling the quotations from agents who supply pharmaceuticals from worldwide manufacturers. Physical Pharmacy concept is further discussed below.

### 2.3.1 The currently available manual system using physical pharmacies:

Quotations are called by S.P.C by publishing worldwide tenders and the lowest tenderer conforming to required quality parameters is selected. Those are distributed not only through their 44 Rajya Osu Sala Outlets but also through the franchised Osu Sala outlets (State Pharmaceutical Corporation, 1999).

Another mandatory requirement is that all importers(suppliers) should have a valid registration certificate issued by the N.M.R.A. (National Medicines Regulatory Authority) for the products they supply. This ensures the suitability of a product to be imported to Sri Lanka for the use of patients (National Medicines Regulatory Authority, 2020).

Table 2.1 provides a comparison between how SPC sells a pharmaceutical product by promoting the generic name & in general how the other private pharmacies sell pharmaceutical products by promoting the brand name (National Medicines Regulatory Authority, 2020).

<b>Generic Name of the Pharmaceutical</b>	<b>How it's sold by S.P.C.</b>	<b>How drugs sold by other pharmacies</b>
<i>Paracetamol</i>	<i>Paracetamol</i>	<i>Panadol, Paramol, Paracetol etc.</i>
<i>Amoxicillin/clavulanate potassium</i>	<i>Amoxicillin</i>	<i>Augmentin, Enhancin, Curam, etc.</i>
<i>Metformin</i>	<i>Metformin</i>	<i>Glucophage, Glycomet, Wallaphage</i>

Table 2. 1 Generic to brand name pharmaceuticals mapping

Even though the majority of the pharmaceuticals exist physically, there's a trend people moving towards online pharmacies too. This was gradually increasing within the urban areas of Sri Lanka such as Colombo & Kandy but with COVID 19 situations online pharmacies again came into the topic since it was difficult to open the pharmacies for the patient with the ongoing situation.

### 2.3.2 Currently available e-pharmacy systems in the market:

Identified few key players such as Health Guard (Healthguard, 2021), Healthnet & Unique Pharmacy (Unique Pharmacy, 2020) are currently in operation online pharmacy platforms for ordering medicines without visiting the physical pharmacy store. The common qualities considering all the above e-pharmacy systems are stated in brief, below.

As observed, most of the e-pharmacy systems sell the branded pharmaceuticals at high prices as prescribed by the doctors.

Further on the next sections it's shown how the current issues are addressed which exist within the e-pharmacy systems and the current physically established pharmacy system which is Rajya Osu Sala & all the pharmacy outlets which exist physically with the intent of delivering the low-priced products.

### 2.3.3 Problems in the current systems available:

❖ Issues in the current **e-pharmacy systems available globally:**

- They mainly sell high priced branded products to patients.
- Sometimes when they sell these brands, those could be of inferior quality than the other brands available which maybe even be offered at lower prices.
- No prominence is given for quality-assured generics at affordable prices.

❖ Issues with the **current physically established pharmacies:**

- There is no proper mechanism to stop the issuing of high-priced branded products by some pharmacists /Salespersons who are engaged in unethical practices even if the customer wants to buy a low-priced quality product. For example, if a customer asks to give a lower-priced brand from a pharmacy, he/she does not know whether it's the lowest brand name, which the pharmacist gives to him/her.
- Choosing a brand name or a generic, constantly include a patient and his/her doctor. The doctor should prescribe it by the generic name and then the patient should be able to decide on the brand according to that generic name of the pharmaceutical. Currently, as most of the doctors prescribe the medicines from its brand name due to the perks, they receive from some pharmaceutical companies' patients don't have the choice of selecting a brand.
- Even though S.P.C. has implemented this system manually, considerable time is consumed to follow the government tender procedure for choosing the right quality generic products at a lower price.
- According to the currently followed practice by most of the private pharmacies, the generic name of a pharmaceutical product is not given due prominence. For example, due to the above, Panadol brand name is currently substituting for its generic name Paracetamol & people used to think the other products such as Paramol, Panadeine, etc. are for different uses (or think these products affect our body differently to the Panadol brand)

### 2.3.4 Benefits of introducing the E-Osu Sala concept:

Using the table 2.2 author has provided the disadvantages of the current pharmacy system context and also how those will be mitigated via the introduced system.

Advantages	Mitigated disadvantages of current e-pharmacies	Mitigated disadvantages of current physical pharmacies
1.The automated evaluation process of finding the quality assured product to each generic pharmaceutical name would make things efficient.	· Sometimes when they sell these brands, those could be of inferior quality than the other brands available which maybe even be offered at lower prices.	· Even though S.P.C. has implemented this system manually, considerable time is consumed to follow the government tender procedure for choosing the right quality generic products at a lower price.
	· No prominence is given for quality-assured generics at affordable prices.	
2.The system will show available brand names related to the current generic pharmaceutical product available on site. So, consumers can choose to take the branded or generic at their own choice.	· There is no proper mechanism to stop the issuing of high-priced branded products by some pharmacists /Salespersons who are engaged in unethical practices even if the customer wants to buy a low-priced quality product. For example, if a customer asks to give a lower-priced brand from a pharmacy, he/she does not know whether it's the lowest brand name, which the pharmacist gives to him/her.	· They mainly sell high priced branded products to patients.
	· Choosing a brand name or generic will constantly include a patient and his/her doctor. The doctor should prescribe it by the generic name and then the patient should be able to decide on the brand according to that generic name of the pharmaceutical. Currently, as most of the doctors prescribe the medicines from its brand name due to the perks, they receive from some pharmaceutical companies' patients don't have the choice of selecting a brand.	
3.It enables to reach more people using an e-commerce site than a physically located pharmacy (which is roughly about 44 pharmacies from S.P.C Corporation).		· Lesser reach than from an online system.

Table 2. 2 Benefits of E- Osu Sala

## 2.4 Related Technologies

The proposed system is designed as an e-commerce system with additional functionalities to occupy the functions for identifying quality conforming least priced products. Hence, following are international e-pharmacy platforms indicated via table 2.3 which are considered to identify the related technologies.

<b>e-pharmacy platform</b>	<b>Used technology</b>
Rite Aid	Magento
The Online Drug Store	BigCommerce
Southstar drug	Shopify
Pill Pack	Custom
Health Warehouse	Custom

*Table 2. 3 Different technologies used for existing e-pharmacy system*

So, as you could see on the above table it's obvious the e-pharmacy system creation is possible using e-commerce platform builders or using a more customized structure. Below the author has elaborated the design technologies considering those two aspects.

### **2.4.1 Building an e-pharmacy using e-commerce platform builders**

As above Magneto, BigCommerce, Oracle Commerce are platforms that allow you to build your e-commerce system without starting it from the scratch. So even a non-IT person could also design an e-commerce site using the already created templates by customizing their site to some extent. So, first, these types of platforms are taken, and a comparison is made below as shown in table 2.4.

<b>Factor</b>	<b>BigCommerce</b>	<b>Shopify</b>	<b>Magento</b>
Pricing	Reasonable	Reasonable	Comparatively Expensive (but have free & paid options)
Ease of Use	Easy	Easy	Complex
Template Selection	Many available	Many available	Many available
Hosting	Cloud-based	Cloud-based	On-site or Cloud-based
Security	Highly Protected	Protected	Depends on the person who develops and use

Features	Feature-rich	Some native features, third-party apps	Feature Rich
Support availability	Vendor Support provided & worldwide developers partnering program	Vendor Support provided	Community Support mainly, Vendor support available for enterprise edition only
Hosting	SaaS	Closed source SaaS	Open source Self-hosted or Paas (Enterprise Edition) SaaS through third parties only
Uses its suites for	Small & large shops that want a streamlined e-commerce experience	Small shops wanting to go online	Huge teams with more resources

Table 2. 4 Comparison among popular e-commerce designing CMS systems (BigCommerce, 2021)

Building an e-commerce site through a custom stack is the other option, which enables you more freedom in customizing the e-pharmacy site that you intend to build.

## 2.4.2 Building an e-pharmacy using a more customized structure

So as discussed earlier developers would be able to build and maintain an e-commerce site by there selves by thinking of the following aspects which need to be covered in terms of creating up and running an e-pharmacy platform.

There are many e-commerce tools and technologies required to build an e-commerce store and operate a successful online business. Both software and hardware technologies must be included in your e-business plan.

### **Web Server**

Web server is used to store the HTML, JavaScript, PHP files and it does facilitate or mediate the communications that happen with the database with the client. Normally for this commonly PHP, Ruby on



Rails, Node.js had being used commonly. The below table 2.5 states some of the advantages coupling them with the front-end technologies.

Language or Language Stack	Advantages
PHP+(CSS+Html+JavaScript)	High-level language, easy-scalable, and easy-to-learn language, flexible and versatile, focuses on readability and efficiency
Ruby on Rails+(CSS+Html+JavaScript)	efficiency and flexibility
MEAN stack (Node.js works as server-side language)	robust, powerful, and capable of handling complex coding, enables you to build both the front end and back-end efficiently

*Table 2. 5 Language stacks and their advantages (Studio, 2020)*

Web servers mainly run-on Windows or Linux OS. These are either being maintained by the company itself or being hosted using third party services.

### ***Server Software***

When a user calls any website on a web browser, the web server recognizes the client is requesting some certain data. So, it attends to that request and serves the exact files to the client or the browser. The web browser then presents these files to the user.

There are numerous types of server software existing together with application software, database server, file server software, and cloud computing software. Apache HTTP Server, Nginx, Microsoft IIS & Lite Speed are some of the server software's used. (Williams & Lane, 2021)

### ***Web Authoring Tools***

Web authoring tools are used to create front end web interfaces. Normally as discussed CSS, HTML, JavaScript, or Bootstrap are used in terms of creating the interface-related files. So, developers could use a text editor ranging from Notepad++ to more complex graphic authoring tools such as Visual Studio.net which have integrated databases. These more complex authoring tools consist of built-in frameworks and debugging tools.

### ***Database System***

A database is a vital part of an e-pharmacy site. Storing of data on products and services of the website such as pricing, description, image, details, and sales. Also, the details related to what customer ordered, their

payment details, shipping details, and contact information is another essential set of details that will consist of an e-commerce database.

It's essential to keep the transactions happen to the database securely and the data on the database is stored securely. Technologies like PHP and MySQL arranges the communication path between the website and the Database management system. (MDN Web Docs, 2021)

### ***Networking***

TCP (transfer control protocol) and IP (internet protocol) defines how computers should connect through the internet and how they share information. Common TCP/IP protocols are HTTPS, HTTP, and FTP.

HTTPS (where the "S" stands for security) guarantees secure communication between the client and Server. (Williams & Lane, 2021)

It's vital to provide a secure connection for the e-pharmacy system. SSL (secure sockets layer) and TLS (transport layer security) protocols could be used to securely route information from the internet in this regard.

### ***Browser Compatibility***

A web browser is a software used to render the information sent by web servers to show a complete page to the user. Common web browsers comprise Mozilla Firefox, Google Chrome, Internet Explorer and Safari. Web developers have to test whether the website could be loaded without any issue on different browsers using multiple devices and screen sizes before going live with the website.

### ***Ports***

Ports Ids which will be added from the TCP layer lets one device connect with another through a unique IP address.

Commonly used port numbers are 80(HTTP), 443 (HTTPS), 21 (FTP), 22 (SSH) & 25(SMTP). Firewalls can block a port to constrict security. (HostPapa, 2021)

### ***Domain Names***

Establishing a prominent domain name for an e-commerce site is a key to take the site towards the community. If a country is having many e-pharmacy platforms, the domain name is crucial to rank the site on the top among other competitive sites.

As examples .com, .net, .uk , .org, .co are some of the prominent domain names in the world. Also, another point to consider is with the increase of traffic and popularity to the site, the vendor needs to get multiple registrations of domains to stop stealing the business name using a different domain.

## 2.5 Related Design Strategies

Most of the e-commerce sites are created based on the client-server architecture which means that the client browser creates transactions via HTTP & TCP protocols. Below illustration is about the high-level view of the architecture.

### 2.5.1 Client-Server architecture

The below figure 2.1 is an illustration of the client-server architecture which is currently being used by e-commerce vendors.

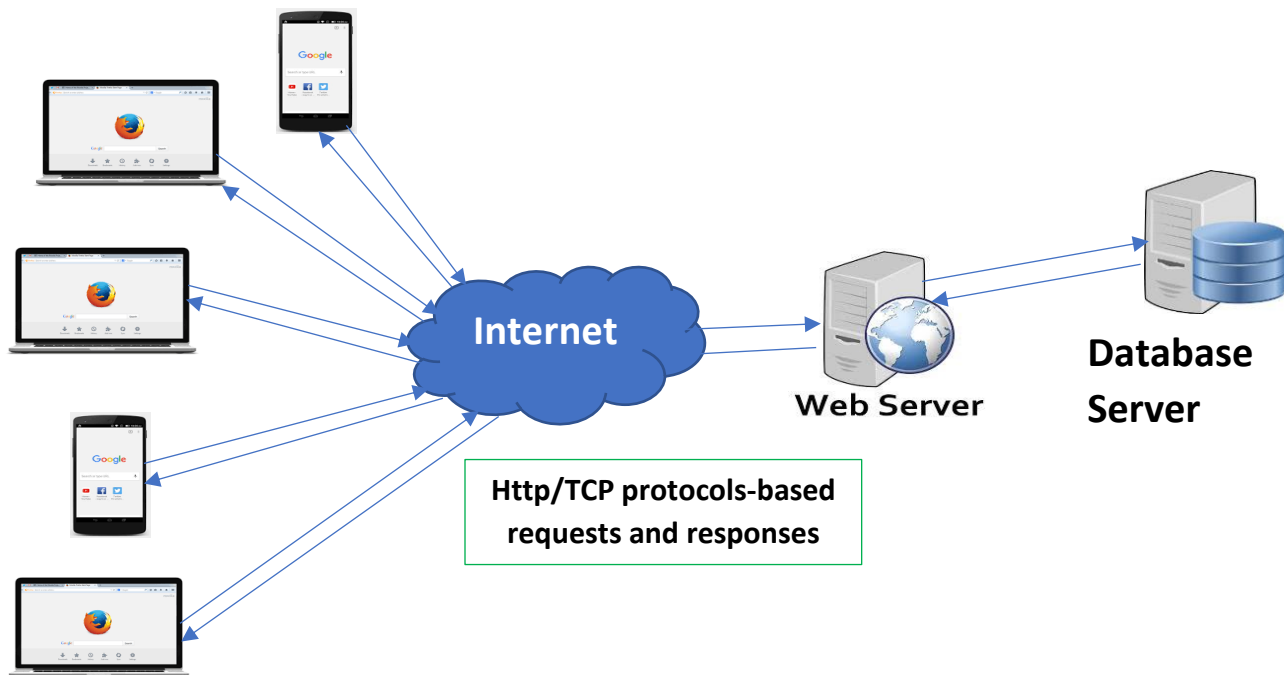


Figure 2. 1 Client-Server architecture

## 2.5.2 Three-Tier Architecture

Three-tier architecture, which separates applications into three logical and physical computing tiers, is the predominant software architecture for traditional client-server applications. Three levels are organized as the presentation tier, application tier, & data tier.

Due to this segregation, each tier can be managed, scaled if needed separately as they use their infrastructure.

### ❖ *The three tiers in detail*

#### **Presentation tier**

This is the tier which the user interacts with and normally it's available to run using a browser, or a desktop application. Considering the e-commerce application development, it's possible to use HTML, CSS, JavaScript many more technologies usually used in web presentation tiers.

Eg: an e-commerce site where the user adds products to the shopping cart, adds payment details, or creates an account. The content can be static or dynamic and is usually developed using HTML, CSS, and JavaScript (Kambalyal, 2015)

#### **Application tier**

The application tier consists of the business logic for the system, which is used to retrieve, insert, delete the data. Also, this tier presents the information which gathers from the presentation layer as well as provides dynamic information required from the DB to the presentation layer.

This layer could use server-side languages such as Python, Java, Perl, PHP and frameworks such as Node.js, Django, ASP.net, etc.

Eg: In an e-commerce site, this tier queries the database to return a certain product's availability or adds details to a user profile.

## **Data-tier**

Database tier or back-end is used to store & manage the information processed by the application. Here a developer could use Relational Database Management System as PostgreSQL, MySQL, MariaDB, MS SQL Server, or No SQL databases such as Cassandra, Mongo DB, etc. (Kambalyal, 2015)

### **❖ *Benefits of three-tier architecture***

Mainly the functional segregation allows to customize & enhance the performance of each tier separately.

Other benefits (compared to single- or two-tier architecture) include:

- Individual tier can be developed faster since the separation and any of them doesn't depend upon one another.
- Any tier can be scaled when needed without depending upon other tiers.
- If in case a malfunctioning happens from one tier it's unlikely the other tiers get affected by it.
- A well-designed application tier can be kept as a barrier for SQL injections & any other malicious activities since the presentation tier only able to communicate with the database tier indirectly via the application tier. (Talib & Alomary, 2016)

### **2.5.3 Other multi-tier architectures**

Other than three-tier architecture there are two-tier architecture and N-Tier architecture as well but the most widely used is the three-tier architecture.

The main reason is when using two-tier architecture application layer and the presentation layer resist at the same level which provides direct access to the data layer. On the other hand, N-Tier architecture is operated in many tiers which increases the cost to maintain the infrastructure.

## 2.5.4 The tendency to outsource the platform and technology stacks needed for e-commerce site maintenance and running

Even though some tend to have a design strategy on their own, nowadays most e-commerce vendors have benefited from the cloud services as it's a pay as you use service. As spoken earlier most of the e-commerce vendors have the option and do use the cloud services at present to sustain their business in a better & cost-effective way.

### ❖ *Cloud Service Models which could be used by e-commerce vendors*

Figure 2.2 is an illustration of the cloud services which will be further elaborated in the next sections.

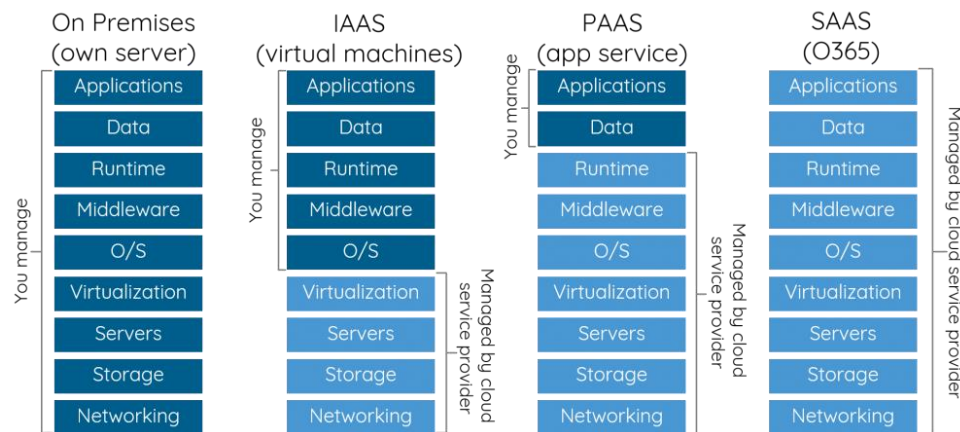


Figure 2. 2 Cloud Service Model (Maria, 2017)

- **Software as a Service (SaaS)**

In this model, each application is hosted and managed by the cloud service provider. Shopify and Demandware are two prominent examples of typical SaaS e-commerce solutions. This is affordable but data security cannot be guaranteed and doesn't have total control over the system. (Talib & Alomary, 2016)

- Platform as a Service (PaaS)

As depicted above the related data and the application will be managed by the application buyer and the other services such as related infrastructure, OS, & environment will be provided by the cloud service provider as a service. This is mostly used by the developers. (Talib & Alomary, 2016)

- Infrastructure as a Service (IaaS)

Here the infrastructure such as computer, networking & storage needed is virtualized by a vendor which could be configured as the user wish. Users will be mostly System Administrators in this situation. (Talib & Alomary, 2016)

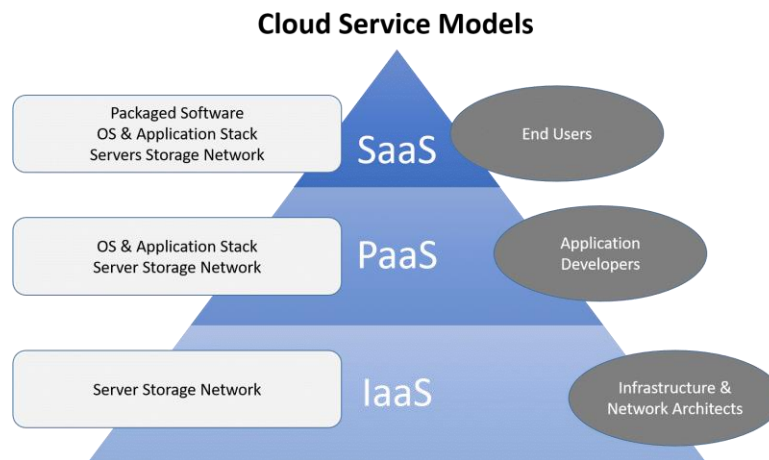


Figure 2. 3 Cloud Service Models 2 (IDM, 2018)

### ❖ *Major advantages & disadvantages of using cloud computing services to e-commerce*

Table 2.6 provides the advantages and disadvantages of using the cloud services from a cloud service provider rather than on-premises catering of the required services.

Advantages	Disadvantages
Cloud built e-commerce as a service provides supports in quick adjusting to market opportunities compared to on-premises internally developed applications.	Potential reduction over the control of providing the customer experience
Cloud-based E-commerce as a service allows faster deployment of software and lowers costs due to the economies of scale.	Long term cost will be higher than the on-premises system
Cloud computing also allows the newly onboarding e-commerce vendors to rent the platform to run their site which will reduce the initial cost of investment.	Risk of data storages being maintained by the service vendors
The ability to do intelligence analysis using the data through these platforms allows the e-commerce vendor to minimize the operation cost & also enterprises only need to focus on the core business sector.	Since the integration with the back-end system is limited, there's a risk of security.
E-commerce vendors can start with the basic supplies and advance their computing resources as their market nurtures with time.	Lack of relevant laws and regulations to protect the cloud service buyers since data storage, security, maintenance, information processing is usually dealt with by the cloud service providers
No need of having high technical skills in terms of infrastructure setup and server-side setup to start or maintain an e-commerce platform.	

Table 2. 6 Pros & Cons of cloud services (Talib & Alomary, 2016)



# 3 Design Architecture Chapter

## 3.1 Introduction

This chapter demonstrates the design of the proposed system and describes methodologies and techniques which have been used to develop the system. The design report emphasizes what are the functions of the system and how these functions are mapped into the back end. These required functions need to be designed using UML diagramming in order to do a proper planning for the implementation stage. So they are illustrated using the related use case diagram, class diagram and the respective sequence diagrams for the system.

In addition to that this chapter will provide the database architecture based for the proposed system. This will be depicted using the ER diagram. Diagram will provide what tables which are used and how they interconnect to each other in order to provide view data.

System architectural design gives the idea about the overall system architecture. Software architectural design is implemented in order to show the interconnection of the system modules of the proposed E-Osu Sala e-commerce system. Integration of these modules makes the entire final system of E-Osu Sala system. Detailed description of these interconnected modules is also discussed in this design chapter. Interface of the system are designed and demonstrated in the design methodology to confirm further how the system flow.

## 3.2 System Architecture

Technologies used on a system is discussed via this section of the chapter. The technologies used in a system does not need to be advanced in order to build a good system but considered technologies should have to be chosen in a manner where it suits the development. So, considering the front-end back-end technologies today there is wide varieties of languages. Further even when the development architecture is considered, there are new innovations, hybrid technologies which are introduced regularly.

So as a ground rule the selection of proper technologies as well as using them correctly are two main factors to consider creating a system to its expected quality. In the coming sections author has elaborated on how

those sections are tackled, by providing the front-end and the back-end languages used along with the development architecture in order to enhance usability, flexibility of the system and functionality of the system.

### 3.2.1 Coding Language

PHP Language - PHP is an acronym for "PHP: Hypertext Preprocessor". IT is a widely used, open-source scripting language. PHP scripts are executed on the server. PHP is free to download and use. PHP files can contain text, HTML, CSS, JavaScript, and PHP code. PHP code is executed on the server, and the result is returned to the browser as plain HTML. PHP can generate dynamic page content and can create, open, read, write, delete, and close files on the server. PHP can collect form data. PHP can add, delete and modify data in database. PHP can be used to control user-access. (plus2net, 2000)

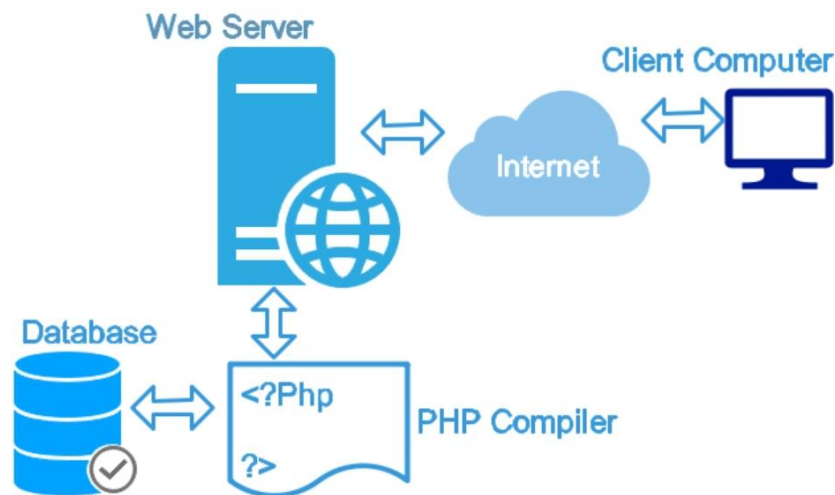


Figure 3. 1 PHP as server-side language (plus2net, 2000)

### 3.2.2 Frameworks

Authors main aim is to use the pure PHP language for the server-side scripting as it gives more flexibility. Further adding to that it provides a better learning on how to arrange a structure for the software development and proceed the coding.

Keeping the above direction as authors main option it's stated as an alternative it's likely to consider the CodeIgniter framework for future development of this project. In consideration of this possibility, below stated is a brief explanation of the CodeIgniter framework.

**CodeIgniter framework** - CodeIgniter is a PHP MVC framework used for developing web applications rapidly. CodeIgniter provides out of the box libraries for connecting to the database and performing various operations. The entire source code for CodeIgniter framework is close to 2MB. This makes it easy to master CodeIgniter and how it works. It also simplifies deploying and updating it. The framework is well documented, and there are good books, tutorials and answered forum questions on CodeIgniter. CodeIgniter has components for sending email, database management, session management and many more. Following image shows how CodeIgniter works. (Guru99, 2021)

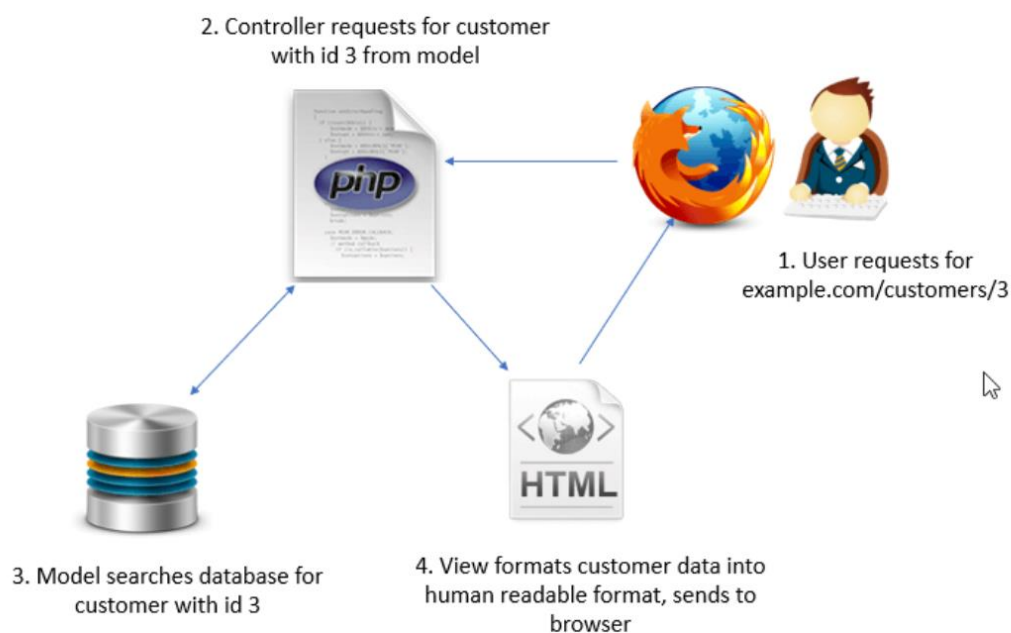


Figure 3. 2 MVC architecture (Guru99, 2021)

In addition to the above HTML, CSS and JavaScript languages will be used for the front-end development. As these are more static if coded in plain, Bootstrap is used for a responsive front-end development. The Bootstrap framework is explained briefly below.

**Bootstrap framework** - Bootstrap has become an essential a tool for front-end developers. Bootstrap is a massive collection of handy, reusable bits of code written in HTML, CSS, and JavaScript. It's also a front-end development framework that allows developers & designers to quickly build fully responsive websites. Bootstrap comes with its own grid system predefined. Defining custom breakpoints for each column is a snap using their extra small, small, medium, large, and extra-large breaks. Bootstrap comes with its own code for automatically resizing images based on the current screen size. Bootstrap comes with a whole barrellful of components that can easily tack onto web page, including, Navigation bars, Dropdowns, Progress bars, Thumbnails. (Chouhan, 2017)

### 3.2.3 Application Development Architecture

When selecting on an architectural pattern author has considered the Monolithic, Layered and Micro Services architectural patterns and author has chosen the Layered architectural pattern out of them comparing the advantages, purpose and usage of the proposed web E-Osu Sala system that is built.

Firstly, there will be the presentation layer where the user interaction will be happening with the system. So, for the development of the UI components of the system HTML, CSS, JS & Bootstrap framework has been used.

Secondly there will be the business logic layer and it's developed using the pure PHP languages without using a framework. However, author could have move in for a framework such as CodeIgniter as mentioned earlier considering and evaluating its advantages specifically for the proposed E-Osu Sala system in the future.

Then the shared utilities layer will be available which is showing the used libraries for each of the layers for this system. Specialty of this layer is this layer could be accessed by any of the other layers directly without going through the layered communication path.

Finally, the data layer is available for the database and for its MySQL is used for the proposed system.

Please refer figure 3.3 on the next page for a better understanding on the used application architecture used on the proposed web-based e-commerce system.

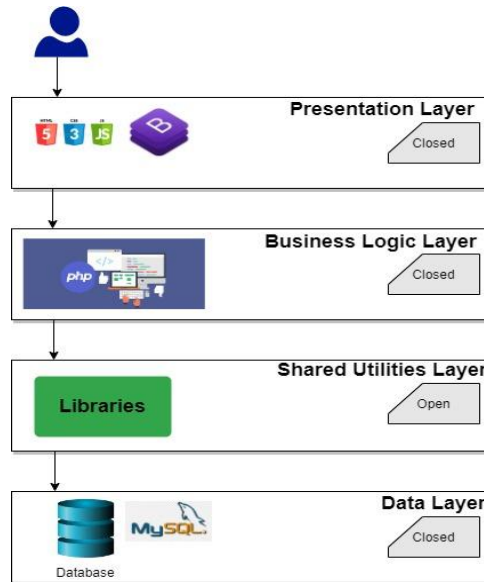


Figure 3. 3 Application development architecture used

## 3.3 UML Diagram

A UML diagram is a diagram grounded on the UML (Unified Modeling Language) with the purpose of visually representing a system along with its main actors, roles, actions in order to better comprehend, or document information about the system.

Visual paradigm is used to design the proposed system's UML diagram. Visual paradigm is considered as the one of the best tools for creating software designs due to its provision of editing the class members and also comes with a sequence diagram editor which makes designing more flexible. The use case diagram of the proposed E-Osu Sala system is indicated using the figure 3.4 below.

### 3.3.1 Use case diagram

On the next page, the high-level use case diagram of the proposed system. This indicates all the crucial functionalities of the system.

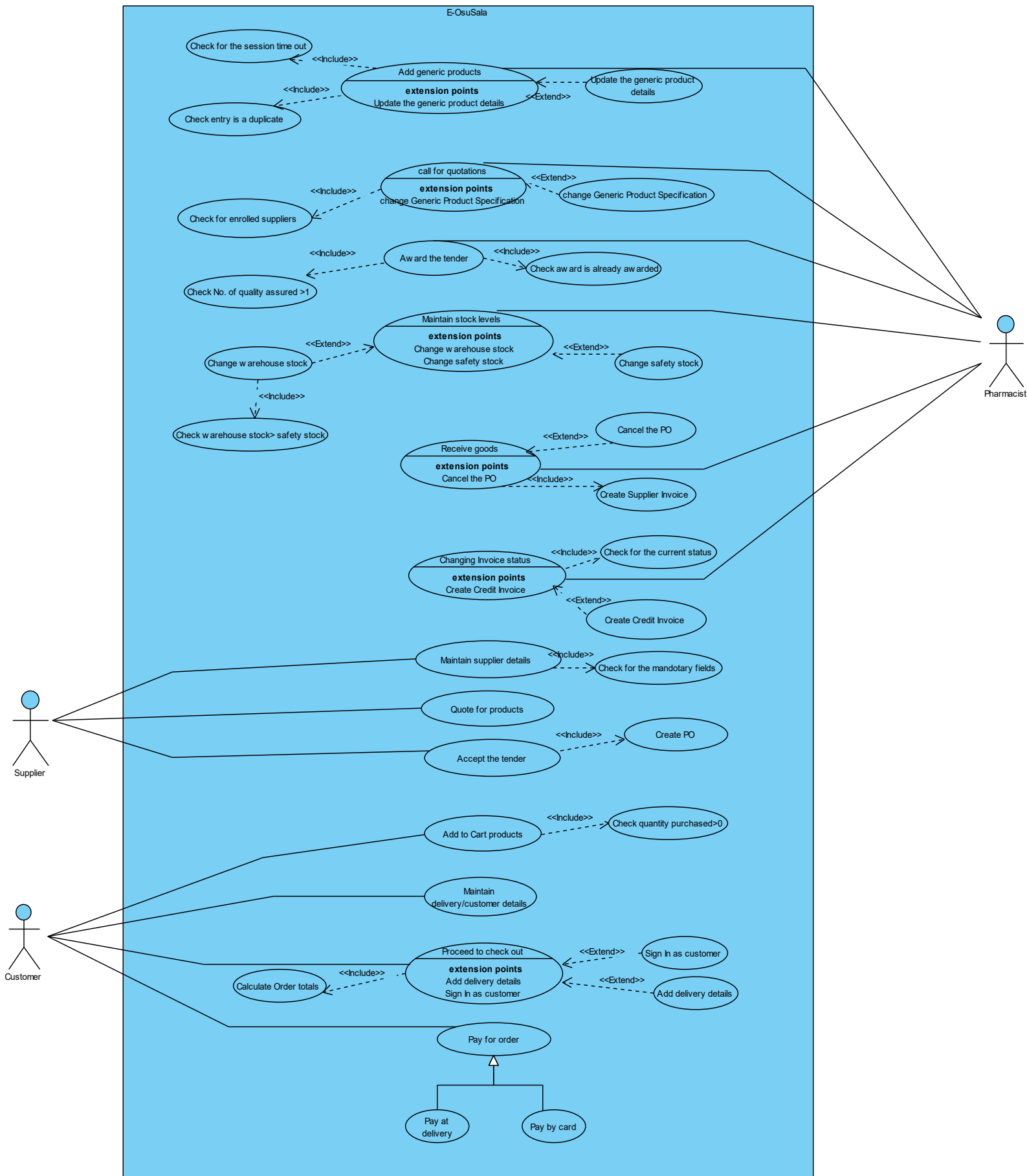


Figure 3. 4 use case

### 3.3.2 Use Case Narratives

The respective use case narrations for the above use cases depicted from the figure 3.4 are indicated from figure 1 to figure 13 in the Appendix A.

These narratives have used to further explain the actors involved, condition related to the use cases and the flows that are needed to follow in relation to trigger the particular use case. In addition to them the expected result of those flows and the alternative flows are explained too in the use case narratives depicted from the tables at Appendix A.

### 3.3.3 Class diagram

The figure 3.5 is the class diagram designed for the proposed system.

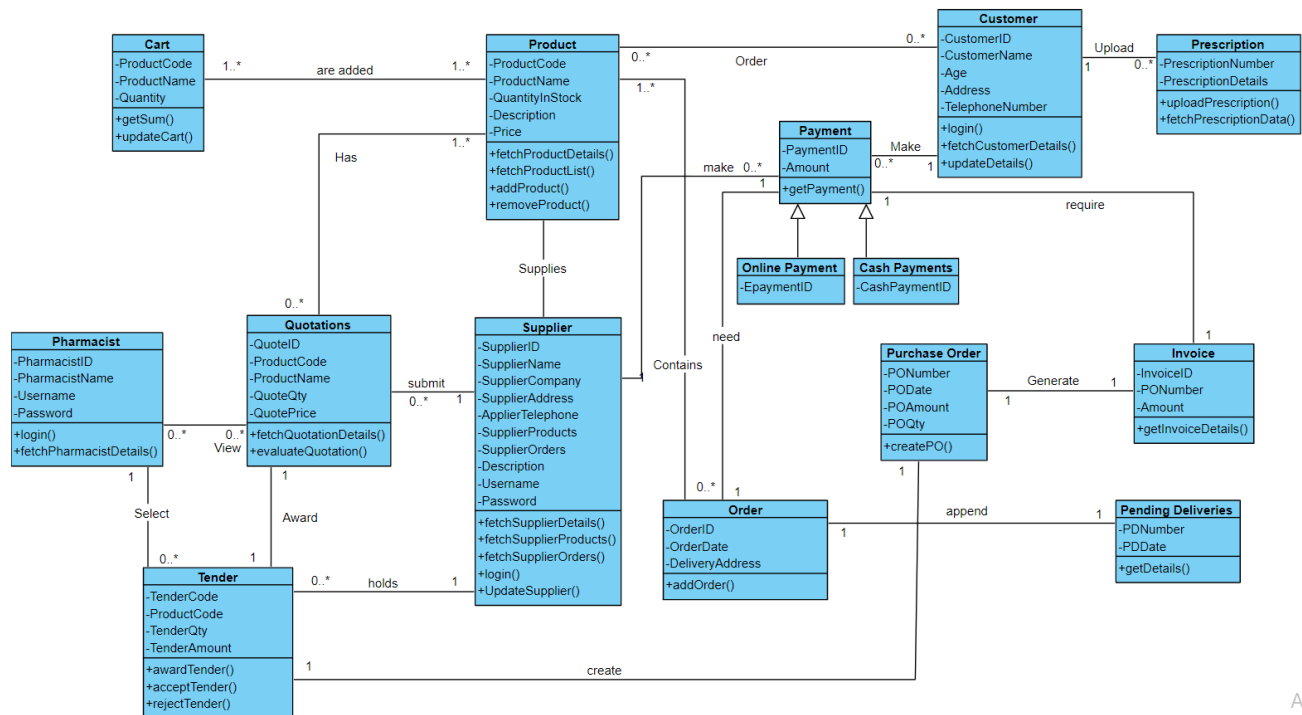


Figure 3. 5 Class Diagram

### 3.3.4 Sequence diagram

The information flow of the system from sequence diagrams depicted below from figure 3.19 to figure 3.37

#### ➤ Call for quotations

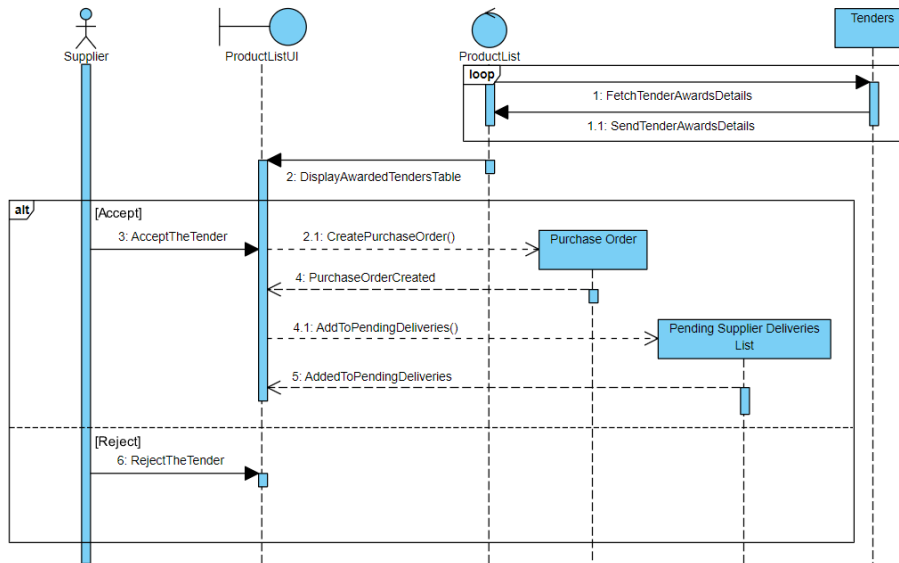


Figure 3. 6 Call for quotations

#### ➤ Award the tender

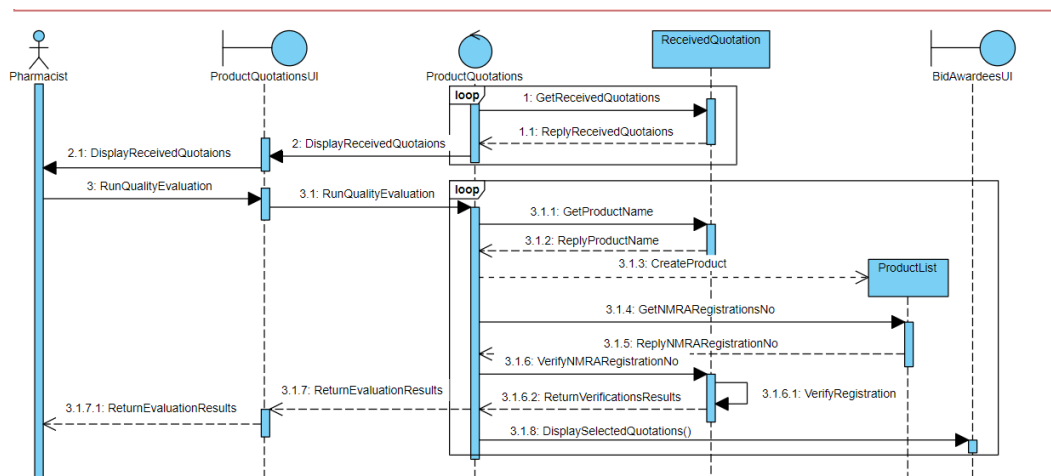


Figure 3. 7 Award the tender



➤ Accept the tender

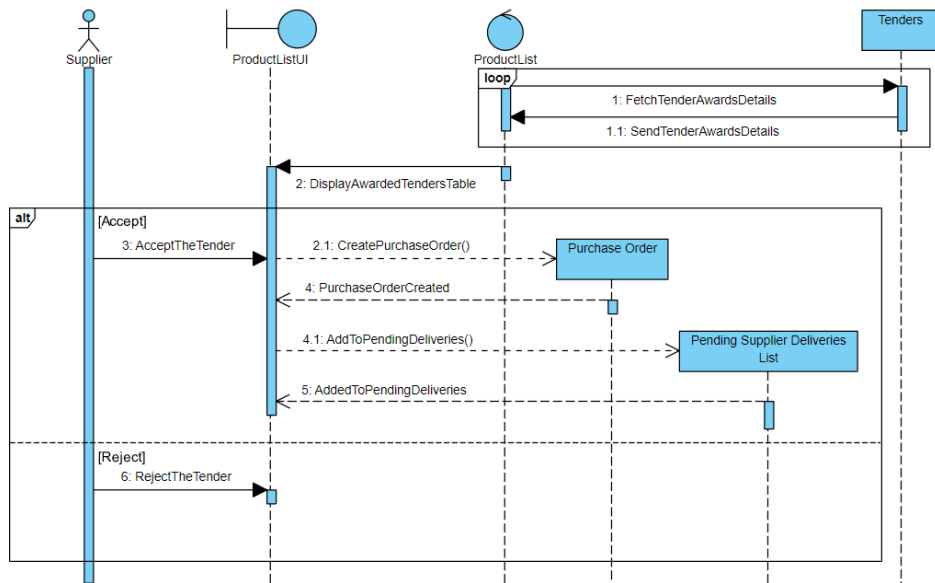


Figure 3. 8 Accept the tender

➤ Add products to the cart

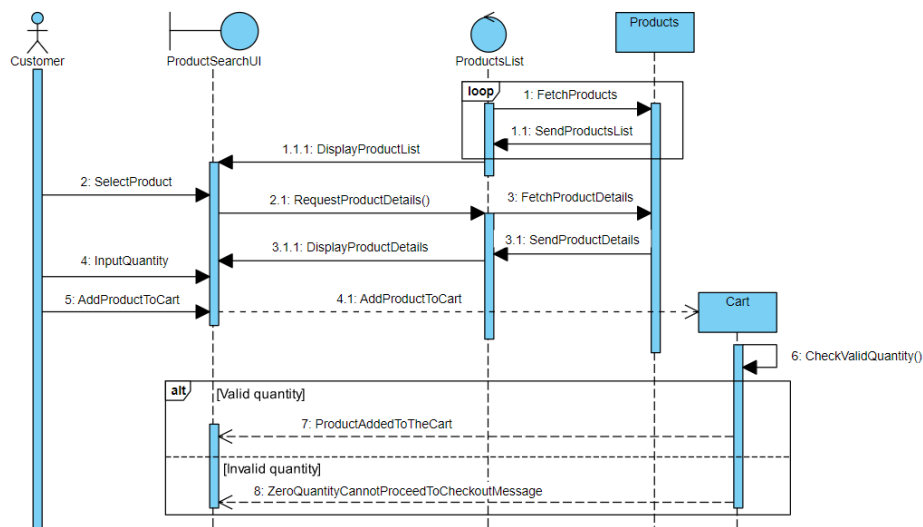


Figure 3. 9 Add products to cart

➤ Change customer order status

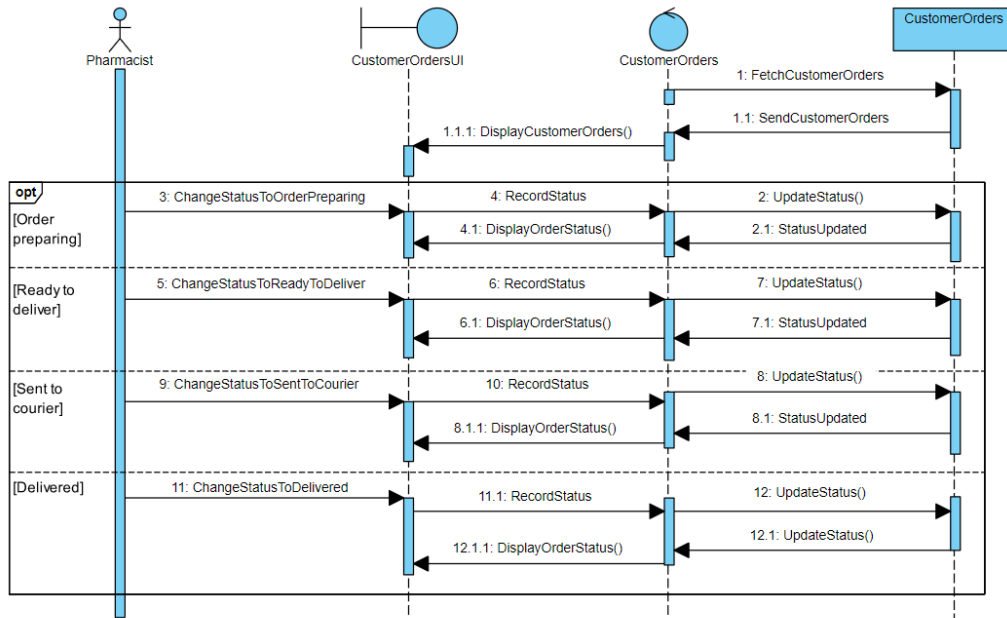


Figure 3. 10 Change customer order status

➤ Changing supplier invoice status

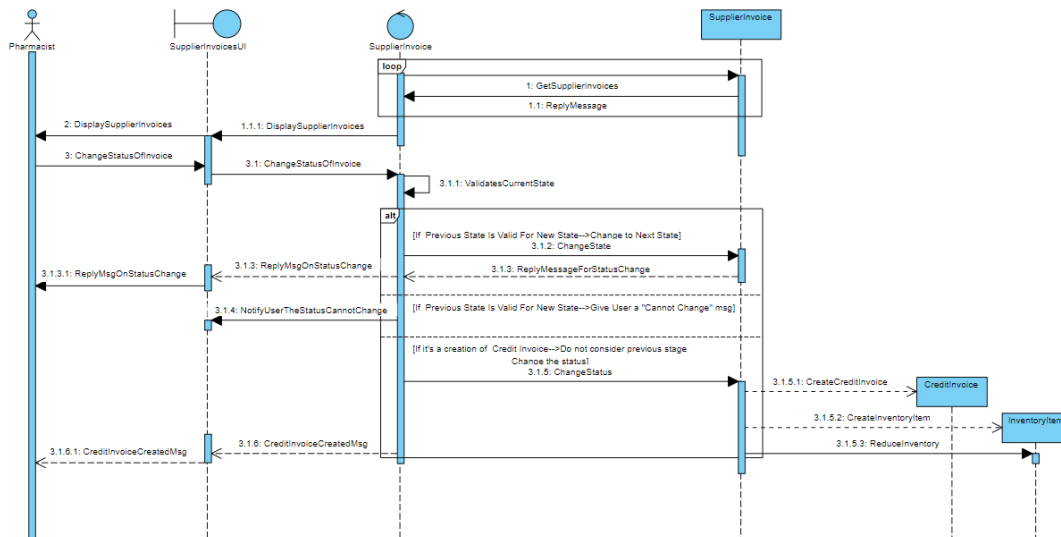


Figure 3. 11 Changing supplier invoice status

➤ Customer registration

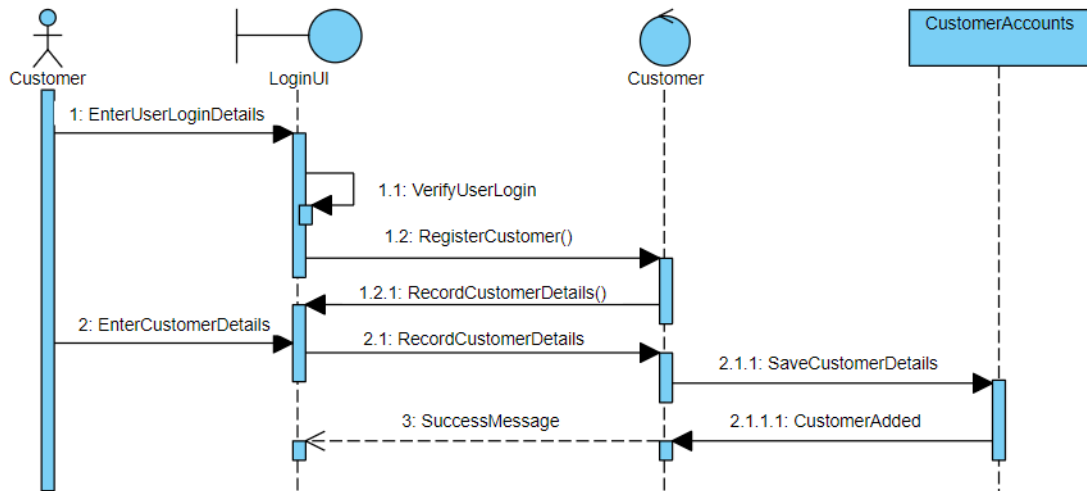


Figure 3. 12 Customer registration

➤ Delete generic products

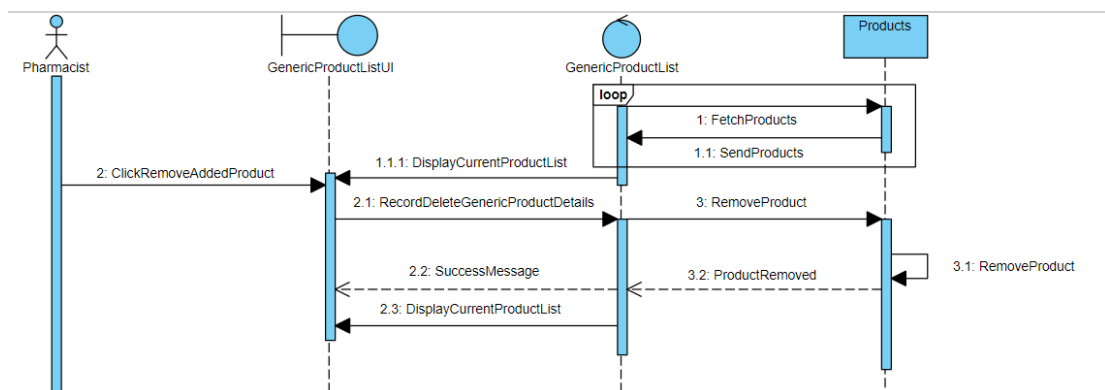


Figure 3. 13 Delete generic products

➤ Goods received

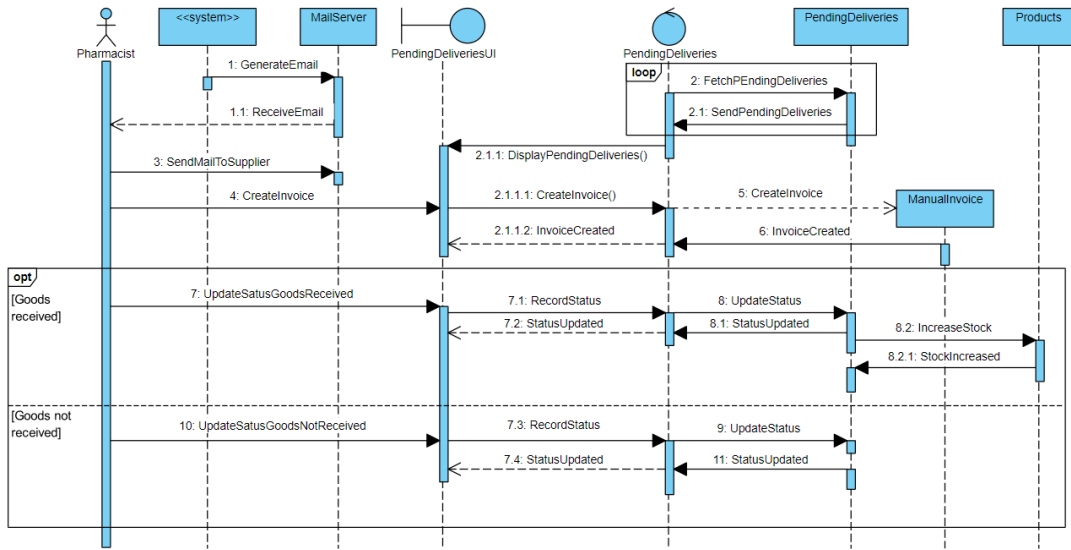


Figure 3. 14 Goods received

- Maintain customer details

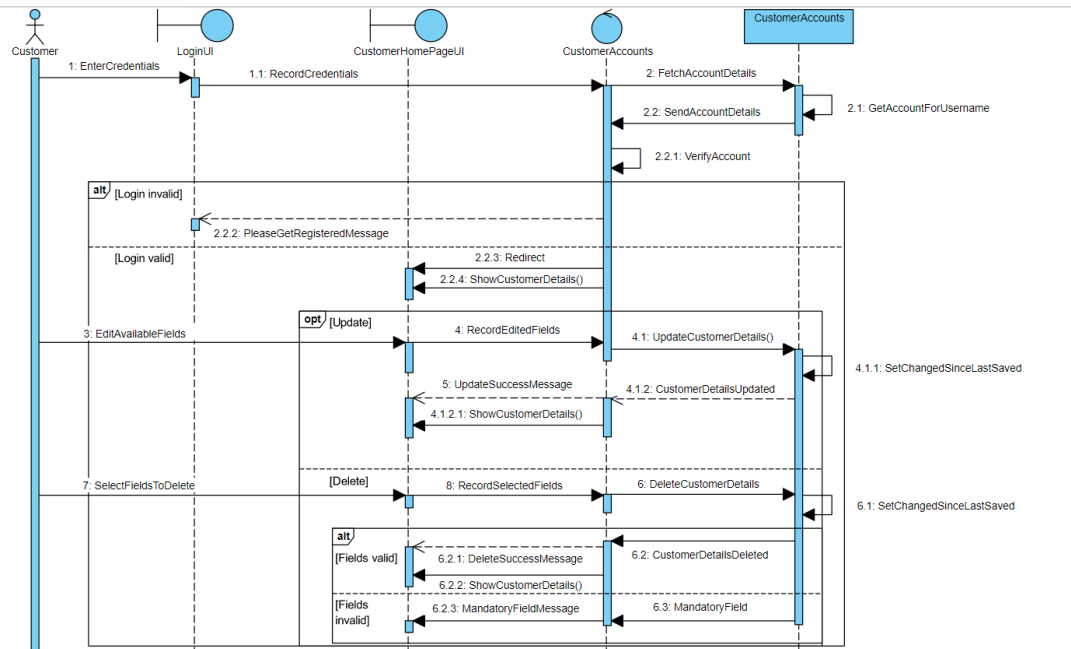


Figure 3. 15 Maintain customer details

➤ Pay for order

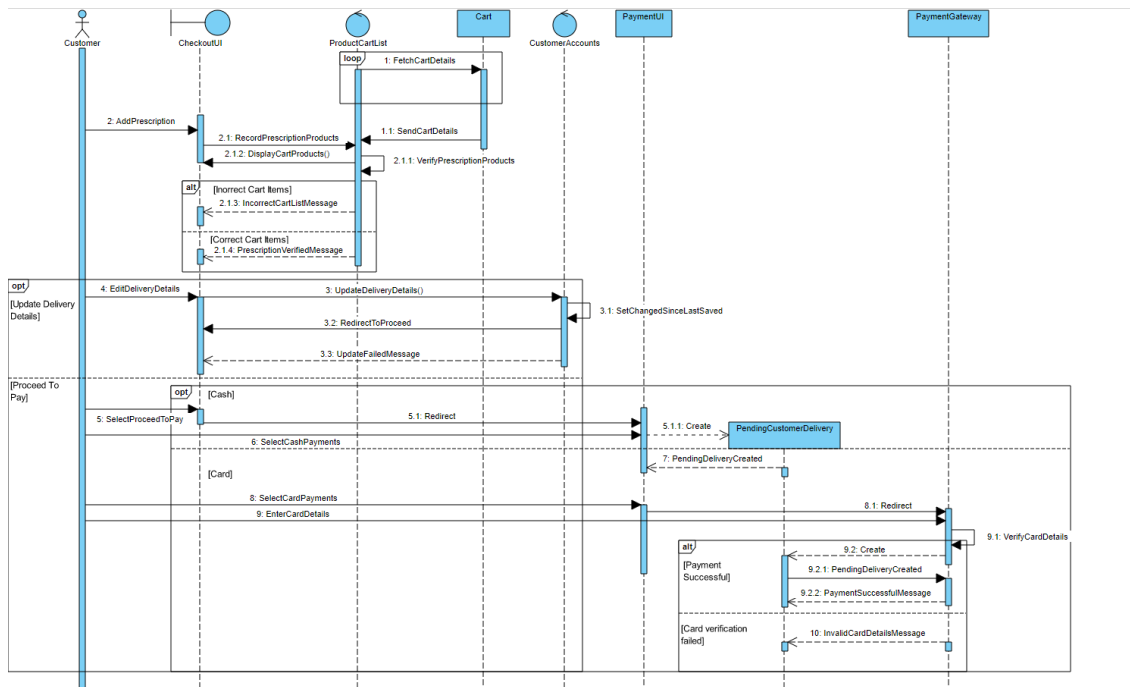


Figure 3. 16 Pay for order

➤ Proceed to checkout

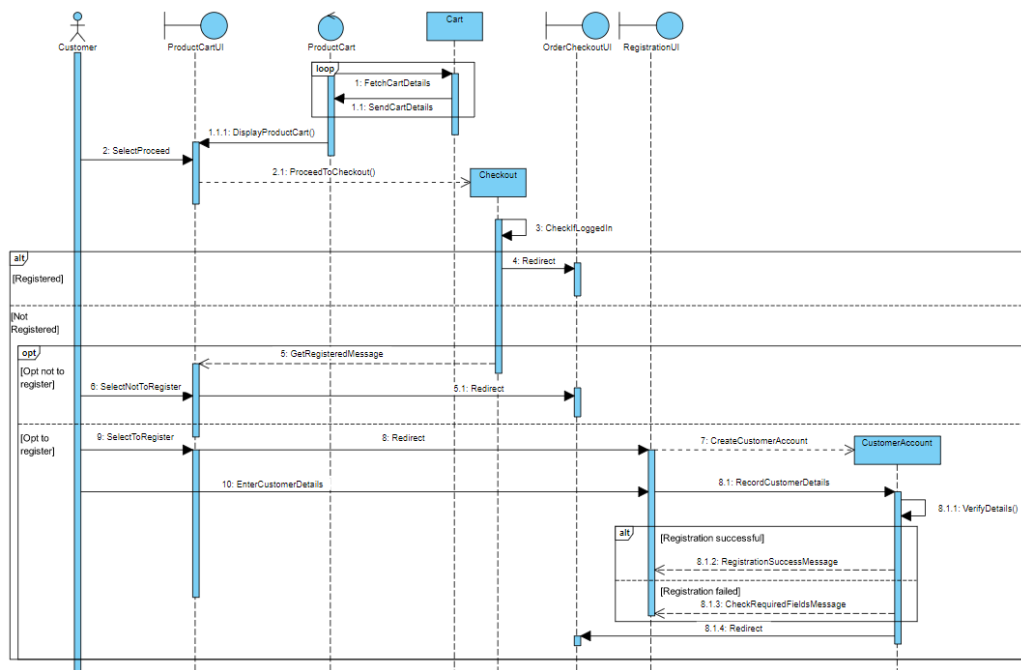


Figure 3. 17 Proceed to checkout

➤ Quote for a product

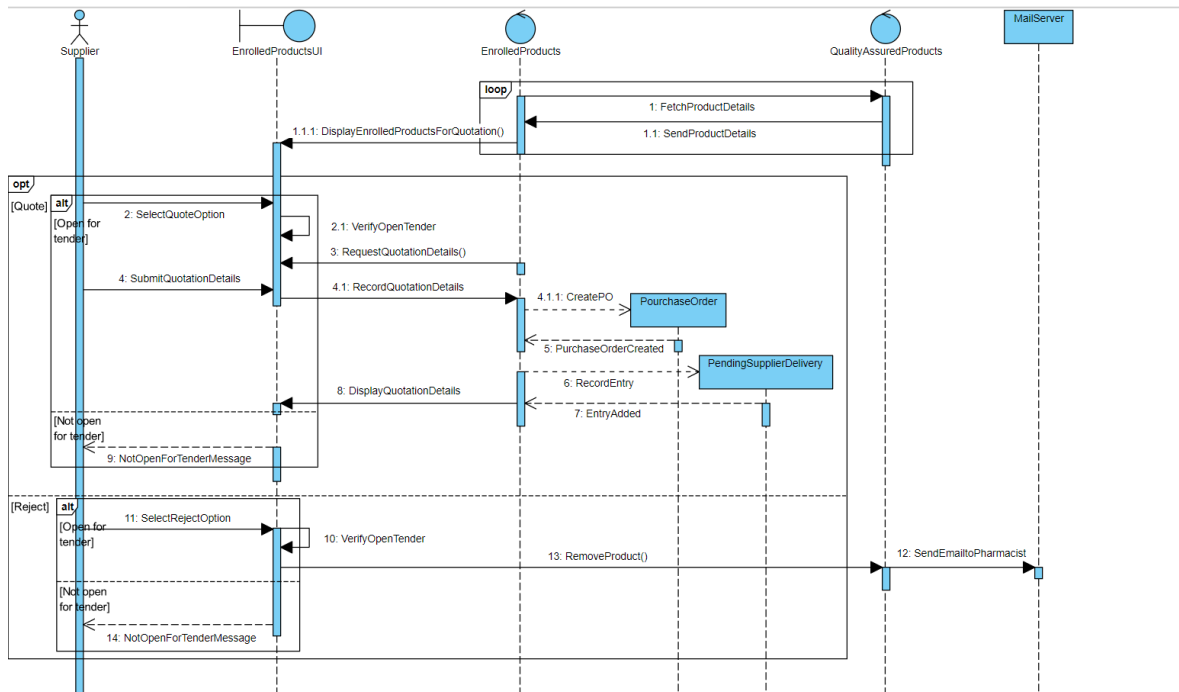


Figure 3. 18 Quote for a product

➤ Change reorder level

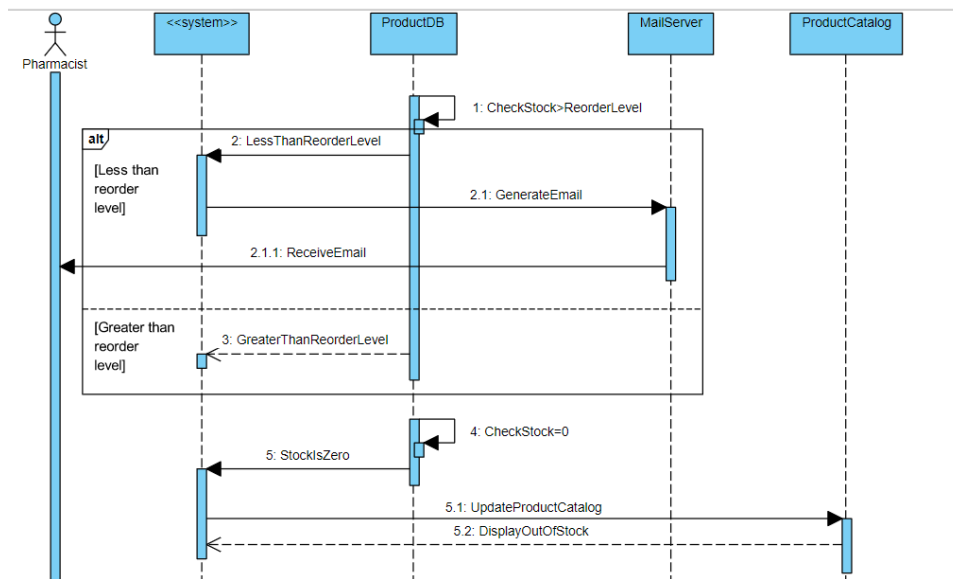


Figure 3. 19 Change reorder level

➤ Receive goods

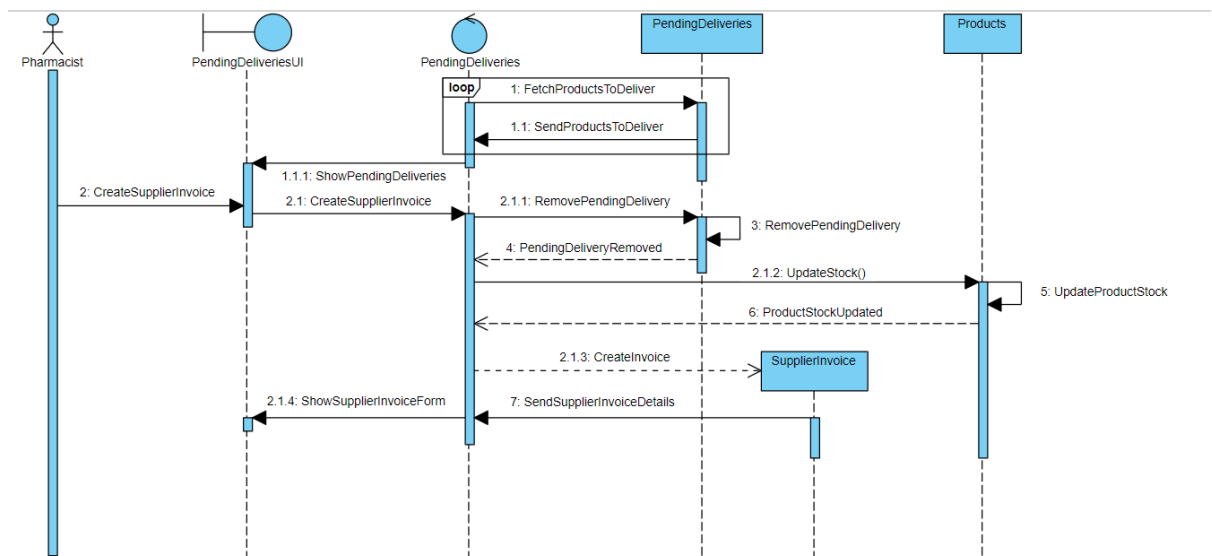


Figure 3. 20 Receive goods

➤ Supplier view details

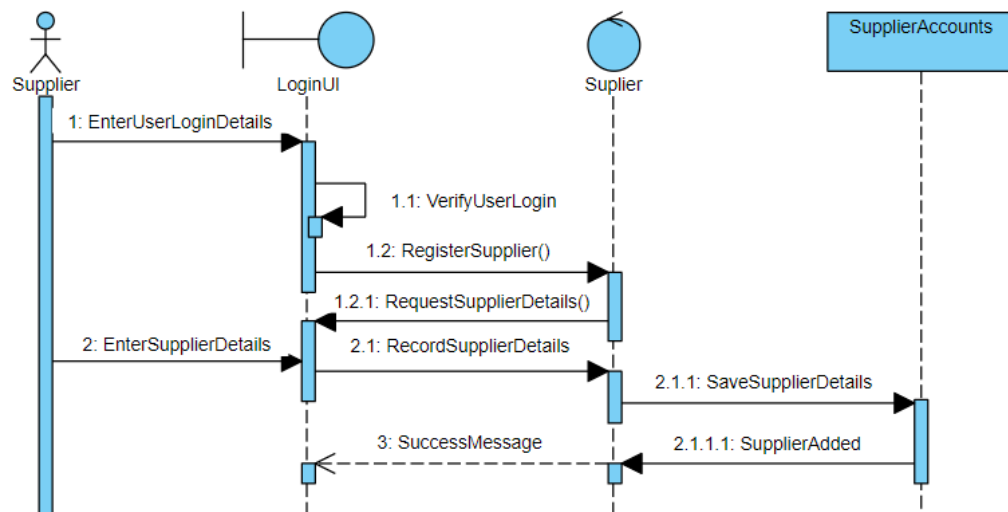


Figure 3. 21 Supplier view details

➤ Supplier registration

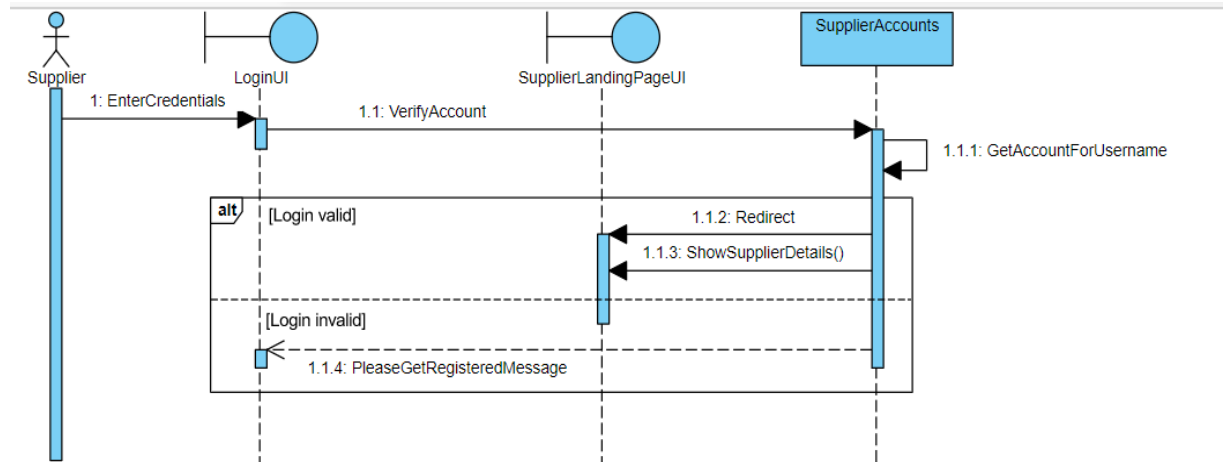


Figure 3. 22 Supplier registration



➤ Supplier delete details

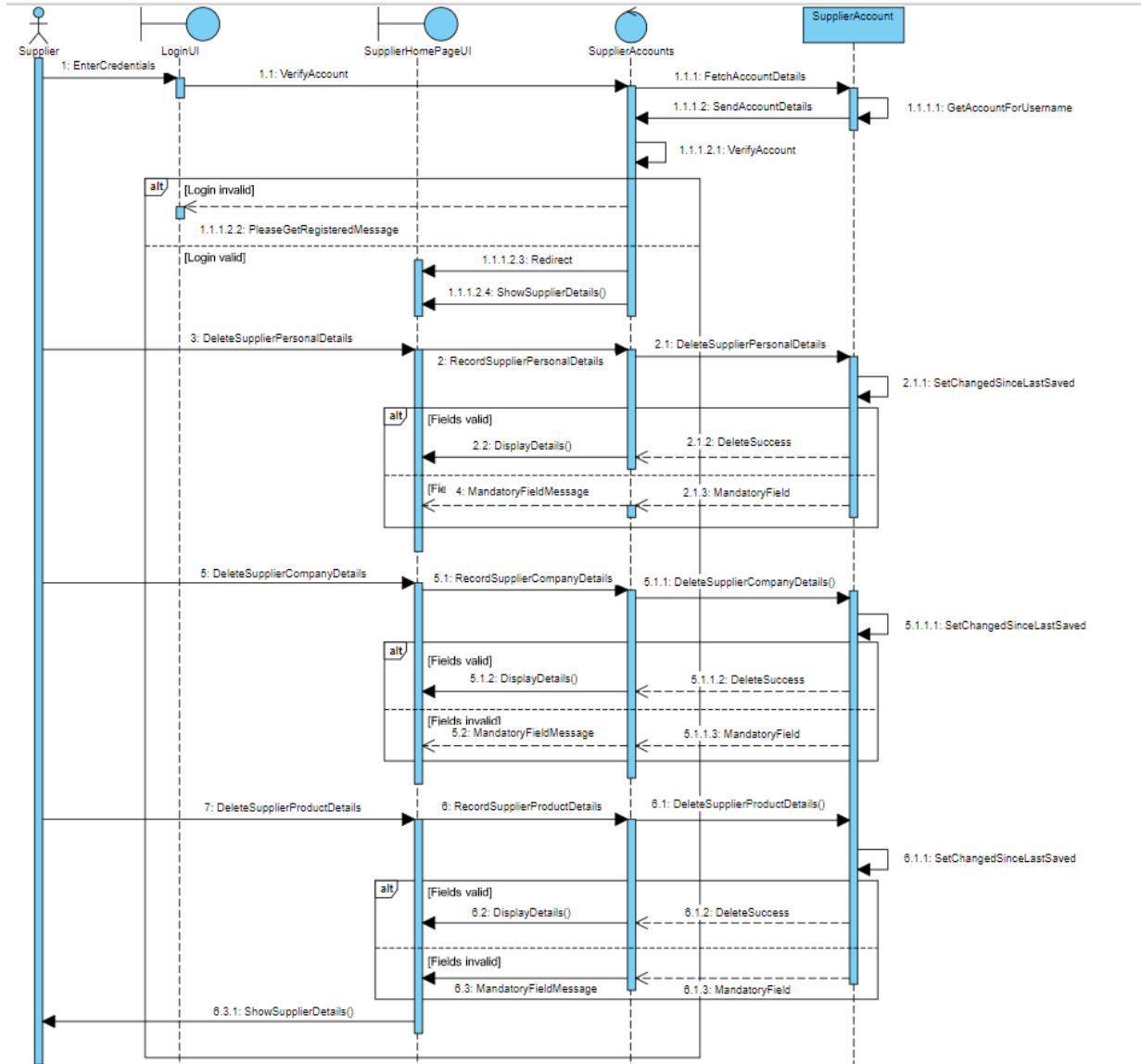


Figure 3. 23 Supplier delete details

➤ Supplier edit details

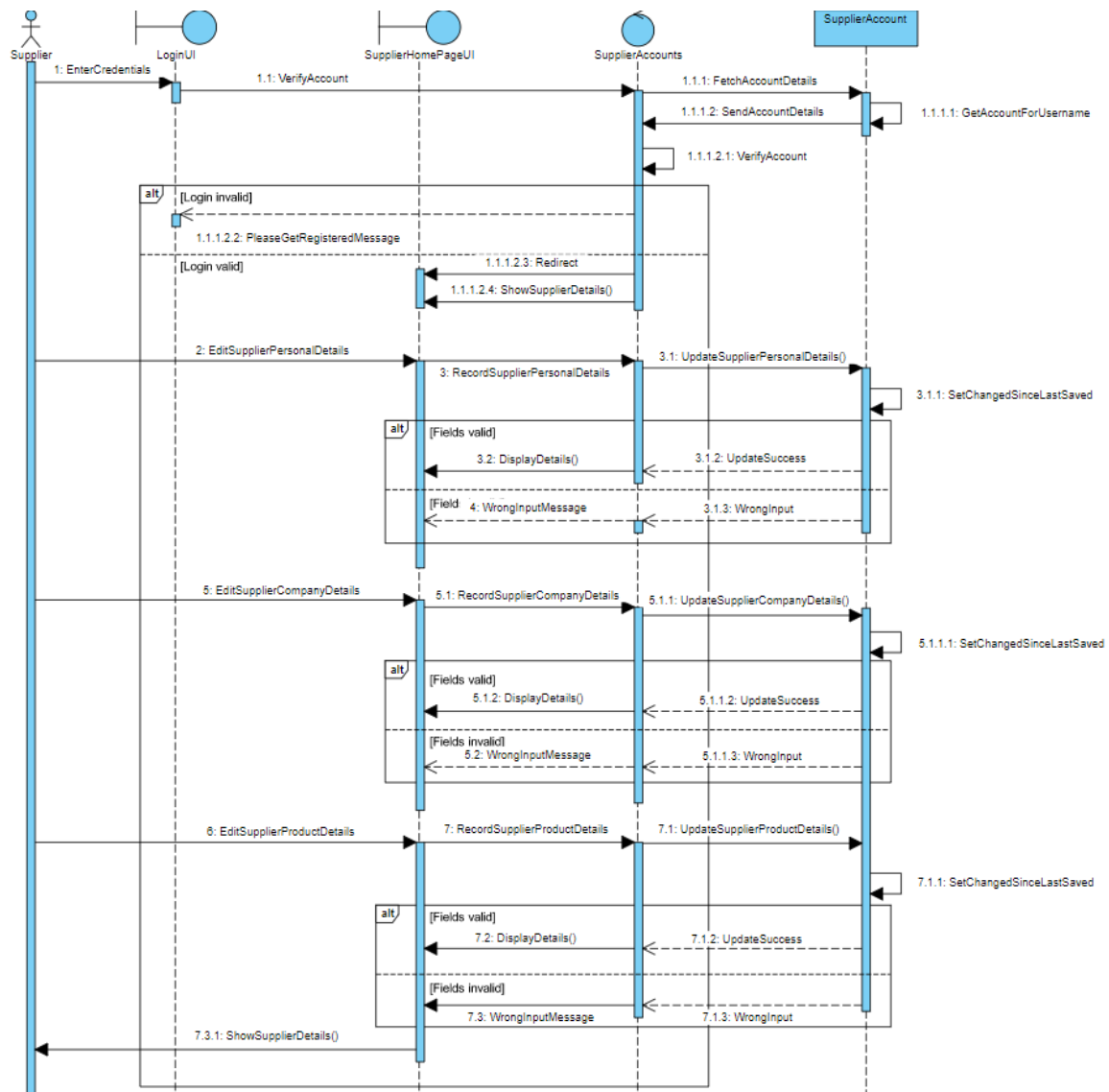


Figure 3. 24 Supplier edit details

### 3.3.5 ER Diagram

I have provided below the ER structure shown via figure 3.25 used for the creation of the database for the proposed system.

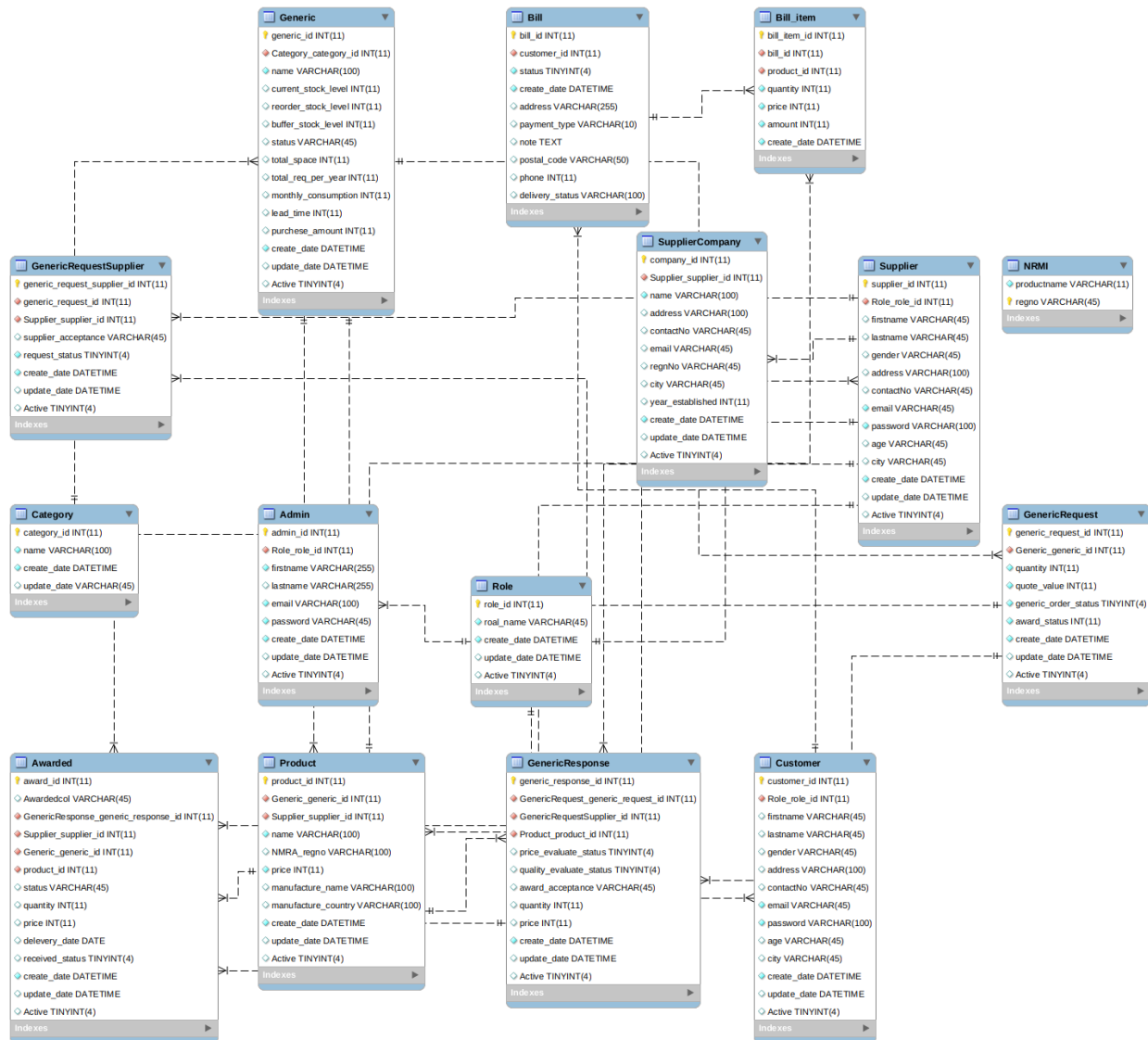


Figure 3. 25 ER diagram

### 3.4 Designed Management Information Systems reports

MIS reports addresses the pharmacist information needs in terms of administering the business and will give a holistic view from the pharmacist's dashboard. Hence as depicted in the screen shots provided via Appendix E, the information related to the stock levels to get an idea on which products are at the edge of re-ordering. So, without any issue the business will flow in a normal situation where seasonal factors come into play.

In addition, these interfaces reporting the information will direct the pharmacist in taking timely decisions without any delay which will eventually support to keep the external interest parties such as customers and the suppliers intact to the system in the longer run.

As discussed previously, below indicated are the information related to the reports that could be generated for the pharmacist via the selection of various parameters to get the stock, sales, & purchasing information. All the information would be able to either view directly from the system or generate to an .csv file for the pharmacist's convenience. (Appendix E)

#### **Reports generated by the system:**

##### **A. Interface giving the details on the current stock level for generics**

Stock management and related information generation is a crucial factor when it comes to pharmaceuticals as it's primarily relates to a person's health. So, the pharmacist needs to evaluate different states of the stock levels within different time periods and using the transaction types taken to change the stock levels. So, this information would be facilitated from the interface on figure 1 at Appendix E.

##### **B. Information shown for the customer orders/sales data**

Further the information related to the customer deliveries are provided in order to take an idea on the pending customer deliveries. So, pharmacist will not need to route into any other section in order to review the customer insights for orders. This information is providing via the figure 2 in the Appendix E.

### C. Information shown for the purchasing data

Also, other aspect that needs to be provided is the data related to the suppliers. Main detail that pharmacist is concerned, and the system needs to be reported to pharmacist is the data related to the awards made to them and also the deliveries relate to a certain product which are yet to be fulfilled. So, this information will be reported to the pharmacist via the interface on figure 3 on Appendix E.

## 3.5 Quality of the solution

Currently identified problem is that most of the pharmacies and online pharmacies are providing the pharmaceuticals in the brand name. This mostly run into situations where the patient or the buyer paying higher values due to the lack of knowledge in the pharmaceutical's domain. As identified the problems and the reasons for them are indicated below.

When considered the current Sri Lankan market context, it's possible to find the physical structure and the online web-based pharmacies in operation. Commonly it's possible to identify the following issues shown via table 3.1 in the current composition.

Problem	Further explanation
Inferior products being delivered to customers	As author have studied from the market this mainly happens through baggage deliveries. Baggage deliveries are taken to the country in small quantities targeting a smaller market. These are either unregistered products or blacklisted products.
High price margins on brands	Branded pharmaceuticals tend have high prices considering their brand name and long-term existence. But the reality is there will be the same quality product at a lower price in market

Pharmacies motive is diverted from quality products at lower price to high priced lower quality products.	There has been a change in the pharmaceuticals practice in 2 <sup>nd</sup> and 3 <sup>rd</sup> world countries to prescribe the product by doctors for benefits received from pharma companies or provide medicines which benefits the vendor rather than the patient/buyer.
The buyer or the patient doesn't have the knowledge on the pharmaceuticals to make a comparison between brands.	They don't have the knowledge on getting a sole decision by themselves. Since they need to depend on the doctor or the pharmacist.

*Table 3. 1 Problems of the current context of the selected domain- e pharmacies*

Also, when taken the physically located pharmacies, below identified issues via table 3.2 are there.

<b>Problem</b>	<b>Further explanation</b>
Physical pharmaceuticals are unable to cater wider market	Current physical market structure doesn't cater their products to the wider market due to the high capital costs that they have to bear.
Even though S.P.C. has implemented the current concept manually it much more time consuming compared to private pharmacies.	considerable time is consumed to follow the government tender procedure for choosing the right quality generic products at a lower price.

*Table 3. 2 Problems of the current context of the selected domain-Physical Pharmacies*

Benefits achieved using the provided design of the solution.

- The automated evaluation process of finding the quality assured product to each generic pharmaceutical name would make things efficient.
- The system will show available brand names related to the current generic pharmaceutical product available on site. So, consumers can choose to take the branded or generic at their own choice.

- It's possible to reach more people using an e-commerce site than a physically located pharmacy. As it's mentioned in the problems even though in the Sri Lankan context S.P.C. has implemented this structure into their physical pharmacies it only caters for a certain limited market (through about 44 pharmacies from S.P.C Corporation).
- It's possible to create a trend among the pharmaceutical vendors to act in such a manner where they give prominence to the generic product name rather than the brand name of the pharmaceutical.
- Most of the current e-commerce sites in the Sri Lankan context is owned by a physical pharmaceutical chain (eg: Healthguard, Unique) & hence individual suppliers aren't able to register able to sell their pharmaceuticals in the market. This will be a good platform for these suppliers to enter into the market.

Please visit the objectives section in order to have an understanding on how different functionality caters to mitigate each of the problems stated and to achieve the benefits as elaborated here.

Due to the architecture and possibility to go for a SaaS based structure in the future, it's possible to achieve the below benefits,

- Cloud built e-commerce as a service provides supports in quick adjusting to market opportunities compared to on-premises internally developed applications.
- Cloud-based E-commerce as a service allows faster deployment of software and lowers costs due to the economies of scale.
- Cloud-based E-commerce as a service allows faster deployment of software and lowers costs due to the economies of scale.
- Cloud computing also allows the newly onboarding e-commerce vendors to rent the platform to run their site which will reduce the initial cost of investment.
- The ability to do intelligence analysis using the data through these platforms allows the e-commerce vendor to minimize the operation cost & also enterprises only need to focus on the core business sector.
- E-commerce vendors can start with the basic supplies and advance their computing resources as their market nurtures with time.

- No need of having high technical skills in terms of infrastructure setup and server-side setup to start or maintain an e-commerce platform. (Talib & Alomary, 2016)

Rite Aid, The Online Drug Store, Southstar drug like sites in the world market are built upon e-commerce platform builders and the software development limits to some extent as they require to use their technology to build the platform. Hence E-Osu Sala is built from scratch.

Also, though the use of bootstrap it's possible to cater different components such as mobile, tablets etc. due to its fluid structure.



# 4 Implementation

## 4.1 Idea on development work

The system is developed using the plane PHP without restricting to a certain framework. Even though that is the direction which the current system has moved, it's being considered pros & cons provided by a MVC architecture as well, to take a decision to switch into a such framework for future developments.

Further in addition to the above technologies the implementation environment was consisting the IDE Visual Code Studio for the debugging and code editing purpose. Further XAMP is used as the web server solution package to complement the development of the e-commerce platform. XAMP is a free and open-source cross platform web server solution stack package developed by Apache which consist Apache HTTP server, Maria DB database and PHP. In addition to that the OS used is windows 10. Please note that for the designing phases Figma, Draw.io software's are used to create architectural designs and for the system functionality mapping. Further support of Stack overflow community is taken to overcome the errors faced at the compilation.

The system is providing all the functionalities which were mentioned in the second chapter except the invoice creation and handling the goods returned related to it due prioritizations done considering the time constraints compared to the initial requirements stated. These will be considered for the future upgrades which will be added to the system in near future. In addition, it was noted that most of the companies are currently using open-source cloud platforms to report their accounting transaction. Hence there was not a requirement by the market for initially intended Accounting and Finance functionality.

There are no major platform dependencies rather than using a later version of the web browsers such as Google Chrome 93, Firefox 91 or IEE 11 since this is based on PHP and major logic will performed at the server side. It's better to have a later version of above browsers to occur the front-end language compilation smoothly through their compilation engines.

Figure 3.26 to figure 3.29 are some of the main code segments in the system functionality. They are included by author in order to give an idea about the development process.

## Stock details

```

        </tr>
    </tfoot>
    <tbody>
        <tr>
            <td><?php echo $row['name']; ?></td>
            <td><?php echo $row['current_stock_level']; ?></td>
            <td><?php echo $row['reorder_stock_level']; ?></td>
            <td><a href="#" class="btn btn-primary btn-user btn-block scrap_btn"
                data-toggle="modal" data-target="#scrapModal"
                data-id="<?php echo $row['generic_id'] ?>"
                Scrap
            </a></td>
            <td><?php echo $row['buffer_stock_level']; ?></td>
            <td>
                <?php
                if ($row['Active'] == 1) {
                    echo 'span class="badge badge-success text">Yes</span>;
                } else {
                    echo 'span class="badge badge-danger text">No</span>;
                }
            </td>
            <td><a href="#" class="btn btn-primary btn-icon-split generic_edit"
                data-toggle="modal" data-target="#addgenericmodal"
                data-name="<?php echo $row['name'] ?>"
                data-category_id="<?php echo $row['category_id'] ?>"
                data-id="<?php echo $row['generic_id'] ?>"
                data-current_stock="<?php echo $row['current_stock_level'] ?>"
                data-reorder_stock="<?php echo $row['reorder_stock_level'] ?>"
                data-buffer_stock="<?php echo $row['buffer_stock_level'] ?>"
                data-status="<?php echo $row['status'] ?>"
                data-monthly-c="<?php echo $row['monthly_consumption'] ?>"
                data-yea-c="<?php echo $row['total_req_per_year'] ?>"
                data-lead-t="<?php echo $row['lead_time'] ?>"
                data-total-s="<?php echo $row['total_space'] ?>"
                data-active="<?php echo $row['Active'] ?>"
                <span class="icon text-white-50">
                    <i class="fas fa-edit"></i>
                </span>
                <span class="text">Edit</span>
            </a></td>
        </tr>
    </tbody>
</table>
</div>
</div>
</div>

```

Figure 3. 26 Stock details

## Stock levels

```

$('#submit').click(function(e) {
    $('#submit').prop('disabled', true);
    // var toMail = $('#email').val();
    var quantity = $('#quantity').val();
    var supp_id = $('#supplier').val();
    var gen_id = $('#gen_id').val();

    $.ajax({
        url: 'model/ajax.php?action=send_mail_to_supplier',
        data: {
            "quantity": quantity,
            "supp_id": supp_id,
            "gen_id": gen_id
        },
        dataType: 'json',
        type: 'POST'
    })
    .done(function(resp) {

        if (resp.code == 200) {
            $('#quoteinvitation').modal('hide');
            alert_toast('Email successfully sent', 'success');
            $('#supplierQ_form').get(0).reset();
            setTimeout(function() {
                location.reload()
            }, 1500)
        } else {
            $('#submit').prop('disabled', false);
            $('#display-error').html('<ul>' + resp.msg + '</ul>');
            $('#display-error').css('display', 'block');
        }
    })
})

$('#quote_edit').click(function(e) {
    $('#display-error').hide();
});

$('#quote_edit').click(function() {
    start_load()
    var cat = $('#supplierQ_form')
    cat.get(0).reset()
    cat.find('[name= gen_id]').val($('#this').attr('data-gen-id'))

    total_spc = $('#this').attr('data-total-space')
    c_stock = $('#this').attr('data-c-stock')
    s_con = $('#this').attr('data-monthly-con')
    lead_time = $('#this').attr('data-lead-time')
    qty = (parseInt(total_spc) - parseInt(c_stock)) + (parseInt(s_con) * parseInt(lead_time));
    $('#quantity').val(qty);
    end_load()
})

```

Figure 3. 27 Stock levels

## Received Quotation

```
<script>
$(document).ready(function() {
  $('#example').DataTable( {
    initComplete: function () {
      this.api().columns().every( function () {
        var column = this;
        var select = $('<select class="custom-select"><option value=""></option></select>');
        select.appendTo( $(column.footer()).empty() )
        .on( 'change', function () {
          var val = $.fn.dataTable.util.escapeRegex(
            $(this).val()
          );
          column
            .search( val ? '^'+val+'$' : '', true, false )
            .draw();
        });
        column.data().unique().sort().each( function ( d, j ) {
          select.append( '<option value="'+d+'">'+d+'</option>' );
        });
      });
    }
  });
});

$("#quality_evo").click(function(){
  $.ajax({
    url: 'model/ajax.php?action=quality_evo',
    datatype: 'json'
  })
  .done(function(resp) {
    if (resp == 1) {
      alert_toast("Data successfully evaluated", 'success');
      setTimeout(function() {
        location.reload()
      }, 1500)
    }
  })
});
});
</script>
```

Figure 3. 28 Received Quotation

## Quality Assured Products

```
<script>
$(document).ready(function() {
  $('#example').DataTable( {
    initComplete: function () {
      this.api().columns().every(function() {
        var column = this;
        var select = $('<select class="custom-select"><option value=""></option></select>');
        select.appendTo( $(column.footer()).empty() )
        .on( 'change', function () {
          var val = $.fn.dataTable.util.escapeRegex(
            $(this).val()
          );
          column
            .search(val ? '^' + val + '$' : '', true, false)
            .draw();
        });
        column.data().unique().sort().each(function(d, j) {
          select.append('<option value="'+d+'">'+d+'</option>');
        });
      });
    }
  });
});

$("#price_evo").click(function(){
  $.ajax({
    url: 'model/ajax.php?action=price_evo',
    datatype: 'json'
  })
  .done(function(resp) {
    if (resp == 1) {
      alert_toast("Data successfully evaluated", 'success');
      setTimeout(function() {
        location.reload()
      }, 1500)
    }
  })
});
});
</script>
```

Figure 3. 29 Quality Assured Products

In addition to the above coding work, front-end prototypes & respective development work for the related user interfaces were parallelly designed with the help of Figma. Interface designs created using Figma are provided the in the Appendix F.

In addition, the created front end views related to the Pharmacist (Admin) which have being used for the evaluation process are depicted below from the figures 3.30 to 3.34.

## Stock details

**E-OSU SALA**

System Admin

Add new generic

### Stock Details

Show 10 entries Search:

Generic Product	Current Stock Level	Re-Order Stock Level	Scrap Product	Buffer Stock	Active	Action
Azithromycin	0	1000	Scrap	500	Yes	Edit
Catheters	7	5	Scrap	2	Yes	Edit
Cefuroxime	0	1000	Scrap	500	Yes	Edit
Disposable Syringes	0	1000	Scrap	500	Yes	Edit

Figure 3. 30 Stock details

## Stock levels

**E-OSU SALA**

System Admin

### Stock Level

Show 10 entries Search:

Generic Product	Current Stock Level	Re-Order Stock Level	Quote	Status
Azithromycin	0	1000	Quote	Yes
Catheters	7	5		Yes
Cefuroxime	0	1000	Quote	Yes
Disposable Syringes	0	1000	Quote	Yes
Gloves	0	1000	Quote	Yes

Figure 3. 31 Stock levels

## Received Quotations

The screenshot displays the 'Received Quotations' page. On the left is a dark sidebar with the 'E-OSU SALA' logo and navigation links: Stock Details, Stock Levels, Received Quotations (active), Quality Assured Quotations, Price Evaluated Products, Pending Deliveries, and Invoiced Deliveries. The top right shows the user 'System Admin' with a profile icon. The main content area has a title 'Received Quotations' and a search bar. Below the search bar is a table with columns: Product, Generic, Registration No, Quality Evaluation Status, and Price Amount. The table is empty, displaying 'No data available in table'. Below the table are five dropdown menus. At the bottom left, it says 'Showing 0 to 0 of 0 entries'. At the bottom right, there are 'Previous' and 'Next' buttons, and a large blue button labeled 'Run quality evaluation'.

Figure 3. 32 Received Quotations

## Quality Assured Quotes

The screenshot displays the 'Quality Assured Quotes' page. The sidebar and top navigation are identical to the previous screenshot. The main content area has a title 'Quality Assured Quotations' and a search bar. Below the search bar is a table with columns: Supplier, Product Band, Registration No, and status for quality. The table is empty, displaying 'No data available in table'. Below the table are four dropdown menus. At the bottom left, it says 'Showing 0 to 0 of 0 entries'. At the bottom right, there are 'Previous' and 'Next' buttons, and a large blue button labeled 'Run price evaluation'.

Figure 3. 33 Quality Assured Quotes

## Price Evaluated Products

The screenshot displays the 'Price Evaluated Products' module in the E-OSU SALA system. The sidebar on the left contains navigation links: Stock Details, Stock Levels, Received Quotations, Quality Assured Quotations, Price Evaluated Products (highlighted), Pending Deliveries, and Invoiced Deliveries. The main panel features a header with 'Generic', 'Required', and 'Fulfilled' filters. Below this is a 'Price Evaluated Quotations' table with columns: Supplier, Generic, Product Band, Price eval status, status of quality, Award to supplier, and Status. The table is currently empty, displaying 'No data available in table' and 'Showing 0 to 0 of 0 entries'. A search bar and pagination controls (Previous, Next) are also visible.

Figure 3. 34 Price Evaluated Products

## 4.2 Module structures

The below mentioned table 3.3 depicts the modules of the proposed system and related functionalities for each of those modules

Modules	Functions
Supplier module	<ul style="list-style-type: none"> <li>Register as a supplier</li> <li>Log in as a supplier</li> <li>Supplier Logout</li> <li>change details</li> <li>Accept the award</li> </ul>
Evaluation module	<ul style="list-style-type: none"> <li>Send request for quotation</li> <li>Make a quotation from the form,</li> <li>Re-confirm the quality,</li> </ul>

	<ul style="list-style-type: none"> <li>• Reject the quotation,</li> <li>• Submit for price evaluation</li> </ul>
Award management module	<ul style="list-style-type: none"> <li>• Send an e-mail to the selected supplier,</li> <li>• Create Purchase order for the supplier,</li> <li>• Create supplier invoice</li> </ul>
Inventory(catalog) module	<ul style="list-style-type: none"> <li>• Purchase/Add new stock</li> <li>• Scrape the existing stock</li> <li>• Sell stocks/reduce stock</li> <li>• Generate stock status reports</li> <li>• Create new stock item--include--&gt;create buffer stock and other details for the product</li> <li>• Change the buffer stock</li> <li>• Determining re-order level</li> <li>• Altering the re-order level</li> <li>• Send an alert to the pharmacist when the re-order level is reached.</li> </ul>
Customer module	<ul style="list-style-type: none"> <li>• Register as a Customer</li> <li>• Login as a customer</li> <li>• Customer Logout</li> <li>• change details</li> <li>• Review orders</li> <li>• Review past orders</li> <li>• Re-order from account</li> </ul>
Cart/Product catalog module	<ul style="list-style-type: none"> <li>• Search for items,</li> <li>• Add item to shopping cart,</li> <li>• Submit the prescription,</li> </ul>

	<ul style="list-style-type: none"> <li>• Review items in the cart</li> <li>• Remove item from cart</li> <li>• Create product specification- Product Catalog &amp; specification update</li> <li>• Update product specification</li> <li>• Add a new generic product</li> <li>• Update generic product details</li> <li>• Remove a generic product--include--&gt;remove product specification</li> <li>• Registration &amp; login use cases</li> </ul>
Checkout module	<ul style="list-style-type: none"> <li>• Place the order</li> <li>• Preview the Invoice</li> <li>• Checkout without account/Guest Checkout</li> </ul>
Payment module	<ul style="list-style-type: none"> <li>• Pay for the order using a credit card</li> <li>• Pay by cash</li> </ul>
Order management	<ul style="list-style-type: none"> <li>• Show the state of the order</li> <li>• Change the status of the invoice to pay</li> </ul>
Admin module	<ul style="list-style-type: none"> <li>• Log in as a Pharmacist/Admin- Registering and Login</li> <li>• Pharmacist logout</li> <li>• Create product specification- Product Catalog &amp; specification update</li> <li>• Update product specification</li> <li>• Add a new generic product</li> <li>• Update generic product details</li> <li>• Send request for quotation</li> <li>• Make a quotation from the form,</li> <li>• Re-confirm the quality,</li> <li>• Reject the quotation,</li> <li>• Submit for price evaluation</li> </ul>



	<ul style="list-style-type: none"> <li>• Send an e-mail to the selected supplier,</li> <li>• Create Purchase order for the supplier,</li> <li>• Inventory system related functions</li> </ul>
--	---

*Table 3. 3 Modules & related functions*

## 4.3 Interaction between the modules

Below diagram, figure 3.35 shows how each of the above-mentioned modules get interacted with each other in the design of the system.

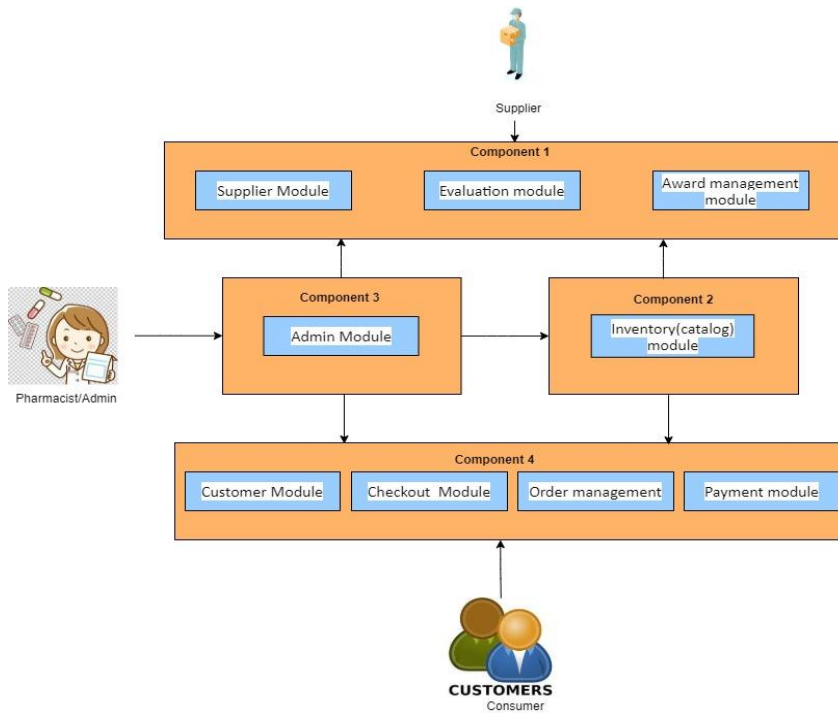


Figure 3. 35 Connectivity between modules

Below diagram, figure 3.36 shows how each of these modules consist in the proposed system.

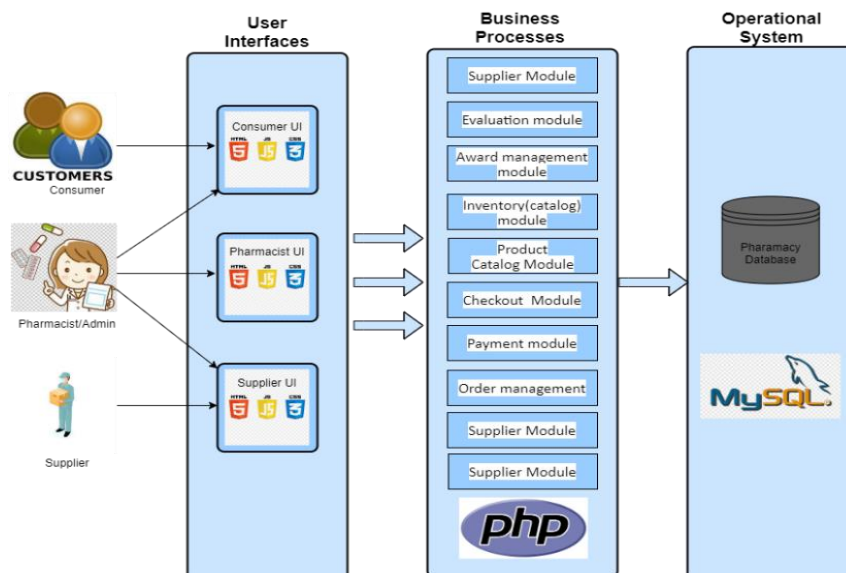


Figure 3. 36 High level architecture of the system

As it's indicated that there are several architecture patterns under the similar systems chapter, modules which are inherited into the system are mapped into the above layered architecture pattern.

So, in the first layer there will be the presentation layer which will consist the UI related components of the system. The user interface is designed and developed using the Bootstrap, CSS, HTML, and JavaScript components.

Further the next layer will be the business layer which will consist the core business processes or the logic of the system. This is planned to develop using the PHP language.

The Business logic will be communicating with the operational system which is the database for the proposed E-Osu Sala system. Relational database schema is used for the E-Osu Sala system and hence MySQL is chosen to develop the database.

# 5 Testing & Evaluation Chapter

## 5.1 Introduction

In this chapter, the approach followed to test the application is described and the implemented application is assessed with a set of identified test cases. Software testing mainly can be divided into two parts where one is improving the products by repeating tests and finding defects and correcting them. Other is to assess the performance levels from the user's perspective in the product. (Naik, 2011)

Issues identified throughout the process were fixed and the results of the final round of tests is included in the test results. The application is also subjected to an evaluation process of which the results are analyzed in order to identify the status and potential for improvement.

## 5.2 Testing Types

A test plan was derived to identify and document the test scope, test requirements and test approaches.

Based on the test plan, the following testing technique was involved in terms of testing the application.

- ❖ Black box testing (Functional a security scenarios)

This was identified as the most suitable testing technique to test the application. This technique tests the application from a user perspective, which is important as majority of the target audience will be non-technical (general public and pharmaceutical suppliers), which makes the accuracy and ease of operation a priority.

## 5.3 Test Cases

The following test cases from TC1 to TC45 were identified to verify application functionality (Appendix C). The respective results received are also given from this section.

ID	Test Case	Status
TC1	Registration	Pass
TC2	Login with valid credentials	Pass
TC3	[NEGATIVE] Login with invalid credentials	Pass
TC4	Logout from the system	Pass
TC5	Check the email validity	Pass
TC6	[NEGATIVE]Check with an invalid email	Pass
TC7	Checking both password and confirm password are equal	Pass
TC8	Supplier or pharmacist trying to access a window without login in. (customer validation done in the customer section for this part)	Pass
TC9	Check whether each user's username is displayed when logged in.	Pass
TC10	Searching products-Inactive generic or brand name	Pass
TC11	Searching products-using brand name	Pass
TC12	Searching products-using generic name	Pass
TC13	Trying to add out of stock products	Pass
TC14	Adding products to the cart	Pass
TC15	Removing products from the cart	Pass
TC16	Proceed to checkout as a registered customer	Pass
TC17	Check whether current orders consist only ongoing orders	Pass

TC18	Check whether the “Past Orders” are having only the delivered orders	Pass
TC19	[NEGATIVE] Proceed to Order-validate for a prescription	Pass
TC20	[POSITIVE]Proceed to Order-validate for a prescription	Pass
TC21	[NEGATIVE]Trying to route into a supplier or pharmacist page after login	Pass
TC22	Quote button should be only enabled when current stock level equals re-order level	Pass
TC23	Toast product as “Out of Stock” when the current stock is 0 on pharmacist’s “stock details window”	Pass
TC24	Check the quality evaluation is ran prior to the price evaluation	Pass
TC25	Check only the quotes with a valid NMRA Reg No. is taken to the quality assured products window after the quality evaluation is ran	Pass
TC26	Check whether the mails are sent to the respective suppliers when needed quotations to be recalled	Pass
TC27	Check whether “required quantity” is higher than the “fulfilled quantity” when “Award & Send mail” button is selected for a quotation made.	Pass
TC28	[NEGATIVE]Check “required quantity” is higher than the “fulfilled quantity” when “Award & Send mail” button is selected for a quotation made.	Pass
TC29	When supplier click “Reject Quotation” under “Received Awards tab”, Fulfilled quantities should get updated in pharmacist’s the pending deliveries window.	Pass
TC30	Check whether the received quotation is removed when the quality is assured	Pass
TC31	Check whether the quality assured quotations are removed when the price is evaluated	Pass
TC32	Received Awards get updated at the supplier when award is received	Pass
TC33	Validate stocks always takes a positive value	Pass
TC34	Run each report to see whether data is taken to the csv properly	Pass

TC35	Add/Invoice button at Pending Deliveries window	Pass
TC36	Add/Invoice button at Pending Deliveries window (required inventory levels are achieved)	Pass
TC37	[NEGATIVE]Add/Invoice button at Pending Deliveries window (But required inventory levels are not achieved)	Pass
TC38	Check required information is filtered for the sales report parameters	Pass
TC39	Check required information is filtered for the purchase report parameters	Pass
TC40	[NEGATIVE]Trying to route into a supplier or customer specific dashboards after login	Pass
TC41	When supplier click “Reject Quotation” under “Received Awards tab”	Pass
TC42	Product Quotation form should auto fill	Pass
TC43	Reject an award button	Pass
TC44	Accept an award button	Pass
TC45	[NEGATIVE]Trying to route into a customer or pharmacist page after login	Pass

Table 4. 1 Test cases

## 5.4 User Evaluation

### 5.4.1 Evaluation approach

The evaluation technique used to evaluate the project are as follows

- ❖ Questionnaire /demonstration-based interviews targeting private 15 employees in 5 pharmaceutical suppliers which involved in tender process. (Appendix D)

Questionnaire followed by application description targeting 15 potential Consumers. (Appendix D)

## 5.5 Results of the Evaluation

### 5.5.1 Analysis of evaluation feedback by pharmaceutical suppliers

The evaluation was carried out with the feedback of pharmaceutical professionals who are involved in tendering process. The sample was taken from the following supplier companies.

- L.W. medicals
- Hemas holdings
- ABC pharma
- Sunshine Holdings
- Yadan Ltd.

Below graph shows the results of the given answers to the questionnaire

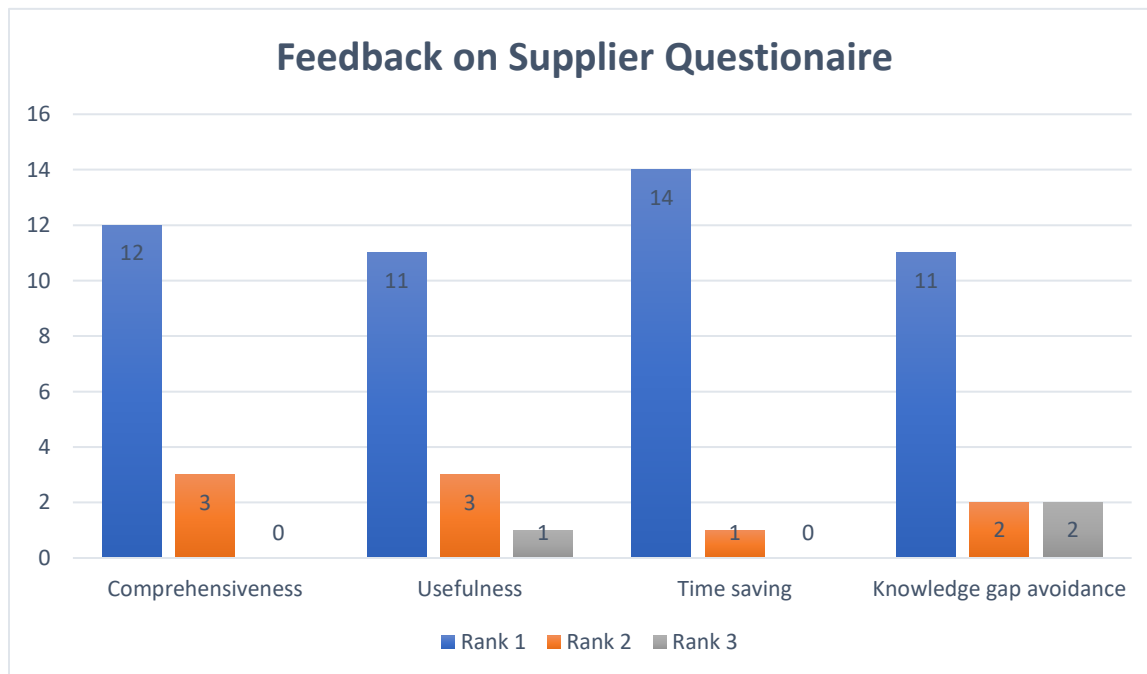


Figure 4. 1 Feedback on Supplier Questionnaire



Evaluation of the application was carried out based on the following criteria.

### **Comprehensiveness**

The application was perceived as sufficient or fulfilling minimum requirements of the process by evaluators. In other terms dealing with the pharmaceuticals industry, it requires us to align with related standards and to avoid any risk that can come up to the pharmaceutical users. For example, through this software the quality is evaluated using the NMRA database for the suppliers who have passed necessary quality parameters.

As per the feedback it's derived that the quality requirements are met. This is because as even in the manual context of the evaluation process system's focus is on NMRA standard and pharmacology standards.

### **Usefulness**

In suppliers' point of view author has mainly focused on identifying whether the introduced system supports the supply chain functionalities of the existing manufacturers or suppliers in terms of efficacy, time saving and the cost saving which will ultimately make an increase in their business value creation.

As per the feedback received from the sample it seems that the application contributes to their value chain in a positive manner considering the time, cost saving & efficacy factors.

### **Discrepancy avoidance**

When there's human intervention to the evaluation and selection process, that process will be more prone to human errors. Also, as mentioned in the issues which led to implement this system, current government pharmaceutical structure under the Health Ministry there is a hierarchical structure which leads to high time consuming and error pruning tender process to identify low priced brands. Further to that different people involved in different evaluation stages tend to be different and due to that there are discrepancies happening in selecting the right & the lowest brand for a period of time.

So as per the evaluation done these discrepancies would be removed due to the automation of the process. But as per the feedbacks it was mentioned that it'll be better if segregations of permissions happened in the pharmacist functions rather than providing the power to a one individual.

### Time saving factor

Evaluators stated that the application saves time by avoiding common discrepancies such as human errors with handling evaluation process omitting the hierarchical structure compared to the government current evaluation process. So, this will be convenient for the supplier as within a very smaller duration, they'll have the opportunity to provide their products to the pharmacy.

### User friendliness

The system is designed in a such a manner where even person who have some experience in using web could grab the options. However there had been a request from a one party to provide a user training for the application for easy understanding. This could be catered via linking a video demonstration for the suppliers who register into the system in the future.

### Feature richness/suggestions for future upgrades

As per the feedback and the discussions had with the suppliers, they were appreciating the existing functionality of the system which caters to manage the stock. However, it was requested by majority to implement the Debit invoicing functionality and Credit invoicing functionality to the system as a future addition to the current functionalities as depicted from figure 4.2.

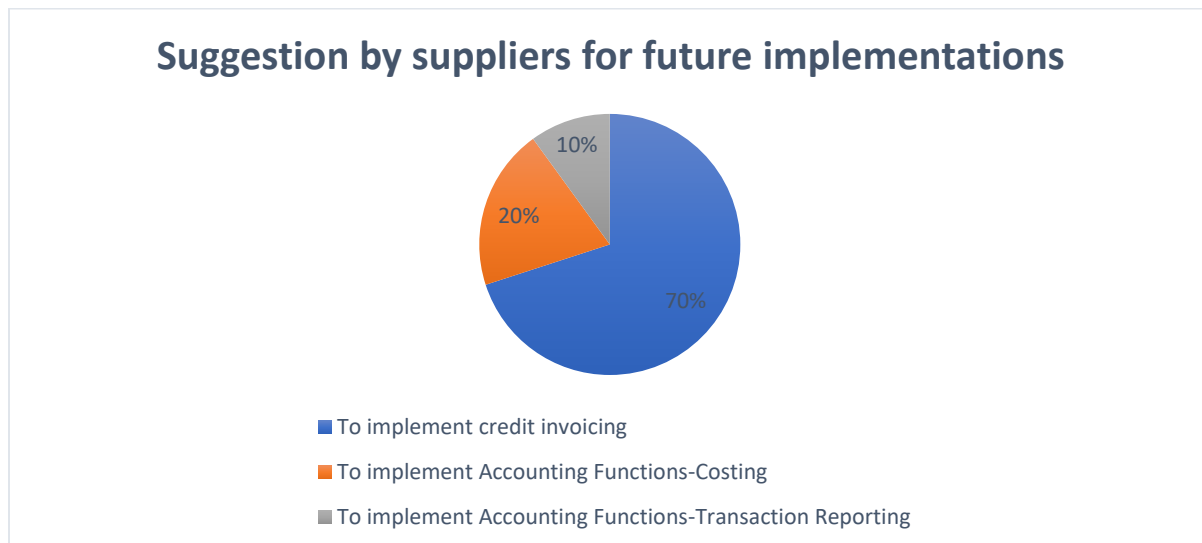


Figure 4. 2 Suggestion by suppliers for future implementations

### 5.5.2 Analysis of evaluation feedback by potential consumers

Application evaluation by potential consumers was carried out using a questionnaire distributed among 15 potential consumers belonging to different professions including medical, IT and other professions. Evaluators representing consumers provided positive feedback and preference for consumer related features. Remote accessibility including online prescription upload and status tracking feature of the order was perceived as a solution for high time consumption in manual process.

Below figure 4.2 shows a graph reflecting the customer feedback for the system.

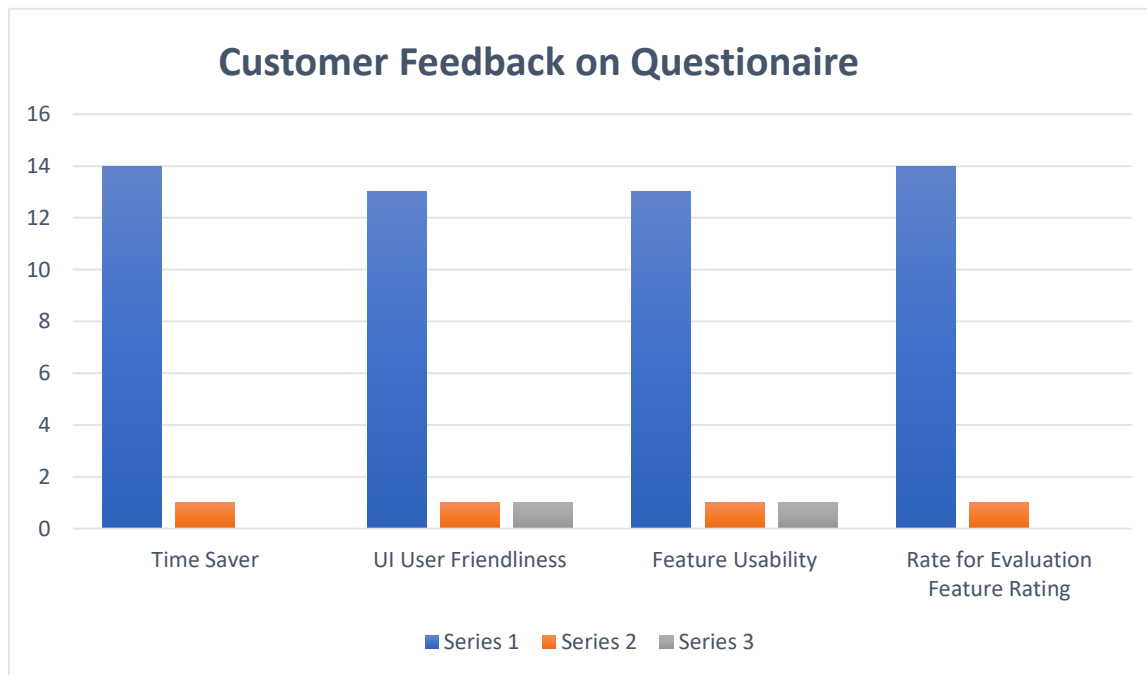


Figure 4. 3 Customer Feedback on Questionnaire

#### Time saving factor

In the normal context of a physical pharmacy consumers need to go to a certain location and buy the required pharmaceuticals. So, this travelling cost and the time is an obvious factor that they could omit using the proposed system as per the received above figures.

## Relevance of customer UI

Customer is having the opportunity to buy the least valued product with the quality through the system and hence they prefer this system. But there was a certain party who mentioned that they prefer a system with wider brand range of pharmaceuticals. But considering the motive of the developed system which is to cater the wider market who suffer from high prices of the pharmaceuticals, implementing that requirement is difficult.

## User friendliness

The application was found to be user friendly by evaluators, as they already used web-based e-commerce platforms. The application is designed in a manner which matches to the existing standard design of e-commerce sites. Hence the application is customer friendly as per the feedback.

## Customer preference to track order status online

All evaluators found the online status order tracking feature is useful as this is an online process and this tracking process will give a physical touch to it. A suggestion was made to extend the tracking process up to the delivery engaging with a couriering company & to handle the returns.

## Suggestions for future upgrades

There was a request to add the order crediting option and the order tracking with an integration of the courier servicing software as well as depicted via the figure 4.4. So those suggestions will be considered for the future developments which are intended to add into the E-Osu Sala system.

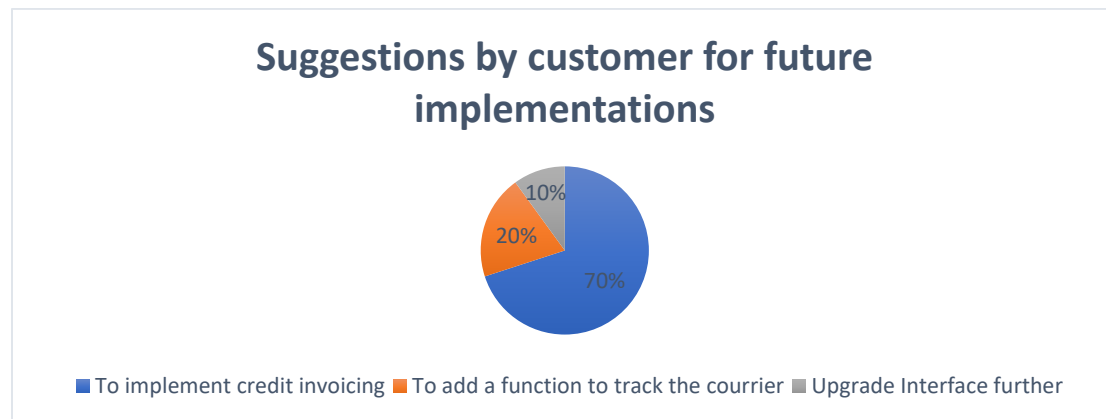


Figure 4. 4 Suggestions by customers for future implementations

# 6 Conclusion

## 6.1 Introduction

This chapter mainly gives an understanding of the work carried out by the author & revelation based on the evaluations and the limitations of the system. Further, some additional features which author intends to implement in the future is stated in the future work section.

## 6.2 Work carried out

Researched pharmaceuticals industry and how the private, public pharmacies operate

Identified the main drawbacks in the current pharmacy system and tried narrowing down the problems for a technology assisted solution

Design and implemented the solution to workable product.

Tested the product using test cases and also taking the expert views of the pharmaceutical professionals and the customers who involved in the regular pharmaceutical vendor's supply chain.

## 6.3 Revelations

Based on the developed system and its evaluation, following revelations has been identified.

Pharmaceutical companies who supply the pharmaceuticals via S.P.C and also directly to the private market is having the opinion that this system will be useful in terms of time, cost saving & efficacy factors compared to supplying their products to the current physical pharmacies.

The solution does make sure to keep its comprehensiveness by assuring the quality of the products added to the product catalog and this automated evaluation process leads treating all the suppliers on an equal stage.

Potentials Consumers have also given a positive feedback to the designed system in terms of the time saving factor and user friendliness. User friendliness is mainly secured by aligning the user interface with the normal e-commerce applications which are hosted in the current context.

## **6.4 Lessons Learnt**

The author was able to gather following knowledge and experiences through this development project.

Initially it was planned to implement the project using the Pure PHP language but considering the structure segregation and the experience gains, later the project was developed via Laravel which is a PHP framework.

It was identified it's better to use an Agile based approach for project implementations is better as the requirements of the projects kept evolving. Requirements gathered had to be fulfilled using different implementations & technologies differing from the initial proposal handover and the requirement analysis phases.

## **6.5 Future Work**

The author thinks to implement the below functionalities in the future and upgrade the system to provide a better service to the interest parties.

- In order to provide a better experience to a wider market segment, system could be improved by adding branded products section to facilitate the customers who willing to go for the pharmaceutical brands.
- As requested on the evaluation stages system needs to be facilitated for any credit made on the stocks either on the supplier or the customer side.

- Prescription processing system could be implemented to automate the prescription evaluation process at the point where customer buys the product.
- Delivery automated tracking system will be implemented to facilitate manual tracking process currently been implemented. Also, system could integrate a third-party application to allow the user to get an update on the purchased good.
- Quality evaluation process could be extended to evaluate & take the products which are not currently registered under the NMRA, but which meets the world pharmaceutical standards such British Pharmacopeia, United States Pharmacopeia, etc. Supplier could be created with a platform to provide a sample test with their ingredient list & system could be upgraded to compare that with the ingredients stated under different world pharmaceutical standards.

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# Appendices

## Appendix A - Use Case Narratives

### Add generic products

Use Case	<b>Add generic products</b>
Primary Actor	Pharmacist
Secondary Actor	-
Assumption	
Pre-Conditions	Pharmacist has registered in the system  Pharmacist has logged in to the system
Triggering Event	Pharmacists click the “Add Generic Product” option.
Main Flow	<ul style="list-style-type: none"><li>• Pharmacist has logged into the system</li><li>• Pharmacists go to the “Current Product List” page</li><li>• Customer selects Add Generic Product option</li><li>• Then system shows the new generic product form.</li><li>• Pharmacist fills the form</li><li>• Then after the new generic product form, system will show the user the new generic product specification form.</li><li>• User fills the product specification form.</li><li>• Pharmacist will then be taken into add inventory related information such as</li></ul>

	warehouse stock capacity, buffer stock, reorder level, safety stock.
Exceptional flow of events	<ul style="list-style-type: none"> <li>• If pharmacist is not registered or logged in pharmacist needs to register or logged into the system.</li> <li>• Pharmacist trying to add two similar generic products to the system, system will give an error.</li> </ul>
Alternative	<ul style="list-style-type: none"> <li>• Pharmacists have the option to remove/alter an added product using remove added product option on the “Current product list”</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>• In successful completion of adding or changing a record system will give a message saying “Product added successfully” or “Product changed successfully”</li> </ul>

Appendix A : Table 1 Add generic products

## Call for quotations

Use Case	<b>Call for quotations</b>
Primary Actor	Pharmacist
Secondary Actor	-
Assumption	
Pre-Conditions	Inventory reorder level is reached. (Not mandatory)

	<p>System has generated e-mail to the pharmacist when reorder level is reached.</p> <p>Pharmacist has registered in the system</p> <p>Pharmacist has logged in to the system</p>
Triggering Event	Pharmacist click the “request quotations” option on.
Main Flow	<ul style="list-style-type: none"> <li>• Pharmacist has logged into the system</li> <li>• Pharmacist go to the “Current Product List” page</li> <li>• Customer selects “request quotations” option</li> <li>• Then system sends quotations for suppliers who is registered for the specific generic product.</li> </ul>
Exceptional flow of events	<ul style="list-style-type: none"> <li>• If no suppliers are registered system generates” No registered suppliers’ error.</li> <li>• If pharmacist change generic product specification from “Change specific option” on “Current Product List”. After changing pharmacist have the option to save it and go back to request quotation option on “Current Product List”.</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>• Suppliers registered for a particular generic product will receive a mail, requesting a quotation.</li> </ul>

Appendix A : Table 2 Call for quotations

## Award the tender

Use Case	<b>Award the tender</b>
Primary Actor	Pharmacist
Secondary Actor	-
Assumption	
Pre-Conditions	Suppliers have quoted for the products
Triggering Event	Pharmacist click the “Run Price Evaluation” option
Main Flow	<ul style="list-style-type: none"> <li>• Pharmacist has logged into the system</li> <li>• Pharmacist go to the quotations for products page.</li> <li>• Pharmacist run the function “Evaluate quotations for quality”</li> <li>• All the products will be viewed in “quality assured products page”</li> <li>• Pharmacist reconfirm the quality assured products for each product using “Assure quality” button.</li> <li>• State for all the product quotations will displayed as “Partially quality assured” or as “Totally quality assured”.</li> <li>• Pharmacist run the function “Evaluate quotations for price”</li> <li>• First three least priced quotations will be displayed in Bid awardees page.</li> <li>• Supplier award the tender from “Award Tender” option available on Bid awardees page.</li> </ul>
Exceptional flow of events	<ul style="list-style-type: none"> <li>• If on the “quality assured products page” will show an information message if at least one product is not quality assured.</li> </ul>

	<ul style="list-style-type: none"> <li>• “Quality assured products page” page will show an error if none of the products are quality assured.</li> <li>• If pharmacist try to award the quotation twice for two awardees, then there will be an error showing up.</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>• Suppliers will receive a mail mentioning that his company has awarded with the tender for the particular generic product.</li> <li>• Supplier enrolled product catalog will get updated with enabled “Accept award” and “Reject Award” options.</li> </ul>

Appendix A : Table 3 Award the tender

## Maintain stock levels

Use Case	<b>Maintain stock levels</b>
Primary Actor	Pharmacist
Secondary Actor	-
Assumption	
Pre-Conditions	<p>Pharmacist has registered in the system</p> <p>Pharmacist has logged in to the system</p>
Triggering Event	Pharmacist click the change stock options available on “Inventory Control”
Main Flow	<ul style="list-style-type: none"> <li>• Pharmacist log into the system</li> <li>• Pharmacist go to “Inventory Control” page</li> <li>• Pharmacist have the option to change warehouse stock, reduce warehouse stock capacity, change the safety stock level</li> </ul>

Exceptional flow of events	<ul style="list-style-type: none"> <li>Pharmacist trying to set warehouse capacity lesser than buffer stock, then system will give an error message as such.</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>In successful completion of the above changes in the fields will update each field and also calculate the new buffer stock which match to each of the above changed parameters.</li> </ul>

Appendix A : Table 4 Maintain stock levels

## Receive goods

Use Case	<b>Receive goods</b>
Primary Actor	Pharmacist
Secondary Actor	-
Assumption	
Pre-Conditions	Pharmacist has logged in to the system
Triggering Event	Pharmacist click the Create Supplier Invoice at the “Pending deliveries” page
Main Flow	<ul style="list-style-type: none"> <li>Pharmacist will log into the system.</li> <li>Pharmacist navigating to the Pending Deliveries page.</li> <li>Pharmacist click the Create Supplier Invoice at the “Pending deliveries” page.</li> </ul>
Exceptional flow of events	

Alternative flows	<ul style="list-style-type: none"> <li>• Purchase Order could be cancelled from the Pending deliveries window.</li> <li>• This will add a mail to the supplier to re tender the product.</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>• Creating the manual supplier invoice will remove the available entry at Pending Deliveries.</li> <li>• Create an entry to the Manual Supplier Invoice window.</li> <li>• Also, this will increase the available stocks of the respective stocks</li> </ul>

Appendix A : Table 5 Receive goods

## Changing Supplier Invoice Status

Use Case	<b>Changing Supplier Invoice Status</b>
Primary Actor	Pharmacist
Secondary Actor	-
Assumption	It's decided at the moment to handle supplier payments separately from the system, manually but the status change of the invoice will allow to take a picture for the pharmacist on the payment.
Pre-Conditions	Pharmacist has created a Supplier Invoice
Triggering Event	Pharmacist selects the drop down indicated as "status"
Main Flow	<ul style="list-style-type: none"> <li>• Pharmacist will log into the system.</li> <li>• Pharmacist navigating to the Supplier Invoices view</li> <li>• Pharmacist selects the drop down indicated as "status"</li> </ul>



	<ul style="list-style-type: none"> <li>Then system validates whether previous state is correct in order to move to the next state</li> </ul>
Exceptional flow of events	<ul style="list-style-type: none"> <li>If it's in the wrong state, there will be a warning message provided prior to changing the state.</li> <li>If the supplier needs to return the goods and create a credit invoice for that then he will have a option to choose create credit invoice and system will generate a credit invoice in the credit invoices view as well as the status will be changes to “credited”</li> </ul>
Alternative flows	<ul style="list-style-type: none"> <li>Skipping the state and moving forward in the states</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>Change of the state at the invoice up to paid</li> </ul>

Appendix A : Table 6 Changing Supplier Invoice Status

## Quote for products

Use Case	<b>Quote for products</b>
Primary Actor	Supplier
Secondary Actor	-
Assumption	
Pre-Conditions	<p>Supplier has registered in the system</p> <p>Supplier has logged in to the system</p>
Triggering Event	Pharmacist click the “Quote” option on “Enrolled Products” view of supplier.

Main Flow	<ul style="list-style-type: none"> <li>• Supplier login to the system</li> <li>• Supplier go to the Enrolled Products tab on supplier profile.</li> <li>• Then supplier would have the option to “quote” for the products on a given generic product which was requested via a mail to quote by pharmacist.</li> <li>• Form for quoting the product will be shown with the price, quantity supplied in editable format.</li> <li>• Successfully adding the details, the supplier will have the option to submit the quotation.</li> </ul>
Exceptional flow of events	<ul style="list-style-type: none"> <li>• If supplier try to quote for a product on uninvited generic product where there’s no current tender, such error message will be given by the system.</li> </ul>
Alternative flows	<ul style="list-style-type: none"> <li>• Supplier can reject the quotation.</li> <li>• This will lead to a reevaluation.</li> <li>• Quality assured product list will remove the rejected quote from its data set.</li> <li>• If supplier reject the quotation, then a mail will be generated to the pharmacist with a link for the quality assured product page.</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>• Quoting for a generic product will create an entry in the “Quotations for Generic Products” window</li> </ul>

Appendix A : Table 7 Quote for products

## Maintain supplier details

Use Case	<b>Maintain supplier details</b>
Primary Actor	Supplier
Secondary Actor	-
Assumption	
Pre-Conditions	Supplier has logged in to the system
Triggering Event	Supplier click the register button or supplier selects edit details button after login
Main Flow	<ul style="list-style-type: none"> <li>• Supplier login to the system with the user credentials</li> <li>• System verifies them.</li> <li>• System shows the related personal details, company details and product details of the registered supplier.</li> <li>• Supplier would have the option to edit, delete available fields.</li> </ul>
Exceptional flow of events	<ul style="list-style-type: none"> <li>• If supplier is not registered on the system prompts, please register as a supplier message</li> <li>• Supplier registers in the system</li> <li>• Next there are fields which cannot be deleted as they are mandatory.</li> <li>• If the supplier tries to delete them system will create a message saying that specific field is mandatory &amp; cannot delete.</li> </ul>
Alternative flows	

Post Conditions	<ul style="list-style-type: none"> <li>This will update the existing data available for the suppliers, delete the existing data available for the suppliers or create a new supplier record</li> </ul>
-----------------	--

Appendix A : Table 8 Maintain supplier details

## Accept the Tender

Use Case	<b>Accept the Tender</b>
Primary Actor	Supplier
Secondary Actor	-
Assumption	
Pre-Conditions	<p>Supplier has registered in the system</p> <p>Supplier has logged in to the system</p>
Triggering Event	Supplier click “accept” button available on the awarded tenders list under the supplier’s product list tab
Main Flow	<ul style="list-style-type: none"> <li>Supplier go to the supplier profile</li> <li>Then go to the product list tab</li> <li>Then supplier will go to the table with details of awarded tenders</li> </ul>
Exceptional flow of events	
Alternative flows	<ul style="list-style-type: none"> <li>Supplier could select the “reject” the tender which is available on the awarded tender’s table.</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>After successfully accepting the tender system will create a PO for the supplier</li> </ul>

	<ul style="list-style-type: none"> <li>• Then also creates an entry at the “Pending Supplier Deliveries list”.</li> </ul>
--	---

Appendix A : Table 9 Accept the Tender

## Add to cart products

Use Case	<b>Add to cart products</b>
Primary Actor	Customer
Secondary Actor	-
Assumption	Customers add to cart after login to the system
Pre-Conditions	<p>Customer registers in the system</p> <p>Customer logs in to the system</p>
Triggering Event	Customer click add to cart the product
Main Flow	<ul style="list-style-type: none"> <li>• Customers go to the product search</li> <li>• Customer selects a product and go to details</li> <li>• Customer add the quantity needed</li> <li>• Customer click add to cart the product</li> </ul>
Exceptional flow of events	<ul style="list-style-type: none"> <li>• If the quantity mentioned is 0 then there will be an error prompted as “cannot proceed to check out if the quantity is zero”</li> </ul>
Alternative flows	<ul style="list-style-type: none"> <li>• Customer could go back to the product list without adding product into cart and continue the search.</li> <li>• A customer could add products to the cart without registering/login into the system.</li> </ul>

	Then at the Order Checkout system will be asked to add the details of the delivery.
Post Conditions	<ul style="list-style-type: none"> <li>Item will be added on to the Customer's cart.</li> </ul>

Appendix A : Table 10 Add to Cart products

## Maintain delivery/customer details

Use Case	<b>Maintain delivery/customer details</b>
Primary Actor	Customer
Secondary Actor	-
Assumption	Customers go through this use case after login to the system
Pre-Conditions	Customer has logged in to the system
Triggering Event	Customers click the register button or Customer selects edit details button after login
Main Flow	<ul style="list-style-type: none"> <li>Customer login to the system with the user credentials</li> <li>System verifies them.</li> <li>System shows the related personal details, residence details of the registered Customer.</li> <li>Customer would have the option to edit, delete available fields.</li> </ul>
Exceptional flow of events	<ul style="list-style-type: none"> <li>If customer is not registered on the system prompts, please register as a customer message</li> <li>customer registers in the system</li> </ul>

	<ul style="list-style-type: none"> <li>• Next there are fields which cannot be deleted as they are mandatory.</li> <li>• If the customer tries to delete them system will create a message saying that specific field is mandatory &amp; cannot delete.</li> </ul>
Alternative flows	
Post Conditions	<ul style="list-style-type: none"> <li>• This will update the existing data available for the customer, delete the existing data available for the customers or create a new customer record</li> </ul>

Appendix A : Table 11 Maintain delivery/customer details

## Proceed to check out

Use Case	<b>Proceed to check out</b>
Primary Actor	Customer
Secondary Actor	-
Assumption	Customers check out after login to the system
Pre-Conditions	<p>Customers go to the product search</p> <p>Customer selects a product and go to details</p> <p>Customer add the quantity needed</p> <p>Customer click add to cart the product</p>
Triggering Event	Customer click proceed to check out option
Main Flow	<ul style="list-style-type: none"> <li>• Customers go to the product cart</li> <li>• Customers select “proceed to check out”</li> </ul>
Exceptional flow of events	<ul style="list-style-type: none"> <li>• If customer is not registered on the system prompts, “If you like to register in the e-osu sala and proceed for the checkout”</li> </ul>

	<ul style="list-style-type: none"> <li>• If yes, selected customer will be landed to the customer registration page and after registration, customer will be taken to the “Order Check out” page with filled delivery details.</li> <li>• If customer selects No, then customer will take to the “Order Checkout” which will show delivery to be filled by the customer.</li> </ul>
Alternative flows	
Post Conditions	<ul style="list-style-type: none"> <li>• Customer will be taken on to the “Order Check out” page with filled delivery details or without the filled delivery details.</li> <li>• Customer will be shown the purchased items in the order cart and it’s total.</li> </ul>

Appendix A : Table 12 Proceed to check out

## Pay for order

Use Case	<b>Pay for order</b>
Primary Actor	Customer
Secondary Actor	-
Assumption	Customers pay by cash at the delivery.
Pre-Conditions	<p>Customers go to the product search</p> <p>Customer selects a product and go to details</p> <p>Customer add the quantity needed</p> <p>Customer click add to cart the product</p>



	<p>Customers go to the product cart</p> <p>Customers select “proceed to check out”</p>
Triggering Event	Customer click proceed to pay option
Main Flow	<ul style="list-style-type: none"> <li>• Customers go to the product cart</li> <li>• Customers select “proceed to check out”</li> <li>• Customer adds the prescription to the system.</li> <li>• System verifies if details &amp; prescription are added.</li> <li>• Customer click proceed to pay option.</li> <li>• System prompts an information message whether customer likes to pay from cash or the card.</li> <li>• If pay by cash is chosen system creates a Pending customer deliveries a record</li> <li>• Pending customer deliveries will be shown for the customer as well as the pharmacist to track the pending orders</li> </ul>
Exceptional flow of events	
Alternative flows	<ul style="list-style-type: none"> <li>• Customer choses pay by card</li> <li>• System will open the payment gateway</li> <li>• Customer adds the payment card details and the payment completes after payment gateway verifies the details.</li> </ul>
Post Conditions	<ul style="list-style-type: none"> <li>• Order will be shown under the “Pending customer deliveries” for the customer as well as for the pharmacist to track the pending orders</li> </ul>

Appendix A : Table 13 Pay for order

## Appendix B - User Manual

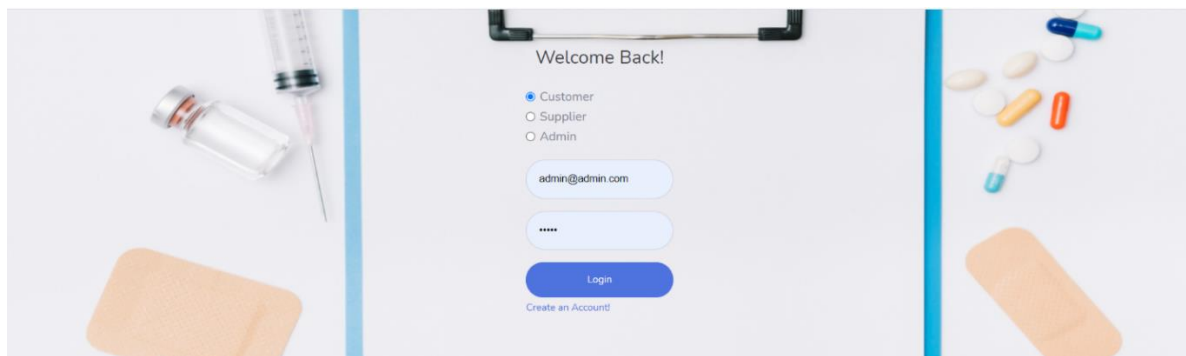
### Pharmacist

#### Login

Go to the login screen

Select Admin from the three radio buttons

You need to provide the login credentials, which tally to Admin permissions

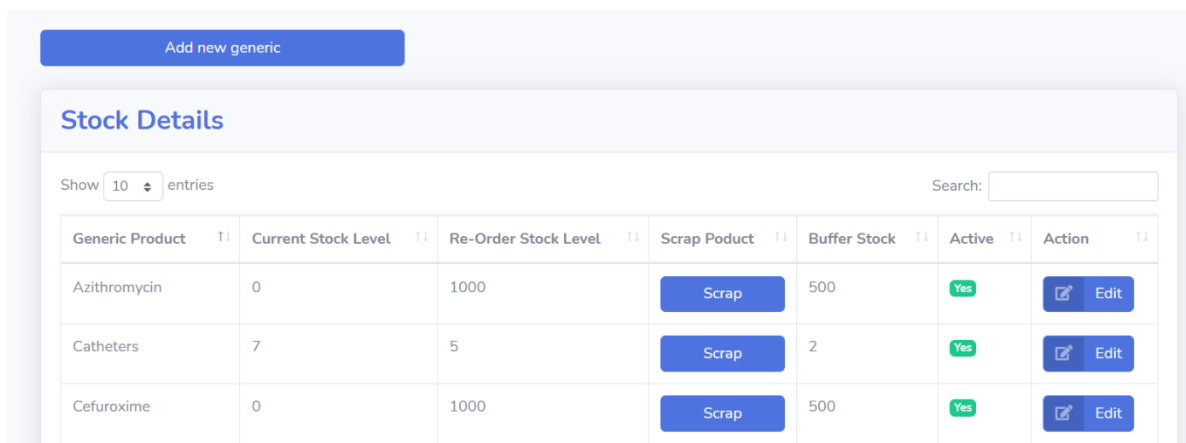


Appendix B : Figure 1 Login page

#### Add a new item to the stock

Go to the “Stock details”

Click on the Add generic” option





Appendix B : Figure 2 Stock Details page

Using the scrap button, facility to scrap a product manually is also given

### Calling quotations for a product

Products which do have a stock quantity lesser than the re order level will give the calling for quotations option

Simply clicking the “Quote”, pharmacist can send mails and invite for the quotations from the suppliers

Stock Level					
Show 10 entries			Search: <input type="text"/>		
Generic Product	Current Stock Level	Re-Order Stock Level	Quote	Status	
Azithromycin	0	1000	 Quote	Yes	
Catheters	7	5		Yes	
Cefuroxime	0	1000	 Quote	Yes	

Appendix B : Figure 3 Stock Levels page

### Quality evaluation

After getting quotations from a supplier, all of those quotations will get populated in the Received quotations window

Then simply “Run quality evaluation” to evaluate quality of the products with the NMRA database inserted to the system.

Received Quotations

Show10entries

Search:

Product	Generic	Registration No	Quality Evaluation Status	Price Amount
No data available in table				

Showing 0 to 0 of 0 entries

Previous

Next

Run quality evaluation

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Appendix B : Figure 4 Received Quotations page

## Price evaluation

All the quality assured quotations will be shown under the “Quality assured quotations” window

Then run the price evaluation for the quotes in order to evaluate for their bid prices

**Quality Assured Quotations**

Show 10 entries Search:

Supplier	Product Band	Registration No	status for quality
No data available in table			

Showing 0 to 0 of 0 entries Previous Next

Run price evaluation

Appendix B : Figure 5 Quality Assured Products page

## Awarding to the suppliers after price evaluation

Pharmacist could simply use the Award button to award a product to a supplier

This option will create an entry on the supplier’s side “Received Awards” table in order to get the acceptance of the award.

Generic Required Fullfilled

Please select generic.. required fulfilled

**Price Evaluated Quotations**

Show 10 entries Search:

Supplier	Generic	Product Band	Price eval status	status of quality	Award to supplier	Status
No data available in table						

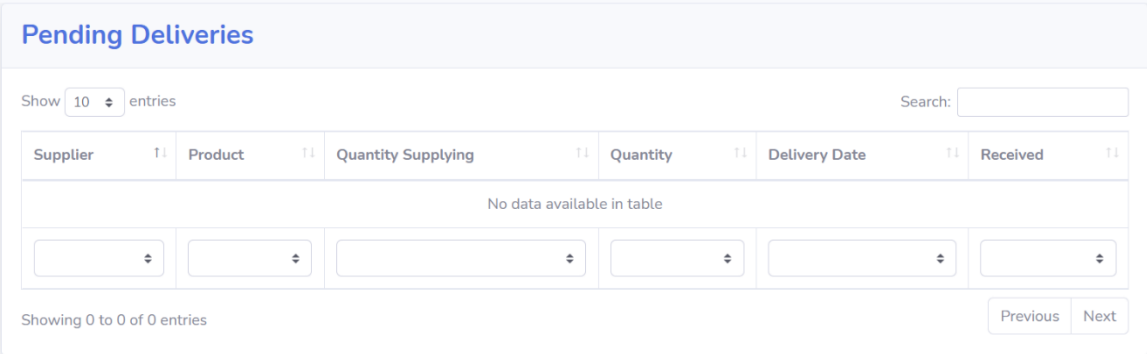
Showing 0 to 0 of 0 entries Previous Next

Appendix B : Figure 6 Price Evaluated Products page

## Invoicing the awaiting orders

When a certain award is accepted, all of the accepted quotes will be shown on the below “Pending Deliveries” window as a pending order

When the order is received to the warehouse pharmacist could simply click the Invoice/ Add to stock at the “received” column option in order to add that order to the inventory.

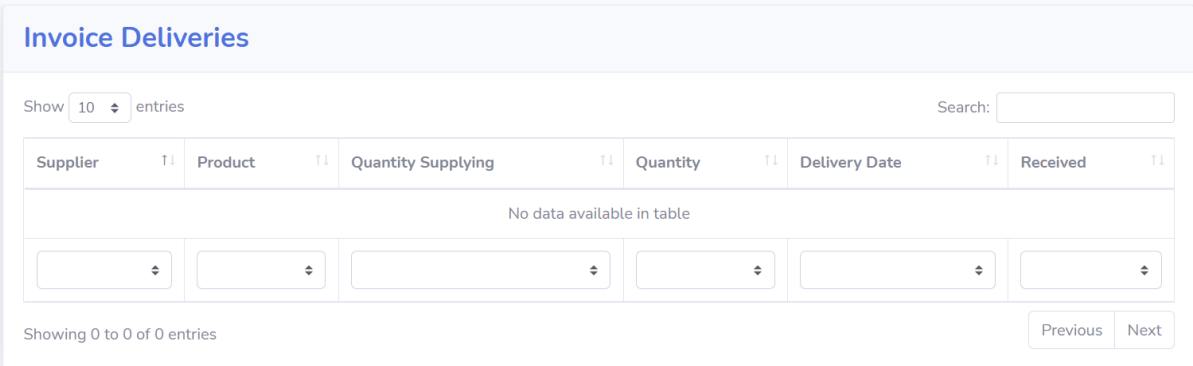


The screenshot shows the 'Pending Deliveries' interface. At the top, there's a title 'Pending Deliveries' in blue. Below it, a 'Show 10 entries' dropdown and a 'Search:' input field are visible. The main area contains a table with columns: 'Supplier', 'Product', 'Quantity Supplying', 'Quantity', 'Delivery Date', and 'Received'. Each column has a small upward and downward arrow icon. The table is currently empty, displaying 'No data available in table'. Below the table, there are six empty input fields with dropdown arrows. At the bottom, it says 'Showing 0 to 0 of 0 entries' and has 'Previous' and 'Next' buttons.

Appendix B : Figure 7 Pending Deliveries page

## Past supplier delivery tracking

All the past deliveries will be kept in the Invoiced Deliveries window for any further reference need of the pharmacist



The screenshot shows the 'Invoice Deliveries' interface. At the top, there's a title 'Invoice Deliveries' in blue. Below it, a 'Show 10 entries' dropdown and a 'Search:' input field are visible. The main area contains a table with columns: 'Supplier', 'Product', 'Quantity Supplying', 'Quantity', 'Delivery Date', and 'Received'. Each column has a small upward and downward arrow icon. The table is currently empty, displaying 'No data available in table'. Below the table, there are six empty input fields with dropdown arrows. At the bottom, it says 'Showing 0 to 0 of 0 entries' and has 'Previous' and 'Next' buttons.

Appendix B : Figure 8 Invoiced Deliveries page

## Customer Deliveries/Orders

When a customer makes an order, it'll be populated under the below window

Using this window pharmacist can give an update to the pharmacist of the customer order by changing the “delivery status”

The screenshot shows a web application window titled "Customer Deliveries". At the top left, there is a "Show 10 entries" dropdown menu. To the right is a "Search:" input field. Below these is a table with four columns: "Supplier", "Product List", "Order Date", and "Delivery Status". The table is currently empty, and a message "No data available in table" is displayed in the center. At the bottom left, it says "Showing 0 to 0 of 0 entries". At the bottom right, there are "Previous" and "Next" buttons.

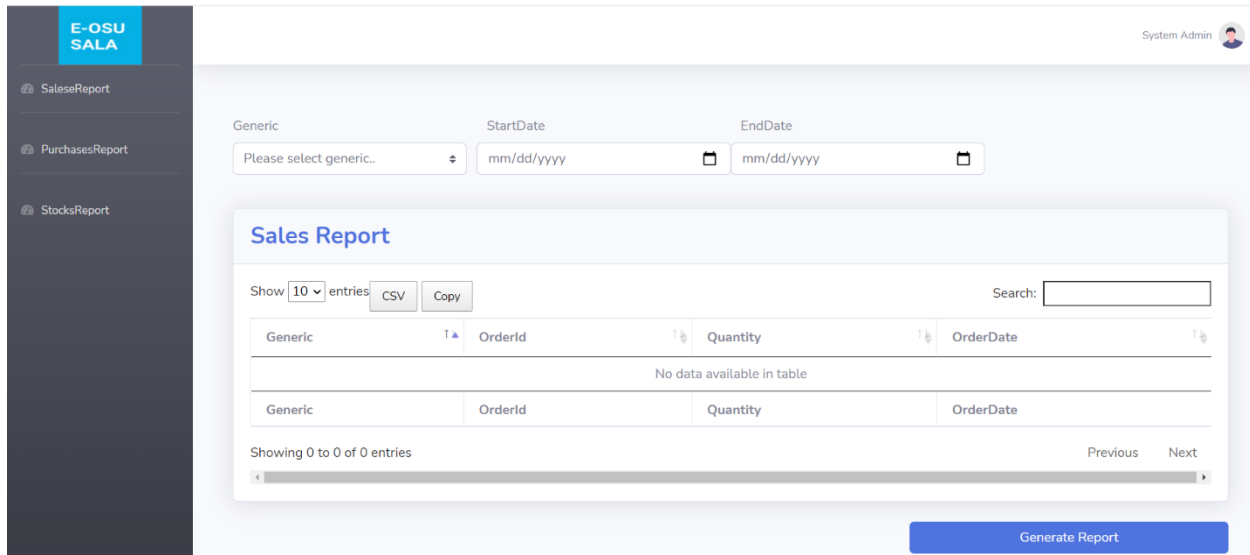
*Appendix B : Figure 9 Customer Deliverables page*

## Transaction Overview

Following reports are provided in order to facilitate the information needs of the pharmacist.

Reports could be generated to get the information regarding the customer orders, received orders by suppliers and the stock movements using following views respectively.

- Sales Report
- Purchase Report
- Stock Report

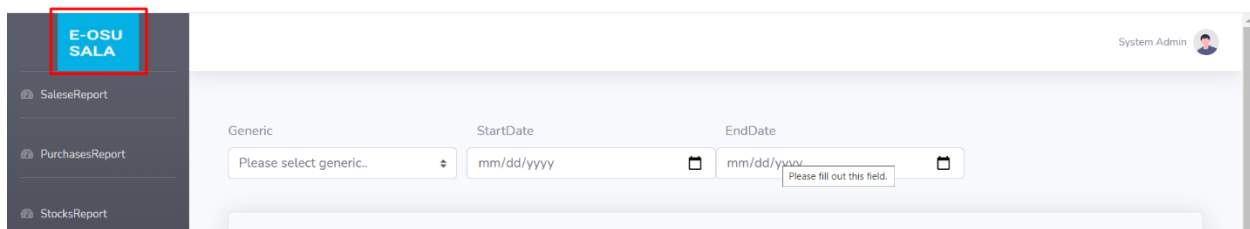


Appendix B : Figure 10 Transaction Overview page

All the reports could be generated to an excel file. This enables the pharmacist to use excel functionalities directly and manipulate/arrange the data further.

So, this will eventually act as a bridge between excel and the system.

Also, if the pharmacist needs to route back to the main views from Transaction overview, he/she can use “E-Osu Sala” icon for that purpose as shown below



Appendix B : Figure 11 Routing option to main view

## Logout

The below profile icon acts as a button for the logout option

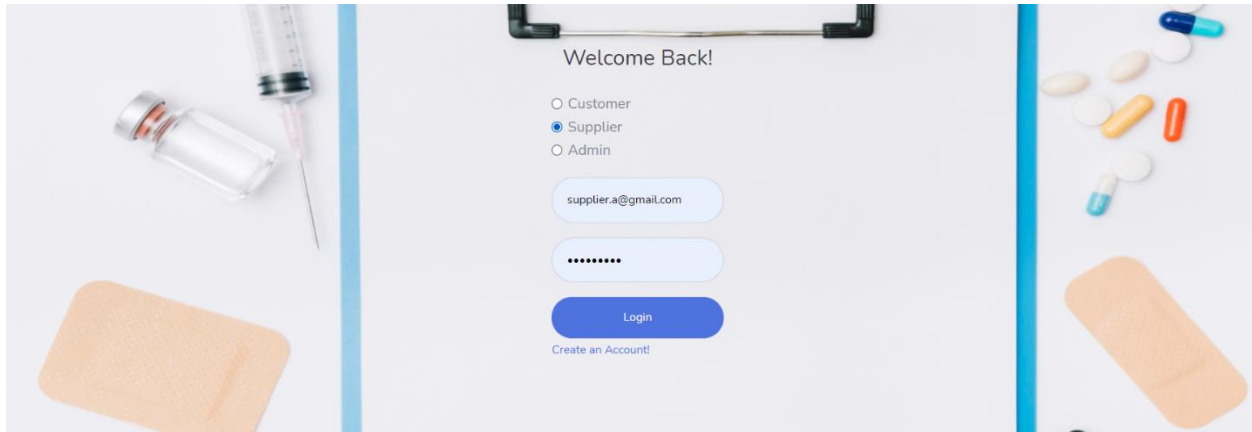


Appendix B : Figure 12 Logout option

## Supplier

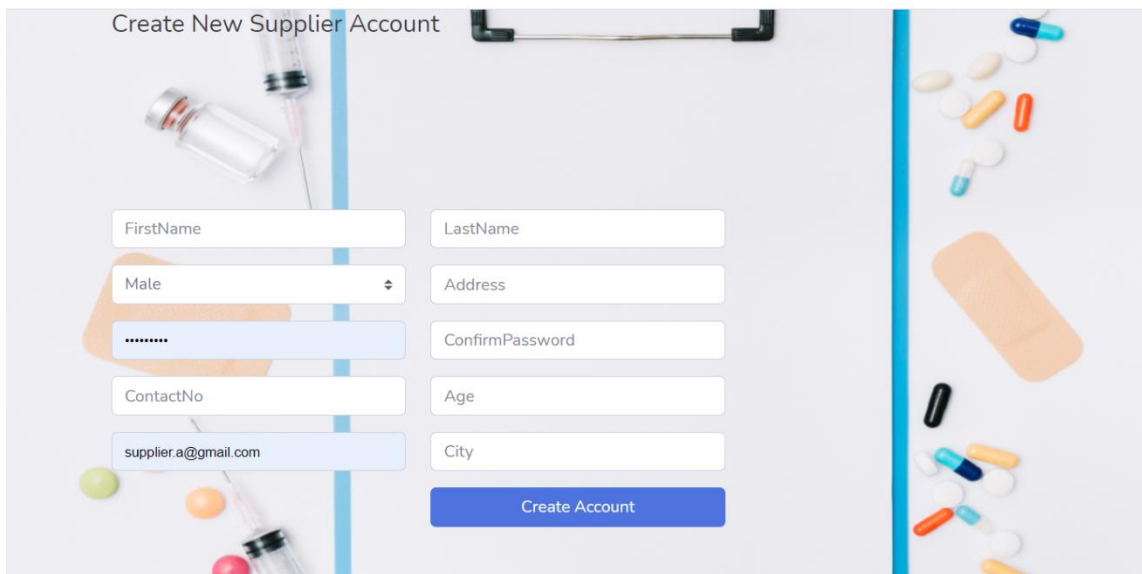
### Register as a supplier

Register as a supplier from the below “create account” option



*Appendix B : Figure 13 Login or Create Account page*

Then the necessary details will be requested with regards to the supplier



*Appendix B : Figure 14 Create new supplier account page*

After creating an account successfully supplier can login to the system.



## Adding companies

Supplier can add several companies to the system under his/her account

Supplier needs to navigate to the below view in order to add a new company record

**Add Company**

**Companies**

Show 10 entries Search:

View	CompanyName	Address	Contact	Email	Reg.NO	Edit
View	A Company	No1,Samagi Mw, Battaramulla	771234567	a.company@gmail.com	REG1234	Edit
View	CompanyName	Address	Contact	Email	Reg.NO	Edit

Appendix B : Figure 15 View used to add new companies

## Adding products to be listed for tenders

Supplier can include his/her products for any generic currently maintained in the site from the below view.

**Add Product**

**Products**

Show 10 entries Search:

View	Generic	Name	NMRA Reg.NO	Price	Edit
View	Azithromycin	Puzucil	M008441	100	Edit
View	Generic	Name	NMRA Reg.NO	Price	Edit

Showing 1 to 1 of 1 entries Previous 1 Next

Appendix B : Figure 16 View used to add new products

## Viewing the tender requests from the admin/pharmacist

All the tender requests will get populated under the below view

Supplier can quote for them simply the “Quote” option or ignore/reject

## Requests for Quotes

Show 10 entries

Search:

Generic Product	Requested Quantity	Quote	Requested Date	Reject
No data available in table				
Generic Product	Requested Quantity	Quote	Requested Date	Reject

Showing 0 to 0 of 0 entries

Previous

Next

Appendix B : Figure 17 View to populate received quotation requests

## Awarded tenders

Received awards will be shown on the below view

Accept and Reject options are provided for each award.

Received Awards

Show 10 entries

Search:

QTY to Supply	Generic	Supplying Product	Accept	Reject
No data available in table				
QTY to Supply	Generic	Supplying Product	Accept	Reject

Showing 0 to 0 of 0 entries

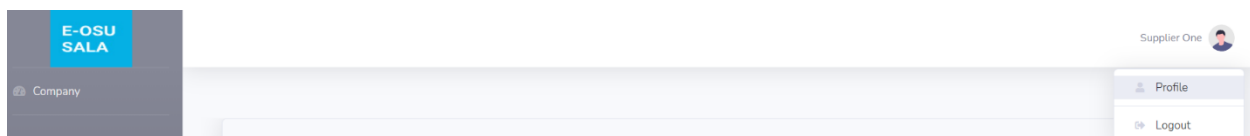
Previous

Next

Appendix B : Figure 18 View to display received awards

## To update account/personal details & logging out from the system

As shown below the profile icon provides options either to move to the profile or to logout from the system as a supplier



Appendix B : Figure 19 Logout & Profile update options

Profile update can be done after moving to the profile & changing the necessary details

*The available options, routings for the customer views & functions are already familiar to the customers as it's designed in a manner which matches to a regular e-commerce site. Hence customer is not required to refer a user manual in order to use this site.*

## Appendix C - Test Cases

### Common test cases used

Test ID	TC1
Test Case	Registration
Pre-Conditions	Go to the home page  Select sign up button  System will direct user to the Sign-Up Customer & Register as a Supplier window  Select Sign Up as a Customer  Then system will direct you to the Customer Registration form.  Enter the personal details  Click Create Account  A customer account will get created
Input Data	Enter the personal details
Expected Output	“Account successfully created” toast will come up
Pass/Fail	Pass

Appendix C : Table 1 Registration

Test ID	TC2
Test Case	Login with valid credentials
Pre-Conditions	Go to the customer Login
Input Data	Username and password
Expected Output	Login to the customer portal. System will direct customer to the customer account
Pass/Fail	Pass

*Appendix C : Table 2 Login with valid credentials*

Test ID	TC3
Test Case	[NEGATIVE] Login with invalid credentials
Pre-Conditions	Go to the customer Login
Input Data	Invalid username and password
Expected Output	System needs to give the invalid username or password error
Pass/Fail	Pass

*Appendix C : Table 3 [NEGATIVE] Login with invalid credentials*

Test ID	TC4
Test Case	Logout from the system
Pre-Conditions	Need to log in to the system  Click the sign out button
Input Data	-
Expected Output	System will direct the user to the home page

Pass/Fail	Pass
-----------	------

*Appendix C : Table 4 Logout from the system*

Test ID	TC5
Test Case	Check the email validity
Pre-Conditions	Route to the customer registration form, supplier registration form  Or  Need to be in the customer or supplier login form
Input Data	Enter a valid email
Expected Output	No error will be given
Pass/Fail	Pass

*Appendix C : Table 5 Check the email validity*

Test ID	TC6
Test Case	[NEGATIVE]Check with an invalid email
Pre-Conditions	Route to the customer registration form, supplier registration form  Or  Need to be in the customer or supplier login form
Input Data	Enter an invalid email
Expected Output	Invalid email will be given
Pass/Fail	Pass

*Appendix C : Table 6 [NEGATIVE]Check with an invalid email*

Test ID	TC7
---------	-----

Test Case	Checking both password and confirm password are equal
Pre-Conditions	Supplier needs to be routed to the “Create New Supplier Account- Mail Confirmation”
Input Data	Enter an unequal password in fields password and confirm password
Expected Output	Error should generate as password and confirm password are not same.
Pass/Fail	Pass

*Appendix C : Table 7 Checking both password and confirm password are equal*

Test ID	TC8
Test Case	Supplier or pharmacist trying to access a window without login in. (customer validation done in the customer section for this part)
Pre-Conditions	Select all pages which needs login (or existing session) to route into.
Input Data	Go to a page using direct URL for that form which checks for an existing session
Expected Output	User should be redirected to the login page.
Pass/Fail	Pass

*Appendix C : Table 8 Supplier or pharmacist trying to access a window without login in. (customer validation done in the customer section for this part)*

Test ID	TC9
Test Case	Check whether each user's username is displayed when logged in
Pre-Conditions	User creates an account in the system

Input Data	Login to the system using the username & password
Expected Output	System should display the user's username at the top of the window
Pass/Fail	Pass

*Appendix C : Table 9 Check whether each user's username is displayed when logged in*

## Test cases for customer modules

Test ID	TC10
Test Case	Searching products-Inactive generic or brand name
Pre-Conditions	Customer needs to be in the home page or product catalog page
Input Data	Search for the available products either using a invalid generic name or brand name
Expected Output	Searched generic product related branded product for the invalid brand names or generics searched should not appear.
Pass/Fail	Pass

*Appendix C : Table 10 Searching products-Inactive generic or brand name*

Test ID	TC11
Test Case	Searching products-using brand name
Pre-Conditions	Customer needs to be in the home page or product catalog page
Input Data	Search for the available products either using the brand name

Expected Output	Searched generic product related branded product for the valid brand names or generics searched should appear.
Pass/Fail	Pass

*Appendix C : Table 11 Searching products-using brand name*

Test ID	TC12
Test Case	Searching products-using generic name
Pre-Conditions	Customer needs to be in the home page or product catalog page
Input Data	Search for the available products using the generic name
Expected Output	Searched generic product related branded product for the valid brand names or generics searched should appear.
Pass/Fail	Pass

*Appendix C : Table 12 Searching products-using generic name*

Test ID	TC13
Test Case	Trying to add out of stock products
Pre-Conditions	Customer needs to be in the home page or product catalog page  Product should be displayed as “Out of stock”  Customer selects add to cart for one of the products
Input Data	Customer selects “add to cart” button
Expected Output	Information message should be given and prevent the product from getting to cart
Pass/Fail	Pass



Appendix C : Table 13 Trying to add out of stock products

Test ID	TC14
Test Case	Adding products to the cart
Pre-Conditions	<p>Customer needs to be in the home page or product catalog page</p> <p>Product should be displayed as “In stock”</p> <p>Customer selects add to cart for one of the products</p> <p>Keep adding several products</p>
Input Data	Customer selects “add to cart” button
Expected Output	<p>Add to cart icon on product catalog should increase the no of items in the cart.</p> <p>If zoom into cart the cart should display the cumulative amount for all the items</p>
Pass/Fail	Pass

Appendix C : Table 14 Adding products to the cart

Test ID	TC15
Test Case	Removing products from the cart
Pre-Conditions	<p>Customer needs to be in the home page or product catalog page</p> <p>Product should be displayed as “In stock”</p> <p>Customer selects add to cart for one of the products</p> <p>Customer route to the cart</p>
Input Data	Customer selects “remove from cart” button
Expected Output	Add to cart icon on product catalog should decrease the no of items in the cart.

	If zoom into cart the cart should display the cumulative amount for only existing items or should display none if no item exists.
Pass/Fail	Pass

*Appendix C : Table 15 Removing products from the cart*

Test ID	TC16
Test Case	Proceed to checkout as a registered customer
Pre-Conditions	Customer needs to be in the home page or product catalog page  Product should be displayed as “In stock”  Customer selects add to cart for one of the products  Then customer select “proceed to checkout” button
Input Data	Then customer select “proceed to checkout” button
Expected Output	System should ask for the billing details
Pass/Fail	Pass

*Appendix C : Table 16 Proceed to checkout as a registered customer*

Test ID	TC17
Test Case	Check whether current orders consist only ongoing orders
Pre-Conditions	Customer needs to be in the home page or product catalog page  Product should be displayed as “In stock”  Customer selects add to cart for one of the products
Input Data	Then customer select “proceed to checkout” button  The order should be shown in current orders

Expected Output	System should add the new order to current orders
Pass/Fail	Pass

*Appendix C : Table 17 Check whether current orders consist only ongoing orders*

Test ID	TC18
Test Case	Check whether the “Past Orders” are having only the delivered orders
Pre-Conditions	Customer needs to be in the home page or product catalog page  Product should be displayed as “In stock”  Customer selects add to cart for one of the products  Then customer select “proceed to checkout” button  Product stays at the current orders
Input Data	Pharmacist change the status of the delivery to “Delivered”
Expected Output	This should move record from “Current Orders” to “Past Orders”
Pass/Fail	Pass

*Appendix C : Table 18 Check whether the “Past Orders” are having only the delivered orders*

Test ID	TC19
Test Case	[NEGATIVE] Proceed to Order-validation for a prescription
Pre-Conditions	Customer needs to be in the home page or product catalog page  Product should be displayed as “In stock”  Customer selects add to cart for one of the products

	<p>Then customer select “proceed to checkout” button</p> <p>Information of the customer will be given except prescription</p> <p>Customers click “Proceed to checkout”</p>
Input Data	Customers click “Proceed to checkout”
Expected Output	System will display an information message showing, “Prescription submission as a mandatory requirement”
Pass/Fail	Pass

Appendix C : Table 19 [NEGATIVE] Proceed to Order-validation for a prescription

Test ID	TC20
Test Case	[POSITIVE]Proceed to Order-validation for a prescription
Pre-Conditions	<p>Customer needs to be in the home page or product catalog page</p> <p>Product should be displayed as “In stock”</p> <p>Customer selects add to cart for one of the products</p> <p>Then customer select “proceed to checkout” button</p> <p>Information of the customer will be given with prescription</p> <p>Customers click “Proceed to checkout”</p>
Input Data	Customers click “Proceed to checkout”
Expected Output	System will direct the customer to the payment gateway.
Pass/Fail	Pass

Appendix C : Table 20 [POSITIVE]Proceed to Order-validation for a prescription

Test ID	TC21
Test Case	[NEGATIVE]Trying to route into a supplier or pharmacist page after login
Pre-Conditions	customer should be logged into the system
Input Data	Go to a supplier or pharmacist dashboard URL's or any other restricted page URL's that cannot be logged in from customer session
Expected Output	System should refrain customer from getting into that page
Pass/Fail	Pass

Appendix C : Table 21 [NEGATIVE]Trying to route into a supplier or pharmacist page after login

## Test cases used for Pharmacist module

Test ID	TC22
Test Case	Quote button should be only enabled when current stock level equals re-order level
Pre-Conditions	Current stock level equals the re-order level
Input Data	
Expected Output	The “email to re-stock” should be enabled
Pass/Fail	Pass

Appendix C : Table 22 Quote button should be only enabled when current stock level equals re-order level

Test ID	TC23
Test Case	Toast product as “Out of Stock” when the current stock is 0 on pharmacist’s “stock details window”
Pre-Conditions	Stock level of a Generic becomes 0
Input Data	-

Expected Output	Product in the Product catalog should give a message as “Out of Stock” when try to add them.
Pass/Fail	Pass

*Appendix C : Table 23 Toast product as “Out of Stock” when the current stock is 0 on pharmacist’s “stock details window”*

Test ID	TC24
Test Case	Check the quality evaluation is ran prior to the price evaluation  Ie: “Quality assured products under the “status for quality” column Quality Assured products window should only be taken for the evaluation for price.
Pre-Conditions	Need to get quotations from the supplier for a specific generic and the quotations needs to be “Quality assured quotations” window.
Input Data	Run “evaluation for price”
Expected Output	Products will be arranged from lowest priced “quality assured” products to the highest on the price evaluated products window.
Pass/Fail	Pass

*Appendix C : Table 24 Check the quality evaluation is ran prior to the price evaluation*

Test ID	TC25
Test Case	Check only the quotes with an valid NMRA Reg No. is taken to the quality assured products window after the quality evaluation is ran
Pre-Conditions	Need to get quotations from the supplier for a specific generic and the quotations.  Run “evaluation for quality”

Input Data	-
Expected Output	Only the quotes with an valid NMRA Reg No. is taken to the quality assured products window after the quality evaluation is ran
Pass/Fail	Pass

*Appendix C : Table 25 Check only the quotes with an valid NMRA Reg No. is taken to the quality assured products window after the quality evaluation is ran*

Test ID	TC26
Test Case	Check whether the mails are sent to the respective suppliers when needed quotations to be recalled
Pre-Conditions	Stock needs to reach the reorder level.  The “Quote” button should be enabled for the respective generic
Input Data	Click on the “Quote” option & generate mails for the connected suppliers
Expected Output	Suppliers should get a mail requesting for their quotes.
Pass/Fail	Pass

*Appendix C : Table 26 Check whether the mails are sent to the respective suppliers when needed quotations to be recalled*

Test ID	TC27
Test Case	Check whether “required quantity” is higher than the “fulfilled quantity” when “Award & Send mail” button is selected for a quotation made
Pre-Conditions	Need to get quotations from the supplier for a specific generic and the quotations needs to be taken up to the “Price Evaluated Products” form.

Input Data	Click on “Award & Send email”
Expected Output	Record will be taken to the Pending Deliveries form & award will be shown at suppliers end to accept.
Pass/Fail	Pass

*Appendix C : Table 27 Check whether “required quantity” is higher than the “fulfilled quantity” when “Award & Send mail” button is selected for a quotation made*

Test ID	TC28
Test Case	[NEGATIVE]Check “required quantity” is higher than the “fulfilled quantity” when “Award & Send mail” button is selected for a quotation made
Pre-Conditions	Need to get quotations from the supplier for a specific generic and the quotations needs to be taken up to the “Price Evaluated Products” form.
Input Data	Click on “Award & Send email”
Expected Output	There will be an error message ““required quantity” is lesser than the “fulfilled quantity””
Pass/Fail	Pass

*Appendix C : Table 28 [NEGATIVE]Check “required quantity” is higher than the “fulfilled quantity” when “Award & Send mail” button is selected for a quotation made*

Test ID	TC29
Test Case	When supplier click “Reject Quotation” under “Received Awards tab”, fulfilled quantities should get updated in pharmacist’s the pending deliveries window
Pre-Conditions	Supplier should be logged into the system



Input Data	Awarded suppliers should go to the “Received Awards tab” reject the awards.
Expected Output	Fulfilled quantities should get updated in pharmacist’s the pending deliveries window.
Pass/Fail	Pass

*Appendix C : Table 29 When supplier click “Reject Quotation” under “Received Awards tab”, fulfilled quantities should get updated in pharmacist’s the pending deliveries window*

Test ID	TC30
Test Case	Check whether the received quotation is removed when the quality is assured
Pre-Conditions	Call the quotations from suppliers  At the evaluation date quotations evaluated for “Quality”
Input Data	Click on “Evaluate for Quality”
Expected Output	Records will be removed from the Received Quotation view
Pass/Fail	Pass

*Appendix C : Table 30 Check whether the received quotation is removed when the quality is assured*

Test ID	TC31
Test Case	Check whether the quality assured quotations are removed when the price is evaluated
Pre-Conditions	Call the quotations from suppliers  At the evaluation date quotations evaluated for “Quality”  Then quality assured quotations are evaluated for the price

Input Data	Click on “Evaluate for Price”
Expected Output	Records will be removed from the Quality Assured Quotations view
Pass/Fail	Pass

*Appendix C : Table 31 Check whether the quality assured quotations are removed when the price is evaluated*

Test ID	TC32
Test Case	Received Awards get updated at the supplier when award is received
Pre-Conditions	Quotations are taken up to the price evaluated products on the evaluations process  Pharmacists click “Award” on the “price evaluated products” form
Input Data	-
Expected Output	Supplier “received awards” view will get the record as an award.
Pass/Fail	Pass

*Appendix C : Table 32 Received Awards get updated at the supplier when award is received*

Test ID	TC33
Test Case	Validate stocks always takes a positive value
Pre-Conditions	There should be at least one generic product with stocks  Go to the stock details window
Input Data	Scrap for a amount which exceeds the current stock level

Expected Output	Pharmacist should not be allowed to scrap beyond '0'
Pass/Fail	Pass

*Appendix C : Table 33 Validate stocks always takes a positive value*

Test ID	TC34
Test Case	Run each report to see whether data is taken to the csv properly
Pre-Conditions	Pharmacist route to each of the reports  Set parameters as required  Fetch data to the view  Create csv from the button
Input Data	Create csv from the button
Expected Output	CSV file with the data will get created with the headings
Pass/Fail	Pass

*Appendix C : Table 34 Run each report to see whether data is taken to the csv properly*

Test ID	TC35
Test Case	Add/Invoice button at Pending Deliveries window
Pre-Conditions	Pharmacist click "Award & Send Mail" on the "price evaluated products" form.  Still the supplier should have accepted the award.  Record available at the Pending Deliveries window
Input Data	Click on Add/Invoice button at Pending Deliveries window

Expected Output	This will increase the stocks on the stock levels window.
Pass/Fail	Pass

*Appendix C : Table 35 Add/Invoice button at Pending Deliveries window*

Test ID	TC36
Test Case	Add/Invoice button at Pending Deliveries window (required inventory levels are achieved)
Pre-Conditions	Pharmacist click “Award & Send Mail” on the “price evaluated products” form.  Still the supplier should have accepted the award.  Record available at the Pending Deliveries window
Input Data	Click on Add/Invoice button at Pending Deliveries window
Expected Output	This will refrain the pharmacist from add or invoicing further suppliers by disabling the “Quote” button
Pass/Fail	Pass

*Appendix C : Table 36 Add/Invoice button at Pending Deliveries window (required inventory levels are achieved)*

Test ID	TC37
Test Case	[NEGATIVE]Add/Invoice button at Pending Deliveries window (But required inventory levels are not achieved)
Pre-Conditions	Pharmacist click “Award & Send Mail” on the “price evaluated products” form.  Still the supplier should have accepted the award.

Input Data	Click on Add/Invoice button at Pending Deliveries window
Expected Output	This will only increase the stocks at the stock levels window.
Pass/Fail	Pass

*Appendix C : Table 37 [NEGATIVE]Add/Invoice button at Pending Deliveries window (But required inventory levels are not achieved)*

Test ID	TC38
Test Case	Check required information is filtered for the sales report parameters
Pre-Conditions	Pharmacist route to the transaction-overview window  Then route to the sales report window
Input Data	Select the generic, start date, end date for the report overview  Then “generate” report
Expected Output	This should generate the information according to the criteria specified in the parameters
Pass/Fail	Pass

*Appendix C : Table 38 Check required information is filtered for the sales report parameters*

Test ID	TC39
Test Case	Check required information is filtered for the purchase report parameters
Pre-Conditions	Pharmacist route to the transaction-overview window

	Then route to the purchase report window
Input Data	Select the supplier, generic, start date, end date for the report overview  Then “generate” report
Expected Output	This should generate the information according to the criteria specified in the parameters
Pass/Fail	Pass

Appendix C : Table 39 Check required information is filtered for the purchase report parameters

Test ID	TC40
Test Case	[NEGATIVE]Trying to route into a supplier or customer specific dashboards after login
Pre-Conditions	Pharmacist should be logged into the system
Input Data	Go to a supplier or customer dashboard or any other restricted page that cannot be logged in from pharmacist’s session
Expected Output	System should refrain pharmacist from getting into that page.
Pass/Fail	Pass

Appendix C : Table 40 [NEGATIVE]Trying to route into a supplier or customer specific dashboards after login

## Test cases used for Supplier

Test ID	TC41
Test Case	When supplier click “Reject Quotation” under “Received Awards tab”
Pre-Conditions	Supplier should be logged into the system

Input Data	Awarded suppliers should go to the “Received Awards tab” reject the awards.
Expected Output	Status should get updated as rejected in suppliers entitled products window.
Pass/Fail	Pass

*Appendix C : Table 41 When supplier click “Reject Quotation” under “Received Awards tab”*

Test ID	TC42
Test Case	Product Quotation form should auto fill
Pre-Conditions	Supplier should be logged into the system  Suppliers select “Quote” button on Invite to Quote option at the viewed table.
Input Data	Click “Quote” under “supplier entitled products” window.
Expected Output	Product Quotation form should auto fill
Pass/Fail	Pass

*Appendix C : Table 42 Product Quotation form should auto fill*

Test ID	TC43
Test Case	Reject an award button
Pre-Conditions	Supplier should be logged into the system  Supplier select Reject button on “Received Awards” window.
Input Data	Click “Reject” under “supplier entitled products” window.
Expected Output	Status will be changed on specific row created on Price Evaluated Products (pharmacists window).

	Fulfilled quantity will get updated at the Price Evaluated Products
Pass/Fail	Pass

Appendix C : Table 43 Reject an award button

Test ID	TC44
Test Case	Accept an award button
Pre-Conditions	Supplier should be logged into the system  Supplier select Accept button on “Received Awards” window.
Input Data	Click “Reject” under “supplier entitled products” window.
Expected Output	It'll remove the entry from "Price Evaluated List" & Create an entry on "Pending deliveries"(view for pharmacist & supplier)
Pass/Fail	Pass

Appendix C : Table 44 Accept an award button

Test ID	TC45
Test Case	[NEGATIVE]Trying to route into a customer or pharmacist page after login
Pre-Conditions	Supplier should be logged into the system
Input Data	Go to a customer or pharmacist dashboard or any other restricted page that cannot be logged in from supplier session
Expected Output	System should refrain supplier from getting into that page
Pass/Fail	Pass

Appendix C : Table 45 [NEGATIVE]Trying to route into a customer or pharmacist page after login



## Appendix D - Evaluation Questionnaires

The questionnaires are prepared in the below manner.

### Questionnaire for potential Suppliers

Mark the appropriate answers with a 'X'.

1. How do you rate the comprehensiveness of this application to the tendering & evaluation process?

<input type="checkbox"/>	Contains enough functionality
<input type="checkbox"/>	Contains minimum required functionality
<input type="checkbox"/>	Need more features

2. How useful do you find this application to you?

<input type="checkbox"/>	Very useful
<input type="checkbox"/>	Might be useful
<input type="checkbox"/>	Not useful

3. Do you think that this application will save time in processing the medicinal needs?

<input type="checkbox"/>	Saves time
<input type="checkbox"/>	Might save time
<input type="checkbox"/>	Does not save time

4. Do you think this application will help avoid the knowledge gap that has between you and the pharmacist by catering the generic products?

<input type="checkbox"/>	Avoids discrepancies
<input type="checkbox"/>	Might avoid discrepancies
<input type="checkbox"/>	Does not avoid any discrepancies

5. How do you rate the user friendliness of the application? (5 being the most use friendly)

<input type="checkbox"/>	1	<input type="checkbox"/>	2	<input type="checkbox"/>	3
--------------------------	---	--------------------------	---	--------------------------	---

6. What would prefer to have as a future upgrade to the system?

<input type="checkbox"/>	To implement credit invoicing facility	<input type="checkbox"/>	To add accounting related functions-for costing	<input type="checkbox"/>	To add accounting functions for transaction reporting
--------------------------	--	--------------------------	---	--------------------------	---

7. Any suggestions to improve the application?

--

8. Please state any other comment you would like to add.

--

## Questionnaire for potential Customer

Mark the appropriate answers with a 'X'.

1. Do you think that this application will save time in processing the medicinal needs?

	Saves time
	Might save time
	Does not save time

2. Please let us know whether the User Interface is user-friendly.

	Familiar & it's similar to other e-commerce sites
	Familiarized with the 1 <sup>st</sup> & 2 <sup>nd</sup> time of use
	It's a new experience at all

3. Do you think this provides the features that the Sri Lankan larger community/market in the pharmaceuticals industry seek as a e-pharmacy app?

	Yes, this is a requirement of the society
	This is good, but can provide more variety of brands
	No, should provide further variety of brands

4. How do you rate the evaluation feature used in the system?

	1		2		3
--	---	--	---	--	---

5. What would prefer to have as a future upgrade to the system?

1	To implement the Credit Invoicing	2	To have a function to track the courier	3	To upgrade the User Interface
---	-----------------------------------	---	---	---	-------------------------------

6. Any suggestions to improve the application?

--

7. Please state any other comment you would like to add.

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## Appendix E - Management Reports

### Interface giving the details on the current stock level for generics

The screenshot shows the 'Stock Report' interface. On the left is a dark sidebar with the 'E-OSU SALA' logo and three menu items: 'SaleseReport', 'PurchasesReport', and 'StocksReport'. The main content area has a top navigation bar with 'System Admin' and a user icon. Below this, there are filters for 'Stock Status' (a dropdown menu), 'StartDate' (a date picker), and 'EndDate' (a date picker). The main section is titled 'Stock Report' and contains a 'Show 10 entries' dropdown, 'CSV' and 'Copy' buttons, and a 'Search:' input field. Below these is a table with columns: 'Generic', 'StockStatus', 'ModifiedDate', and 'ModifiedAmount'. The table is currently empty, displaying 'No data available in table'. At the bottom of the table area, it says 'Showing 0 to 0 of 0 entries' with 'Previous' and 'Next' links. A blue 'Generate Report' button is located at the bottom right of the interface.

Appendix E : Figure 1 Stock level details

### Information shown for the customer orders/sales data

The screenshot shows the 'Sales Report' interface. On the left is a dark sidebar with the 'E-OSU SALA' logo and three menu items: 'SaleseReport', 'PurchasesReport', and 'StocksReport'. The main content area has a top navigation bar with 'System Admin' and a user icon. Below this, there are filters for 'Generic' (a dropdown menu), 'StartDate' (a date picker), and 'EndDate' (a date picker). The main section is titled 'Sales Report' and contains a 'Show 10 entries' dropdown, 'CSV' and 'Copy' buttons, and a 'Search:' input field. Below these is a table with columns: 'Generic', 'OrderId', 'Quantity', and 'OrderDate'. The table is currently empty, displaying 'No data available in table'. At the bottom of the table area, it says 'Showing 0 to 0 of 0 entries' with 'Previous' and 'Next' links. A blue 'Generate Report' button is located at the bottom right of the interface. At the very bottom of the page, there is a small copyright notice: 'Copyright © 2021'.

Appendix E : Figure 2 Customer Order details

## Information shown for the purchasing data

E-OSU  
SALA

SaleseReport

PurchasesReport

StocksReport

System Admin

SupplierGenericStartDateEndDate

Select supplier..Select supplier..mm/dd/yyyymm/dd/yyyy

Purchases Report

Show 10 entries CSV CopySearch:

Supplier	Generic	PurchasedDate	Quantity	Price
No data available in table				
Supplier	Generic	PurchasedDate	Quantity	Price

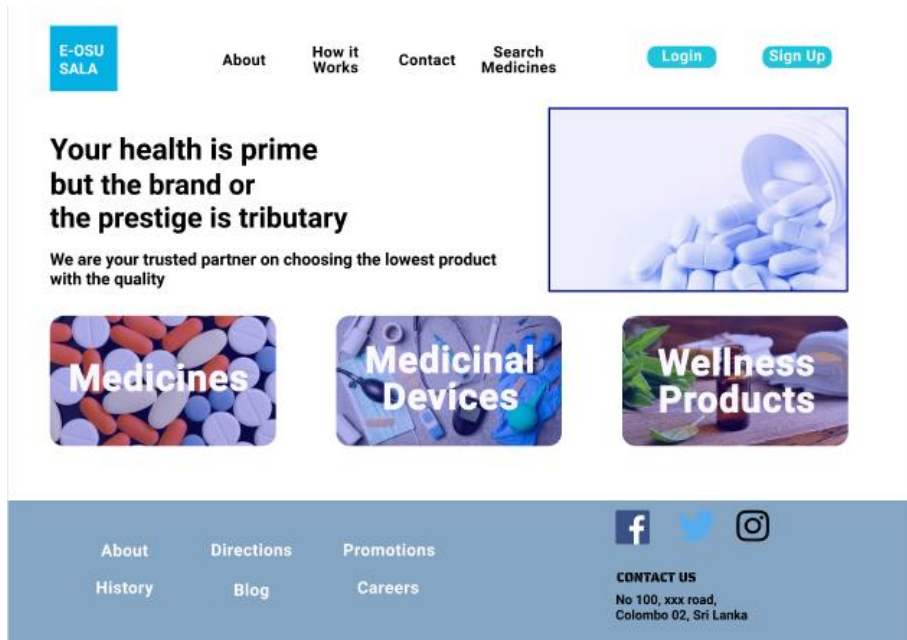
Showing 0 to 0 of 0 entriesPreviousNext

Generate Report

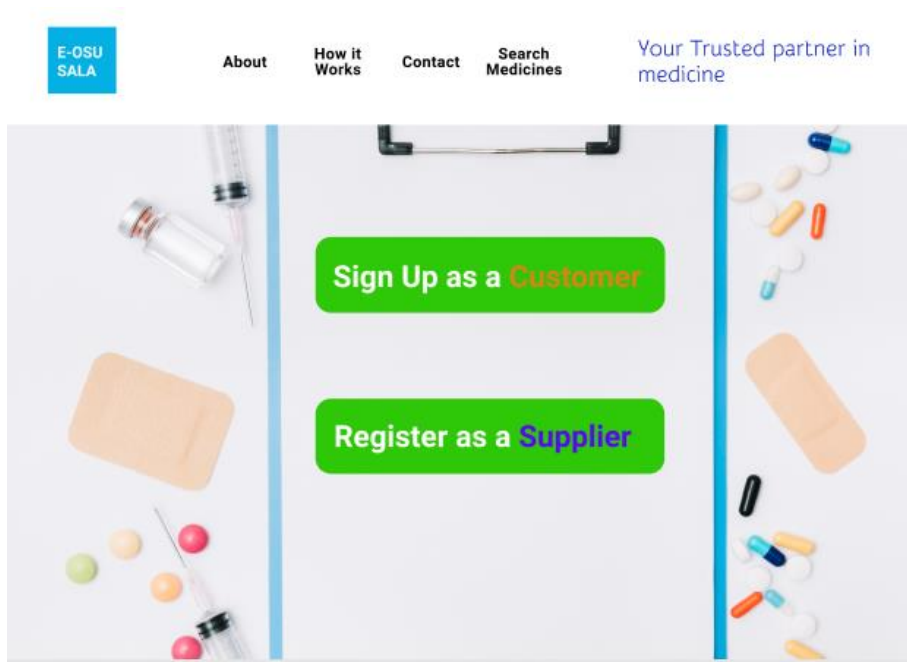
Appendix E : Figure 3 Purchasing details

## Appendix F - Figma designs

### Views related to common designs

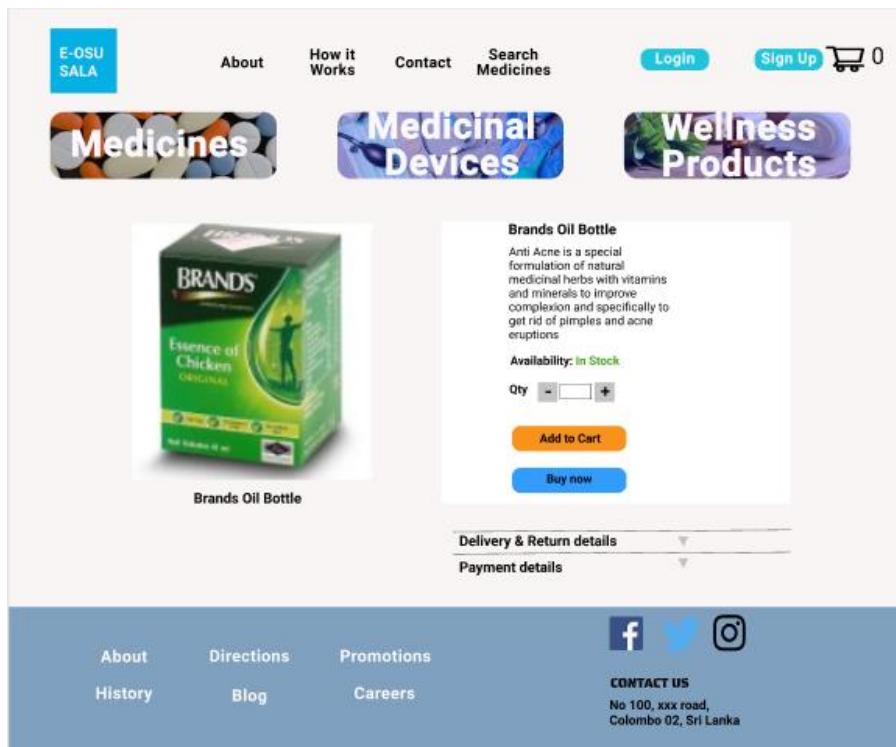


Appendix F : Figure 1 Index page

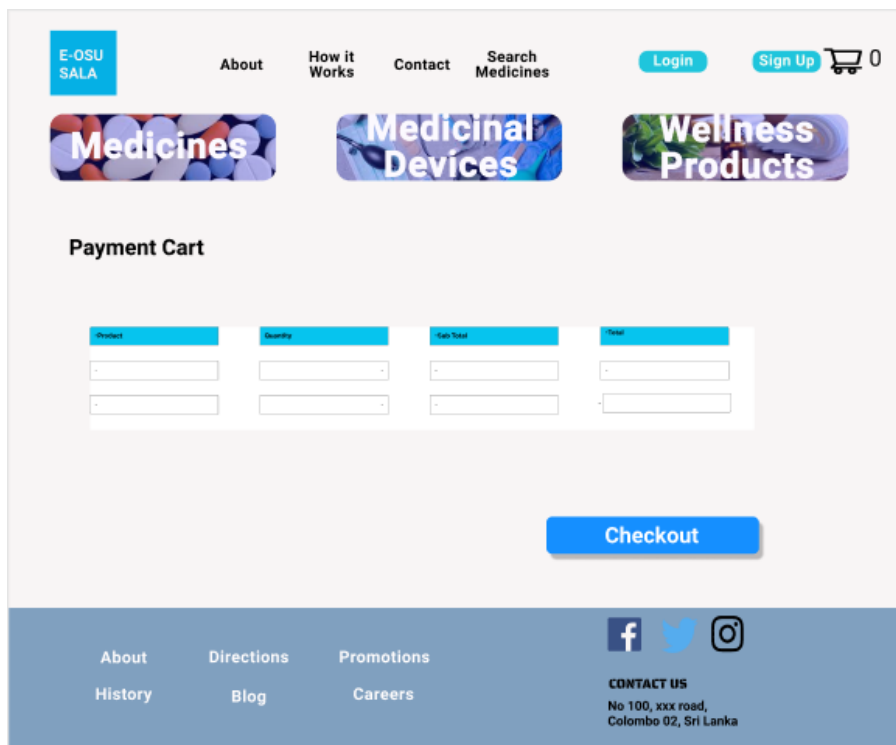


Appendix F : Figure 2 Registration view

## Views related to customer



Appendix F : Figure 3 Product Catalog



Appendix F : Figure 4 Cart view



E-OSU  
SALA

About
How it Works
Contact
Search Medicines

Login
Sign Up

0

Medicines

Medicinal Devices

Wellness Products

\*\*If Signed Up below details will be autofilled

Frame 3

First Name :

Gender :

Address :

Contact No :

E-mail :

Delivery Date :

Additional Comments:

Frame 2

Frame 5

Last Name :

Age :

City :

Frame 4

Payment Method :

☒ Visa/Master Card
 ☐ Cash On Delivery

Proceed to Order

Attach a prescription

About
Directions
Promotions

History
Blog
Careers

f

**CONTACT US**  
 No 100, xxx road,  
 Colombo 02, Sri Lanka

Appendix F : Figure 5 Checkout

E-OSU  
SALA

About
How it Works
Contact
Search Medicines

Login
Sign Up

0

Medicines

Medicinal Devices

Wellness Products

Payment Gateway

After payment customer will  
 have a option to see order  
 clicking a button or  
 automatically



About
Directions
Promotions

History
Blog
Careers



f

**CONTACT US**  
 No 100, xxx road,  
 Colombo 02, Sri Lanka

Appendix F : Figure 6 Payment Gateway

<div>E-OSU SALA</div> <div>Home</div> <div>Current Orders</div> <div>Past Orders</div> <div>User Details</div>	Current Orders		Hi Cust				
	Order No.	Supplier	Prescription	Product Brand	Total Price	Status of Order	Delivery Date
	12			XXXXX	XXXXX	Delivered	XXXXX
	23			XXXXX	XXXXX	Invoiced / Ready to Deliver	XXXXX
	32			XXXXX	XXXXX	Preparing Order	XXXXX
	42			XXXXX	XXXXX	Sent to Courier	XXXXX
	51			XXXXX	XXXXX	Delivered	
	6			XXXXX	XXXXX	Delivered	
	7			XXXXX	XXXXX	Delivered	
	8			XXXXX	XXXXX	Delivered	

Appendix F : Figure 7 Current Orders for a customer

<div>E-OSU SALA</div> <div>Home</div> <div>Current Orders</div> <div>Past Orders</div> <div>User Details</div>	Past Orders		Hi Cust				
	Order No.	Supplier	Prescription	Product Brand	Total Price	Status of Order	Delivery Date
	12			XXXXX	XXXXX	Delivered	XXXXX
	23			XXXXX	XXXXX	Delivered	XXXXX
	32			XXXXX	XXXXX	Delivered	XXXXX
	42			XXXXX	XXXXX	Delivered	XXXXX
	51			XXXXX	XXXXX	Delivered	
	6			XXXXX	XXXXX	Delivered	
	7			XXXXX	XXXXX	Delivered	
	8			XXXXX	XXXXX	Delivered	

Appendix F : Figure 8 Past Orders for a customer

## Views related to Pharmacist

E-OSU  
SALA

Stock Levels

Stock Details

Received Quotations

Quality Assured Quotations

Price Evaluated Products


Pending Deliveries

Invoiced Deliveries

Customer Deliverables

Stock Level Status

Hi Pharm



View Product Specification	Generic Product	Current Stock Level	Re-order Stock level	Invite to Quote	Status
<a href="#">View</a>	Generic 1	XXXXX	XXXXX	<a href="#">E-mail to re-stock</a>	Price Evaluated
<a href="#">View</a>	Generic 2	XXXXX	XXXXX	<a href="#">E-mail to re-stock</a>	Price Evaluated
<a href="#">View</a>	Generic 3	XXXXX	XXXXX	<a href="#">E-mail to re-stock</a>	
<a href="#">View</a>	Generic 4	XXXXX	XXXXX	<a href="#">E-mail to re-stock</a>	
<a href="#">View</a>	Generic 5	XXXXX	XXXXX	<a href="#">E-mail to re-stock</a>	
<a href="#">View</a>	Generic 6	XXXXX	XXXXX	<a href="#">E-mail to re-stock</a>	
<a href="#">View</a>	Generic 7	XXXXX	XXXXX	<a href="#">E-mail to re-stock</a>	
<a href="#">View</a>	Generic 8	XXXXX	XXXXX	<a href="#">E-mail to re-stock</a>	

Appendix F : Figure 9 Stock level status

E-OSU  
SALA

Stock Levels

Stock Details

Received Quotations

Quality Assured Quotations

Price Evaluated Products


Pending Deliveries

Invoiced Deliveries

Customer Deliverables

Received Quotations

Hi Pharm



Generic 1

Generic 3

Generic 4

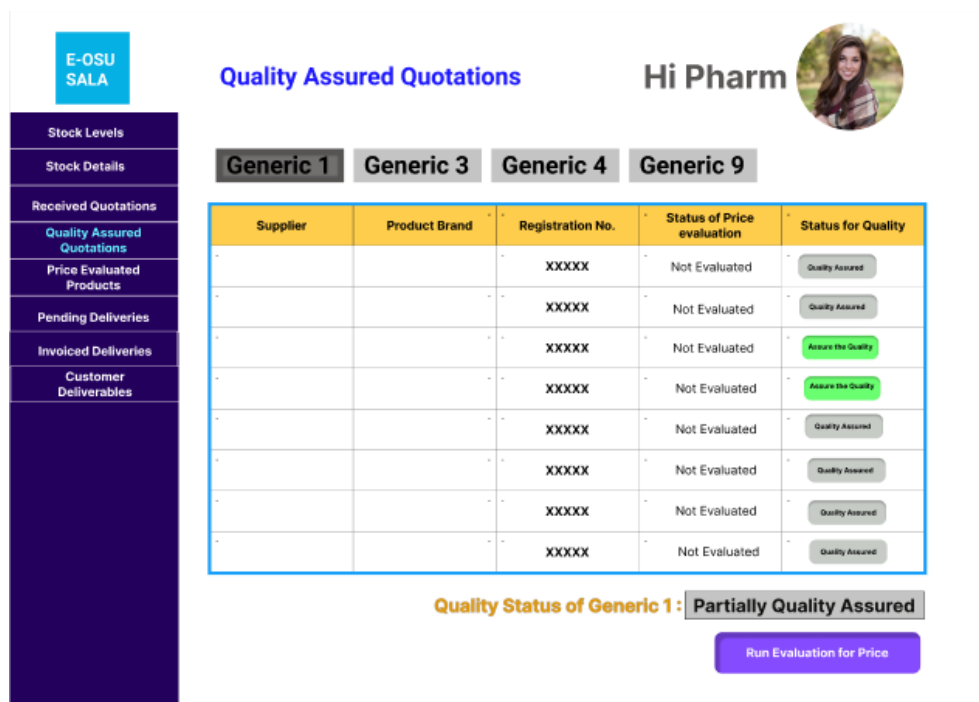
Generic 6

Generic 7

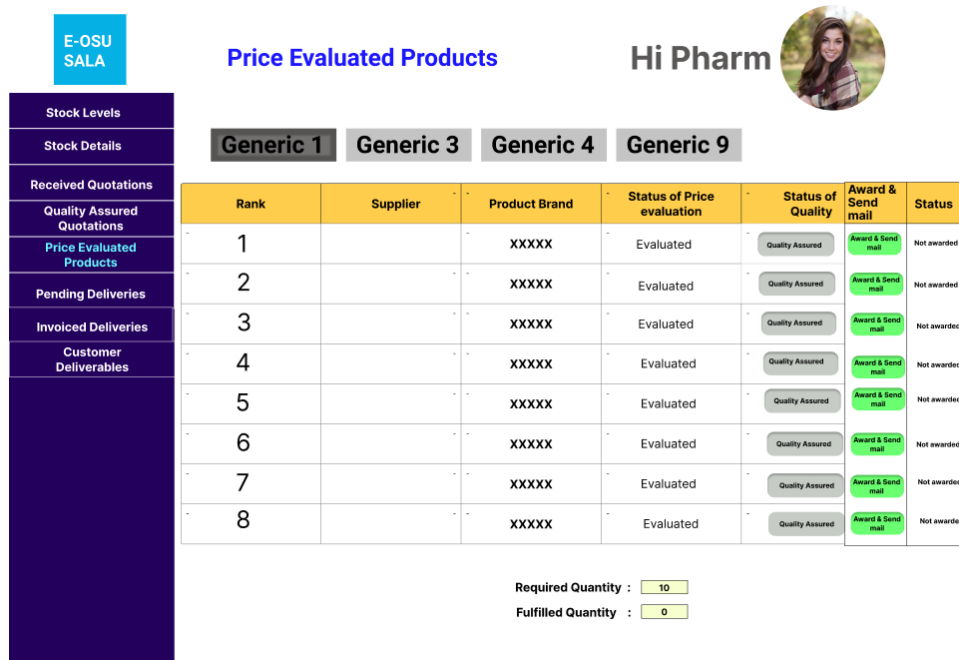
Supplier	Product Brand	Registration No.	Status of Price evaluation	Status for Price
		XXXXX	Not Evaluated	<a href="#">Assure the Quality</a>
		XXXXX	Not Evaluated	<a href="#">Assure the Quality</a>
		XXXXX	Not Evaluated	<a href="#">Assure the Quality</a>
		XXXXX	Not Evaluated	<a href="#">Assure the Quality</a>
		XXXXX	Not Evaluated	<a href="#">Assure the Quality</a>
		XXXXX	Not Evaluated	<a href="#">Assure the Quality</a>
		XXXXX	Not Evaluated	<a href="#">Assure the Quality</a>
		XXXXX	Not Evaluated	<a href="#">Assure the Quality</a>

Run Evaluation for Quality

Appendix F : Figure 10 Received quotations



Appendix F : Figure 11 Quality assured quotations



Appendix F : Figure 12 Price evaluated products

E-OSU  
SALA

Stock Levels

Stock Details

Received Quotations

Quality Assured Quotations

Price Evaluated Products

Pending Deliveries

Invoiced Deliveries

Customer Deliverables

Invoiced Deliveries

Generic 1


Generic 3

Generic 4

Generic 6

Generic 7

Hi Pharm



Supplier	Product Brand	Invoice No	Quantity supplying	Delivery date	Delivered Date	Create Credit Invoice
-	-	XXXXX	2	XX/XX/XXXX	XX/XX/XXXX	Credit Invoice
-	-	XXXXX	2	XX/XX/XXXX	XX/XX/XXXX	Credit Invoice
-	-	XXXXX	2	XX/XX/XXXX	XX/XX/XXXX	Credit Invoice
-	-	XXXXX	4	XX/XX/XXXX	XX/XX/XXXX	Credit Invoice

Appendix F : Figure 13 Invoiced deliveries

E-OSU  
SALA

Stock Levels

Stock Details

Received Quotations

Quality Assured Quotations

Price Evaluated Products

Pending Deliveries

Invoiced Deliveries

Customer Deliverables

Pending Deliveries

Generic 1


Generic 3

Generic 4

Generic 6

Generic 7

Hi Pharm



Supplier	Product Brand	Award Status	Quantity supplyin	Delivery date	Add to stock/Creates Invoice	Reject the acceptance
-	-	Accepted	2	XX/XX/XXXX	Add/Invoice	Reject
-	-	Accepted	2	XX/XX/XXXX	Add/Invoice	Reject
-	-	Accepted	2	XX/XX/XXXX	Add/Invoice	Reject
-	-	Accepted	4	XX/XX/XXXX	Add/Invoice	Reject

Required Quantity :

10

Fulfilled Quantity :

10

Appendix F : Figure 14 Pending deliveries