
Project Title : Maersk Line

Module Code : CT071-3-5-3-DDAC Designing & Developing Cloud Applications

Lecturer Name : DR. KALAI ANAND RATNAM

Student Name : NG YEW NENG

Student ID : TP034796

Intake Code : UC3F1706SE

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## Acknowledgement

First of all, I would like to deliberate a great recognition to Mr. Kalai Anand Ratnam for his professional guidance during the lectures and tutorials which helps me to have a better understanding in designing and developing cloud application. Practices done during tutorials are really helpful in completing the project.

Besides, I would also like to express my deepest appreciation to my friends for assisting me throughout the project. Whenever there's some uncertainties during the development, we will always have discussion for helping each other in resolving the particular issues.

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# 1.0 Introduction

## 1.1 Project Background

Maersk Line was founded in 1928 in which is the global container division and largest operating unit of the A.P. Moller – Maersk Group, a Danish business conglomerate. Being the largest container shipping company in global, Maersk Line is having customers through 374 officers in 116 countries with the employment of approximately 7,000 sea farers and approximately 25,000 land-based people. Maersk Line is also operating in 100 countries with over 600 vessels and capacity of 2.6 million TEU (Twenty-foot Equivalent Unit), Maersk Line is already handling all the cargo it can manage.

As the volume of most of the goods it was shipping had grown to full capacity, a cloud powered solutions was decided to be acquired by the company and it would be a crucial part of rectifying the situation. Maersk Line has decided to consolidate all of its data centers and server rooms operating worldwide onto a virtualized platform to support further business growth and increase organizational flexibility.

## 1.2 Objectives

- To design and develop a CMS (Container Management System) for Maersk Line in order to manage the containers in which will reduce overall supply chain costs and manage logistics efficiently

## 1.3 Scopes

- To demonstrate the understanding of cloud computing in various forms and how Microsoft Azure & AWS fits within the cloud computing space
- To explore the Microsoft Azure & AWS development environment
- To design, implement, and deploy web application on Microsoft Azure & AWS
- To architecturally design efficient applications utilizing Microsoft Azure & AWS

## 1.4 Requirement Specifications

To design and develop a single tenant web solution that

- Processing from import, export, and transshipment to gate operations
- Able to scale the solution to meet necessary demands during peak seasons
- Improves profitability, reduce costs, increases productivity, eradicates errors and optimizes resources to future-proof the cargo handling business for high performance
- Assurance and reliability through Failover Management
- Allocates inbound containers to yard locations and plan outbound containers to individual hauler vehicles, delivering an exceptional level of automation and removing human error accurately
- Manage the entire booking process from schedule search to booking confirmation

## 1. 5 Summary of Major Functions

| User | Functions |
|---|---|
| Admin, Agent | - Login<br>- Logout |
| Admin | - Register agent<br>- Add, Edit, View Ship<br>- Add, Edit, View Schedule<br>- Edit, View Customer<br>- View Order |
| Agent | - Add, Edit, View Customer<br>- Add, View Order |

Table 1.5 Summary of Major Functions

# 2.0 Project Plan

## 2.1 Work Breakdown Structure

| WBS | Task Name | Duration |
|---|---|---|
| **1** | **Maersk Line** | **24 days** |
| **1.0** | **Introduction** | **1.38 days** |
| 1.1 | Project Background | 2 hrs |
| 1.2 | Objectives | 2 hrs |
| 1.3 | Scopes | 2 hrs |
| 1.4 | Requirement Specifications | 3 hrs |
| 1.5 | Summary of Major Functions | 2 hrs |
| **2.0** | **Project Plan** | **0.25 days** |
| 2.1 | Work Breakdown Structure | 1 hr |
| 2.2 | Gantt Chart | 1 hr |
| **3.0** | **Design** | **6 days** |
| 3.1 | Design Considerations | 1 day |
| 3.2 | Cloud Architecture | 1 day |
| **3.3** | **Modelling** | **4 days** |
| 3.3.1 | Use Case Diagram | 1 day |
| 3.3.2 | Use Case Specification | 1 day |
| 3.3.3 | Sequence Diagram | 1 day |
| 3.3.4 | Class Diagram | 1 day |
| **4.0** | **Implementation** | **13 days** |
| 4.1 | ASP.NET Web Application | 1 day |
| 4.2 | Azure Resource Groups | 2 days |
| 4.3 | Azure SQL Server | 2 days |
| 4.4 | Azure SQL Servers | 2 days |
| 4.5 | Azure Web Application Service | 2 days |
| 4.6 | Azure Traffic Manager | 2 days |
| 4.7 | Azure Web Application Autoscaling | 2 days |
| 5.0 | User Interface | 1 day |
| **6.0** | **Test Plan & Testing Discussion** | **2 days** |
| 6.1 | Functional Testing | 1 day |
| 6.2 | Performance Testing | 1 day |
| 7.0 | Conclusion | 3 hrs |

Table 2.1 WBS

## 2.2 Gantt Chart

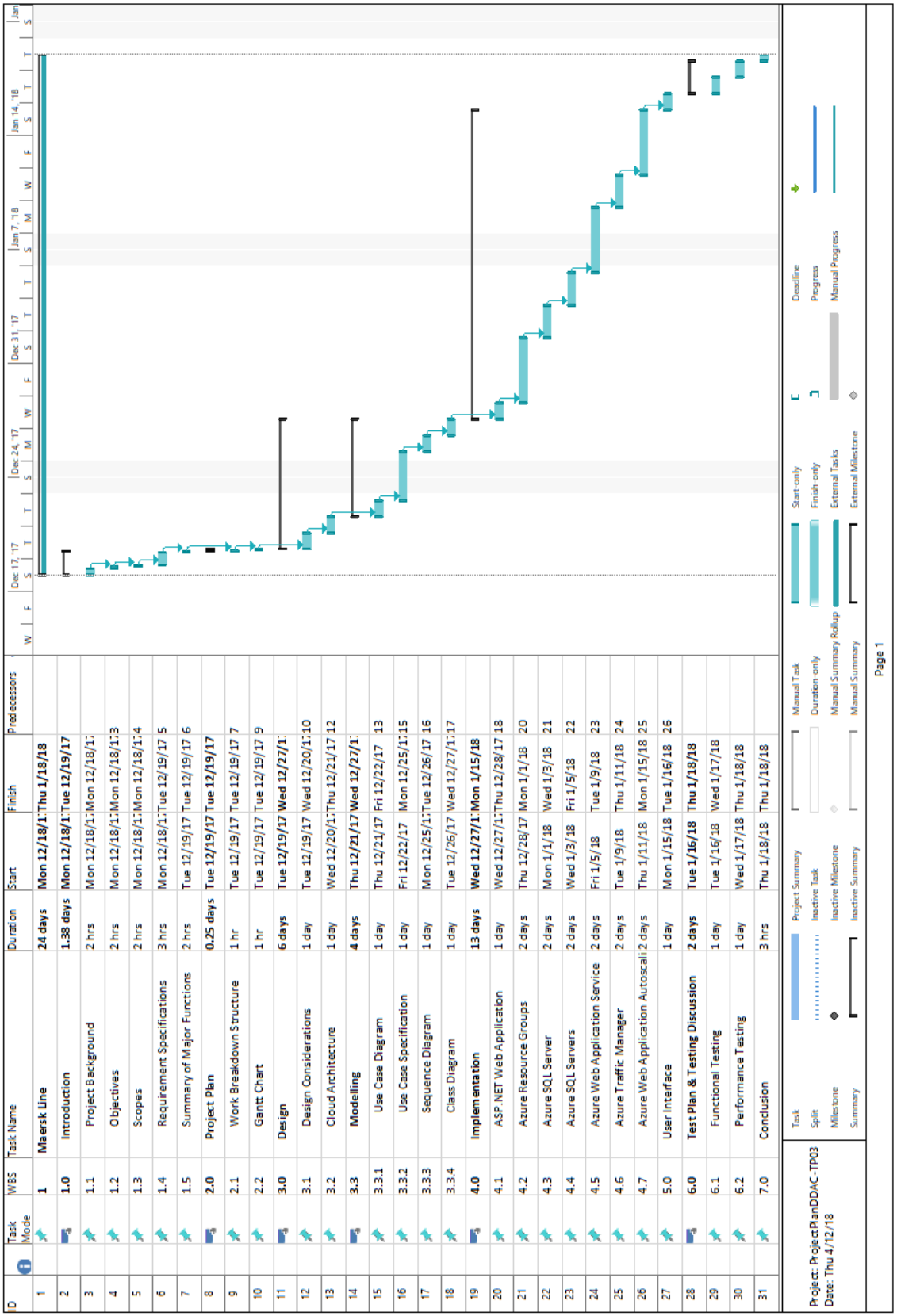


Figure 2.2 Gantt Chart

# 3.0 Design

## 3.1 Design Considerations

Before designing the models, some considerations are needed to be undertaken to ensure the system will be designed efficiently. Since Maersk Line is going to expand their business, considerations in the sense of data consolidation, moving to cloud platform, ability to scale the system for meeting the needs of demands during peak seasons, and more are very essential for building the solution. The solution is expected to be developed to improve organizational flexibility and support further business growth within a given budget and time span.

## 3.2 Cloud Architecture

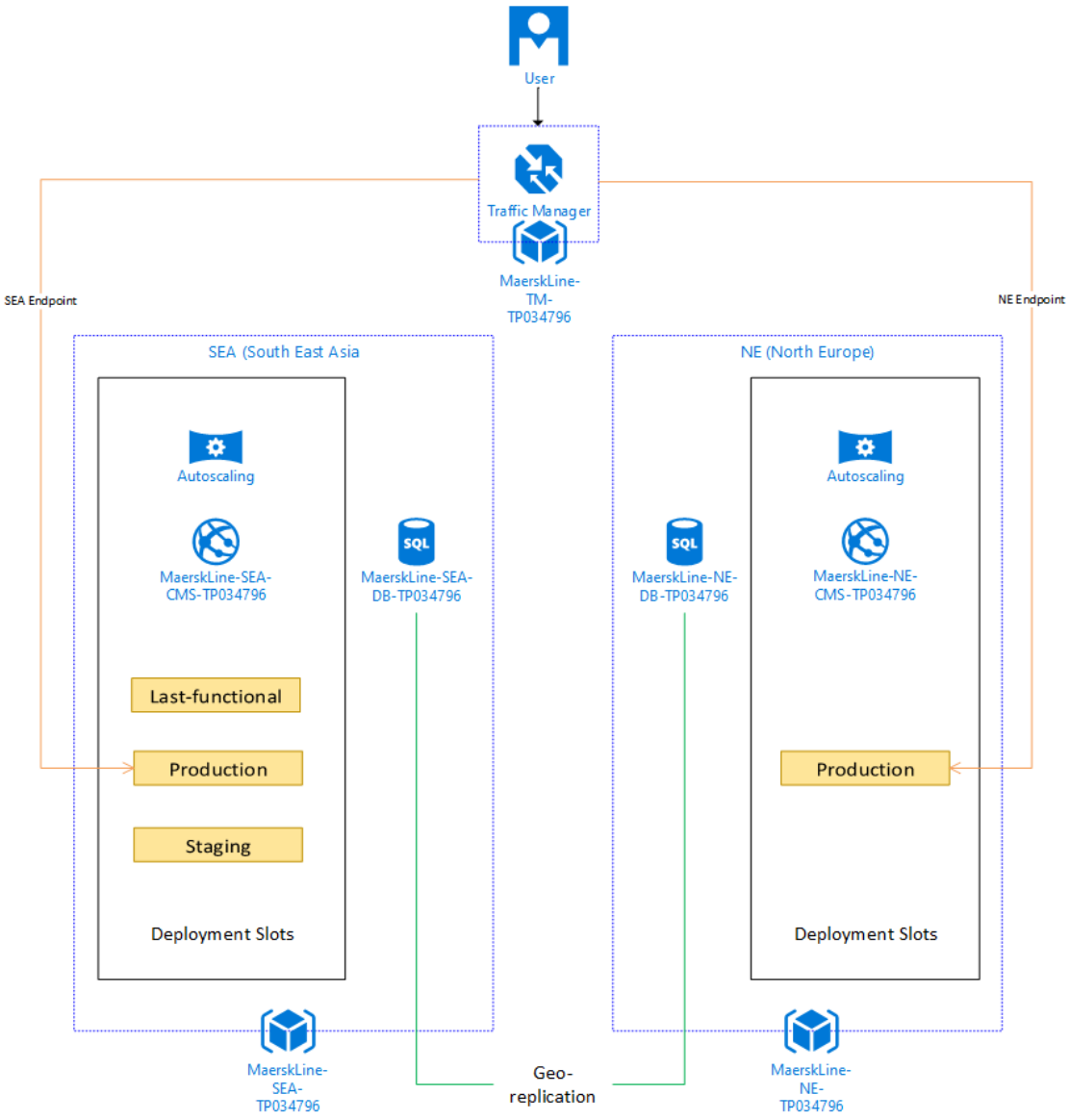


Figure 3.2 Cloud Architecture

Figure above shows the deployment of Maersk Line Project onto Microsoft Azure cloud platform. SEA (South East Asia) region is selected as the primary service while the NE (North Europe) region is selected as the secondary service for the demonstration. A traffic manager is used to determine which service to redirect the user based on the location of particular user. A SQL Database is available to write data from user and read data for user. The SQL Database of NE is secondary where it was geo-replicated from the primary SQL Database which is the SEA. The NE SQL Database also having a failover policy where it will be executed for any catastrophic incident. The autoscaling service is provided for scaling the web app to optimize performance for users.

## 3.3 Modelling

### 3.3.1 Use Case Diagram

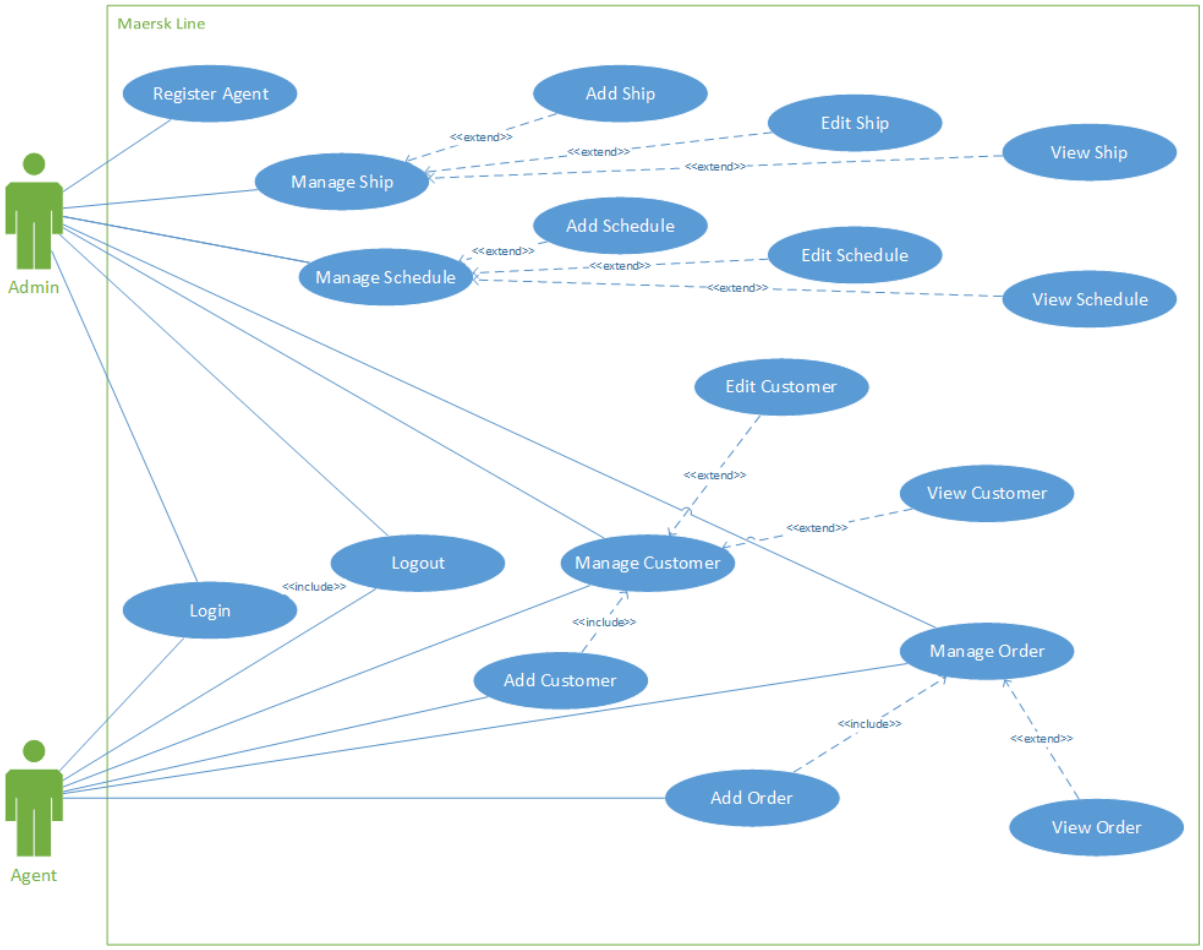


Figure 3.3.1 Use Case Diagram

### 3.3.2 Use Case Specification

| | |
|---|---|
| **Use case:** | Login |
| **Summary:** | The user is able to login to the system and access the functionalities provided. |
| **Dependency:** | - |
| **Actors:** | Admin, Agent |
| **Precondition:** | The system displays the Login Page. |
| **Description of main sequence:** | 1. The user enters username and password.<br>2. The system will verify the credentials provided by the user.<br>3. The user clicks on 'Login' button |
| **Description of alternative sequence:** | 1(a). If the credentials are incorrect, an error message will be displayed. |
| **Post condition:** | The user is able to access functionalities based on different authorities. |

| | |
|---|---|
| **Use case:** | Admin Register Agent |
| **Summary:** | The admin is able to register new agents. |
| **Dependency:** | - |
| **Actors:** | Admin |
| **Precondition:** | The system displays the Register Page. |
| **Description of main sequence:** | 1. The user enters details of new agent.<br>2. The user clicks on 'Register button |
| **Description of alternative sequence:** | - |
| **Post condition:** | A new agent is added. |

| | |
|---|---|
| **Use case:** | Admin Manage Ship |
| **Summary:** | The admin is able to manage ships. |
| **Dependency:** | <<extend>> Add Ship<br><<extend>> Edit Ship<br><<extend>> View Ship |
| **Actors:** | Admin |
| **Precondition:** | The system displays the admin homepage. |
| **Description of main sequence:** | If the user has chosen to<br>1. Add Ship<br>a. Enter ship details<br>b. Click on 'Save' button<br>2. Edit Ship<br>a. Select a ship<br>b. Enter new ship details<br>c. Click on 'Save' button<br>3. View Ship<br>a. Click on 'View Ship' |
| **Description of alternative sequence:** | - |
| **Post condition:** | For<br>1. Add Ship |

| | |
|---|---|
| | a. A new ship will be added<br>2. Edit Ship<br>a. The ship will be updated<br>3. View Ship<br>a. The ships will be displayed |

| | |
|---|---|
| **Use case:** | Admin Manage Schedule |
| **Summary:** | The admin is able to manage schedules. |
| **Dependency:** | <<extend>> Add Schedule<br><<extend>> Edit Schedule<br><<extend>> View Schedule |
| **Actors:** | Admin |
| **Precondition:** | The system displays the admin homepage. |
| **Description of main sequence:** | If the user has chosen to<br>1. Add Schedule<br>a.Enter schedule details<br>b. Select a ship<br>c. Click on 'Save' button<br>2.Edit Schedule<br>d. Select a schedule<br>e. Enter new schedule details<br>f. Click on 'Save' button<br>3.View Schedule<br>g. Click on 'View Schedule |
| **Description of alternative sequence:** | - |
| **Post condition:** | For<br>1.Add Schedule<br>a. A new schedule will be added<br>2. Edit Schedule<br>a. The schedule will be updated<br>3. View Schedule<br>a. The schedules will be displayed |

| | |
|---|---|
| **Use case:** | Admin Manage Customer |
| **Summary:** | The admin is able to manage customers. |
| **Dependency:** | <<extend>> Edit Customer<br><<extend>> View Customer |
| **Actors:** | Admin |
| **Precondition:** | The system displays the admin homepage. |
| **Description of main sequence:** | If the user has chosen to<br>1. Edit Customer<br>a. Select a customer<br>b. Enter new customer details<br>c. Click on 'Save' button<br>2. View Customer<br>a. Click on 'View Customer |

| | |
|---|---|
| **Description of alternative sequence:** | - |
| **Post condition:** | For<br>1.Edit Customer<br>a. The customer will be updated<br>2.View Customer<br>a.The customers will be displayed |

| | |
|---|---|
| **Use case:** | Admin View Order |
| **Summary:** | The admin is able to manage orders. |
| **Dependency:** | - |
| **Actors:** | Admin |
| **Precondition:** | The system displays the admin homepage. |
| **Description of main sequence:** | Click on 'View Order' |
| **Description of alternative sequence:** | - |
| **Post condition:** | The orders will be displayed |

| | |
|---|---|
| **Use case:** | Agent Manage Customer |
| **Summary:** | The agent is able to manage customers. |
| **Dependency:** | <<extend>> Add Customer<br><<extend>> Edit Customer<br><<extend>> View Customer |
| **Actors:** | Agent |
| **Precondition:** | The system displays the agent homepage. |
| **Description of main sequence:** | If the user has chosen to<br>1.Add Customer<br>a.Enter customer details<br>b. Click on 'Save' button<br>2.Edit Customer<br>a. Select a customer<br>b.Enter new customer details<br>c. Click on 'Save' button<br>3.View Customer<br>a.Click on 'View Customer |
| **Description of alternative sequence:** | - |
| **Post condition:** | For<br>1.Add Customer<br>a.A new customer will be added<br>2.Edit Customer<br>d. The customer will be updated<br>3. View Customer<br>a. The customers added by particular agent will be displayed |

| | |
|---|---|
| **Use case:** | Agent Manage Order |
| **Summary:** | The agent is able to manage orders. |
| **Dependency:** | <<extend>> Add Order<br><<extend>> View Order |
| **Actors:** | Agent |
| **Precondition:** | The system displays the agent homepage. |
| **Description of main sequence:** | If the user has chosen to<br>1. Add Order<br>a. Enter order details<br>b. Click on 'Save' button<br>2. View Order<br>a. Click on 'View Order |
| **Description of alternative sequence:** | - |
| **Post condition:** | For<br>1.Add Order<br>a. A new order will be added<br>2.View Order<br>b. The orders added by particular agent will be displayed |

## 3.3.3 Sequence Diagram

### *3.3.3.1 Login*

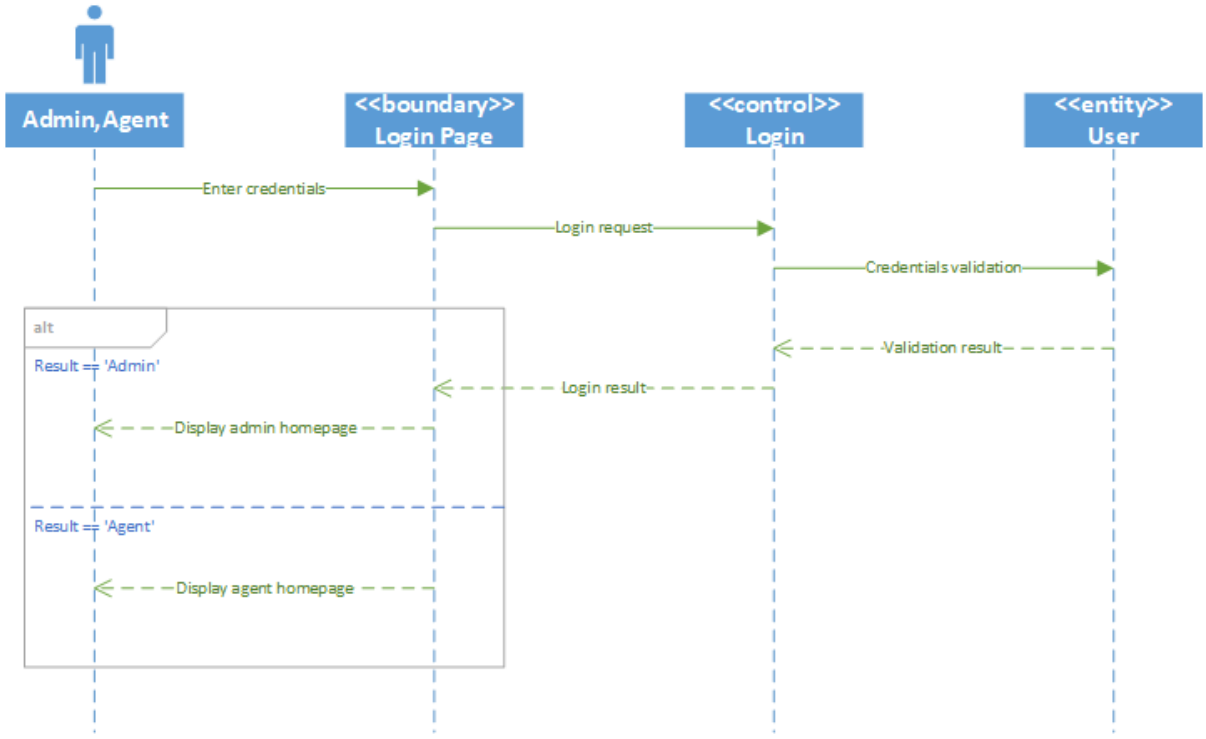


Figure 3.3.3.1 Login

### *3.3.3.2 Admin Register Agent*

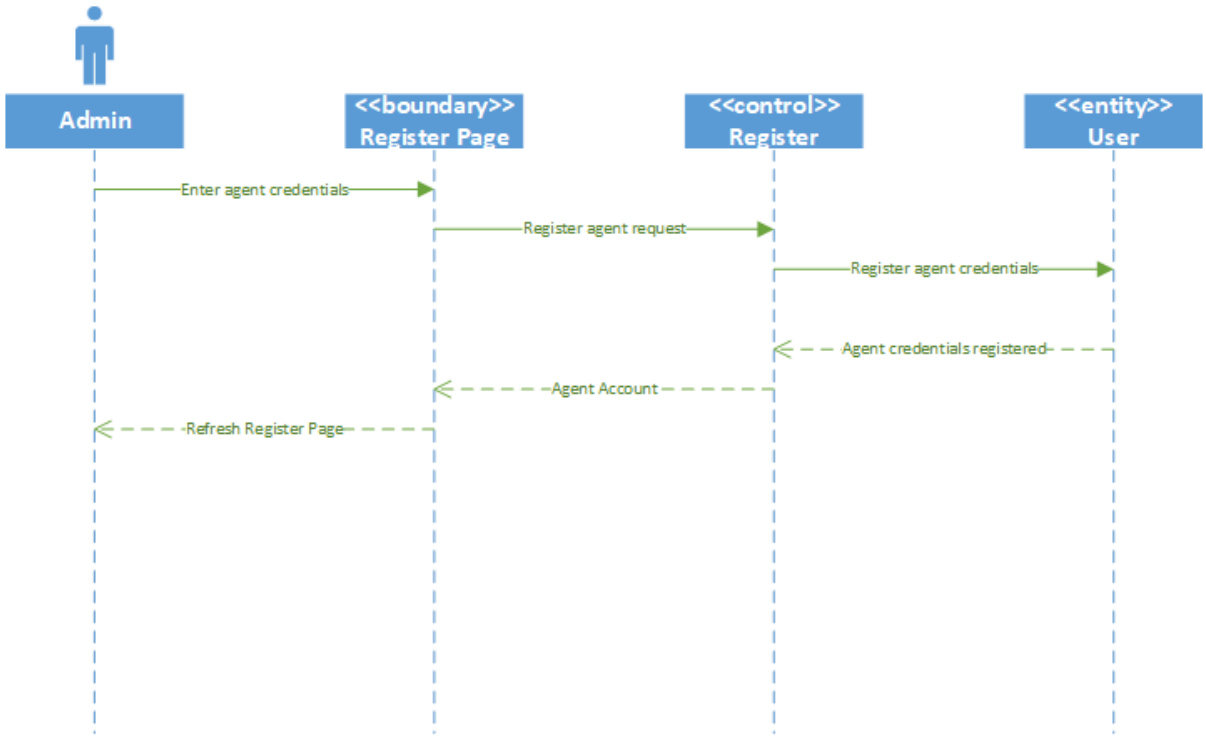


Figure 3.3.3.2 Admin Register Agent

### *3.3.3.3 Admin Manage Ship*

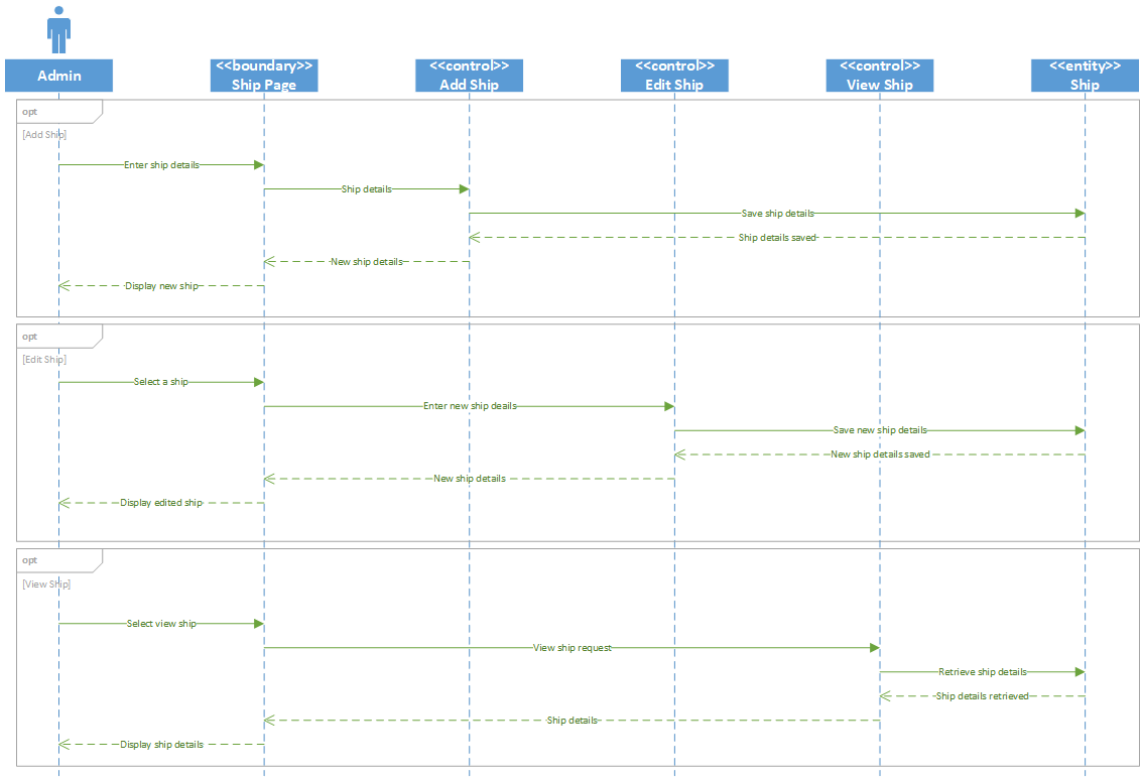


Figure 3.3.3.3 Admin Manage Ship

### *3.3.3.4 Admin Manage Schedule*

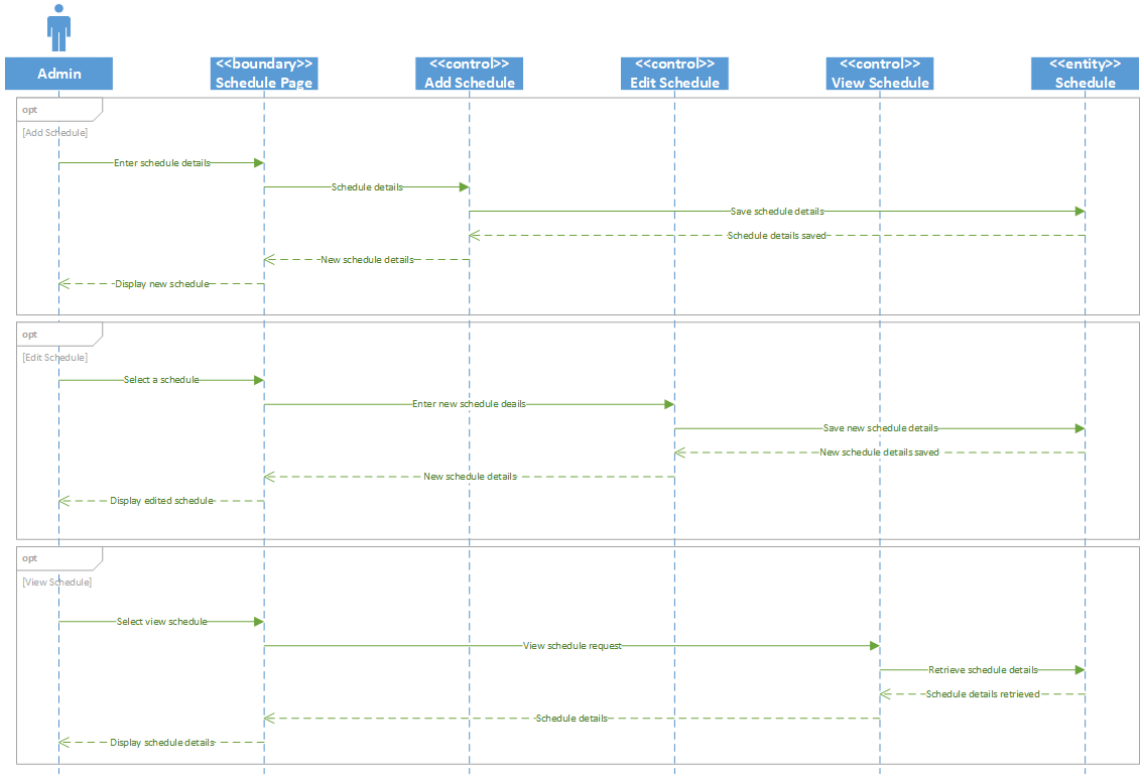


Figure 3.3.3.4 Admin Manage Schedule

### *3.3.3.5 Admin Manage Customer*

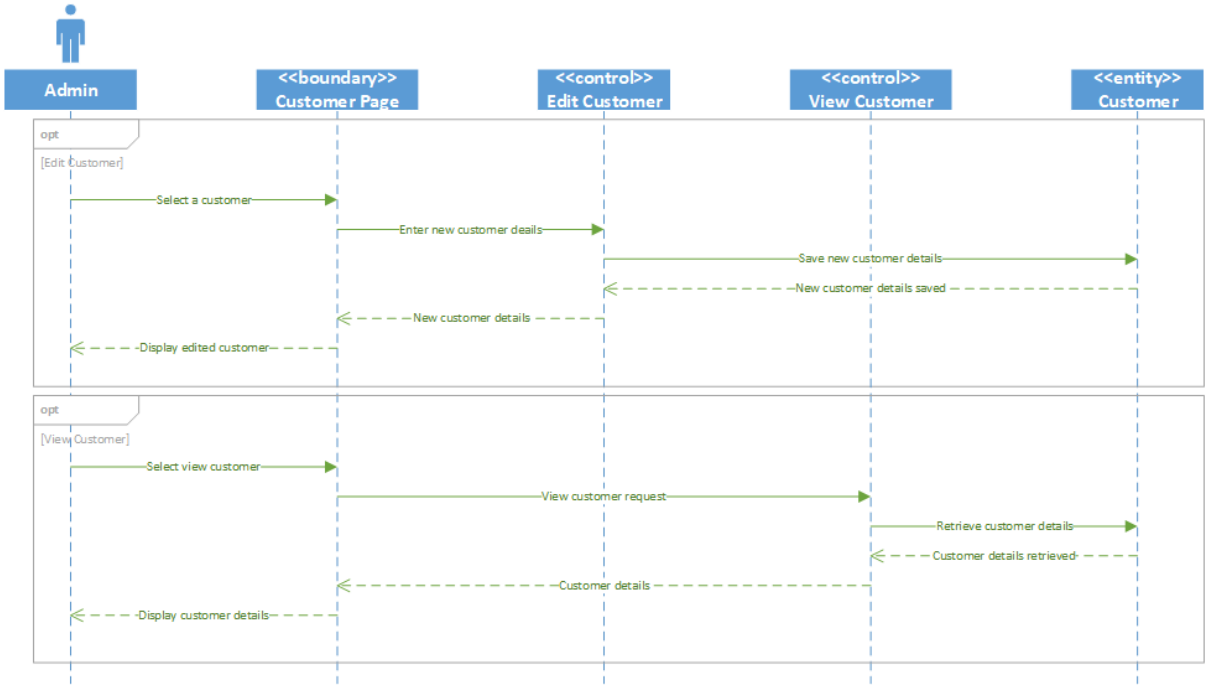


Figure 3.3.3.5 Admin Manage Customer

### *3.3.3.6 Admin View Order*

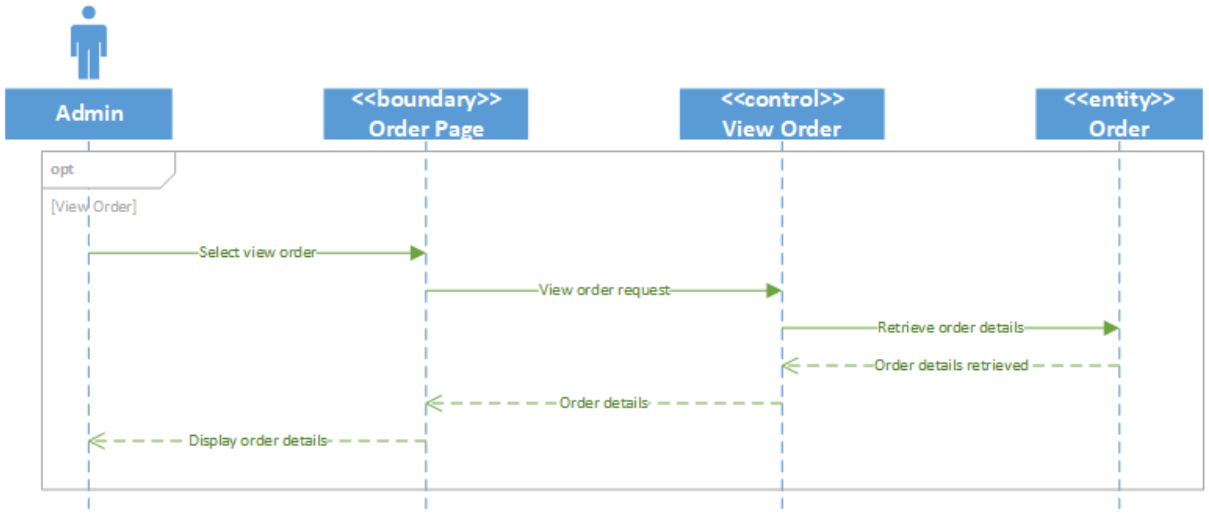


Figure 3.3.3.6 Admin View Order

### *3.3.3.7 Agent Manage Customer*

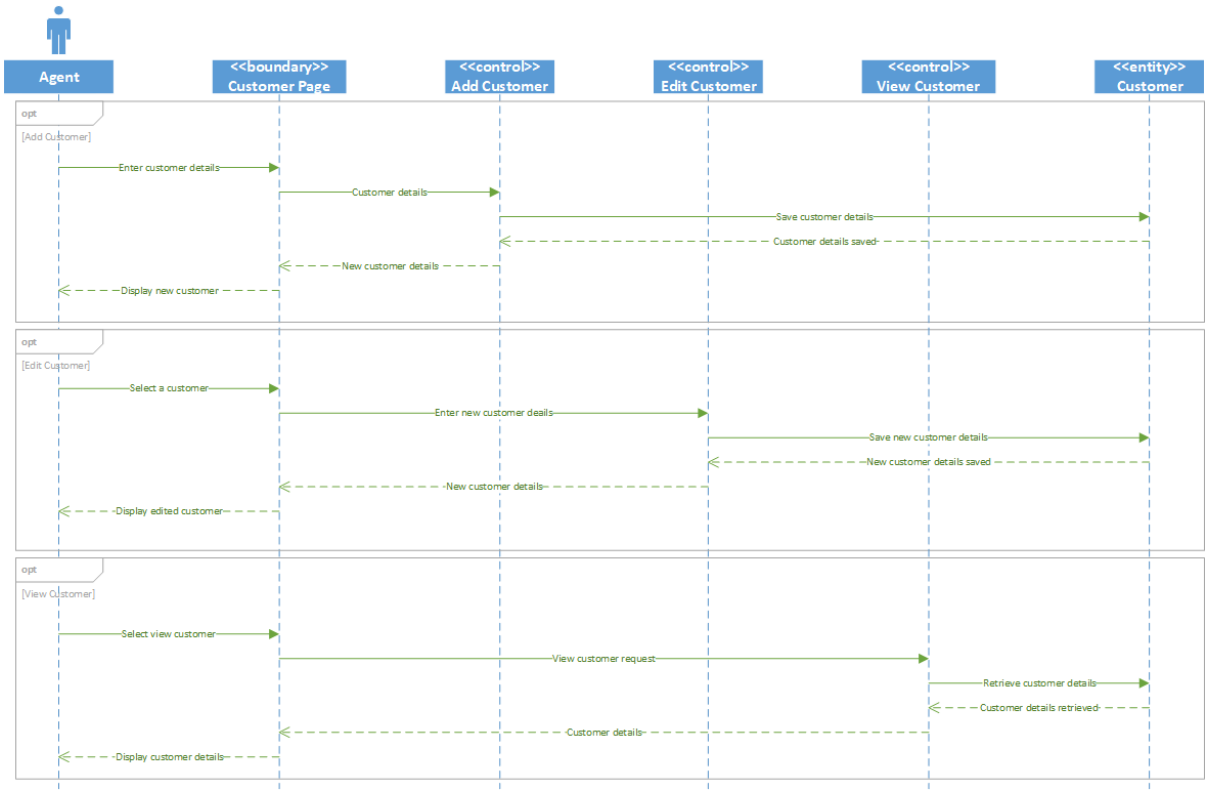


Figure 3.3.3.7 Agent Manage Customer

### *3.3.3.8 Agent Manage Order*

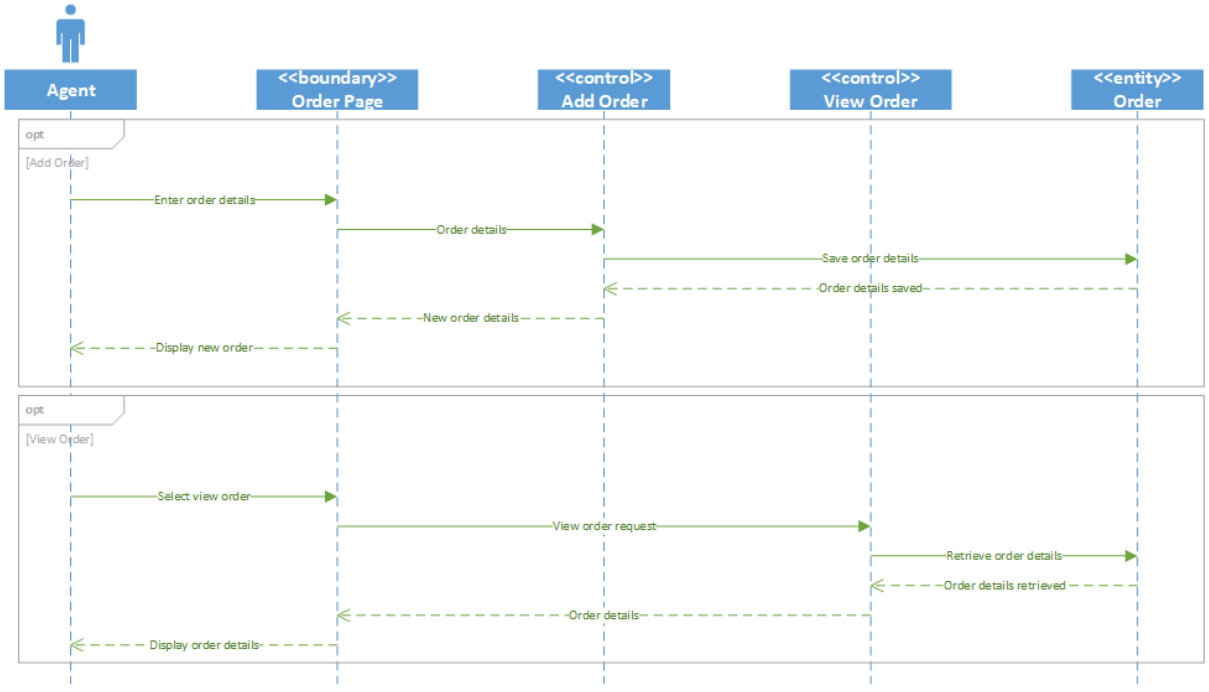


Figure 3.3.3.8 Agent Manage Order

### 3.3.4 Class Diagram

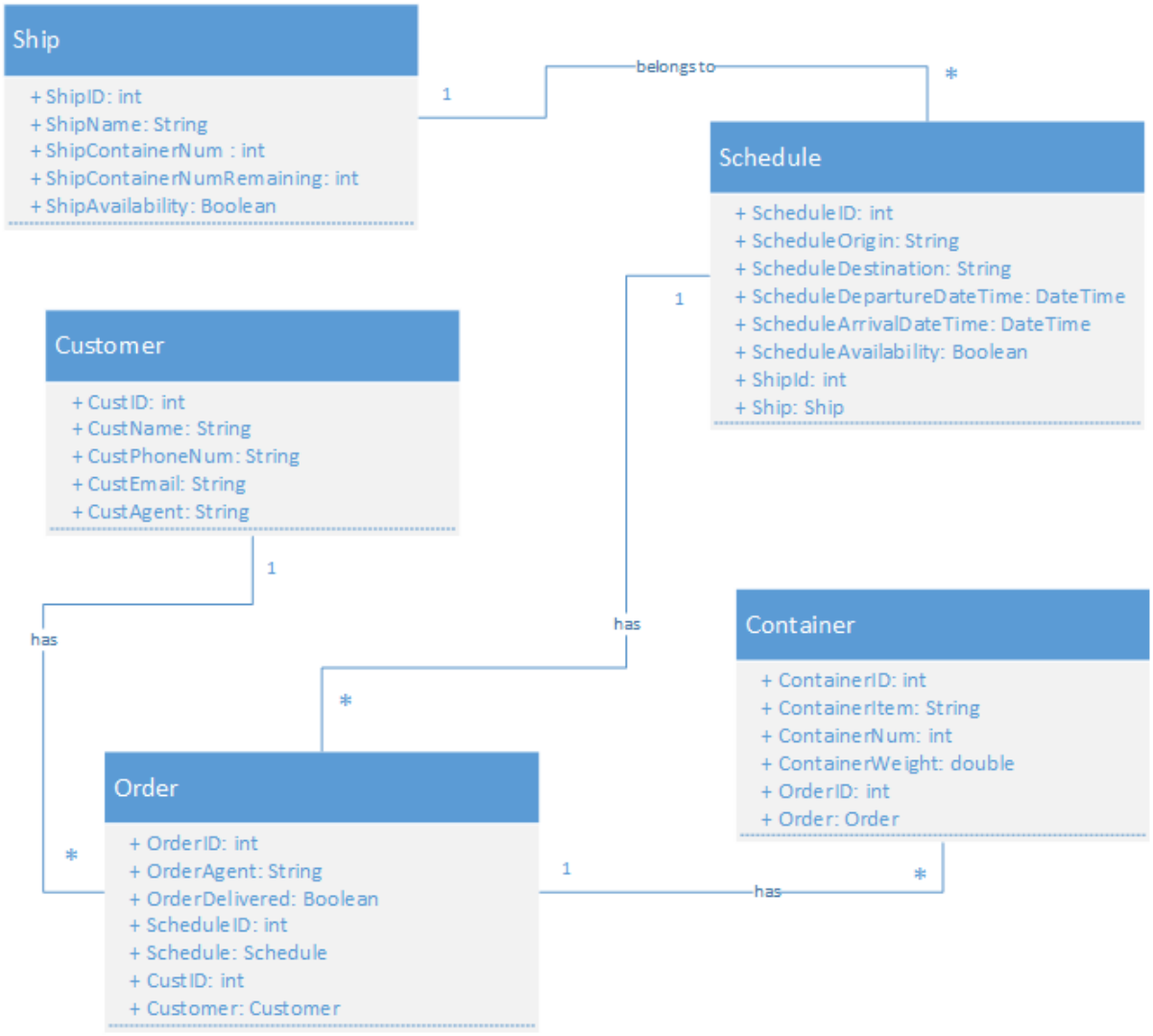


Figure 3.3.4 Class Diagram

# 4.0 Implementation

## 4.1 ASP.NET Web Application

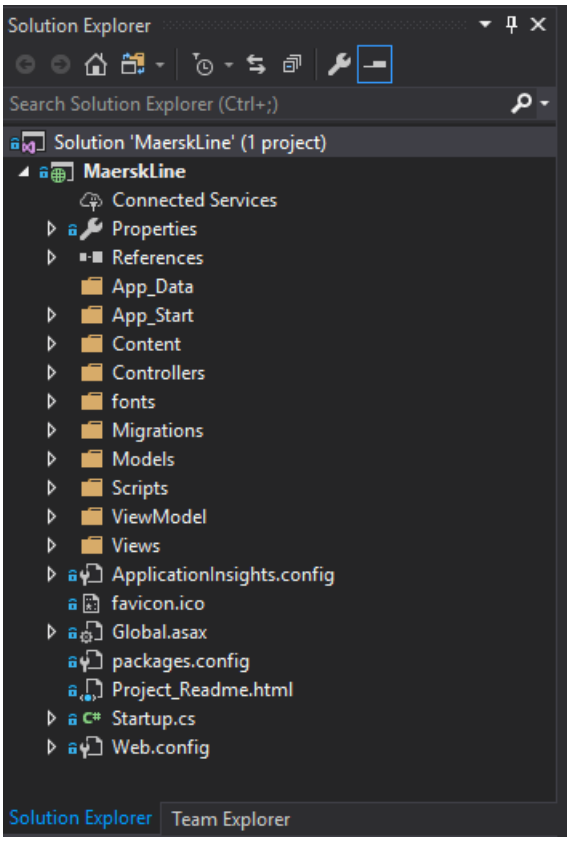


Figure 4.1 Maersk Line Project

The Maersk Line Project is developed using ASP.NET MVC 5 in Visual Studio 2017 with the help of Bootstrap and JavaScript. ASP.NET MVC 5 is a technology that allows to build dynamic websites using Model-View-Controller technology which emphasizes on clean architecture, test-driven development, and extensibility (Sabnis, 2014). Bootstrap is the most popular framework consists of HTML (Hypertext Markup Language), CSS (Cascading Style Sheets), and JS (JavaScript) to develop responsive, mobile first projects on the web (Rascia, 2015). JavaScript is a scripting language that allows to create dynamically updating content, HTML is a markup language to structure and vie meaning to web content, and CSS is a language of style rules to apply styling to the HTML content (Alanfeld, 2018). The collaboration among these components are the essential elements to build up the Maersk Line Project.

## 4.2 Azure Resource Groups

| NAME | SUBSCRIPTION | LOCATION |
|---|---|---|
| MaerskLine-NE-DB-TP034796 | Free Trial | North Europe |
| MaerskLine-NE-TP034796 | Free Trial | North Europe |
| MaerskLine-SEA-DB-TP034796 | Free Trial | Southeast Asia |
| MaerskLine-SEA-TP034796 | Free Trial | Southeast Asia |
| MaerskLine-TM-TP034796 | Free Trial | Southeast Asia |

Figure 4.2 Maersk Line Resource Groups

The figure above shows the resource groups created in Azure for the Maersk Line Project. A resource group is an identifier that will be applied by Azure Resource Manager with resources to group them together (Microsoft, 2017).

### 4.2.1 Resource Groups of Web Application Service

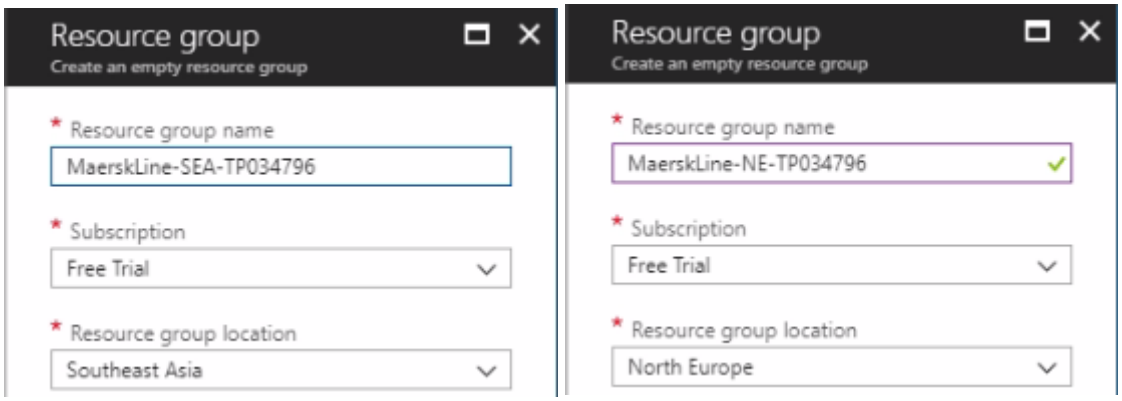


Figure 4.2.1 Resource Groups of Web Application Service

There are 2 resources groups being created in which differentiated as primary and secondary web application. The name of both resource groups is distinctive where the primary resource group is for SEA while the secondary resource group is for NE. A thing to be noted here is that **SEA is for South East Asia** while **NE is for North Europe** as the short forms will be massively used in following explanations.

### 4.2.2 Resource Groups of SQL Database

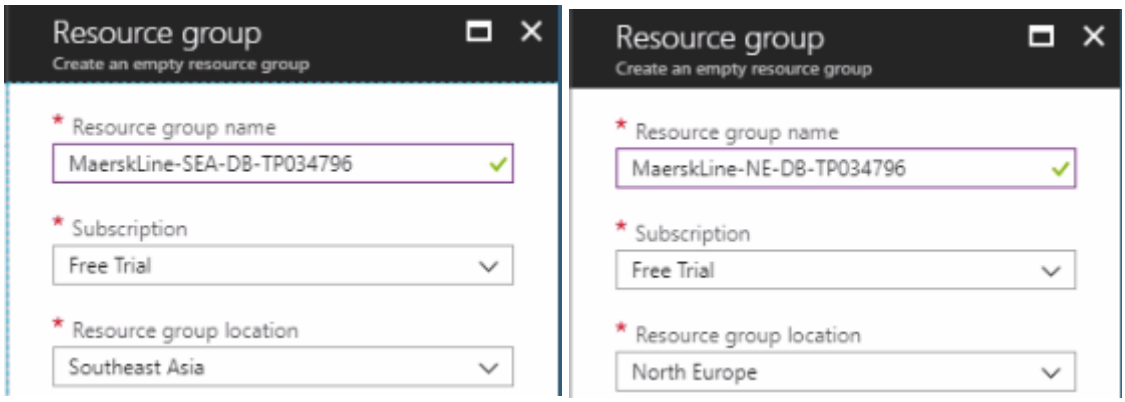


Figure 4.2.2 Resource Groups of SQL Database

Similar to web application, 2 resource groups will be created for SQL Database as well in which is separated into primary and secondary SQL Database too. The word DB in each resource group refers to Database.

### 4.2.3 Resource Group of Traffic Manager

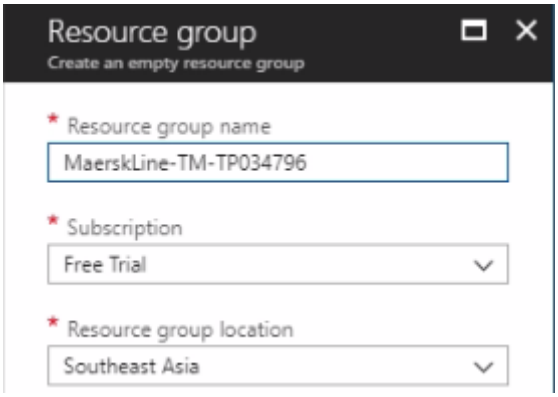


Figure 4.2.3 Resource Group of Traffic Manager

A resource group of Traffic Manager will be created as well and the word TM is referring to Traffic Manager.

## 4.3 Azure SQL Server

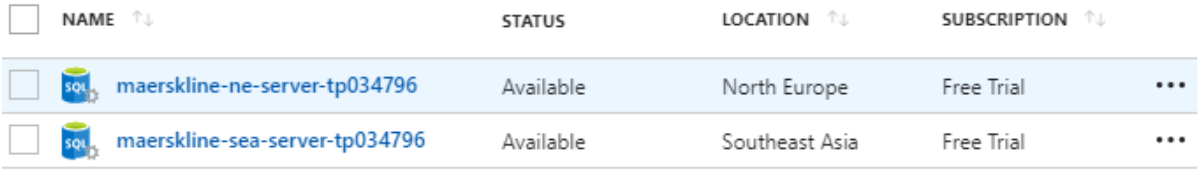


Figure 4.3 Azure SQL Server

There are 2 SQL Server being created as there are 2 SQL Database for Maersk Line Project. Azure SQL Server is having a shared code base with SQL Database (Microsoft, 2018).

### 4.3.1 Setup SQL Servers

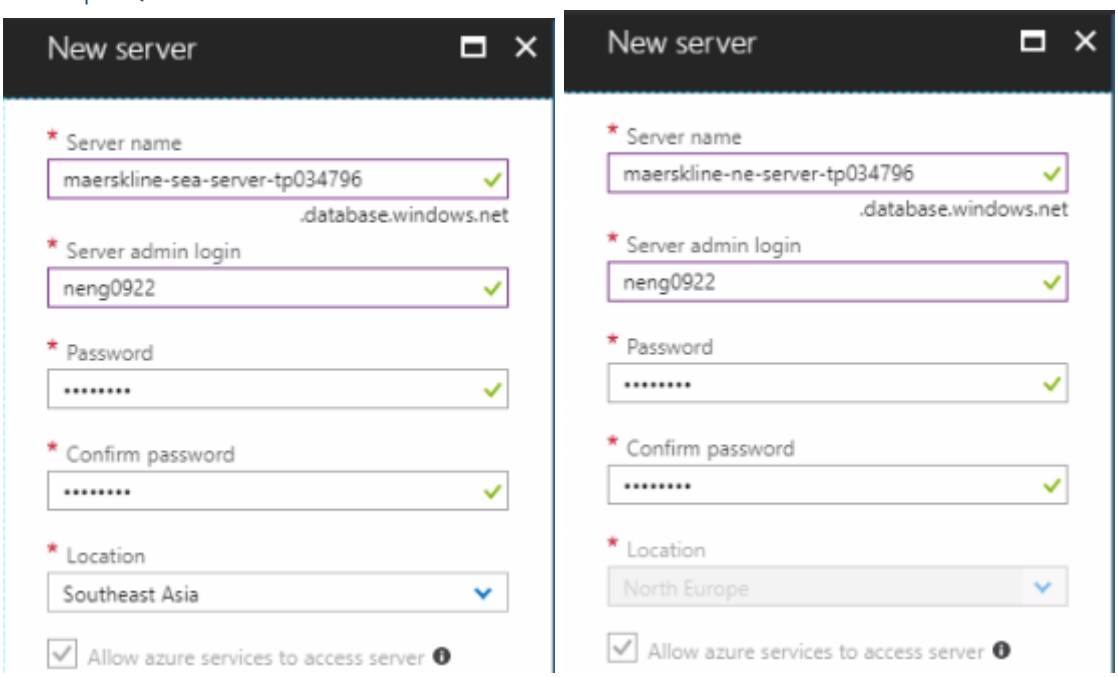


Figure 4.3.1 Setup SQL Servers

The SQL Server is required to host the SQL Database where the name of 2 SQL Servers are distinctive as shown in figure above.

## 4.4 Azure SQL Database

### 4.4.1 Setup Primary SQL Database

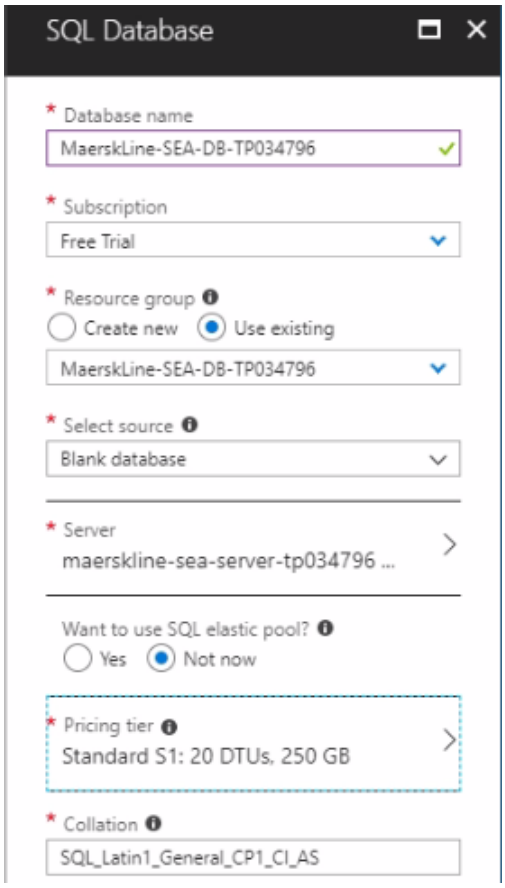


Figure 4.4.1 (a) Setup Primary SQL Database

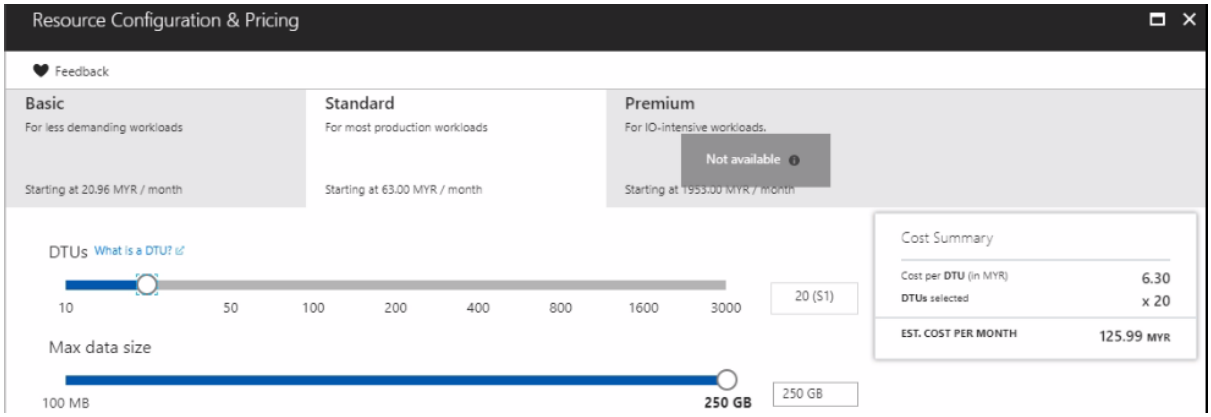


Figure 4.4.1 (b) SQL Resource Configuration & Pricing

The primary SQL Database is being created with the primary SQL Server selected. For resource configuration and pricing, the same configuration will be used for both primary and secondary SQL Database in which is 20 DTUs (Database Transaction Units) and 250 gigabytes of max data size.

### 4.4.2 Setup Secondary SQL Database

#### *4.4.2.1 Geo-Replicate Secondary Database*

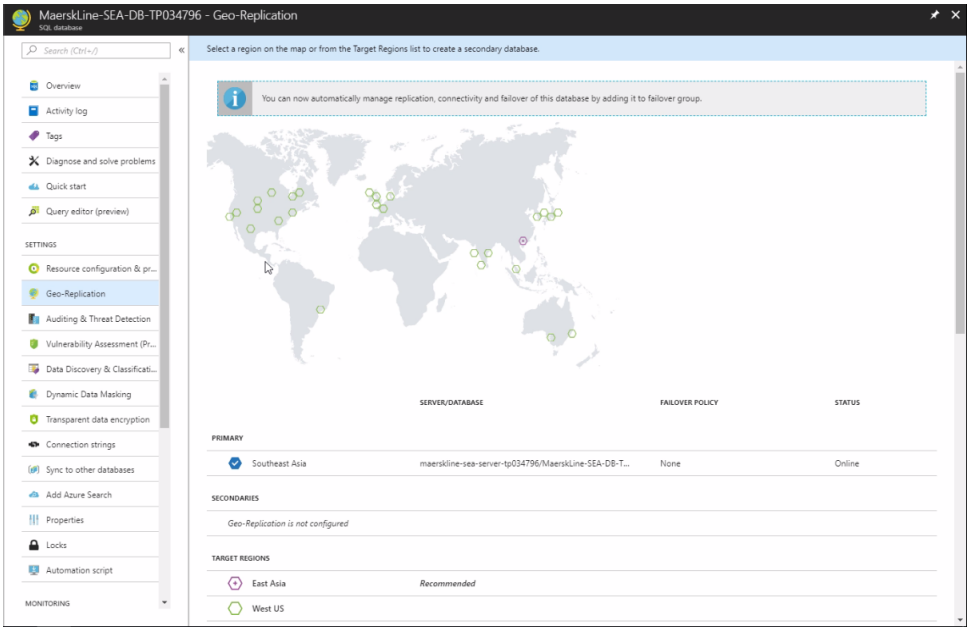


Figure 4.4.2.1 (a) Replicate Secondary Database

For creating the secondary SQL Database, a geo-replication will be used to replicate primary SQL Database to different region. An active geo-replication allows the secondary databases to query and available for failover is there's a data center outage or inability to connect the primary database (Microsoft, 2018).

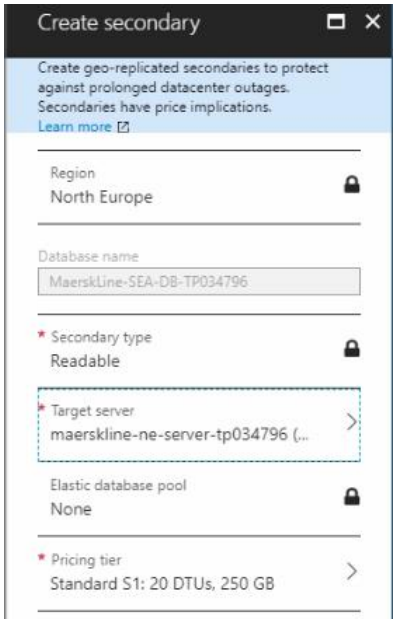


Figure 4.4.2.1 (b) Create Secondary SQL Database

NE is being selected as the secondary SQL Database with the selection of NE SQL Server.

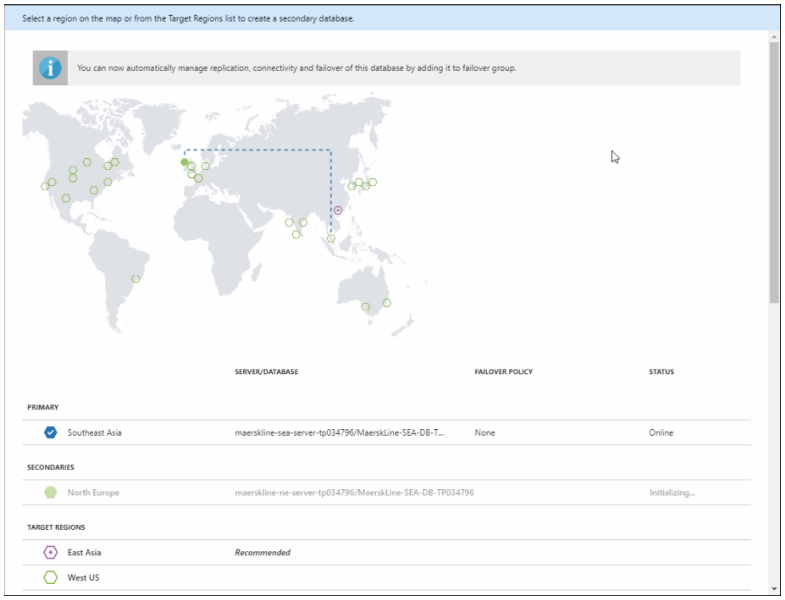


Figure 4.4.2.1 (c) Replicating Secondary Database

The dotted lines shown in figure above is the progress of geo-replicating the secondary SQL Database (NE) with primary Database (SEA).

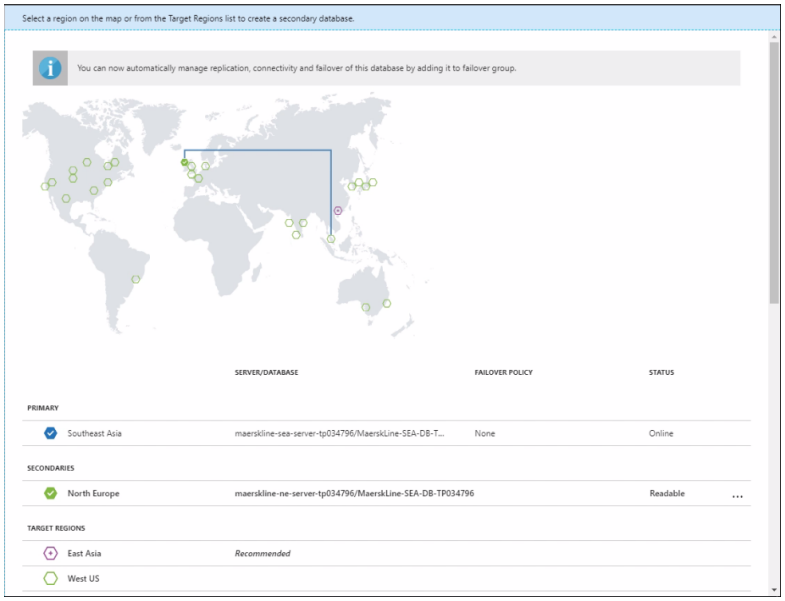


Figure 4.4.2.1 (d) Secondary Database Replicated

When the geo-replication is complete, a solid line will be displayed as shown in figure above.

### *4.4.2.2 Configure Failover Policy*

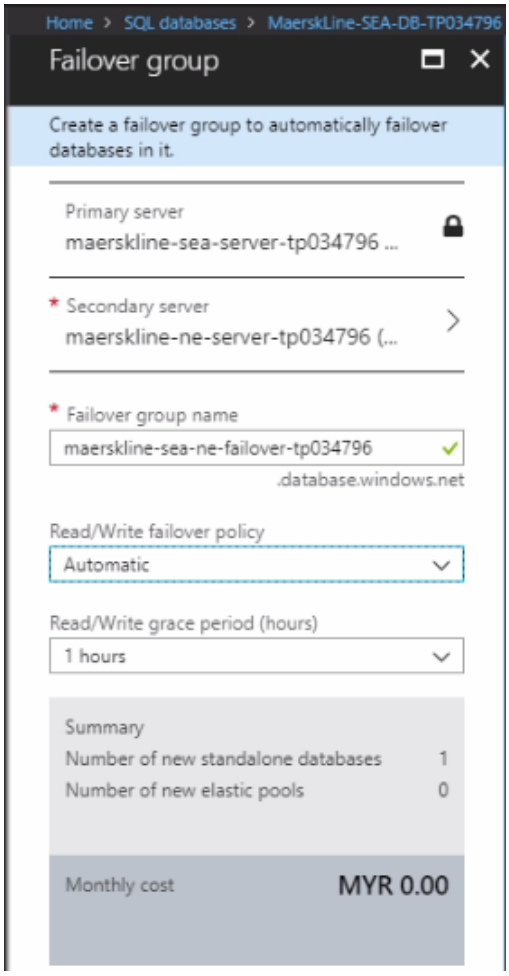


Figure 4.4.2.2 (a) Create Failover Group

The failover group will be created after the secondary database has been completely replicated. The Azure SQL Database auto-failover groups is a SQL Database feature designed to manage geo-replication relationship, connectivity, and failover at scale automatically (Microsoft, 2018). Primary server for failover group is SEA while secondary server is NE.

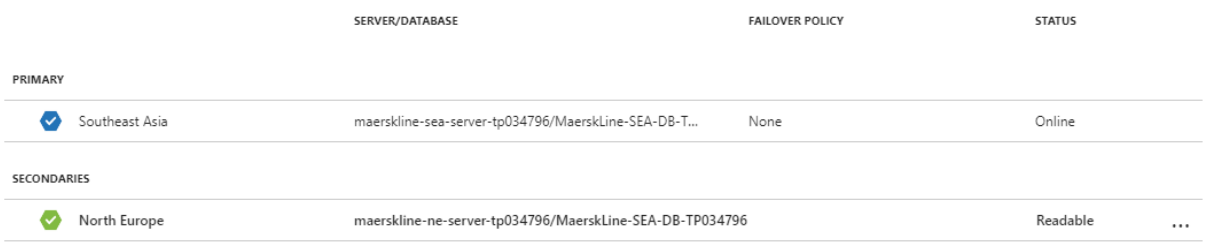


Figure 4.4.2.2 (b) Failover Policy Configured

Figure above is the result for a configured failover policy.

## 4.5 Azure Web Application Service

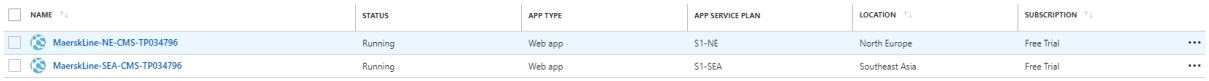


Figure 4.5 Azure Web Application Service

### 4.5.1 Setup Web Application Service

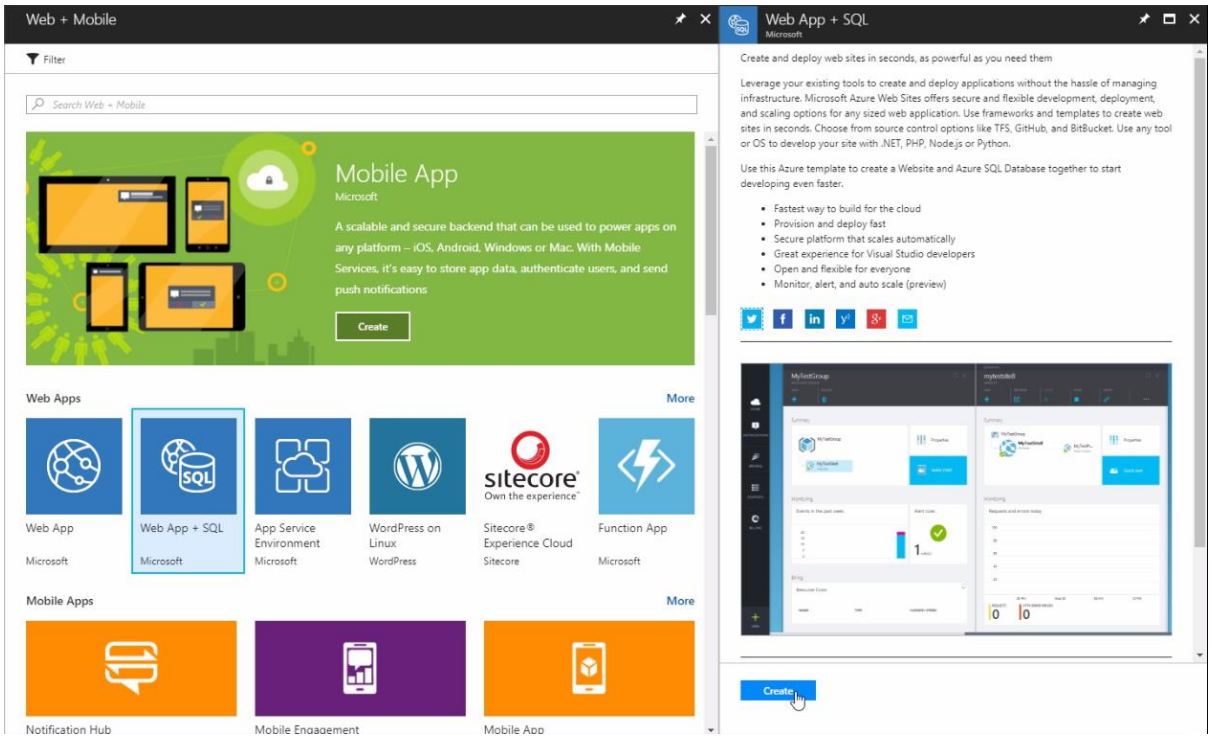


Figure 4.5.1 (a) Create Web App + SQL

Azure App Service is a service to host web applications which run and scale with ease on Windows-based environments (Microsoft, 2017). A web app with SQL will be created to host Maersk Line Project.

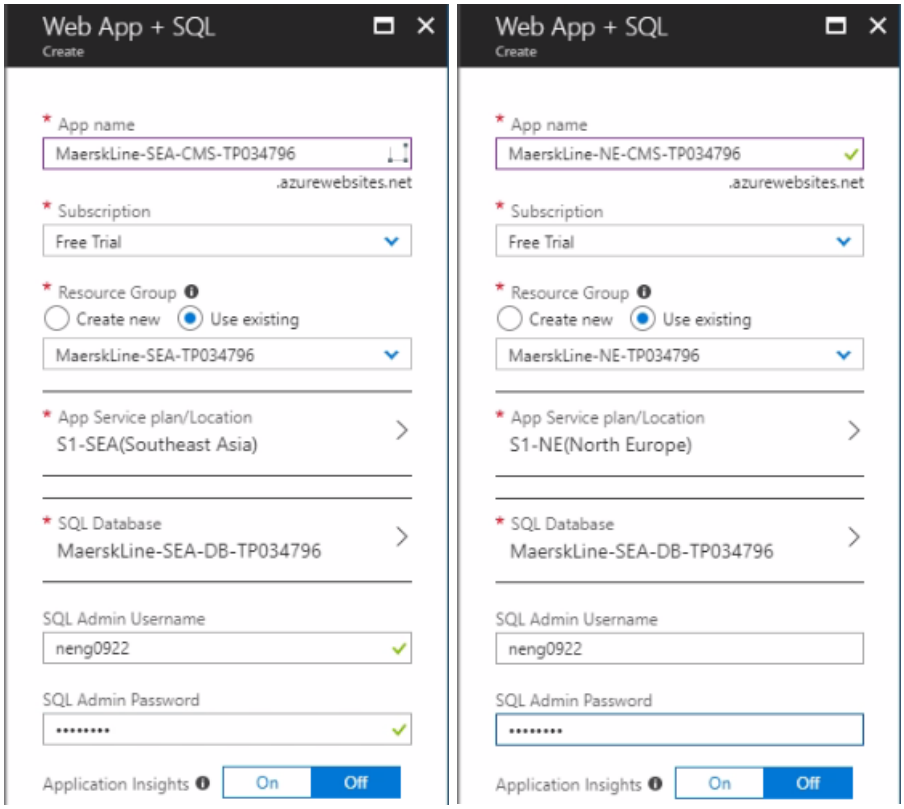


Figure 4.5.1 (b) Setup Web App + SQL

The web app with SQL will be created for both SEA and NE but with distinctive app name and using different resource group.

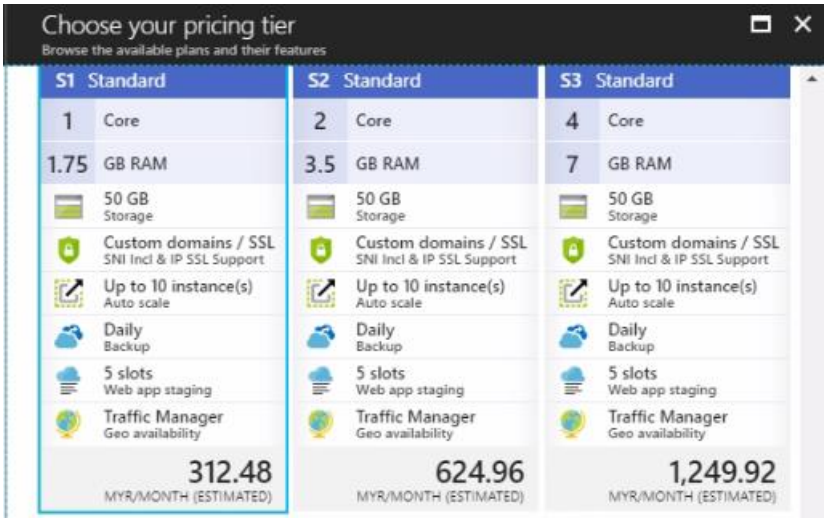


Figure 4.5.1 (c) Setup Web App Pricing Tier

The S1 Standard pricing tier is selected for both web apps as the specifications are enough for the demonstration of Maersk Line Project.

### 4.5.2 Deploy ASP.NET Web Application

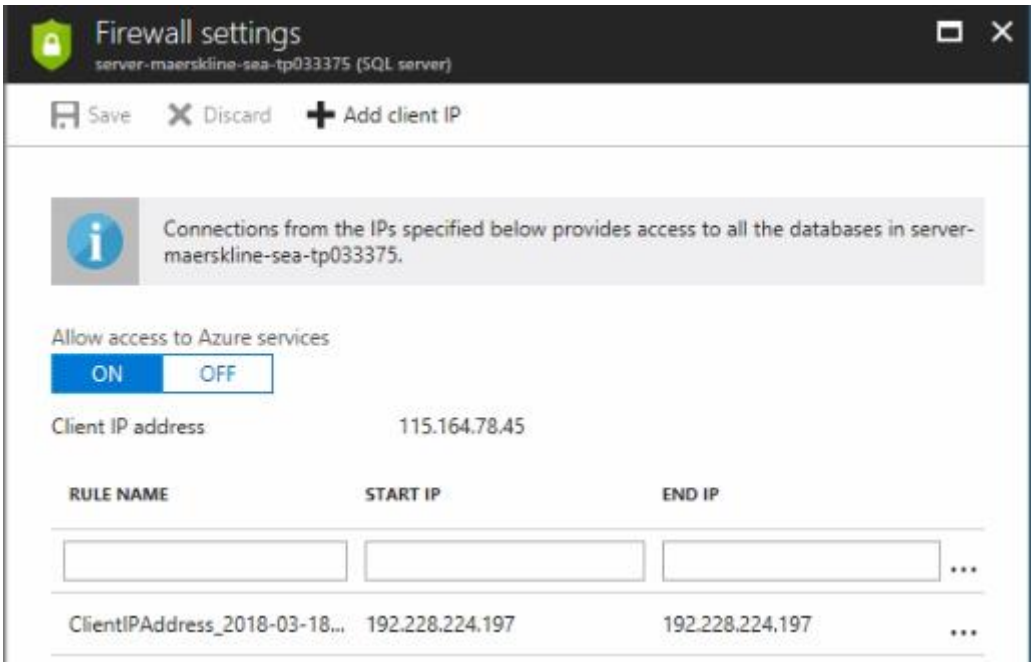


Figure 4.5.2 (a) Firewall Settings

Before publishing the Maersk Line Project, the client IP needs to be added for ensuring the IP address is allowed for further access.

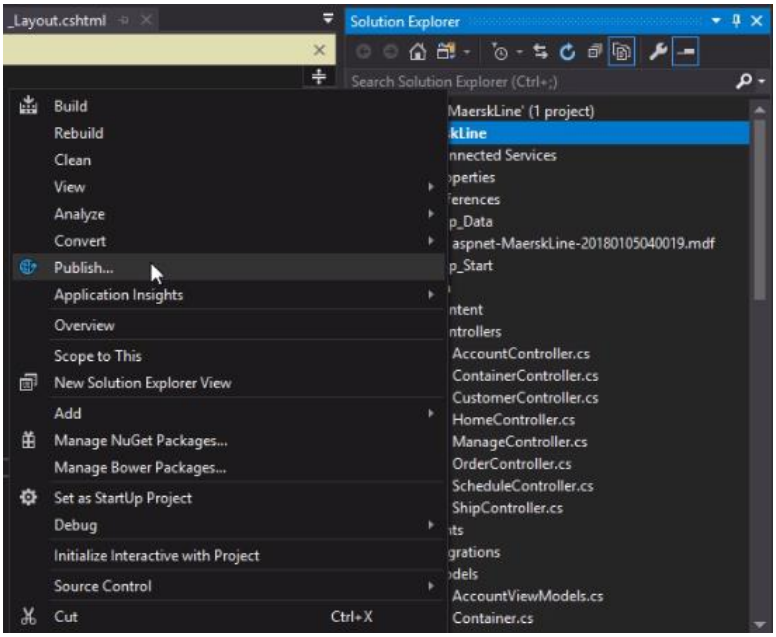


Figure 4.5.2 (b) Publish Maersk Line Project

After the setting up of resource groups, SQL Database, SQL Servers, and Web Apps with SQL are completed, the Maersk Line Project is able to be published onto Azure cloud platform.

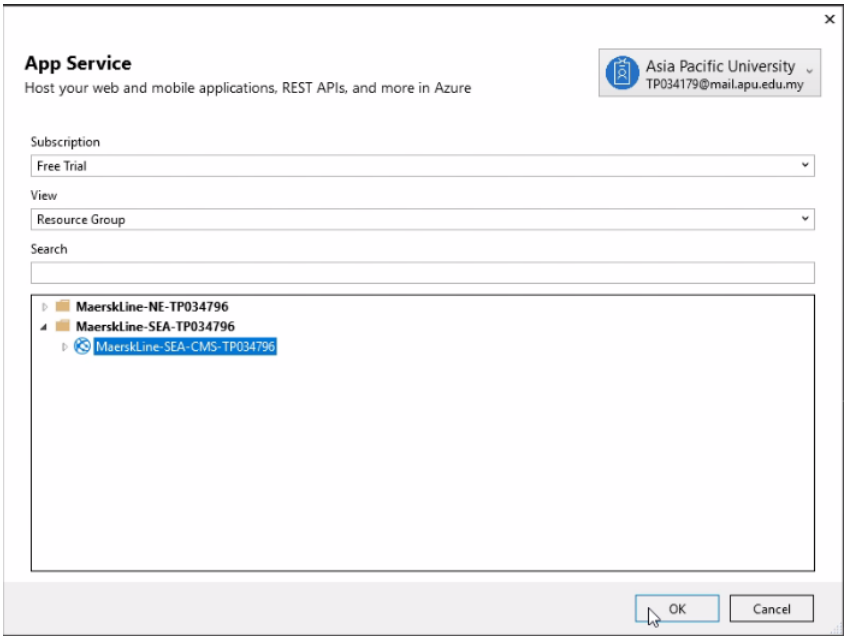


Figure 4.5.2 (c) Select App Service

The App Service of SEA will be firstly chosen first while the App Service of NE will be chosen after the App Service of SEA has finished publishing.

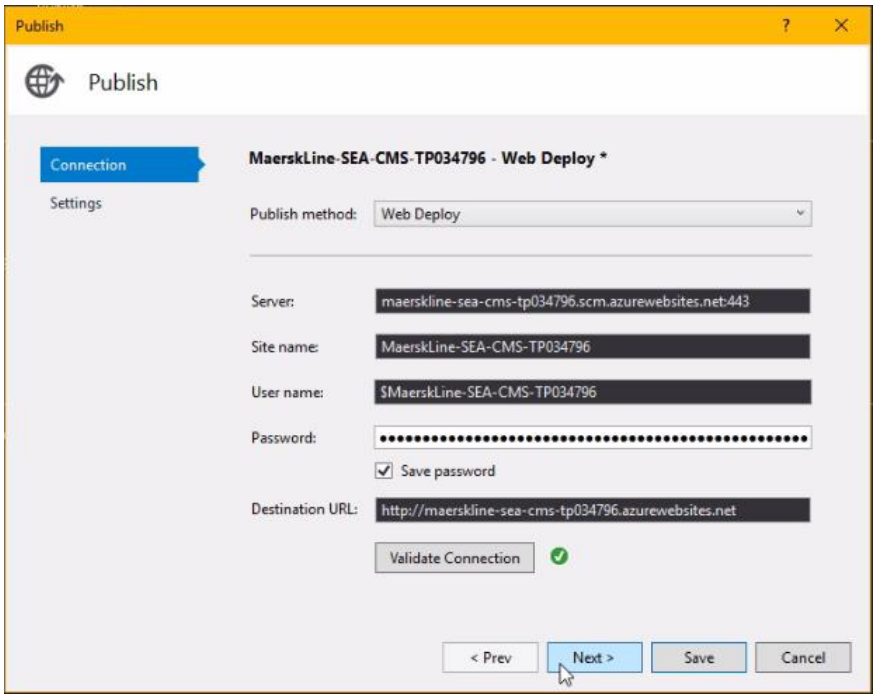


Figure 4.5.2 (d) Web App Publish Connection

For the Publish Connection, the ‘Web Deploy’ publish method will be chosen and connection will be validated first before proceeding to next step.

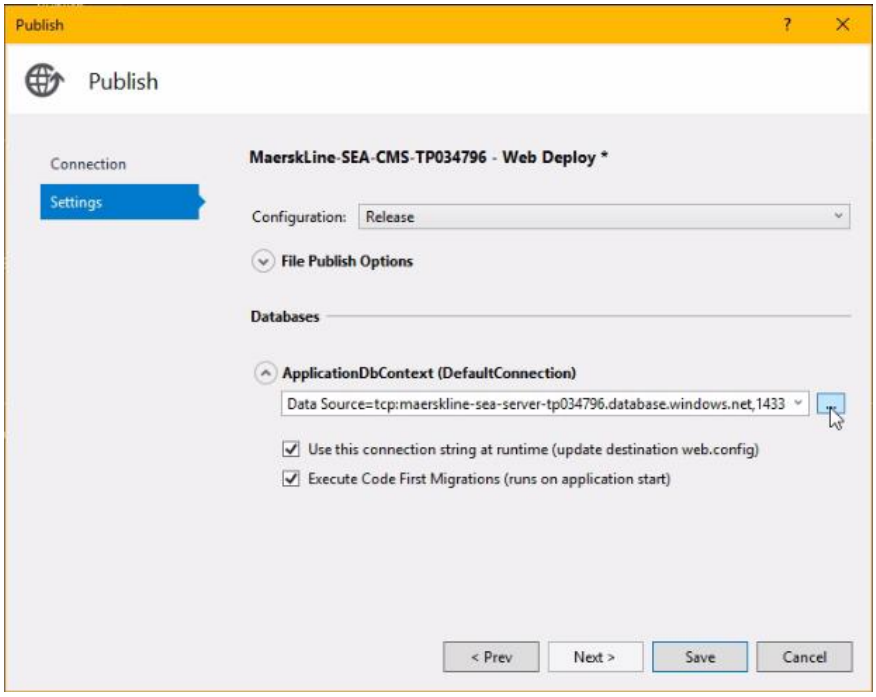


Figure 4.5.2 (e) Web App Publish Settings

For the Publish Settings, the ‘Release’ configuration will be chosen and the ‘Execute Code First Migration’ will also be selected. The reason for selecting the ‘Execute Code First Migration’ is because the solution was developed with code first migration.


Figure 4.5.2 (f) Web App of SEA

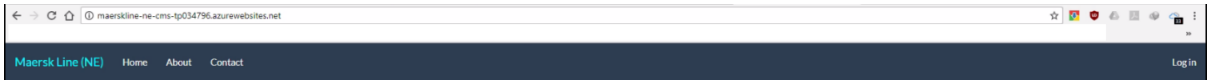


Figure 4.5.2 (g) Web App of NE

Figures above are the result of deployment for web app of both SEA and NE.

## 4.6 Azure Traffic Manager

### 4.6.1 Setup Traffic Manager Profile

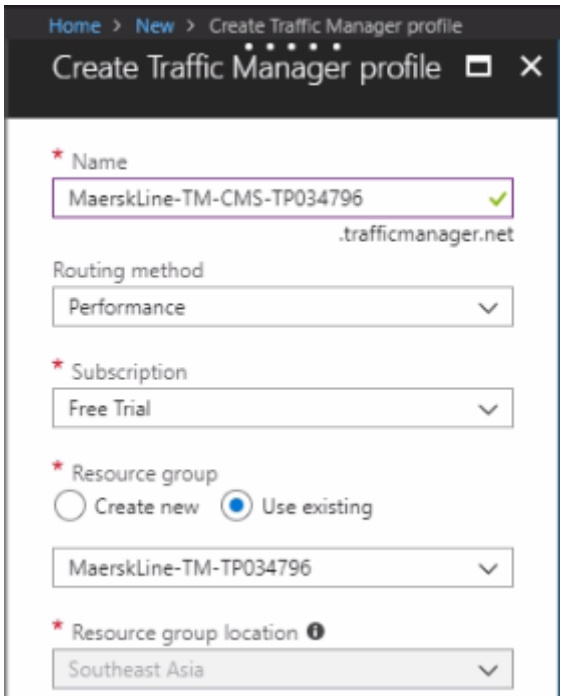


Figure 4.6.1 Create Traffic Manager Profile

After that, a Traffic Manager Profile will be created and the word 'TM' is referring to Traffic Manager. Traffic Manager Profile is using traffic-routing methods for controlling the distribution of traffic to the cloud services or website endpoints (Microsoft, 2017).

### 4.6.2 Setup Endpoints

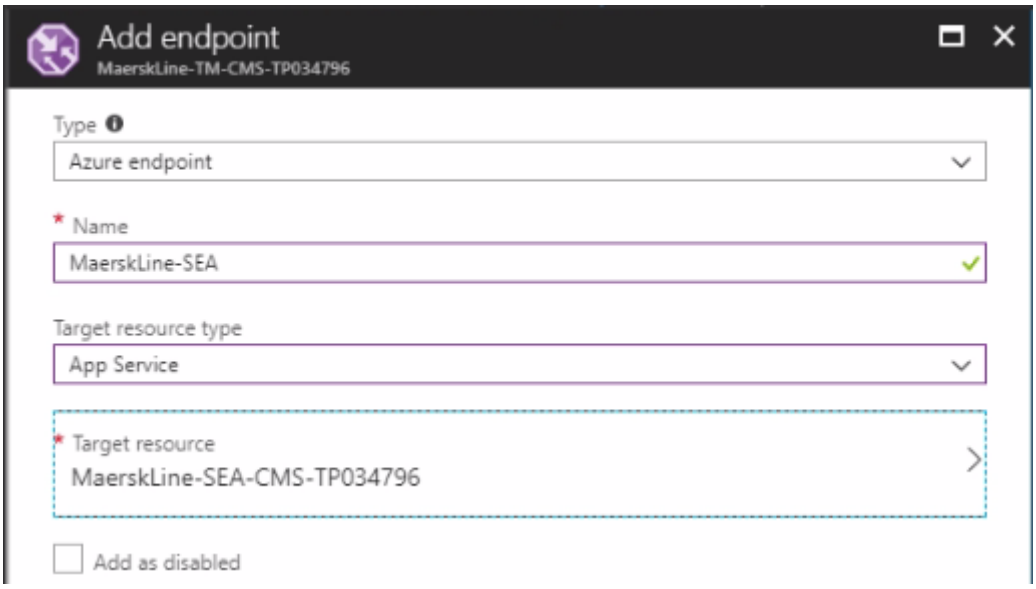


Figure 4.6.2 (a) Setup Endpoints for SEA

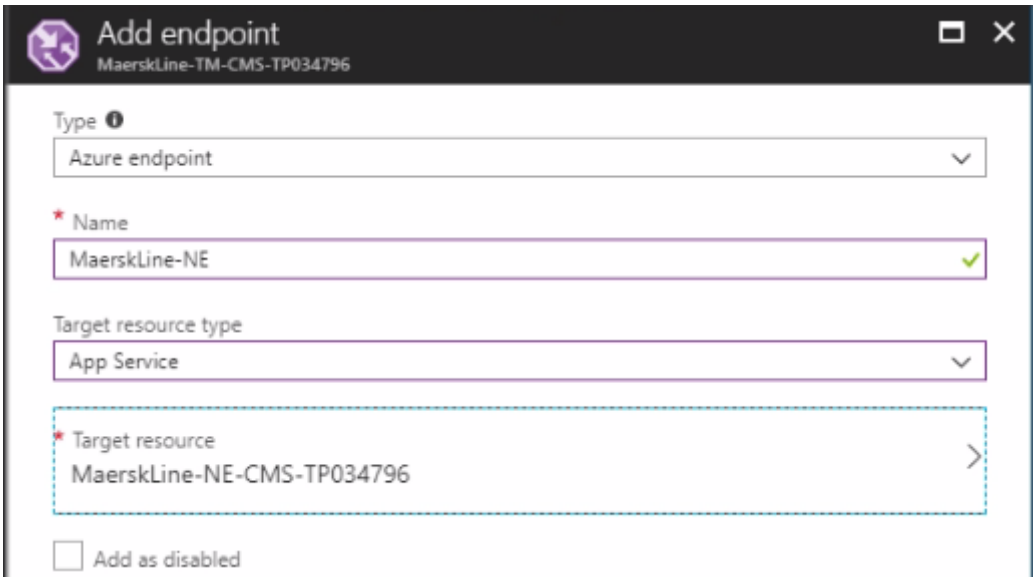


Figure 4.6.2 (b) Setup Endpoints for NE

The Traffic Manager of Microsoft Azure allows to control the distribution of network traffic to application deployments running in different datacenters where each application deployment will be configured as an endpoint in Traffic Manager (Microsoft, 2017). An endpoint has been added for both SEA and NE web app services.

### 4.6.3 Testing Traffic Manager & Endpoints

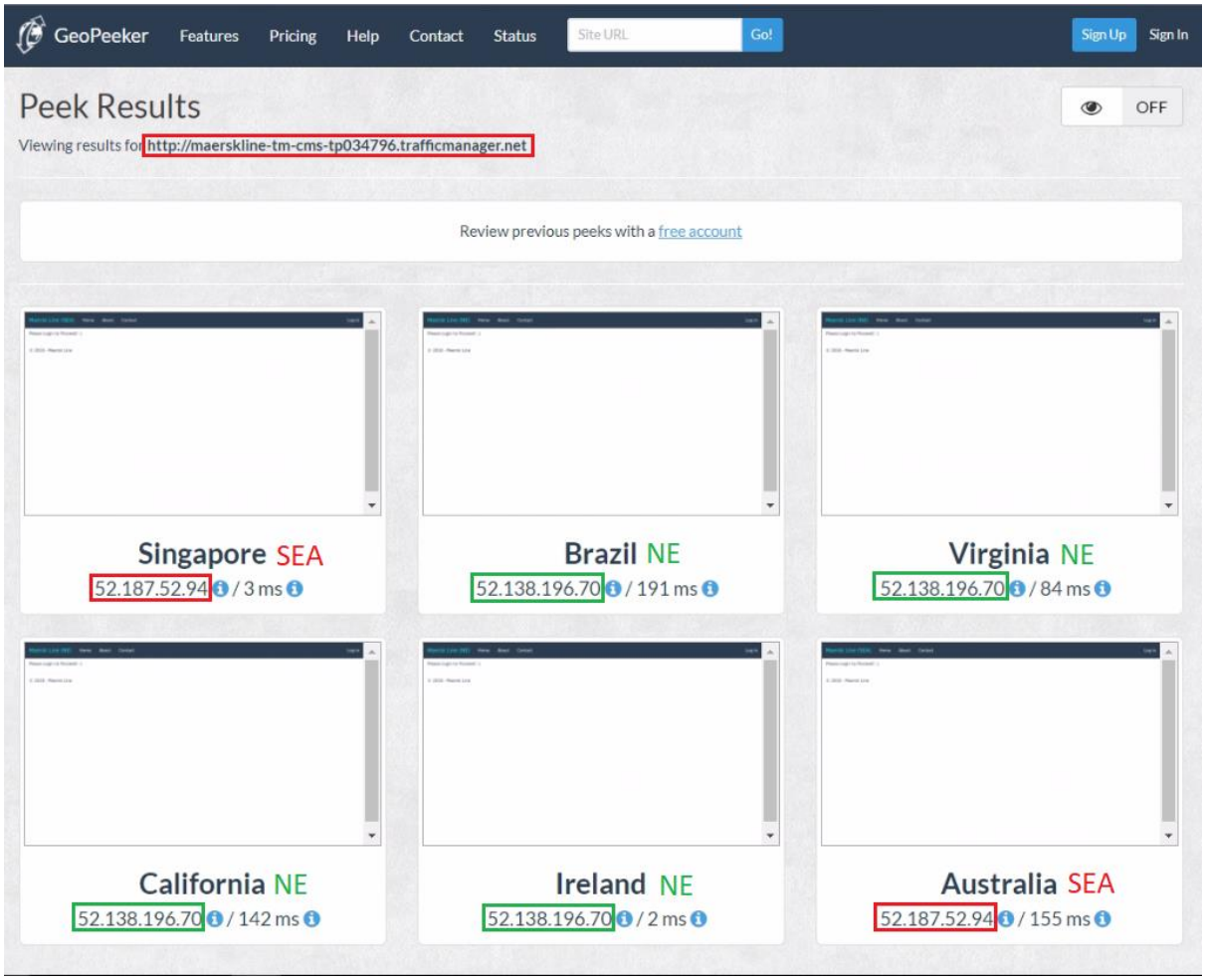


Figure 4.6.3 Peek Results of GeoPeeker for Traffic Manager

The Traffic Manager and Endpoints will be tested with GeoPeeker using the URL of traffic manager for ensuring the Traffic Manager is working as expected. As from the figure above, the IP address of SEA is the same and same goes to NE.

## 4.7 Azure Web Application Autoscaling

### 4.7.1 Setup Web Application Scale Out

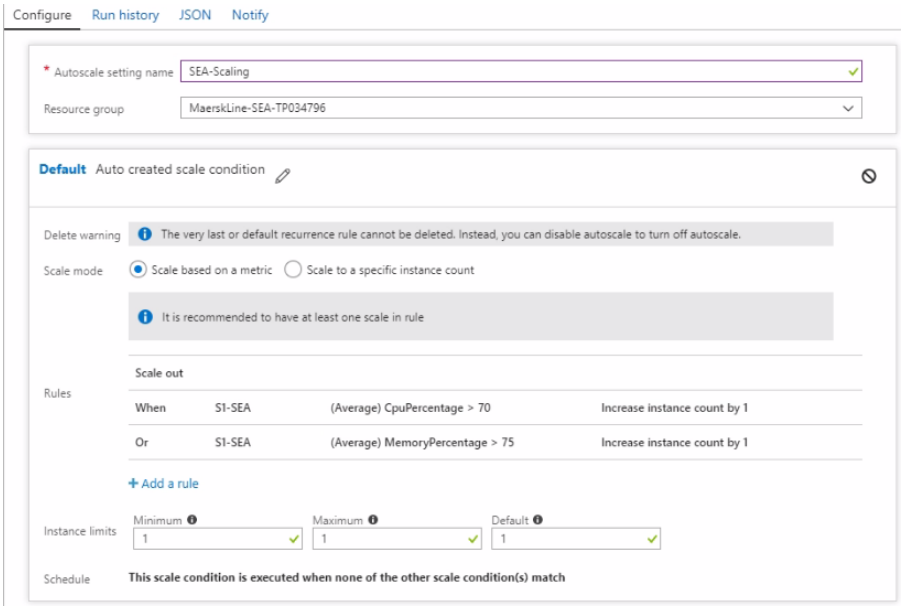


Figure 4.7.1 Setup Web Application Scale Out

### 4.7.2 Setup Scale Rule for Auto Scaling Plan

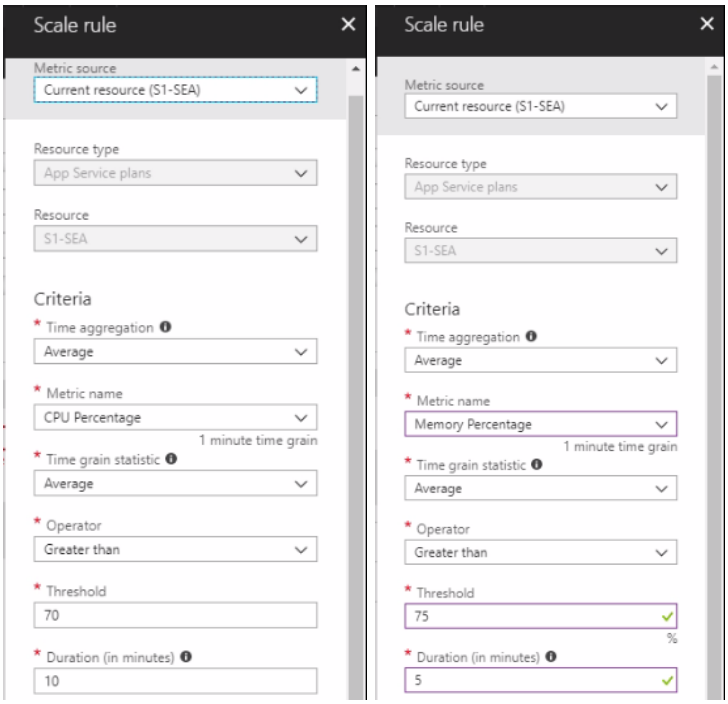


Figure 4.7.2 Setup Scale Rule for Auto Scaling Plan

Azure autoscale helps applications to perform at best when demand changes (Microsoft Azure, 2018). The CPU percentage and Memory percentage will be scaled for the Maersk Line Project as to provide the most suitable environment for different users.

# 5.0 User Interface

## 5.1 Homepage

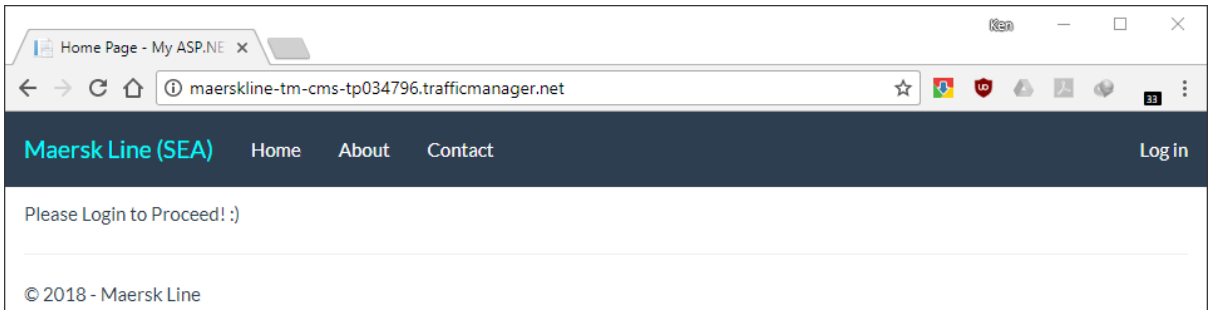


Figure 5.1 Homepage

## 5.2 Login

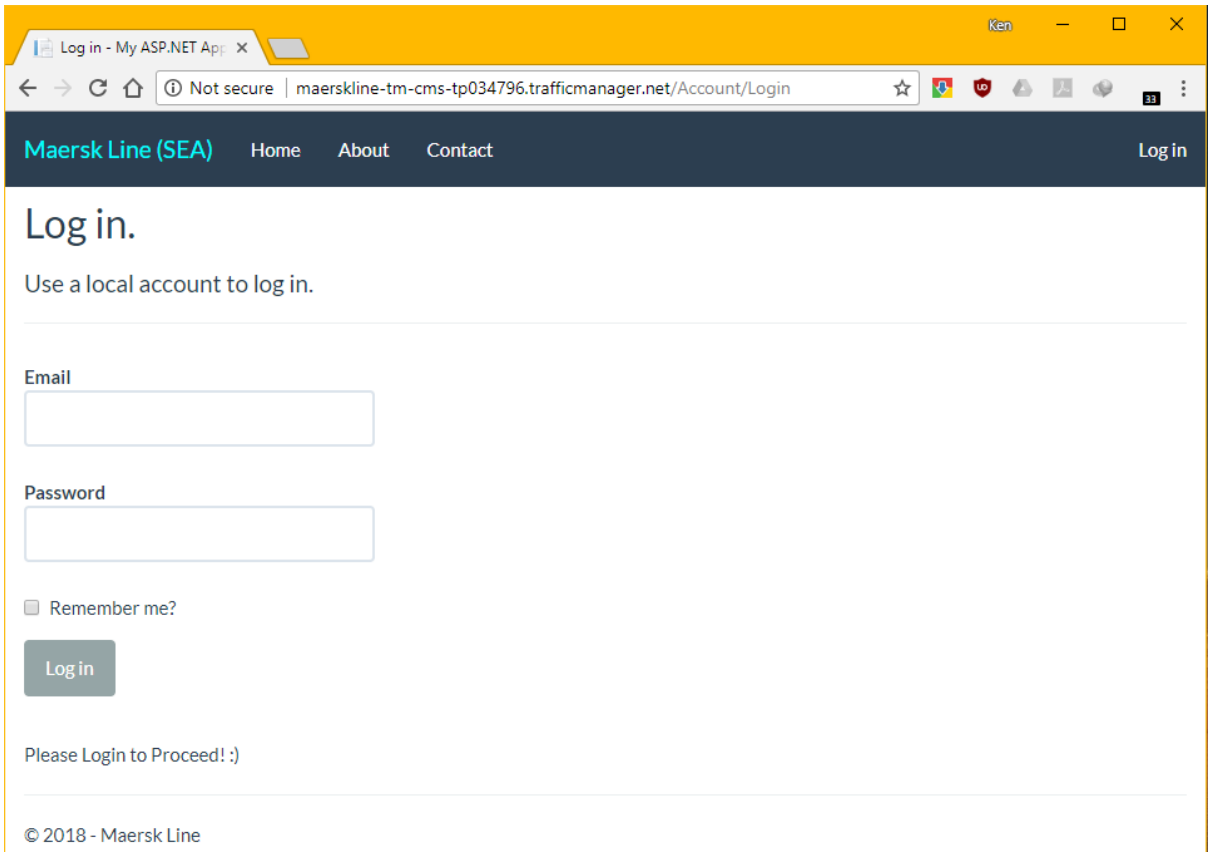


Figure 5.2 Login

## 5.3 Admin

### 5.3.1 Admin Homepage

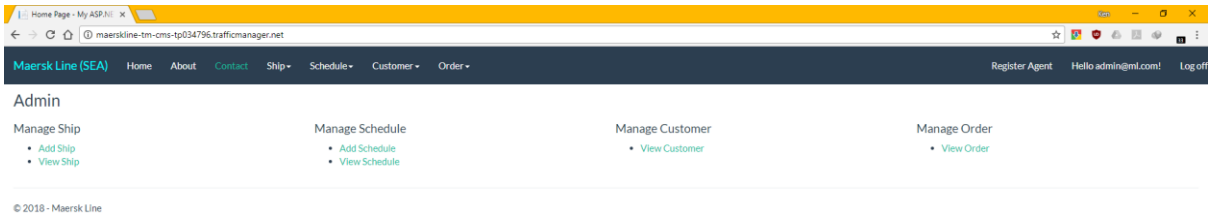


Figure 5.3.1 Admin Homepage

### 5.3.2 Admin Register Agent

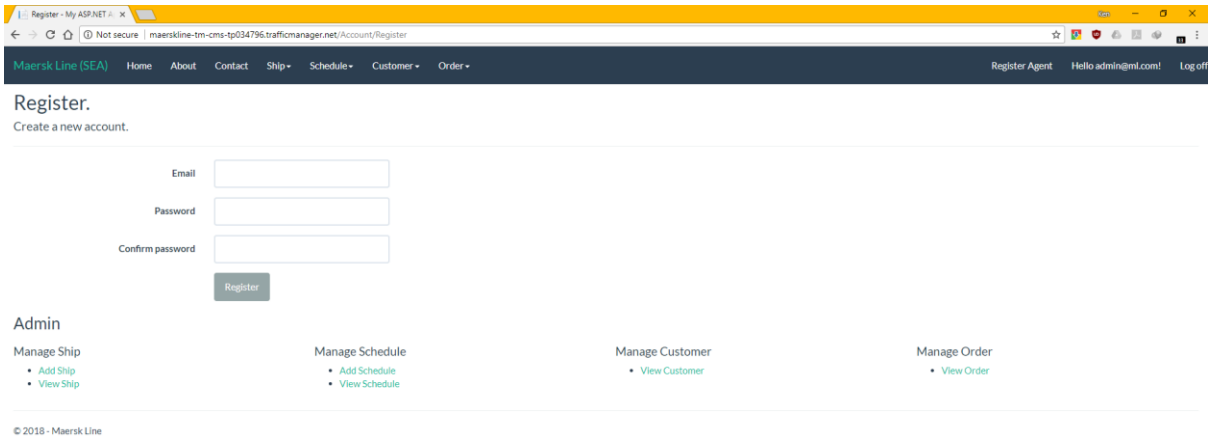


Figure 5.3.2 Admin Register Agent

### 5.3.3 Admin Add/Edit Ship

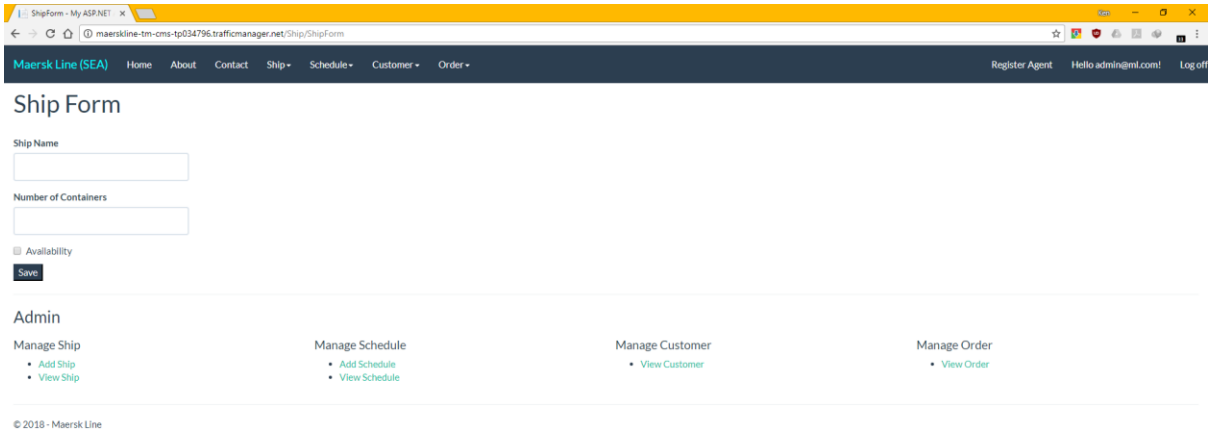


Figure 5.3.3 Admin Add Ship

### 5.3.4 Admin View Ship

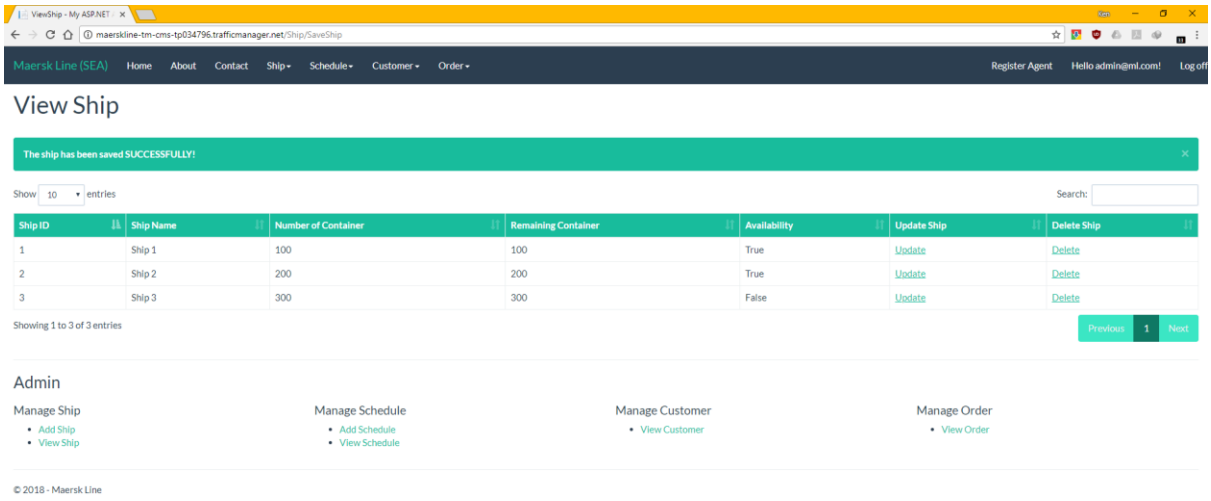


Figure 5.3.4 Admin View Ship

### 5.3.5 Admin Add/Edit Schedule

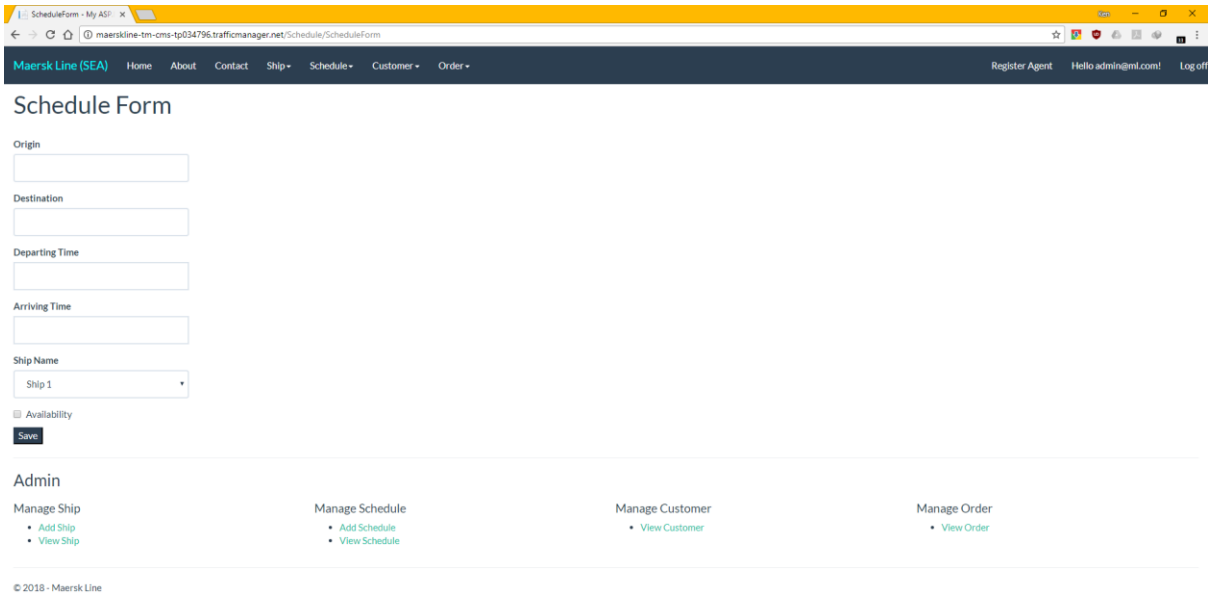


Figure 5.3.5 Admin Add Schedule

### 5.3.6 Admin View Schedule

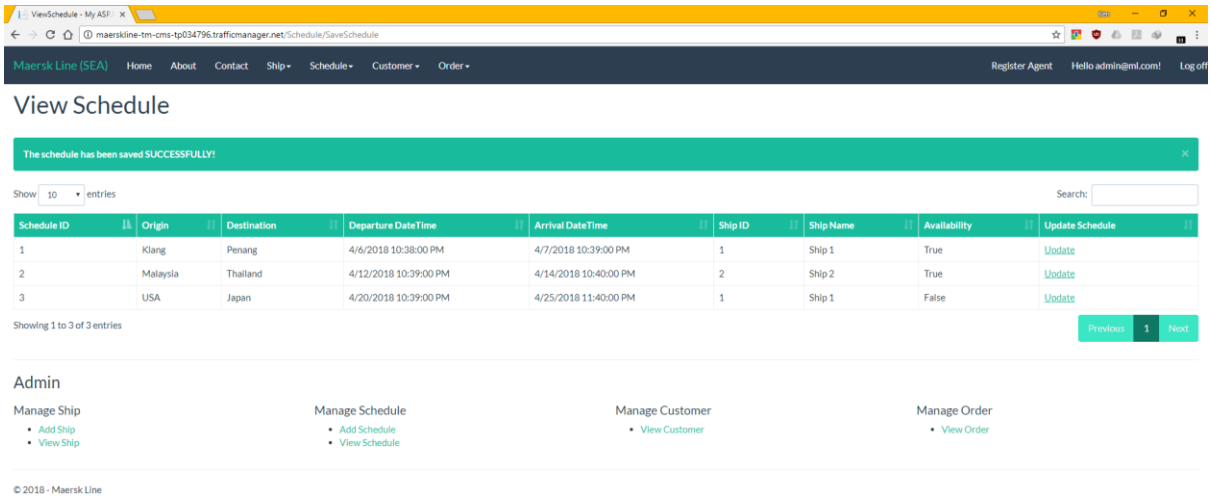


Figure 5.3.6 Admin View Schedule

### 5.3.7 Admin View Customer

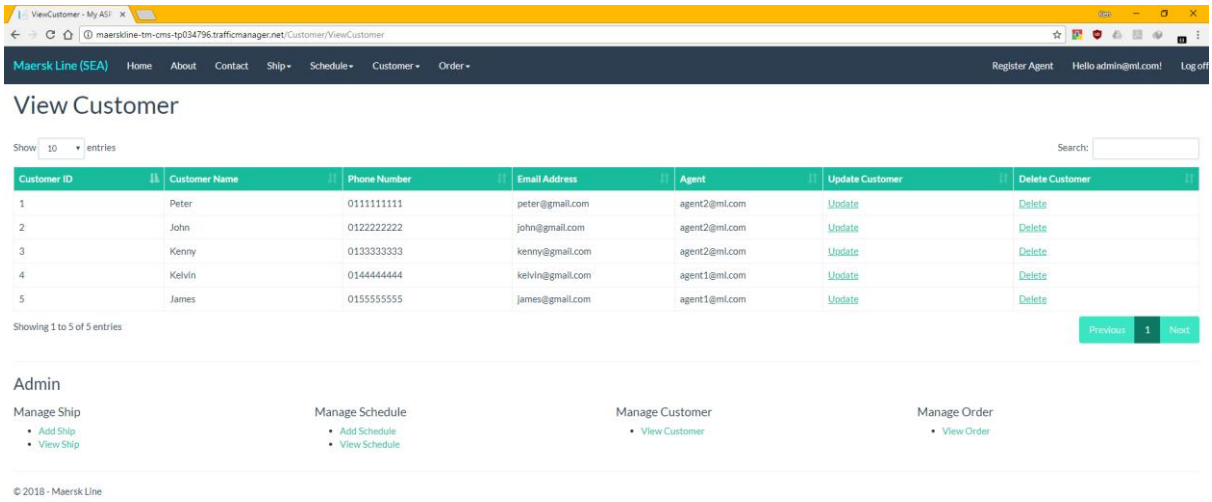


Figure 5.3.7 Admin View Customer

Different to Agent, Admin can view all the customers added by all the agents.

### 5.3.8 Admin View Order

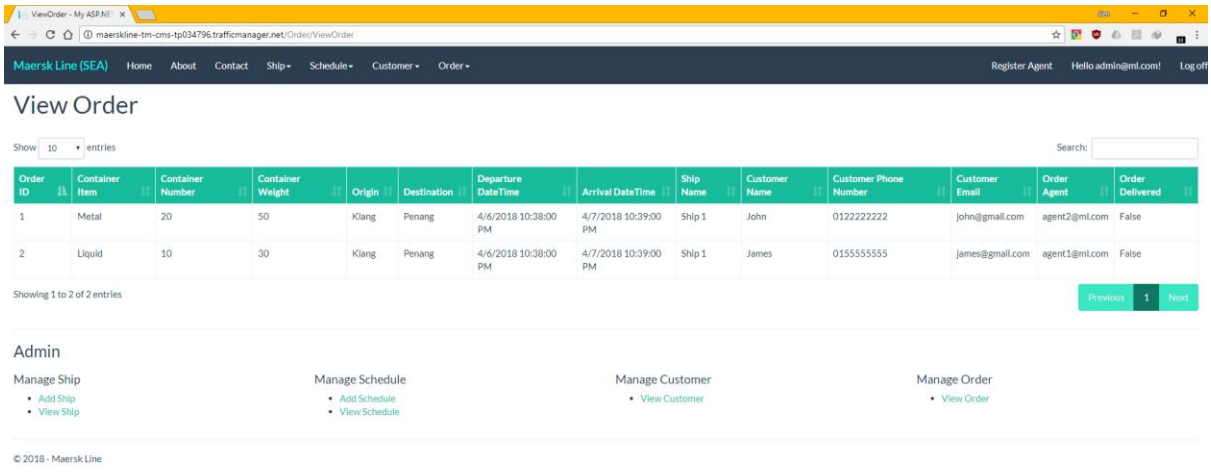


Figure 5.3.8 Admin View Order

Different to Agent, Admin can view all the orders made by all the agents.

## 5.4 Agent

### 5.4.1 Agent Homepage

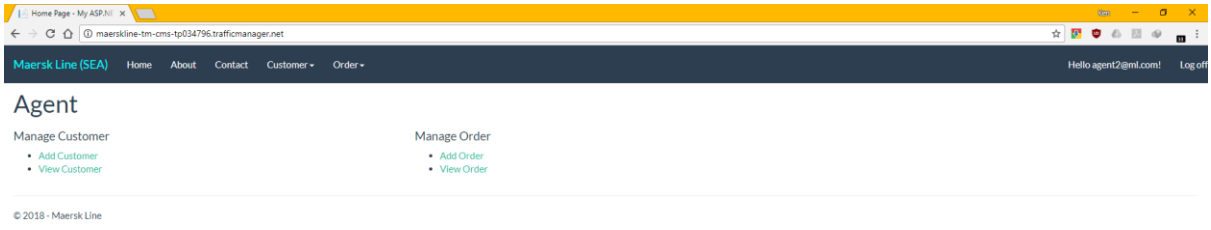


Figure 5.4.1 Agent Homepage

### 5.4.2 Agent Add/Edit Customer

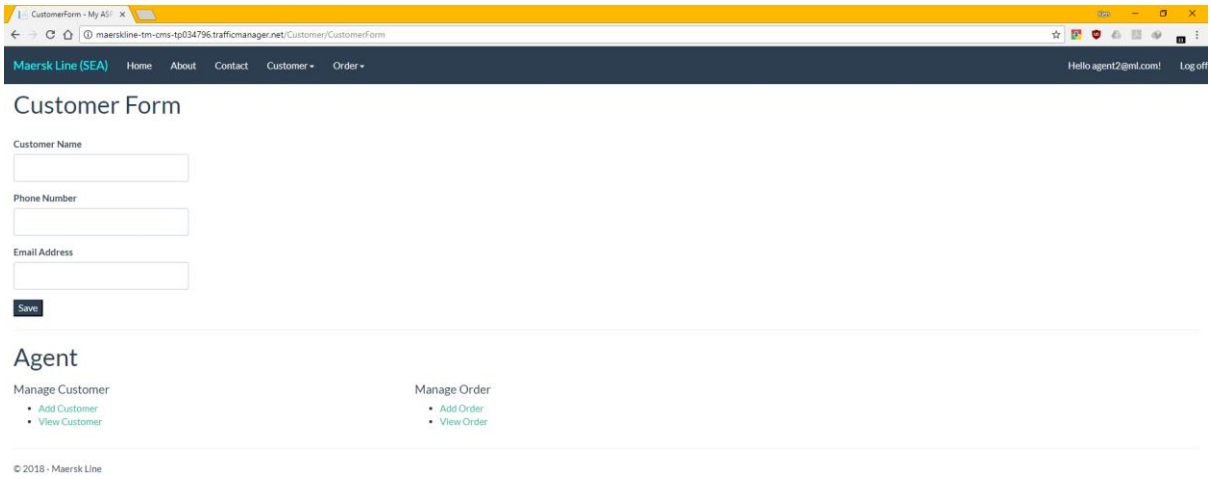


Figure 5.4.2 Agent Add Customer

### 5.4.3 Agent View Customer

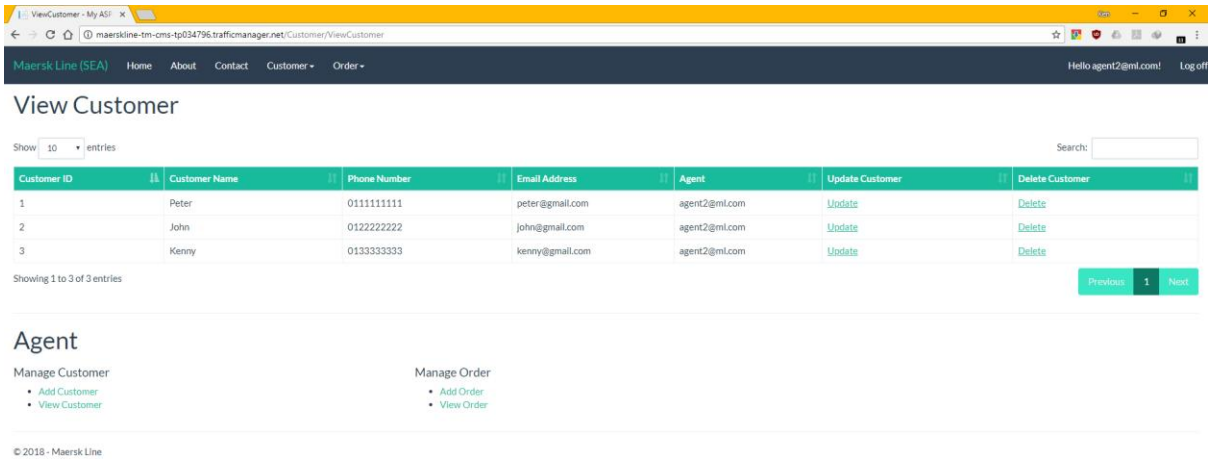


Figure 5.4.3 Agent View Customer

Different to Admin, Agent can only view the customers added by their own.

### 5.4.4 Agent Add Order

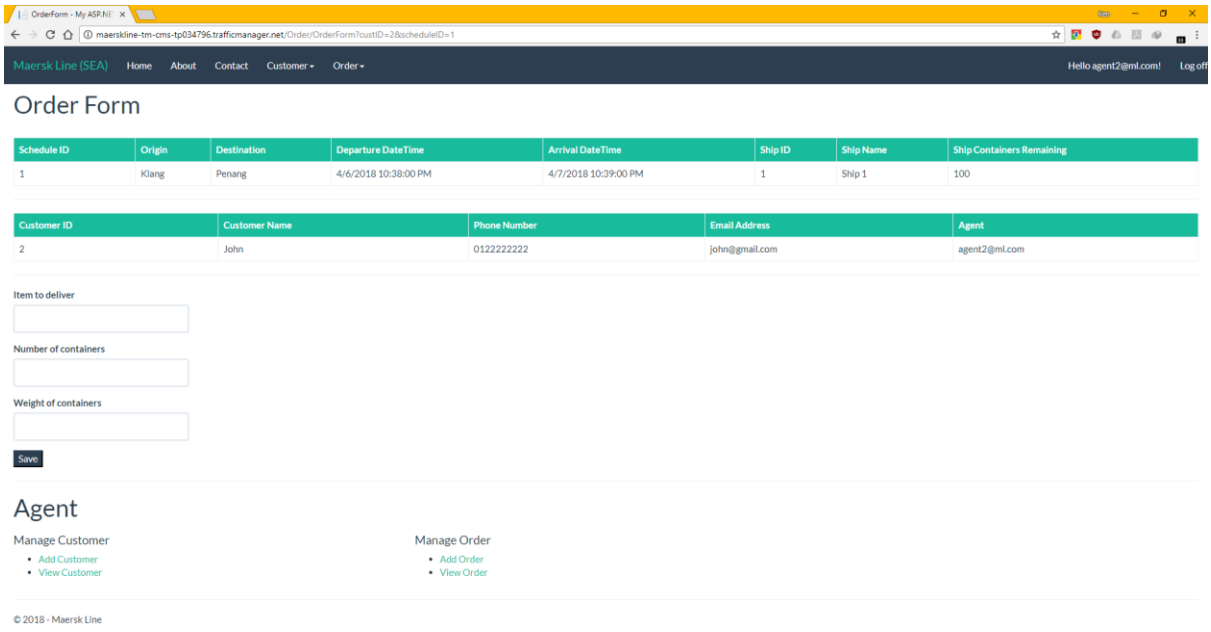


Figure 5.4.4 Agent Add Order

### 5.4.5 Agent View Order

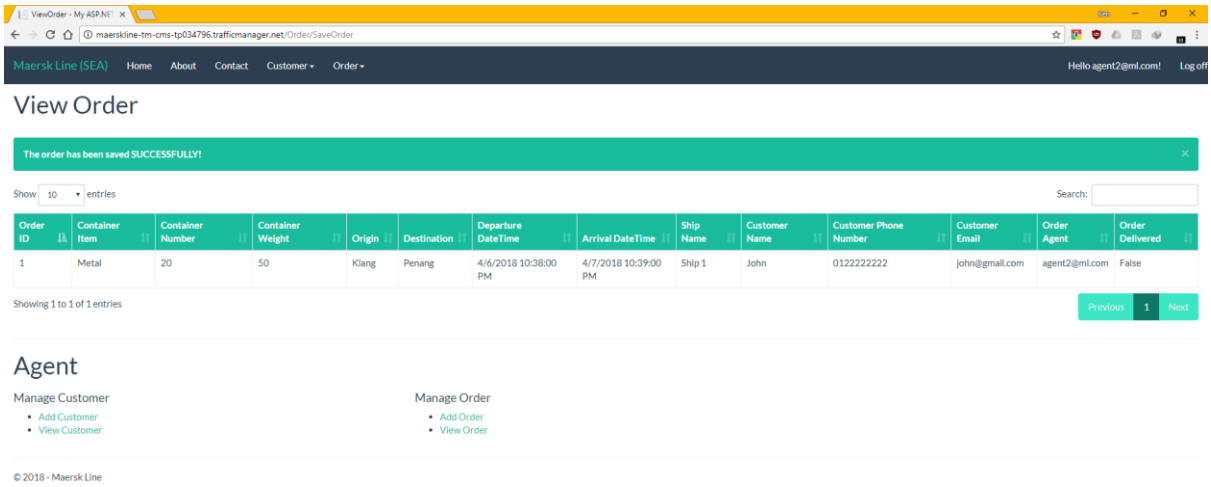


Figure 5.4.5 Agent View Order

Different to Admin, Agent can only view the orders made by their own.

# 6.0 Test Plan & Testing Discussion

## 6.1 Functional Testing

| Test Module | Login | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT001-1 | Username and Password are correct | 1. Enter Username and Password<br>2. Clicks on Login button | (Admin)<br>Username: admin@ml.com<br>Password:Admin_123<br>Or<br>(Agent)<br>Username: agent1@ml.com<br>Password:Agent_123 | User will be redirected to Admin/Agent Homepage | User will be redirected to Admin/Agent Homepage |
| UT001-2 | Username and/or Password are/is incorrect | | Username:user123<br>Password:abc123 | An error message will be shown | An error message will be shown |
| UT001-3 | Username and/or Password are/is blank | | - | An error message will be shown | An error message will be shown |

| Test Module | Admin Register Agent | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT002-1 | Username and Password are entered | 1. Enter Username and Password<br>2. Clicks on Register button | (Agent)<br>Username: agent7@ml.com<br>Password:Agent_123 | A success message will be shown | A success message will be shown |
| UT002-2 | Username and/or Password are/is blank | | - | An error message will be shown | An error message will be shown |

| Test Module | Admin Add Ship | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT003-1 | Ship details are entered | 1. Enter ship name<br>2. Enter number of containers | Ship name: Ship 5<br>Number of containers: 500 | A success message will be shown | A success message will be shown |
| UT003-2 | Ship details are blank | | - | An error message will be shown | An error message will be shown |

| Test Module | Admin Edit Ship | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT004-1 | Ship details are entered | 1. Select a ship<br>2. Enter ship name<br>3. Enter number of containers<br>4. Click on 'Save' button | Ship name: Ship 8<br>Number of containers: 5000 | A success message will be shown | A success message will be shown |
| UT004-2 | Ship details are blank | | - | An error message will be shown | An error message will be shown |

| Test Module | Admin Edit Ship | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT004-1 | Ship details are entered | 1. Select a ship<br>2. Enter ship name<br>3. Enter number of containers<br>4. Click on 'Save' button | Ship name: Ship 8<br>Number of containers: 5000 | A success message will be shown | A success message will be shown |
| UT004-2 | Ship details are blank | | - | An error message will be shown | An error message will be shown |

| Test Module | Admin View Ship | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT005-1 | View ship details | 1. Select 'View Ship' in homepage or navigation bar | - | The ship details will be shown | The ship details will be shown |

| Test Module | Admin Add Schedule | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT006-1 | Schedule details are entered | 1. Enter origin<br>2. Enter destination | Origin: Malaysia<br>Destination: Thailand<br>Departing Time: 4/9/2018 11:22 | A success message will be shown | A success message will be shown |

| | | | | | |
|---|---|---|---|---|---|
| | | 3. Enter departing time<br>4. Enter arriving time<br>5. Select a ship<br>6. Click on 'Save' button | Arrival Time: 4/10/2018 12:30<br>Ship Name: Ship 2 | | |
| UT006-2 | Schedule details are blank | | - | An error message will be shown | An error message will be shown |

| **Test Module** | Admin Edit Schedule | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT007-1 | Schedule details are entered | 1. Select a schedule<br>2. Enter origin<br>3. Enter destination<br>4. Enter departing time<br>5. Enter arriving time<br>6. Select a ship<br>7. Click on 'Save' button | Origin: Malaysia<br>Destination: Thailand<br>Departing Time: 4/19/2018 11:22<br>Arrival Time: 4/20/2018 12:30<br>Ship Name: Ship 2 | A success message will be shown | A success message will be shown |
| UT007-2 | Schedule details are blank | | - | An error message will be shown | An error message will be shown |

| **Test Module** | Admin View Schedule | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT008-1 | View schedule details | 1. Select 'View Schedule in homepage or navigation bar | - | The schedule details will be shown | The schedule details will be shown |

| **Test Module** | Agent Add Customer | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT009-1 | Customer details are entered | 1. Enter customer name<br>2. Enter phone number<br>3. Enter email address<br>4. Click on 'Save' button | Customer name: Jenny<br>Phone number: 0142356237<br>Email address: jenny@email.com | A success message will be shown | A success message will be shown |
| UT009-2 | Customer details are blank | | - | An error message will be shown | An error message will be shown |

| **Test Module** | Admin/Agent Edit Customer | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT010-1 | Customer details are entered | 1. Select a customer<br>2. Enter phone number<br>3. Enter email address<br>4. Click on 'Save' button | Phone number: 01235243215<br>Email address: abc@email.com | A success message will be shown | A success message will be shown |
| UT010-2 | Customer details are blank | | - | An error message will be shown | An error message will be shown |

| **Test Module** | Admin/Agent View Customer | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT011-1 | View customer details | 1. Select 'View Customer in homepage or navigation bar | - | The customer details will be shown | The customer details will be shown |

| **Test Module** | Agent Add Order | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT012-1 | Order details are entered | 1. Select Schedule<br>2. Select Customer<br>3. Enter Item to Deliver<br>4. Enter Number of Containers<br>5. Enter Weight of Containers<br>6. Click on 'Save' button | Item to Deliver: Liquid<br>Number of Containers: 20<br>Weight of containers: 30 | A success message will be shown | A success message will be shown |
| UT012-2 | Order details are blank | | - | An error message will be shown | An error message will be shown |

| **Test Module** | Admin/Agent View Order | | | | |
|---|---|---|---|---|---|
| **Test ID** | **Test Case** | **Steps** | **Test Data** | **Expected Result** | **Actual result** |
| UT013-1 | View order details | 1. Select 'View Order in homepage or navigation bar | - | The order details will be shown | The order details will be shown |

## 6.2 Performance Testing

The performance of web app can be tested to assess whether the app is ready for release. A VSTS (Visual Studio Team Services) account is required for the testing (Microsoft, 2018). The performance test feature can be found in web app service.

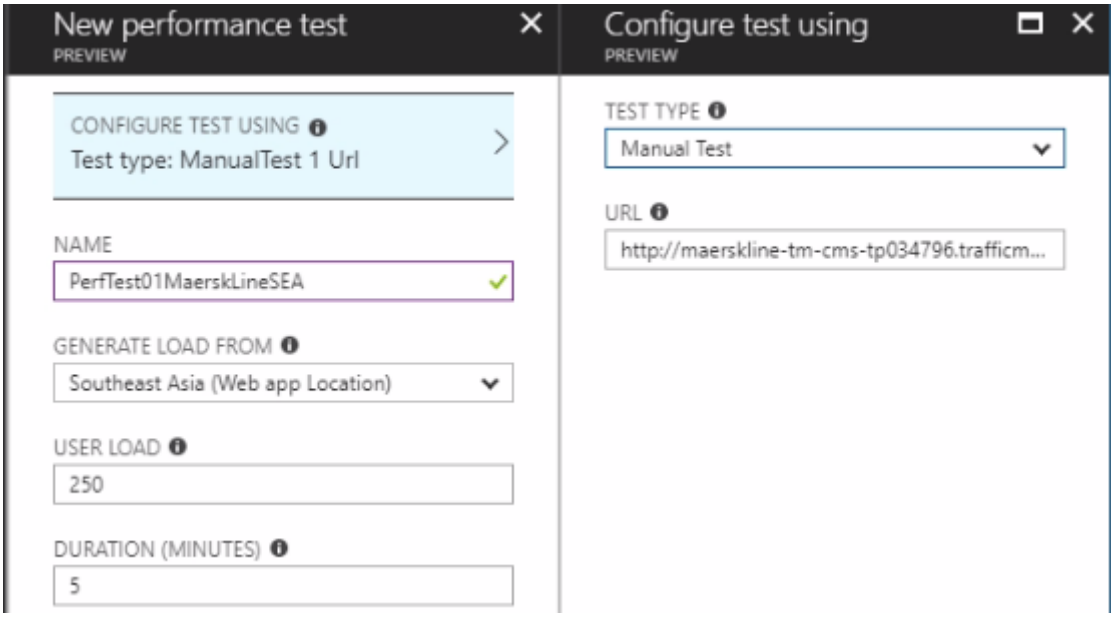


Figure 6.2 (a) Setup Performance Test

The performance test is set for 250 user load and 5 minutes of duration with manual test type.

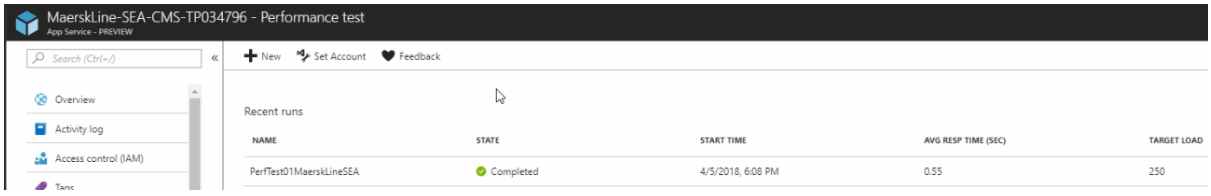


Figure 6.2 (b) Status of Performance Test

Figure above shows that the performance test is in queue and approximately 15 minutes is needed for the test to be completed.

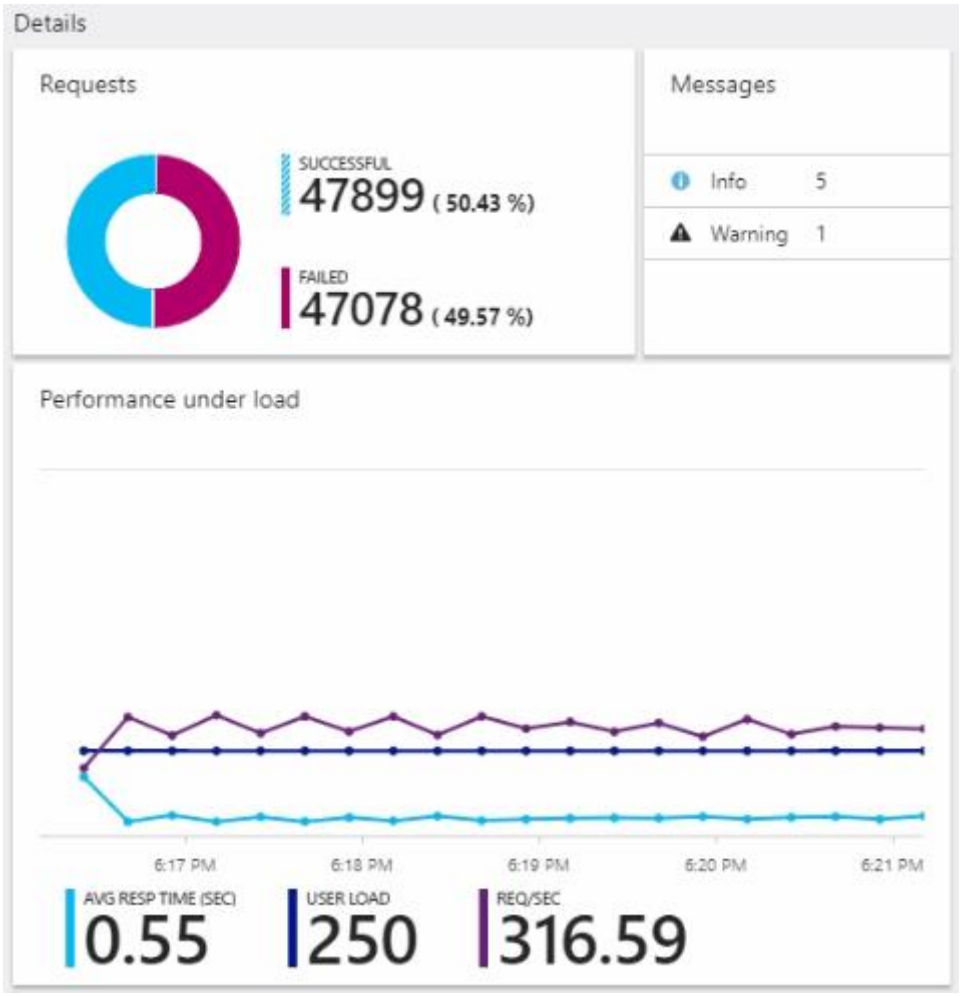


Figure 6.2 (c) Result of Performance Test

Figure above shows the result of performance test in which having 0.55 seconds of average responding time and 316.59 request per second with more than half of the requests are successful even in a place with a very poor internet connection.

## 7.0 Conclusion

I've faced some challenges throughout the development of this project especially in the part of deploying the solution onto cloud platform. This is because the cloud deployment is a fresh topic to me as I have no experience in deploying a solution to the cloud platform such as Microsoft Azure. Furthermore, the deployment of Microsoft Azure involves credit which is referring to real money where I have to be more be careful dealing with to avoid any catastrophe event.

However, after putting a lot of effort in researching and discussion with friends, the solution has finally been deployed onto Microsoft Azure successfully. I've also gained a massive knowledge throughout the development in which will definitely help me out in my future career. Maersk Line is now able to run smoothly on Microsoft Azure and has met the requirements of the project.

Although the solution has met the requirements and deployed onto Microsoft Azure, I believe that the solution can be further improved for achieving a better performance. One small suggestion for the company is to implement Google Analytic to perform business analysis in which might help in increasing business opportunities as well as generating revenues.

## 8.0 References

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# 9.0Appendix

1. URL of GitHub (Document and Source Code included)
    a. https://github.com/neng0922/MaerskLine-TP034796
2. URL of Presentation Video
    a. https://web.microsoftstream.com/video/1db92a2c-da54-45a6-815e-f98dc81944a7
3. Credentials for testing purpose
    a. Admin
        i. Username: admin@ml.com
        ii. Password: Admin_123
    b. Agent
        i. Username: agent1@ml.com (for Agent 2 is agent2@ml.com and so on)
        ii. Password: Agent_123 (password is same for all agents)