



Kent Ridge Technology



MERLION BANK

ENTERPRISE TRACK

SYSTEM ANALYSIS & DESIGN REPORT

PRESENTED BY ES05

GUO ZIYU	A0130982E
HAN FENGWEI	A0133994U
LAI QING	A0114992Y
PENG YONGXUE	A0125967R
YANG SHUANGHE	A0126241U
ZHOU JINGYUAN	A0133961E

TEAM ADVISOR: DENG YIMENG

Table of Contents

1. Executive Summary	6
2. Summary of Findings	8
2.1 Introduction.....	8
2.2 Enterprise System	8
2.2.1 <i>Organizational Hierarchy</i>	8
2.2.2 <i>Business Flow</i>	9
2.2.3 <i>Business Entity Description</i>	10
2.2.4 <i>Subsystem Description</i>	15
3. Business Requirement Analysis	18
3.1 Common Infrastructure (AAU ID:01).....	18
3.1.1 <i>Business Analysis</i>	18
3.1.2 <i>Business Process</i>	19
3.1.3 <i>System Requirement Analysis</i>	23
3.2 Customer Management System (AAU ID: 02)	28
3.2.1 <i>Business Analysis</i>	28
3.2.2 <i>Business Process</i>	29
3.2.3 <i>System Requirement Analysis</i>	33
3.3 Deposit Account Management System (AAU ID: 03)	37
3.3.1 <i>Business Analysis</i>	37
3.3.2 <i>Business Processes</i>	39
3.3.3 <i>System Requirement Analysis</i>	47
3.4 Card Management System (AAU ID: 04)	50
3.4.1 <i>Business analysis</i>	50
3.4.2 <i>Business processes</i>	51
3.4.3 <i>System requirements analysis</i>	58
3.5 Loan Management System (AAU ID: 05)	65
3.5.1 <i>Business Analysis</i>	65
3.5.2 <i>Business Processes</i>	66
3.5.3 <i>System Requirement Analysis</i>	74
3.6 Billing and Payment System (AAU ID: 06)	78
3.6.1 <i>Business Analysis</i>	78
3.6.2 <i>Business Processes</i>	82
3.6.3 <i>System Requirements Analysis</i>	89
3.7 Wealth Management System (AAU ID: 07)	98

3.7.1 <i>Business Analysis</i>	98
3.7.2 <i>Business Processes</i>	100
3.7.3 <i>System Requirements Analysis</i>	108
3.8 Portfolio Management System (AAU ID: 08).....	111
3.8.1 <i>Business Analysis</i>	111
3.8.2 <i>Business Processes</i>	112
3.8.3 <i>System Requirements Analysis</i>	115
3.9 Customer Analytics & Business Intelligence System (AAU ID: 09).....	118
3.9.1 <i>Business Analysis</i>	118
3.9.2 <i>Business Processes</i>	119
3.9.3 <i>System Requirements Analysis</i>	123
4. High-level System Architecture	126
4.1 List of System, Sub-system & Application	126
4.2 Visual Table of Contents	130
4.3 Overall Entity Class Diagram.....	131
5. Functional Modules Design	133
5.1 Common Infrastructure.....	133
5.1.1 <i>UML Use Case Diagram</i>	133
5.1.2 <i>UML Use Case Description</i>	134
5.1.3 <i>UML Entity Class Diagram</i>	138
5.1.4 <i>UML Sequence Diagram – Customer Log In</i>	139
5.1.5 <i>UML Non-Entity Diagram</i>	140
5.2 Customer Management System	141
5.2.1 <i>UML Use Case Diagram</i>	141
5.2.2 <i>UML Use Case Description</i>	142
5.2.3 <i>UML Entity Class Diagram</i>	145
5.2.4 <i>UML Sequence Diagram – Enquiry Processor Replies Case</i>	146
5.2.5 <i>UML Non-Entity Diagram</i>	147
5.3 Deposit Account Management System.....	148
5.3.1 <i>UML Use Case Diagram</i>	148
5.3.2 <i>UML Use Case Description</i>	149
5.3.3 <i>UML Entity Class Diagram</i>	154
5.3.4 <i>UML Sequence Diagram – Open Account</i>	155
5.3.5 <i>UML Non-Entity Diagram</i>	156
5.4 Card Management System.....	157
5.4.1 <i>Use Case Diagram</i>	157

5.4.2 Use Case Description	158
5.4.3 UML Entity Class Diagram.....	161
5.4.4 UML Sequence Diagram – Activate Debit Card.....	162
5.5 Loan Management System	163
5.5.1 Use Case Diagram	163
5.5.2 Use Case Description.....	164
5.5.3 UML Entity Class Diagram.....	168
5.6 Billing and Payment System.....	170
5.6.1 UML Use Case Diagram.....	170
5.6.2 UML Use Case Description.....	171
5.6.3 UML Entity Class Diagram.....	176
5.6.4 UML Sequence Diagram – Fast Transfer to Other Banks	178
5.7 Wealth Management System	179
5.7.1 UML Use Case Diagram.....	179
5.7.2 UML Use Case Description.....	180
5.7.3 UML Entity Class Diagram.....	184
5.7.4 UML Sequence Diagram	185
5.8 Portfolio Management System	186
5.8.1 UML Use Case Diagram.....	186
5.8.2 UML Use Case Description.....	187
5.8.3 UML Entity Class Diagram.....	191
5.8.4 UML Sequence Diagram	192
5.9 Customer Analytics & Business Intelligence System	193
5.9.1 UML Use Case Diagram.....	193
5.9.2 UML Use Case Description.....	194
5.9.3 UML Entity Class Diagram.....	197
5.9.4 UML Sequence Diagram – Analyze Customer Lifetime Value	198
6. User Interface Design	199
6.1 Design Principles	199
6.2 Overall Design Theme	200
7. Naming and Packaging Conventions	209
8. Declaration of Open Source Code	210
9. Unit Testing Plan	212
9.1 Integration Testing.....	212
9.2 Unit Testing	213

10. Project Management Plan	231
11. Conclusion	239
12. References	240
Table of changes	241

1. Executive Summary

Although there have been indicators suggesting a decline in global economy, Singapore as a flourishing financial center of international prestige, stood out in 2014 for its continued vibrancy. In 2003 alone, financial services contributed for 11.6% of Singapore's gross domestic product, while employing merely 5% of the country's population, rendering it the most profitable service industry in Singapore (Tan, 2005). In 2016, Singapore has edged past Hong Kong to become the third largest financial center in the world, further proving the vitality of Singapore's economy.

The repute of Singapore is premised on its strong monitoring framework and pro-business environment, cultivating it as an international harbor for finance industry. As a result, both overseas and local financial institutions base their headquarters in Singapore. Today, there are as many as 117 foreign banks and 6 local banks fighting for a share in the market. Meanwhile, an increasing number of banks have chosen to base their operational headquarters in Singapore to better cater for their regional group activities. Clearly, Singapore, as a regional financial center, hosts a promising yet highly competitive market.

Since Merlion Bank is entering the market dominated by traditional banking giants, it is crucial to ensure its survival by finding its competitive edge. As information technology is playing a more and more important role in our daily lives, digitalized online banking system, with its benefits of reducing cost and increasing efficiency, will largely benefit Merlion Bank (Deutsche Bank, 2015). It has been shown that banks could manage to remove 20 to 25 percent of their cost by leveraging a digital shift to their operation. On the contrary, laggards could suffer from 35 per cent of net profit eroded (Olanrewaju, 2014).

Thus, Merlion Investment Holding decides to position its newly established Merlion Bank as a top-notch direct bank, which aims to fully digitalize its banking service. Emphasizing strongly on online banking system which incorporates Business Intelligence (BI) and analytical Customer Relationship Management (CRM) system, Merlion Bank visions to reward its customers with higher interest rates by mitigating cost on brick-and-mortar branches. Furthermore, customer analytics enables Merlion Bank to know our customers well and obtain valuable insights about them. Subsequently, by taking actions to address customer concerns,

the bank may reduce churn rate and retain customer loyalty so as to gain competitive edge over other more established traditional banks.

Hence, Kent Ridge Technology has prepared a detailed system analysis and design report for the successful implementation of Merlion Banking System (MBS) based on the requirements from Merlion Investment Holding, to facilitate, complement, and enhance the operations of Merlion Bank's business processes. This report includes comprehensive analysis of Merlion Bank, and our proposed features for each subsystem of MBS. We believe that with our recommended solutions, MBS will greatly streamline their operations and survive in the competitive financial market.

2. Summary of Findings

This section will cover the key findings we derived from our analysis of Merlion Bank's operations and the implementation of the proposed Merlion Banking System (MBS).

2.1 Introduction

After the thorough and exhaustive examination of Merlion Bank's business operations, we are able to escalate from the prime requirement specifications, to convey and offer a feasible solution that will streamline and propel Merlion Bank's success in the regional market.

Tremendous appreciation for the unconditional guidance and support we received from the management team at Merlion Bank, such that we KRT was able to build up from our premier System Proposal to accomplish this System Analysis and Design Report that entails every respect of MBS.

Included in this section is our team's analysis of Merlion Bank's organizational hierarchy including the different divisions that support this structure. A short description of the different subsystems of the MBS will also be encapsulated. Subsequently, we will present our meticulous investigation of the requirement analysis in the next section, which will demonstrate the key business processes that are required to be encapsulated by MBS.

2.2 Enterprise System

The Merlion Banking System is a corporate-wide information system, which is designed to coordinate and synchronize the business processes across various divisions of the company. Although this system is planned in a modular fashion to customize its functionalities within each division for better efficiency, it also encourages communication and data sharing across departments to achieve higher productivity on the corporate level.

2.2.1 Organizational Hierarchy

The diagram below depicts the organizational structure of Merlion Bank.

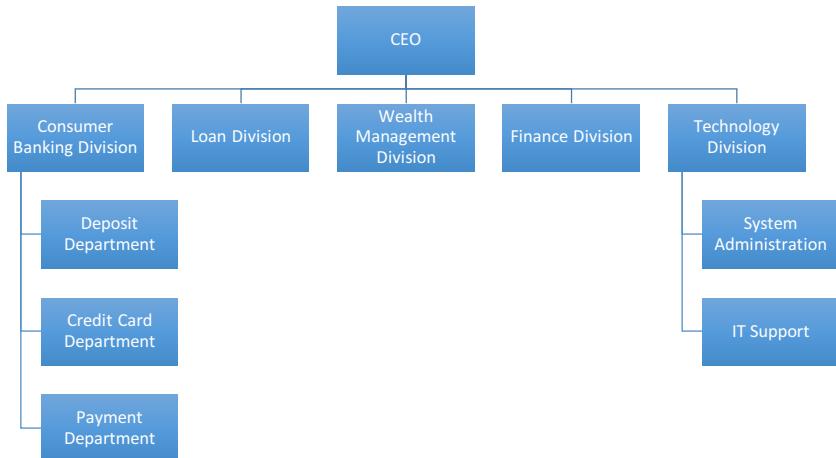


Figure 1: Organizational Structure of Merlion Bank

The Chief Executive Officer (CEO) of Merlion Bank makes strategic, unstructured decisions. CEO sets goals and direction for the company based on the historical report and his/her projection of the future. These decisions include launching of a new product, acquisition of an external company, and expansion of the business field.

The strategic vision from the CEO is then passed down to various divisions where the corporate-level goal is interpreted in the context of different specializations. Division managers make semi-structured decisions based on the reports submitted from various departments and then digest these reports to summarize the performance of the entire division, making sure it is succinct for CEO to view and understand.

Finally, the departments on the operational level realize the requirements given by division managers through day-to-day business activities. Department managers supervise daily operations and handle exceptional pop-up cases that cannot be solved by ordinary employees. They are mainly in charge of structured, repetitive tasks including account opening, loan approval, and IT maintenance.

2.2.2 Business Flow

The diagram below demonstrates the business operations and interactions among different business entities introduced earlier in the organization hierarchy. The arrows represent the information flow from high level management to operational level as well as the data and reports transmitted within Merlion Bank's business process.

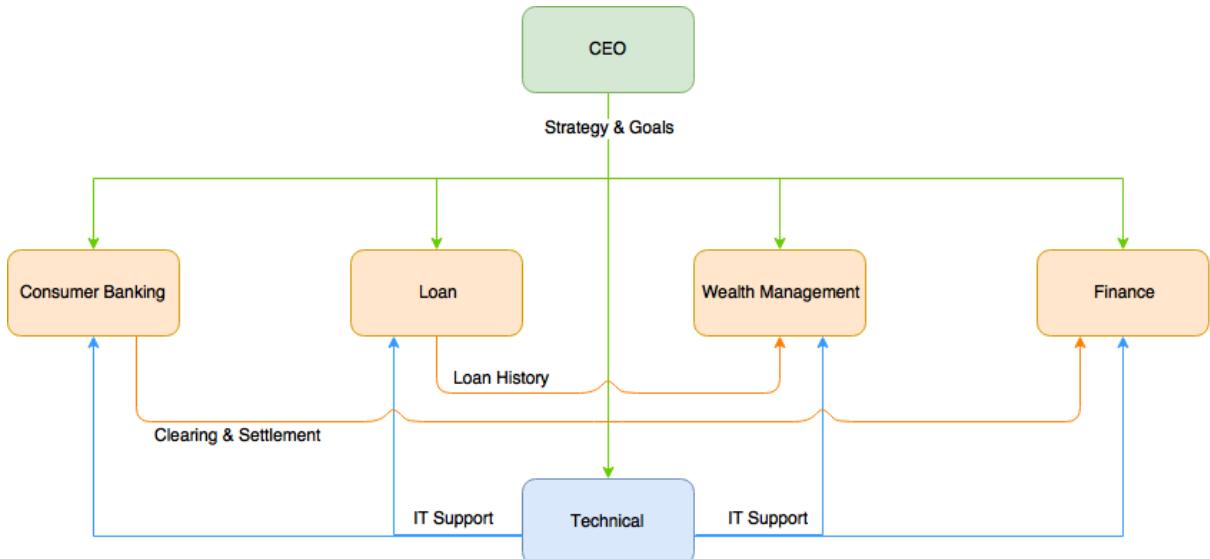


Figure 2: Merlion Bank Business Flow

2.2.3 Business Entity Description

The system is designed modularly so that Merlion Bank employee will only be able to access modules and functions applicable to their assigned role. The table below summarizes the roles in each departments and the corresponding responsibilities of each role. In addition, there are 3 positions in each managed department, being *managers*, *officers*, and *staff*. For the Board of Directors, there are in total 6 positions including: *CEO (Chief Executive Officer)*, *CIO (Chief Information Officer)*, *CFO (Chief Finance Officer)*, *CMO (Chief Marketing Officer)*, *CTO(Chief Technology Officer)* and *COO (Chief Operating Officer)*

Staff	Description of Responsibilities
Board of Directors	<p><u>Strategy & Planning</u></p> <p>The directors of Merlion Bank are concerned with the performance of business and operation process of the bank. By monitoring the earnings, expenditures, reserves and risks of the bank through analytical reports, the directors aim to analyze the effectiveness of adopted methodologies in each department and then make critical decisions pertaining to the development of Merlion Bank.</p> <p>With assistance of the business intelligence system of Merlion Bank, the directors are able to segment customers, forecast the demand and spot potential business opportunities. Based on the directors' knowledge and experience, he or she could propose strategies regarding banking services and products. Meanwhile, the director is also responsible for verifying strategies proposed by other employees of Merlion bank.</p>
Card Department	<p><u>Card Management</u></p> <p>Card Department Manager is responsible for overviewing and ensuring a smooth functional process of the entire department.</p> <p>Once customer submits credit card application, Credit Card Verifiers will verify authenticity of the submitted documents and check correctness of the information provided during the application.</p> <p>Credit Card Managers subsequently approve/reject credit card applications, monitor customer's card related activities and update customer's credit report based on customer's behaviors.</p> <p>Card Specialists would be expected to provide professional solutions when forwarded with unsolved enquiries regarding card related issues.</p>

Deposit Department	<p><u>Deposit Account Management</u></p> <p>Deposit Department Manager as the leader of Deposit Department, is responsible for managing, organizing and planning for the department's strategies and functions.</p> <p>After the new customers have applied for a new deposit accounts and submitted their scanned copies of identification documents, Deposit Account Verifiers are in charge of document verification.</p> <p>Similar to all other departments, Deposit Department have its Deposit Specialists who are responsible for answering unresolved issues about deposit accounts.</p>
Loan Department	<p><u>Loan Management</u></p> <p>Loan Officer is responsible for communicating with customers to understand their demands and record application information.</p> <p>Mortgage Appraiser is the one in charge of valuating loan applicants' collateral assets. With documentations collected by loan officer and assets valuation report provided by mortgage appraiser, Underwriter is responsible for evaluating each loan application and then either approves or rejects it.</p> <p>Loan Officer, who follows up loan repayment progress, is in charge of monitoring loan balance and taking care of bad debt and mortgage redemption. Underwriter is the one entitled to update status of each loan application.</p> <p>Loan Specialists deal with unsolved enquiry issues related to loans.</p>

Sales Department Staff	<p>Wealth Management</p> <p>Relationship Managers (RMs) are in charge of wealth management process of their own assigned customers. They approach customers to understand their financial goals and suggest wealth management products according to each customer's case. RMs need to follow up with each wealth management portfolio to adjust products, valuate and review portfolio performance.</p> <p>Sales Department Manager is responsible for assigning RM to customers and monitoring sales department's activities. With higher authority, the sales department manager is able to access all wealth management portfolios to view performance and make higher-level decisions.</p> <p>Customer Analysis</p> <p>Sales Department Manager is responsible for identifying potential customers who might be interested in wealth management products. By accessing the opportunity list generated by the business intelligence system, the sales department manager carries on with further research and analysis to find potential business opportunities.</p> <p>Customer Relationship</p> <p>It's RMs' responsibility to be aware of their own customers' activities, no matter related to wealth management or not. Despite the fact that RMs are not necessarily always be the one who handles each enquiry and proceed each activity, it's crucial for RMs to be aware of the status quo and maintain a good relationship with each customer.</p>
------------------------	--

	<p>Wealth Management Specialists are responsible for providing solutions for filtered enquiries from customer service agents in the wealth management field.</p>
Operation Department	<p><u>Customer Service</u></p> <p>The Operation Department Manager oversees and ensures the proper functioning of the Operation Department. He/she also tackles with the management and strategic issue of the division.</p> <p>Counter Tellers provide face-to-face service to customers and offer instant support for financial matters, including account opening and closure, fund transfer, loan application, cash deposit and withdrawal, billing and payment, and other general enquiries.</p> <p><u>Customer Enquiry</u></p> <p>Customer Service Agents are responsible for answering incoming calls to deal with customers' enquiries. For enquiries which call center agent is unable to handle, they record the case and pass to Enquiry Processors to proceed.</p> <p>Enquiry Processor are in charge of managing unsolved enquiries and reply to customers with the solutions. For the situation when the Enquiry Processor are not capable of solving the case, an issue will be recorded and forwarded to relevant department specialists to answer. Once answered, Enquiry Processor will reply the case and send back to enquiring customers.</p> <p>Operation Specialists are also assigned to answer the unsolved operation issues of Merlion Bank.</p>

2.2.4 Subsystem Description

To fully support the daily operation of Merlion Banking System, four subsystems are constructed. They are: Merlion Bank Internal System; External Parties System; Internet Banking System; Mobile Web Application. Since MBS is a large enterprise system which involves multiple entities, the subsystems target different user groups and define their operation scope.

Subsystem	User	Core Functionality Provided
A. Merlion Bank Internal System	Bank Staff	<p><u>Banking Activities Automation</u></p> <p>Merlion Bank's Internal System is responsible for all backend processing, including interest accrual, balance debit/credit, transfer, report & statement generation. The digitalization and automation of these business processes saves effort and time for bank employees and allows them to focus more on personalized profitable activities such as wealth management services.</p> <p><u>Save and Retrieve Customer Records</u></p> <p>Merlion Bank Internal System enables document digitalization. It manages customer personal information, transaction history, account balance in a centralized database. Its powerful yet flexible search function helps bank staffs to retrieve customer information effectively and efficiently. The entries in the database also provide data source for customer analytics and business intelligence which supports high-level decision making process.</p>

		<u>Customer Service</u> Customer-fronting employees such as counter tellers and call center agents benefit largely from Merlion Bank Internal System because it enables them to record customer reported issues, track status, update customer information and perform many more activities on a computer to effectively shorten their processing time and improve quality of service.
B. External Parties System	Merchant; Acquirer; Card Networks; ACH; MEPS; SWIFT;	<u>Data Sharing</u> External Parties System is responsible for data sharing among different external entities and networks. It involves service such as payment, billing, transfer and allows external systems to access to relevant account information from Merlion Bank. This system enables Merlion Bank to extend its service to offer more options which lead to greater flexibility and convenience to customers.

C. Internet Banking Website	Customer	<p><u>Self-service Banking</u></p> <p>As a direct bank, Merlion Bank has to offer Internet Banking Website where customers can conduct major banking service online. After customer applies for a bank account on the website, he/she will be given an online banking account. Customers could use this account to log in and perform transfer, payment, loan application and other activities by themselves.</p> <p><u>Communication</u></p> <p>If customers have concerns or enquiries about their banking experience at Merlion Bank, they could compose and send an enquiry on the Internet Banking Website. The enquiry will then be routed to a specialist who is responsible to reply incoming enquiries as soon as possible. Merlion Bank wish to provide customers the most professional answer within 3 working days.</p>
D. Mobile Web Application	Customer	<p><u>Accessibility</u></p> <p>Merlion Bank also allows its customers to log in to Merlion Internet Banking Website on their mobile devices. The Mobile Web Application provides responsive user interface which will fit the screen of any mobile devices and hence ensure an easy user experience. As such, Merlion Bank clients are able to manage their bank accounts wherever and whenever they prefer.</p>

3. Business Requirement Analysis

In this section, we will document a business analysis of all the subsystems that have been previously marked out in the preliminary requirements specification received by Kent Ridge Technology. This shall contain the core Business Objectives of each subsystem as well as the Business Assumptions we have made. A detailed analysis of the Business Processes of each subsystem will then be provided, followed by a System Requirements Analysis section where we explain how we intend to craft our Merlion Banking System(MBS) to address these needs.

Finally, an exhaustive list of the System Functionalities will then be provided to present a detailed picture of the final system we are going to implement.

3.1 Common Infrastructure (AAU ID:01)

3.1.1 Business Analysis

The Common Infrastructure system provides functionalities for user account management, user access control, as well as logging. System administrator should be able to manage employee accounts such as account creation, update, and deletion. For each employee, once the account has been created by system administrator, he/she should be able to reset his/her password for security reasons. Besides, system administrator should be able to assign, update, and cancel role for an employee as well.

Logging functionalities should also be provided by Common Infrastructure System to traces all the users' financially material transactions and sensitive user actions. Validation mechanisms are built to ensure account security. All login attempts will go through the One Time Password (OTP) mechanism. Captcha mechanism will be invoked after 3 times of failed login attempts, while account lockout will happen after 5 times. In this way, a robust and resilient platform of high security standards will be created to protect the integrity of the system and ensure accountability of the users.

Business Objectives

- Allow secured log in and validation check for logging users.
- Allow system administrator to manage employee account, such as create, update, and delete employee account
- Allow system administrator to assign, update, and delete role for an employee
- Allow employees should only be allowed to access functions needed to perform their duties.
- Allow staff of Merlion Bank to reset his/her password of employee account
- Allow staff of Merlion Bank to communicate with one another with internal communication system
- Keep track of all important activities at both user level and system level for security and troubleshooting purpose

3.1.2 Business Process

A) Create Employee Account & Assign Role

System administrator should be able to create account newly hired employees so that they would be able to access systems to perform their duties.

Scenario: System Administrator Elsa creates a new account for an employee Anna

1. System administrator Elsa enters personal particulars for Anna as follow:
 - a. Name: Anna Chua
 - b. Department: Loan Department
 - c. Position: Manager
2. Elsa selects “Loan Department Manager” from drop-down menu for Anna’s first role and “Sales Department Manager” for her second role
3. System checks database and does not find any conflicts.
4. System assigns a user account id of 0001 and generates a password “xwqocwc” for Anna.

5. System displays the notification saying that “A new employee account has been successfully created!”

B) Edit Employee Account

This enables system administrator to edit employee account and edit role of an employee.

Scenario: System Administrator Elsa edits account for an employee Anna

1. System administrator Elsa logs in to Merlion Bank Internal System
2. Elsa searches for loan department staff Bob by keying in “Anna”
3. System displays a list of user account profile of which the field “Name” contains “Anna”
4. Elsa selects the correct user account profile and clicks “Edit” button
5. All the fields become editable

After all the fields become editable, system administrator can edit department and position of a staff, as well as delete role of a staff if the staff no longer need to perform a role.

Scenario: System Administrator Elsa deletes a role of an employee Anna

1. Elsa clicks “Delete” icon besides first role (“Loan Department Manager”) of staff Anna’s user account profile
2. System displays a notification saying that “Are you sure to delete the role?”
3. Elsa confirms the action by clicking “Yes”
4. System deletes the role of Anna in database and role “Loan Department Manager” disappears from Anna’s user account profile
5. Elsa clicks “Save” button
6. System displays a notification saying that “User account has been successfully updated”

C) Delete Staff Account

This enables system administrator to delete a staff account from database if the staff is no longer employed by Merlion Bank. For potential future references, the deleted employee will be moved to archive employee list.

Scenario: System Administrator Elsa creates a new account for an employee Anna

1. System administrator Elsa logs in to Merlion Bank Internal System
2. Elsa searches for loan department staff Bob by choosing “Loan Department” at Department filter at the employee list form header, and “Staff” at the Position filter.
3. System displays a list of user account profile of which fulfill the criteria
4. Elsa selects the correct user account profile and clicks the dustbin icon to delete
5. System displays the notification saying that “Are you sure to delete the the user account?”
6. Elsa confirms the action by clicking “Yes”
7. System displays the notification saying that “User account has been successfully deleted”
8. Bob’s profile has removed from the Current Employee list to Archived Employee list

D) User Log in & Log out

Employees and customers should be able to log in to and log out from Merlion Banking System using their user account id and password.

E) Forget password

If employees or customers forget their user account password, they can reset the password using Merlion Banking System.

Scenario: Employee Danny resets his password.

1. Danny clicks “Forget Password”.
2. Danny enters his email.
3. System detects for Danny’s email address and sends to his email a link that expires in five minutes to change his password.
4. Danny clicks on the email link and enters his new password as follow:
 - a. New Password: danny1970
 - b. Type new password again: danny1970
5. System did not detect any error.
6. System accepts changes to account password
7. System displays the notification saying that “Your password has been successfully updated”

F) Reset Employee Account Password

This enables staff of Merlion Bank to change password of his/her own user account.

Scenario: Loan department manager Anna resets password for her employee account

1. Loan department manager logs in to Merlion Bank Internal System with the following information:
 - a. User Account ID: 0001
 - b. Password: xwqocwc
2. System verifies user account id and password from database, and does not find any conflict
3. Anna clicks her own user account profile and then clicks “Reset Password” button
4. System displays the page for changing password
5. Anna input the information as follow:
 - a. Old Password: xwqocwc
 - b. New Password: anna1970
 - c. Confirm New Password: anna1970

6. System checks that no conflict appears for the new password that is keyed in twice
7. System displays the notification saying that “Your user account password has been successfully updated!”

G) Internal Messaging

Communication and collaboration are key processes in helping to create business value. Therefore, it is important that Merlion Banking System provide a platform for employees to communicate with their co-workers in an easy and secure manner.

H) Send firm-wide announcement

It can be troublesome to send a message to all staff of Merlion Bank due to the large number of staff members. Announcements and broadcasts help ensure that all staff members receive the information in a timely manner and can thus act on it immediately.

I) Send Notifications & Emails to Customer

System should be able to send notifications to customer’s mailbox on Internet Banking Website to remind customers of events such as application result of loan, monthly bank statement, reply to customer’s enquiry, etc. System should also be able to automatically send bank statement or notifications to customer’s personal email account.

3.1.3 System Requirement Analysis

Business Assumptions

- All staff have access to Merlion Bank internal communication system
- One employee can only have one employee account
- When creating a new employee account, system administrator must assign role(s) to the employee

- One employee can be assigned multiple roles
- Staff can only have access to functionalities which are necessary to perform their duties

To address the business requirements of the Common Infrastructure System in the preliminary requirements specifications, a System User Account Management Module, an Internal Communication Module, an External Communication Module, and a Security Module will be constructed for Merlion Bank Internal System. These four modules are described as follows:

a) System User Account Management Module

The module will be used by employees and system administrators of Merlion Bank. Employees would be able to reset their password for user account. System administrators would be able to manage employee user account creation, editing, deletion, as well as role assignment, editing, and deletion. Additionally, it will be used to review logs and identify suspicious activities of users or suspicious activities carried out on systems.

b) Internal Communication Module

The module will be used by all employees of Merlion Bank for timely and seamless communication. All employees can send messages to individual person and some employees will be able to post announcements and broadcasts which can notify all staff members of Merlion Bank.

c) External Communication Module

The module will be used for purpose of sending notifications and emails to customer. Certain events will trigger system to send emails to customer's personal email account. Besides, system will also be able to send notifications to customer's mailbox on Internet Banking Website to remind customers of certain events.

d) Security Module

This module will be used to protect the confidentiality and integrity of all data handled by the system at both transport and application layer. All the online banking activities and other

activities involving sensitive data are protected by Secure Socket Layer (SSL) as a method of transport layer security. At application layer, various security methods will be adopted, including but not limited to robust login and logout protection, role-based and need-based access control, hashing and encryption of sensitive information and logging at both system and user level. In particular, deposit account number, card number and account balance will be encrypted to protect Merlion Bank customer's confidential data.

To address the business requirements of the Common Infrastructure System in the preliminary requirements specifications, a Customer Account Management Module will be constructed for Internet Banking Website and Mobile Web Application. The module is described as follows:

e) Customer Account Management Module

The module will be used by customers to manage their user account. Customer will be able to log in and out of his user account. For security purpose, customer can replace his old password with new password. If customer forgets his password, he/she will be able to retrieve his lost password through email verification. Besides, customer can also choose to delete his user account for Internet Banking Website.

System Functionalities

Function Name	Remark	AAU ID		
Code				
A.1 Common Infrastructure				
A.1.1 System User Account Management Module				
A.1.1.1	Create staff account	System administrator creates new staff account		
A.1.1.2	View staff accounts	System administrator views all the staff accounts, and associated roles and permissions		
A.1.1.3	Update staff account	System administrator updates staff account information		
A.1.1.4	Delete staff account	System administrator deletes staff account		
A.1.1.5	Reset account password	Staff resets password of his user account		

A.1.1.6	View role	System administrator views all roles assigned to a staff	
A.1.1.7	Assign role	System administrator gives staff certain access right by assigning them a new role	
A.1.1.8	Delete role	System administrator deletes a role of staff, and the access right attached to the role deleted will be canceled	
A.1.1.9	Log in	Staff logs in to Merlion Bank Internal System	
A.1.1.10	Log out	Staff logs out from Merlion Bank Internal System	
A.1.1.11	Forget password	Staff retrieves lost password through email verification	

A.1.2 Internal Communication Module

A.1.2.1	Send messages	Staff sends messages to individual staff	1
A.1.2.2	View messages	Staff views messages sent by other staff	
A.1.2.3	Delete messages	Staff clears history	
A.1.2.4	Send announcements	Staff sends announcements	
A.1.2.5	View announcements	Staff views announcements	

A.1.3 External Communication Module

A.1.3.1	Send notifications to customer's mailbox	System sends notifications to customer's mailbox on Internet banking Website	1
A.1.3.2	Send email to customer's personal email account	System sends email to customer's personal email account	

A.1.4 Security Module

A.1.4.1	Session inactivity logout	Session will automatically logout after 15 minutes of inactivity	1
A.1.4.2	Logging	System traces all the users' financially material transactions and sensitive user actions	
A.1.4.3	Hash password	System uses hashing to protect password	

A.1.4.4	Encrypt sensitive data	System uses Secure Socket Layer(SSL) to encrypt sensitive data for transport layer security	
A.1.4.5	Account lock out	If customer inputs password wrongly for three times at login page, system will send one-time password (OTP) to customer's phone number. The OTP is required for customer to login again to his/her online banking account.	
A.1.4.6	Captcha mechanism	If customer inputs password wrongly for three times at login page, system will require customer to pass the simple test before login to protect website against bots	
A.1.4.7	Second factor authentication	System sends SMS to customer's phone number to facilitate authentication if customer requests for any service on the online banking system	

C.1 Customer Account Management Module

C.1.1	Delete account	Customer chooses to delete his/her account for Merlion Online Banking	1
C.1.2	Change password	Customer replaces old password with a new password	
C.1.3	Forget password	Customer retrieves lost password through email verification	
C.1.4	Log in	Customer logins to their account by user account number and password	
C.1.5	Log out	Customer logs out of their account	

D.1 Customer Account Management Module

D.1.1	Delete account	Customer chooses to delete his/her account for Merlion Online Banking	1
D.1.2	Change password	Customer replaces old password with a new password	
D.1.3	Forget password	Customer retrieves lost password through email verification	

D.1.4	Log in	Customer logs in to their account by user account number and password	
D.1.5	Log out	Customer logs out of their account	

3.2 Customer Management System (AAU ID: 02)

3.2.1 Business Analysis

The Customer Management System is required to provide both **operational** and **collaborative** CRM capabilities to Merlion Bank.

Operational CRM is to ensure a consistent data usage and sharing across all department within Merlion Bank. To achieve information consistency, a centralized database is managed to store all customer information in its most updated version. This system tracks both basic and advanced customer information for various usages, from mailing, loan application, to wealth management decisions and customer analysis. As a direct bank, Merlion Bank's Customer Management System enables customer to edit and change their basic profile over the Internet easily without making their way to the physical branches. However, for verification and security purposes, customers with wealth management services are still advised to meet their Relationship Managers (RM) for advanced information management. Since all customer-related information is captured and stored in Customer Management System, the Personal Data Protection Act (PDPA) must be complied with. Moreover, a comprehensive security mechanism should be implemented to ensure a specific bank employee could only view customer data he/she needs to know without exceeding the boundaries.

Collaborative CRM provides seamless customer service across all contact points of Merlion Bank, which include brick-and-mortar branch, call center, postal mail, as well as online channels such as Internet banking website and email. When a customer reports an issue via any of the contact points mentioned above, the system should create a new case which may consist of a single issue or multiple issues. The case will be auto-forwarded to a relevant specialist regarding the nature and content of the problem. Customer Management System promotes a smooth customer experience by sharing case status and customer information among all contact points so that minimal information is required from customer when they contact Merlion Bank.

To build a stronger tie with our valuable clients, RM will be notified by the system when RM's customer creates a new case. Similar to customer profiles, customer report cases should also be kept within a tight security mechanism.

Business Objectives

- Allow customers to edit their basic information.
- Allow RMs to manage customer's advanced information.
- Search customers through various dynamic filters for bank employees to find out the relevant customer information.
- Ensure all contact points have the access to the updated customer information when a customer report a case.
- Inform RMs with the latest customer case status.

3.2.2 Business Process

A) Edit Customer Basic Information

As a direct bank, Merlion Bank allows its customers to change their basic information via online banking system. Alternatively, customers can change their basic information by approaching any of the contact points maintained by Merlion Bank.

Scenario: Edit customer basic information (Via online banking system)

1. Customer Tom logs in to Internet Banking Website of Merlion Bank
2. Tom clicks "Update personal profile"
3. Tom looks for "Mobile phone Number" column under "Contact Details" section
4. Tom changes his number from 94631826 to 83357621
5. Tom receives OTP at his new phone number
6. Tom types in OTP for verification
7. Tom clicks "Update" button at the bottom of the webpage
8. System displays "Mobile number updated" message

Scenario: Edit customer basic information (Via call center)

1. Call center agent Kim receives a phone call from Customer Tom
2. Tom informs Kim that he wants to update his new phone number
3. Kim asks Tom for his name and NRIC/Passport number
4. Kim searches for Tom in Merlion Bank Internal System according to the ID number provided by him
5. Kim clicks “Update customer profile”
6. Kim changes mobile phone number from 94631826 to 83357621
7. Kim clicks “Update” button at the bottom of the webpage
8. System displays “Mobile number updated” message

B) Edit Customer Advanced Information

Since only customers with wealth management services have their advanced information captured in the system, not all customers are required to manage their advanced profile. If customer needs to modify advanced information, he/she has to inform his/her RM. RM may arrange a meeting with customer or a chat over the phone to discuss and finally update the customer’s advanced profile. The reason why customer cannot edit their own advanced information is because a minor change in advanced profile may cause a big difference in wealth management decisions, and hence the portfolio of wealth management. Therefore, Merlion Bank encourages all of its customers to discuss with RM before changing advanced profile.

Scenario: Edit customer advanced profile

1. Customer Tom contacts his RM Mike and discusses his change in advanced information field
2. Mike acknowledges and verifies the change
3. Mike logs in to Merlion Bank Internal System as an RM
4. Mike clicks “Update customer advanced profile”
5. Mike changes Tom’s “Financial Goal” from “\$50,000/year” to “\$70,000/year”
6. Mike clicks “Update” button at the bottom of the webpage
7. System displays “Financial goal updated” message

C) Search Customer

The search function enables Merlion Bank to discover more information from its customers and use it in profit-driven activities, such as email marketing. Various filters provided allow the bank to group customers into different categories according to their information recorded.

Scenario: Sales manager Terry searches for potential customer

1. Terry logs in to Merlion Bank Internal System
2. Terry clicks “Search customer”
3. Terry sets “Customer Age” to be “less than 50 years old” and sets “Deposit Account Balance” to be “more than \$8,000”
4. System searches through the entire database and displays a list of customers whose age is under 50 with monthly income higher than \$8,000

D) Record an Enquiry

Customers of Merlion Bank are provided with a wide range of options when they encounter a problem during their banking experience. They may compose an enquiry on Merlion Internet Banking Website, or write an email. If customers prefer an offline approach, they are able to call hotline or come down to the Merlion Bank home branch.

Scenario: Customer composes an enquiry on Internet Banking Website

1. Customer Tom logs in to Merlion Bank Internet Banking Website
2. Tom clicks “Message” and then selects “Write an enquiry”
3. Tom chooses “Enquiry Type” as “Customer Account” from the dropdown menu
4. Tom then writes in the text box for “Description”:
“If someone overseas wishes to transfer fund to my Merlion Bank deposit account, what information do I need to provide him other than my SWIFT code?”
5. Tom clicks “Submit” button at the end of the webpage
6. System displays “Your enquiry has been sent” message and issues a Case ID (e003289) to Tom

Scenario: Customer makes enquiry at the counter

1. Customer Tom informs Counter Teller Ben that his new debit card has not been mailed to his address
2. Ben clicks “Record a customer enquiry”
3. Ben asks Tom for his account number and selects Tom’s account in Merlion Bank Internal System
4. Ben selects “Debit Card” from the dropdown menu and types in the “Case Description” text box:
“Customer has not received his newly issued debit card from his home address recorded in our system. Please update the status of card issuance and speed up the process. Thanks.”
5. Ben clicks “Submit” button
6. System displays “Customer case submitted” with a Case ID (c002849)
7. Ben copies the Case ID (c002849) and passes to Tom for status tracking.

E) Add Follow-up Questions

After customer’s enquiry is answered, system will notify customer for the result. When customer views the solution to the case, he/she may be unsatisfied with the result. Then, there is an option provided by the website for customer to post a follow-up question to the previous case. The follow-up question shares the same Case ID and is attached to the previous case so that the problem-solving employee will have a better understanding of the background information.

Scenario: Customer adds follow-up question

- | |
|--|
| <ol style="list-style-type: none"> 1. Customer Tom logs in to Merlion Internet Banking Website 2. Tom selects "Notifications" and clicks on “Your enquiry has a new response” 3. Tom views the response which does not fully answer his question 4. Tom clicks “Add follow-up questions” 5. Tom writes his follow-up questions:
 <i>“Thank you for your answer. However, I am uncertain about the address you mentioned. Should it be the address of Merlion Bank home branch or the address of the branch where I opened my account?”</i> 6. Tom clicks “Submit” button |
|--|

7. System displays “Follow-up question submitted” message

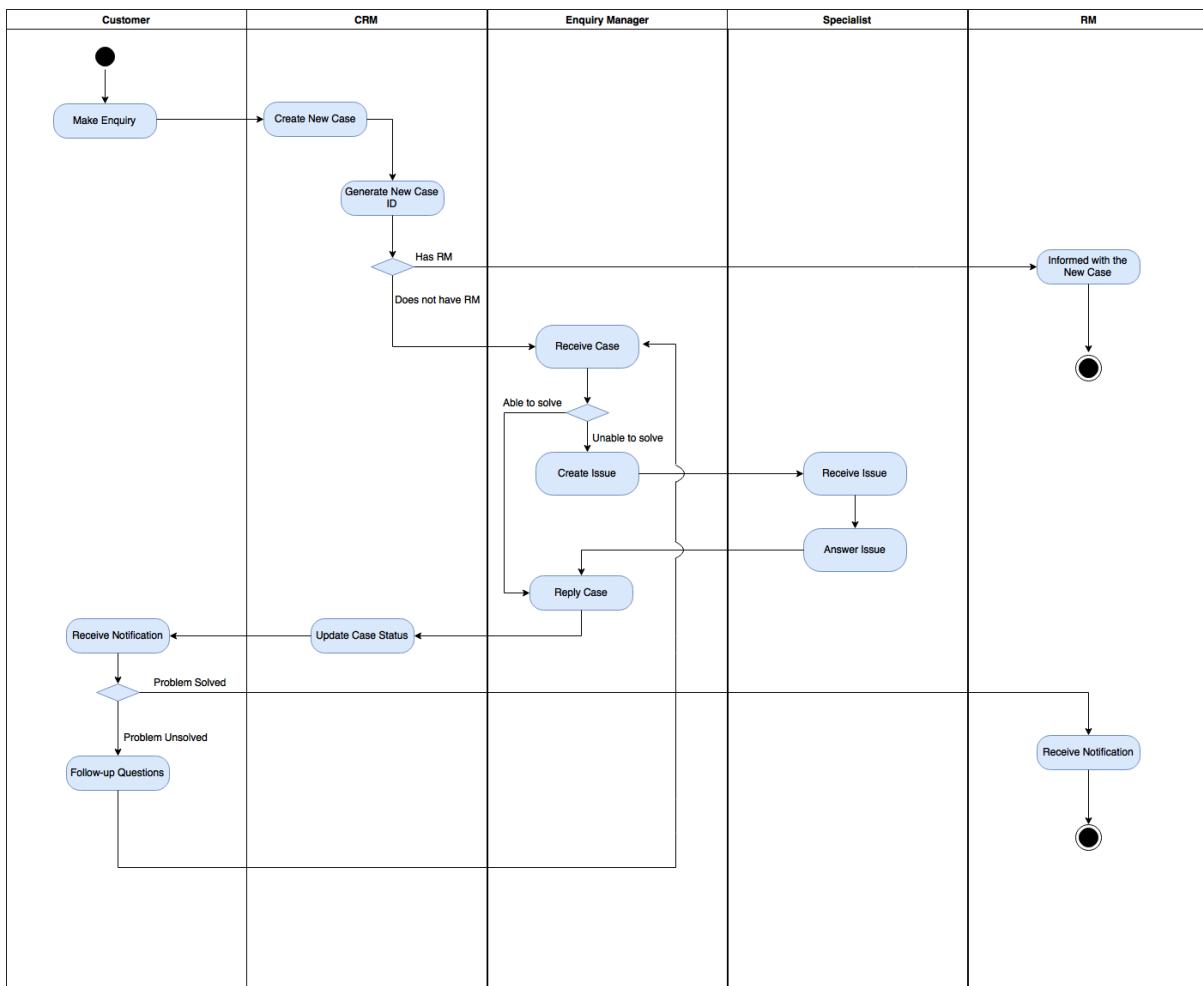


Figure 3: Activity Diagram - Enquiry Process

3.2.3 System Requirement Analysis

Business Assumptions

- Customer profile is created when customer opens an account at Merlion Bank.
- Advanced customer information is only created when customer subscribes to wealth management services and is managed by customer’s RM.
- Customer is only able to edit basic information.
- Cases received via phone call, postal mail and email are recorded into Merlion Bank’s system by customer service center employees.

- When a new case is created by the system, a unique case ID is auto-generated.
- Customer Management System implements a security mechanism that restrict access to customer information on a “need-to-know” basis.

To address the business requirements of Customer Management System, a customer information module, a customer advanced information module, and an enquiry management module should be constructed.

a) Customer Information Module

This module will be used by customer-fronting employees to acquire basic information about a customer and support identification purpose if necessary. Call center employees and counter tellers are able to edit customer information when they are informed by the customer about the latest change of personal particulars, such as phone number or home address. All staffs are given the access right to view basic customer profile inside this module to assist them with their daily business processes.

b) Customer Advanced Information Module

This module will mainly be used by Relational Managers. Only employees with the role of an RM are allowed by the system to manage customer’s advanced profile as the profile contains many private and secrete information about customers who have subscribed to wealth management services. RMs use this module to store customer’s advanced information such as number of dependents, education level, residential status, occupation and income situation. With the support of Merlion Bank’s Business Intelligence System, RMs are able to make wiser and quicker wealth management related decisions. When customer wishes to change advanced profile like financial goal, customer is advised to inform his/her RM about the change which will then be completed by the RM. Moreover, this module allows RMs and their sales managers to search for potential customers by setting criteria for different filters. After acquiring various groups with similar characteristics, they may conduct marketing activities targeting these groups of people according to their traits.

c) Enquiry Management Module

This module is used by customer service employees, including call center employees and counter tellers. They record customer enquiry in this module so that it can be routed to specialists for resolution according to the enquiry type selected. The module will auto-generate a Case ID every time a new case is recorded in the system. When customers refer to their previous cases, client-facing employees can easily search for the case customer is mentioning either through Case ID or customer name and personal ID. This module helps Merlion Bank to store customer's enquiry history which can be viewed whenever it is necessary to promote efficiency.

d) Customer Account Management Module

This module enables Merlion Bank customers to manage their personal profiles through viewing and editing account functionalities. On Merlion Internet Banking Website, customers are also able to write and submit enquiries online. This module builds a closer tie between customers and Merlion Bank.

System Functionalities

Function Name	Remark	AAU ID		
Code				
A.2 Customer Management System				
A.2.1 Customer Information Management Module				
A.2.1.1	Edit basic customer information	Teller updates basic customer information such as, contact information and address		
A.2.1.2	View basic customer information	Teller views basic customer information		
A.2.2 Customer Advanced Information Management Module				
A.2.2.1	Edit advanced customer information	RM updates advanced customer information mainly used in wealth management such as, individual risk profile and financial goals		

A.2.2.2	View advanced customer information	RM views advanced customer information	
A.2.2.3	Search customer	RM searches customer information through dynamic filters and searching criteria	
A.2.3 Enquiry Management Module			
A.2.3.1	Create enquiry case	Customer-fronting employees add a new case to customer enquiry with detailed description of the problem. A case can consist of one or many issues	2
A.2.3.2	Update enquiry status	Customer service employees update enquiry status	
A.2.3.3	Forward enquiry to specialist	According to its category, system routes enquiry to relevant customer service employee for resolution	
A.2.3.4	Search enquiry	Customer-fronting employees and RM search case by its case ID	
A.2.3.5	View enquiry	Customer-fronting employees and RM view a list of customer enquiries with corresponding status	
A.2.3.6	Solve case	Enquiry Processor solve cases if the enquiries can be answered by him/her	
A.2.3.7	Create issue	When incapable to solve the enquiries, Enquiry Processor create one or more issues about the enquiries and forward to different relevant departments' specialists.	
A.2.3.8	Solve issue	Different departments' specialists solve issues forwarded by the Enquiry Processors.	
C.1 Customer Account Management Module			
C.1.6	View accounts	Customer views his/her own account information	2

C.1.7	Update accounts	Customer updates his/her basic information such as, contact number, home address, etc	
C.1.8	Submit enquiry	Customer submits enquiry by briefly describe the problem encountered	
C.1.9	View enquiry	Customer views the status of the enquiry submitted, whether it is solved by an employee or not	
C.1.10	Add follow-up questions	If the resolution does not address customer's concern, customer may add follow-up questions	
D.1 Customer Account Management Module			
D.1.6	View accounts	Customer views his/her own account information	2
D.1.7	Update accounts	Customer updates his/her basic information such as, contact number, home address, etc	
D.1.8	Submit enquiry	Customer submits enquiry by briefly describe the problem encountered	
D.1.9	View enquiry	Customer views the status of the enquiry submitted, whether it is solved by an employee or not	
D.1.10	Add follow-up questions	If the resolution does not address customer's concern, customer may add follow-up questions	

3.3 Deposit Account Management System (AAU ID: 03)

3.3.1 Business Analysis

The Deposit Account Management System (DAMS) is the core of Merlion Banking System. It manages some of the most important information of customer accounts, including account balance, transaction history, and interest rates. DAMS acts as a centerpiece in Merlion Banking System since all deposit account management task must be assigned back to DAMS to ensure a consistent account balance and transaction records across all channels.

Although DAMS connects with many other systems, it functions on its own most of the time and seldom requires human processing. Firstly, it debits or credits a certain amount from customer's account when customer makes a transaction or pays a bill. Secondly, it accrues interest of each account on daily basis and credits the accumulated interest at the end of each month. Thirdly, DAMS records transaction history of each account and prepares an e-statement for customer to check monthly.

DAMS is also used for account opening and account closure process. As a direct bank, Internet Banking Website of Merlion Bank encourages its customers to apply for an account online. DAMS then receives the application request with necessary customer information and uploaded document for verification. It should allow deposit account manager to view application request with supplementary documents attached and makes a decision whether to approve or reject the application.

DAMS is also responsible for internal fund transfer within Merlion Bank. When a customer of Merlion Bank wishes to transfer fund to another Merlion Bank account, DAMS debits on the paying account and credits on the payee account without going through clearing and settlement process via external parties. In addition, customer is able to manage up to a maximum number of 20 payees in their online banking account to speed up transaction process without the hassle of entering payee information.

Business Objectives

- Provide online account opening and account closure service
- Calculate daily interest of each account
- Maintain customer transaction history and produce e-statement monthly
- Manage customer account balance and ensure the balance is updated and shared across all operational systems
- Allow customer to transfer fund within Merlion Bank without passing through external entities for clearing and settlement procedures
- Allow customer to manage up to 20 payees and save their payment information to accelerate transaction process in the future

3.3.2 Business Processes

A) Open Account

As a direct bank, Merlion Bank encourages its customers to begin their Merlion banking experience by opening accounts online. This means that it is no longer necessary for customers to approach a counter teller in a branch before they can create an account under their name. To open an account via Merlion Internet Banking Website, customer only needs to select account type, provide mandatory personal information, upload supplementary document for verification, and add initial deposit to activate account after account is opened. Ideally, customer is able to open account within ten minutes if all information provided is correct. For new customer, deposit account verifier would verify the information provided and system issues an account number for Tom and sends confirmation email to new customer.

Instead of keying in all details as the new customers, existing customers can create a new account without repeating the same process. Upon login, an existing customer can simply indicate their desired account type, confirm the application, and then transfer initial deposit to complete the application.

Scenario: Customer opens an account on Internet Banking Website

1. Customer Tom clicks “Open Account” on Merlion Internet Banking Website
2. After reading detailed information about each account type, Tom chooses “Monthly Saving Account”
3. Tom then fills in all the mandatory information required by the system:
 - a) Name: Tom Tan
 - b) Gender: Male
 - c) Nationality: Singaporean
 - d) NRIC/Passport: S9384832K
 - e) Address: 35 Smith Avenue #03-25
 - f) Postal Code: 637283
 - g) Contact Number: 93848492

- h) Email Address: tom_tan@hotmail.com
 - i) Date of Birth: 01/07/1993
 - j) Occupation: Accountant
 - k) Company: DBS
4. Tom upload the scanned copy of his NRIC
 5. System displays Terms & Conditions and require customer digital signature
 6. Tom signs using a mouse and saves it into the system
 7. System forwards scanned documents to Deposit Account Verifier to verify customer information
 8. Deposit Account Verifier approves the information
 9. System issues an account number for Tom and send confirmation email to Tom
 10. Tom deposits \$5,000 into his new account as initial deposit
 11. Tom's new account is successfully activated

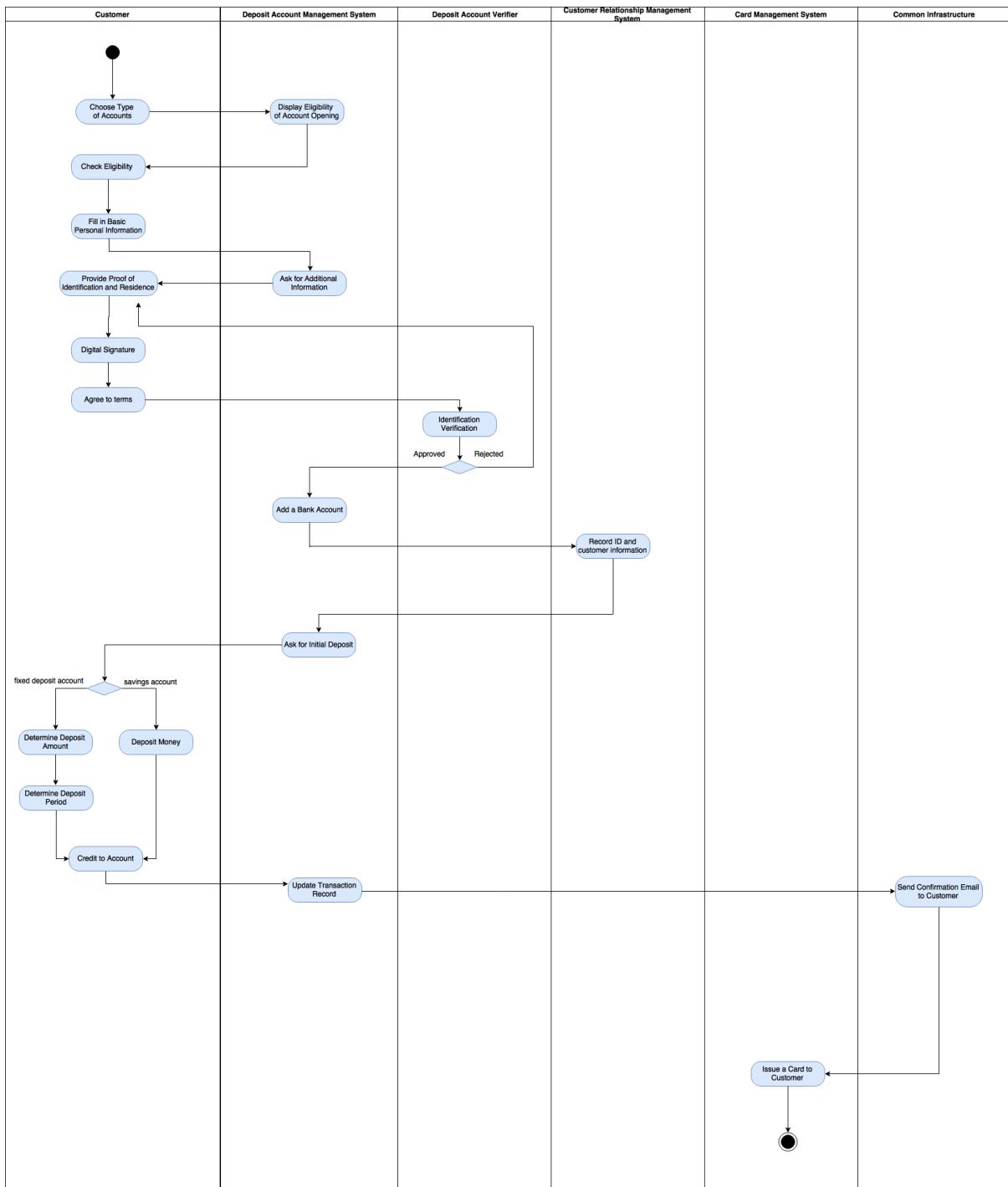


Figure 4: Activity Diagram - Online Account Opening

B) Close Account

When customer wishes to close a Merlion Bank Account, he/she could also achieve this online. However, before account closure customer needs to enter OTP for verification purpose. System would ensure there is no account balance left either through transfer or withdraw and no loan/wealth service under this deposit account. When customer intends to close account,

system will also ask customer for their feedback to identify areas of improvement to enhance Merlion Bank's service in the future.

Scenario: Customer closes an account on Internet Banking Website

1. Customer Tom logs in to Merlion Internet Banking Website
2. Tom clicks "View my accounts"
3. Tom selects the account he wishes to close and clicks "Delete account"
4. System displays a dropdown menu containing some of the common reasons for account closure
5. Tom selects "I'm going to live/study abroad" from the dropdown menu
6. System detects there is no balance left in the deleting account
7. System requires Tom to fill in and sign a closure form
8. System detects there are other accounts under Tom and deletes information associated with this account only
9. System sends a confirmation email to Tom

C) Payee Management

If customer makes transfer frequently to certain accounts, he/she is allowed to add up to 20 accounts in the system. By saving payee information, customer do not need to input information repeatedly before every transfer process which makes it much more efficient. When customer uses up the 20 vacancies and wishes to add more payee account, he/she has to make a decision to clear some of the previous records to open up a space for new payee. Although limiting the total number of payees may create inconvenience to Merlion Bank customers, the bank still prioritizes payee's security over transfer efficiency as there can be cases that customer's online banking account is hacked and payee's private banking information is exposed to malicious external parties.

Scenario: Add a payee

1. Customer Tom logs in to Merlion Internet Banking Website
2. Tom clicks "Add recipient"
3. Tom enters OTP for verification
4. Tom enters Payee information as below:

- Recipient's Name: Sharon Tan
 - Recipient's Account Number: 1232-1122334455
5. Tom clicks "Save" button
 6. System displays "Payee added successfully" message

Scenario: Delete a payee

1. Customer Tom logs in to Merlion Internet Banking Website
2. Tom clicks "Payee Management" and then clicks "Delete" button beside Payee Tony's name
3. System displays warning message "Are you sure to delete this payee?"
4. Tom selects "Yes"
5. System displays "Payee deleted" message

D) Intra-bank Fund Transfer

DAMS enables customer to transfer funds between two Merlion Bank accounts which requires no external clearing and settlement processes. If customer transfers to an account frequently, he/she may choose to add the account to payee list in order to speed up the whole transfer process. If this is just a one-time transfer, customer do not need to add recipient into payee list which has a limited size of 20. Customer needs to enter OTP for verification purpose once he/she intends to transfer fund within Merlion bank.

Scenario: Transfer to a Merlion Bank account

1. Customer Tom logs in to Merlion Internet Banking Website
2. Tom clicks "To Other Merlion Accounts (One Time)" button
3. Tom chooses "One-time transfer"
4. Tom enters payee information:
 - Recipient's Name: Sharon Tan
 - Recipient's Account Number: 1232-1122334455
5. Tom enters transfer amount \$150
6. Tom clicks "OK"
7. System displays "Are you sure to transfer \$150 to Amy Wong?"
8. Tom clicks "Yes"

9. System displays “Transfer completed” message

E) Cash Deposit / Withdrawal

Since Merlion Bank targets itself as a direct bank, it focuses its service online while maintaining only one home branch in Singapore. At Merlion Bank’s home branch, customers may withdraw or deposit cash over the counter. There is also a cash position management process where counter tellers are required to input total cash amount received at the start of the shift and the amount submitted at the end of the shift. In order to drive more customer from its brick-and-mortar branch to online banking website, over-the-counter (OTC) transactions at Merlion Bank may be charged with service fees accordingly. Hence, it is not recommended to deposit cash or withdraw cash at Merlion Bank’s home branch. Alternatively, customers are encouraged to perform online transfer to other cards or accounts. Merlion Bank also plans to join the ATM network so that customers will be given more options for performing transactions, including cash deposit and withdrawal. Merlion Bank customers may be able to enjoy ATM service at Phase Two of the project.

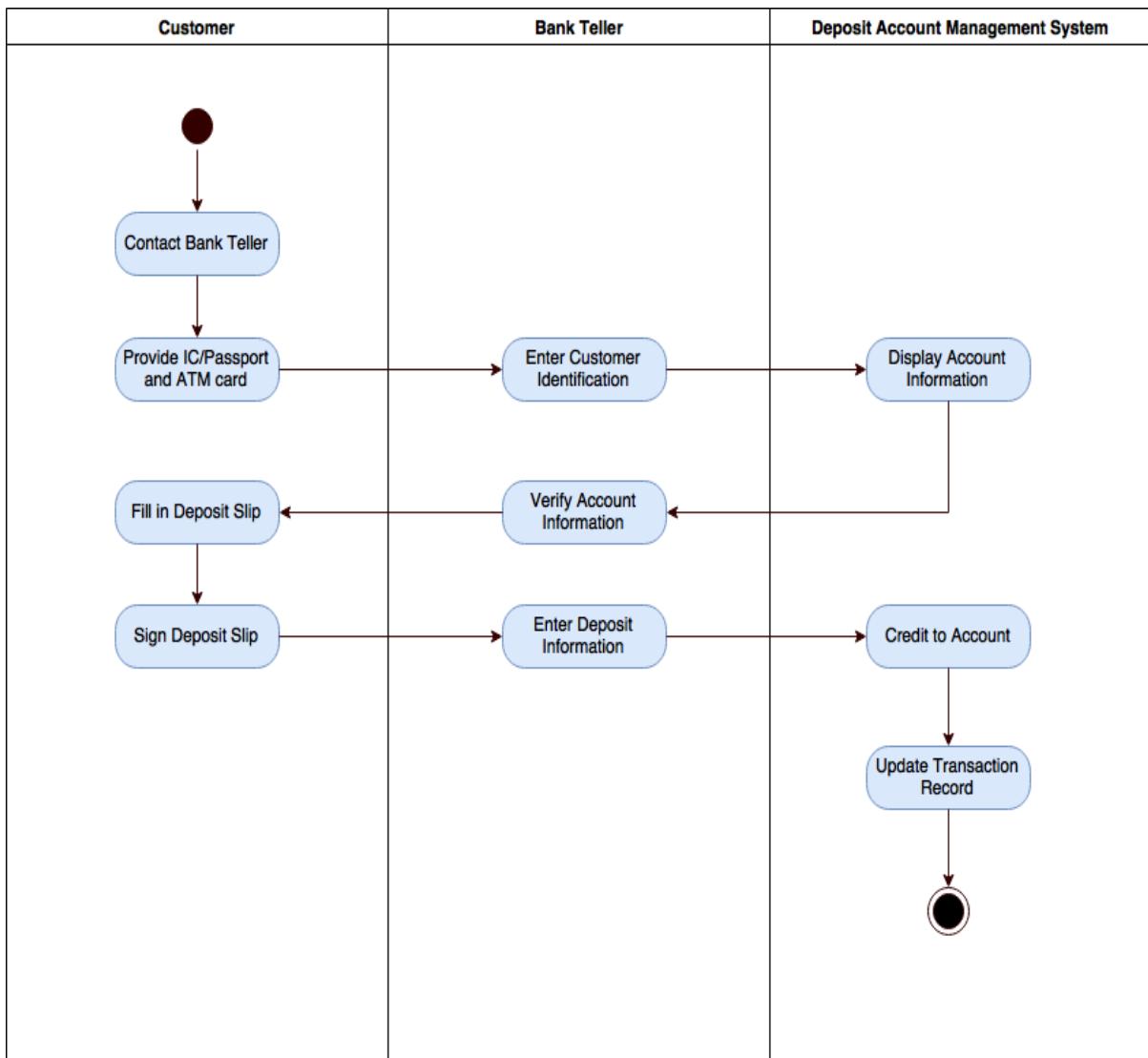


Figure 5: Activity Diagram - Cash Deposit

F) View Transaction History

Merlion Bank staff and customer will be able to view transaction history of an account. It is essential for loan officer to review a loan applicant's credibility and make informed decisions based on the transaction records.

Scenario: Customer views transaction history

1. Customer Tom logs in to Merlion Internet Banking Website
2. Tom clicks “View my transaction history” and chooses the range to be “Past 30 days”

3. System retrieves and displays Tom's transaction records for the past 30 days

G) View e-Statement

At the end of each month, DAMS will automatically generate an e-statement and send it to customer's registered email address. Every e-statement will contain account balance and transaction history of all deposit accounts at Merlion Bank which will help customers to understand their monthly income and spending in details.

H) Interest Accrual and Crediting

At Merlion Bank, interests are accrued on a daily basis and credited to each account at the end of the month. Each account may follow a different interest rate scheme based on the account type. Currently, Merlion Bank offers 3 types of savings account (Basic Savings Account, Bonus Savings Account, Monthly Savings Account) and Fixed Deposit Account.

Basic Savings Account is the most fundamental account type which only requires \$1 initial deposit. This account follows a tiered interest rate scheme with a base interest rate of 0.05%. When the account balance is between \$350,001 to 1000,000, the interest rate will be compounded at a rate of 0.08%. When it is above \$1000,000, the interest rate is 0.1% annually.

Bonus Savings Account requires an initial deposit of \$10,000. This account type shares a same base interest rate of 0.05% as Basic Savings Account. In addition, there is a bonus interest of 0.75% monthly if customer does not withdraw money within that month.

Monthly Savings Account does not require an initial deposit but demands a minimal monthly saving of \$50. It has a base interest rate of 0.05% and if customer makes no withdrawal within the month a bonus interest of 0.35% will be activated.

Interest rates for Fixed Deposit Account vary according to tenure and principal amount. Interest is credited to the account at the end of the tenure and early withdrawal may cause penalty. Normally, the longer the tenure is, the higher the interest rate will be.

3.3.3 System Requirement Analysis

Business Assumptions

- The digital signature provided by customer is his/her own signature. Customer is expected to reproduce the same signature whenever required in future activities
- Customer needs to ensure there is zero account balance before applying for account closure
- Interest is accrued at 23:59 daily and accumulated interest is credited to deposit account at 23:59 of the last day of each month
- It is the customer's responsibility to ensure the accuracy of payee's information
- Customer can only deposit Singapore dollar as the only currency in their deposit account

To address the business requirement of the DAMS, an account management module, an account balance management module, and an interest crediting management module should be constructed.

a) Account Management Module

This module will be used mainly by Merlion Bank to help its customers keep track of their banking history and their account balance. It also marks the beginning of every customer's banking experience with Merlion Bank where customers can open their deposit accounts via Internet Banking Website. At the end of each month, system will generate and send an e-statement summarizing the transactional activities of customers' accounts for that particular month which assists customers to recognize their spending habits and keep track of their finances.

b) Account Balance Management Module

This module will primarily be used by counter tellers to perform fund transfer as well as cash deposit and withdrawal. After transaction, account balance will be debited or credited accordingly.

c) Interest Crediting Management Module

This module basically manages interest calculation in every account. At Merlion Bank, interests are accrued on a daily basis and paid out at the end of the month.

d) Deposit Account Management Module

This module is used by customers to perform deposit account related operations, including account opening and closure, intra-bank fund transfer, payee management. It also offers customers better visibility to their account, being able to view transaction history and e-statement monthly.

System Functionalities

Function Name	Remark	AAU ID
Code		
A.3 Deposit Account Management System		
A.3.1 Account Management Module		
A.3.1.1	Add a New Account	Teller helps customer to create a new account.
A.3.1.2	Delete a Account	Teller helps customer to closes his/her bank account.
A.3.1.3	View Transaction History	Staff views customer transaction history.
A.3.1.4	View Information of All Accounts	Staff views all customer account information including account number, account type, etc.
A.3.1.5	View Bank e-Statement	Teller may view and print bank statement for customer.
A.3.2 Account Balance Management Module		
A.3.2.1	Fund Transfer	Teller performs bank internal fund transfer
		3

A.3.2.2	Cash Deposit	Teller collects cash from customer and helps to deposit cash	
A.3.2.3	Cash Withdrawal	Teller withdraws cash and hand over to customer	

A.3.3 Interest Crediting Management Module

A.3.3.1	Accrue Interest	System calculates the interest accrued on the end-day balance of each account.	3
A.3.3.2	Credit Interest	System credits interest for saving accounts monthly.	

C.2 Deposit Account Management Module

C.2.1	Open an account	Customer creates a new deposit account	3
C.2.2	Delete an account	Customer closes his/her deposit account	
C.2.3	View transaction history	Customer views his/her transaction history of a particular account	
C.2.4	View account balance	Customer views his/her account balance	
C.2.5	View account information	Customer views the account related information, including account number, account type, etc	
C.2.6	View e-statement	Customer views his/her bank statement in pdf version	
C.2.7	Intra-bank fund transfer	Customer transfers money to an account which is also under Merlion Bank	
C.2.8	Add payee	Customer adds a payee for internal bank fund transfer	
C.2.9	Delete payee	Customer deletes existing payees	

D.2 Deposit Account Management Module

D.2.1	Open an account	Customer creates a new deposit account	3
D.2.2	Delete an account	Customer closes his/her deposit account	
D.2.3	View transaction history	Customer views his/her transaction history of a particular account	

D.2.4	View account balance	Customer views his/her account balance	
D.2.5	View account information	Customer views the account related information, including account number, account type, etc	
D.2.6	View e-statement	Customer views his/her bank statement in pdf version	
D.2.7	Intra-bank fund transfer	Customer transfers money to an account which is also under Merlion Bank	
D.2.8	Add payee	Customer adds a payee for internal bank fund transfer	
D.2.9	Delete payee	Customer deletes existing payees	

3.4 Card Management System (AAU ID: 04)

3.4.1 Business analysis

The card management system is one of the key operational components in the core banking system, including both the debit card and credit card management. Customers are allowed to apply for debit cards and credit cards, manage the cards, and use their cards to make payments via various channels, such as supermarket, shopping center, and online e-commerce websites.

The debit card is used by the customer to make a deposit, withdraw money, and make payments. The customer's debit card would be created immediately upon the completion of the card application. Debit cards are automatically linked with the customer's deposit account to ensure the basic operations. The card also provides cashback rewards for customer payments.

The application of credit card goes through a more rigorous process, where employees in the credit card management department need to evaluate the customer's creditworthiness and set credit limit based on the evaluation upon approval of the credit card. Customers can purchase goods and services by the credit card and make repayment at the end of each month, while

interests are charged on the unpaid balances. The repayment history is also recorded as part of the credit report of the customer.

Payment for goods and services can be done by both debit card and credit card. Merlion Bank performs the role of a card issuer, and is integrated with the payment systems of global card network such as EuroPay, MasterCard and Visa. The payment authorization process goes through the chain of merchant, acquiring bank, card network, Merlion Bank, and is finally approved or declined by the Merlion Bank. The clearing and settlement is done at the end of day to settle payments for different financial parties involved.

Business objectives

- Allow customers to apply for debit card and credit card
- Allow customers to make payment by debit card and credit card
- Allow customers to manage their debit and credit card
- Manage customers credit card repayment and update customer's creditworthiness
- Facilitate the clearing and settlement for the transactions of the day

3.4.2 Business processes

A) **Apply for debit card**

The customer is required to possess a Merlion Bank deposit account before applying for a debit card. After customer applies for a debit card, the card will be linked with the deposit account that customer specified in the application form. The debit card is mailed to the customer upon successful application, and the activation information is emailed to the customer. After the customer receives the card, he/she is required to login to his/her online banking account and activate the card by entering the card number and the activation code. The card is only available to use after activation.

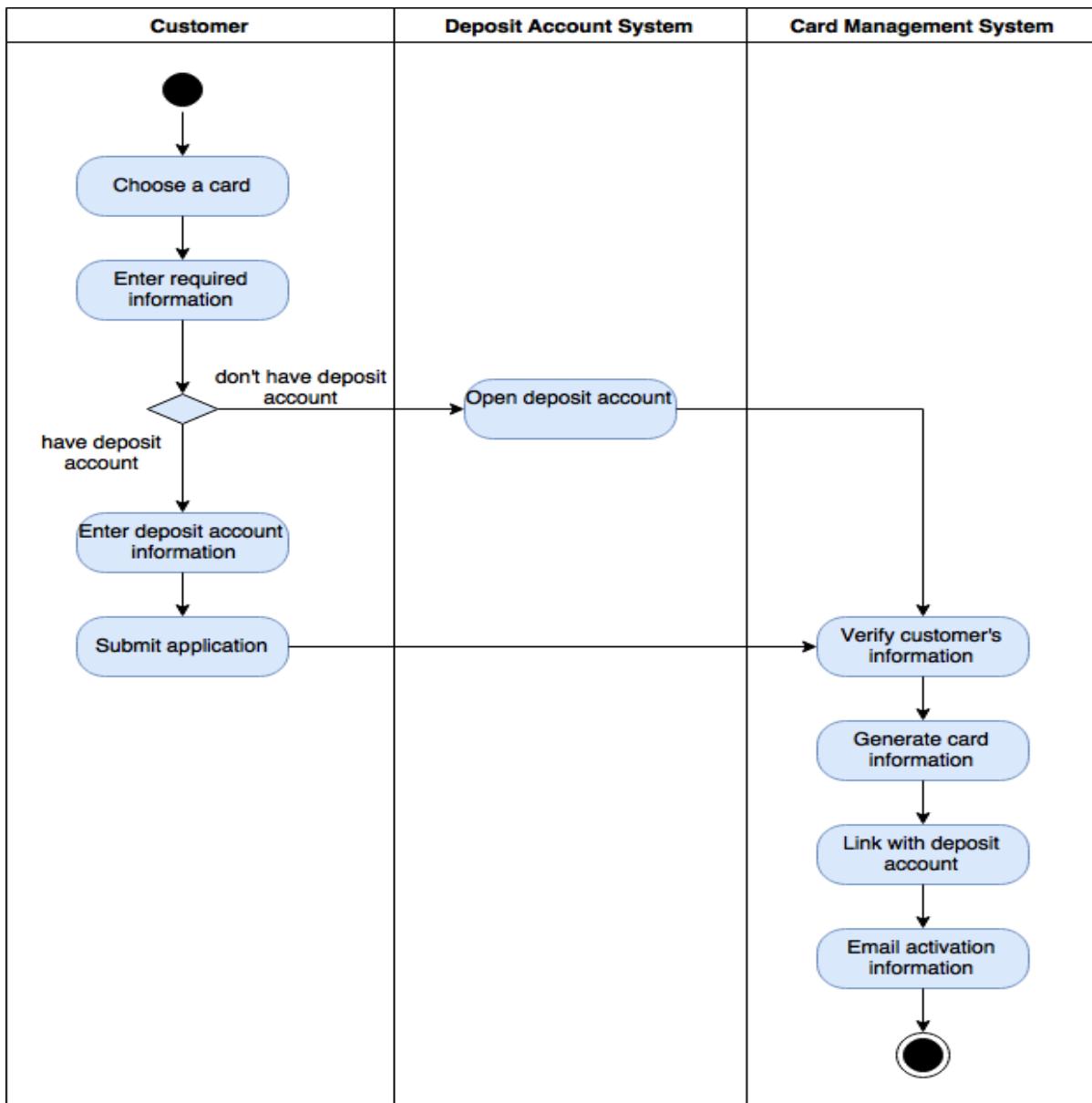


Figure 6: Activity Diagram: Debit Card Application

B) Apply for credit card

Customer needs to submit his/her personal information, residential details and employment details with relevant supporting documents in order to apply for a credit card. Credit card verifier will firstly evaluate the authenticity of the submitted documents and then check whether the information provided by customer matches with the uploaded documents. If every piece of information is correct, the application will be forwarded to credit card manager who will make decision of approval based on each applicant's credit report, income situation and other related information. Merlion Bank implements a decision support system which

suggests a plausible credit limit range to credit card manager based on applicant's monthly income and a default probability with a risk grade inside credit report. With the intelligent support from the system, credit card manager sets credit limit of the applied credit card which will then be mailed to the customer. After the customer receives the card, he/she is required to login to his/her online banking account and activate the card by entering the card number and security code printed on the back of the card, as well as the OTP sent to card holder's registered mobile number. The card is only available to use after activation.

Scenario: Customer Tom applies for a credit card

1. Tom clicks on “apply for credit card” button.
2. Tom views the list of credit cards available, and chooses the VISA-enabled credit card.
3. Tom checks that he meets the minimum income requirement and is eligible to apply for the credit card
4. Tom is required to input his contact information as follow:
 - Title: Mr.
 - Name: Tom Ng
 - Contact number: 83****21
 - Email address: tomng1980@gmail.com
5. Tom is required to input his personal information as follow:
 - Name (to appear on card): Tom Ng
 - Nationality: Singaporean
 - NRIC/Passport Number: S055****E
 - Home country: Singapore
 - Date of birth: 1980/08/07
 - Marital status: married
 - Number of dependent: 1
 - Gender: male
 - Education: university
 - Annual income: S\$45,000
 - Proof of income: CPF

6. Tom uploads his CPF statement
7. Tom is required to input his residential information as follow:
 - Residential address: House 5, Level 2, Unit 1. Tampines, 7 Hougang Avenue 3. (S)530007
 - Residential ownership: self-owned
 - Residential type: condominium
 - Length of stay at address: 3 years 5 months
8. Tom is required to input his employment information as follow:
 - . Employment status: employee
 - Job title: senior management
 - Company name: IBM
 - Company address: 10 Marina Boulevard, #43-01, Tower 2, Marina Bay Financial Center
 - Business type: IT
 - Length of employment: 2 years 1 month
 - Billing address: home
9. Tom declares that he has read and understood the credit card declaration. Tom sets credit limit preference to \$3,000 per month.
10. Tom clicks on the “submit” button and finishes his application
11. System verifies Tom’s information and checks if Tom has met the basic requirement
12. Staff evaluates Tom’s ability and reliability to make repayment.
13. Staff creates credit card for Tom and sets the credit limit to \$2,500 per month.
14. The credit card is emailed to Tom, and email is send to Tom for activation.

C) Report lost card

The customers can go through certain authentication process on his/her online banking website to report a lost card and request for issuance of a new card. The card will be terminated and all the information will be transferred to the new card. The new card will be mailed to the customer and is required to go through the activation process as well.

Scenario: Customer Tom reports a lost debit card

1. Tom logs in to his online banking account.
2. Tom clicks “report lost card” button.
3. Tom sees the authentication page. Tom clicks on “get OTP via SMS” button and enters the OTP code he received via email.
4. Tom views the list of cards and chooses the lost debit card
5. Tom clicks on the “report lost card”.
6. Tom is required to pay \$10 for the new card. Tom chooses to deduct the \$10 from his deposit account.
7. Tom is notified that the lost card is terminated and a new card will be mailed to him.
8. Tom receives email regarding the activation code of the new card.
9. Tom receives the new debit card.
10. Tom logs in to his online banking account.
11. Tom activates his new card.

D) Cancel credit card

If the customer requires to cancel the credit card, system will check if the customer’s outstanding balance has been paid in full and alternative arrangements have been made to the recurring bill payments. The card is only cancelled after successful settlement of all the debts.

E) Make payment

The customer can use debit card and credit card to pay for goods and services at the places accepting VISA or MasterCard payments. To process the transaction, the merchant’s EFTPOS terminal generates the transaction authorisation request and forwards it to the merchant’s acquiring bank. The acquiring bank forwards the request to the respective card network, such as VISA and MasterCard. The card network then routes the request to the card issuing bank, in this case, Merlion Bank, to check the eligibility of the transaction. After Merlion bank approves or declines the request, the authorization information is then sent back to the merchant via the same route in order for the merchant to complete the transaction.

The amount of transaction is immediately locked in the customer's account if the customer pays by debit card.

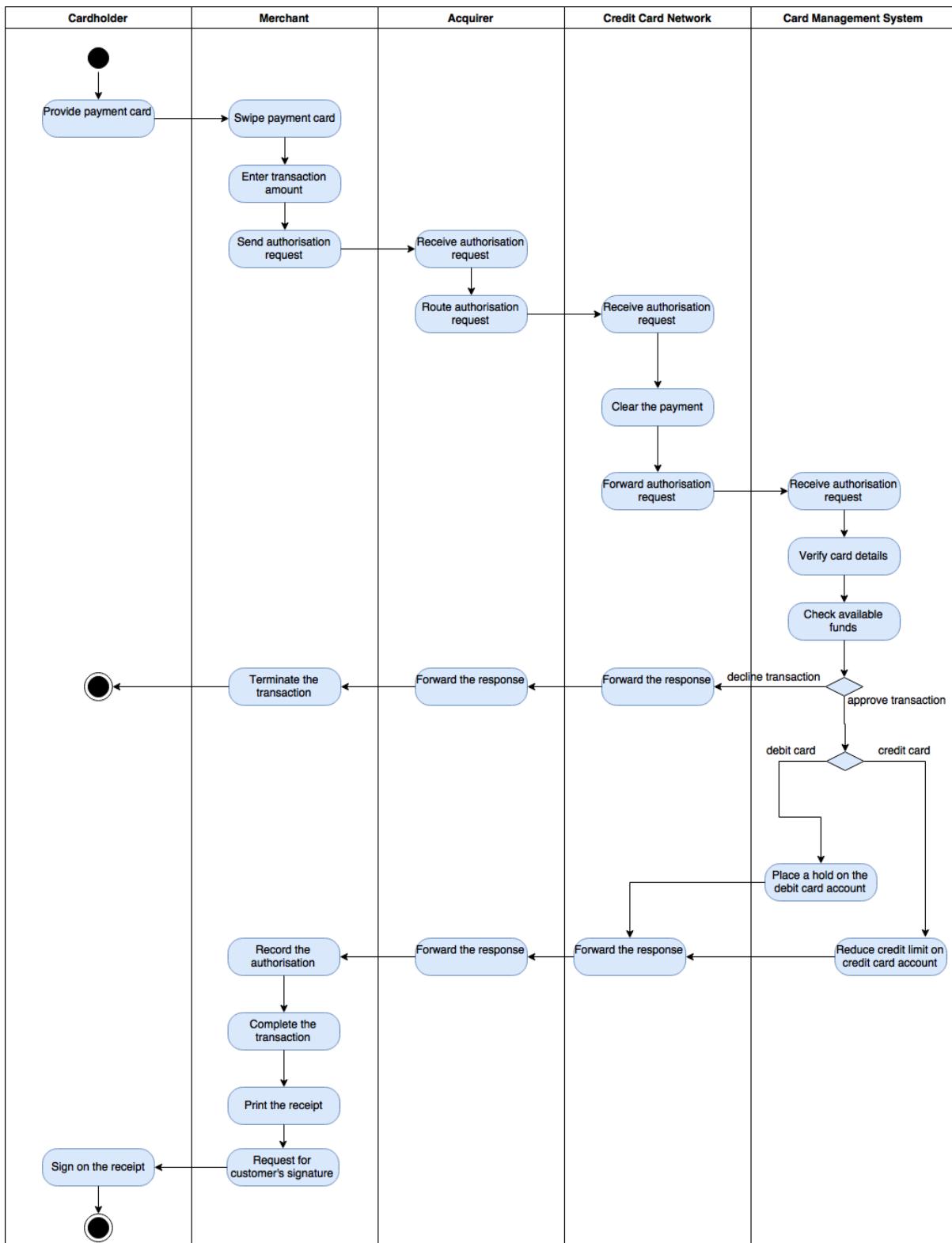


Figure 7: Activity Diagram - Transaction Process

F) Facilitate clearing and settlement

The merchant's EFTPOS terminal will record down all the authorised transactions of the day. At the end of the day, all the transactions are summarized in a batch and forwarded to the merchant's acquiring bank. The acquirer then credits the merchant's account and electronically submits the batch to the card network for settlement. The card network pays the acquirer, debits Merlion Bank's account, and sends the transactions to Merlion Bank. The Merlion Bank posts the transactions to the customer's account, and sends statement to the customer at the end of each month.

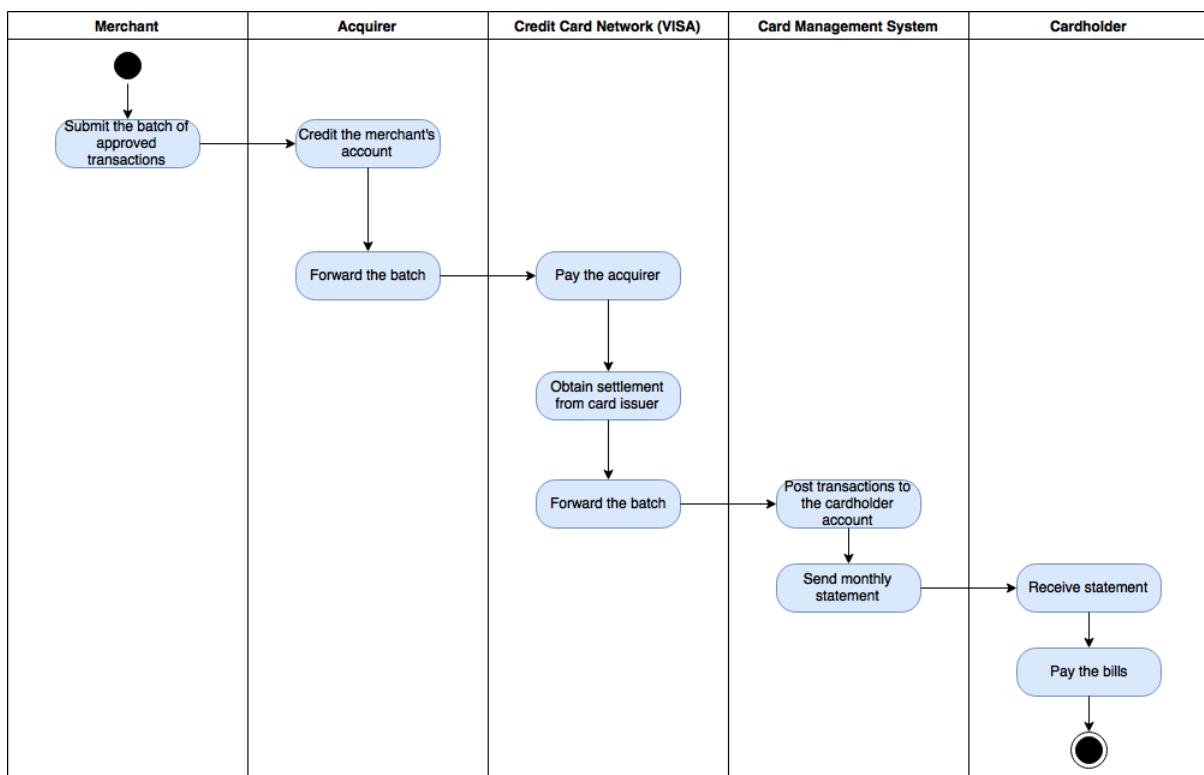


Figure 8: Activity Diagram - Clearing & Settlement

G) Handle chargebacks

After the customer receives statement for credit card at the end of each month, the customer can file a dispute and request for chargeback regarding the fraudulent transactions found. The common reasons for a chargeback are: fraudulent transactions, credit not processes, items not received, or error occurred due to technical problems. After the cardholder files a chargeback, a provisional credit is provided to the cardholder and the chargeback is initiated and forwarded to the merchant's acquiring bank to check the validity. If the chargeback is found

invalid, Merlion Bank will charge the cardholder on the chargeback. The customer's credit may also be affected by the invalid chargeback. However, if the chargeback is valid, the merchant will be asked to provide needed document or proof to remedy the chargeback, or the chargeback amount will be provided to the customer.

3.4.3 System requirements analysis

Business assumptions

- Two types of debit cards are provided with same basic functions of cash deposit and withdraw, and cashback reward scheme. The only difference is that one card can make payment by VISA whereas the other card does by MasterCard.
- All types of transactions are involved in the debit card cashback scheme
- The cashback amount is automatically updated into customer's debit card account at the end of the month
- Two types of credit cards are provided with same basic functions but different credit card networks (VISA & MasterCard).
- Credit card account is provided for the credit cardholder. Customer can save money, make payment, and withdraw with a relatively high interest.
- The MasterCard and VISA card network are assumed to have the same clearing and settlement process. System simulates the clearing and settlement process of VISA card network.

To address the business requirements of Card Management System in the preliminary requirements specifications, a debit card module, a credit card module, and a card management module will be constructed. A merchant management module, an acquirer management module, and a card network management module in the system for the external parties involved are also constructed to facilitate the operation. These six modules are described as follows:

a) Debit card module

This module will primarily be used by staff in the debit card department to view and monitor the customer's' debit cards.

b) Credit card module

This module will primarily be used by staff in the credit card department to view and manage the customer's credit cards, evaluate customers information and respond to credit card applications. It will also facilitate the staff to deal with chargeback requests and update customer's credit report.

c) Card management module

This module will preliminary be used by customers to performance all the tasks related to debit and credit cards. The customers will be able to apply for new card, report lost card, monitor card information, make payment, make repayment, and request for chargebacks.

d) Merchant management module

This module will be built to simulate the processing of an EFTPOS terminal of the merchants. It is preliminary used for forwarding transaction authorization requests and do batching at the end of the day.

e) Acquirer management module

This module will be built to simulate the processing of the acquiring bank of the merchant. It is preliminary used for forwarding requests and information between merchants and card networks.

f) Card network management module

This module will be built to simulate the processing of the card network. It is preliminary used for routing requests and information to different acquiring banks and card issuing banks, and processing clearing and settlement at the end of the day.

Function	Name	Remark	AAU
Code			ID
A.4 Card Management System			
A.4.1 Debit Card Module			
A.4.1.1	View debit card	Card manager views all debit card accounts.	4
A.4.1.2	View card canceled	Card manager views all card canceled.	
A.4.2 Credit Card Module			
A.4.2.1	View credit card	Card manager views credit card accounts.	4
A.4.2.2	View card canceled	Card manager views all card canceled.	
A.4.2.3	Manage lost card	Card manager acknowledges lost card and issue a new card for customer to replace the lost card.	
A.4.2.4	View credit report	Card manager views credit report of a customer.	
A.4.2.5	Approve credit card	Card manager evaluates applicant's profile and sets credit level for the card.	
A.4.2.6	Manage chargeback	Card manager takes action based on customer's chargeback request.	
A.4.2.7	Update credit report	Card manager edits customer's credit report based on customer's behavior.	
B.1 Card Management System			
B.1.1 Merchant Management System			

B.1.1.1	Forward authorization request	System forwards authorization request to the acquirer.	4
B.1.1.2	Complete transaction	System acts upon approved or declined authorization and records approved transaction.	
B.1.1.3	Create batch	System updates all approved transactions on a batch and forwards it to the acquirer.	
B.1.1.4	Update settlement	System updates settlement status.	

B.1.2 Acquirer Management Module

B.1.2.1	Forward authorization request	System forwards authorization request to the card network and forwards approved or declined authorization to the merchant.	4
B.1.2.2	Create batch	System forwards the merchant's batch to the card network for clearing.	
B.1.2.3	Update settlement	System updates settlement status.	
B.1.2.4	Credit merchant's account	System credits merchant's account.	

B.1.3 Card Network Management Module

B.1.3.1	Forward authorization request	System forwards authorization request to the issuing bank and forwards approved or declined authorization to the acquirer.	4
B.1.3.2	Process clearing	System sends each approved transaction to the appropriate issuing bank	

B.1.3.3	Transfer to acquirer	System pays the acquirer.	
B.1.3.4	Update settlement	System updates settlement status.	
C.5 Card Management Module			
C.5.1	Apply debit card	System verifies customer's information, approves or rejects the application, and generates debit card for the customer. System automatically generates internet banking account for the new customer.	4
C.5.2	Activate debit card	Customer uses the activation information received via email to activate their card.	
C.5.3	Cancel debit card	Customer decides to terminate the debit card.	
C.5.4	Apply credit card	Customer deletes existing payees.	
C.5.5	Activate credit card	Customer uses the activation information received via email to activate their card.	
C.5.6	Cancel credit card	Customer decides to terminate the credit card.	
C.5.7	Make repayment	Customer makes repayment for the credit card.	
C.5.8	Request for chargeback	Customer requests for chargeback if there is a dispute regarding transaction.	
C.5.9	View outstanding balance	Customer views his/her outstanding balance for the credit card.	

C.5.10	View credit report	Customer views his/her credit report in pdf version.	
C.5.11	Report card loss	Customer reports card loss. System will locks the previous card, and issue a new card to the customer.	
C.5.12	Debit card payment	If customer makes payment by debit card, system charges customer deposit account upon successful transaction	
C.5.13	Credit card payment	If customer makes payment by credit card, system adds transaction to customer's bill for repayment.	
C.5.14	Set daily transaction limit	Customer set daily transaction limit for debit card.	
C.5.15	Card Expiration	System sends email to customer to remind him/her about the expiration of debit card or credit card	
C.5.16	Change password for debit card	Customer change password for debit card	
C.5.17	Forget password for debit card	Customer reset password when forget his/her password for debit card.	
C.5.18	Request for card replacement	Customer requests for card replacement when the card is damaged or the card is going to be expired.	
D.5 Card Management Module			
D.5.1	Apply debit card	System verifies customer's information, approves or rejects the application, and generates debit card for the customer. System automatically generates internet banking account for the new customer.	4

D.5.2	Activate debit card	Customer uses the activation information received via email to activate their card.
D.5.3	Cancel debit card	Customer decides to terminate the debit card.
D.5.4	Apply credit card	Customer deletes existing payees.
D.5.5	Activate credit card	Customer uses the activation information received via email to activate their card.
D.5.6	Cancel credit card	Customer decides to terminate the credit card.
D.5.7	Make repayment	Customer makes repayment for the credit card.
D.5.8	Request for chargeback	Customer requests for chargeback if there is a dispute regarding transaction.
D.5.9	View outstanding balance	Customer views his/her outstanding balance for the credit card.
D.5.10	View credit report	Customer views his/her credit report in pdf version.
D.5.11	Report card loss	When customer report card loss, system locks the previous card, and issue a new card to the customer.
D.5.12	Debit card payment	If customer makes payment by debit card, system charges customer deposit account upon successful transaction
D.5.13	Credit card payment	If customer makes payment by credit card, system adds transaction to customer's bill for repayment.

D.5.14	Set daily transaction limit	Customer set daily transaction limit for debit card.
D.5.15	Debit Card Expiration	System sends email to customer to remind him/her about the expiration of debit card.
D.5.16	Change password for debit card	Customer change password for debit card
D.5.17	Forget password for debit card	Customer reset password when forget his/her password for debit card.
D.5.18	Request for card replacement	Customer requests for card replacement when the card is damaged or the card is going to be expired.

3.5 Loan Management System (AAU ID: 05)

3.5.1 Business Analysis

The Loan Management System (LMS) is to support the loan division in their operations to receive loan applications, process applications, manage loan repayment, manage mortgage redemption, and manage defaults on loans. It is a key function forming the backbone of Merlion Bank's core services, as it is the main earning stream. With the monthly installments and interest component of the payback, bank can earn a steady income in a fixed timeframe.

The LMS system provides a seamless application process for customers to easily submit and manage their loan application online. It also incorporates analytical functions to facilitate loan division staff, including loan managers and underwriting team, to access and decide on outcome of the applications. The repayment management module of LMS is responsible for the payback of borrowers. Different channels of installments, such as auto-deduction and

manual repayment, will be supported so as to cater to different customers' preferences. When customers apply for a secured loan and have cleared the repayment, the mortgage redemption subsystem will be in charge of redeeming the collaterals for them. Lastly, when the borrower is not able to clear the loan, the bad debt management subsystem would take charge of the default and carry out measures to recover the loss.

Business Objectives

- Create and manage loan applications, including submission of documents, pre-process the documents to aid the loan managers to make decisions, and to store applicants' information into database.
- Provide digital channels for repayment
- Facilitate mortgage redemption when loans are cleared
- Compensate loss and support follow-up actions when there is default on loans
- Update status and information of loans when applicable

3.5.2 Business Processes

A) Loan Application

The LMS is in charge of receiving incoming application for both secured and unsecured loans.

The detailed options of loans that Merlion Bank provides are presented below:

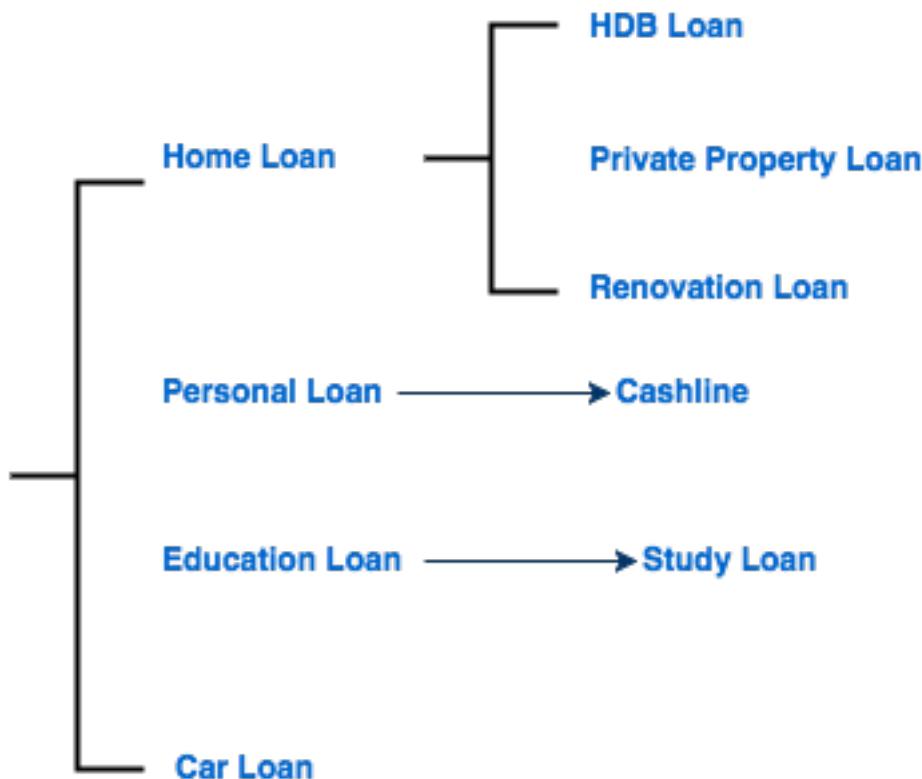


Figure 9: Loan Types Offered by Merlion Bank

Borrowers of HDB Loans and Private Property Loans are required to declare if the loan is for **refinancing** (changing of original loan plans) or **new purchase**. Detailed documents of original loan plans are required to submit for refinancing requests, while purchasing documents are required for new purchases.

The loan packages and repayment plans are briefly introduced as follows:

Mortgage loans (HDB & Private Property):

The applicants are required to meet the minimum requirements regarding certain aspects, especially age and monthly income. The loan amount is decided based on the customer's income, age, value of property, etc. It is in compliance with the government's regulation on the Loan-To-Value ratio.

Merlion Bank offers two types of interest plans for the mortgage loans, being the **floating rate package** and the **fixed rate package**. The fixed rate package has a certain fixed interest for the first 3 years of the loan and floating interest rate calculated based on the Singapore Interbank Offered Rate (SIBOR), while the floating rate package offers fluctuant interest rate throughout the loan. The detailed interest rate packages are as shown below:

Loan\Package	Floating rate	Fixed rate
HDB Loan	SIBOR + 1.3% p.a.*	Year 1-3: 1.8% p.a. fixed Year 3 onwards: SIBOR +1.2% p.a.

Private Property	Year 1-3: SIBOR + 0.8% Year 3 onwards: SIBOR +1.2% p.a.	Year 1-3: 1.8% p.a. fixed Year 3 onwards: SIBOR +1.2% p.a.
-----------------------------	--	---

* p.a.: per annual

The required loan tenure from Merlion Bank is between 5 to 25 years, decided based on customer's income and other financial commitments to ensure affordability of loans.

Renovation loan:

Renovation loan is available for customers to perform renovation tasks. The applicants are required to meet the minimum requirements regarding certain aspects, especially age and monthly income. This type of loan is only granted for certain types of expenses specified by the bank. The renovation loan granted to customers falls into the interval between S\$5,000 to S\$30,000. Interest rates differ with different repayment plans from 1 to 7 years.

Cashline:

Cashline is customer's personal line of credit. Customer are able to apply for amount at maximum 4 times of the his/her monthly income, or 10 times if the customer's monthly income exceeds S\$10,000. Repayment and interest only applies if customer has used or withdrawal money from the cashline in the respective month. Customers may also be penalized if they cannot fulfill the repayment requirement within the specified period, namely a month.

Study loan:

This type of loan only applies to students, sometimes with certain requirements on the applicant's income. The maximum loan amount granted is 8 times of the applicant's monthly income, or S\$200,000, whichever is lower. Students are required to repay full amount in a maximum of 10 years.

Car loan:

This type of loan is secured by the customer's car as the collateral. Customers are able to apply for loan at maximum 60% or 70% of their car's value. This type of loan has a maximum loan tenure of 7 years.

When the borrowers choose to apply for a specific loan on the Merlion Bank website, the system will prompt the customer to complete a series of questions, so as to collect necessary information about the applicant. This information includes, personal information, employment information, residential details, financial commitments, and financial requests. Customers are required to upload signature as well as required documents if necessary, including NRIC, latest income tax notice of assessment, latest salary slip, latest one year CPF Contribution History Statement, and information of collateral. The system will collect the data and store into database for loan officers to view and make decisions.

Scenario: Full-time salaried employee Amy apply for a home loan

1. Amy logs in to Merlion Bank website and clicks "Loan" tab
2. Amy clicks "Apply for a loan"

3. Amy indicates choice of loan as “HDB loan”
4. Amy fills in basic and detailed personal information
5. Amy fills in contact details & residential details
6. Amy fills in employment details
7. Amy fills in all of her financial commitments, including all credit cards, loans and other types of debts
8. Amy chooses “new purchase” and fills in the property information of the HDB newly purchased
9. Amy fills in financial requests and some other required information of the property, indicating her preferred repayment plan
10. Amy uploads all the required documents, including softcopy of NRIC, Option to Purchase, latest tax assessment, and CPF statement
11. Amy reads all declarations and provides digital signature at the end of the application
12. LMS prompts Amy of success of application.

B) Process application data

After receiving the application, loan officers will verify customer's particulars before forwarding to underwriting team to evaluate. Loan officers will contact customer for resubmission of documents if submitted information is deemed not enough or outdated.

The LMS is capable of pre-process the data before forwarding to underwriting team, linking to the Decision Support system in Customer Analytics and Business Intelligence system. Such functions include calculating customer affordability and risk ratio, providing employee with suggested interval of loan amount and tenure, and highlighting the parts of the information that will increase the risk of granting the loan to the borrower, such as low credit score, history of bad debt, frequent change of jobs, etc. Major metrics applied, such as Loan-To-Value Ratio(LTV), Total Debt Servicing Ratio(TDSR), and Mortgage Service Ratio(MSR), are in compliance with government's regulations and are calculated based on information gathered from internal database, credit report of the customer, and application information.

Scenario: Loan officer process application of HDB loan

1. Loan officer Ben view application from Amy

2. Loan officer Ben review Amy's information and documents, and check that Amy's documents are sufficient for evaluation
3. Loan officer Ben verify that Amy's documents are all valid and that Amy meets the requirement of this loan application
4. Loan officer Ben forward Amy's application to appraiser team for property valuation

After validation, loan officer will forward the necessary pre-processed documents to underwriting team for final decision of whether or not the loan will be offered to the borrower. For the mortgage loans such as home loans and car loans, while the information is sufficient and verified, loan officers will forward the application to appraiser first to determine the value of asset and report result to the underwriting team.

Scenario: Underwriting team process application of HDB loan

1. Underwriting team views application documents from Amy
2. Underwriting team views the calculated customer affordability and risk ratio, and suggested loan amount interval and tenure
3. Underwriting team views the customer's credit report for more detailed information
4. Underwriting team views the highlighted information of Amy, and determines the final amount and duration of loan issued
5. Underwriting approves the application
6. The bank will contact customer via email to arrange a meeting for signing the contract

For mortgage loan, the maximum loan amount granted is decided by the LTV ratio specified by the government. The underwriting team will take the lower value between the customer's property purchase price and the appraised value as the amount to calculate the maximum loan value. The customer's age and other financial commitments are also taken into consideration to determine the LTV and the loan maximum.

When the underwriting team process the applications, all information including customer's credit report and mortgage appraisal, will be viewed and evaluated. Underwriting team will be assisted by the Decision Support system from Business Intelligence system, which provides a calculated range of recommended loan amount, customer's risk level, and other non-quantified

variables such as education level and frequency of job changes, etc. Finally, underwriting team will decide to approve or reject the loan, and the loan amount tenure if the loan is granted.

C) Closing

After the approval of loan issuance, the relevant documents will be sent to borrower via electronic emails, postage and LSM portal. Borrower will be asked to sign the loan contract and exchange of title of property contract online. An application fee will be charged to both successful and rejected applicants. The loan amount will also be credited to borrower's account.

The complete processing flow of loan application will be shown by the activity diagram below:

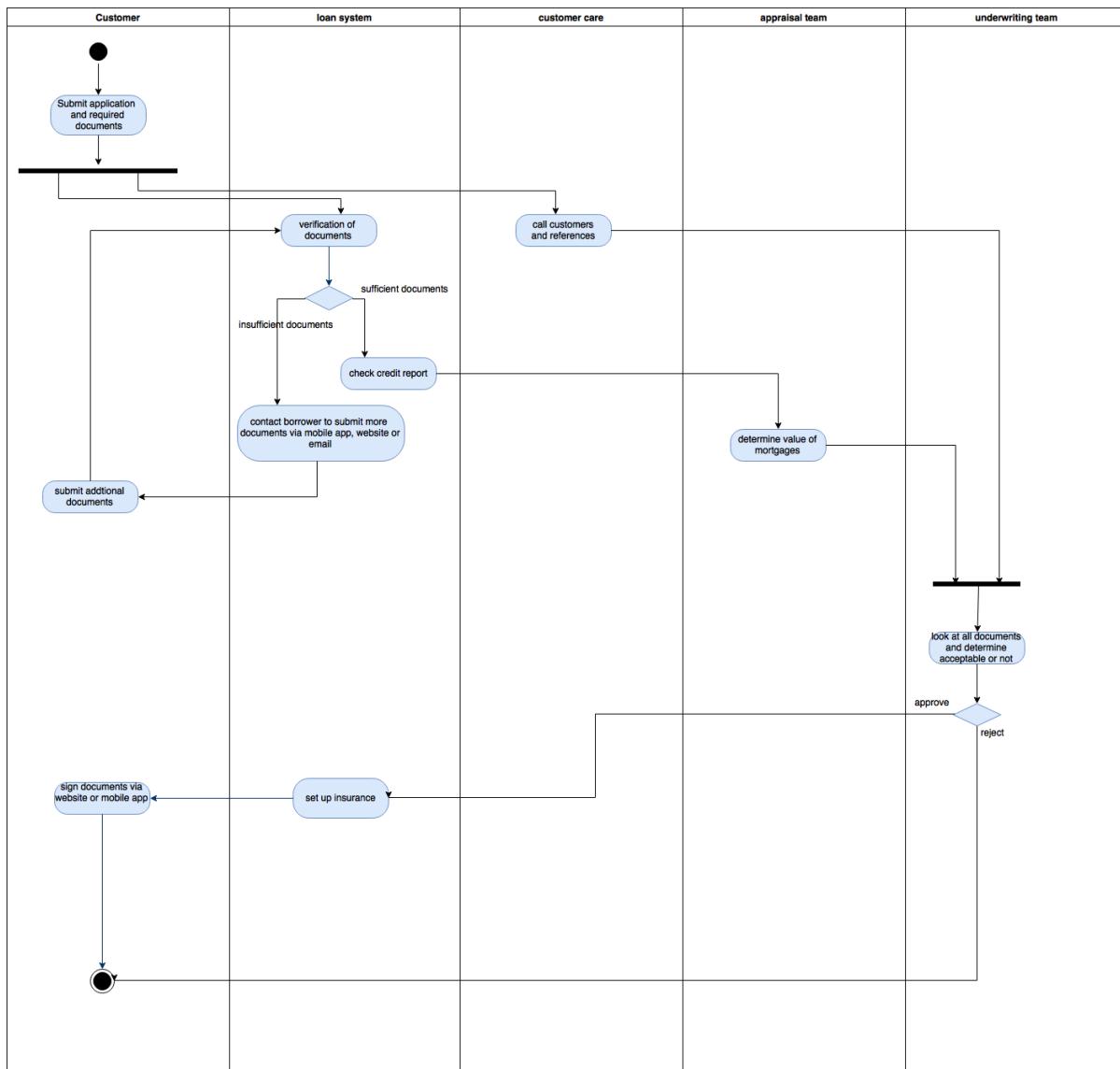


Figure 10: Activity Diagram - Loan Application

D) Repayment management

With the success of loan approval, the borrower will start to repay the loan at the predetermined time interval. Customer can view the details of each granted loan on a loan dashboard, which includes the outstanding balance, the next repayment date and interest rate etc. Outstanding balance will include both the principal and the interest accrued. Customer can choose to make part of the repayment by CPF. For the rest of the payment, either automatic debiting assigned bank account, or voluntary online payment after each repayment period, can be chosen to repay the loan. When manually repaying borrower is late for installment, a late fee will be charged at either \$15 or 5% or the installment, whichever is greater. The late repayment will also be recorded in the repayment history by LMS. At the end of the installment, the loan balance will be shown to borrower. The borrower can also check the loan balance anytime during the repayment process.

Scenario: Cat is late for repayment for 5 days

1. Cat logs in to Merlion Bank website
2. Cat clicks “My Account” tab
3. Cat clicks “Loans”
4. Cat clicks “Repayment” for her \$500 installment
5. LMS displays a charge of \$525, including the installment and 5% late fee.
6. Cat makes a payment with her existing Merlion Bank deposit account
7. LMS receives payment and display remaining loan balance.

Customer is also allowed to cancel his/her loan, whereby the customer will make full payment before the determined tenure. However, a penalty fee will be implied.

Merlion Bank will remind a loan borrower regularly after a delay of repayment. When a customer is having difficulties in repaying loans, he/she can contact Merlion Bank to discuss possibility of altering the repayment plan to suit his/her ability. However, when the borrower is not able to repay his/her loan after a time period of 6 months, a default on loan is filed by

Merlion Bank and is reported to the Credit Bureau to be recorded in customer's credit report. The status of loan will be converted "loss", stating that the loan will not be cleared by the customer. A series of measures will be carried out to recover loss of the bank. The credit score of borrower will be deducted. A bad debt history will also be recorded in borrower's credit report.

Merlion Bank will also take legal actions including suing the customers, apply for bankruptcy of borrower. Subsequently, for the mortgage borrowers, the bank will exercise foreclosure, gain lien of property, and request to sell asset and retrieve less than full payment.

For unsecured loan borrowers, LMS will continue to add default fees and interest to their loan balance until they can repay back the full amount. Merlion Bank will turn over to a collection agency, and pursue legal actions such as request the court to garnish borrower's other income like wages or putting a lien on borrower's assets.

If the borrower has accounts in Merlion Bank, LMS will proceed to seize the remaining money for repayment. Paychecks which are transferred to borrower's account will also be garnished.

E) Mortgage Redemption

For secured loan borrowers, when the loan is cleared, he/she is able to request for redemption of his/her collateral. The Title Deeds will be released back to the borrowers, together with the remaining title documents and re-assigned life policies. The LMS will delete reference to the redeemed mortgage at the Land Registry, and update the asset title on relevant documents.

When the borrower has installed more than the loan amount, an overpayment will occur and loan balance will be negative. As such, the system will credit the overpayment back to the paying account, then update the loan balance. A redemption fee will be applied to borrower after the process.

Scenario: Amy requests for redemption of her house
<ol style="list-style-type: none">1. Amy logs in to Merlion Bank website2. Amy clicks "My Account" tab

1. Amy logs in to Merlion Bank website
2. Amy clicks "My Account" tab

3. Amy clicks “Loans”
4. Amy clicks “Repayment”
5. Amy views her loan balance, which displays as “\$0.00”
6. Amy clicks “Request for Redemption”
7. Amy confirms her contacts and address
8. Amy submits her request to arrange a meeting
9. LMS confirms the submission and forwards the request to the loan department employee
10. Merlion Bank employee will arrange a face-to-face meeting with the customer to redeem the collaterals

3.5.3 System Requirement Analysis

Business Assumptions

- Loan interests for all types of loans are higher than the rebate interest given to customers.
- The underwriting team and appraiser are insourced to internal underwriter team and appraisal team.
- The repayment plans are restricted to auto-deduction from assigned account, and manual online payment
- Decision of whether to issue a loan is dependent on loan officers on a case by case basis.
- Credit assessment is based on applicants’ credit score, net income, TDSR, employment history and repayment history.
- Loan-to-value(LTV) ratio is calculated to measure lending risk of a loan.
- Insurance are not required for all types of loans as collaterals will guarantee prevention from loss.
- Merlion Bank have sufficient asset to meet any requested loan amount.
- Communication with borrowers are through Merlion Bank website and electronic mailing

To address the business requirements of the Loan Management function, a Loan Management Subsystem, a Loan Repayment Subsystem, a Mortgage Redemption Subsystem and a Bad Debt Management Subsystem will be constructed. These 4 subsystems are described as follows:

a) Loan Management Module

This subsystem will be used by the loan managers and underwriting teams from the Loan department at the Merlion Bank home branch. With the functions of processing all incoming loan applications, this module will draw on the applicant's data recorded from the LMS portal to facilitate Loan managers and underwriting team to establish evaluation and develop final decision of acceptability of loan.

b) Loan Repayment Module

This subsystem will be used by loan managers from loan department to collect repayment. It will provide the platform to the borrowers to pay back their loan in fixed time intervals such as each month or each year. The system will also monitor whether there is a late repayment. When a repayment has not taken place in a month, a warning will automatically be delivered to the borrowers, and the system will prompt the loan managers to pay attention to the case.

This subsystem also contains a bad debt management sub module. It is responsible for recovering financial loss from defaults on loans. These measures mainly include overtaking collaterals, garnishing paychecks and remaining sum in the borrower's accounts.

c) Mortgage Redemption Module

This subsystem will be used by loan managers to redeem secured loan borrowers' collaterals. The system will mainly be in charge of processing the exchange of titles of property. Documents including Title Deeds, reference to the property, life policy, etc, need to be updated in the process.

System functionalities

Functionality Name Code	Remark	AAU ID
A.5 Loan Management System		
A.5.1 Loan Management Module		
A.5.1.1	View applicant's information	Loan officer & underwriter can view application information
A.5.1.2	View applicant's credit report	Loan officer & applicant can view applicant's credit report
A.5.1.3	Request for information update	Loan officer can request customer to update loan application information and upload new documents
A.5.1.4	Verify applicant's information	Loan officer can verify customer's information and forward to underwriter to approve/reject the loan
A.5.1.5	Submit mortgage evaluation	Mortgage appraiser can submit the evaluation result of customer's property
A.5.1.6	Approve loan application	Underwriter can approve or reject loan
A.5.2 Loan Repayment Module		
A.5.2.1	View customer loan information	Loan officer & customer can view loan information on loan dashboard

A.5.2.2	Update customer loan status	Loan officer & customer can deduct repayment & late fee from payable account	
A.5.4.1	View loan balance	Loan officer can view remaining loan balance	
A.5.4.2	View collateral information	Loan officer can view asset's information	
A.5.4.3	Update collateral information	Loan officer can change title of property	

A.5.3 Mortgage Redemption Module

A.5.3.1	View collateral information	Loan officer can view collateral information	5
A.5.3.2	Process collateral reception	Loan officer process exchange of mortgage title	

C.3 Loan Management Module

C.3.1	Request for loan	Customer submits loan request to Merlion Bank.	5
C.3.2	Submit supporting documents	Customer can upload relevant supporting documents for review	
C.3.3	View loan information	Customer can view loan information, including account balance, repayment history, records of defaults	
C.3.4	Make repayment	Customer can install repayment to clear loan.	

C.3.5	Cancel loan	Customer can request for cancelation of current loan by making the full repayment and bear some penalty fee.	
D.3 Loan Management Module			
D.3.1	Request for loan	Customer submits loan request to Merlion Bank.	5
D.3.2	Submit supporting documents	Customer submits supporting documents for approval.	
D.3.3	View application status	Customer can view loan application status.	
D.3.4	View loan account balance	Customer can views loan account balance.	
D.3.5	Cancel loan	Customer can request for cancelation of current loan by making the full repayment and bear some penalty fee.	

3.6 Billing and Payment System (AAU ID: 06)

3.6.1 Business Analysis

The Billing and Payment function is the key service that Merlion Bank provides to its customers. Billing and Payment System (BPS) of Merlion Bank System (MBS) is dedicated to ensuring smooth transactions during ad-hoc and regular bill payment, as well as local and international fund transfer. While it is obvious that the digital transaction process requires little human intervention, multiple third parties are involved in the clearing and settlement process.

The Automated Clearing House (ACH), MAS Electronic Payment System (MEPS) and other collaborator banks all play a role in the billing and payment service.

For the payment sector, the service can be segmented into local fund transfer and international fund transfer. For international fund transfer, SWIFT international fund transfer is provided. Within local fund transfer, it can be divided into intra-bank fund transfer and inter-bank transfer. While it is apparent that the intra-bank transfer commonly only concerns of direct debiting and crediting of payer and payee's accounts, inter-bank transfer is more complex than simple addition and subtraction. Merlion Bank's BPS essentially incorporate three inter-bank fund transfer measures, including Interbank GIRO system (IBG), Fast And Secure Transfers (FAST) system and exchanging cheques.

Inter-bank GIRO System (IBG)

In IBG system, the initiator can be either payer or payee. When a payment request is sent to BPS, BPS will first view the credit limit of the originator, and then send request for payment to SACH. SACH then generate net settlement amount and net clearing figures, which are essentially the changes of sum in the two involving banks, to MEPS. At the same time, SACH will forward the payment instruction to receiving bank for credit/debit of the second party's account. If the recipient bank rejects the request, SACH will forward the rejection message to Merlion Bank and readjust settlement amount. Upon approval of payment/collection, SACH will forward the approval message to Merlion Bank. A credit/debit statement is generated for the first party and second party respectively. The BPS will then debit/credit the originator's account accordingly and update payment status and transaction record.

There are in total 3 types of GIRO transactions, being one time transfers, recurrent transfers and standing instruction transfer.

One-time transfer is initiated by the payer. Being much alike to the normal inter-bank deposit accounts transfer, one-time transfer will go through the clearing and settlement process at SACH, which will forward to the receiving bank immediately. A payer can also construct a recurrent GIRO payment, to carry out a fixed amount payment in fixed intervals. In this case, the payer needs to complete an application online, providing the billing organization name,

account, billing reference, fixed deducted amount as well as the duration of intervals. This method is usually adopted by payers of regular fixed bills.

Unlike the former two, a standing instruction is initiated by the payee. A payer needs to file an application and agreement to release the permission to the bank and billing organization to deduct the required amount when needed. Every time a deduction needs to take place, the billing organization will inform Merlion Bank of the amount, and Merlion Bank will automatically deduct the amount from payer's account. The amount will be reflected on the transaction history. The deducted amount can vary from time to time, depending on the bills occur. This is common in situations including paying school fees, phone bills, etc.

Fast and Secured Transfer (FAST)

The newer FAST system allows local transfer of SGD amounts up to \$50,000 per transaction almost immediately. Compare to GIRO where the waiting time is commonly 1-2 days, FAST advantages users by allowing immediate transfer. To allow immediate fund transfer, the FAST payments will be processed at SACH in batches for the settlement process. SACH will first record down the transaction figures and inform participating banks before actual settlement, such to save the time from repeating the actual settlement. At the end of each day, the net clearance figures will be forwarded to MEPS, where the actual settlement will take place by debiting and crediting participating banks' master accounts at MEPS, according to the net figures.

Cheque

Cheques are only allowed to transfer SGD fund within Singapore. The cheque processing path is very similar to that of GIRO. The deposit of cheque is only performed in our home branch at Raffles Place. After being presented a cheque, we will credit the payee's account provisionally, which means that the fund is "On Hold". Our staff will use a cheque reader to extract the MICR data (ECS data) and store into the system. Our staff will then send the cheque to SACH later in the day. BPS will forward the MICR information to SACH for clearance and settlement, followed by sending the net settlement amount to MEPS for broadcast and settlement. SACH will also forward the MICR data and physical cheque to the issuing bank

for debit of the issuing person's account. If the request is rejected, the issuing bank will return the cheque to SACH, who will readjust the net figures and forward the cheque to Merlion Bank by 12:00 the next working day. Otherwise if the request is approved, no action is required. The payee will be able to withdraw the "On Hold" fund after 14:00 the second business day.

On the other hand, if Merlion Bank receive a collection request from SACH, BPS will check the remaining sum of the issuer's account balance. If there are enough fund, Merlion Bank will approve the request and debit and amount accordingly from the issuer's account. The whole process will take up to 2 working days.

Society for Worldwide Interbank Financial Telecommunications (SWIFT)

To achieve international fund transfer, Merlion Bank will collaborate with SWIFT, which is an interbank communication system rather than a fund transfer system. SWIFT is used to share financial information between financial institutions around the world. A SWIFT message can be sent from one bank to another bank via SWIFT network, to request for a transfer. A SWIFT code is uniquely assigned to each of the participating bank. To perform a transfer, a customer needs to provide a foreign account number, transfer amount and the destined bank's unique SWIFT code. A S\$25 processing fee per transaction is charged and the fund will be received after up to 5 days. The bank will also charge a premium for different currency transfer. The exchange rate we offer will be higher than the prevailing price, so as to ensure larger profit earned and to encourage same currency transfer. The transaction will go through clearance at Clearinghouse Interbank Payments System (CHIPS), followed by actual settlement at MEPS.

Billing

As for the other integral of BPS, the billing system works in a similar way as payment system, except that payer needs to specify a corporate entity instead of an individual, as the payee. There are two types of bill payment: ad-hoc bill payment and regular bill payment. For ad-hoc bill payment, the process is equivalent to non-standing GIRO payment, where the payer needs to specify the billing reference number. Payer has the choice to switch the billing to be recurrent.

For regular bill payment, payer needs to set up a standing IBG instruction. Payee will deduct specified amount after every billing period on the stated day of month.

Business Objectives

- Ensure reliable transaction
- Ensure all transactions are secured and accessible only to higher rank staff in relevant divisions
- Minimize waiting time to provide responsive service
- Provide records for all transactions

3.6.2 Business Processes

A) Set up an IBG arrangement

As IBG can be initiated by both payer and payee, user need to specify the transaction is a payment or collection instruction. In most cases, individual customers will initiate a payment instruction, while corporate customers will initiate a collection instruction from their customers, which can also be categorized into the billing sector.

For GIRO payment within the same bank, the process is rather simple as the BPS only has to check the credit limit of the payer, and directly debit from payer's account and credit payee's account. However, as mentioned above, GIRO payment between different banks has a more tedious process. The following activity diagram depicts the process of GIRO transaction between different banks.

The setup of GIRO arrangements can be done via online BPS portal. A GIRO Application Form need to be filled.

Scenario: User Alan apply for GIRO payment through Merlion Bank online website

1. Alan logs in to Merlion Bank website

2. Alan clicks “Pay” tab
3. Alan clicks “GIRO Arrangement”
4. Alan clicks “Application”
5. Alan completes “Merlion Bank all-in-one GIRO form”
6. Alan types in phone number “12345678” and clicks “receive OTP”
7. Alan receives OTP and types in “kasdf134” in as OTP
8. Alan can view status of GIRO application

The recipient will indicate the outcome in the next bill of the Merlion Bank account used for regular deductions. Any new GIRO arrangements will take at least 21 days to take effect. Upon successful arrangement, customer will receive notification after each deduction via Merlion Bank website notification, electronic email and SMS.

B) Receive payment via IBG

To receive payment via IBG, the payee and payer need to reach an agreement in advance. The payer need to put in place a IBG arrangement specifying the payee’s information. If the payer has insufficient funds in his/her bank account, no funds will be deducted from the payer’s account. Merlion Bank will inform payee about the unsuccessful GIRO collection via the same channels, so that payee can follow up with the payer.

The whole process of a GIRO transfer is shown below.

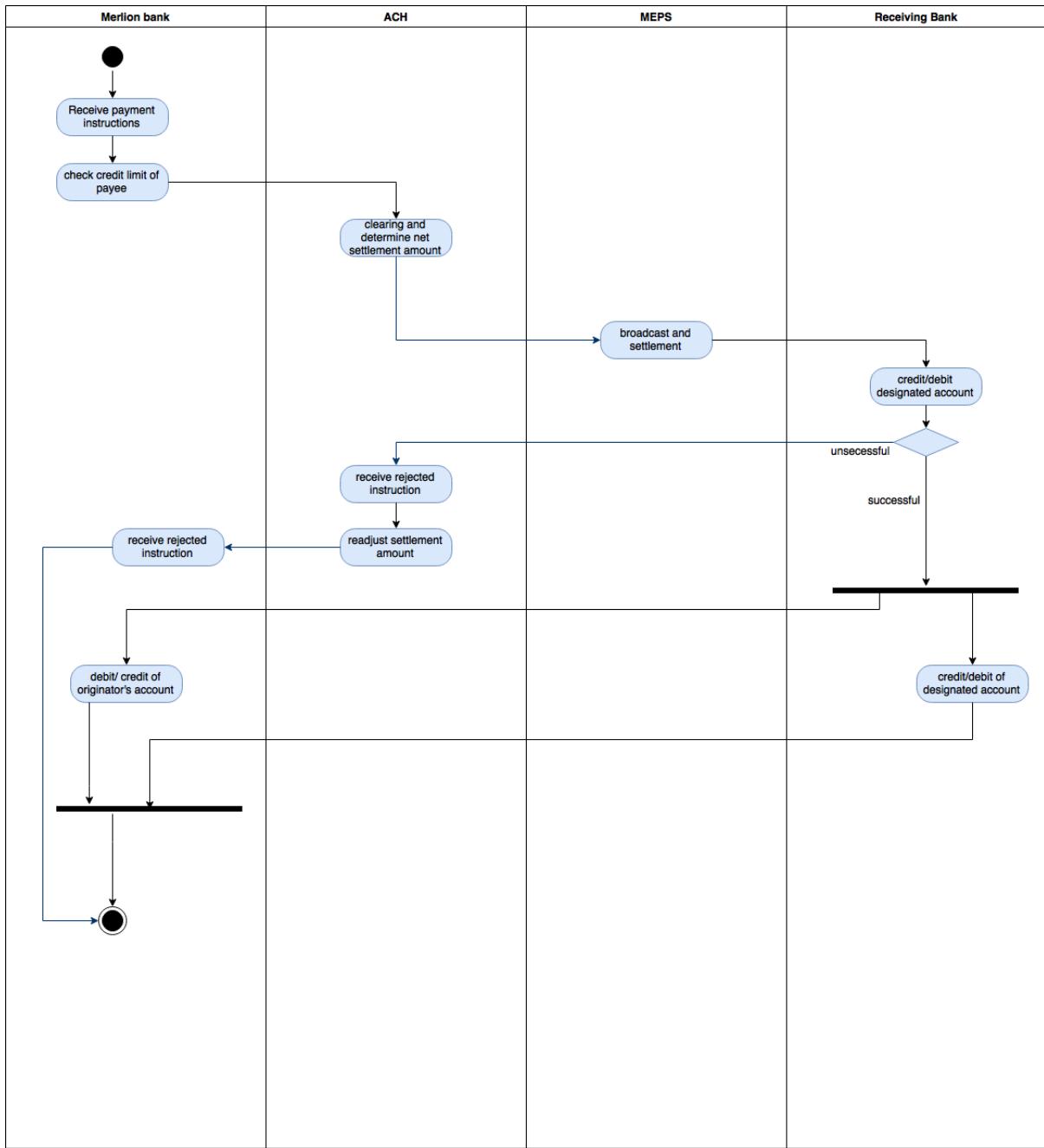


Figure 11: Activity Diagram - GIRO

C) Initiate FAST transfer

The process of FAST transfer is similar to that of simple account transfer. The user can simply send the payment instruction via BPS online portal. The beneficiary will receive the funds within five minutes after the payment has been made, upon a successful credit. Both parties will receive an email alert.

The information that the payer needs to provide is: beneficiary name, beneficiary bank account number, purpose code, beneficiary bank name and the amount.

Scenario: Ben wants to transfer S\$10,000 to his friend Carol

1. Ben logs in to Merlion Bank website portal
2. Ben clicks “Transfer” tab
3. Ben clicks “To Other Bank”
4. Ben types in “Carol Wong” as beneficiary name
5. Ben types in “123-45678-9” as beneficiary account number
6. Ben choose “01” as purpose code
7. Ben types in “S\$10,000” as amount
8. Ben types in phone number “12345678” and clicks “receive OTP”
9. Ben receives OTP and types in “kasdf134” in as OTP
10. Ben receives confirmation of payment via email and transaction history in his account center on Merlion Bank website after 1 minute.

D) Clearing a cheque

As the clearance of cheque takes place at our home branch, the main task of BPS is to store, forward and update the information of the cheques deposited.

Scenario: Don deposit a cheque with value of S\$50,000 from DBS

1. Don arrives at counter at Merlion Bank home branch
2. Don deposit the cheque into the cheque deposit box
3. BPS credit Don’s account with S\$50,000 on-hold fund
4. Don can check the cheque status from Merlion Bank website, which shows “pending” at the time
5. BPS alert Don via email and notification box on Merlion Bank website about clearance of cheque
6. A S\$0.80 per cheque transaction fee is deducted from the cheque amount

7. Don can withdraw the S\$49,999.20 from his account

The backend workflow of clearing cheques is shown by the activity diagram.

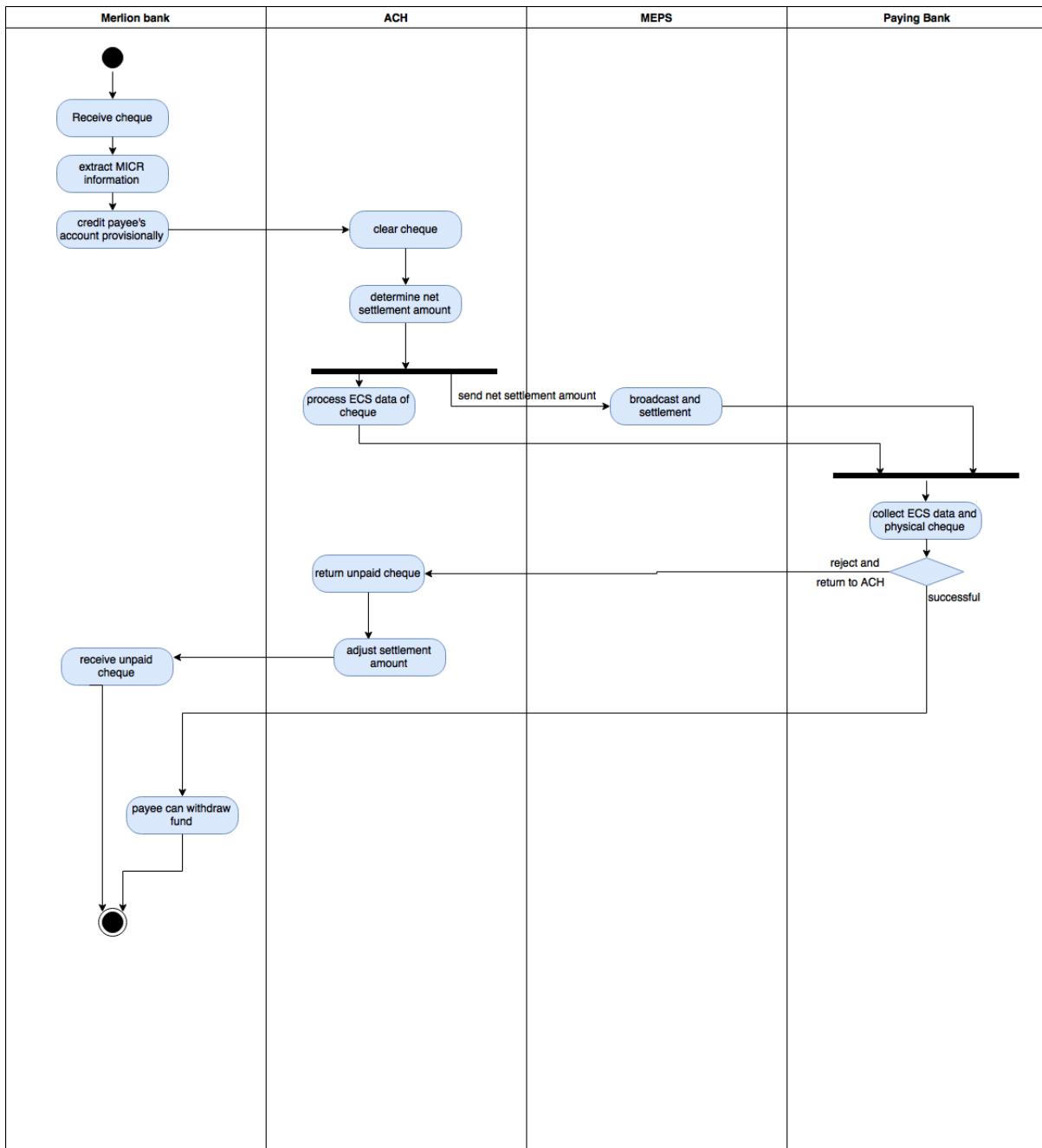


Figure 12: Activity Diagram - Cheque

E) Making a SWIFT transfer

The process of making a SWIFT transfer is very similar to that of making a FAST transaction, except that the payer need to provide the SWIFT code of the beneficiary's bank. The SWIFT code is uniquely assigned to each participating banks. For example, the Italian bank UniCredit Banca, headquartered in Milan, will have a SWIFT code of UNICRITMM. The payer need to initiate a transfer by paying the bank an amount sufficient to cover the cost of the transfer as well as the amount to be sent, as the sender will be charged during the process. Moreover, if the remittance is subject to an exchange rate, the bank will charge a premium (\$10.00) and earn money on the exchange rate as well. Thus, users are encouraged to perform transfers that are sent and received in the same currency.

The customer can make a SWIFT transfer via walk-in or online payment.

Scenario: Ethan transfer USD\$10,000 to Frank in Italy

1. Ethan logs in to the Merlion Bank website
2. Ethan clicks "Transfer" tab
3. Ethan clicks "Overseas Transfer"
4. Ethan clicks "SWIFT transfer"
5. Ethan specifies "Frank Geller" as recipient name
6. Ethan specifies "123-55555-11" as account number
7. Ethan specifies "Italy" as destination country
8. Ethan specifies "UNICRITMM" as SWIFT code
9. Ethan specifies "USD" as receiving currency
10. BPS alert Ethan of S\$25.00 charge of processing fee
11. Ethan clicks accept
12. Ethan types in phone number "12345678" and clicks "receive OTP"
13. Ethan receives OTP and types in "kasdf134" in as OTP
14. Ethan can check transfer status on Merlion Bank portal, which shows "pending" at the time
15. Ethan receives email notice about successful transfer

The role of BPS in this service is rather simple. BPS is in charge of sending the SWIFT message to recipient's bank via SWIFT network, waiting for approval/rejection message from SWIFT network, and update the status of payment.

For receiving a SWIFT payment, BPS will credit money to recipient's account accordingly and send approval message to paying bank via SWIFT network.

F) Set up a billing arrangement

A billing arrangement is essentially the standing instruction GIRO fund transfer. To set up a regular bill payment, customer needs to set up an IBG standing instruction. Only the billing organizations, which have been registered with Merlion Bank, can be arranged with a GIRO standing transfer instruction. The billing organizations will thus be permitted to deduct the fluctuating bill at regular time frame, and the transfer request will be initiated by the organizations themselves. To initiate an ad-hoc bill payment, user needs to go through the non-standing GIRO transfer process, where the billing reference number needs to be specified. User is able to configure it to be recurrent during the process as well.

Scenario: Gina set up a billing arrangement to pay school fee annually to NUS

1. Gina logs in to Merlion Bank website
2. Gina selects “Pay” tab
3. Gina selects “Pay Bills”
4. Gina selects “Set up Regular Billing Arrangement”
5. Gina completes “All-in-one GIRO Application Form”, in which she indicate “National University of Singapore” as recipient name and check “Education Institutes” under recipient
6. Gina provides billing reference number
7. Gina types in phone number “12345678” and clicks “receive OTP”
8. Gina receives OTP and types in “kasdf134” in as OTP
9. Gina completes application and view status of GIRO application, which is stated as “pending”
10. Gina receives successful arrangement via email
11. Gina receives deduction notice every year after deduction of school fee

For ad-hoc bill payers, a simple transaction process will be performed by them.

Scenario: Helen pays her phone bill to Starhub

1. Helen logs in to Merlion Bank website
2. Helen selects “Pay” tab
3. Helen selects “Pay Bills”
4. Helen selects “Bill Payment”
5. Helen selects “Starhub” under billing companies
6. Helen provides billing reference number
7. Helen views bill outstanding balance of S\$40.00
8. Helen fills in S\$40.00 as paying amount
9. Helen types in phone number “12345678” and clicks “receive OTP”
10. Helen receives OTP and types in “kasdf134” in as OTP
11. Helen provides Merlion Bank deposit account number and PIN
12. Helen completes ad-hoc bill payment

3.6.3 System Requirements Analysis

Business Assumptions

- Cheque clearance is done at the counter by counter-teller. An MICR check reader will be used.
- Merlion Bank has already joined the FAST payment system, IBG system and SWIFT system.
- Connection with ACH is already established.
- Merlion Bank issue cheques by counter pickup or mailing. A cheque writer machine can be used to write a cheque.

To address the business requirements of the billing and payment functions, 5 subsystems are categorized based on the different payment channels that BPS supports, which are GIRO Transfer subsystem, FAST Fund Transfer subsystem, Cheque Management subsystem, SWIFT International Transfer subsystem and the Billing Management subsystem. All of the

subsystems will be used by the staff in Payment Department under Consumer Banking Division. In addition, the third parties who are responsible for clearing and settlement will also be simulated in the system.

a) GIRO Transfer Module

This subsystem will be used to facilitate all GIRO transactions payment and collection requests. It is responsible for actual debit and credit of users' accounts, sending/ receiving instructions to/from ACH, update the users' account balances and update transfer status. As the main functions are done mostly by the algorithms in the system, the staff in Payment Department are mostly in charge of maintenance of the system, assessing data and transaction history when necessary and editing data.

b) FAST Fund Transfer Module

This subsystem will be responsible for the incoming and outgoing FAST transfer requests. As there is no third party involved besides the paying/receiving bank and Merlion Bank, this module will only be dealing with the partnering banks. It will provide the means for users to apply for FAST Fund Transfer payment and collection, allow users to view transfer status and account balance, as well as debit and credit of user's account. The staff in Payment Department will conduct maintenance of system, assessment and editing of data.

c) Cheque Management Module

This subsystem is used by the Payment Department and the counter tellers to store and process the cheque data. The module will acquire inputs including the MICR information of the received cheques from the MICR cheque reader machines at the counter, and also from manual editing of counter tellers and Payment Department staff. The module will store and forward the MICR cheque information to ACH and second party bank, provide status check, and update the cheque user's account balances.

d) SWIFT International Transfer Module

The SWIFT International Transfer Subsystem is the only channel Merlion Bank provides for overseas fund transfer. The system will perform simple functions like forwarding and receiving SWIFT messages, checking credit limit of payers' accounts, crediting and debiting, and updating transfer status as well as account balances.

e) Billing Management Module

The Billing Management Subsystem performs the similar functions as the GIRO Transfer Subsystem, except that all transfers are designating corporates as recipients.

f) ACH Module

This module will be built to simulate the clearing, settlement and forwarding of payment instructions. It acts as a bridge between the receiving bank, MEPS, and the paying bank. It is also in charge of clearing of cheques.

g) MEPS Module

This module is established to simulate the processing of clearing and settlement results from ACH. It is essentially in charge of storing the net settlement results and broadcasting it to the originating and receiving banks.

h) SWIFT Module

This subsystem is to simulate the international payment network. It primarily act as a bridge between the paying and receiving banks by receiving, processing and forwarding the instructions and responses from them.

i) External Bank Module

This module is to simulate the transactions to, from, and between external banks. It acts as a simulation of assets movements involving external partner banks.

j) Billing and Payment Processor Module

This module is to simulate the billing and payment processor organization which processes, records and forwards the billing and payment requests between Merlion Bank and partner billing organizations.

System functionalities

Functionality Code	Name	Remark	AAU ID
A.6 Billing and Payment System			
A.6.1 FAST Fund Transfer Module			
A.6.1.1	FAST transfer to other bank	Counter teller helps customer to conduct FAST transfer	6
A.6.2 GIRO Transfer Module			
A.6.2.1	Add standing GIRO arrangement	Counter teller helps customer to add a standing GIRO transfer arrangement	6
A.6.2.2	View standing GIRO arrangement	Counter teller can view existing standing GIRO transfer arrangement	
A.6.2.3	View GIRO records	Counter teller can view history of GIRO withdrawals	
A.6.2.4	Delete standing GIRO arrangement	Counter teller helps customer to delete standing GIRO arrangement	
A.6.2.5	Change standing GIRO payment limit	Counter teller helps customer to change the daily transfer limit of standing GIRO payments	
A.6.2.6	Approve standing GIRO application	Billing and Payment Processor approves or rejects a standing GIRO application	

A.6.3 Billing Management Module			
A.6.3.2	One-time GIRO transfer	Counter teller helps customer to conduct an one-time GIRO transfer	6
A.6.3.3	Recurrent GIRO transfer	Counter teller helps customer to conduct a recurrent GIRO transfer	
A.6.3.4	View non-standing GIRO arrangements	Counter teller views existing non-standing GIRO arrangements	
A.6.3.5	Delete non-standing GIRO arrangement	Counter teller deletes a non-standing GIRO arrangement	
A.6.3.6	Register billing organization	Billing and Payment Processor registers a new billing organization	
A.6.3.7	Input real currency exchange rate	Billing and Payment Processor enters real time currency exchange rate that is set by the bank	
A.6.3.8	View recurrent payment history	Counter teller can view customer's recurrent payment history	
A.6.4 Cheque Management Module			
A.6.4.1	View issued cheque status	Counter teller can check the status of received cheques	6
A.6.5 SWIFT International Transfer Module			
A.6.5.1	Process SWIFT transfer	Counter teller process received SWIFT transfer	6
A.6.5.2	Change SWIFT transfer limit	Counter teller can help customer to change SWIFT transfer limit	

B.2 Billing and Payment System			
B.2.1 Clearance Module			
B.2.1.1	SACH FAST transfer clearance	SACH clears FAST transfer.	6
B.2.1.2	SACH other transactions clearance	SACH clears normal and GIRO transactions	
B.2.1.3	CHIPS clearance	CHIPS clears SWIFT transactions	
B.2.1.4	Cheque clearance	SACH clears cheques	
B.2.2 Settlement Module			
B.2.2.1	MEPS FAST transfer settlement	MEPS settles FAST transfer	6
B.2.2.2	MEPS other transaction settlement	MEPS settles other transactions	
B.2.3 SWIFT Module			
B.2.3.1	Send SWIFT message	SWIFT network sends out SWIFT message to other bank	6
B.2.3.2	Forward payment instruction	SWIFT system sends payment request to instructed receiving bank based on SWIFT code.	
B.2.4 External Bank Module			

B.2.3.1	Other bank sends FAST transfer to Merlion Bank	Other bank sends out FAST transfer request to Merlion Bank	6
B.2.3.2	Other bank conducts FAST transfer to other bank	Other bank request for FAST transfer to other bank	
B.2.5 Billing and Payment Processor Module			
B.2.5.1	Process bills	Billing and payment processor process bills	6
C.4 Billing and Payment Module			
C.4.1 FAST Fund Transfer Module			
C.4.1.1	FAST transfer to other bank	Customer requests for FAST transfer, and provide required information including recipient's account number and amount.	6
C.4.1.2	Add payee from other bank	Customer adds a regular FAST payment payee	
C.4.1.3	Delete payee from other bank	Customer deletes a regular FAST payment payee	
C.4.2 GIRO Transfer Module			
C.4.2.1	Add standing GIRO arrangement	Customer adds a standing GIRO transfer arrangement	6
C.4.2.2	View standing GIRO arrangement	Customer views existing standing GIRO transfer arrangement	
C.4.2.3	View GIRO records	Customer views history of GIRO withdrawals	

C.4.2.4	Delete standing GIRO arrangement	Customer deletes standing GIRO arrangement	
C.4.2.5	Change standing GIRO payment limit	Customer changes the daily transfer limit of standing GIRO payments	

C.4.3 Billing Management Module

C.4.3.1	Add new billing organization	Customer add a new billing organization to billing organization list	6
C.4.3.2	One-time GIRO transfer	Customer conducts an one-time GIRO transfer	
C.4.3.3	Set up recurrent GIRO transfer	Customer conducts a recurrent GIRO transfer	
C.4.3.4	View recurrent payment history	Customer views recurrent GIRO payment history	
C.4.3.5	View non-standing GIRO arrangements	Customer views existing non-standing GIRO arrangements	
C.4.3.6	Delete non-standing GIRO arrangement	Customer deletes a non-standing GIRO arrangement	

C.4.4 Cheque Management Module

C.4.4.1	View cheque status	Customer checks the status of received cheques	6
---------	--------------------	--	---

C.4.5 SWIFT International Transfer Module

C.4.5.1	Request for SWIFT transfer	Customer conducts a SWIFT transfer	6
---------	----------------------------	------------------------------------	---

C.4.5.2	Change SWIFT transfer limit	Customer changes SWIFT transfer limit	
---------	-----------------------------	---------------------------------------	--

D.4 Billing and Payment Module

D.4.1 FAST Fund Transfer Module

D.4.1.1	FAST transfer to other bank	Customer requests for FAST transfer, and provide required information including recipient's account number and amount.	6
D.4.1.2	Add payee from other bank	Customer adds a regular FAST payment payee	
D.4.1.3	Delete payee from other bank	Customer deletes a regular FAST payment payee	

D.4.2 GIRO Transfer Module

D.4.2.1	Add standing GIRO arrangement	Customer adds a standing GIRO transfer arrangement	6
D.4.2.2	View standing GIRO arrangement	Customer views existing standing GIRO transfer arrangement	
D.4.2.3	View GIRO records	Customer views history of GIRO withdrawals	
D.4.2.4	Delete standing GIRO arrangement	Customer deletes standing GIRO arrangement	
D.4.2.5	Change standing GIRO payment limit	Customer changes the daily transfer limit of standing GIRO payments	

D.4.3 Billing Management Module

D.4.3.1	Add new billing organization	Customer adds a new billing organization to billing organization list	6
D.4.3.2	One-time GIRO transfer	Customer conducts an one-time GIRO transfer	
D.4.3.3	Set up recurrent GIRO transfer	Customer conducts a recurrent GIRO transfer	
D.4.3.4	View recurrent payment history	Customer views recurrent GIRO payment history	
D.4.3.5	View non-standing GIRO arrangements	Customer views existing non-standing GIRO arrangements	
D.4.3.6	Delete non-standing GIRO arrangement	Customer deletes a non-standing GIRO arrangement	
D.4.4 Cheque Management Module			
D4.4.1	View cheque status	Customer checks the status of received cheques	6
D.4.5 SWIFT International Transfer Module			
D.4.5.1	Request for SWIFT transfer	Customer conducts a SWIFT transfer	6
D.4.5.2	Change SWIFT transfer limit	Customer changes SWIFT transfer limit	

3.7 Wealth Management System (AAU ID: 07)

3.7.1 Business Analysis

The Wealth Management System is to facilitate wealth management teams to make decisions on recommending wealth management proposals and plans to Merlion Bank's customers. It is a key function that supports Merlion Bank's main approach to make profits. Savings and Investment are the two different kind of wealth management services provided.

The system must be able to advise Relationship Managers on different wealth management proposals and plans that are suitable for a customer based on analysis of his family information, financial goals, risk profile, and other advanced information. A knowledge management system featuring a knowledge repository, which contains wealth planning case studies, will be incorporated into Wealth Management System to provide computerized decision support for Relationship Managers.

The Wealth Management System will be able to provide personalized wealth management plans for customers and facilitate Relationship Managers to make informed decision. It enables Relationship Managers to conduct asset allocation and security selection process in order to make each portfolio more profitable and meanwhile lowering the risk.

While communicating with customers regarding wealth management planning, the relationship manager could use the investment calculator included in our system to show statistics to customers. Since calculations and statistics are more direct and easy to understand, this could be a way to convince customers to trust our expert suggestions.

The system is also linked to Portfolio Management System, which manages all the portfolios of customers. The system will be able to generate a weekly portfolio performance report for customers to track their portfolio performance and decide on whether or not to perform asset reallocation.

One thing to note is that Merlion Bank, as a direct bank, allows customers to purchase Saving Plans from the iBanking system on their own. Unlike making investment, Savings are much more stable and riskless. Customers are encouraged to make use of our retirement planner or education planner to make decision on which plan to choose. SECURITIES AND FUTURES ACT (CAP. 289) - NOTICE ON THE SALE OF INVESTMENT PRODUCTS is the document for customer to read and sign before proceed to the actual purchase act. On the other hand, customers are also welcomed to contact with our Relationship Managers to inquiry the Saving Plans issue.

Business Objectives

- Create customer's advanced profile which includes family information and financial goals of the customer
- Saving Plans (retirement plans and education plans) and Investment Plans are the two kind of wealth management services provided to customers of Merlion Bank
- Provide an online test for customers to do risk tolerance test and create customer's risk profile
- Fetch wealth management planning case studies from database to provide decision support for Relationship Managers
- Allow Relationship Managers to approach the embedded investment calculator
- Assist Relationship Managers with the asset allocation, security selection and other wealth management planning stages.
- Allow Relationship Managers & Sales Department Managers to view their customers' portfolio performance report

3.7.2 Business Processes

A) Assign relationship manager to customer

After customer contacts Merlion Bank for wealth management services, system will search for customer's profile in database. If the customer is an existing customer who has already been assigned a Relationship Manager, the customer will be directed to his original Relationship Manager. If the customer has never requested for Merlion Bank's wealth management service before, the sales department manager will randomly assign a Relationship Manager to the customer via Merlion Bank Internal System. In the case when the customer is not satisfied with the assigned Relationship Manager, he/she can contact customer service staff to request for a change of assigned RM.

Scenario: Assign relationship manager to customer

1. Customer Tom contacts Merlion Bank over internet banking website and requests for wealth management services
2. System checks if the customer has been assigned a relationship manager
3. If Tom has not been assigned a relationship manager, system will send a notification to sales department manager and create an entry in “Assign Relationship Manager” page. The default status for the entry is “pending”
4. Sales department manager John logs in to Merlion Bank Internal System and noticed the notification sent by system.
5. John clicks the “Assign Relationship Manager” tab and sees all the pending entries.
6. John assigns a relationship manager to a customer by choosing name of the RM (Mike) from a drop-down menu.
7. John clicks the “confirm” button
8. System updates the status of the entry to “completed”
9. System sends a notification to the relationship manager Mike about the customer assignment done by John

B) Create Advanced Profile of Customer

Before any wealth management services, customers are advised to firstly complete a risk tolerance test on our iBanking website, so as to get a gist of which financial products are more suitable for themselves, and to help generate their risk profile for Relationship Manager’s evaluation and preparation before a face-to-face meeting. The public can also perform the quiz on our public home page, where no information will be stored and the main purpose is for self-understanding. Customer can also contact Relationship Manager to assist them. The risk tolerance test consists of 6 questions, which helps to determine customer’s psychological level of acceptance towards difference risk level of investments.

The questions are as follow:

- Age
- Portion of monthly income to put in the investment
- Determine investment portfolio type by specifying potential gain and loss rate
- Tolerance towards potential market fluctuations and loss

- Investment experience
- Long term and short term investment approach

The results will be categorized into 3 level of risk tolerance level, high, middle and low. Some of the questions are listed below:

Risk Tolerance Test:

To obtain above-average returns on my Investments, I am willing to accept above-average risk.

Disagree strongly

Agree strongly

If my investments lose money over the course of a year, I can easily resist the temptation to sell them.

Disagree strongly

Agree strongly

I know quite a bit about economic issues and personal investing.

Disagree strongly

Agree strongly

To calculate the risk tolerance factor, we will assign score 1-5 to each answer, while “disagree strongly” being 1, and agree strongly being 5. The total marks will be summed together to get a total risk score, from which the customer will be categorized into a risk group. The attribution will be shown by the table below:

Risk Group	1	2	3
Score Range	<10	10-19	20-30
Group	Conservative	Moderate	Aggressive

Assets allocation plans:	Equity 30% Fixed Income 70%	Cash equivalents 15% Bonds 75% Stocks 70%	Equity 80% Fixed Income 20%
--------------------------	--------------------------------	---	--------------------------------

The different tolerance level will result in the difference in recommended financial products. For example, a highly risk-tolerant customer will be recommended larger percentage of high-risk products and less or even no products at middle or low risks.

Financial goals could also be declared before meeting with a Relationship Manager. The purpose of doing this is to make the wealth management planning process more efficient. When it comes to the face-to-face meeting with the Relationship Manager, the process will be less time consumed. Financial goals are the specific aim of financial return after specified range of period. Each financial goal will have a corresponding portfolio. Customers may access the investment calculator, in this way, they may obtain a clearer view on how they want to invest. Relationship Manager will then arrange an offline meet up to collect further advanced information from customer such as family information and income which are not covered by the basic customer profiles. The higher the return and the shorter the period is, the higher the risk of investment is likely to be. Relationship Manager will demonstrate basic investment concepts and processes to customer, so as to allow customers to make informed decisions about resetting his/her financial goal(s). Customer also needs to provide the intended initial invested amount after receiving Relationship Manager's advice. To deliver service with greater flexibility, Merlion Bank also provides 4 types of financial goals to cater to different preference of planning. Different plans have different required inputs. The financial goals are:

Starting Balance Target Date Monthly Installment Target Return	Starting Balance Target Date Product Monthly Profit
Starting Balance Target Date Target Return	Starting Balance Monthly Installment Target Date Product Monthly Profit

Customers are not allowed to change their financial goals before the contracted period has ended. However, if the customer wishes to withdraw some amounts of money before the end date, he/she can inform and discuss with his/her Relationship Manager. The Relationship Manager will remind the customer about the consequences, such as the likelihood of investing the remaining amount of money in riskier products to meet the financial goals.

Scenario: Relationship manager creates advanced profile of customer

1. Relationship manager Mike logs in to Merlion Bank Internal System
2. Mike clicks “Create Advanced Profile” button
3. System displays the “Advanced Profile” page
4. Mike input the following information of the customer Tom:
 - Family information
 - Monthly income
 - Financial goals
5. Mike clicks “Next” and inputs Tom’s answer to the questions designed for customer risk tolerance test
6. Mike clicks “Save” button
7. System displays the summary of Tom’s advanced profile which includes the mark gained for customer risk tolerance test and indicates that the advanced profile has been successfully saved into database

C) View Proposed Wealth Management Proposals

After the advanced profile of a customer has been created, Relationship Manager can make use of Decision Support system of Wealth Management System to recommend investment plans to customers. To generate recommendations for suitable investment products, including *stocks*, *bonds*, and *cash equivalents*, Decision Support system will analyze customer’s advanced profile. The variables the system has considered include the financial conditions of customer, risk tolerance score and other information that contributes to the receptivity towards different financial products. Besides the recommended investment plans, a list of portfolios of past wealth management cases will also be included. These cases are from past customers who have similar backgrounds, risk tolerance level and financial goals as the processing customer. This will facilitate the Relationship Manager and act as a reference to make a sound decision.

After Relationship Manager has selected the recommended plan(s), customer will discuss with Relationship Manager and decide on which plan(s) to buy or invest on. Each plan will consist of a suggestion of attributed weightage of each kind of product. For example, for a highly risk-

tolerant customer, Relationship Manager may suggest him/her to invest in a plan that place more weightage on riskier products. After viewing the proposed plans from Relationship Manager, customer will then tell the Relationship Manager if he/she approves/rejects the plan. Upon customer's approval of the investment plan, Relationship Manager will then present the investment agreement contract for customer to sign. If customer rejects the plan, Relationship Manager has to revise the plan and resend it to customer for further revision or confirmation.

Scenario: View proposed wealth management proposals

1. Relationship Manager Mike selects customer Tom's advanced profile
2. Mike clicks "View Proposed Plans" button
3. System generates and displays several wealth management proposals
4. Mike discuss with Tom about suggested wealth management plans given Tom's information
5. Tom decides on buying Stock A
6. Mike presents Tom with an agreement contract
7. Tom signs the contract

D) Create Portfolio

Once the contract is confirmed, Relationship Manager will select the customer and create a new portfolio for the customer.

During the process of creating a portfolio, Relationship Manager will conclude the actual *assets allocation* based on the selected plan. To maximize stability and minimize exposure to potential risk, Merlion Bank purses *diversification strategy* during assets allocation. This is to avoid over-reliance on a sole product. Relationship Manager is likely to diversify the product categories dabbled in, with an emphasis on a specific type of product as stated in the wealth management plan. The financial categories include:

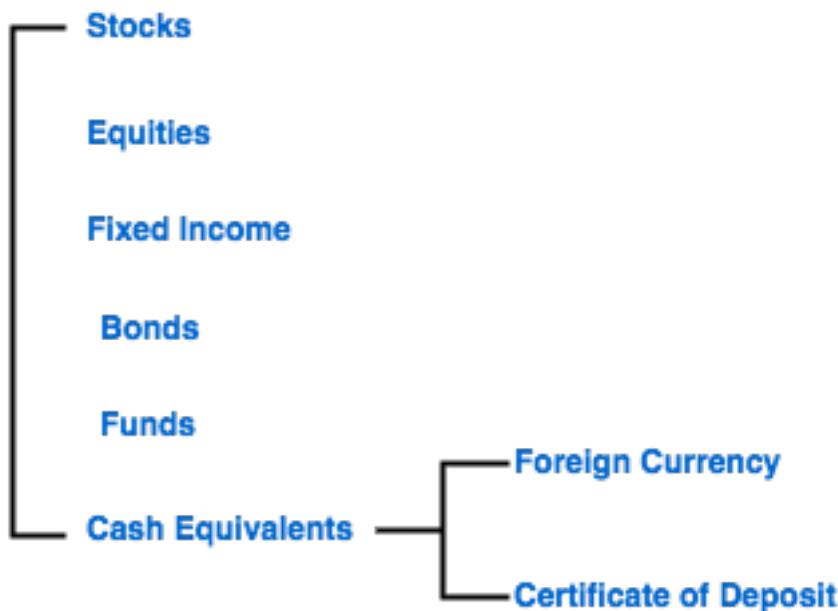


Figure 13: Categories of Financial Products

After settlement on actual investing products, customer will need to invest the required starting sum to kick-start the portfolio. Relationship Manager subsequently starts monitoring the portfolio performance.

Scenario: Create a new portfolio

1. Customer Tom chooses wealth management plan A and signs contract with Merlion Bank
2. Relationship Manager Mike logs in to Merlion Bank Internal System
3. Mike confirms that there is no problem with the contract
4. Mike selects Tom in PMS system and clicks “Create A Portfolio” button
5. System displays “portfolio” page of customer Tom

6. Mike clicks “Add New Product” button in “Portfolio” page and inputs the following information:
 - Product name
 - Number of unit purchased
7. Mike repeated step 5 until all the products Tom has chosen are added to the portfolio
8. Mike clicks “Confirm” button to confirm the information input
9. System saves the portfolio and displays the notification saying that “A portfolio has been successfully created!”

Relationship Manager makes the decision on choosing proper investment plans from the wealth management proposals recommended by the BI system. Besides the recommendations from the system, the Relationship Manager will also decide based on his/her past experience, financial knowledge and other unquantifiable information of the customer. After choosing the proposed plans, Relationship Manager will send the plans to customer’s mailbox on Customer Internet Banking Website to obtain approval, or arrange face-to-face appointments with customer to introduce each proposed plans to customers before obtaining approval.

Scenario: Send proposed plans to customer

1. Relationship Manager Mike chooses wealth management plans from plans recommended by the system
2. Mike clicks the “Send” button
3. System sends an email which contains the wealth management plan Mike has chosen to customer Tom’s mailbox
4. System sends a notification to Tom

The above business processes can be shown in an activity diagram as follow:

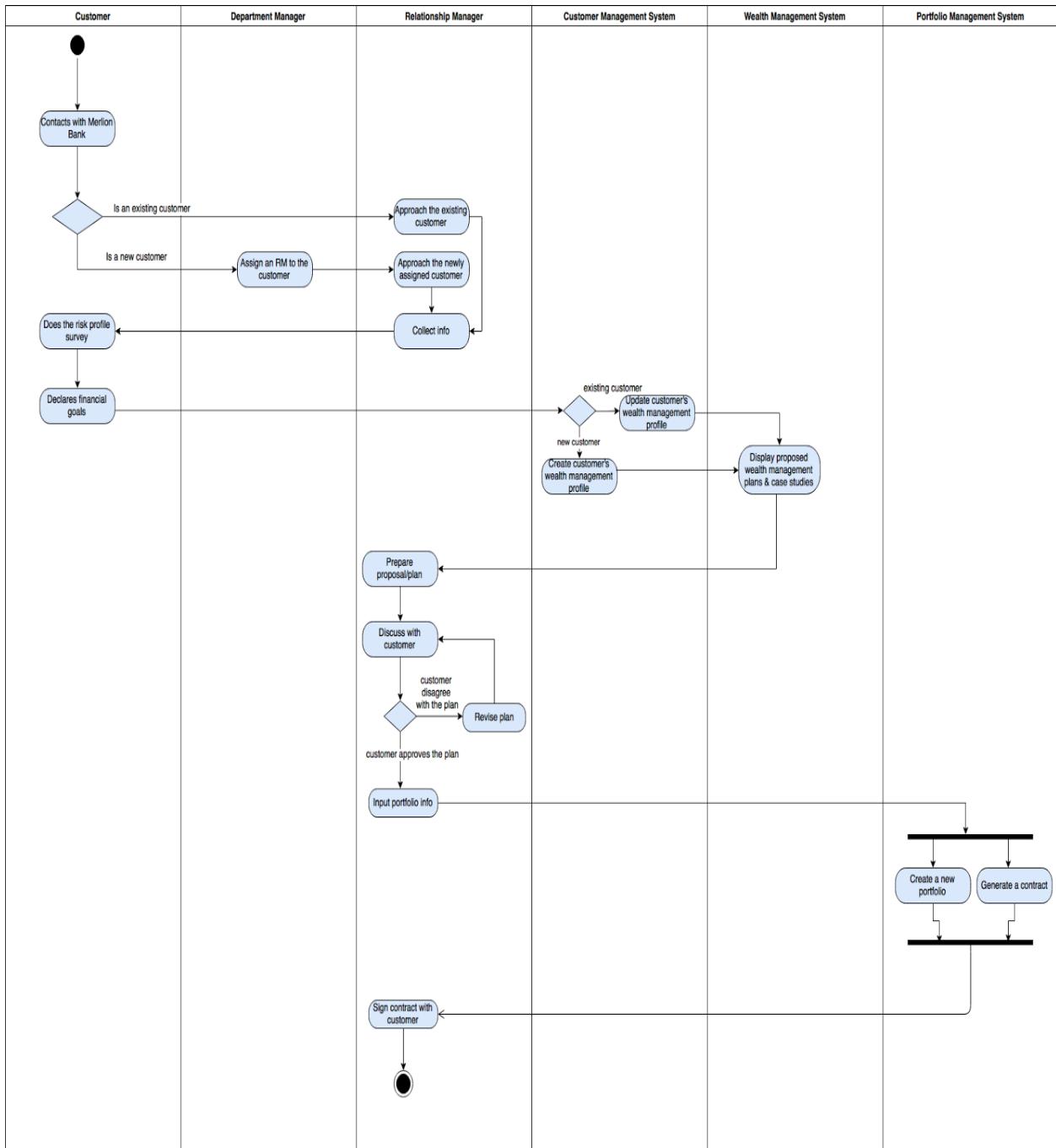


Figure 14: Activity Diagram - Wealth Management Process

3.7.3 System Requirements Analysis

Business Assumptions

- As a direct bank, we encourage customers to conduct the risk tolerance test and declare their financial goals before they meet with our Relationship Managers. The risk profile will be created once the customer complete the test. The financial

goals will also be stored to assist the assigned relationship manager to prepare for the meeting.

- On the other hand, with no risk profile recorded or financial goals declared, the Relationship Manager will ask the customer to conduct the risk tolerance test and declare financial goals meeting via Merlion Bank Internal System during face-to-face meeting.
 - Further advanced information such as number of dependents would be recorded during the face-to-face meeting.
 - The proposed wealth management proposals and plans are generated based on customer's financial goals, risk profile as well as advanced information.
 - Once the customer has chosen his preferred wealth management plan, the financial goal cannot be modified by customers or staff of Merlion Bank
 - The actual portfolio will be created by the Relationship Manager by going through the wealth management planning stages such as asset allocation and security selection based on all information gathered as well as the chosen proposed plan.

To address the business requirements of the Wealth Management System in the preliminary requirements specifications, a Wealth Management Planning Module will be constructed for Merlion Bank Internal System:

a) Wealth Management Planning Module

This module will primarily be used by Relationship Managers from sales department to make informed decision on recommending wealth management proposals for customers. It will also provide a platform for Relationship Managers to input customer's advanced information such as financial goals, and risk tolerance information, as well as family information. The system will incorporate a Decision Support section to generate recommended wealth management plans by analyzing all the gathered information to facilitate Relationship Managers during the decision making process. Platforms for Relationship Managers to conduct asset allocation and security selection are also provided to assist the wealth management planning.

A Wealth Management Module will be constructed for Internet Banking Website and Mobile Web Application. The module is described as follows:

b) Wealth Management Module

This module will be primarily used by customers to review their portfolios and their performance, as well as monitor their financial goals using Internet Banking Website or mobile web application.

System Functionalities

Functionality Name	Remark	AAU ID
Code		
A.7 Wealth Management System		
A.7.1 Wealth Management Planning Module		
A.7.1.1	Assign Relationship Manager	Sales department manager can assign Relationship Manager to new wealth management customer
A.7.1.2	Guide financial goal declaration	Relationship Manager can guide customer to declare financial goal(s) via Internal System
A.7.1.3	Guide risk tolerance test	Relationship Manager can guide customer to perform risk tolerance test via Internal System
A.7.1.4	View customer list	Relationship Manager can view the customer list
A.7.1.5	Create advanced profile	Relationship Manager can create advanced profile for new wealth management customers
A.7.1.6	Create customer portfolio	Relationship Manager can create new customer portfolio based on financial goals
A.7.1.7	View system-proposed plans	Relationship Manager can view system-proposed wealth management plans based on customer's information
A.7.1.8	Select recommended plans	Relationship Manager can select recommended plans from system-proposed plans to recommend to customers
C.6 Wealth Management Module		
C.6.1	Do risk tolerance test	Customer can perform a risk tolerance test to assess risk level

C.6.2	Declare financial goals	Customer can declare financial goals via Internet Banking system	
C.6.3	View wealth plan information	Customer can view information of wealth plan online	
D.6 Wealth Management Module			
D.6.1	Do risk tolerance test	Customer can perform a risk tolerance test to assess risk level	7
D.6.2	Declare financial goals	Customer can declare financial goals via Internet Banking system	
D.6.3	View wealth plan information	Customer can view information of wealth plan online	

3.8 Portfolio Management System (AAU ID: 08)

3.8.1 Business Analysis

The Portfolio Management System(PMS) is to support the staff from sales department to maintain and manage the portfolios of customers. Once customer has signed contract with Merlion Bank, relationship manager must create a portfolio of the customer. After the portfolio is created, relationship manager must keep monitoring performance of the portfolio and re-allocate the assets based on the valuation of the portfolio provided by the PMS system.

In order to ease relationship manager's daily job, there should be an easy-to-use user interface for relationship manager to input and maintain customer's portfolio. Therefore, PMS system must provide intuitive monitoring tools such as charts and tables for relationship managers to reflect the performance and valuation of the portfolio. Besides, it must enable relationship

manager to create a new portfolio, and modify the portfolio to reflect the asset re-allocation and balancing.

In order to provide more accurate valuation information to reflect the net worth of customer's portfolio, PMS system must make use of appropriate valuation methodologies and criteria to evaluate different financial instruments such as real estate properties and private equities.

Business Objectives

- Create and maintain customer's portfolio
- Provide portfolio monitoring tools such as charts and tables
- Provide portfolio valuation report for relationship manager
- Update and modify customer's portfolio to reflect asset re-allocation and balancing
- Allow customers to view their portfolio performance report on internet banking website or on mobile phones

3.8.2 Business Processes

A) View Portfolio Report

The system will generate and send a portfolio performance report to customer's mailbox every other month. Customer can also log in to Internet Banking Website to view the monthly report anytime he/she wishes. While the monthly report summarizes the portfolio performance in the past month, the daily accessible report indicates the fluctuation trend within the previous one year. Besides, Relationship Manager of the customer will also be able to view the monthly portfolio performance report of his customer via Merlion Bank Internal System.

Scenario A: View portfolio report (customer)

1. System sends monthly portfolio performance report to customer Tom on the last day of each month
2. Tom logs in to Internet Banking Website

- | |
|---|
| <ol style="list-style-type: none"> 3. Tom clicks “View Portfolio Performance Report” button 4. System displays the monthly report using charts and tables |
|---|

Scenario B: View portfolio report (Relationship Manager)

- | |
|---|
| <ol style="list-style-type: none"> 1. Relationship Manager Mike logs in to Merlion Bank Internal System 2. Mike selects customer Tom from the customer list 3. Mike clicks “View Portfolio Performance Report” button 4. System displays the monthly report using charts and tables |
|---|

B) View Portfolio Valuation

After portfolio(s) is(are) created, Relationship Manager will carry on and monitor portfolio performance. As there are different types of financial products, Relationship Manager adopts different approach to manage products with different volatility and risk level. For portfolios with riskier and more volatile products, Relationship Manager will monitor it more frequently, and vice versa. To help relationship manager better manage the portfolio, a filter function is implemented to help Relationship Manager to filter out different groups of portfolios.

Relationship manager will be able to view the valuation of each asset. Merlion Banking System makes use of various valuation methodologies. For instance, the valuation of private equities will be based on the book value which is provided by a certified organization. Besides, system will also provide risk exposure analysis to evaluate the volatility of a portfolio. For instance, if relationship manager tries to add a new asset or asset class to a portfolio, system will calculate and reflect changes in overall risk-return characteristics to help relationship manager make decision.

C) Update Portfolio

After viewing the portfolio valuation, Relationship Manager can modify customer’s portfolio. Relationship Manager can add a new product, remove a product, edit the unit price, and edit number of units purchased to reflect assets re-allocation and balancing. The Portfolio system

acts as guidance of decision, as it will remind Relationship Manager when an update of portfolio is against the current market trend of the products.

In addition, since Relationship Manager pursues different methodology for different type of wealth plans, he/she needs to monitor and update riskier products more frequently to avoid unnecessary loss. The more risky the product is, the higher the frequency of update will be.

D) Portfolio Performance Reviewing

Every half-year Relationship Manager will arrange a meeting with customer to review customer's portfolio performance. During the meeting, customer has a chance to understand the performance in detail, and request for asset reallocation. Customer can choose to revise wealth management plan, altering portion of different products, reallocate certain assets, or stick to the original plan after reviewing the portfolio performance. Besides, customer can also request to terminate the wealth management plan and sign termination agreement with Merlion Bank. However, a penalty fee will apply, which depends on the starting balance, terminating time, profits gained and risk level. For example, for the savings plans, which normally span 10-20 years and include education, retirement and family saving plans, will incur higher penalty fees due to long timespan. On the other hand, investment plans tend to incur lower penalty fee due to shorter investing time. In addition, the higher the starting balance is, the higher the profit gained, and the higher the risk of plan is, the higher the penalty fee will be. After the agreement is signed, the remaining credit of the portfolio will be transferred to customer's account.

The portfolio performance reviewing process can be shown in an activity diagram as follow:

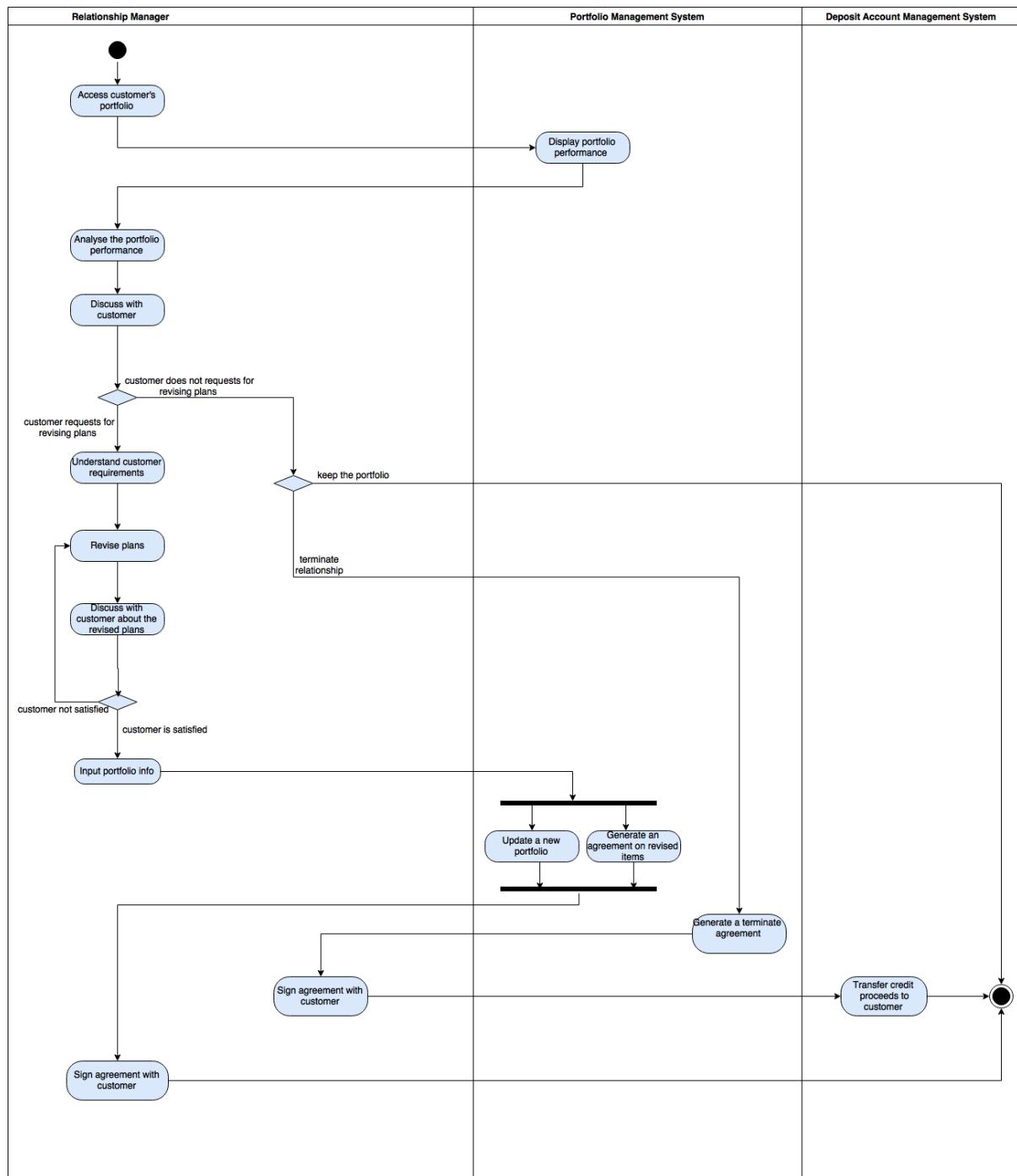


Figure 15: Portfolio Performance Review

3.8.3 System Requirements Analysis

Business Assumptions

- The actual trade related activities are performed offline in a separated trading system
 - Relationship manager can only view portfolios of his own customers

- Daily operations of the portfolio is decided by relationship manager, and customer cannot view the daily operations performed by his relationship manager

To address the business requirements of the Portfolio Management System in the preliminary requirements specifications, a Portfolio Creation and Updating Module and a Portfolio Valuation Module will be constructed. These two modules are described as follows:

a) Portfolio Creation and Updating Module

This module will be used by relationship manager from sales department of Merlion Bank. It enables relationship manager to create a new portfolio for his customer, and modify the portfolio based on the portfolio performance and valuation to reflect assets diversification and changes happened during assets re-allocation process.

b) Portfolio Performance Reviewing Module

This module will be used by staff from sales department to view customer's portfolio performance report using Merlion Bank Internal System.

c) Portfolio Valuation Module

This module will be used by Relationship Manager from sales department of Merlion Bank. It provides portfolio valuation using charts and tables as monitoring tools for Relationship Manager to track the performance of the portfolio. Relationship Manager will view the portfolio valuation, and then modify the portfolio accordingly based on his professional knowledge with the support of portfolio creation and updating module.

System Functionalities

Functionality	Name	Remark	AAU
Code			ID
A.8 Portfolio Management System			
A.8.1 Portfolio Creation and Updating Module			

A.8.1.1	Add a new portfolio	Relationship manager & Department manager can add a new portfolio	8
A.8.1.2	Update a portfolio	Relationship manager & Department manager can update a portfolio	
A.8.2 Portfolio Performance Reviewing Module			
A.8.2.1	View Portfolio Report	Relationship Manager can view portfolio valuation shown in charts and tables	8
A.8.3 Portfolio Valuation Module			
A.8.3.1	View Portfolio Valuation	Relationship Manager can view portfolio valuation shown in charts and tables	8
C.7 Portfolio Management Module			
C.7.1	View Portfolio(s)	Customer view own portfolio(s)	8
C.7.2	Terminate portfolio	Customer can terminate own portfolio(s) and accept penalty.	
C.7.3	View monthly portfolio performance report	Customer can view monthly portfolio performance report on Merlion Internet Banking website.	
C.7.4	Review portfolio performance	Customers reviews portfolio performance every half year with relationship manager.	
D.7 Portfolio Management Module			
D.7.1	View Portfolio(s)	Customer view own portfolio(s)	8
D.7.2	Terminate portfolio	Customer can terminate own portfolio(s) and accept penalty.	

D.7.3	View monthly portfolio performance report	Customer can view monthly portfolio performance report on Merlion Internet Banking website.	
D.7.4	Review portfolio performance	Customers reviews portfolio performance every half year with relationship manager.	

3.9 Customer Analytics & Business Intelligence System (AAU ID: 09)

3.9.1 Business Analysis

The Customer Analytics & Business Intelligence System is (CABIS) to help high-level management of Merlion Bank with decision-making, cutting cost, and identifying business opportunities. For high-level management who make strategic business decisions including placing priorities, setting goals and directions of Merlion Bank, CABIS system provides business insights based on data analysis results to facilitate management to make more informed decisions.

CABIS system makes use of various analytics tools, techniques, and metrics to enable CEO and department managers to have an overview of the performance of Merlion Bank. For instance, It identifies and differentiates customers to apply customized marketing strategy to different customer segments. It also evaluates Merlion Bank's performance based on customer acquisition and attrition rate over a certain period. Besides, CABIS system calculates the estimated cost of retaining customers from different segments, and therefore helps high-level management of Merlion Bank to apply the insights gained to make business strategies for retaining existing customers.

CABIS system is also in charge of supporting business activities in other systems using data analysis and algorithms. It analyzes financial goals and risk profile of the customer and return the analysis results to Wealth Management System to facilitate Relationship Managers to make

decision on choosing wealth management proposals and plans for his customer. CABIS system also provides support for loan managers during the decision making process to approve a loan application through analyzing customer's credit score, credit history, debt and income, as well as collaterals.

Business Objectives

- Help in segmentation of customers through Customer Lifetime Value(CLV) or Recency, Frequency, and Monetary(RFM) analysis to better target different customer segments with different marketing strategies
- Provide business intelligence dashboard for management to gain insights from product sales performance, customer attrition rate, and customer acquisition rate
- Generate opportunity list of potential customers for wealth management services based on the analysis of customer cashflow statement and net worth statement
- Calculate estimated customer retention cost for different customer segments and help management make decision on retaining customers
- Analyze financial goals, risk profile, and other financial information of customer, and recommend wealth management plans and proposals to help relationship manager in decision making process
- Help loan managers during decision making process to approve a loan application

3.9.2 Business Processes

A) View Opportunity List

Sales department manager can log in to Merlion Bank Internal System to view a list of potential customers for wealth management services. Manager can filter the opportunity list by only viewing potential customers whose net worth is within certain range.

Scenario: View opportunity list

1. Sales Department manager Jeff logs in to Merlion Bank Internal System
2. Jeff clicks "Business Intelligence" tab

3. System displays customer analytics and business intelligence section with BI dashboard shown as the first page
4. Jeff clicks “Opportunity List” tab
5. System displays a list of customers who may be target customers of sales department
6. Jeff selects the “net worth: >\$1,000,000” checkbox from system filter
7. The opportunity list will be filtered according to net worth of customer, and system will only display customers whose net worth is more \$1,000,000
8. Jeff selects customer “John” from opportunity list
9. System will display detailed information about John which includes:
 - Net worth range
 - Contact number
 - Recommended financial instruments

B) View Product Sales Performance

Sales department manager can view product sales performance report to review the overall performance of different products over a certain period. For instance, system can show the top 10 product by sales with their respective revenue shown in a bar chart. Besides, the percentage of various products sold will also be displayed in a pie chart to reflect the product sales performance. In order to view the overall tendency of wealth management products sales of Merlion Bank, sales department manager can choose either weekly view or monthly view of the total revenue gained from product sales.

C) View Customer Acquisition & Attrition Rate

In order to have a sense of Merlion Bank’s overall performance, CEO can make use of BI dashboard to view the weekly or monthly customer acquisition rate and customer attrition rate through intuitive line chart. Additionally, when customer decides to terminate relationship with Merlion, a questionnaire will pop up to ask customer about the reason. While viewing customer attrition rate in BI dashboard, CEO can also get to know the main reasons why customers terminate relationship with Merlion Bank through a pie chart showing the percentage of different reasons.

D) View Estimated Customer Retention Cost

While deciding on business strategies about retaining customers of Merlion Bank, CEO can make use of BI dashboard to view estimated customer retention cost. It facilitates the decision making process of CEO by specifying customer retention cost for various customer segments. After executing the business strategies, CEO can examine the effectiveness of the strategy to retain customers by looking at the customer attrition rate which is also shown in BI dashboard.

E) View Customer Segments

CEO of Merlion Bank can view percentage of different customer segments, which are categorized based on analysis of customer's net worth statement, cashflow statement and customer lifetime value. System displays percentage of different customer segments (high-value customer, medium-value customer, and low-value customer) with pie chart.

We have adopted the 80/20 principle, which states that the top 20% of customers will bring in 80% of the revenue of the company. The principle is illustrated by the following Pyramid model:

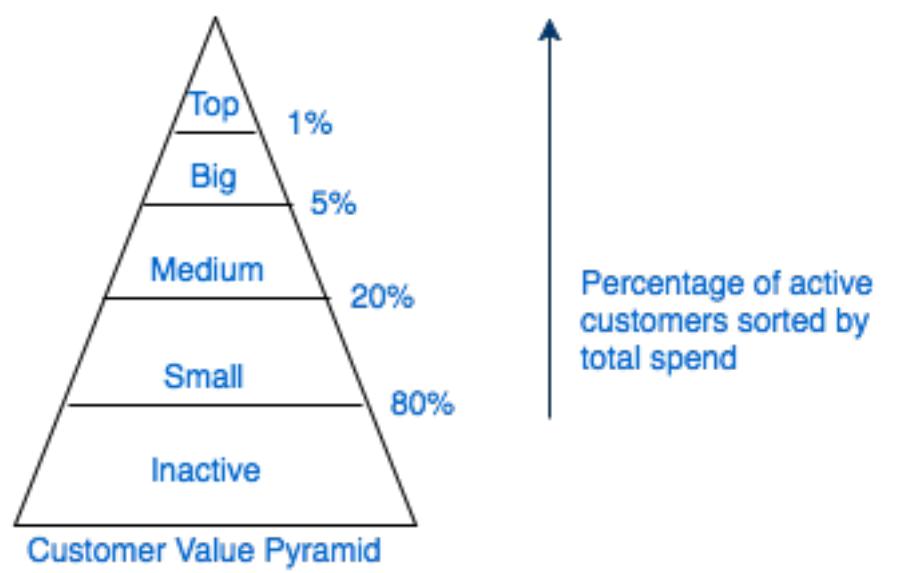


Figure 16: Customer Value Pyramid

Based on the principle, we decide to put strong emphasis on segmenting and targeting those highest valued customers. The segmentation of customers is based on RFM scoring methods.

R stands for Recency (R), which means the number of days between the first date concerned (in this case we will take the first day of a year) and the date of the last active user's transaction. For example, user A who has performed his last transaction on 1st May, user A will have an R-value of 120 (4 months).

F stands for Frequency (F), which is the number of transactions the user has performed within the period concerned (from 1 Jan to 31st December or otherwise specified).

M stands for Monetary (M), which is the total value of transactions the user has made within the above-mentioned period.

For each of the factor, a numeric level scale from 1 to 5 is used to measure the value of the customer. The detailed assignment of value is as follow:

Factor \ Level	1	2	3	4	5
Recency (R)	0-5	6-10	11-15	16-25	25-31
Frequency (F)	0-15	16-40	41-80	81-150	41 and more
Monetary (M)	\$0-\$500	\$501-\$1500	\$1501-\$5000	\$5001-\$10,000	\$10,000 and more

In addition to RFM analysis, Merlion Bank also adopts the Customer Lifetime Value (CLV) method to sieve out the most valuable customers. In CLV uses simple subtraction method, to calculate the profit of Merlion Bank makes on each customer. While deposit interest rewards are the main outlay stream, loan interest is the main profit source of Merlion Bank. CLV takes each customer's total estimated interest based on tenure established, and minus each customer's total interest rewards based on the average customer lifetime. By calculating using big data of customers' information, we are able to generate an average customer lifetime, and using the average lifetime to multiply by annual interest reward, we will be able to estimate the average outlay. The result of profit subtracting outlay will be the CLV value of one customer. To calculate each customer's CLV value, BI system will repeat the mentioned steps for each customer.

By combining the mentioned two analyses, the BI system will be able to screen out the overlapped most valuable, and to reach a more accurate estimation of customer value.

3.9.3 System Requirements Analysis

Business Assumptions

- Only CEO and department managers of Merlion Bank can view business intelligence dashboard
- Department managers can only view information that is related to their respective departments
- Customers are segmented based on Customer Lifetime Value(CLV) and Recency, Frequency, and Monetary(RFM) analysis

To address the business requirements of Customer Analytics & Business Intelligence System in the preliminary requirements specifications, a Customer Segment Analysis Module, a Dashboard Module, and a Customer Insights Module will be constructed. These three modules are described as follows:

a) Customer Segment Analysis Module

This module will be used by CEO of Merlion Bank. It enables CEO to have an overview of Merlion Bank's customer with intuitive visual presentation of different customer segments.

b) Dashboard Module

This module will be used by CEO and department managers of Merlion Bank. It facilitates CEO in making decisions about business strategies by monitoring the overall performance of Merlion Bank from various aspects such as wealth management product sales performance, customer acquisition rate, as well as customer attrition rate. Sales department manager can also make use of this module to gain insights about potential customers for wealth management services.

c) Customer Insights Module

This module will be used by CEO of Merlion Bank. CEO can view estimated retention cost and customer lifetime value for different customer segments, and also support the decision-making process for loan management department and card management department. Therefore it facilitates obtain insights about how to retain customers of Merlion Bank in a more cost-effective way.

System Functionalities

Functionality Code	Name	Remark	AAU ID
A.9 Customer Analytics and Business Intelligence System			
A.9.1 Customer Segment Analysis Module			
A.9.1.1	View customer segment	CEO can view customers from different segments such as high-value customers, medium-value customers, and low-value customers	9
A.9.2 Dashboard Module			
A.9.2.1	View opportunity list	Sales department managers can view opportunity list of potential customers for wealth management	9
A.9.2.2	View product sales performance	CEO and sales department managers can view performance of different product sales	
A.9.2.3	View customer attrition rate	CEO can view customer attrition rate	
A.9.2.4	View customer acquisition rate	CEO can view customer acquisition rate	
A.9.3 Customer Insights Module			
A.9.3.1	View estimated customer retention cost	CEO can view estimated customer retention cost for different customer	9

	for different customer segments	segments(high-value, medium value, low-value)	
A.9.3.2	View customer lifetime value of customers from different segments	CEO can view customer lifetime value of customers from different segments(high-value, medium value, low-value)	
A.9.3.3	View decision support result	Card manager and underwriter can view decision support result	

4. High-level System Architecture

4.1 List of System, Sub-system & Application

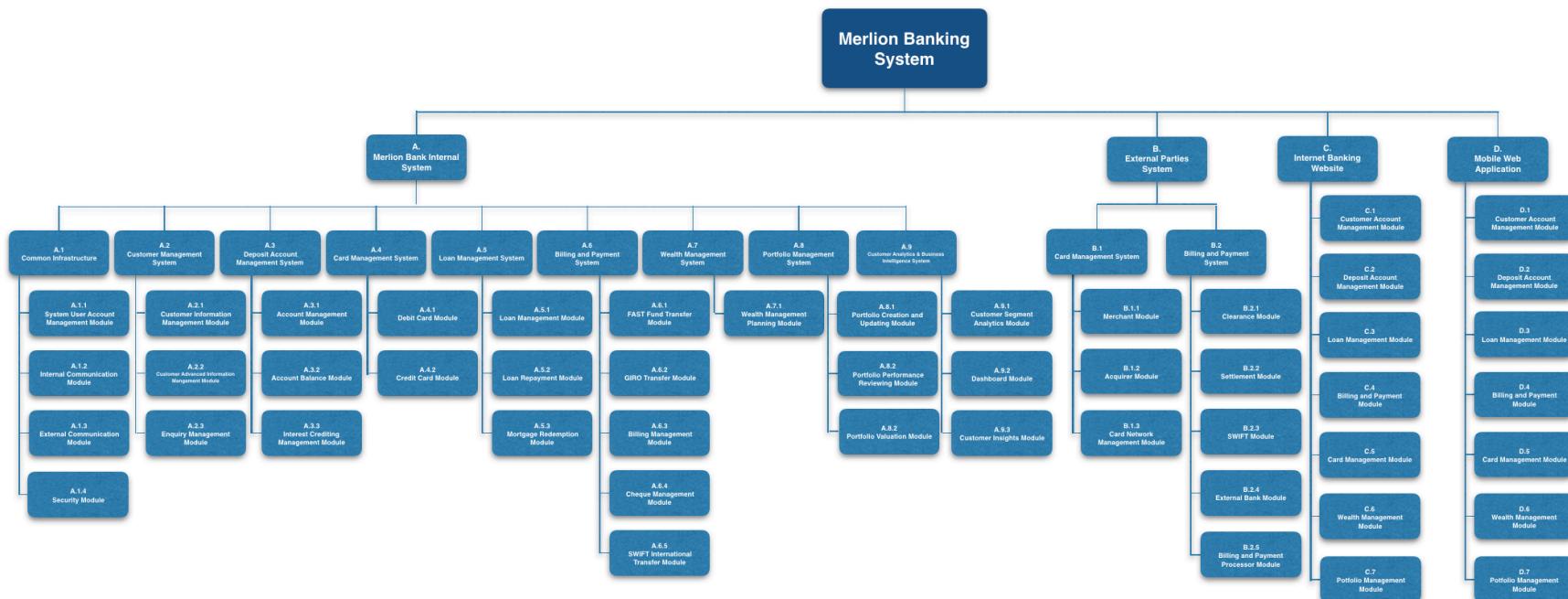
ID	Name	AAU ID
A.	Merlion Bank Internal System	
A.1	Common Infrastructure	1
A.1.1	System User Account Management Module	1
A.1.2	Internal Communication Module	1
A.1.3	External Communication Module	1
A.1.4	Security Module	1
A.2	Customer Management System	2
A.2.1	Customer Information Management Module	2
A.2.2	Customer Advanced Information Management Module	2
A.2.3	Enquiry Management Module	2
A.3	Deposit Account Management System	3
A.3.1	Account Management Module	3
A.3.2	Account Balance Management Module	3
A.3.3	Interest Crediting Management Module	3
A.4	Card Management System	4
A.4.1	Debit Card Module	4
A.4.2	Credit Card Module	4
A.5	Loan Management System	5

A.5.1	Loan Management Module	5
A.5.2	Loan Repayment Module	5
A.5.3	Mortgage Redemption Module	5
A.6	Billing and Payment System	6
A.6.1	FAST Fund Transfer Module	6
A.6.2	GIRO Transfer Module	6
A.6.3	Billing Management Module	6
A.6.4	Cheque Management Module	6
A.6.5	SWIFT International Transfer Module	6
A.7	Wealth Management System	7
A.7.1	Wealth Management Planning Module	7
A.8	Portfolio Management System	8
A.8.1	Portfolio Creation and Updating Module	8
A.8.2	Portfolio Performance Reviewing Module	8
A.8.3	Portfolio Valuation Module	8
A.9	Customer Analytics and Business Intelligence System	9
A.9.1	Customer Segment Analytics Module	9
A.9.2	Dashboard Module	9
A.9.3	Customer Insights Module	9
B	External Parties System	
B.1	Card Management System	4

B.1.1	Merchant Management Module	4
B.1.2	Acquirer Management Module	4
B.1.3	Card Network Management Module	4
B.2	Billing and Payment System	6
B.2.1	Clearance Module	6
B.2.2	Settlement Module	6
B.2.3	SWIFT Module	6
B.2.4	External Bank Module	6
B.2.5	Billing and Payment Processor Module	6
C	Internet Banking Website(for customers)	
C.1	Customer Account Management Module	1, 2
C.2	Deposit Account Management Module	3
C.3	Loan Management Module	5
C.4	Billing and Payment Module	6
C.5	Card Management Module	4
C.6	Wealth Management Module	7
D	Mobile Web Application(for customers)	
D.1	Customer Account Management Module	1, 2
D.2	Deposit Account Management Module	3
D.3	Loan Management Module	5
D.4	Billing and Payment Module	6

D.5	Card Management Module	4
D.6	Wealth Management Module	7

4.2 Visual Table of Contents



4.3 Overall Entity Class Diagram

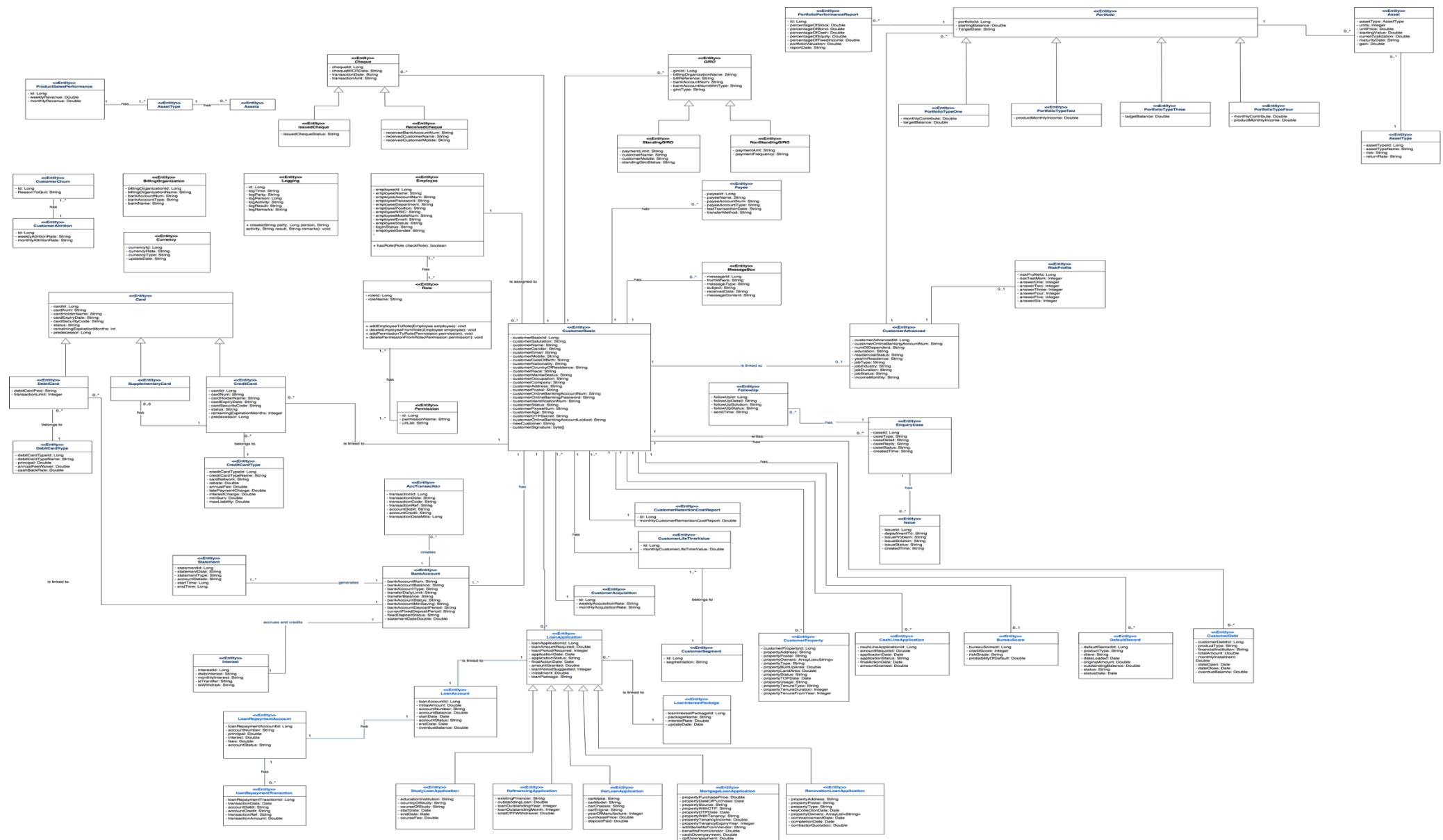


Figure 17: Entity Diagram for Merlion Banking System

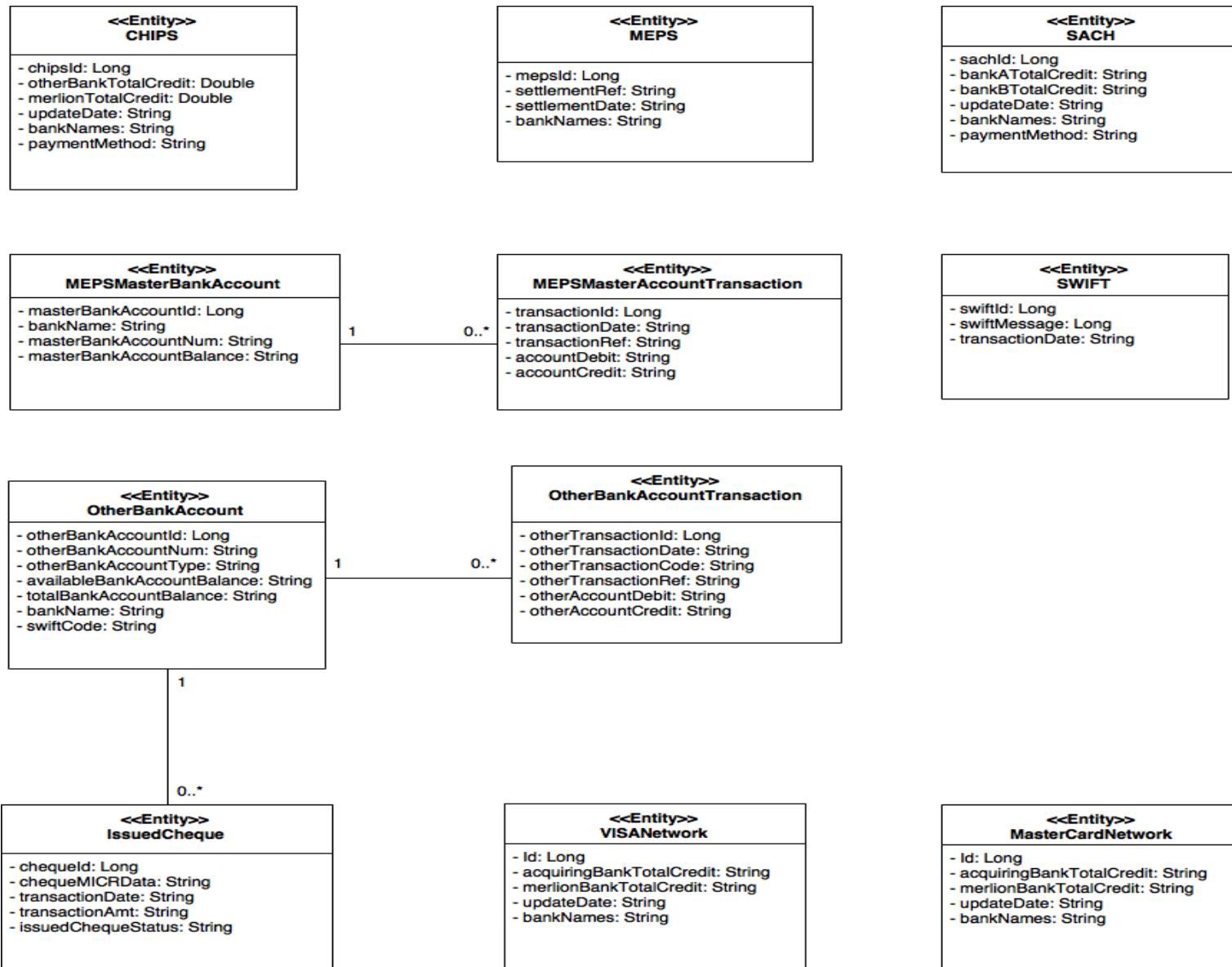


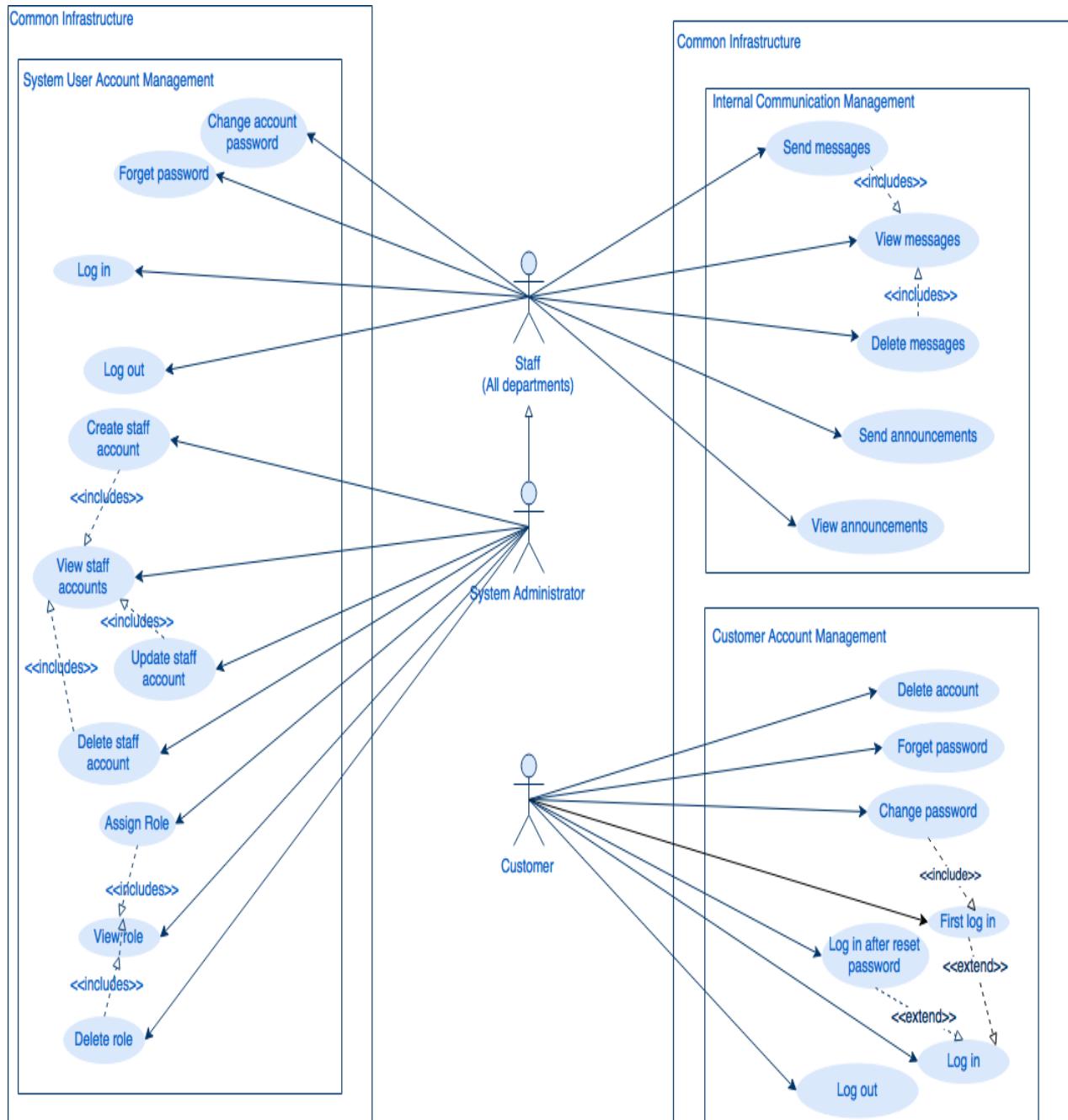
Figure 18: Entity Diagram of External Simulation System

5. Functional Modules Design

In this section, we will demonstrate the 9 respective subsystems that have previously been marked out in our Merlion Bank System.

5.1 Common Infrastructure

5.1.1 UML Use Case Diagram



5.1.2 UML Use Case Description

5.1.2.1 Staff Reset Account Password

Use Case Name	Reset Account Password
Description	Staff wishes to reset his/her password for staff account
Actors	Staff
Triggers	Staff forgets password and wishes to reset his/her password to login
Goals	An initial password and a link will be sent to staff email address to guide him/her to reset account password
Preconditions	<ul style="list-style-type: none"> 1. Staff already has an existing account 2. Staff has access to the email address provided in his/her profile
Postconditions	Staff will reset his/her password for account
Extension Points	None
Basic Course	<ul style="list-style-type: none"> 1. Staff selects “Employee Login” at homepage 2. Staff clicks “Forget Password” button 3. Staff provide identification number and registered email 4. System search for a staff with the exact identification number 5. System generates a random password, which will be sent to the registered email 6. Staff receives email and logs in with the initial password 7. System prompts staff to change password 8. Staff enters initial password, then enters new password twice, and clicks “Change my password” 9. System validates the entered password, hashes the new password and updates the staff’s password in database. The password is changed successfully
Alternative Courses	<p>9a. Entered new passwords are shorter than minimum length of 8</p> <ul style="list-style-type: none"> 1. System prompts staff to re-enter a longer password 2. Continue at Step 8
Exception Courses	<p>3a. Staff forgets registered email</p> <ul style="list-style-type: none"> 1. Staff cancel reset password request 2. Use case terminates

5.1.2.2 Log In

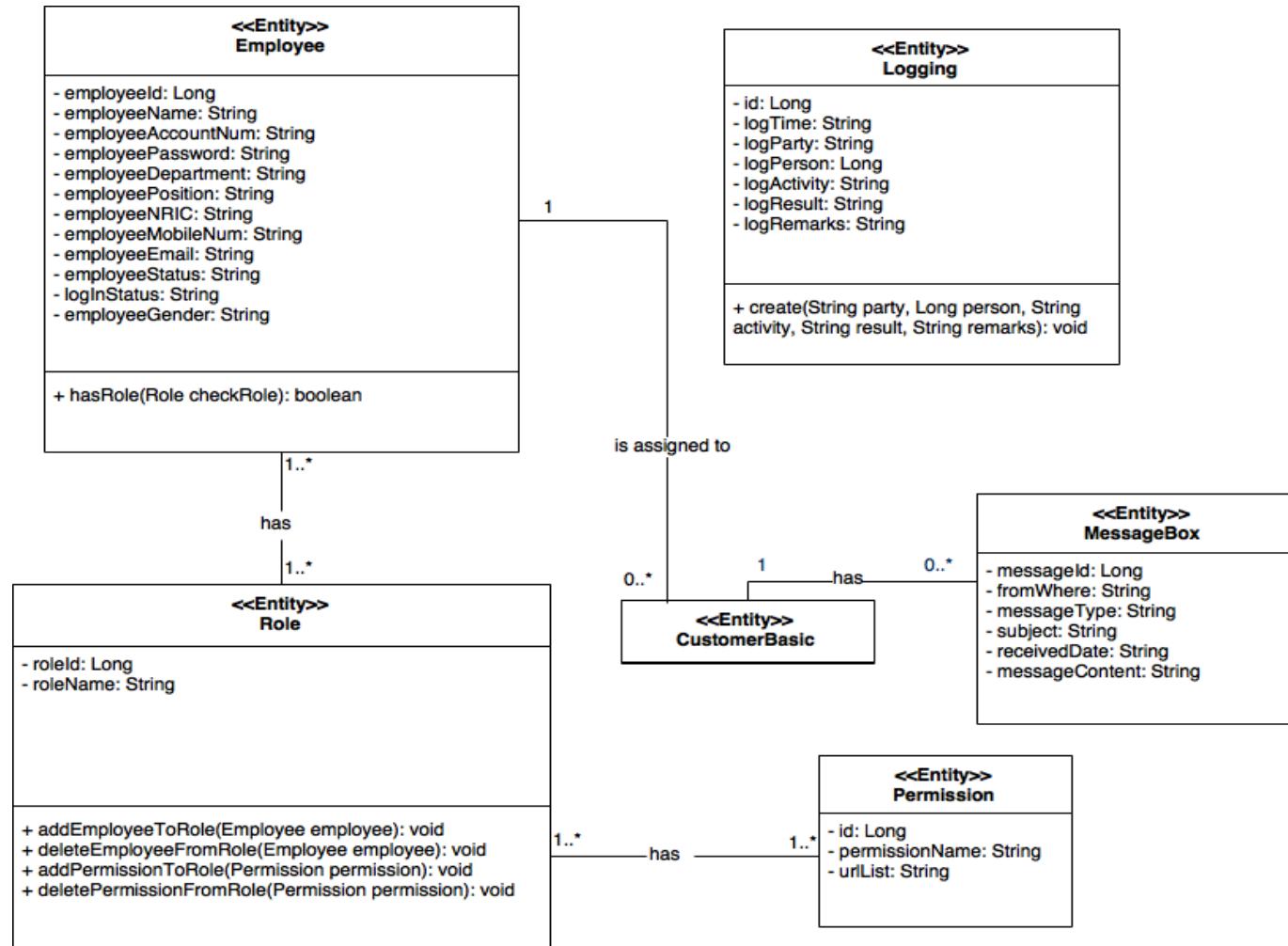
Use Case Name	Log In
Description	Customer logs into Merlion iBanking System
Actors	Customer
Triggers	Customer wishes to log into Merlion iBanking System using User ID and PIN
Goals	Customer successfully logs in
Preconditions	<ul style="list-style-type: none"> 1. Customer has an existing account 2. Customer enters User ID and PIN correctly
Postconditions	Customer logs in and is directed to internet banking home page
Extension Points	None
Basic Course	<ul style="list-style-type: none"> 1. Customer opens log in page 2. Customer enters User ID 3. Customer enters PIN 4. Customer clicks “Log In” button 5. System sends OTP to registered mobile number 6. Customer receives OTP and enters OTP 7. Customer clicks “Submit” 8. Customer successfully logs into Internet Banking home page
Alternative Courses	<ul style="list-style-type: none"> 2a. Customer forgets User ID <ul style="list-style-type: none"> 1. Customer clicks “Forgot User ID” 2. Customer enters identification number 3. Customer clicks Request OTP, receives and enters OTP 4. System display customer’s User ID 5. Customer logs in with retrieved User ID 6. Continue at Step 2 3a. Customer forgets PIN <ul style="list-style-type: none"> 1. Customer clicks “Forgot PIN” 2. Customer enters identification number 3. Customer clicks Request OTP, receives and enters OTP 4. System sends reset password to customer’s registered email 5. Customer receive system generated initial password 6. Customer logs in with initial password 7. System prompts customer to change password 8. Customer successfully changes password 9. Customer logs in 10. Continue at Step 3 3b. Customer enters incorrect PIN for 3 times <ul style="list-style-type: none"> 1. Captcha activated and prompts customer to complete simple test

	<p>2. Customer complete captcha test Continue at Step 3</p>
Exceptional Courses	<p>3c. Customer enters incorrect PIN for 5 times</p> <ol style="list-style-type: none"> 1. Account is locked out 2. Use case terminates <p>5a. Customer does not have access to registered mobile number</p> <ol style="list-style-type: none"> 1. Customer cancel login request <p>Use case terminates</p>

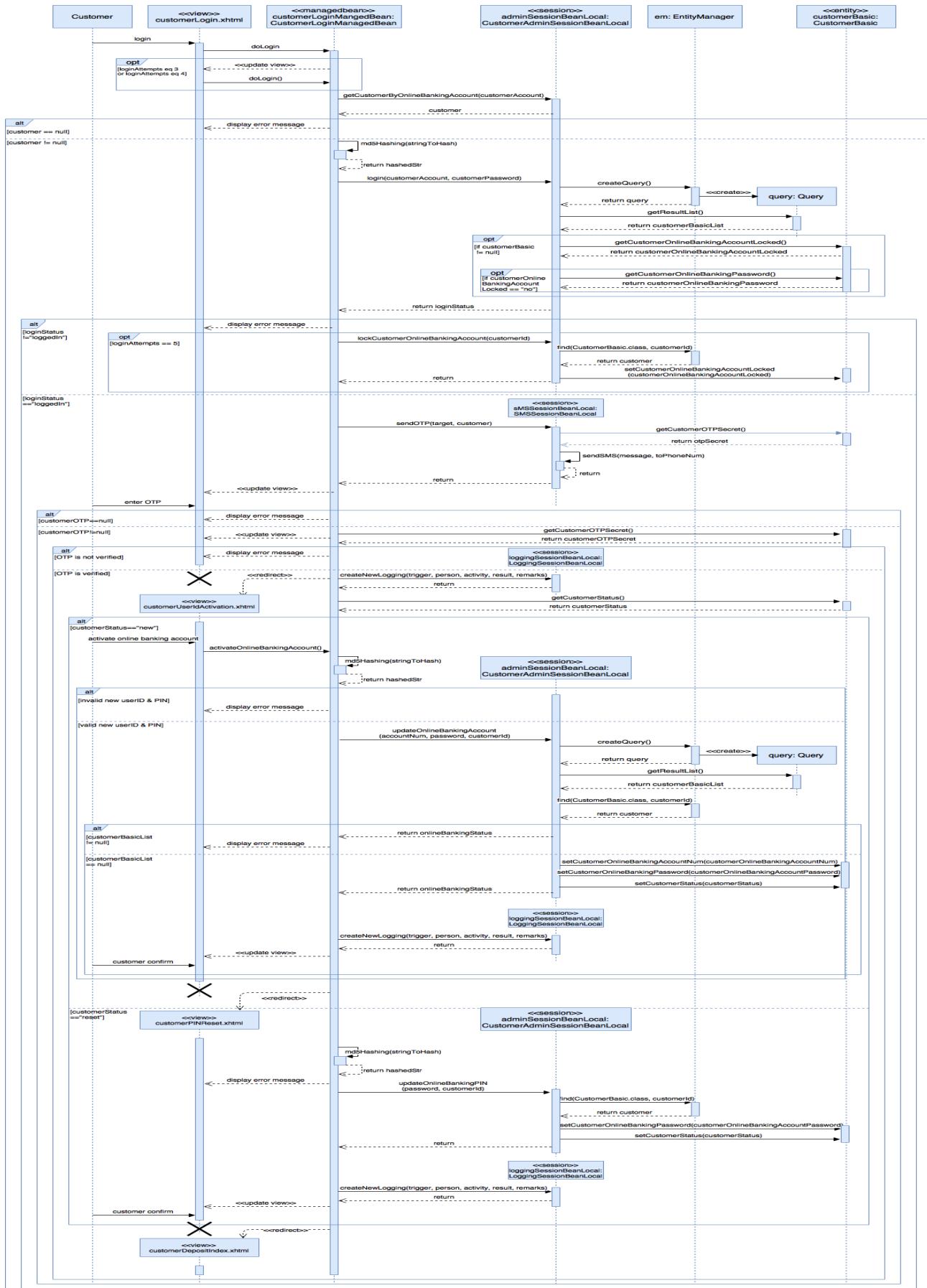
5.1.2.3 System Administrator Add Employee

Use Case Name	Add Employee
Description	System Administrator wishes to add a new employee
Actors	System Administrator
Triggers	<ol style="list-style-type: none"> 1. Hiring a new employee 2. Re-adding a deleted employee
Goals	To create a new employee account with assigned role in the system
Preconditions	<ol style="list-style-type: none"> 1. System Administrator has an account with the access right to edit employees' roles 2. System Administrator has logged in
Postconditions	<ol style="list-style-type: none"> 1. New employee is added to the system
Extension Points	None
Basic Course	<ol style="list-style-type: none"> 1. System Administrator selects “Employee Account Management” 2. System Administrator selects “Add” at the bottom of the list of current employees 3. System Administrator enters detailed information of new employee <ol style="list-style-type: none"> a) Name b) Gender c) Mobile No. d) Email 4. System Administrator chooses position details of employee. <ol style="list-style-type: none"> a) Department b) Position c) Role 5. System Administrator clicks “Confirm” and then “Submit” 6. New employee is successfully added to current employee list
Alternative Courses	None
Exceptional Courses	<p>6a. System Administrator enters employee that already exists</p> <ol style="list-style-type: none"> 1. System displays error message 2. Use case terminates

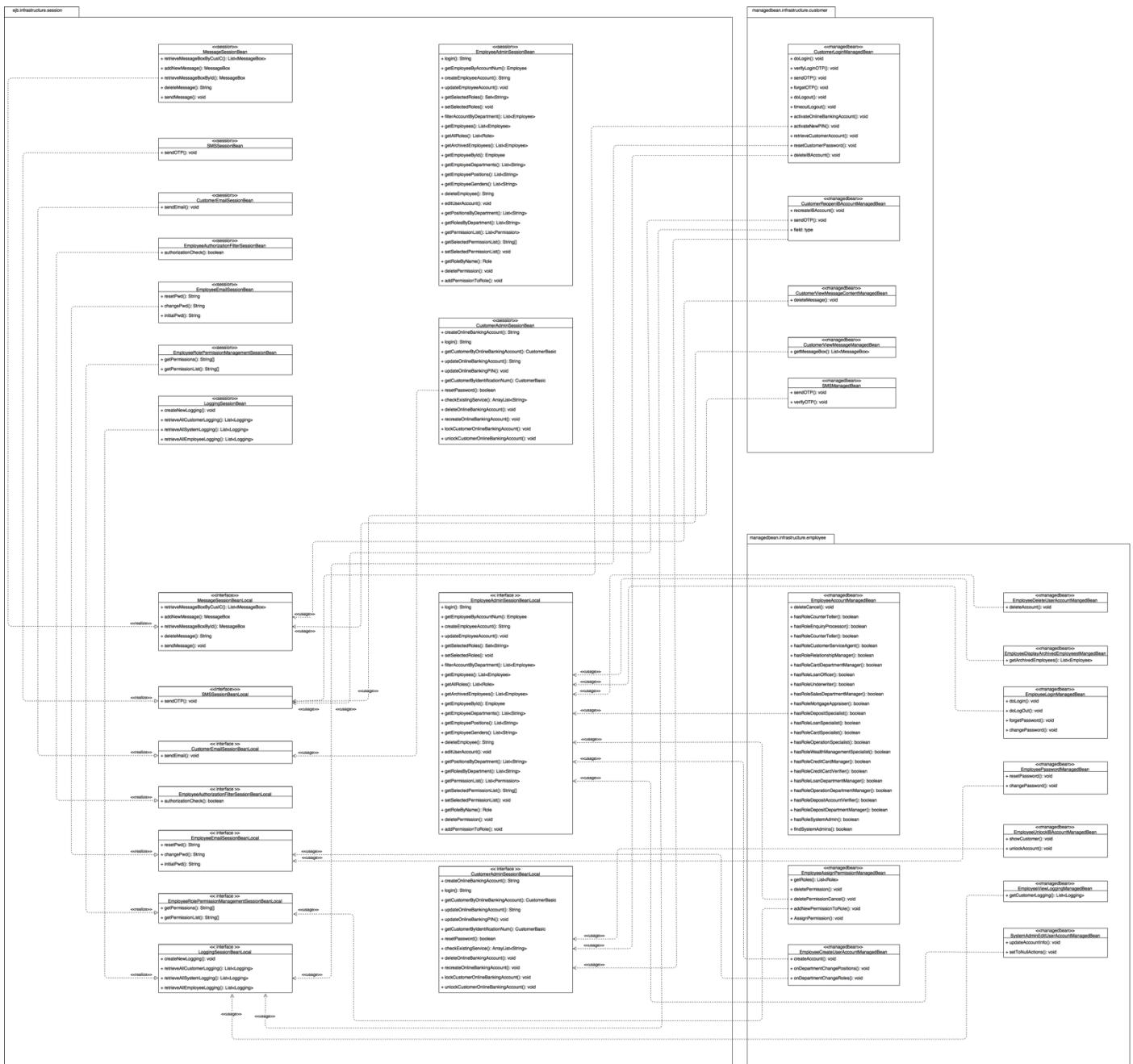
5.1.3 UML Entity Class Diagram



5.1.4 UML Sequence Diagram – Customer Log In

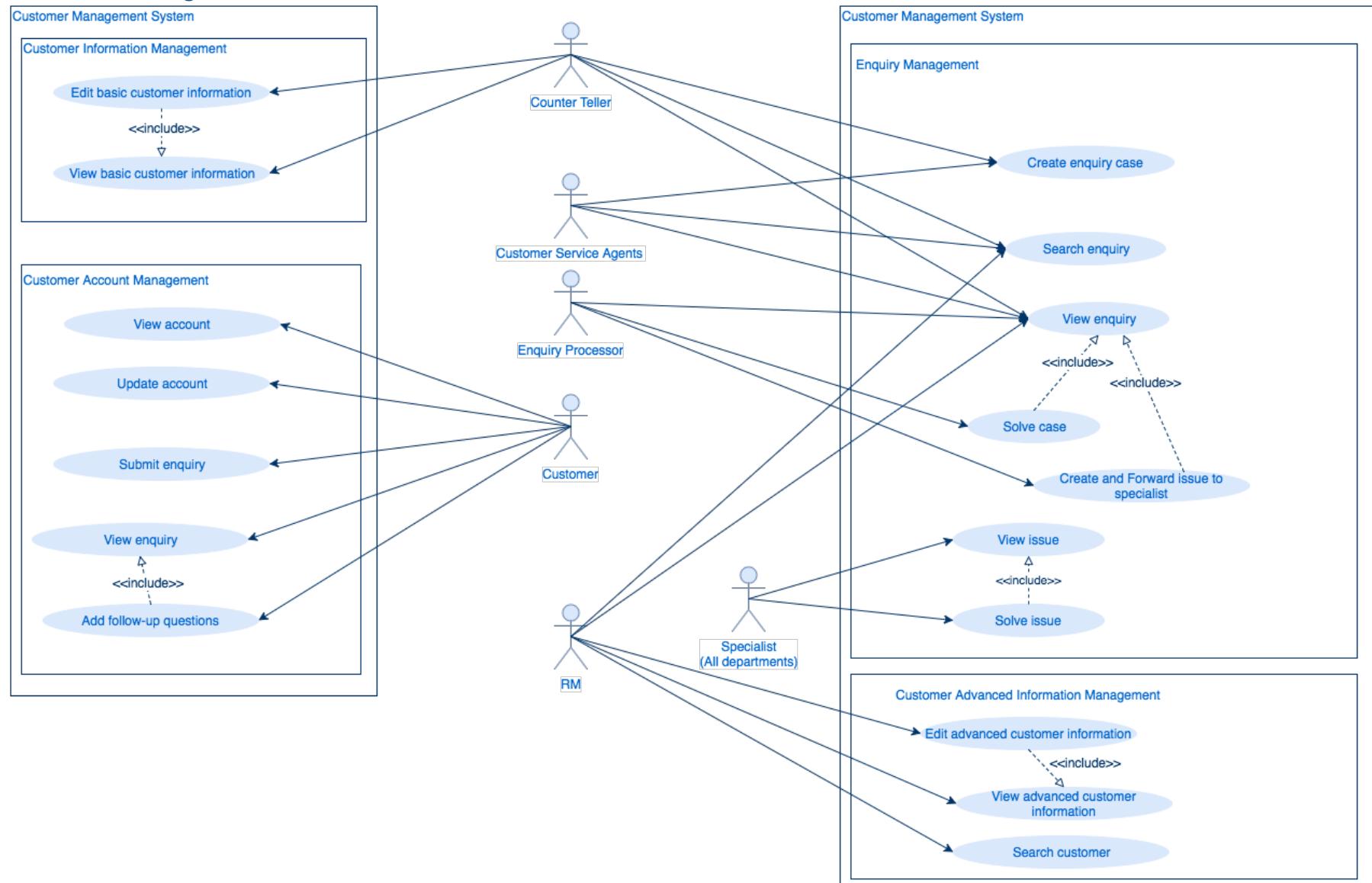


5.1.5 UML Non-Entity Diagram



5.2 Customer Management System

5.2.1 UML Use Case Diagram



5.2.2 UML Use Case Description

5.2.2.1 Update Account

Use Case Name	Update Account
Description	Customer changes his/her basic profile information
Actors	Customer
Triggers	Customer wishes to update his/her basic profile information
Goals	Customer successfully changes his/her basic profile information
Proconditions	<ol style="list-style-type: none"> 1. Customer has an existing account and its corresponding password 2. Customer is logged into the Internet Banking system 3. List of basic profile information is stored in the system 4. Customer has access to updated mobile phone number if he/she wishes to update mobile number
Postconditions	Customer's basic profile information is successfully updated
Extension Points	None
Basic Course	<ol style="list-style-type: none"> 1. Customer selects "Update Profile" 2. Customer modifies fields that need to be updated 3. Customer clicks "Update" 4. System prompts "Update Successful" 5. Customer successfully updates the profile information
Alternative Courses	<ol style="list-style-type: none"> 2a. Customer need to reset to previous information in the field <ol style="list-style-type: none"> 1. Customer clicks "Reset" 2. All fields are reset to the information before 3. Continue at Step 2 3a. Fields edited includes mobile number <ol style="list-style-type: none"> 1. System pop up reminder that an OTP will be sent to the updated mobile number for validation 2. Customer selects "Update" 3. Fields except for the mobile number are successfully updated 4. System sends OTP to updated mobile number 5. Customer enters the received OTP 6. System prompts OTP is correct 7. Continue at Step 5
Exceptional Courses	None

5.2.2.2 Enquiry Processor Solve Enquiry Case

Use Case Name	Solve case
Description	Enquiry Processor solves the pending enquiry cases
Actors	Enquiry Processor
Triggers	Enquiry Processor wishes to solve an unsolved enquiry case
Goals	To solve the pending enquiry case and send reply to customer
Preconditions	<ul style="list-style-type: none"> 1. There are pending enquiries sent by customers 2. Enquiry Processor has an account with the role “Enquiry Processor” and its permission 3. Enquiry Processor has logged into Merlion Bank internal system
Postconditions	Enquiry Processor solves enquiry cases
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 4. Enquiry Processor selects “View Pending Enquiries” 5. System displays list of pending enquiries and details: <ul style="list-style-type: none"> i. Case ID ii. Created Time iii. Detail iv. Status v. Issue Created vi. All Issues Replied 1. Enquiry Processor chooses one pending enquiry from the enquiry cases list and clicks “Reply” 2. System displays enquiry details and a list of follow-up(s) to this enquiry case 3. Enquiry Processor clicks “Yes” under “Are you able to answer this enquiry?” 4. Enquiry Processor checks all boxes in front of the follow-ups 5. Enquiry Processor inputs answer to the follow-up questions 6. Enquiry Processor clicks “Send” 7. Enquiry status changes to “Solved”
Alternative Courses	None
Exceptional Courses	<p>5a. Enquiry Processor is able to answer some of the follow-ups but not all</p> <ul style="list-style-type: none"> 1. Enquiry Processor clicks “No” under “Are you able to answer this enquiry?” 2. Enquiry Processor input his/her doubting issue(s) about the enquiry case related to different department <ul style="list-style-type: none"> i. Enquiry Processor clicks “Send Issue and Record Another” if there is more than one issue need to be sent 3. Enquiry Processor clicks “Yes” under “Are you able to answer this enquiry?” 4. Enquiry Processor checks the boxes in front of the follow-ups he/she could answer 5. Enquiry Processor inputs reply to the follow-up questions and clicks “Send” 6. Enquiry Status becomes “In Progress” 7. Use case terminates <p>5b. Enquiry Processor is not able to answer the enquiry case</p> <ul style="list-style-type: none"> 1. Enquiry Processor clicks “No” under “Are you able to answer this enquiry?” 2. Enquiry Processor input his/her doubting issue(s) about the enquiry case based on different regarding department 3. Enquiry Processor clicks “Send Issue and Record Another” if there is more than one issue need to be sent

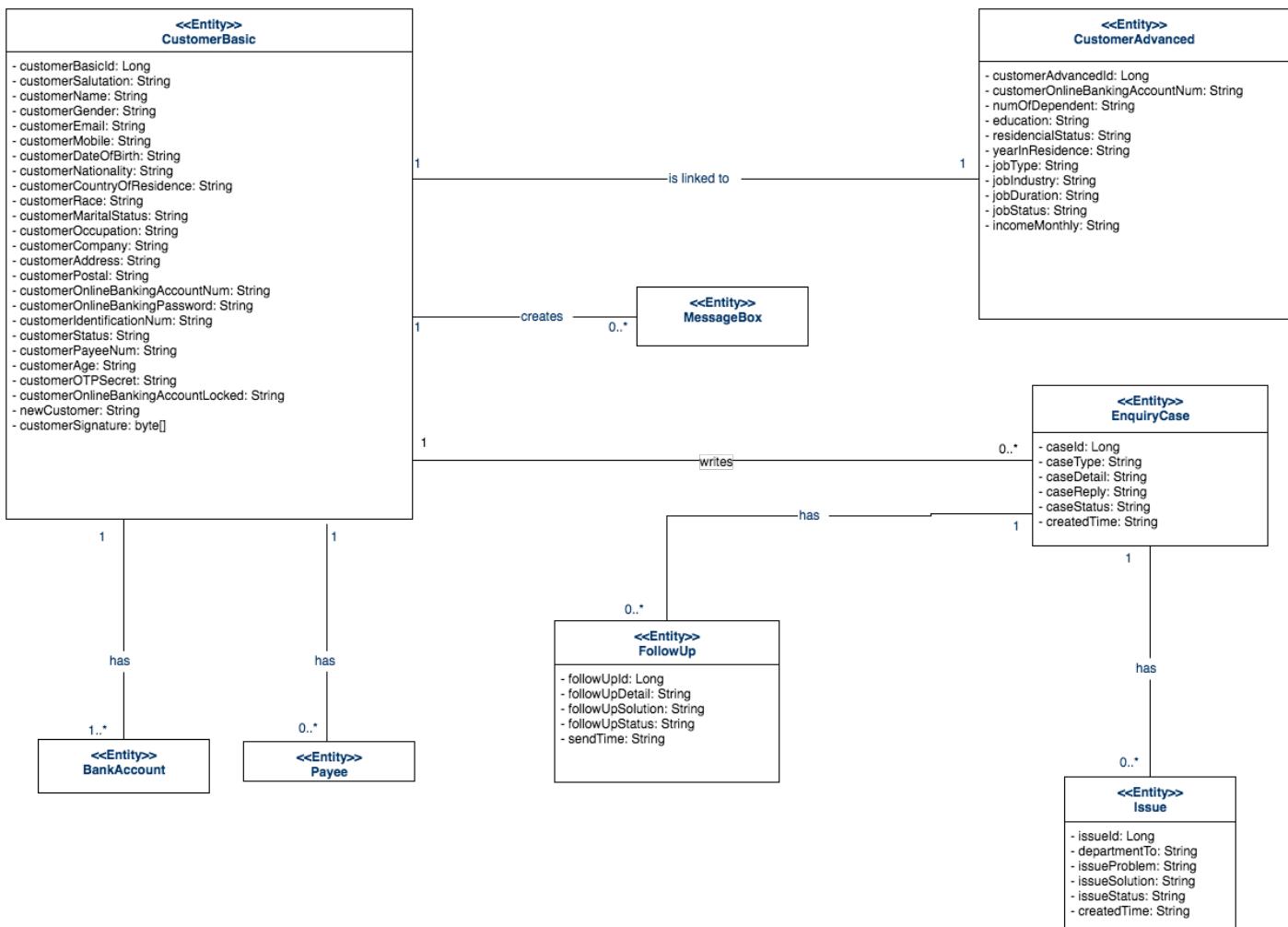
	<ol style="list-style-type: none"> 4. Enquiry Processor clicks “Send Issue and Quit” if only one issue need to be sent 5. Use case terminates
--	---

5.2.2.3 Counter Teller Creates Enquiry Case

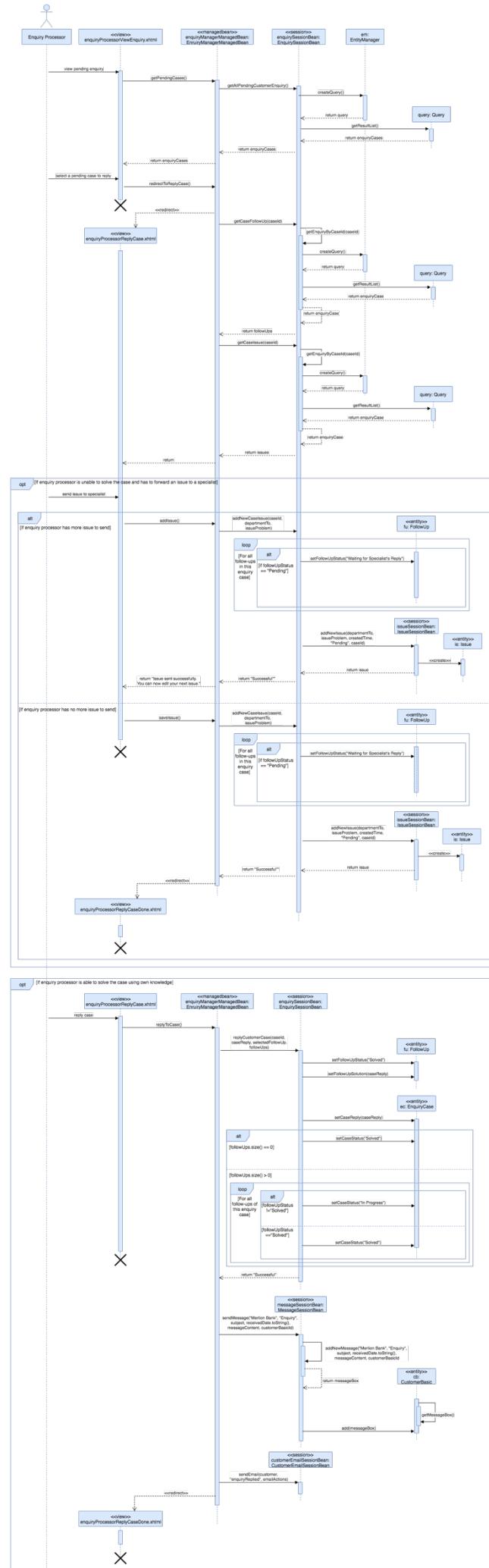
Use Case	Create enquiry case
Description	Counter Teller adds a new enquiry case into the system
Actors	Counter Teller
Triggers	Customer report an enquiry at the counter
Goals	Add a new customer enquiry into the system
Preconditions	<ol style="list-style-type: none"> 1. Enquiring customer is an existing customer of Merlion Bank 2. Enquiring customer is face to face with the counter teller at Merlion Bank home branch 3. Counter Teller is not able to answer the enquiry and need assistance from Enquiry Processors or Specialists 4. Counter Teller has an Merlion Bank internal system account with the role of “counter teller” 5. Counter Teller is logged in as Counter Teller
Postconditions	New enquiry added successfully into the system
Extension Points	None
Basic Course	<ol style="list-style-type: none"> 1. Counter Teller selects “Create Enquiry Case” 2. Counter Teller enters customer’s NRIC/Passport 3. System clicks “Show Customer” 4. System display customer’s basic information <ul style="list-style-type: none"> a) Salutation b) Name c) NRIC/Passport d) Customer Online Banking Acc. Num 5. Counter Teller verifies with customer 6. Counter Teller selects “View and Write Enquiry” 7. Counter Teller selects area of enquiry from drop down box: <ul style="list-style-type: none"> a) Credit Card b) Saving Account c) Loan d) Online Banking e) Fund Transfer f) Wealth Management g) Others 8. Counter Teller summarize customer’s enquiry in input box 9. Counter Teller selects “Send Enquiry” 10. System prompts “Customer Enquiry Has Been Recorded Successfully”
Alternative Courses	None

Exceptional Courses	<p>4b. Customer's NRIC/Passport is not found</p> <ol style="list-style-type: none"> 1. Customer is not an existing customer 2. Counter Teller cancel enquiry request 3. Use case terminates <p>5a. Information displayed does not tally with customer</p> <ol style="list-style-type: none"> 1. Counter Teller cancel enquiry request 2. Use case terminates
----------------------------	---

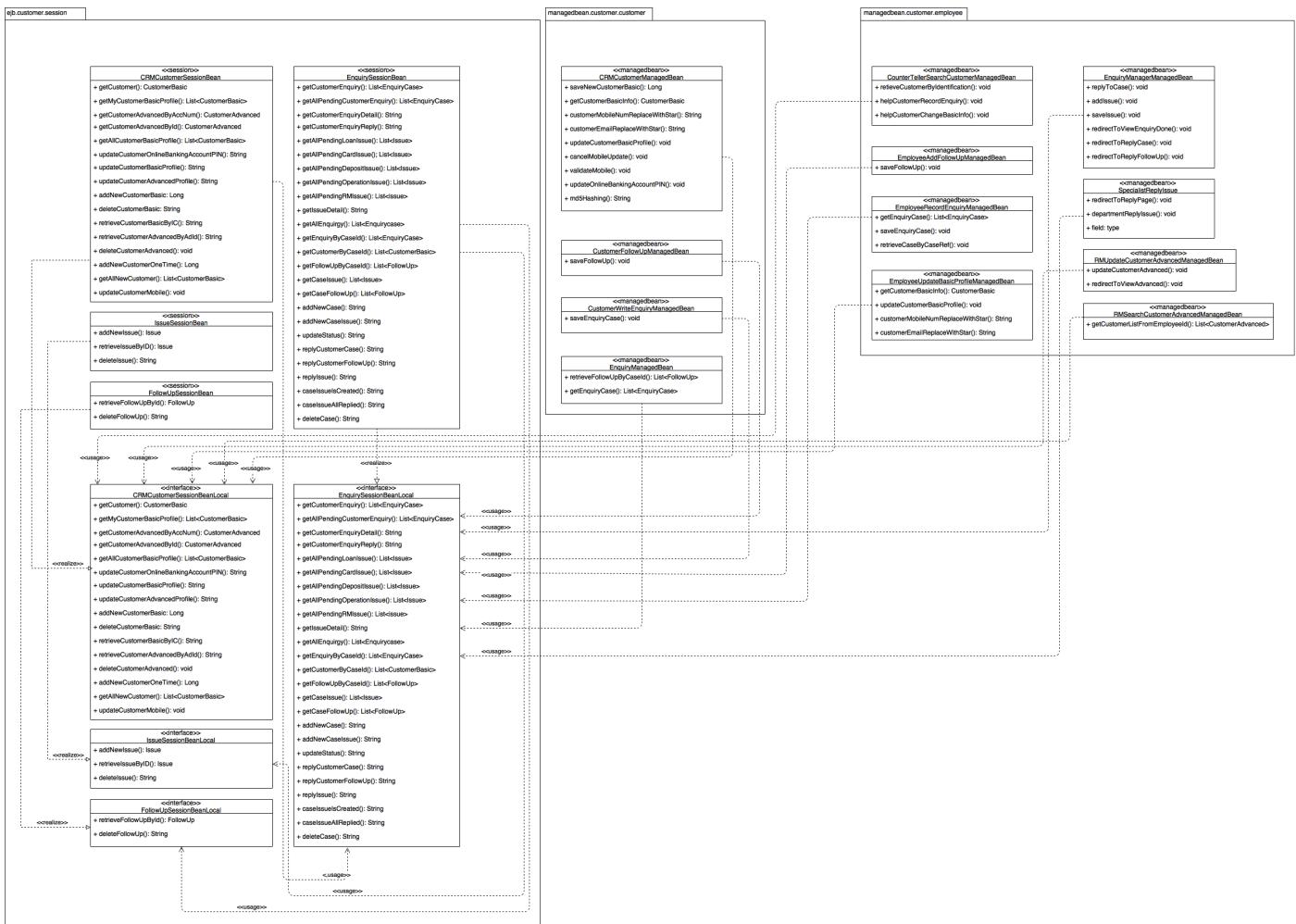
5.2.3 UML Entity Class Diagram



5.2.4 UML Sequence Diagram – Enquiry Processor Replies Case

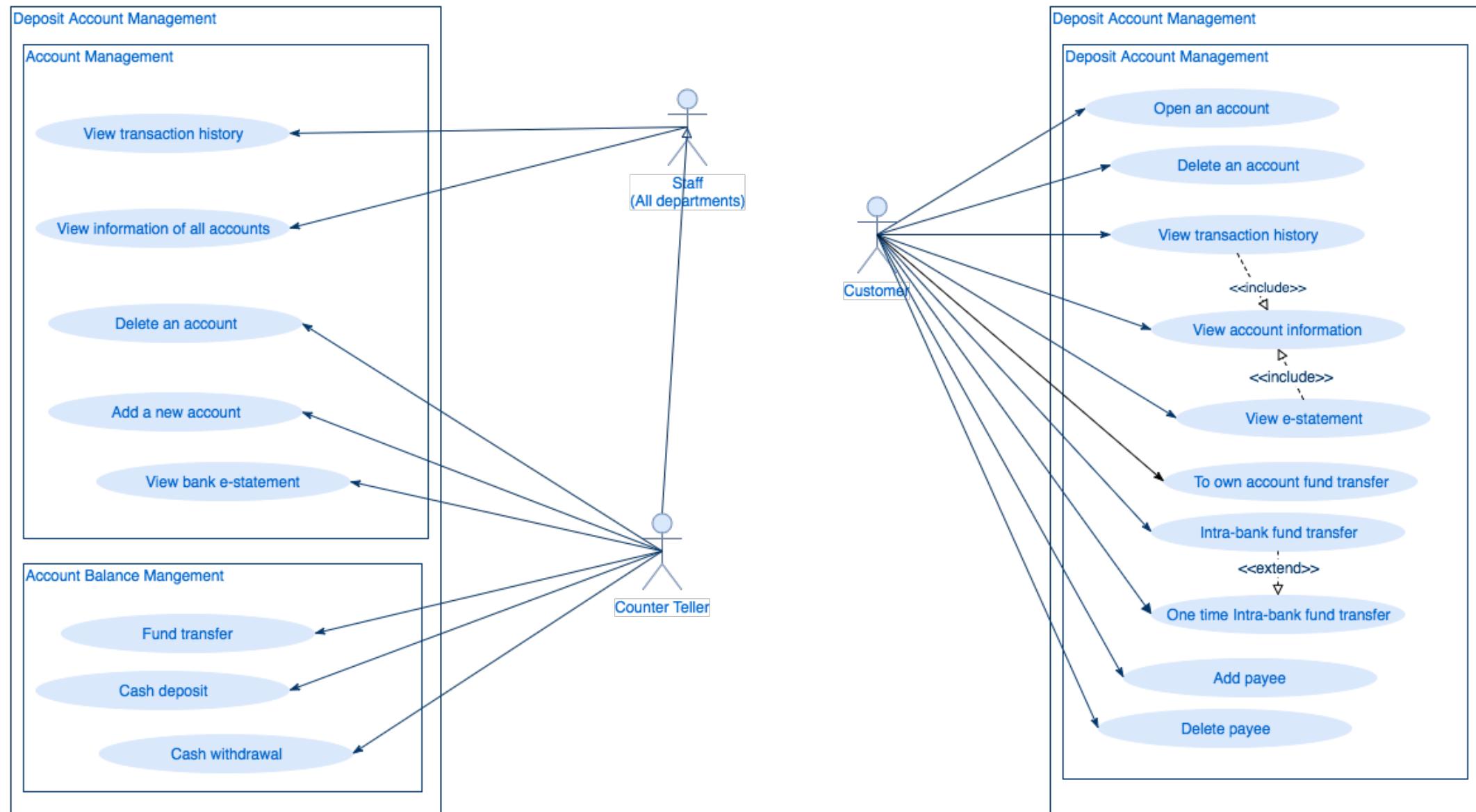


5.2.5 UML Non-Entity Diagram



5.3 Deposit Account Management System

5.3.1 UML Use Case Diagram



5.3.2 UML Use Case Description

5.3.2.1 Open an account

Use case name	Open an account
Description	Customer opens an deposit account via Merlion Bank Website
Actors	Customer
Triggers	Customer wishes to open a new deposit account online
Goals	Customer successfully opens a new deposit account and activates it
Preconditions	<ul style="list-style-type: none"> 1. Customer has valid identification, home address and other required detailed information 2. Customer has access to Merlion Bank Internet Banking portal 3. Customer has a scanned copy of relevant documents
Postconditions	Customer successfully opens and activates a new deposit account
Extension Points	None
Basic Course	<ul style="list-style-type: none"> b. Customer selects “Open Account” at home page c. Customer reads information of different account types and choose applied account type d. Customer chooses Deposit Period if chosen Fixed Deposit Account as account type e. Customer clicks “Next” f. Customer enters personal information <ul style="list-style-type: none"> a) Whether is an existing customer b) Salutation c) Name d) Date of birth e) Gender f) Mobile number g) Email 5. Customer clicks “Next” 6. Customer enters detailed information: <ul style="list-style-type: none"> a) Nationality <ul style="list-style-type: none"> i. If foreigner, whether customer is PR <ul style="list-style-type: none"> 1. If not PR, enters Passport No. 2. If PR, enters NRIC No. ii. If Singaporean, enters NRIC No. b) Country of Residence c) Race d) Marital Status e) Occupation f) Name of company 1. Residential Address 7. Customer clicks “Next” 8. Customer uploads softcopy of identification 9. Customer provides digital signature using a mouse 10. Customer clicks “Submit” 11. Customer clicks “Next” 12. System display list of all entered information

	<p>13. Customer reads and checks box to agree to the terms</p> <p>14. Customer pass Captcha test</p> <p>15. Customer clicks “Open Account”</p> <p>16. System prompts “open account application received”</p> <p>17. Customer receives confirmation email with account number and initial password after 2-5 working days</p> <p>18. Customer reimburses initial deposit within 7 days after account opened</p> <p>19. New account successfully activated</p>
Alternative Courses	<p>9a. Customer is not satisfied with the outcome of signature</p> <ol style="list-style-type: none"> 1. Customer clicks “Clear” button 2. Old signature is cleared 3. Continues at Step 9
Exceptional Courses	<p>15g. Customer is younger than 16 years old</p> <ol style="list-style-type: none"> 1. System display error message 2. Customer cancel open account request 3. Use case terminates

5.3.2.2 Cash Deposit

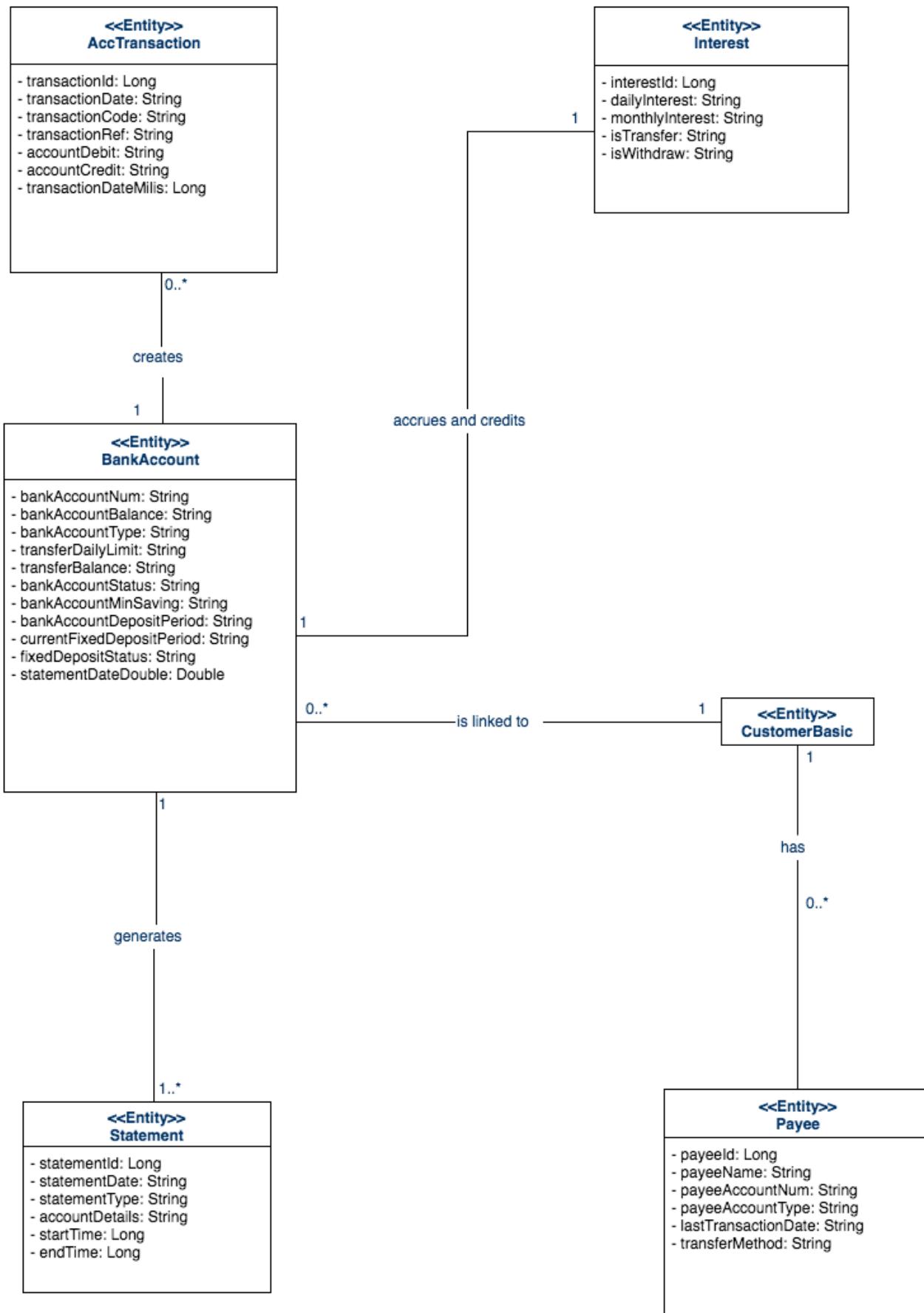
Use case name	Cash deposit
Description	Counter Teller deposit money into customer's account for customer, after receiving correct amount of cash from customer
Actors	Counter Teller
Triggers	Customer wishes to deposit money into an Merlion Bank account by handing over cash to Counter Teller
Goals	Counter Teller successfully deposit corresponding amount of money into customer's account
Preconditions	<ol style="list-style-type: none"> 1. Counter Teller has an existing account with the role Counter Teller 2. Counter Teller is logged into the Merlion Bank Internal System 3. Customer has an existing account at Merlion Bank
Postconditions	Counter Teller successfully deposit corresponding amount of money into customer's specified account
Extension Points	None
Basic Courses	<ol style="list-style-type: none"> 1. Counter Teller receives cash 2. Counter Teller selects "Cash Deposit" 3. Counter Teller enters cash amount into "Deposit Amount" field 4. Customer provides deposit account number 5. Counter Teller enters account number into "Account Number" field 6. Counter Teller selects "Deposit" 7. System display successful deposit message and transaction detail: <ol style="list-style-type: none"> 1. Transaction Id 2. Status Message 3. Bank Account Number 4. Deposit Amount
Alternative Courses	None
Exceptional Courses	<p>6b. Account number is not in database</p> <ol style="list-style-type: none"> 1. System display error message "Account number is not found" 2. Counter Teller checks entered account number corresponds with provided account number 3. Customer cancel deposit request 4. Use case terminates

5.3.2.3 Intra-bank Fund Transfer

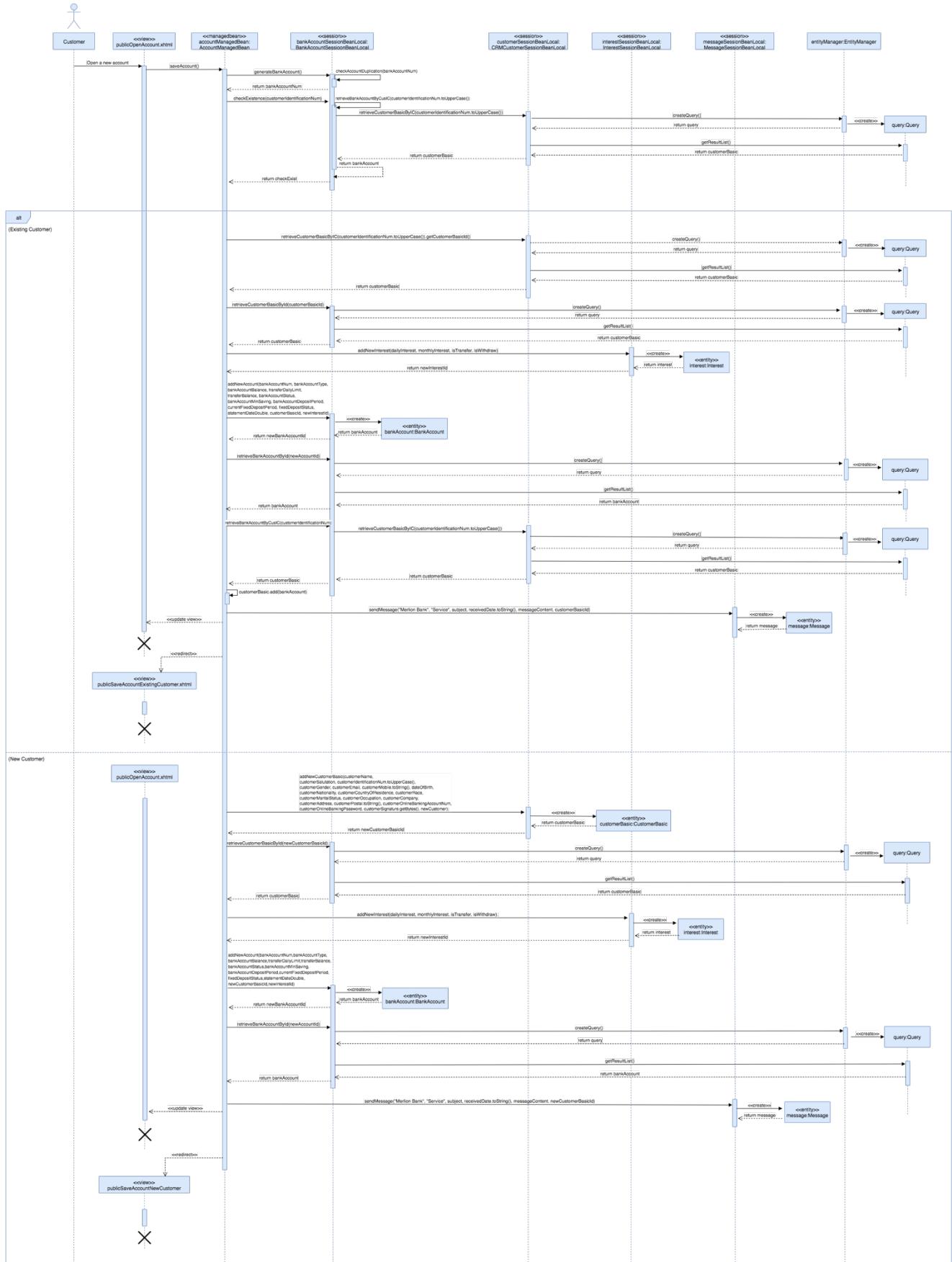
Use case name	Intra-bank fund transfer
Description	Customer transfer fund to another Merlion Bank account online
Actors	Customer
Triggers	Customer wishes to transfer fund to another Merlion Bank account via Internet Banking website
Goals	Customer transfers fund from (one of) his/her account(s) to another Merlion Bank account
Preconditions	<ul style="list-style-type: none"> 1. Customer has an existing Merlion Bank account 2. Customer has the account number for recipient 3. Customer has logged in to Merlion Bank Internet Banking system
Postconditions	<ul style="list-style-type: none"> 1. Customer's account balance is debited with the transferred amount 2. Recipient's account is credited with the transferred amount
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> a) Customer selects "Transfer" tab b) Customer selects "To Other Merlion Accounts" c) Customer selects payee from list of pre-added payee(s) and completes the recipient information: d) To: <ul style="list-style-type: none"> a) Account b) Currency e) Customer selects the account from list of account(s) owned by him/her f) System displays Authorized Daily Limit and Remaining Daily Limit g) Customer enters transfer amount and completes the payer information: <ul style="list-style-type: none"> I. From: <ul style="list-style-type: none"> a) Account b) Currency c) Amount h) Customer selects "Next" i) System prompts "Your transaction has been completed" and transaction details: j) Customer selects "View Transaction Details" k) Transaction reference number for your records l) Recipient Account m) Transfer Amount n) System displays detailed transaction records <ul style="list-style-type: none"> i. From <ul style="list-style-type: none"> a. Account Number b. Latest Account Balance b) To <ul style="list-style-type: none"> a. Account Number b. Latest Account Balance c. Transfer Amount d. Transaction Reference Number
Alternative Courses	None
Exceptional Courses	7a. Customer enters amount greater than daily transfer limit

- | | |
|--|--|
| | <p>3. System displays error message: "Dear Customer, your transfer amount has been exceeded your daily transfer limit. You remaining daily limit is XXXX."</p> <ol style="list-style-type: none"> 1. Customer cancels transfer request 2. Use case terminates <p>7b. Customer attempts to transfer to a fixed deposit account</p> <p>3. System displays error message: "Dear Customer, you are not allowed to transfer fund to a fixed deposit account."</p> <ol style="list-style-type: none"> 1. Customer cancels transfer request 2. Use case terminates <p>7c. Customer has insufficient account balance</p> <p>3. System displays error message: "Failed! Your account balance is insufficient."</p> <ol style="list-style-type: none"> 1. Customer cancels transfer request 2. Use case terminates <p>7d. Customer attempts to transfer to the paying account</p> <p>3. System displays error message: "Failed! Fund transfer cannot be done within the same account."</p> <ol style="list-style-type: none"> 1. Customer cancels transfer request 2. Use case terminates <p>7e. Customer attempts to transfer from an inactive account or both accounts are inactive</p> <ol style="list-style-type: none"> 2. System displays error message: <ol style="list-style-type: none"> a. "Failed! Your account(from) has not been activated." or 1. "Failed! Both of accounts have not been activated." 2. Customer cancels transfer request 3. Use case terminates |
|--|--|

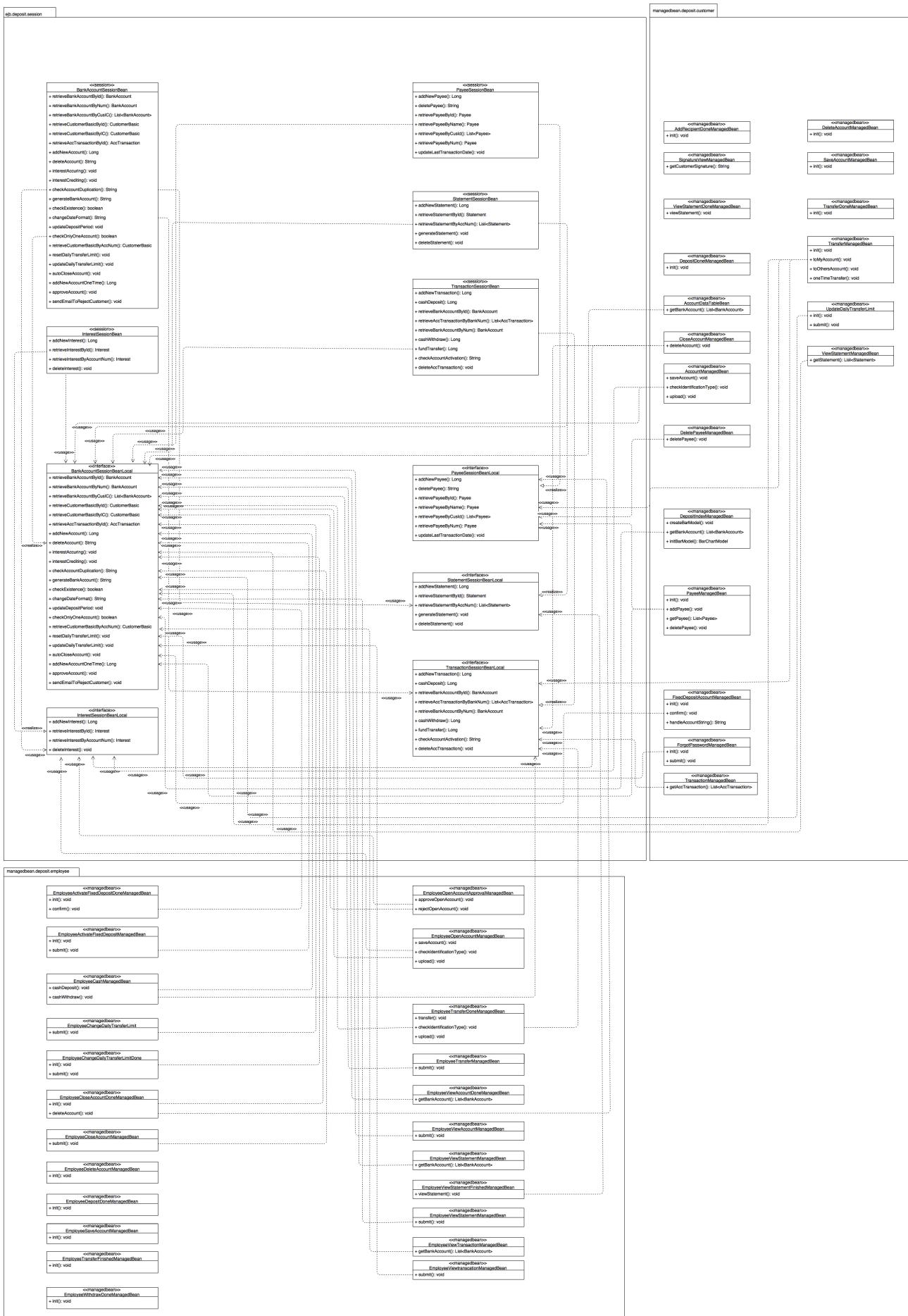
5.3.3 UML Entity Class Diagram



5.3.4 UML Sequence Diagram – Open Account

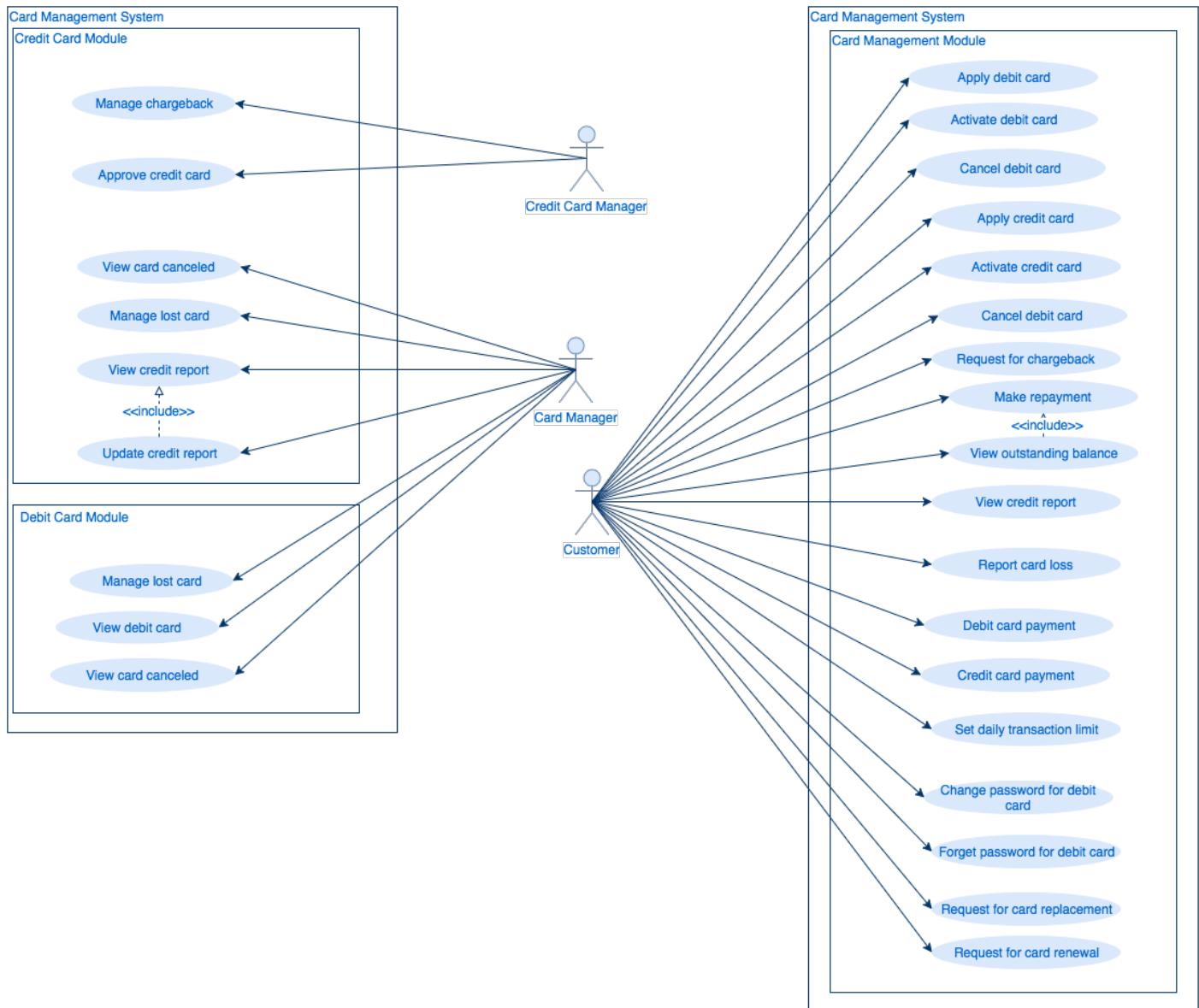


5.3.5 UML Non-Entity Diagram



5.4 Card Management System

5.4.1 Use Case Diagram



5.4.2 Use Case Description

5.4.2.1 Activate Debit Card

Use case name	Activate debit card
Description	Customer activates debit card before using it for the first time
Actors	Debit card holder
Triggers	Merlion Bank sends physical debit card to customer after customer's application
Goals	Customer's debit card is activated and ready to use
Preconditions	<ul style="list-style-type: none"> 1. Customer applies for a debit card successfully 2. Customer receives the applied credit card with valid security code printed on the back of the card 3. Customer receives a OTP from the same mobile number registered in his/her own customer basic profile
Postconditions	Customer is able to use this debit card for transaction and other activities
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 1. Customer selects "Activate card" under "Card" tab on Merlion iBanking home page 2. Customer inputs card number and card holder name printed on the debit card 3. Customer enters 3-digit security code at the back of the card and OTP which will be sent to his/her registered mobile number 4. If all information entered is correct, system will display "Your card has been activated and is ready to use."
Alternative Courses	2a. If customer chooses to activate a renewed card, the old card will be immediately cancelled while the new card will be activated, provided customer enters correct security code & OTP.
Exceptional Courses	<ul style="list-style-type: none"> 3a. Customer enters incorrect security code for 5 times <ul style="list-style-type: none"> 1. Account is locked out 2. Use case terminates 3b. Customer does not have access to registered mobile number <ul style="list-style-type: none"> 1. Customer cancel login request 2. Use case terminates

5.4.2.2 Renew Debit Card

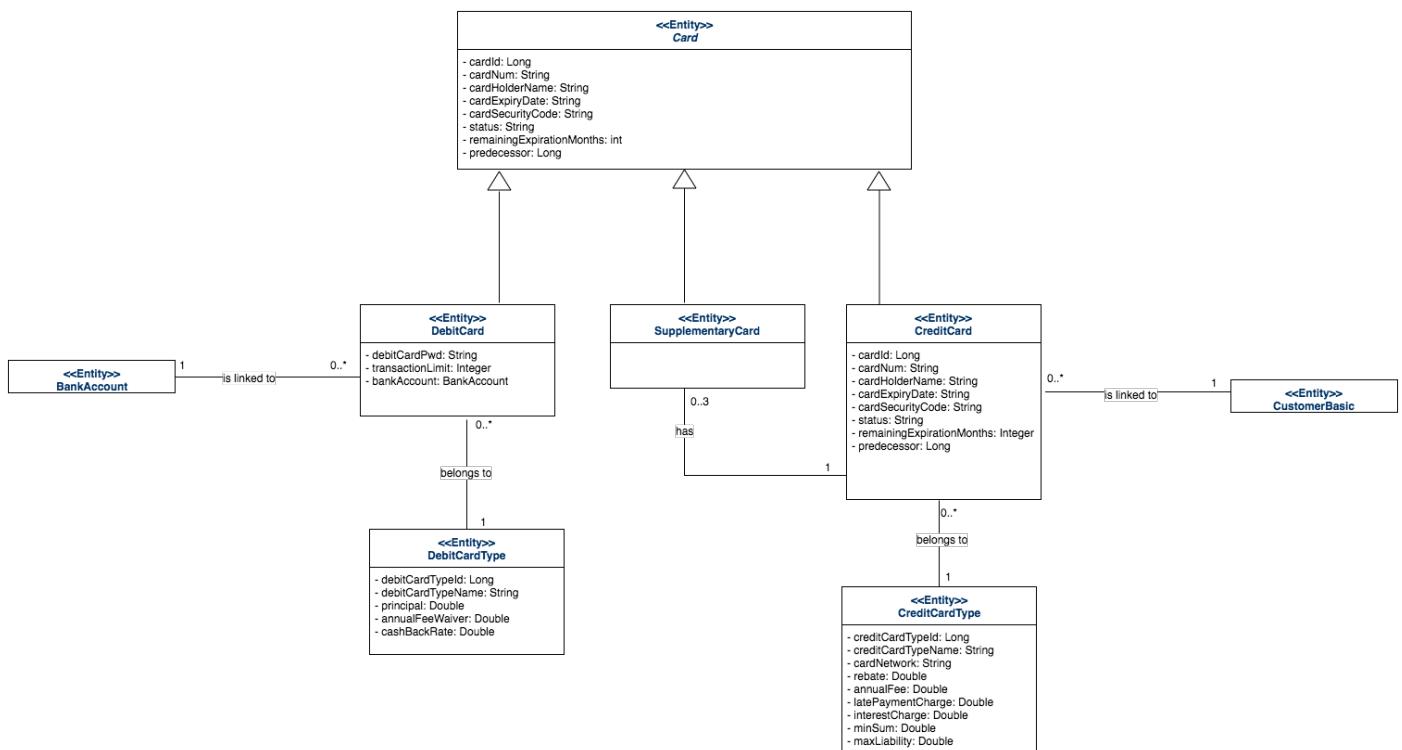
Use case name	Renew debit card
Description	Customer renews debit card via Merlion iBanking website before it expires
Actors	Debit card holder
Triggers	Merlion Bank sends notification email to debit card holder 3 months before debit card's expiry date, noticing card holder to renew the card
Goals	Debit card holder successfully renews his/her debit card
Preconditions	<ul style="list-style-type: none"> 1. Customer has a valid Merlion Bank debit card which has not expired 2. The renewed debit card is within 3 months before its expiry date 3. Customer has an existing Merlion iBanking account
Postconditions	Merlion Bank will mail him/her a newly extended debit card which requires activation before usage
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 1. Customer selects "Renew Card" under "Card" tab on Merlion iBanking home page 2. Customer selects the debit card he/she wishes to renew from a dropdown list of all expiring cards under his/her account 3. Customer clicks "Renew this card" button 4. System displays "You have successfully renewed your debit card! We will mail your new card to you very soon."
Alternative Courses	None
Exceptional Courses	None

5.4.2.3 Manage Chargeback

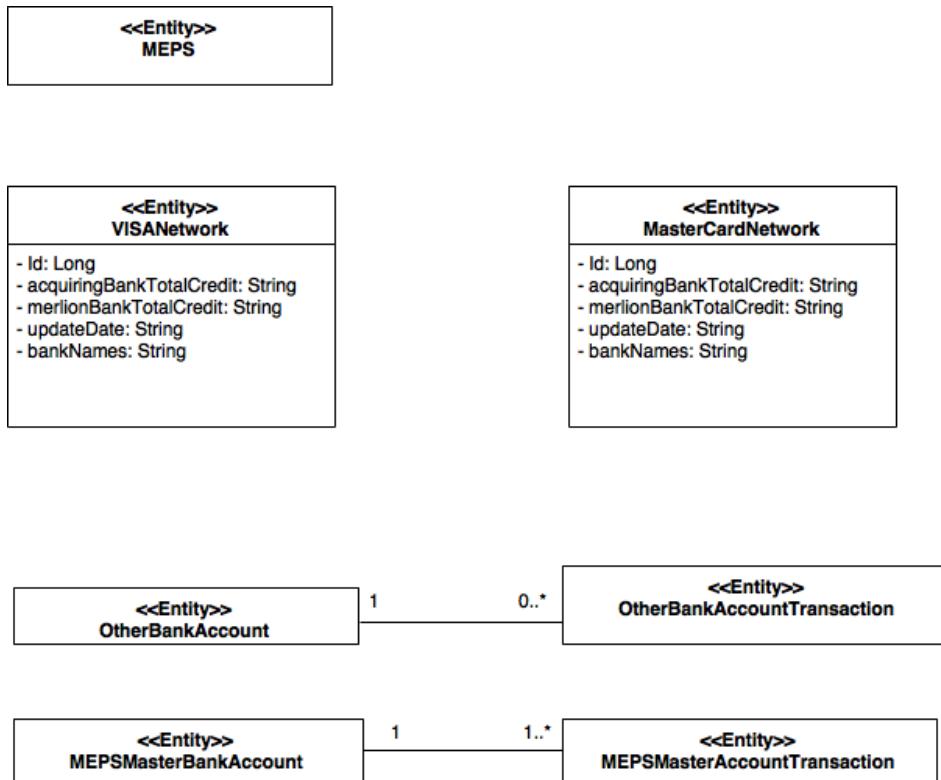
Use case name	Manage credit card chargeback
Description	Credit card manager receives chargeback case and then verifies the case before making a decision whether to approve or reject customer's dispute
Actors	Credit card manager
Triggers	Customer identifies a fraudulent transaction and then submits a chargeback dispute
Goals	Credit card manager approves/rejects chargeback dispute
Preconditions	<ul style="list-style-type: none"> 1. Customer holds a valid credit card issued by Merlion Bank 2. Customer disputes on a seemingly fraudulent transaction
Postconditions	<ul style="list-style-type: none"> 1. If credit card manager approves dispute, the dispute transaction amount will be credited to customer's account 2. If credit card manager rejects dispute, a processing fee will be charged from customer's credit card
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 1. Credit card manager clicks "Manage Chargeback" 2. Credit card manager selects a chargeback dispute case to investigate 3. Credit card manager contacts the merchant and the merchant's acquiring bank related to the disputed transaction 4. Merchant's acquiring bank researches on the case and sends investigation results to Merlion Bank 5. Based on the results provided by the acquiring bank, credit manager then makes a decision whether to approve or decline the dispute
Alternative Courses	<p>5a. Credit card manager approves chargeback dispute</p> <ul style="list-style-type: none"> 1. Disputed amount is credited back to customer's credit card 2. Customer will be notified with this outcome via personal email and Merlion iBanking messagebox <p>5b. Credit card manager declines chargeback dispute</p> <ul style="list-style-type: none"> 1. A processing fee is charged from customer's credit card 2. Customer will be notified with this outcome via personal email and Merlion iBanking messagebox
Exceptional Courses	None

5.4.3 UML Entity Class Diagram

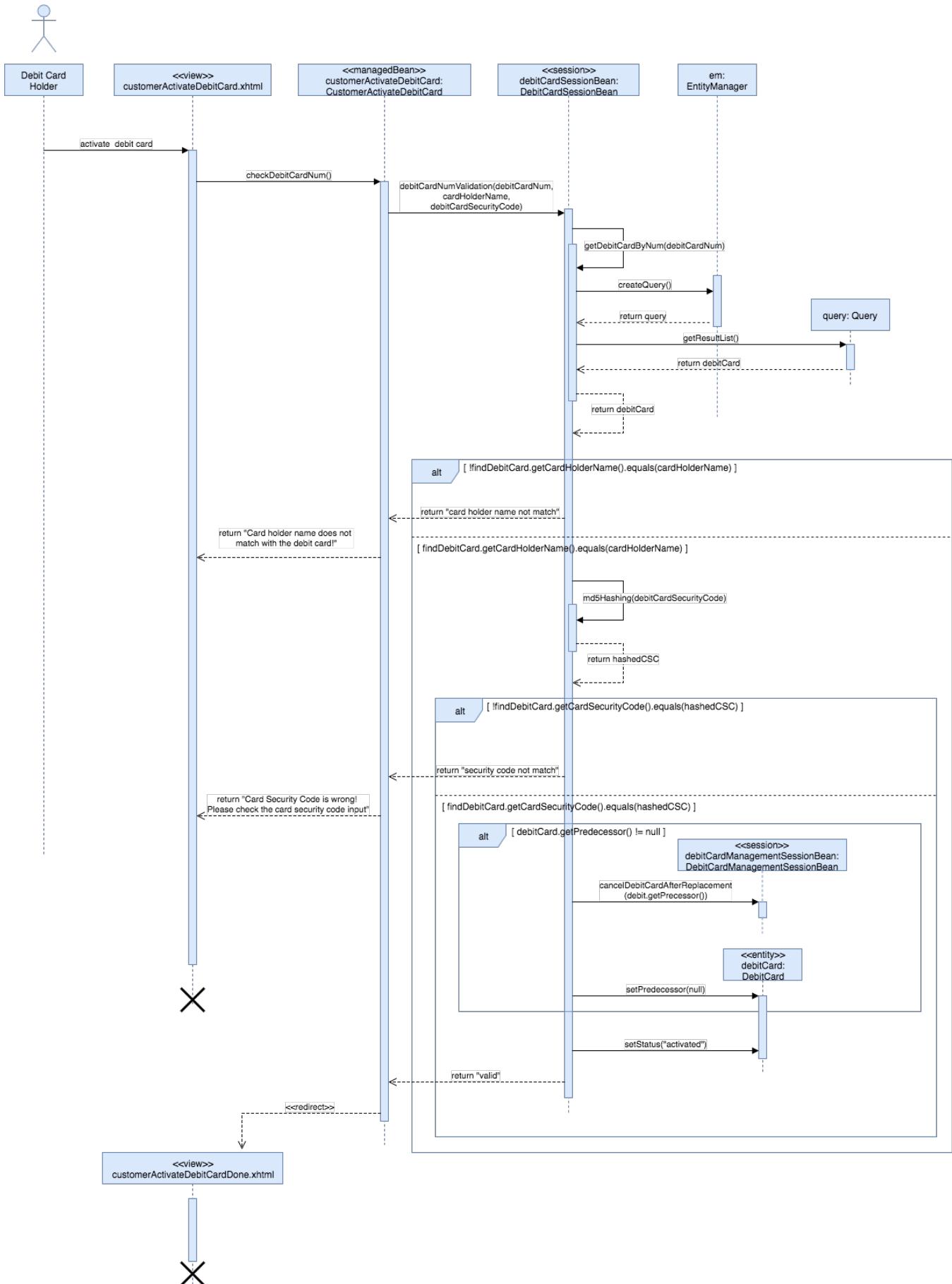
5.4.3.1 Card Management System Entity Diagram



5.4.3.2 Card Management System Entity Diagram – External Parties System

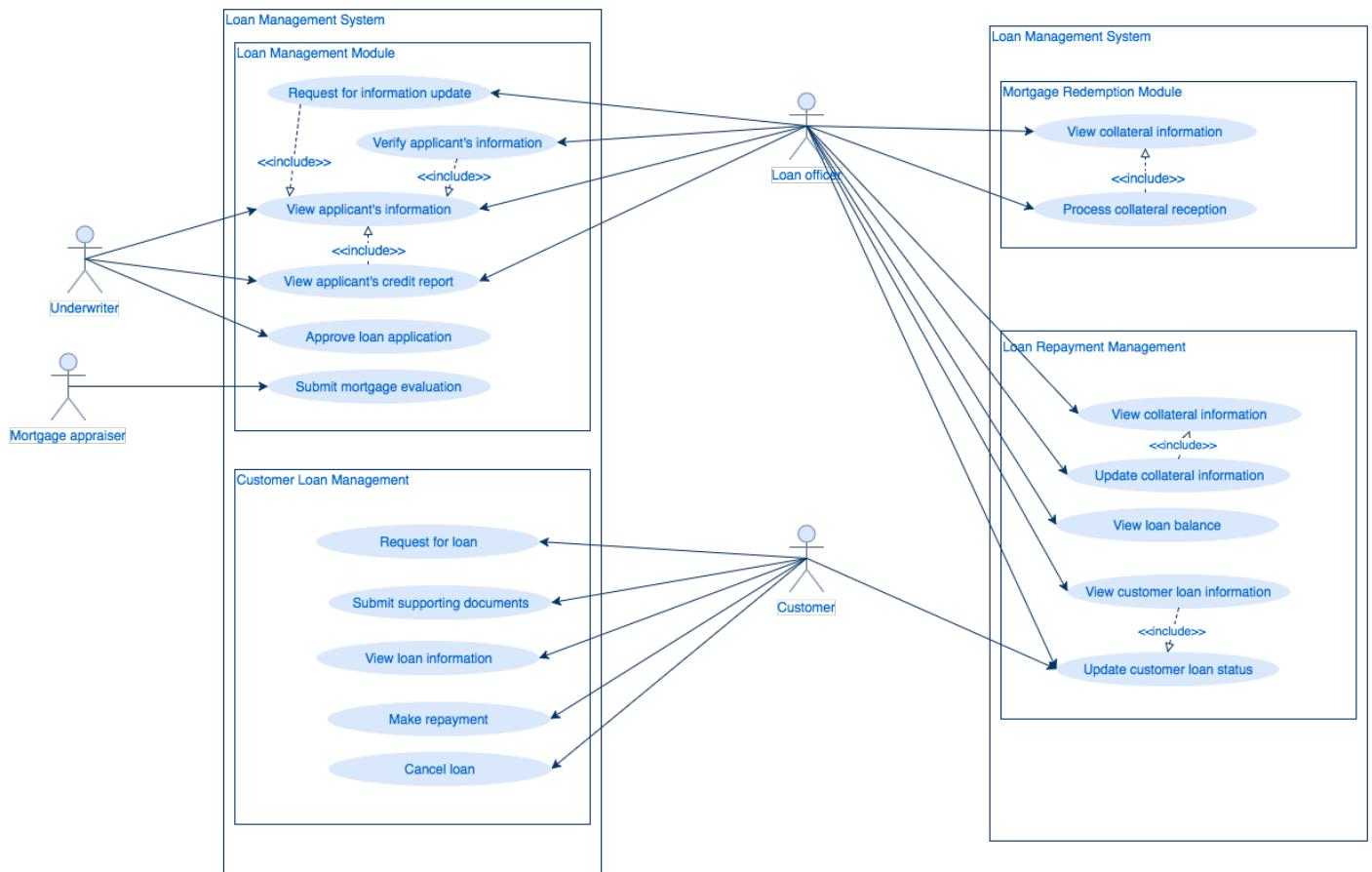


5.4.4 UML Sequence Diagram – Activate Debit Card



5.5 Loan Management System

5.5.1 Use Case Diagram



5.5.2 Use Case Description

5.5.2.1 Loan Application

Use Case Name	Request for loan
Description	Customer wishes to apply for a loan via Internet Banking System
Actors	Customer
Triggers	Customer does not have sufficient fund for an event
Goals	Customer successfully applies for a loan
Preconditions	<ul style="list-style-type: none"> 1. Customer has soft copies of all the required documents 2. Customer is at Merlion Bank index page
Postconditions	Customer has successfully applied for interested loan
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 3. Customer selects “Loan” 4. Customer chooses loan type: <ul style="list-style-type: none"> . Home loan a. Personal loan b. Education loan c. Car loan 5. Customer enters personal information: <ul style="list-style-type: none"> a) Basic information b) Personal details c) Employment details d) Financial commitments e) Property details f) Financial request g) Supporting documents h) Confirmation 1. Customer confirms application details 2. System displays “Application successful!”
Alternative Courses	<p>4a. Customer input preferred tenure as shorter than 5 years and longer than 25 years.</p> <ul style="list-style-type: none"> 1. System displays “Fail! Loan tenure should be 5~25 years” 2. Continues at Step 3
Exceptional Courses	<p>4b. Customer is under 21 years old or over 60 years old</p> <ul style="list-style-type: none"> 1. System displays “Fail! Applicant should be over 21 years old and below 60 years old” 2. Use case terminates <p>4c. Customer's monthly income, which includes fixed monthly income and 70% of other monthly income, is less than \$2000.</p> <ul style="list-style-type: none"> 1. System displays “Fail! Applicant should have over than \$2000 monthly income” 2. Use case terminates

5.5.2.2 Loan Approval

Use case name	Approve loan application
Description	Underwriter approve loan application based submitted information
Actors	Underwriter
Triggers	Customer submits new loan application
Goals	Approval of loan application
Preconditions	<ul style="list-style-type: none"> 1. Underwriter has an account with the role “Underwriter” 2. Information submitted to underwriter is verified by loan officers and is sufficient 3. Underwriter is logged in in Internal System
Postconditions	Submitted loan application is approved by underwriter
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 4. Underwriter selects “Process pending loan applications” 5. System displays list of pending loan applications 6. Underwriter selects one pending loan application 7. System displays: <ul style="list-style-type: none"> a. Analysis result b. Recommended loan amount range c. Analyzed risk level d. Tenure length <ul style="list-style-type: none"> i. Customer preference ii. Recommended tenure e. Highlights f. Education g. Employment history h. Customer profile 8. Underwriter evaluate values and enter following: <ul style="list-style-type: none"> a. Approved loan amount b. Approved tenure 1. Underwriter clicks “Approve” 2. System prompts “Loan application is approved successfully.”
Alternative Courses	<p>6a. Underwriter inputs loan amount that exceeds bank regulated maximum value or below bank regulated minimum value</p> <ul style="list-style-type: none"> 2. System displays <ul style="list-style-type: none"> a. <i>“Loan amount is too high”</i> or 1. <i>“Loan amount is too low”</i> 2. Continues at Step 5 <p>6b. Underwriter inputs tenure length that exceeds maximum value of 25 years or below minimum value of 5 years</p> <ul style="list-style-type: none"> 2. System displays <ul style="list-style-type: none"> a. <i>“Tenure is too short”</i> or 1. <i>“Tenure is too long”</i> 2. Continues at Step 5 <p>6c. Underwriter inputs loan amount that is more than 60% of property purchase price for applicants whose age + loan tenure is larger than 65 or more than 80% for applicants whose age + loan tenure is less than 65</p> <ul style="list-style-type: none"> 1. System displays “Loan amount is too high”

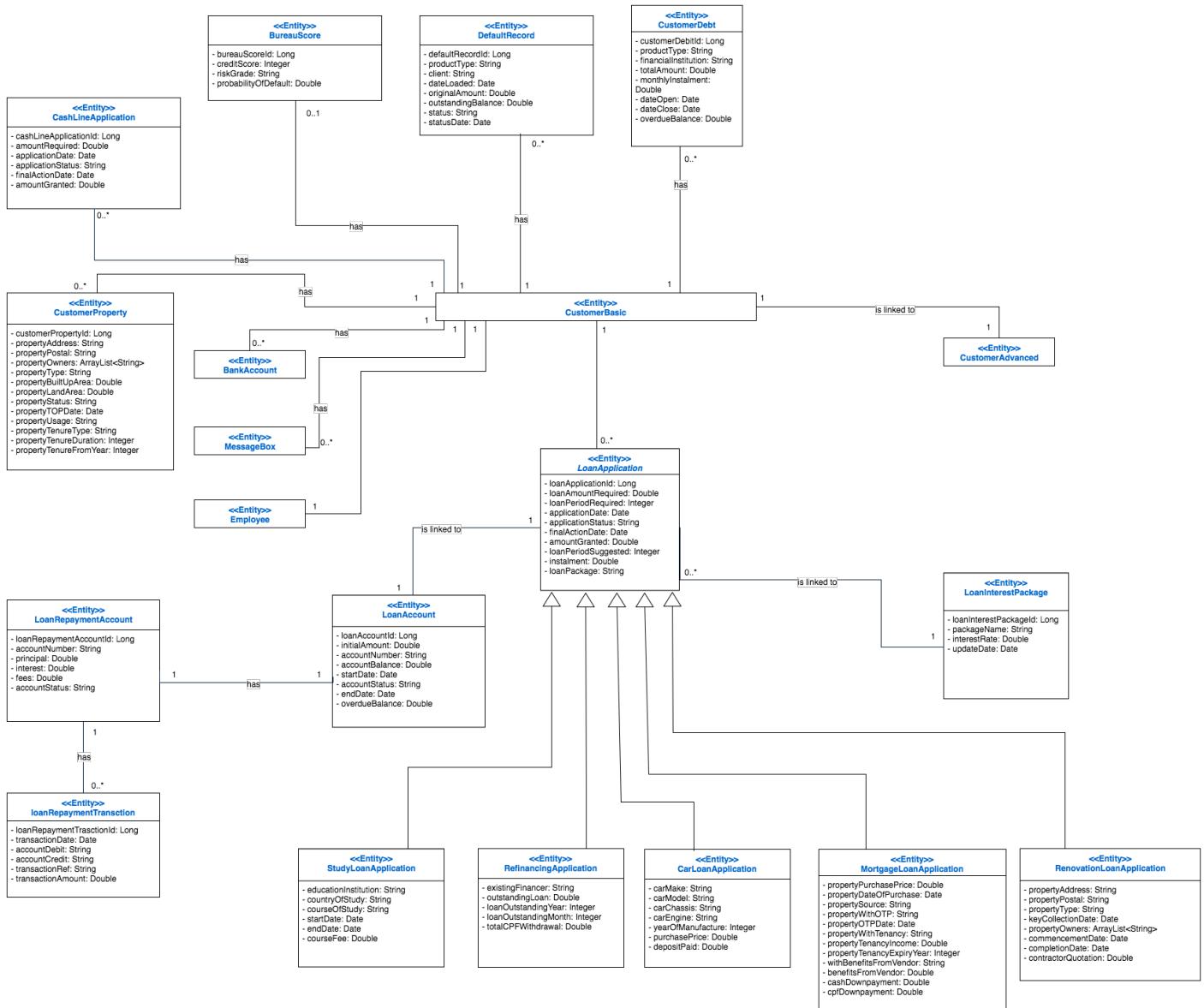
	2. Continues at Step 5
Exceptional Courses	6a. Underwriter chooses to reject the application 1. Underwriter clicks "Reject" 2. Use case terminates

5.5.2.3 Loan Repayment

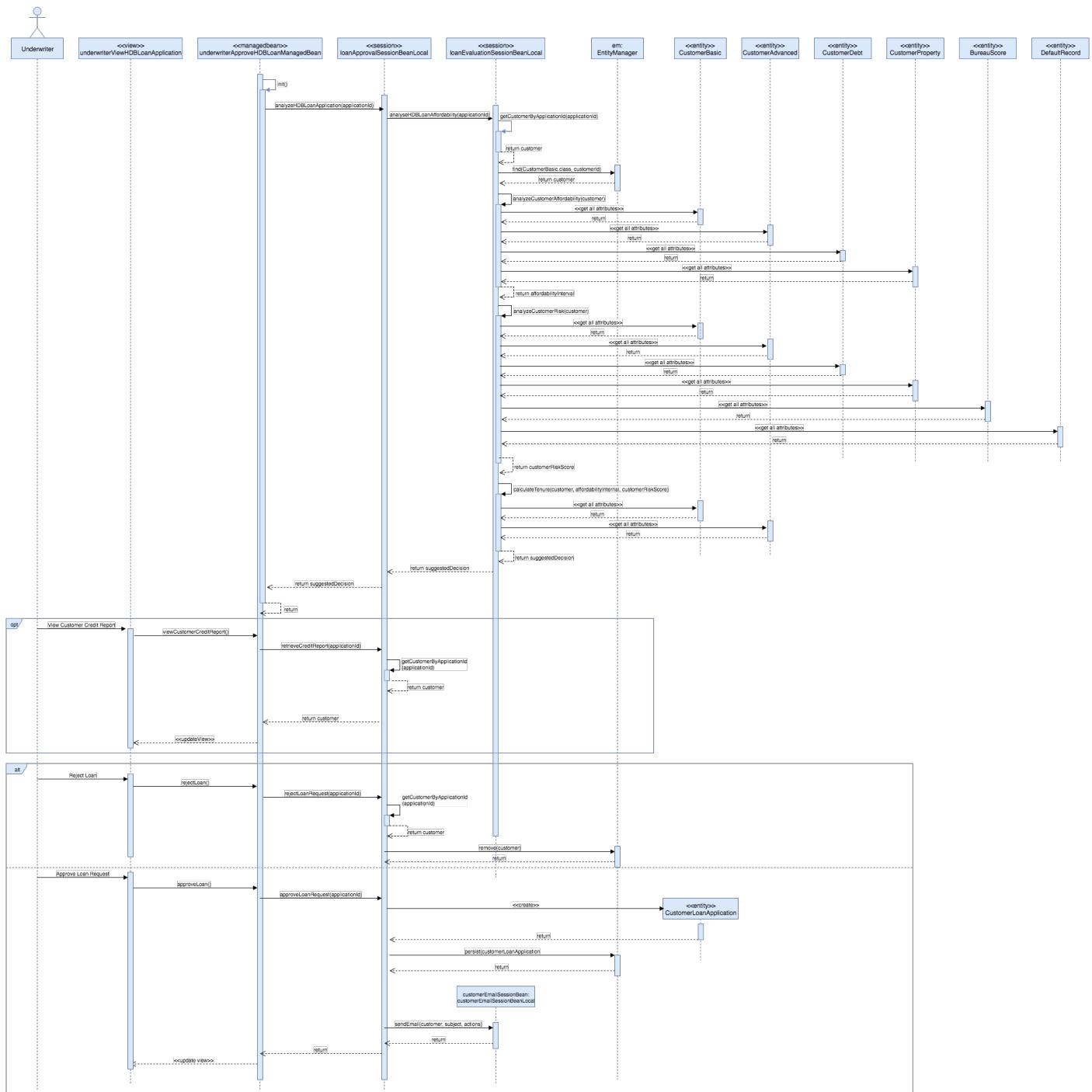
Use case name	Make repayment
Description	Customer make repayment for loans after loan is granted
Actors	Customer
Triggers	Customer has received approval of loan
Goals	Customer successfully install repayment via Merlion Bank Internet Banking System
Preconditions	1. Customer has an existing account and is logged in 2. Customer is already granted with a loan 3. Customer chooses regular installment repayment plan instead of GIRO deduction
Postconditions	Customer has successfully performed installment for his/her chosen repayment plan
Extension Points	None
Basic Courses	4. Customer selects "Loan" 5. Customer selects "View loan profile" 6. System prompts user to complete OTP validation 7. Customer passes OTP validation 8. System displays list of granted loan(s) and their next installment balance 9. Customer selects "Make repayment" 10. System displays channels of payment: a. Transfer from Merlion Bank b. Transfer from other banks 1. Customer chooses intrabank transfer from Merlion Bank deposit accounts 2. System displays list of deposit account(s) of borrower 3. Customer chooses paying account 4. Customer enters PIN and amount to pay 5. System displays "Repayment successful" and display payable balance as \$0
Alternative Courses	8a. Customer chooses "Transfer from other banks" 6. System displays repayment account details: a. Receiving account b. Recipient c. Reference number 1. Customer make transfer from other bank 2. Continues from Step 12 12a. Customer makes payment amount that is \$xx less than payable balance 1. System displays payable balance as \$xx 2. Customer still need to pay the remaining \$xx before next installment date 3. Continues from Step 12 12b. Customer makes payment amount that is \$xx more than payable balance

	<ul style="list-style-type: none">a) System displays payable balance as -\$xxb) Overpaid amount \$xx will be saved to clear next installment amountc) Continues from Step 12
Exceptional Courses	None

5.5.3 UML Entity Class Diagram

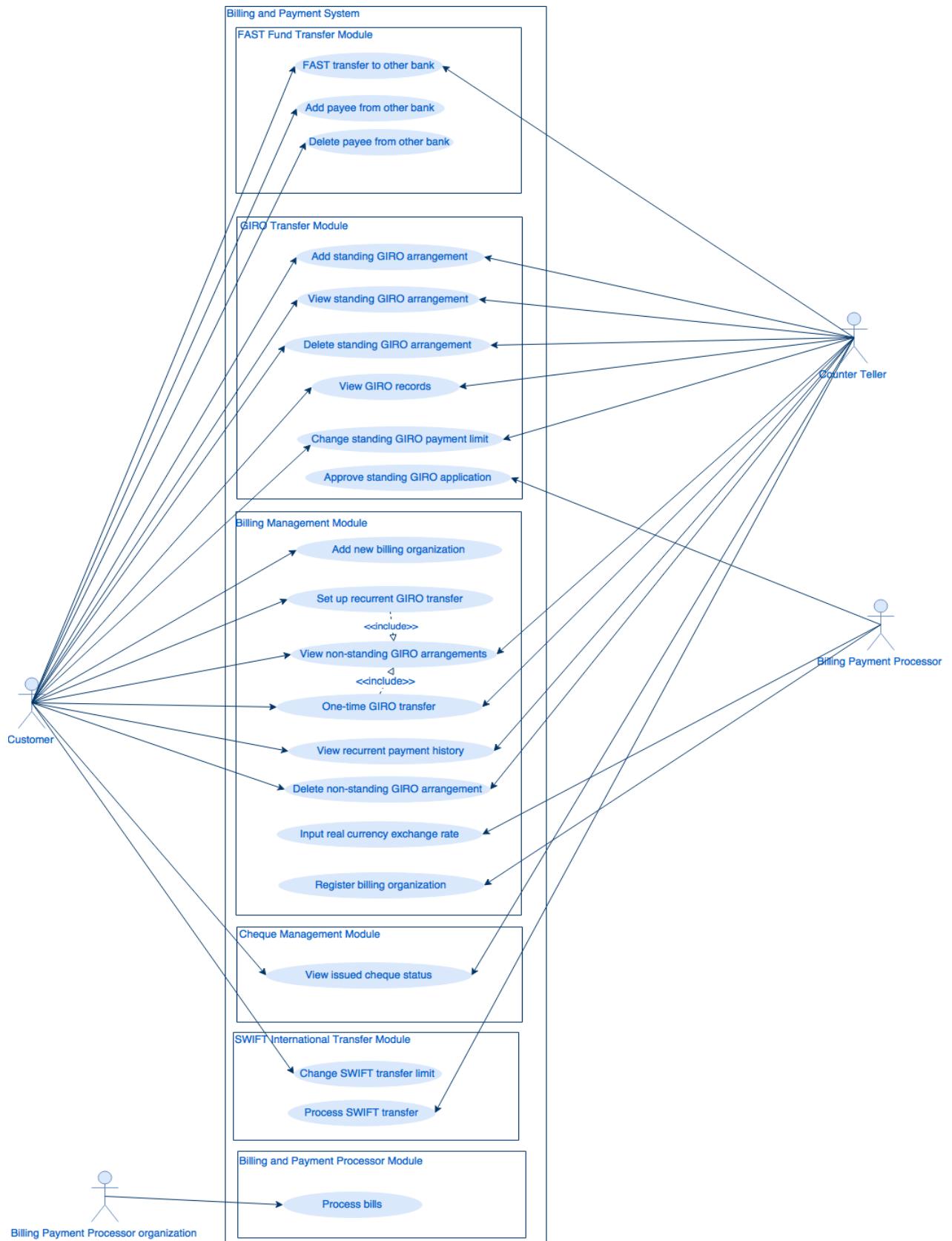


5.5.4 UML Sequence Diagram – HDB Loan Approval



5.6 Billing and Payment System

5.6.1 UML Use Case Diagram



5.6.2 UML Use Case Description

5.6.2.1 FAST Transfer to Other Banks

Use case name	FAST Transfer to other bank
Description	Customer request for FAST transfer to account from other bank
Actors	Customer
Triggers	Customer wishes to make a FAST transfer to an outside bank account
Goals	Customer successfully makes a FAST transfer from his/her Merlion Bank account to an outside bank account
Preconditions	<ul style="list-style-type: none"> 1. Customer already has a Merlion Bank deposit account 2. Customer is logged in 3. Customer has account information of recipient 4. Customer has added the recipient into his/her FAST payee list
Postconditions	Customer successfully makes a FAST transfer to his/her intended recipient's account from outside Merlion Bank
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 1. Customer selects “Transfer” tab 2. Customer selects “FAST transfer to other bank” 3. Customer selects paying account from a list of existing Merlion Bank deposit account(s) 4. Customer selects recipient account from a list of pre-added FAST payees 5. Customer enters amount to be transferred 6. Customer selects “Submit” 7. Request of transfer is forwarded to SACH for clearance 8. SACH records transaction figures 9. SACH forwards paying instruction to recipient bank 10. Recipient bank acknowledges and approve transaction 11. SACH replies Merlion Bank about approval of transaction 12. Merlion Bank debits payer’s account 13. System prompts “FAST transfer is successful”
Alternative Courses	<p>6a. Customer attempts to transfer amount that exceeds the daily limit of \$50,000</p> <ul style="list-style-type: none"> 1. System displays error message “<i>Failed! Your transfer amount exceeds \$50,000</i>” 2. Continues at Step 4
Exceptional Courses	<p>7a. Customer has insufficient account balance</p> <ul style="list-style-type: none"> 1. System displays error message: a. “<i>Failed! Your account balance is insufficient.</i>”

- | | |
|--|--|
| | <p>2. Customer cancels transfer request</p> <p>3. Use case terminates</p> <p>7b. Customer attempts to transfer to the paying account</p> <ol style="list-style-type: none"> 1. System displays error message: <p>a) <i>"Failed! Fund transfer cannot be done within the same account."</i></p> <p>2. Customer cancels transfer request</p> <p>3. Use case terminates</p> <p>7c. Customer attempts to transfer from an inactive account or both accounts are inactive</p> <ol style="list-style-type: none"> 1. System displays error message: <p>a. <i>"Failed! Your account (from) has not been activated."</i>
 <i>or</i>
 <i>b. Failed! Both of accounts have not been activated."</i></p> <p>3. Customer cancels transfer request</p> <p>4. Use case terminates</p> |
|--|--|

5.6.2.2 SWIFT Transfer

Use case name	Request for SWIFT transfer
Description	Customer requests to make an international fund transfer using SWIFT network
Actors	Customer
Triggers	Customer wishes to make an international fund transfer to overseas recipient
Goals	Customer successfully makes a fund transaction via SWIFT network to an international recipient
Preconditions	<ol style="list-style-type: none"> 1. Customer has an existing Merlion Bank deposit account 2. Customer has information and SWIFT code of the recipient's bank account 3. Customer is logged in
Postconditions	Customer successfully conducts a SWIFT international fund transfer
Extension Points	None
Basic Courses	<ol style="list-style-type: none"> 1. Customer selects "Transfer" tab 2. Customer selects "SWIFT transfer" 3. Customer selects paying account from a list of owned Merlion Bank deposit accounts 4. Customer chooses paying currency 5. Customer enters payee's account information: <ol style="list-style-type: none"> a) Account number b) Destination country c) SWIFT code d) Receiving currency 6. System displays final deduction amount including: <ol style="list-style-type: none"> a. Processing fee b. Different currency transaction fee 7. Customer selects "Submit" 8. System displays "Request is sent successfully!"
Alternative Courses	<p>7a. Customer enters incorrect SWIFT code</p> <ol style="list-style-type: none"> 1. System displays error message: "<i>Failed! SWIFT code is invalid</i>" 2. Continues at Step 5 <p>7b. Customer requests to transfer amount exceeding daily transfer limit</p> <ol style="list-style-type: none"> 1. System displays error message: "<i>Failed! Amount exceeds daily transfer limit</i>" 2. Continues at Step 5

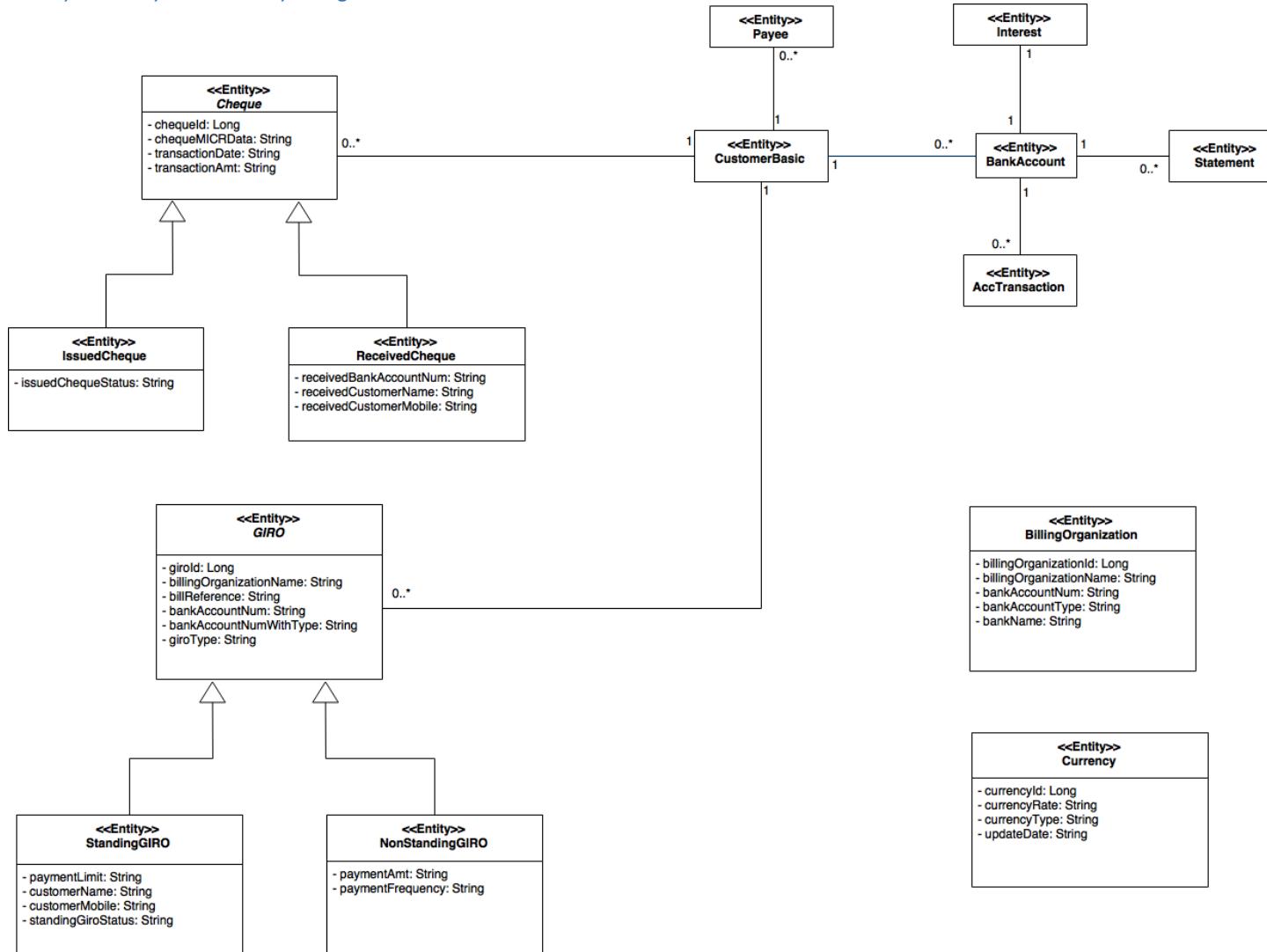
Exceptional Courses	<p>7c. Customer has insufficient account balance</p> <ol style="list-style-type: none">1. System displays error message: "<i>Failed! Your account balance is insufficient.</i>"1. Customer cancels transfer request2. Use case terminates
---------------------	---

5.6.2.3 Establish Recurrent GIRO Transfer

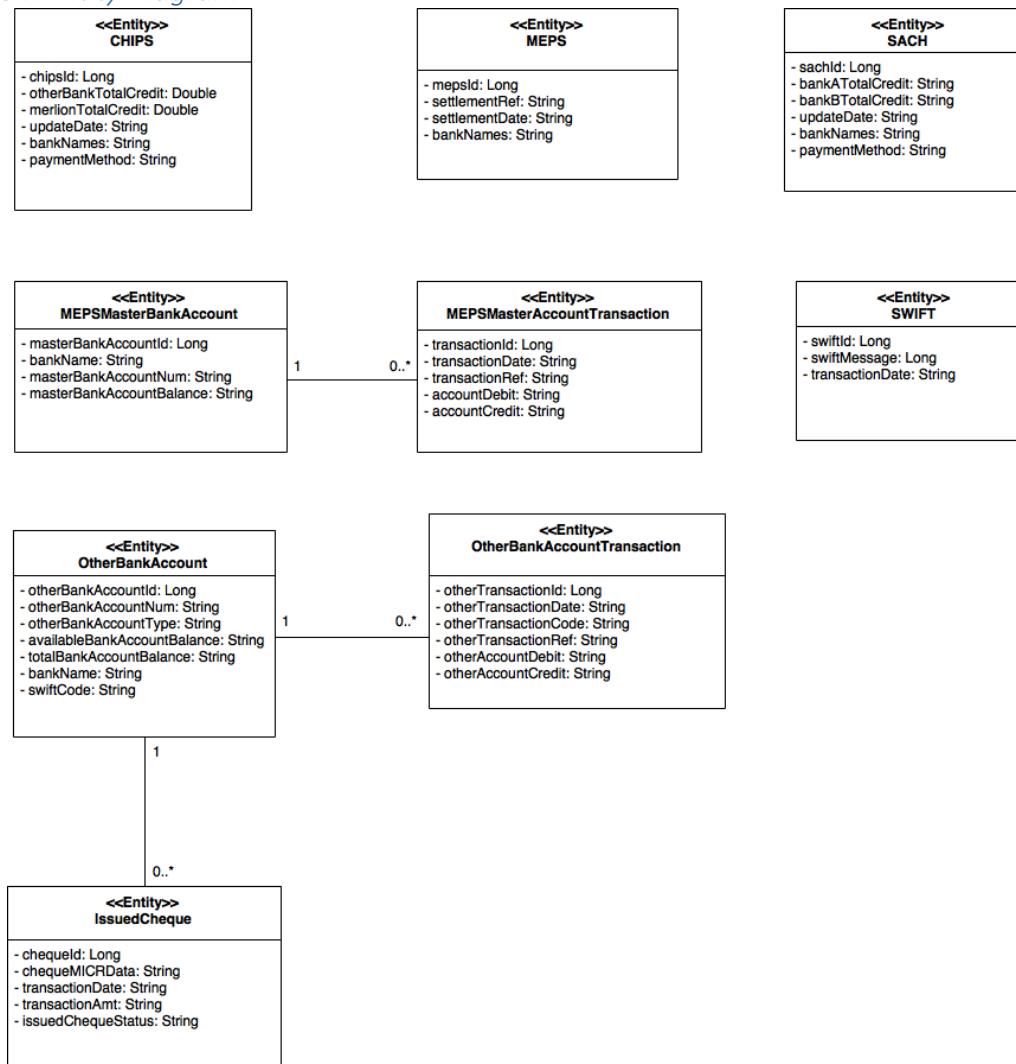
Use case name	Establish recurrent GIRO transfer
Description	Customer establish a recurrent GIRO transfer that transfer a fixed amount from his/her deposit account in regular basis
Actors	Customer
Triggers	Customer wishes to save troubles from repeatedly make the same transaction to the same payee
Goals	Customer successfully establishes a recurrent GIRO transfer instruction
Preconditions	<ul style="list-style-type: none"> 1. Customer has an existing Merlion Bank deposit account 2. Customer has information of the recipient (billing organization) and its billing reference number 3. Customer is logged in
Postconditions	Customer successfully establishes a recurrent GIRO transfer instruction
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 1. Customer selects “Transfer” tab 2. Customer selects “Recurrent GIRO transfer” 3. Customer selects “Add Billing Organization” 4. Customer enters billing organization’s details: <ul style="list-style-type: none"> 1. Frequency of transfer 2. Organization name 3. Billing reference number 5. Customer selects “Submit” 6. System displays list of added billing organization(s) including newly added billing organization 7. Customer enters paying amount about the transaction in the editable table of recurrent GIRO payees 8. Customer clicks “Transfer” at the row of the recipient billing organization 9. System prompts “Transfer successfully”
Alternative Courses	<p>2a. Billing organization is already added</p> <ul style="list-style-type: none"> 1. Continues at Step 6
Exceptional Courses	<p>8a. Customer has insufficient account balance</p> <ul style="list-style-type: none"> 1. System displays error message: “<i>Failed! Your account balance is insufficient.</i>” 2. Customer cancels transfer request 3. Use case terminates

5.6.3 UML Entity Class Diagram

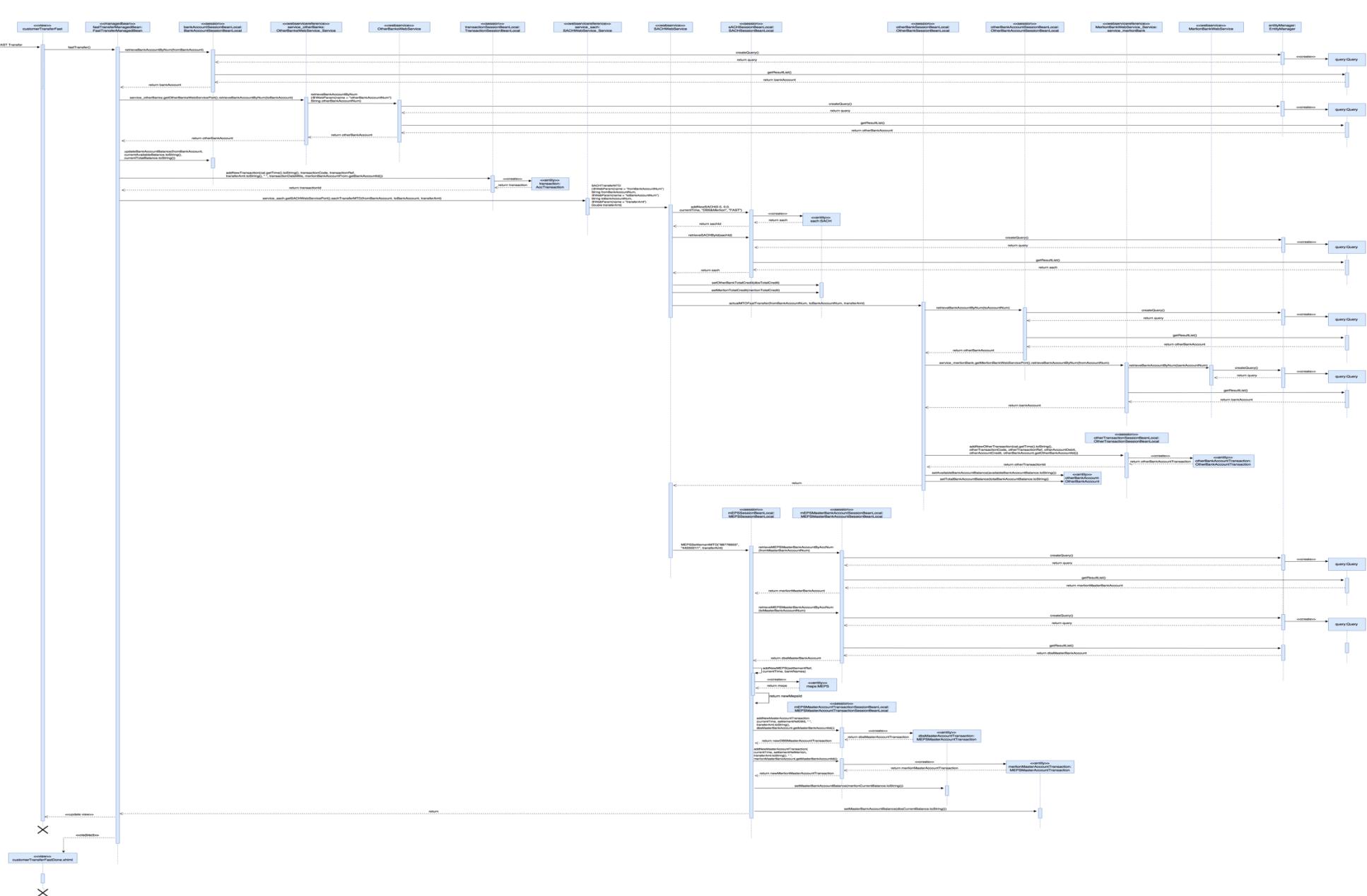
5.6.3.1 Billing and Payment System Entity Diagram



5.6.3.2 Billing and Payment System Entity Diagram

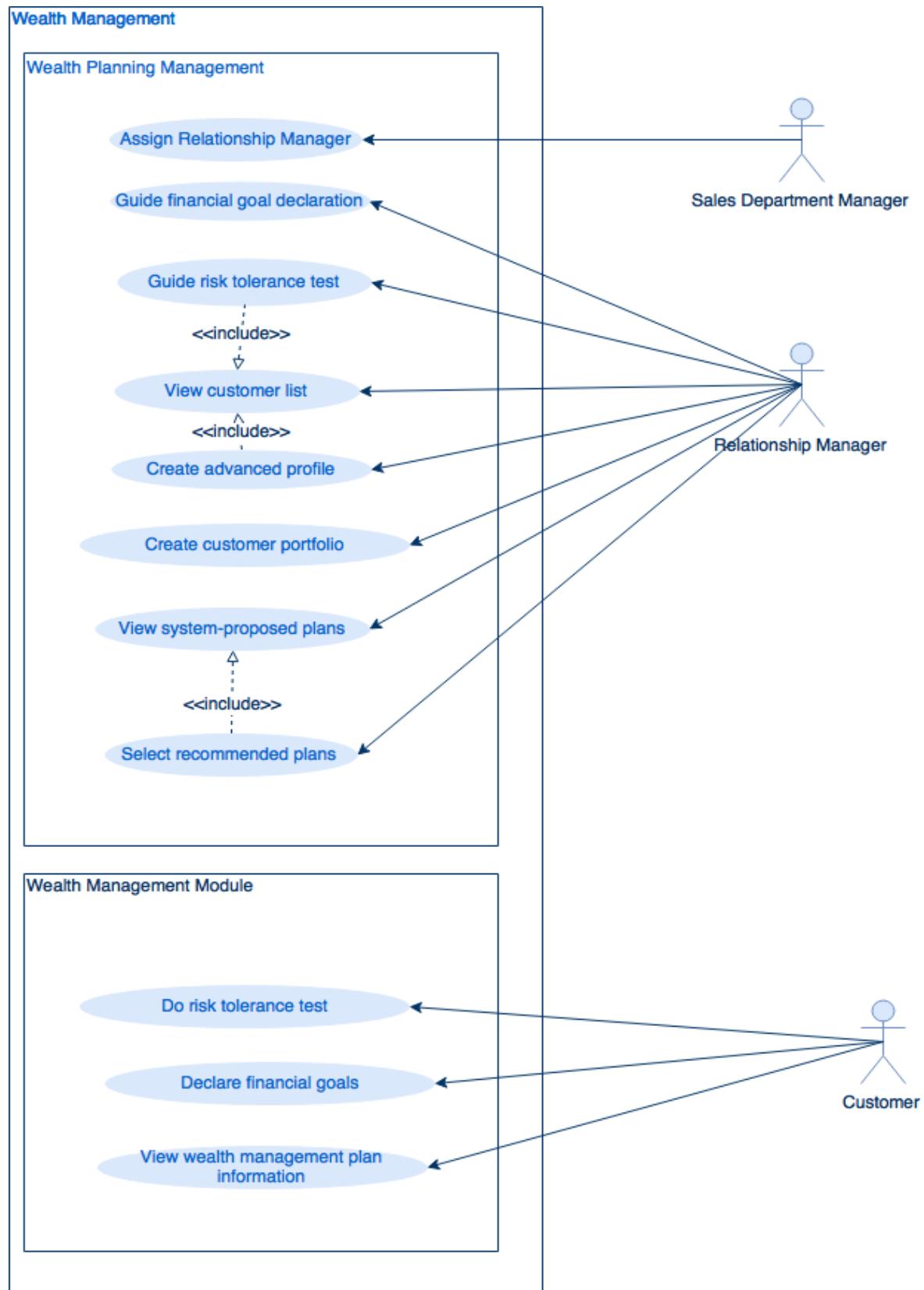


5.6.4 UML Sequence Diagram – Fast Transfer to Other Banks



5.7 Wealth Management System

5.7.1 UML Use Case Diagram



5.7.2 UML Use Case Description

5.7.2.1 Create Portfolio

Use case name	Plan and create a portfolio for the customer
Description	Relationship Manager goes through the wealth management planning process to plan and create a portfolio for a certain customer
Actors	Relationship Manager
Triggers	Upon having the customer's agreement on one particular proposed wealth management plan, Relationship Manager now need to plan and create the actual portfolio according to all information gathered and the proposed plan agreed.
Goals	Relationship Manager successfully creates a portfolio for the customer
Preconditions	<ol style="list-style-type: none"> 1. Relationship Manager has an existing Merlion Bank account with the role of "Relationship Manager" 2. Relationship Manager is logged into the Merlion Bank internal system 3. The customer has a Merlion Bank Deposit Account 4. The Risk Profile has been created for the customer 5. The Advanced Profile had been created for the customer 6. The customer has agree on one particular proposed wealth management plan
Postconditions	Relationship Manager successfully creates a portfolio for the customer
Extension Points	None
Basic Courses	<ol style="list-style-type: none"> 2. Relationship Manager reviews result of the completed risk tolerance test 3. Relationship Manager reviews financial goals declared by the customer 4. Relationship Manager asks for more advanced information of the customer and then advanced profile will be created 5. Relationship Manager explains all the proposed plans to the customer and the customer will then approve a particular one 6. Sign contracts 7. Relationship Manager does the asset allocation and security selection to design the portfolio 8. Relationship Manager then make decision on the portfolio and the portfolio will be created
Alternative Courses	None
Exceptional Courses	<p>1a. No risk tolerance test record has been found</p> <ol style="list-style-type: none"> 1. System displays the risk tolerance test questions 2. Relationship Managers guides the customer to do the test <p>2a. No financial goals have been found</p>

	<ol style="list-style-type: none">1. Relationship Manager asks the customer to declare his/her financial goals2. Investment Calculator may be used to show statistics
--	--

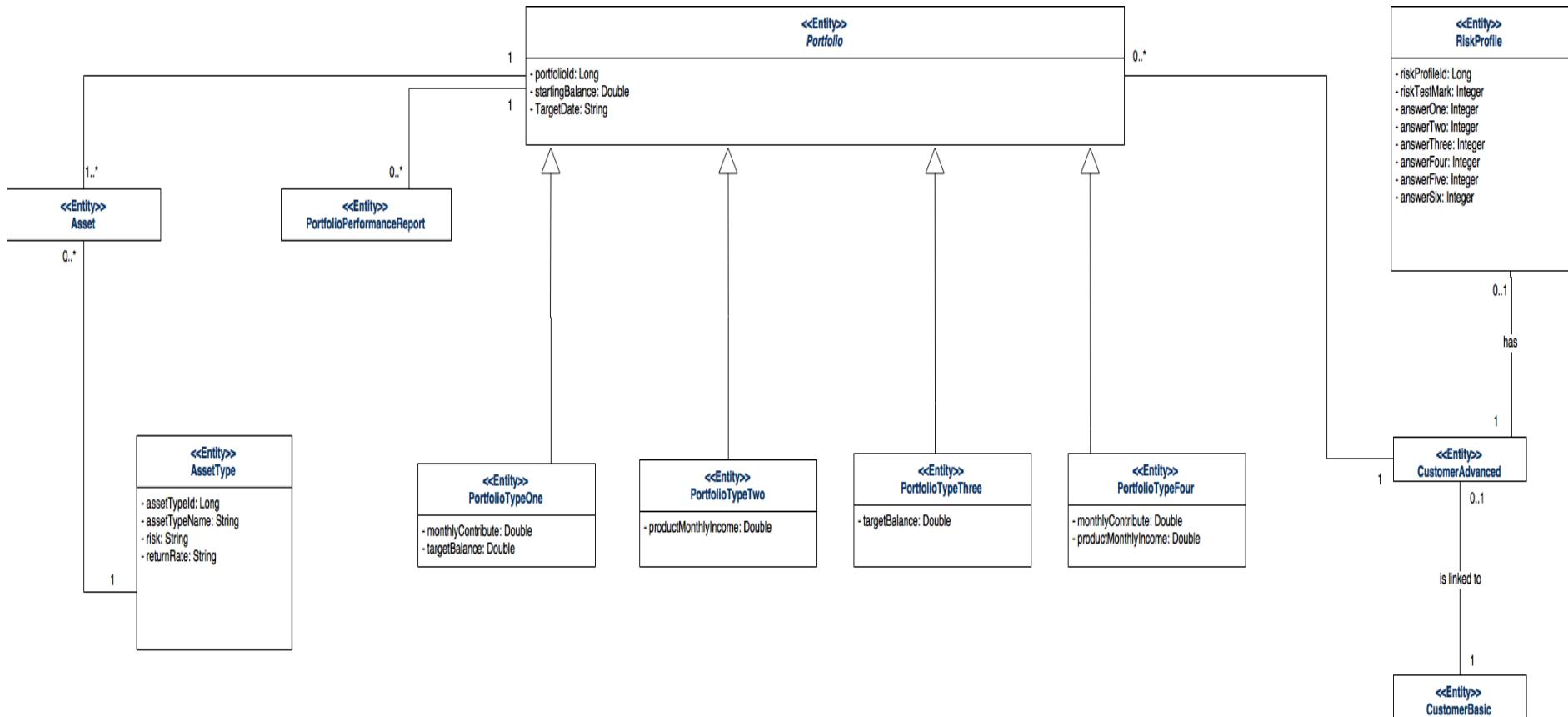
5.7.2.2 Perform Risk Tolerance Test

Use case name	Customer conduct risk tolerance test
Description	Customer completes risk tolerance test on his/her own or together with the Relationship Manager
Actors	Customer Relationship Manager
Triggers	Relationship Manager needs to assess customer's level of risk tolerance so as to recommend financial plans according to customer's preference
Goals	<ol style="list-style-type: none"> 1. Relationship Manager successfully assist customer and complete the risk tolerance test via Merlion Bank Internal System 2. Customers successfully completes risk tolerance test on his/her own via Internet Banking system
Preconditions	<ol style="list-style-type: none"> 1. Relationship Manager has an existing Merlion Bank account with the role of "Relationship Manager" 2. The customer is a wealth management plan customer 3. Relationship Manager is logged into the Merlion Bank internal system
Postconditions	The risk profile of the customer has been created
Extension Points	None
Basic Courses	<ol style="list-style-type: none"> 1. Relationship Manager inputs customer's identification number to check for existing deposit account(s) 2. Relationship Manager selects "Perform risk tolerance test" 3. System displays list of risk tolerance test questions 4. Relationship Manager assist customers to complete the list of questions 5. Customer completes the risk tolerance test
Alternative Courses	<p>1a. Customer has already completed the risk tolerance test by his/her self</p> <ol style="list-style-type: none"> 1. Customer logs into the Merlion Internet Banking System 2. Customer selects "Wealth Management" 3. Customer selects "Perform risk tolerance test"
Exceptional Courses	<p>2a. Customer does not own a deposit account in Merlion Bank</p> <ol style="list-style-type: none"> 1. Relationship Manager assist customer to open a deposit account

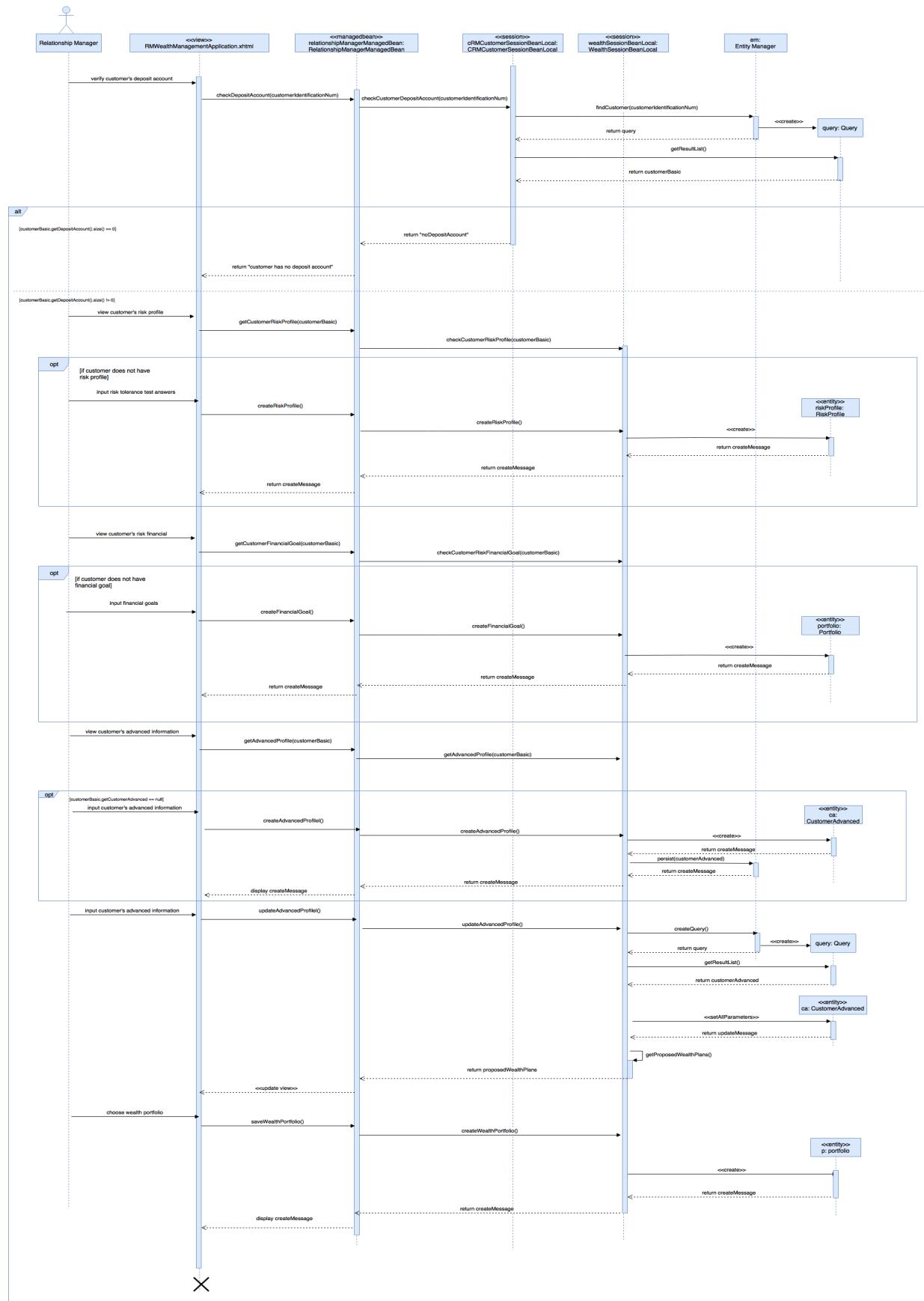
5.7.2.3 Declare Financial Goal(s)

Use case name	Customer declares financial goal(s)
Description	Customer declare financial goals on his/her own on the iBanking System
Actors	Customer
Triggers	Customer declares his/her own financial goals
Goals	Customer's financial goals are recorded
Preconditions	<ol style="list-style-type: none"> 1. The customer has an active iBanking Account 2. The customer has logged into the iBanking System
Postconditions	Customer's financial goals are recorded
Extension Points	None
Basic Courses	<ol style="list-style-type: none"> 1. Customer declares financial goals: <ul style="list-style-type: none"> • Invest amount • Investment period • Expected return 2. Customer clicks "Submit" button
Alternative Courses	None
Exceptional Courses	<p>2a. Customer never clicks the "Submit" button</p> <ol style="list-style-type: none"> 1. The financial goals won be recorded

5.7.3 UML Entity Class Diagram

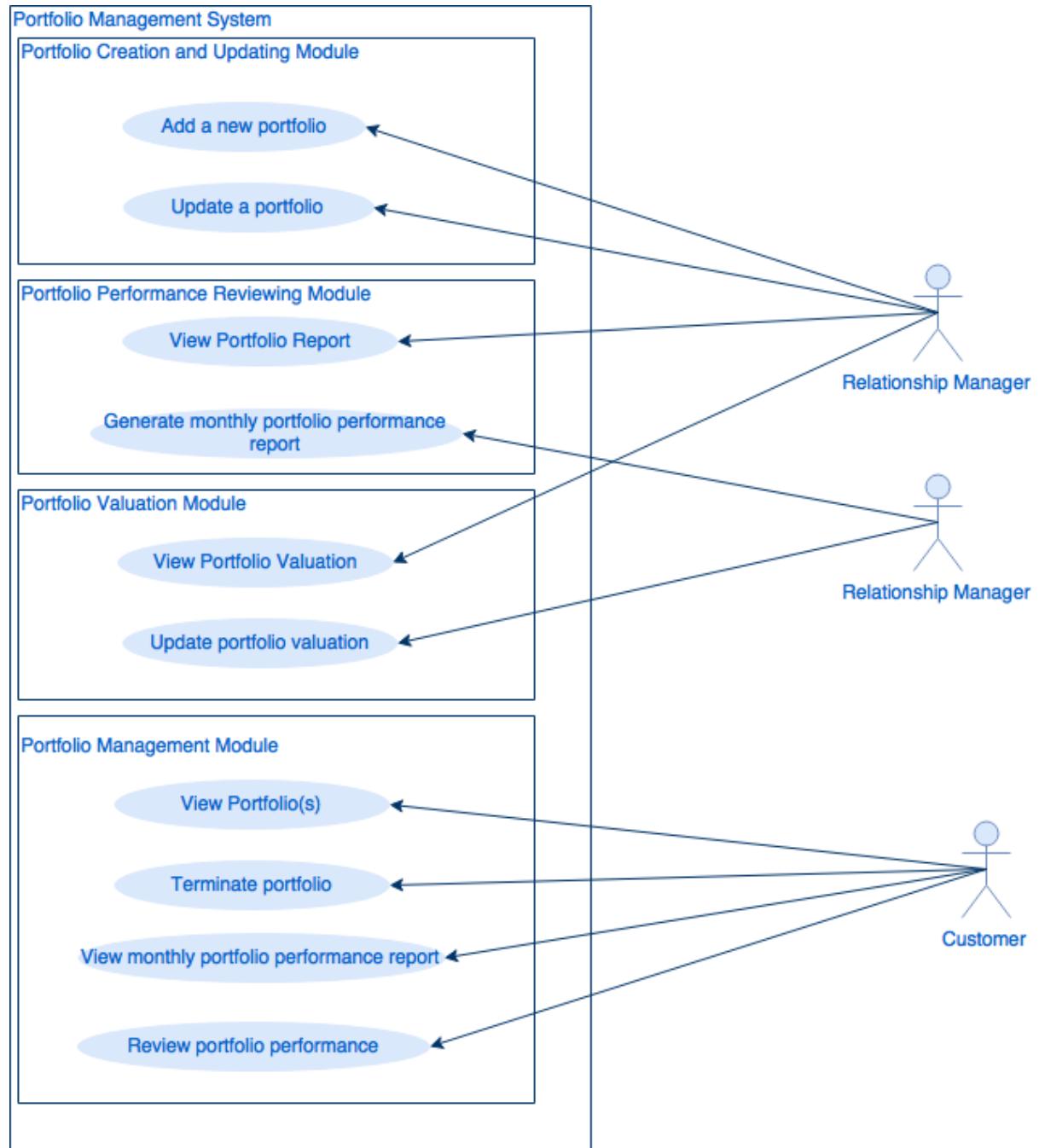


5.7.4 UML Sequence Diagram



5.8 Portfolio Management System

5.8.1 UML Use Case Diagram



5.8.2 UML Use Case Description

5.8.2.1 Update Portfolio

Use case name	Update portfolio
Description	Relationship Manager perform updates to customer's portfolio to maximize profits
Actors	Relationship Manager
Triggers	Relationship Manager wants to ensure customer's wealth plan obtains maximum return
Goals	Relationship Manager successfully perform an update to customer's portfolio(s)
Preconditions	<ol style="list-style-type: none"> 1. Relationship Manager is assigned with at least one wealth management customer 2. Customer has at least one portfolio 3. Relationship Manager has an existing account with the role "Relationship Manager" assigned 4. Relationship Manager is logged in to the internal system
Postconditions	Relationship Manager successfully updates customer's portfolio
Extension Points	None
Basic Courses	<ol style="list-style-type: none"> 1. Relationship Manager selects "Update Portfolio" 2. System displays a list of portfolios 3. Relationship Manager selects one portfolio 4. Relationship Manager selects products that need to be removed 5. Relationship Manager selects "Remove" 6. System displays updated available balance and product list 7. Relationship Manager selects "Add product" 8. System displays a list of product options 9. Relationship Manager selects products to add 10. Relationship Manager selects "Add" 11. System displays updated available balance and product list 12. Relationship Manager edit units bought for each product 13. System displays updated available balance
Alternative Courses	<p>5a. Relationship Manager acts against market trend. Removing product is gaining profit.</p> <ol style="list-style-type: none"> 1. System prompts "Your action does not conform with market trend. Are you sure to proceed?" 2. Relationship Manager chooses "Yes" 3. Continues from Step 6 <p>7a. Relationship Manager acts against market trend. Adding product is at lost.</p> <ol style="list-style-type: none"> 1. System prompts "Your action does not conform with market trend. Are you sure to proceed?" 2. Relationship Manager chooses "Yes"

	<p>3. Continues from Step 8</p> <p>12a. Relationship Manager acts against market trend. Edition of portion is against its earning performance.</p> <ol style="list-style-type: none"> 1. System prompts “Your action does not conform with market trend. Are you sure to proceed?” 2. Relationship Manager chooses “Yes” 3. Continues from Step 13
Exceptional Courses	None

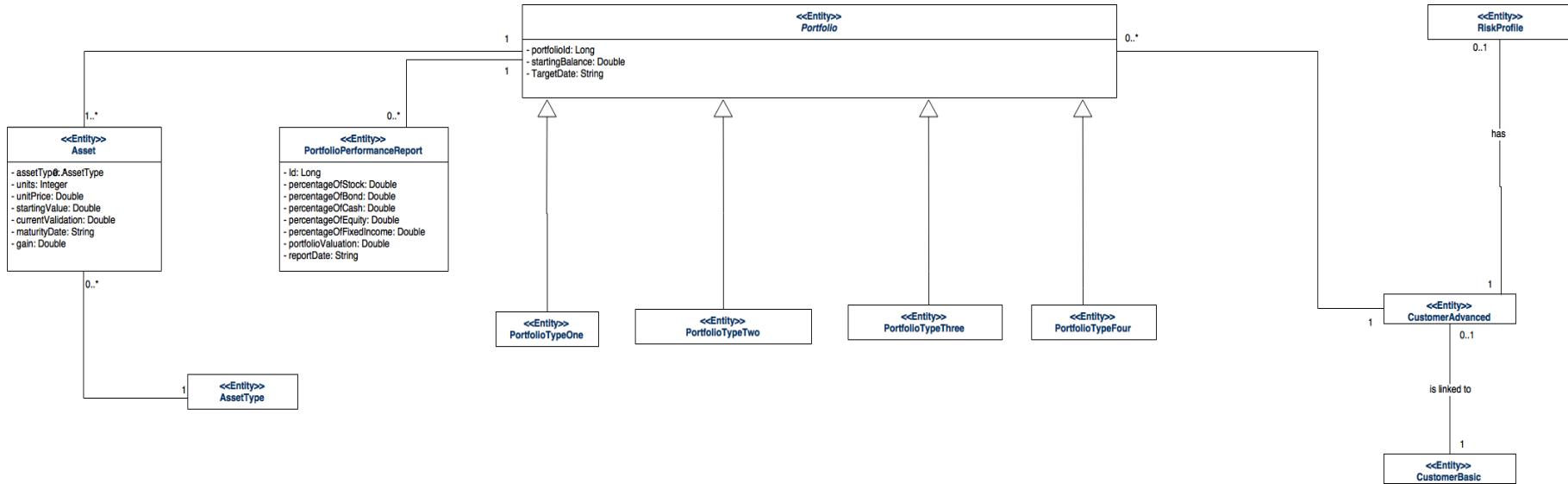
5.8.2.2 Generate Monthly Portfolio Performance Report

Use case name	Generate monthly portfolio performance report
Description	System generates monthly portfolio performance report for Relationship Manager and customer to view
Actors	System
Triggers	Every end of the month
Goals	System display performance report of customer's portfolio
Preconditions	<ul style="list-style-type: none"> 1. There are existing wealth management customers 2. All value submitted by the customers are valid
Postconditions	Performance of portfolio(s) is successfully calculated and displayed
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 1. System retrieves all earning histories of existing portfolios over the past one month 2. System calculates profit rate and loss rate by analyzing portfolio history 3. Portfolio probability trend is calculated and summarized in a chart 4. System displays performance report
Alternative Courses	None
Exceptional Courses	None

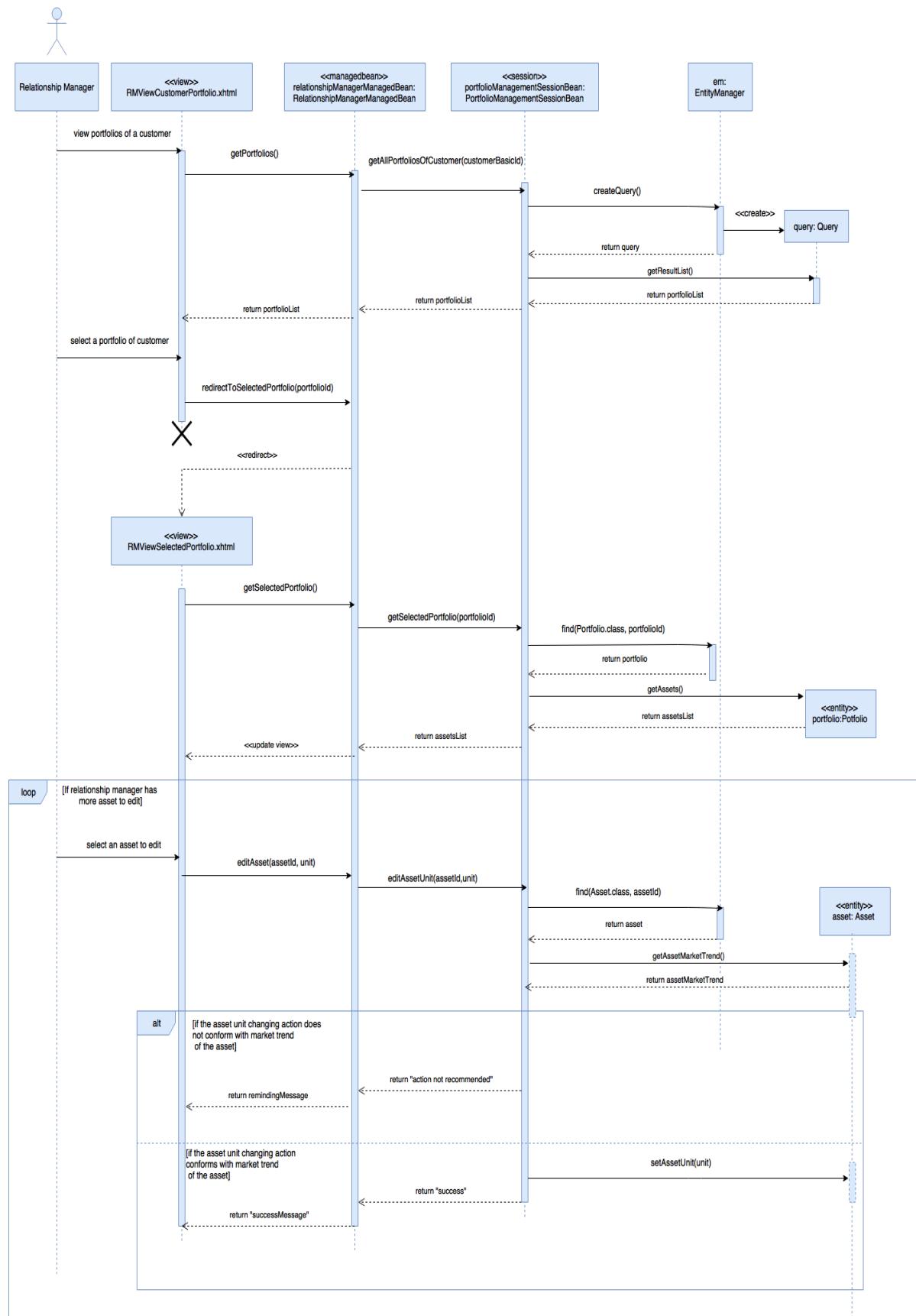
5.8.2.3 Terminate Portfolio

Use case name	Terminate portfolio
Description	Customer terminates portfolio online and accept penalty
Actors	Customer
Triggers	Customer wishes to withdraw from investment
Goals	Customer successfully terminates portfolio
Preconditions	<ul style="list-style-type: none"> 1. Customer has existing portfolio(s) 2. Customer has an existing Merlion Internet Banking account and is logged in
Postconditions	Customer successfully terminates portfolio
Extensions Points	None
Basic Courses	<ul style="list-style-type: none"> 3. Customer selects “Terminate Portfolio” 4. Customer selects terminating portfolio from a list of portfolio(s) 5. Customer selects “Terminate” 6. System calculates terminating penalty fees based on: <ul style="list-style-type: none"> a) Starting balance b) Terminating time c) Profits gained d) Product risk level 1. Customer selects “Confirm” 2. System displays “Portfolio successfully terminated”
Alternative Courses	None
Exceptional Courses	None

5.8.3 UML Entity Class Diagram

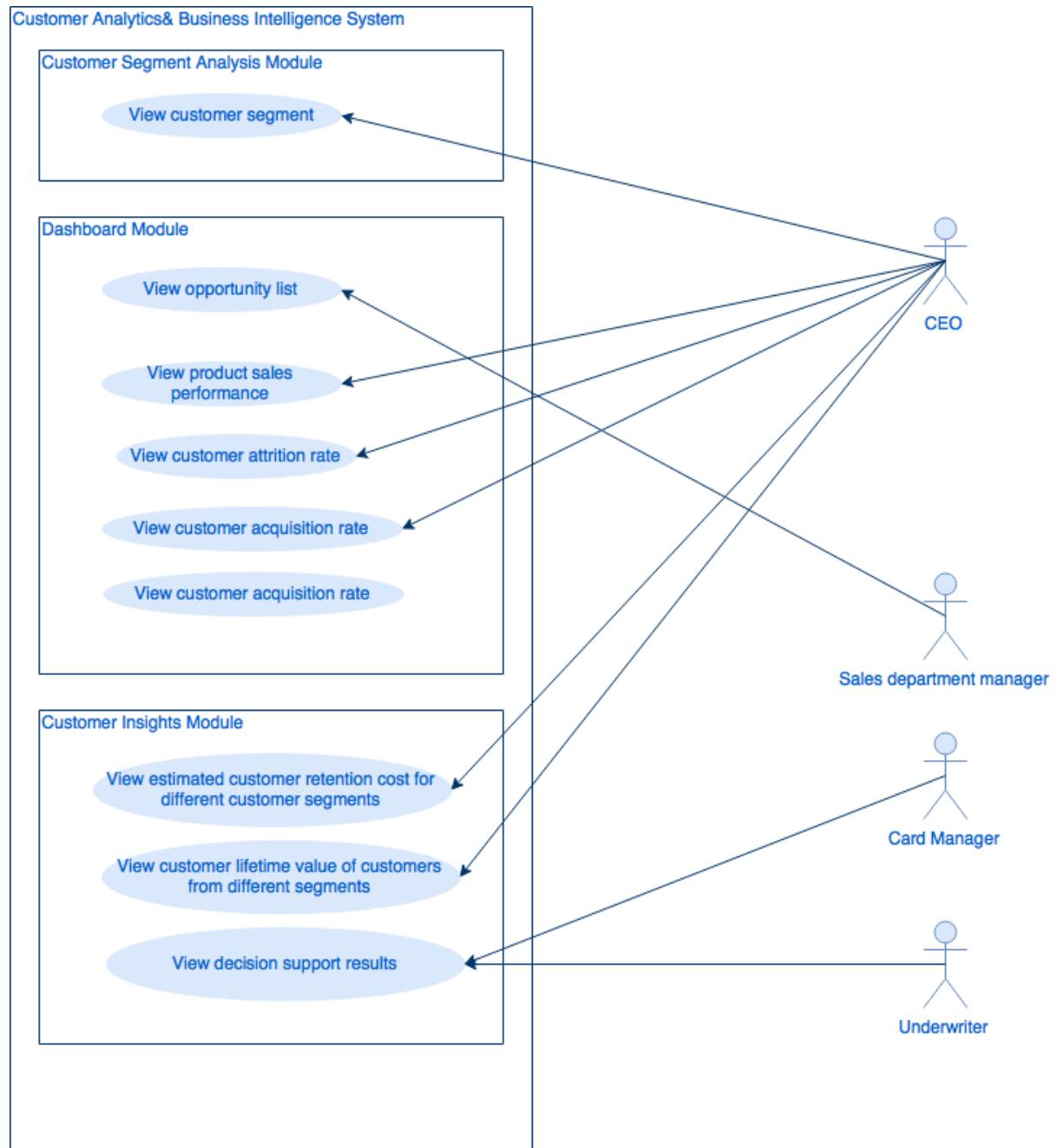


5.8.4 UML Sequence Diagram



5.9 Customer Analytics & Business Intelligence System

5.9.1 UML Use Case Diagram



5.9.2 UML Use Case Description

5.9.2.1 Analyze Customer Lifetime Value

Use Case Name	Analyze Customer Lifetime value
Description	System calculates customer life time value for strategic planning purpose
Actors	System
Triggers	Every end of the month
Goals	To calculate the average customer lifetime value of each customer by estimating net profit generated by the customer
Preconditions	<ol style="list-style-type: none"> 1. Analyzed customer has more than one existing deposit accounts in Merlion Bank 2. Merlion Bank has sufficient customers to perform big data analysis
Postconditions	Customer Lifetime Value of a customer is successfully calculated and stored
Extension Points	None
Basic Courses	<ol style="list-style-type: none"> 1. System retrieves customer's loan history 2. System calculates estimated revenue earned during loan tenure by: $\text{Estimated total loan interest} = \text{Loan tenure} \times \text{interest rate}$ 3. System retrieves customer's deposit account information 4. System retrieves Average customer lifetime by referring to big data analytics, which calculates the average lifetime of a customer. 5. System calculates estimated outlay by: $\text{Estimated total interest rewards} = \text{Deposit balance} \times \text{interest reward} \times \text{average customer lifetime}$ 6. System determined Customer Lifetime Value by: $\text{Customer Lifetime Value} = \text{Estimated total loan interest} - \text{estimated total interest rewards}$ 7. Repeat Steps 1-6 for all customers who has patronize Merlion Bank for over 1 year
Alternative Courses	None
Exceptional Courses	None

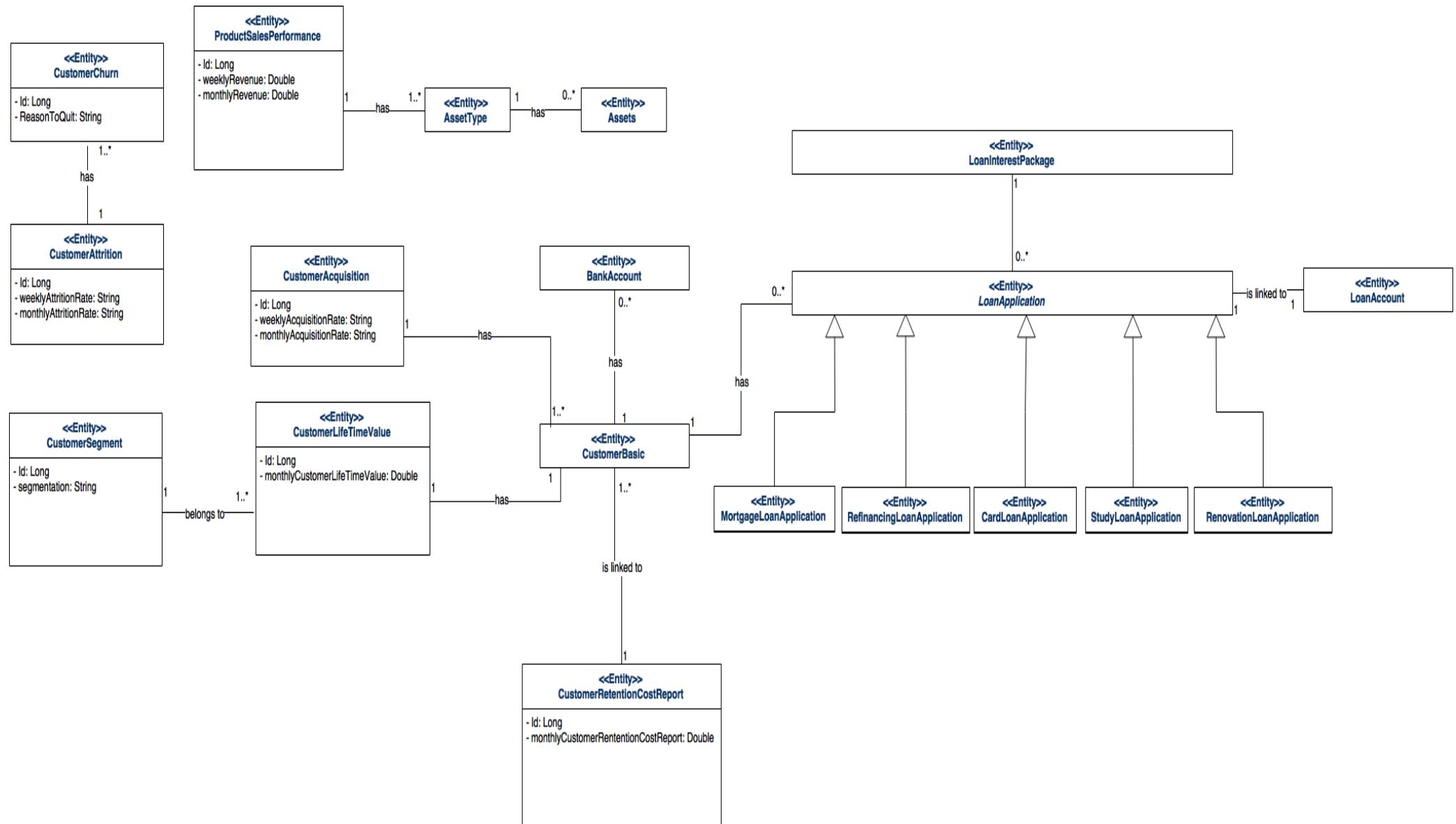
5.9.2.2 Analyze Product Sales Performance

Use case name	Analyze product sales performance
Description	System calculates sales performance for all products
Actors	System
Triggers	Every end of the week and every end of a month
Goals	System calculates performance analytics from the product trading history
Preconditions	There are transactions of financial products
Postconditions	Product sales performance analytics results are calculated and stored in system
Extension Points	None
Basic Courses	<ol style="list-style-type: none"> 1. System retrieves all financial product sales transaction history during the specified period 2. System retrieves the dealing price (or average dealing price) of each product at the specified period 3. System retrieves the quantity sold for each product 4. System calculates total transaction volume for each financial product 5. System displays comparison between different products via pie charts
Alternative Courses	None
Exceptional Courses	None

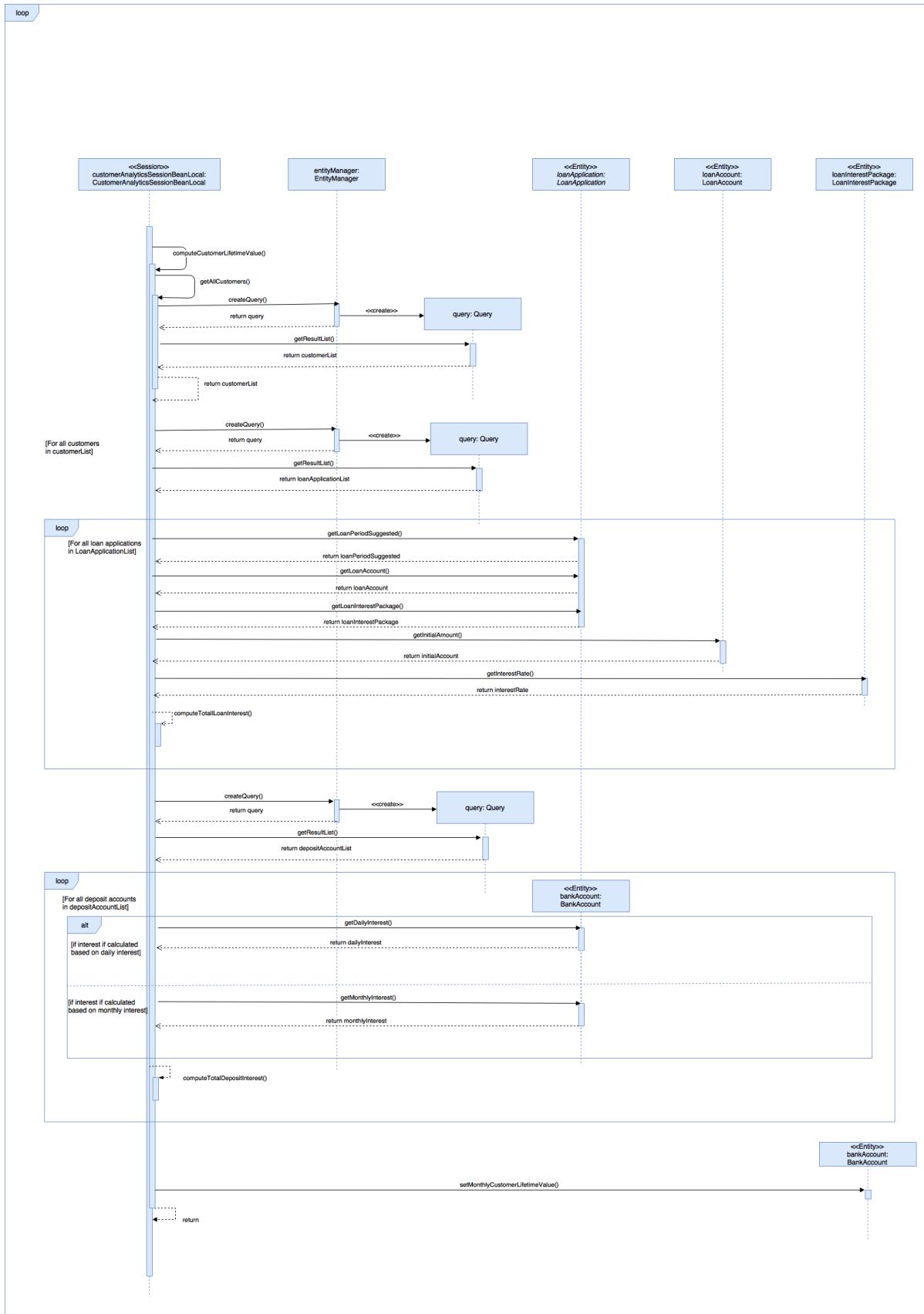
5.9.2.3 Decision Support for Loan Management System

Use case name	Decision Support for Loan Management System
Description	System calculates customer's repaying ability and borrowing risk for reference when determine credit limits for credit cards, and loan amount granted.
Actors	System
Triggers	<ul style="list-style-type: none"> 1. Incoming new credit card application 2. Incoming new loan application
Goals	To compute suitable range of credit limit and loan amount based on customer's information
Preconditions	<ul style="list-style-type: none"> 1. There are existing credit card application and loan application for evaluation 2. All required customer information is sufficient
Postconditions	System generate a recommended range for credit limit and loan amount granted
Extension Points	None
Basic Courses	<ul style="list-style-type: none"> 1. System retrieves customer's financial information including income and other commitments 2. System calculates and obtain a recommended range based on customer's affordance 3. System retrieves customer's credit report and financial records 4. System generates a borrowing risk coefficient to indicate the borrowing risk of the customer 5. System narrows down recommended range considering the coefficient 6. System displays the final recommended range
Alternative Courses	None
Exceptional Courses	None

5.9.3 UML Entity Class Diagram



5.9.4 UML Sequence Diagram – Analyze Customer Lifetime Value



6. User Interface Design

This section will cover the User Interface Design of the online portal running on the Merlion Bank System. Separate platforms will be provided for the customers and the employees, as both user bases have different intended sets of tasks to perform. Bearing in mind the User Centred Design Philosophy (UCD), KTR strives to provide an intuitive, easy-to-use and aesthetic user interface. We keep inline with the pervasive design strategies, including minimalism and visual hierarchy, so as to allow our clients to easily grasp the functions of our portal.

6.1 Design Principles

Along the way while designing the user interface, we try our best to adhere to the following 3 principles as our guidelines.

1. Intuitive

As we put a strong emphasis on the usability our web portal, we try our best to let our users understand the UI components with ease. Besides being efficient in all workflows, making our system easily digestible is also crucial. By organizing our content of each web page in a intelligent and clear way, the cognitive workload of users is reduced. The visual hierarchy strategy also helps the users to conserve their attention for their tasks and the primary function of the web page. We also employ a minimalistic approach by omitting distractible materials, adopting simple recognizable icons, building a natural and efficient workflow, and so on.

2. Consistent

To perfect our user experience, our team strives to keep each of our webpage to be consistent in style of workflow as well as design. This is of tremendous importance, as any obstacles in comprehending our interface due to an inconsistency with the existing grasp of our design, will significantly affect our users' experience. This is especially true as MBS system is prepared for all job roles and kinds of customer services. The constant switching of jobs of employees and adoption of new services of customers should not hinder them from using the system due to a inconsistency in design style.

3. Aesthetic

Admittedly, aestheticism is another significant factor that contributes to our user experience. Our team has put in efforts to produce balanced layouts with sufficient spacing and labeling. The theme colours we adopt for both our logo and our UI are proved to be matching and pleasing to view.

6.2 Overall Design Theme

We utilize Primefaces theme packages for our overall design theme to produce a sleek, utility and responsive site that can be run on all electronic devices. The colours adopted for both the company logo we designed and our overall layout are dark blue and golden yellow, which radiate loyalty and wisdom, as well as affluence and success.

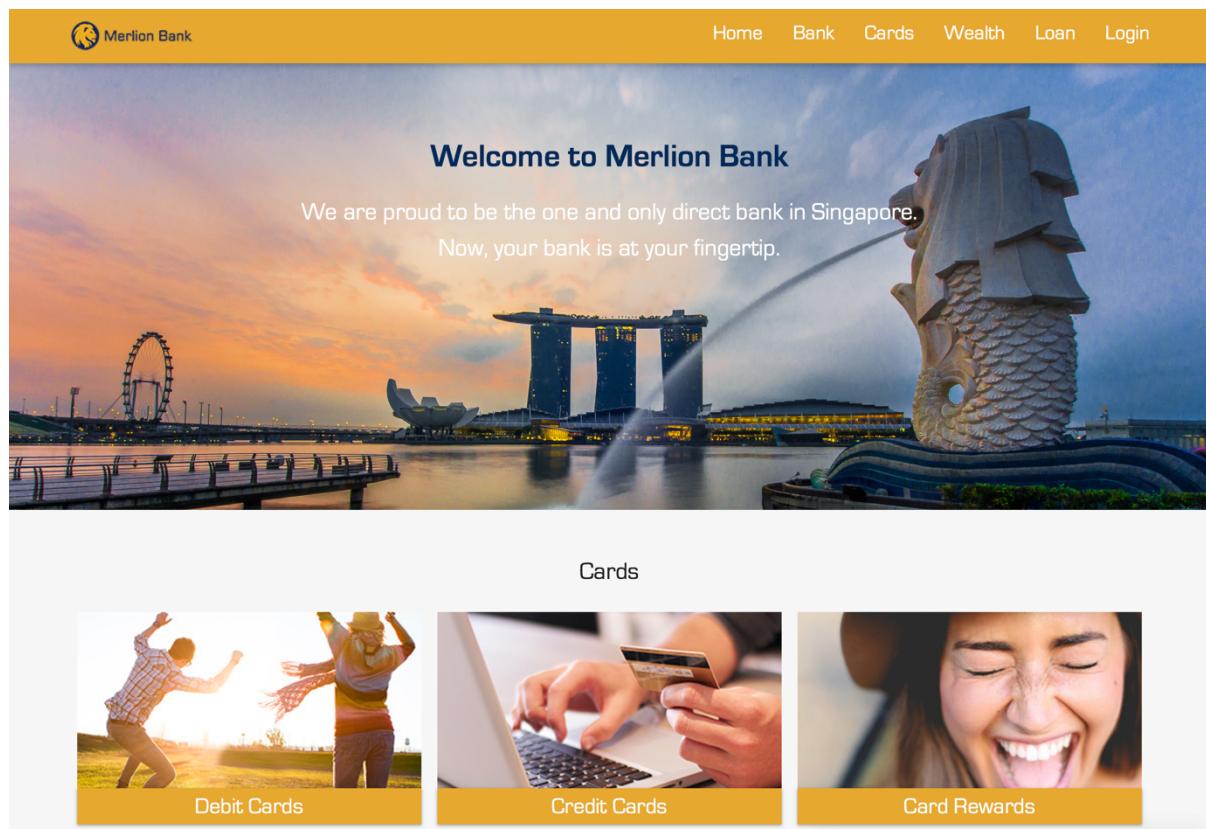


Figure 19: Home page

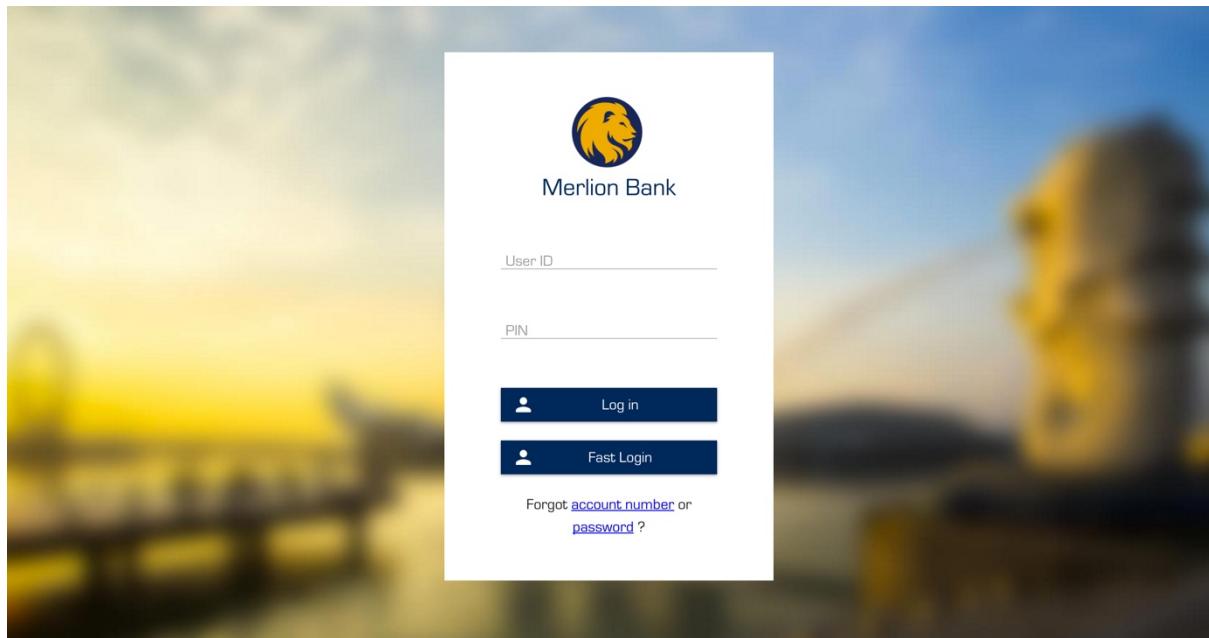


Figure 20: Customer Login

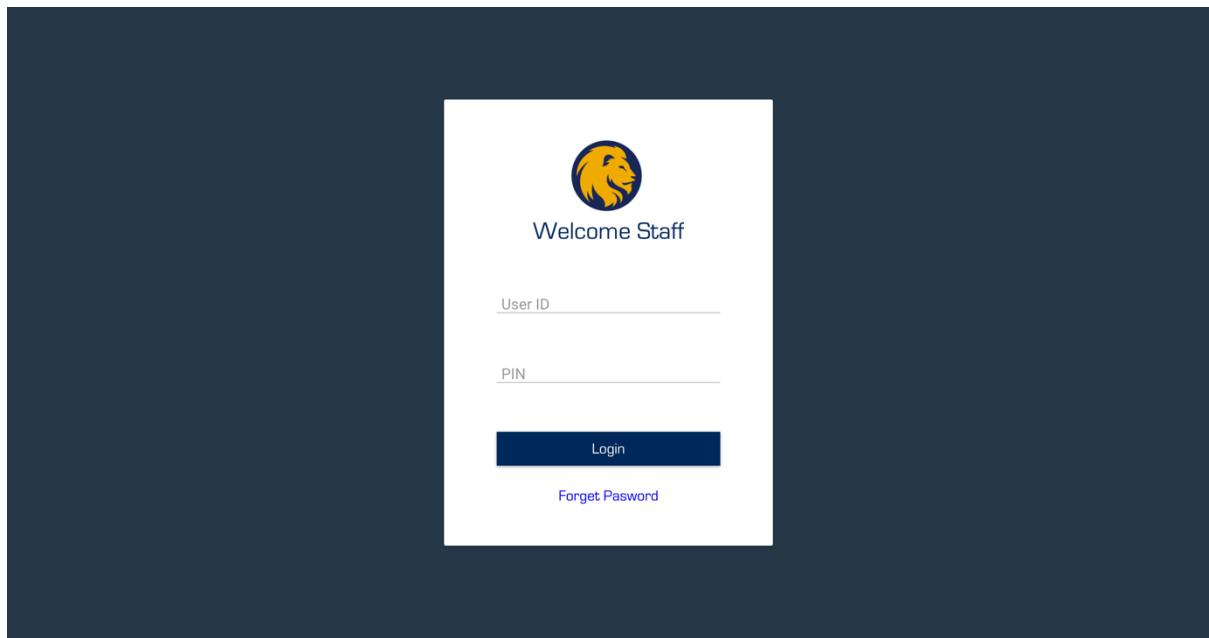


Figure 21: Employee Login

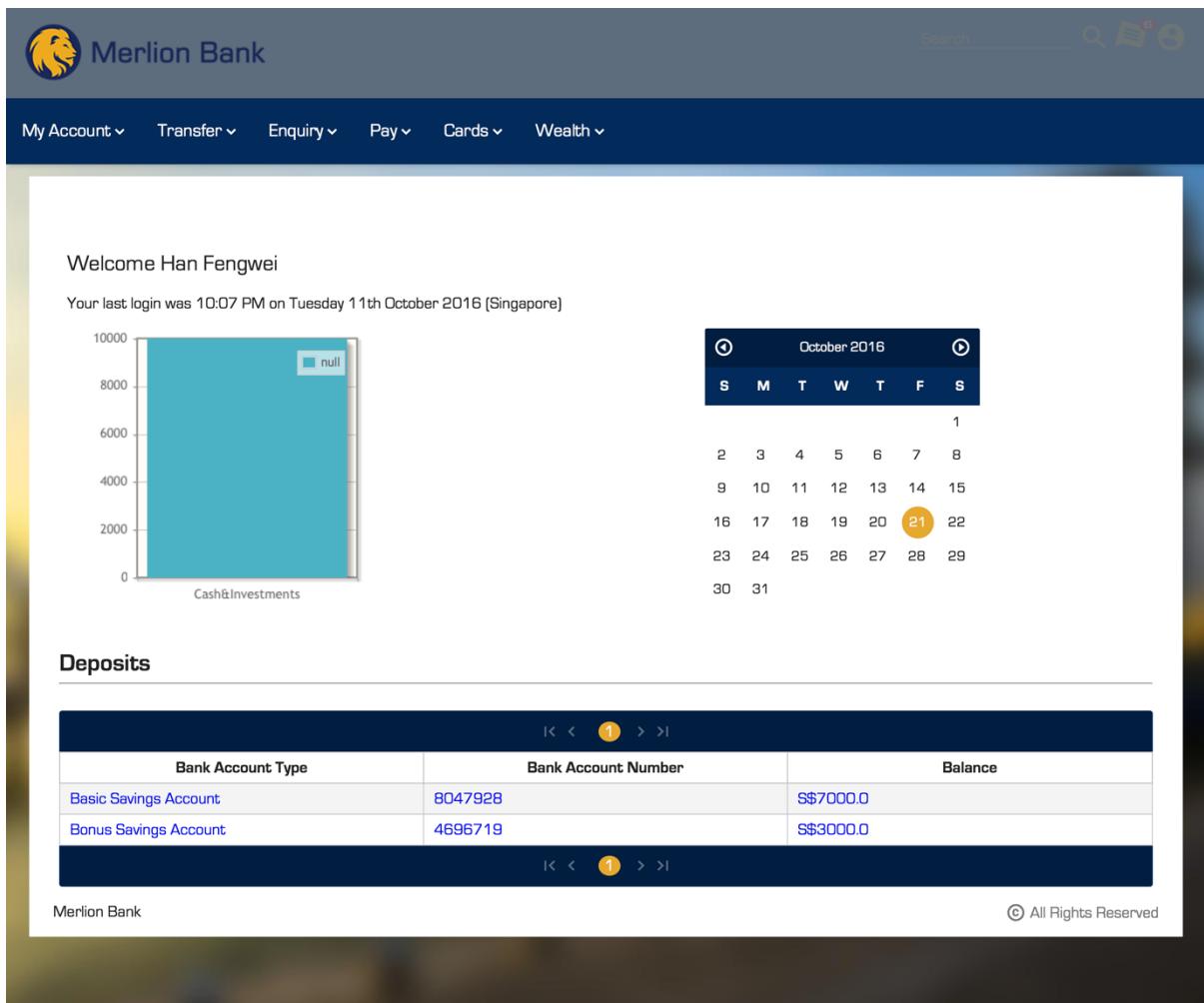


Figure 22: Customer Index

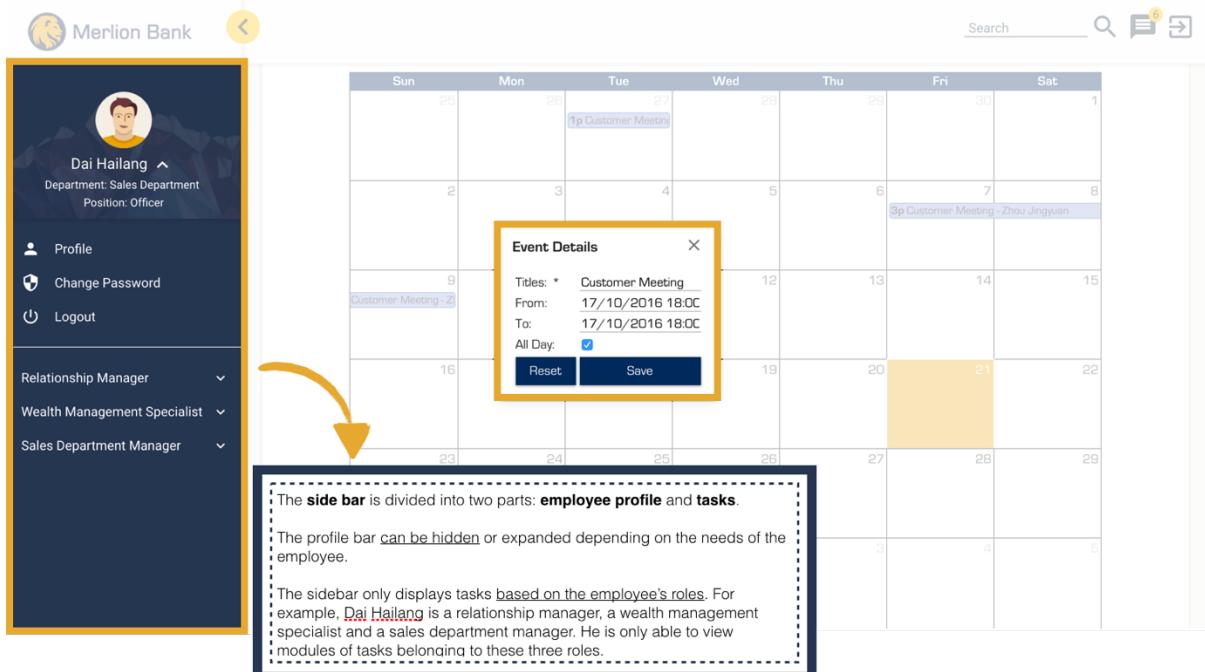


Figure 23: Employee Index

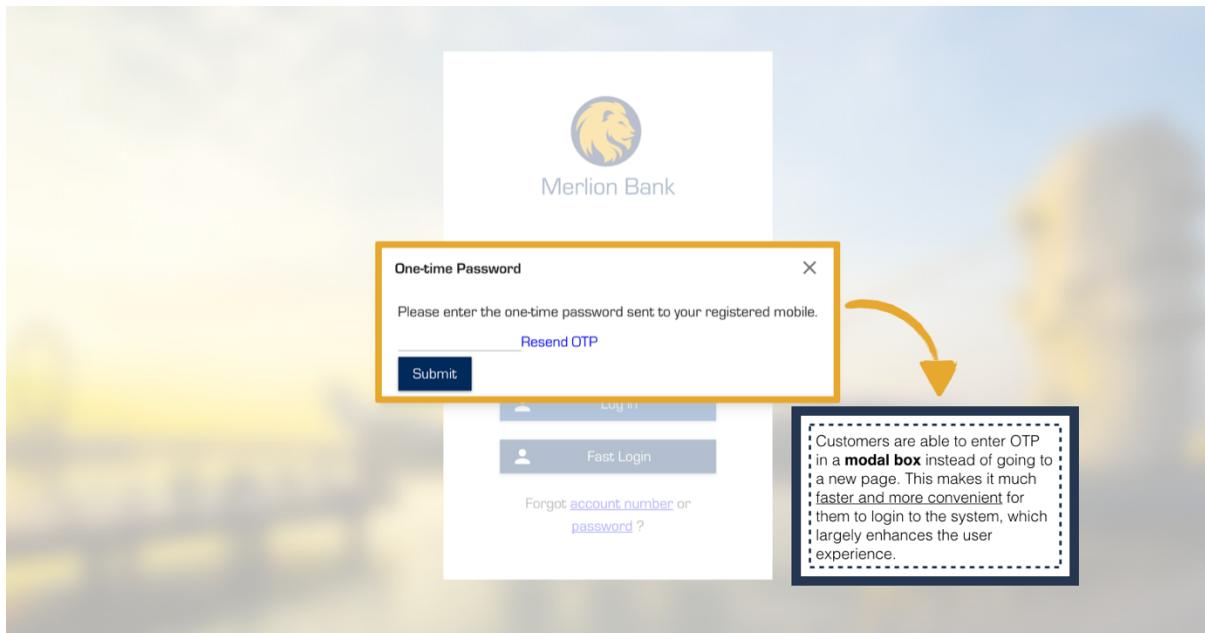


Figure 24: OTP

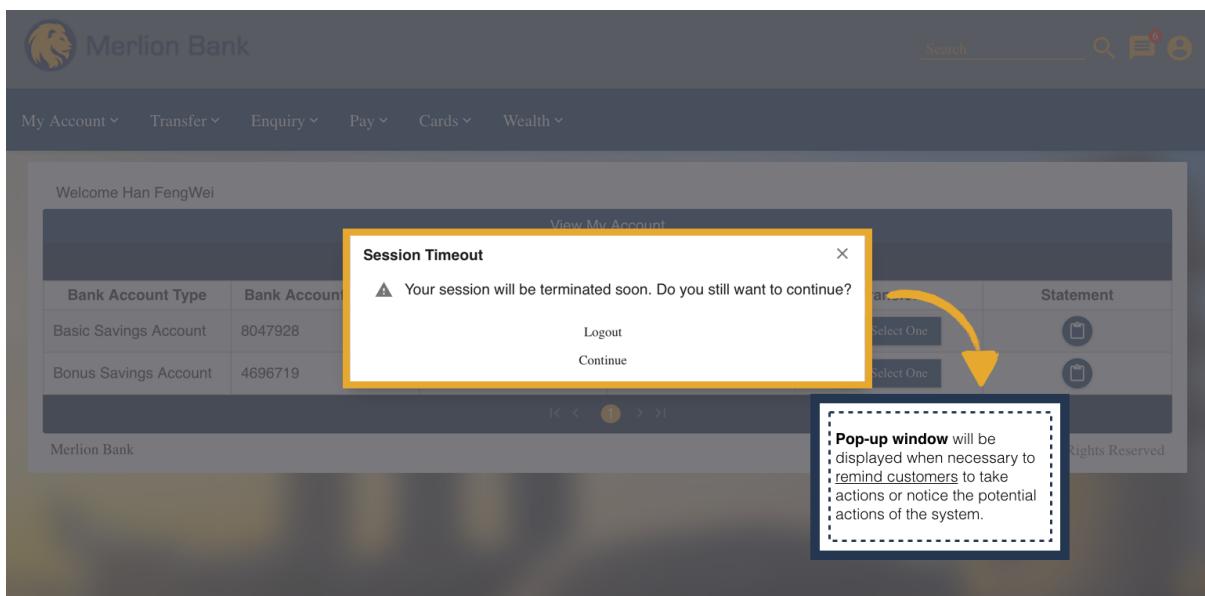


Figure 25: Session Time Out

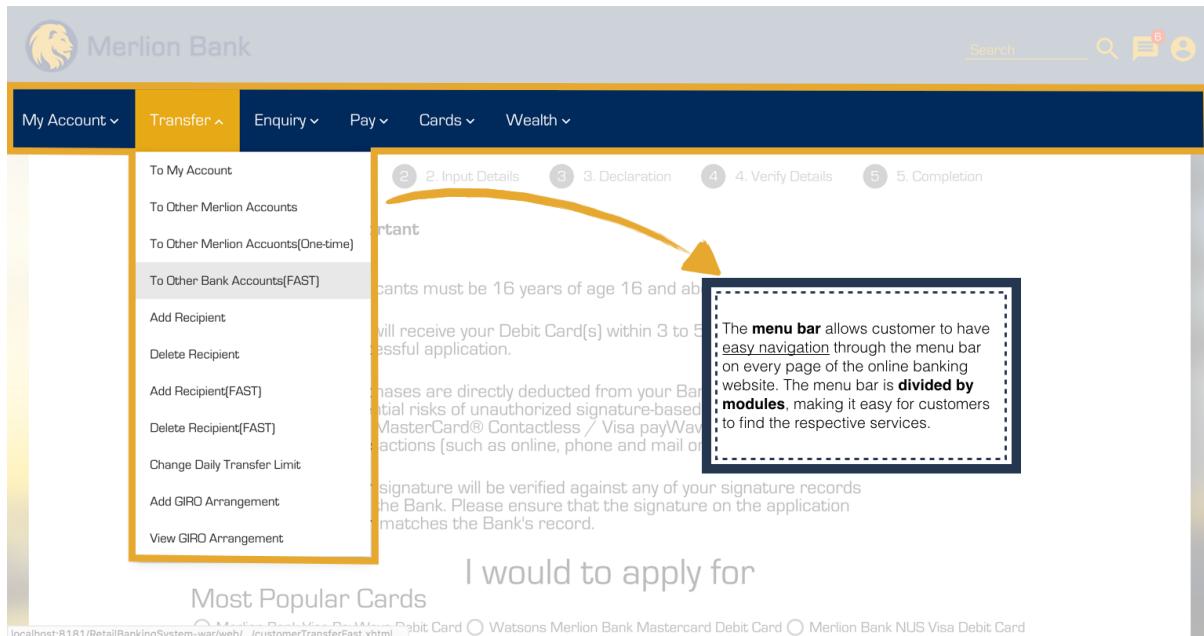


Figure 26: Menu Bar

The screenshot shows the Merlion Bank website interface for opening an account. At the top, there is a breadcrumb navigation: Home > Open Account. Below this is a form with several fields: Nationality (dropdown, currently set to China), Singapore PR (radio buttons, Yes or No, Yes selected), Passport No. (text input), Country of Residence (dropdown, Please Select), Race (dropdown, Please Select), and Marital Status (dropdown, Please Select). A yellow arrow points from the breadcrumb navigation area to the 'Nationality' field. A callout box highlights the 'Breadcrumbs' at the top of the page, stating that they allow customers to know the current page and have easy navigation to every level of the system.

Figure 27: Breadcrumb

The screenshot shows the Merlion Bank Open Account application form. At the top, there is a navigation bar with the Merlion Bank logo and a 'Home > Open Account' link. Below the navigation bar, a horizontal steps bar indicates the current step: '1 Account Information' (highlighted in orange), '2 Personal Information', '3 Detailed Information', '4 Supporting Document', and '5 Confirmation'. The main form area contains several input fields:

- Nationality:** * Singapore (highlighted with an orange border)
- NRIC No.:** *
- Country of Residence:** * Please Select
- Race:** * Please Select
- Marital Status:** * Please Select
- Occupation:** * Please Select

A yellow arrow points from the 'NRIC No.' field towards a callout box containing the following text:

The system provides an **intuitive design** that only displays the required fields according to the customer's previous inputs into the system.

For example, if the customer is a Singaporean, the system will ask the customer to enter his/her NRIC directly. If the customer is a foreigner, the system will ask if customer is Singapore PR, then ask the customer to enter the respective identification number.

Figure 28: Intuitive Design

The screenshot shows the Merlion Bank Open Account application form. At the top, there is a navigation bar with the Merlion Bank logo and a 'Home > Open Account' link. Below the navigation bar, a horizontal steps bar indicates the current step: '1 Account Information' (highlighted in orange), '2 Personal Information' (highlighted in blue), '3 Detailed Information', '4 Supporting Document', and '5 Confirmation'.

The main form area contains several input fields:

- Existing Customer of Merlion Bank:** Yes No
- Salutation:** * Ms
- Name(As per NRIC/Passport):** *
- Date Of Birth:** * 11/30 Required Field
- Gender:** * Male Female
- Mobile Number:** *

A yellow arrow points from the 'Existing Customer of Merlion Bank' field towards a callout box containing the following text:

Steps displayed on top of the application form informs customers of their current progress and provides a rough guideline on the information required by the system.

A yellow arrow points from the 'Name(As per NRIC/Passport):' field towards another callout box containing the following text:

The system enables **data validation** for all input fields. Customers can have direct view of the **error message** beside the fields and change the inputs based on the cues given by the system.

A yellow arrow points from the 'Mobile Number:' field towards a final callout box containing the following text:

Error messages are displayed in **red** to notify customers of incorrect inputs.

Figure 29: Steps bar

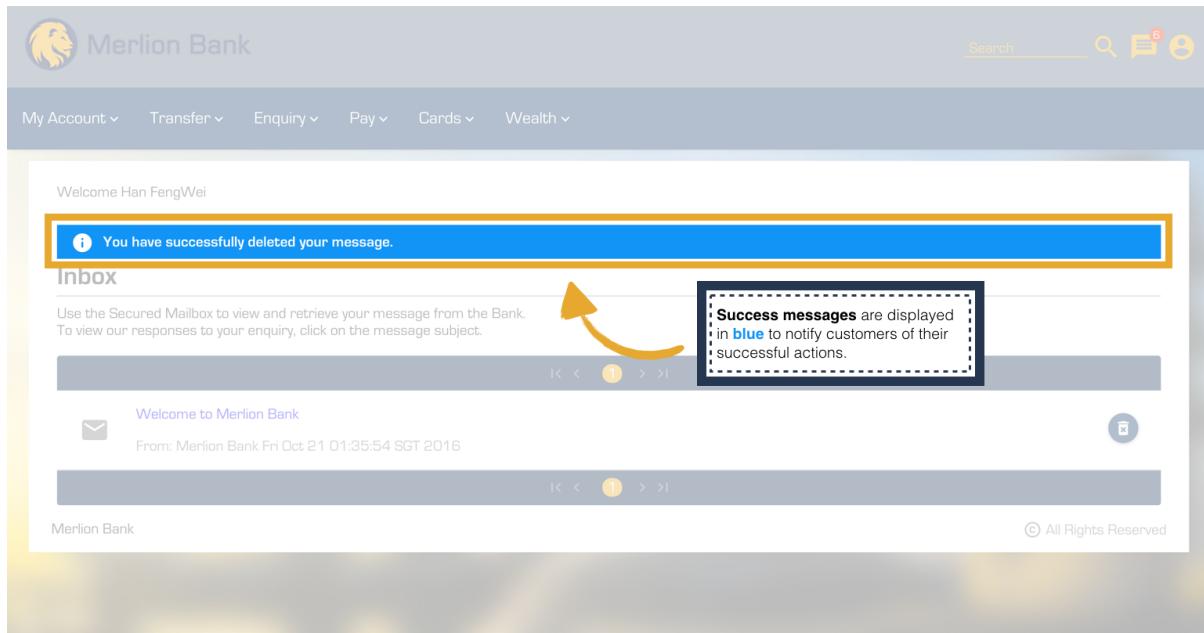


Figure 30: Success Message Bar

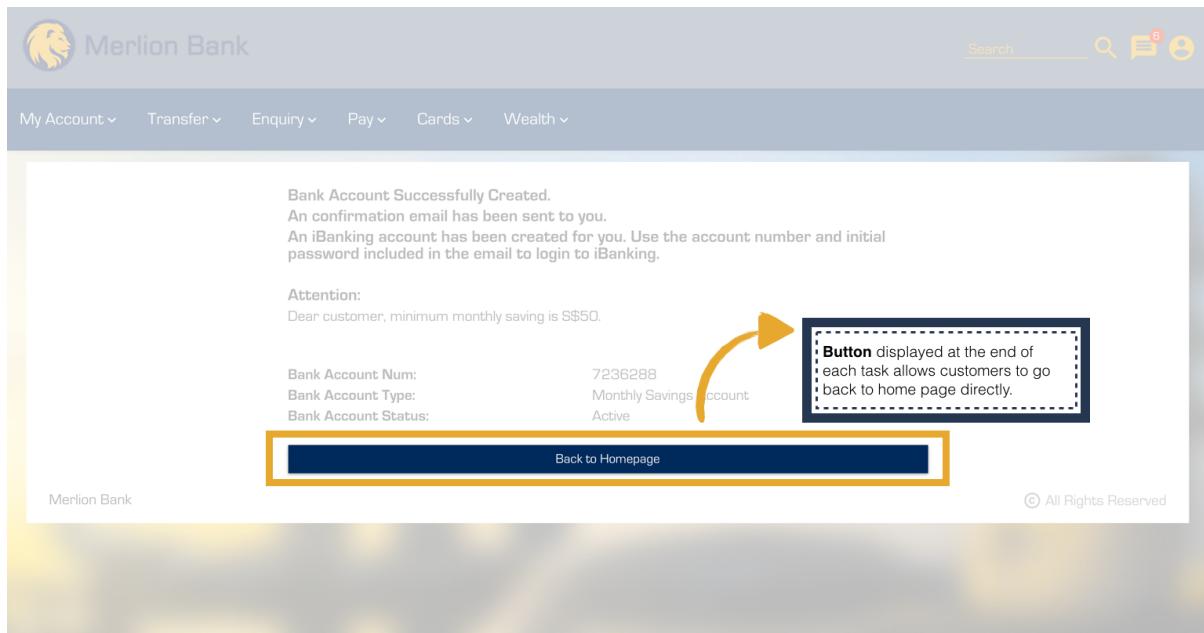


Figure 31: Back Button

You have logged in as System Admin

[Current Employee](#) [Archived Employee](#)

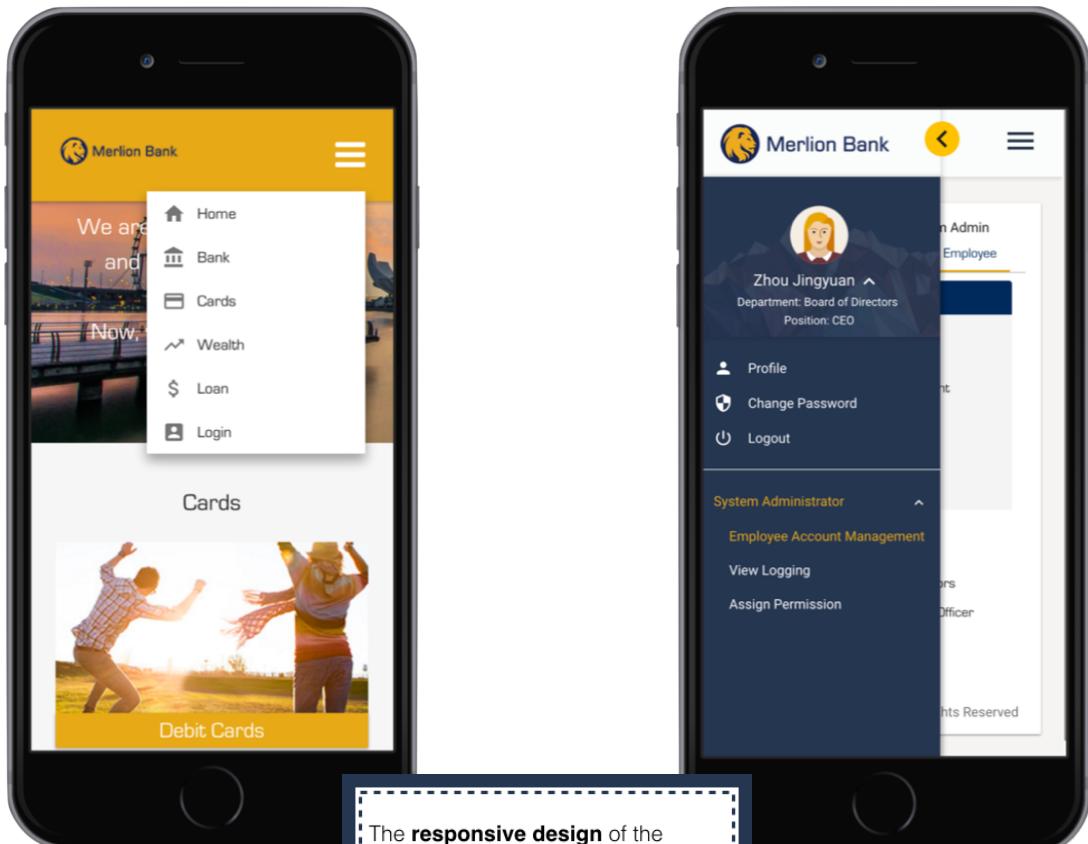
Current Employee

Name	Gender	Department	Position	Mobile Number	Email				
Yang Shuanghe	Female	Loan Department	<input type="checkbox"/> Staff	<input type="checkbox"/> Manager	<input type="checkbox"/> Chief Executive Officer	<input type="checkbox"/> Chief Operation Officer	zhoujingyuan1996@gmail.com		
Lai Qing	Female	Operation Department	<input checked="" type="checkbox"/> Officer	<input type="checkbox"/> Manager	<input type="checkbox"/> Chief Executive Officer	<input type="checkbox"/> Chief Operation Officer	zhoujingyuan1996@gmail.com		
Dai Hailang	Male	Sales Department	<input type="checkbox"/> Staff	<input type="checkbox"/> Manager	<input type="checkbox"/> Chief Executive Officer	<input type="checkbox"/> Chief Operation Officer	zhoujingyuan1996@gmail.com		
Fan Shimeng	Female	Deposit Department	<input type="checkbox"/> Staff	<input type="checkbox"/> Manager	<input type="checkbox"/> Chief Executive Officer	<input type="checkbox"/> Chief Operation Officer	zhoujingyuan1996@gmail.com		

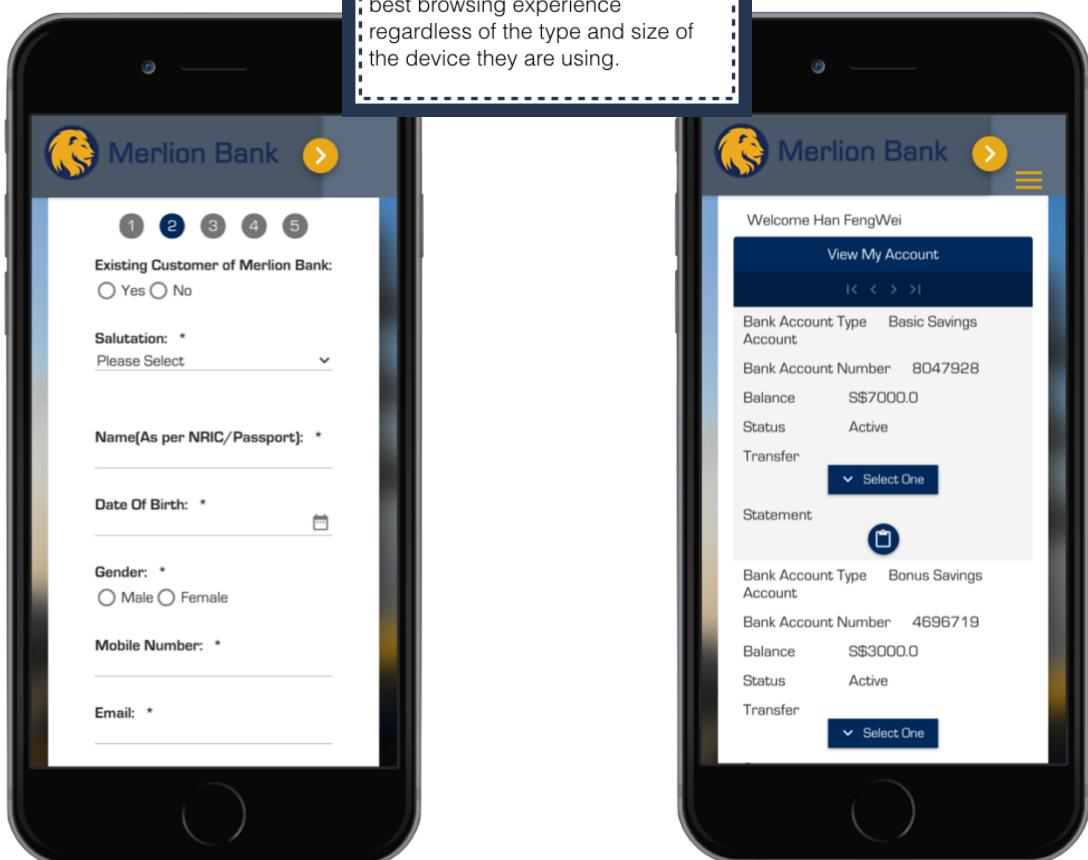
Merlion Bank

Tabs and data tables are presented to provide a comprehensive and clear view of all the information retrieved. Employs are able to sort and filter data by different attributes.

Figure 32: Data Table



The **responsive design** of the system allows users to receive the best browsing experience regardless of the type and size of the device they are using.



Welcome Han FengWei	
View My Account	
Bank Account Type	Basic Savings Account
Bank Account Number	8047928
Balance	S\$7000.0
Status	Active
Transfer	Select One
Statement	
Bank Account Type	Bonus Savings Account
Bank Account Number	4696719
Balance	S\$3000.0
Status	Active
Transfer	Select One

7. Naming and Packaging Conventions

S/N	Convention Type	Description	Example
01	EJB Package Naming	<p>Top level package begins with ejb. Each main module has its own package and sub packages. Each sub package is divided into bean, entity and session.</p> <p>The sub package ejb.common.util contains all the various helper JavaBeans.</p>	ejb.customer.entity, ejb.deposit.session, ejb.infrastructure.entity
02	Web Module Package Naming	All the servlets for each module are placed under their respective package. Each package is named by its function and are written in lower cases.	filter listener
03	Web Folder Naming	<p>Top level folder begins with web.</p> <p>Each main module has its own folder and sub folders. There are in total 3 sub folders, naming internalSystem, merlionBank and onlineBanking.</p>	web/internalSystem/infrast ructure
04	Servlet Path Naming	All servlet paths begin with /web followed by the module and sub module names.	/web/internalSystem/infras tructure/employeeLogin
05	JSP/JSF File Naming	All filenames for JSP/JSF pages begin with executors of the functions follow by the page name.	employeeTransfer.xhtml counterTellerAddNewCase.xhtml
06	Entity Class Naming	All Entity Class are named with their	Employee.java Payee.java

		function name and are written in Title Case with no spaces.	
07	Session EJB Naming	All Session EJB begins with their name and ends with SessionBean and are written in Title Case with no spaces. Their local and remote interface ends with SessionBeanLocal and SessionBean respectively.	BankAccountSessionBean.java EnquirySessionBeanLocal.java EnquirySessionBean.java
08	JSF Managed Bean Naming	All JSF Managed Beans begin with their name in Title Case with no spaces, and end with ManagedBean .	EnquiryManagedBean.java CloseAccountManagedBean.java

8. Declaration of Open Source Code

S/N	Type	Complete Name with Version (Filename)	Source	Usage Location
1	LI	PrimeFaces 6.0 (primefaces-6.0.jar)	http://www.primefaces.org	All web pages
2	LI	Apache Commons IO 2.5 (commons-io-2.5-javadoc.jar, commons-io-2.5.jar)	https://commons.apache.org/proper/commons-io/download_io.cgi	managedbean.deposit, managedbean.loan
3	LI	JasperReports Library 6.2.2 (commons-collections-3.2.1.jar, commons-digester-2.1.jar, commons-logging-1.1.1.jar, groovy-all-2.0.1.jar, iText-2.1.7.js2.jar,	https://mvnrepository.com , https://sourceforge.net/projects/jasperreports/files/jasperreports/JasperReports%206.2.2/	EmployeeViewState FinishManagedBean.java, ViewStatementDoneManagedBean.java

		jasperreports-6.2.2.jar, jasperreports-fonts-6.2.2.jar, jcommon-1.0.15.jar, jfreechart-1.0.12.jar, png-encoder-1.5.jar)		
4	LI	Aerogear OTP (aerogear-otp-java-1.0.0.jar)	https://mvnrepository.com/artifact/org.jboss.aerogear/aerogear-otp-java/1.0.0	all functions implementing OTP services
5	LI	Twilio Java (twilio-java-sdk-5.11.0.jar)	https://mvnrepository.com/artifact/com.twilio.sdk/twilio-java-sdk/5.11.0	SMSSessionBean.java
6	LI	Apache Httpcore (httpcore-4.4.5.jar)	https://hc.apache.org/downloads.cgi	SMSSessionBean.java
7	LI	Apache HttpClient (httpclient-4.5.2.jar)	https://hc.apache.org/downloads.cgi	SMSSessionBean.java
8	LI	Apache Commons Logging 1.2 (commons-logging-1.2.jar)	https://hc.apache.org/downloads.cgi	SMSSessionBean.java
9	LI	Jackson Core Asl (jackson-core-asl-1.9.13.jar)	https://mvnrepository.com/artifact/org.codehaus.jackson/jackson-core-asl/1.9.13	SMSSessionBean.java
10	LI	Jackson Mapper Asl (jackson-mapper-asl-1.9.13.jar)	https://mvnrepository.com/artifact/org.codehaus.jackson/jackson-mapper-asl/1.9.13	SMSSessionBean.java
11	LI	Apache Commons Codec 1.10 (commons-codec-1.10.jar)	https://hc.apache.org/downloads.cgi	SMSSessionBean.java
12	LI	Apache Commons Lang3 3.4 (commons-lang3-3.4.jar)	https://hc.apache.org/downloads.cgi	SMSSessionBean.java

9. Unit Testing Plan

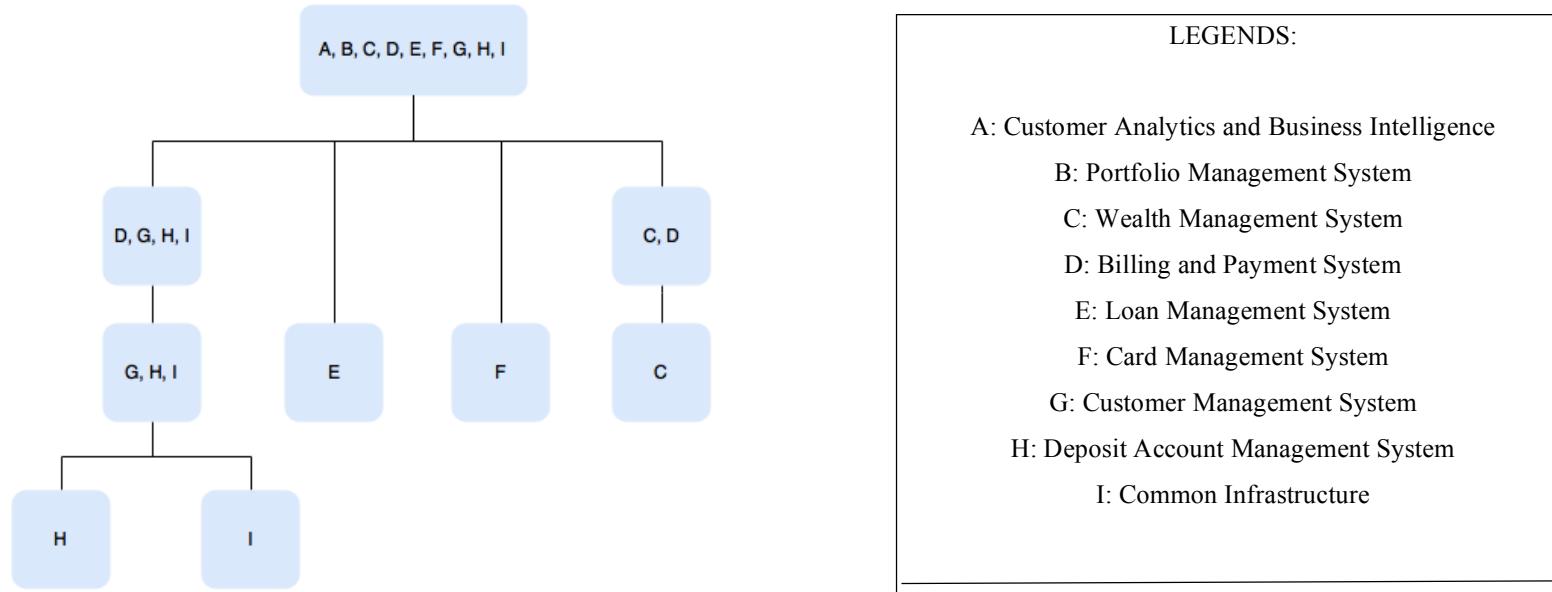


Figure 33: Bottom-up Testing Plan

9.1 Integration Testing

Our team intends to adopt the bottom-up strategy. To start, we will generate a list of test cases for every functionality in each session bean for certain subsystems. Subsequently the testing process will be spread across all the subsystems. Eventually, a system-wide test suite would be created in order to run all the individual test suites.

9.2 Unit Testing

We have written test cases for Customer Management System, Deposit Account Management System and Common Infrastructure modules to satisfy the requirement to test 1/3 of all developed session beans. These modules account for a total of 16 EJB Session Beans. Test cases were generated using equivalence class partitioning with a minimum of one test case for each equivalence class. Both valid and invalid situations have been taken into consideration.

Test	Test Data	Assertion	Outcome
AAU – Customer Management System			
CRMCustomerSessionBeanRemoteTest			
testGetCustomer	“JohnLee1”	assertNotNull(result) assertTrue(result instanceof MessageBox) assertEquals(“A12345678”, result.getCustomerIdentificationNum())	passed
testUpdateCustomerOnlineBankingAccountPIN1	“JohnLee1”, “123456”, “12345678”	assertEquals(“Update Successful”, updateStatus)	passed
testUpdateCustomerOnlineBankingAccountPIN2	“JohnLee1”, “111111”, “12345678”	assertEquals(“Incorrect Current Password”, updateStatus)	passed
testUpdateCustomerOnlineBankingAccountPIN3	“JohnLee1”, “123456”, “123456”	assertEquals(“Same Password”, updateStatus)	passed
testUpdateCustomerBasicProfile1	“JohnLee1”, “Chinese”, “Singapore”, “Single”, “Student”,	assertEquals(“Update Successful”, updateStatus)	passed

	“NTU”, “erhe@hotmail.com”, “98678075”, “PGP, BLK24, #04-G, 11829”, “118429”		
testUpdateCustomerAdvancedProfile	“1”, “University”, “7000”, “5”, “Self-employed”, “Media”, “Consultant”, “3”, “Rented”, “3”)	assertEquals(“Update Successful”, updateStatus)	passed
testAddNewCustomerBasic	“Mark Zuckerberg”, “Mr”, “Z12345678”, “male”, “erhe@hotmail.com”, “98678075”, “14/May/1984”, “United States”, “United States”, “Eurasian”, “Married”, “CEO”, “Facebook”, “FB Street”, “123456”, null, null, null, “new Customer”)	assertEquals(“10”, newCustomerId)	passed
testDeleteCustomerBasic1	“JohnLee2”	assertEquals(“Delete Customer Successfully”, deleteMessage)	passed
testRetrieveCustomerBasicByIC1	“G12345678”	assertNotNull(result) assertEquals(“JohnLee1”, result.getCustomerName())	passed
testRetrieveCustomerBasicByIC2	“FakeUser”	assertTrue(result.isEmpty())	passed
testRetrieveCustomerAdvancedByAdId1	“1”	assertNotNull(result)	passed

		assertEquals("JohnLee1", result.getCustomerOnlineBankingAccountNum())	
testRetrieveCustomerAdvancedByAdId2	"100"	assertTrue(result.isEmpty())	passed
testDeleteCustomerAdvanced1	"10"	assertEquals("Delete Successfully", deleteMessage)	passed
testGetAllNewCustomer	Nil	assertFalse(result.isEmpty()) assertEquals("4", result.size())	passed
testUpdateCustomerMobile	"94694628"	assertEquals("Update Successfully", result.size())	passed
EnquirySessionBeanRemoteTest			
testGetAllEnquiry	Nil	assertFalse(result.isEmpty()) assertEquals("4", result.size())	passed
testGetEnquiryByCaseId	"1"	assertFalse(result.isEmpty())	passed
testGetCustomerByCaseId	"1"	assertNotNull(result) assertEquals("John Lee", result.getCustomerName)	passed
testGetAllPendingCustomerEnquiry	Nil	assertFalse(result.isEmpty()) assertFalse("10", result.size())	passed
testGetAllPendingLoanIssue	Nil	assertFalse(result.isEmpty())	passed

		assertFalse("1", result.size())	
testGetAllPendingCardIssue	Nil	assertFalse(result.isEmpty()) assertFalse("3", result.size())	passed
testGetAllPendingDepositIssue	Nil	assertFalse(result.isEmpty()) assertFalse("2", result.size())	passed
testGetAllPendingOperationIssue	Nil	assertFalse(result.isEmpty()) assertFalse("0", result.size())	passed
testGetAllPendingRMIssue	Nil	assertFalse(result.isEmpty()) assertFalse("4", result.size())	passed
testGetCustomerEnquiryDetail	"1"	assertNotNull(result) assertEquals("How should I apply for a credit card?", returnedDetail)	passed
testGetCustomerEnquiryReply	"1"	assertNotNull(result) assertEquals("Please contact with our staff", returnedIssueReply)	passed
testGetIssueDetail	"1"	assertNotNull(result) assertEquals("Test Issue", returnedIssueDetail)	passed
testGetCaseIssue	"1"	assertFalse(result.isEmpty()) assertEquals("2", result.size())	passed
testGetCaseFollowUp	"1"	assertNotNull(result)	passed

		assertEquals("Test Follow Up", returnedCaseFollowUp)	
testDeleteCase	"2"	assertEquals("Delete Successfully", deleteMessage)	passed
testGetFollowUpByCaseId	"1"	assertFalse(result.isEmpty()) assertEquals("2", result.size())	passed
testAddNewCase	"May I delete my iBanking account?", "Others", "2016-Oct-16 13:25:22", "Pending", "Dear Customer, thank you for your enquiry. We will get back to you soon"	assertEquals("Enquiry sent successfully", addMessage)	passed
testUpdateStatus1	"1", "I want to update my enquiry"	assertEquals("Update Successful", updateMessage)	passed
testAddFollowUp	"1", "I have another enquiry..."	assertEquals("Sent Successful", addMessage)	passed
testAddNewCaseIssue	"1", "Sales Department", "Test Issue Content"	assertEquals("Successful", addMessage)	passed
testReplyCustomerFollowUp	"1", "Test Follow Up Solution"	assertEquals("Reply Sent Successful", replyMessage)	passed
testReplyIssue	"1", "Test Reply Issue"	assertEquals("Reply Sent Successful", replyMessage)	passed

testCaseIssueIsCreated1	“1”	assertEquals(“Yes”, returnedMessage)	passed
testCaseIssueIsCreated2	“4”	assertEquals(“No”, returnedMessage)	passed
testCaseIssueAllReplied1	“1”	assertEquals(“Yes”, returnedMessage)	passed
testCaseIssueAllReplied2	“4”	assertEquals(“No”, returnedMessage)	passed
FollowUpSessionBeanRemoteTest			
testRetrieveFollowUpById1	“1”	assertNotNull(result) assertEquals(“Test Follow Up”, returnedFollowUp)	passed
testRetrieveFollowUpById2	“60”	Unexpected Exception: EntityNotFoundException	passed
testDeleteFollowUp	“4”	assertEquals(“Delete Successfully”, returnedFollowUp)	passed
IssueSessionBeanRemoteTest			
testAddNewIssue	“Loan Department”, “Test Issue Content”, “2016-Oct-20 13:25:22”, “Pending”, “1”	assertNotNull(result)	passed
testDeleteIssue	“5”	assertEquals(“Delete Successfully”, deleteMessage)	passed
testRetrieveIssueByID	“1”	assertNotNull(result)	passed
AAU – Deposit Account Management System			
BankAccountSessionBeanRemoteTest			

testRetrieveBankAccountById	“1”	assertTrue(result instanceof BankAccount); assertEquals(“Basic Savings Account”, result.getBankAccountType())	passed
testRetrieveBankAccountByNum	“John Lee”	assertTrue(result instanceof BankAccount); assertEquals(“Basic Savings Account”, result.getBankAccountType())	passed
testRetrieveBankAccountByCusIC	“G12345678”	assertTrue(result instanceof BankAccount); assertEquals(“Basic Savings Account”, result.getBankAccountType())	passed
testRetrieveCustomerBasicById	“1”	assertTrue(result instanceof Customer); assertEquals(“JohnLee1”, result.getCustomerOnlineBankingAccounnNu m)	passed
testRetrieveCustomerBasicByIC	“G12345678”	assertTrue(result instanceof Customer); assertEquals(“JohnLee1”, result.getCustomerOnlineBankingAccounnNu m)	passed
testRetrieveAccTransactionById	“1”	assertTrue(result instanceof Transaction);	passed
testAddNewAccount	“456316”, “Basic Savings Account”, “0”, “2000”, “0”, “inactive”, “2000”, “10”, null, null, null, “1”, “1”	assertEquals(“Create Successfully”, createMessage)	passed

testDeleteAccount	“456316”	assertEquals(“Deleted Successfully”, createMessage)	passed
testCheckAccountDuplication	“456316”	assertEquals(“Duplicated”, checkMessage)	passed
testGenerateBankAccount	“111111”	assertEquals(“Success”, checkMessage)	passed
testCheckExistence1	“A12345678”	assertTrue(result)	passed
testCheckExistence2	“T11111111”	assertFalse(result)	passed
testChangeDateFormat	Date customerDateOfBirth	assertEquals(“Duplicated”, checkMessage)	passed
testUpdateDepositPeriod	“456316”, “5”	assertEquals(“Update Successfully”, updateMessage)	passed
testCheckInterestRate	“40”	assertEquals(“0.0005”, returnedInterestRate)	passed
testCheckOnlyOneAccount	“A12345678”	assertFalse(result)	passed
testRetrieveCustomerBasicByAccNum	“456316”	assertTrue(result instanceof Customer); assertEquals(“JohnLee1”, result.getCustomerOnlineBankingAccoutnNu m)	passed
testUpdateDailyTransferLimit	“456316”, “5000”	assertEquals(“Update Successfully”, updateMessage)	passed
testResetDailyTransferLimit	“456316”, “5000”	assertEquals(“Update Successfully”, updateMessage)	passed

testAutoCloseAccount	Nil	assertEquals("Close Successfully", closeMessage)	passed
testAddNewAccountOneTime	"456316", "Basic Savings Account", "0", "2000", "0", "inactive", "2000", "10", null, null, null, "1", "1"	assertEquals("Add Successfully", addMessage)	passed
testApproveAccount	"A12345678"	assertEquals("No", result.getNewCustomer())	passed
testSendEmailToRejectCustomer	"A12345678"	assertEquals("Send Successfully", sendMessage)	passed
InterestSessionBeanRemoteTest			
testAddNewInterest	"0.01", "0.05", "Yes", "No"	assertEquals("5", result)	passed
testRetrieveInterestById	"5"	assertNotNull(result) assertEquals("0.01", result.getDailyInterest())	passed
testRetrieveInterestByAccountNum	"1"	assertNotNull(result) assertEquals("0.01", result.getDailyInterest())	passed
testDeleteInterest	"5"	assertEquals("Delete Successfully", deleteMessage)	passed
PayeeSessionBeanRemoteTest			
testAddNewPayee	"Han Fengwei", "456321", "Basic Savings Account", 2016-Oct-20 13:25:22", "6"	assertEquals("2", returnedPayeeId)	passed

testDeletePayee	“456321”	assertEquals(“Successfully deleted!”, deleteMessage)	passed
testRetrievePayeeById	“2”	assertNotNull(result) assertEquals(“Han Fengwei”, result.getPayeeNum())	passed
testRetrievePayeeByName	“Han Fengwei”	assertNotNull(result) assertEquals(“2”, result.getPayeeId())	passed
testRetrievePayeeByCusId	“1”	assertFalse(result.isEmpty()) assertEquals(“2”, result.size())	passed
testRetrievePayeeByNum	“456321”	assertNotNull(result) assertEquals(“2”, result.getPayeeId())	passed
testUpdateLastTransactionDate	“562134”	assertEquals(“Update Successfully”, updateMessage)	passed
StatementSessionBeanRemoteTest			
testAddNewStatement	“2016-Oct-20 13:25:22”, “Transaction”, “Basic Savings Account”, 20, 30, “562134”	assertNotNull(result) assertEquals(“2”, returnedStatementId)	passed
testRetrieveStatementById	“2”	assertNotNull(result)	passed

testRetrieveStatementByAccNum	“562134”	assertNotNull(result)	passed
testHandleStatementDate	“12”	assertEquals(“Dec 2016”, returnedStatementDate)	passed
testDeleteStatement	“2”	assertEquals(“Delete Successfully”, deleteMessage)	passed
TransactionSessionBeanRemoteTest			
testAddNewTransaction	“2016-Oct-20 13:25:22”, “14121”, “12435321”, “132421”, “564323”, “1”	assertEquals(“Transfer Successfully”, deleteMessage)	passed
testCashDeposit	“562134”, “2000”	assertNotNull(result)	passed
testRetrieveBankAccountById	“1”	assertNotNull(result) assertEquals(“562134”, result.getBankAccountNum())	passed
testRetrieveAccTransactionByBankNum	“562134”	assertFalse(result.isEmpty()) assertEquals(“2”, result.size())	passed
testRetrieveBankAccountByNum	“562134”	assertNotNull(result) assertEquals(“1”, result.getBankAccountID())	passed
testCashWithdraw	“562134”, “200”	assertEquals(“2”, returnedTransactionId())	passed
testFundTransfer	“562134”, “163412”, “200”	assertEquals(“3”, returnedTransferId())	passed

testCheckAccountActivation1	“562134”, “2000”	assertEquals(“Initial deposit amount is insufficient”, returnedTransferId())	passed
testCheckAccountActivation2	“562134”, “4000”	assertEquals(“Activated successfully”, returnedTransferId())	passed
testDeleteAccTransaction	“562134”, “1000000”	assertEquals(“Please contact us at 800 820 8820 or visit our branch”, returnedTransferId())	passed
AAU – Common Infrastructure			
CustomerAdminSessionBeanRemoteTest			
testCreateOnlineBankingAccount	“6”	assertEquals("not a new customer", createMessage)	passed
testLogin1	“JohnLee1”, “123456”	assertEquals("LoggedIn", loginMessage)	passed
testLogin2	“JohnLee6”, “123456”	assertEquals("invalidAccount", loginMessage)	passed
testLogin3	“JohnLee6”, “111111”	assertEquals("invalidPassword", loginMessage)	passed
testLogin4	“JohnLee1”, “123456”	assertEquals("locked", loginMessage)	passed
testGetCustomerByOnlineBankingAccount1	“562134”	assertNotNull(result) assertEquals(“JohnLee1”, result.getCustomerName())	passed
testGetCustomerByOnlineBankingAccount2	“111111”	assertTrue(result=null)	passed
testUpdateOnlineBankingAccount	“hehe0204”, “123456”, “6”	assertEquals(“activated”, updateMessage)	passed

testUpdateOnlineBankingPIN	“6”, “12345678”	assertEquals(“Update Successfully”, updateMessage)	passed
testGetCustomerByIdentificationNum1	“G12345678”	assertNotNull(result) assertEquals(“JohnLee1”, result.getCustomerName())	passed
testGetCustomerByIdentificationNum2	“G12341211”	assertTrue(result=null)	passed
testResetPassword	“G12345678”	assertTrue(returnedValue)	passed
testCheckExistingService	“1”	assertFalse(result.isEmpty()) assertEquals(“2”, result.size())	passed
testDeleteOnlineBankingAccount	“10”	assertEquals(“Delete Successfully”, deleteMessage)	passed
testLockCustomerOnlineBankingAccount	“6”	assertEquals(“Locked the account”, deleteMessage)	passed
testUnlockCustomerOnlineBankingAccount	“6”	assertEquals(“Unlocked the account”, deleteMessage)	passed
EmployeeAdminSessionBeanRemoteTest			
testLogin1	“1001”, “12345678”	assertEquals("LoggedIn", loginMessage)	passed
testLogin2	“1200”, “123456”	assertEquals("invalidAccount", loginMessage)	passed
testLogin3	“1001”, “111111”	assertEquals("invalidPassword", loginMessage)	passed
testLogin4	“1001”, “12345678”	assertEquals("locked", loginMessage)	passed

testGetEmployeeByAccountNum	“1001”	assertNotNull(result) assertEquals(“Zhou Jingyuan”, result.getEmployeeName())	passed
testFindRole	“1”	assertNotNull(result)	passed
testCreateEmployeeAccount	“Jack”, “male”, “Sales Department”, “Manager”, “A111122X, “98678075”, “erhe@hotmail.com”, “Counter Teller”	assertNotNull(returnedMessage)	passed
testUpdateEmployeeAccount	“1”, “Jack”, “Card Department”, “Manager”, “98678075”, “erhe@hotmail.com”, “Counter Teller”	assertEquals(“Update Successfully”, updateMessage)	passed
testGetSelectedRoles	“1”	assertFalse(result.isEmpty()) assertEquals(“1”, result.size())	passed
testSetSelectedRoles	“Counter Teller”, String[] selectedPermission	assertEquals(“Update Successfully”, updateMessage)	passed
testFilterAccountByDepartment	“Card Department”	assertFalse(result.isEmpty()) assertEquals(“2”, result.size())	passed
testGetEmployees	Nil	assertFalse(result.isEmpty()) assertEquals(“7”, result.size())	passed
testGetAllRoles	Nil	assertFalse(result.isEmpty())	passed

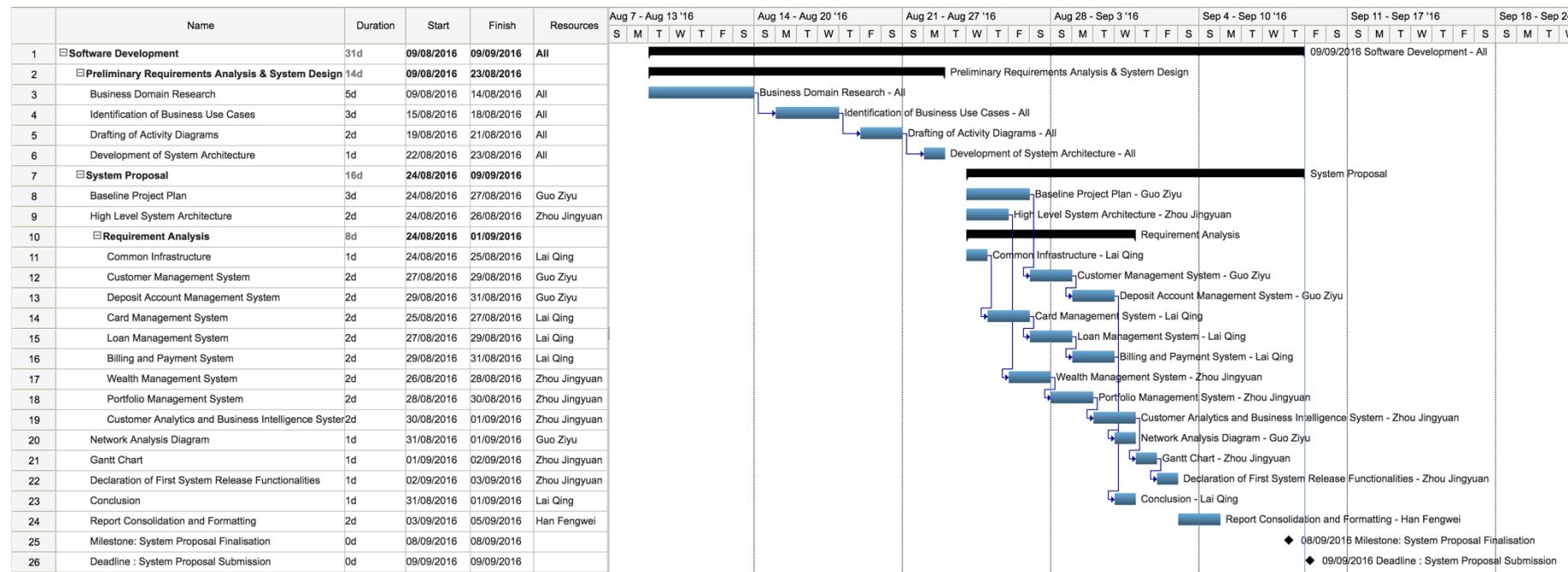
		assertEquals("22", result.size())	
testGetArchivedEmployees	Nil	assertFalse(result.isEmpty()) assertEquals("1", result.size())	passed
testGetEmployeeById	"3"	assertNotNull(result) assertEquals("Yang Shuanghe", result.getEmployeeName())	passed
testGetEmployeeDepartments	Nil	assertFalse(result.isEmpty()) assertEquals("7", result.size())	passed
testGetEmployeePositions	Nil	assertFalse(result.isEmpty()) assertEquals("7", result.size())	passed
testGetEmployeeGenders	Nil	assertFalse(result.isEmpty()) assertEquals("7", result.size())	passed
testDeleteEmployee	employee	assertEquals("Delete Successfully", result.size())	passed
testEditUserAccount	"1", "Jack", "Card Department", "Manager", "98678075", "erhe@hotmail.com"	assertEquals("Update Successfully", editMessage)	passed
testGetPermissionList	"Counter Teller"	assertFalse(result.isEmpty()) assertEquals("16", result.size())	passed
testGetSelectedPermissionList	"1"	assertFalse(result.isEmpty()) assertEquals("2", result.size())	passed

testSetSelectedPermissionList	“Card Specialist”, String[] selectedPermission	assertEquals(“Set Permissions Successfully”, result.size())	passed
testGetRoleByName	“Enquiry Processer”	assertNotNull(result) assertEquals(“Enquiry Processer”, result.getRoleName())	passed
testDeletePermission	“Counter Teller”, “View Enquiry”	assertEquals(“Delete Successfully”, deleteMessage)	passed
testAddPermissionToRole	“Counter Teller”, “View Enquiry”	assertEquals(“Add Successfully”, addMessage)	passed
EmployeeEmailSessionBeanRemoteTest			
testResetPwd1	“A12345678”, “erhe@hotmail.com”	assertEquals(“valid”, addMessage)	passed
testResetPwd2	“A11111111”, “erhe@hotmail.com”	assertEquals(“invalid”, resetMessage)	passed
testChangePwd1	“123456”, “12345678”, “1”	assertEquals(“success”, resetMessage)	passed
testChangePwd2	“123456”, “123456”, “1”	assertEquals(“equal”, resetMessage)	passed
testChangePwd3	“111111”, “12345678”, “1”	assertEquals(“invalid”, resetMessage)	passed
testInitialPwd	“A12345678”, “erhe@hotmail.com”	assertEquals(“valid”, initialMessage)	passed
EmployeeRolePermissionManagementSessionBeanRemoteTest			
testGetPermissions	“Relationship Manager”	assertFalse(result.isEmpty())	passed
LoggingSessionBeanRemoteTest			

testRetrieveAllCustomerLogging	Nil	assertFalse(result.isEmpty())	passed
testRetrieveAllEmployeeLogging	Nil	assertFalse(result.isEmpty())	passed
testRetrieveAllSystemLogging	Nil	assertFalse(result.isEmpty())	passed
MessageSessionBeanRemoteTest			
testRetrieveMessageBoxByCusIC	“A12345678”	assertNotNull(result)	passed
testAddNewMessage	“Merlion Bank”, “Service”, “Welcome to Merlion Bank ”, “Fri Oct 14 13:12:27 SGT 2016”, “Welcome to Merlion Bank!”, “1”	assertTrue(result instanceof MessageBox); assertEquals(“Merlion Bank”,result.getFromWhere())	passed
testRetrieveMessageBoxById	“1”	assertNotNull(result) assertTrue(result instanceof MessageBox);	passed
testDeleteMessage	“1”	assertEquals(“Delete Successfully”,result.getFromWhere())	passed
testSendMessage	“Merlion Bank”, “Service”, “Welcome to Merlion Bank ”, “Fri Oct 14 13:12:27 SGT 2016”, “Welcome to Merlion Bank!”, “1”	assertEquals(“Send Successfully”, sendMessage)	passed
SMSSessionBeanRemoteTest			
testSendOTP	CustomerBasic customer	assertEquals(“Send Successfully”, sendMessage)	passed

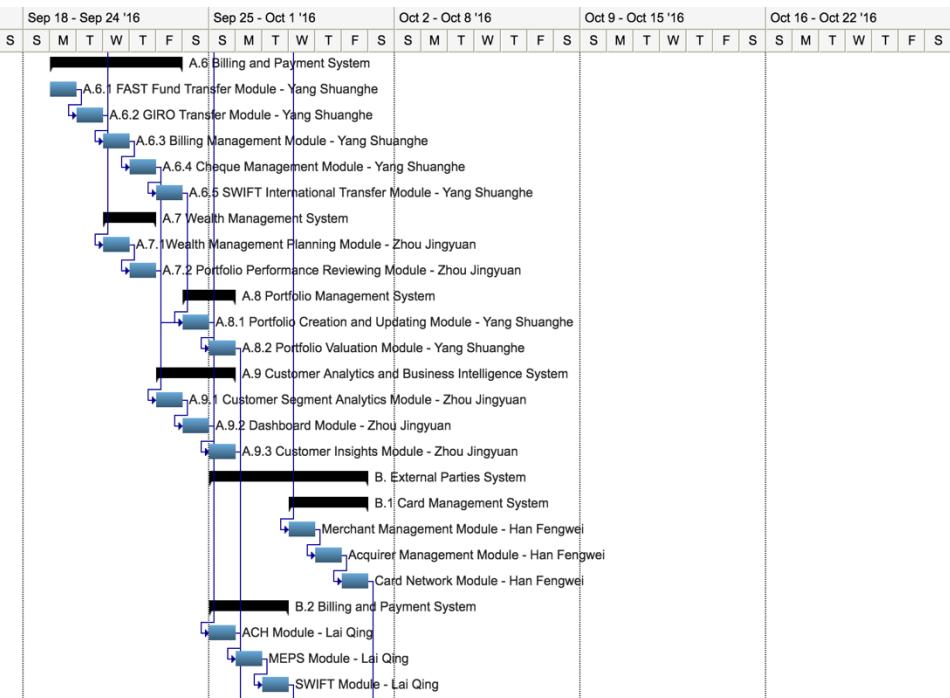
testSendSMS	“Hi Customer”, “98678075”	assertEquals(“Send Successfully”, sendMessage)	passed
-------------	---------------------------	---	--------

10. Project Management Plan



	Name	Duration	Start	Finish	Resources	Sep 11 - Sep 17 '16					Sep 18 - Sep 24 '16					Sep 25 - Oct 1 '16					Oct 2 - Oct 8 '16					Oct 9 - Oct 15 '16					Oct 16 - Oct 22 '16							
						S	M	T	W	F	S	S	M	T	W	F	S	S	M	T	W	F	S	S	M	T	W	F	S	S	M	T	W	F	S			
27	Software Development	73d	09/08/2016	21/10/2016																																Software Development		
28	System Analysis and Design Report	54d	09/08/2016	02/10/2016																																		
29	Summary of Findings	2d	19/09/2016	21/09/2016	Lai Qing																															System Analysis and Design Report		
30	Requirement Analysis	3d	19/09/2016	22/09/2016	Guo Ziyu																																	
31	High Level System Infrastructure	2d	19/09/2016	21/09/2016	Zhou Jingyuan																																	
32	Functional Modules Design	54d	09/08/2016	02/10/2016																																Functional Modules Design		
33	A.1 Common Infrastructure	4d	21/09/2016	25/09/2016																																A.1 Common Infrastructure		
34	A.1.1 System User Account Management Module	1d	21/09/2016	22/09/2016	Han Fengwei																																A.1.1 System User Account Management Module - Han Fengwei	
35	A.1.2 Internal Communication Module	1d	22/09/2016	23/09/2016	Han Fengwei																																A.1.2 Internal Communication Module - Han Fengwei	
36	A.1.3 External Communication Module	1d	23/09/2016	24/09/2016	Han Fengwei																																A.1.3 External Communication Module - Han Fengwei	
37	A.1.4 Security Module	1d	24/09/2016	25/09/2016	Han Fengwei																																A.1.4 Security Module - Han Fengwei	
38	A.2 Customer Management System	3d	22/09/2016	25/09/2016	Han Fengwei																																A.2 Customer Management System	
39	A.2.1 Customer Information Management Module	1d	22/09/2016	23/09/2016	Guo Ziyu																																A.2.1 Customer Information Management Module - Guo Ziyu	
40	A.2.2 Customer Advanced Information Management Module	1d	23/09/2016	24/09/2016	Guo Ziyu																																A.2.2 Customer Advanced Information Management Module - Guo Ziyu	
41	A.2.3 Enquiry Management Module	1d	24/09/2016	25/09/2016	Guo Ziyu																																A.2.3 Enquiry Management Module - Guo Ziyu	
42	A.3 Deposit Account Management System	3d	19/09/2016	22/09/2016																																	A.3 Deposit Account Management System	
43	A.3.1 Account Management Module	1d	19/09/2016	20/09/2016	Peng Yongxue																																	A.3.1 Account Management Module - Peng Yongxue
44	A.3.2 Account Balance Management Module	1d	20/09/2016	21/09/2016	Peng Yongxue																																A.3.2 Account Balance Management Module - Peng Yongxue	
45	A.3.3 Interest Crediting Management Module	1d	21/09/2016	22/09/2016	Peng Yongxue																																A.3.3 Interest Crediting Management Module - Peng Yongxue	
46	A.4 Card Management System	3d	25/09/2016	28/09/2016																																	A.4 Card Management System	
47	A.4.1 Debit Card Module	1d	25/09/2016	26/09/2016	Han Fengwei																																A.4.1 Debit Card Module - Han Fengwei	
48	A.4.2 Credit Card Module	1d	26/09/2016	27/09/2016	Han Fengwei																																A.4.2 Credit Card Module - Han Fengwei	
49	A.4.3 Payment Module	1d	27/09/2016	28/09/2016	Han Fengwei																																A.4.3 Payment Module - Han Fengwei	
50	A.5 Loan Management System	4d	21/09/2016	25/09/2016																																	A.5 Loan Management System	
51	A.5.1 Loan Management Module	1d	21/09/2016	22/09/2016	Lai Qing																																A.5.1 Loan Management Module - Lai Qing	
52	A.5.2 Loan Repayment Module	1d	22/09/2016	23/09/2016	Lai Qing																																A.5.2 Loan Repayment Module - Lai Qing	
53	A.5.3 Mortgage Redemption Module	1d	23/09/2016	24/09/2016	Lai Qing																																A.5.3 Mortgage Redemption Module - Lai Qing	
54	A.5.4 Bad Debt Management Module	1d	24/09/2016	25/09/2016	Lai Qing																																A.5.4 Bad Debt Management Module - Lai Qing	

	Name	Duration	Start	Finish	Resources
55	❑ A.6 Billing and Payment System	5d	19/09/2016	24/09/2016	
56	A.6.1 FAST Fund Transfer Module	1d	19/09/2016	20/09/2016	Yang Shuanghe
57	A.6.2 GIRO Transfer Module	1d	20/09/2016	21/09/2016	Yang Shuanghe
58	A.6.3 Billing Management Module	1d	21/09/2016	22/09/2016	Yang Shuanghe
59	A.6.4 Cheque Management Module	1d	22/09/2016	23/09/2016	Yang Shuanghe
60	A.6.5 SWIFT International Transfer Module	1d	23/09/2016	24/09/2016	Yang Shuanghe
61	❑ A.7 Wealth Management System	2d	21/09/2016	23/09/2016	
62	A.7.1 Wealth Management Planning Module	1d	21/09/2016	22/09/2016	Zhou Jingyuan
63	A.7.2 Portfolio Performance Reviewing Module	1d	22/09/2016	23/09/2016	Zhou Jingyuan
64	❑ A.8 Portfolio Management System	2d	24/09/2016	26/09/2016	
65	A.8.1 Portfolio Creation and Updating Module	1d	24/09/2016	25/09/2016	Yang Shuanghe
66	A.8.2 Portfolio Valuation Module	1d	25/09/2016	26/09/2016	Yang Shuanghe
67	❑ A.9 Customer Analytics and Business Intelligence	3d	23/09/2016	26/09/2016	
68	A.9.1 Customer Segment Analytics Module	1d	23/09/2016	24/09/2016	Zhou Jingyuan
69	A.9.2 Dashboard Module	1d	24/09/2016	25/09/2016	Zhou Jingyuan
70	A.9.3 Customer Insights Module	1d	25/09/2016	26/09/2016	Zhou Jingyuan
71	❑ B. External Parties System	6d	25/09/2016	01/10/2016	
72	❑ B.1 Card Management System	3d	28/09/2016	01/10/2016	
73	Merchant Management Module	1d	28/09/2016	29/09/2016	Han Fengwei
74	Acquirer Management Module	1d	29/09/2016	30/09/2016	Han Fengwei
75	Card Network Module	1d	30/09/2016	01/10/2016	Han Fengwei
76	❑ B.2 Billing and Payment System	3d	25/09/2016	28/09/2016	
77	ACH Module	1d	25/09/2016	26/09/2016	Lai Qing
78	MEPS Module	1d	26/09/2016	27/09/2016	Lai Qing
79	SWIFT Module	1d	27/09/2016	28/09/2016	Lai Qing



	Name	Duration	Start	Finish	Resources	Sep 25 - Oct 1 '16						Oct 2 - Oct 8 '16						Oct 9 - Oct 15 '16						Oct 16 - Oct 22 '16						Oct 23 - Oct 29 '16						Oct 30 - Nov 5 '16					
						S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
80	▣ C. Internet Banking Website(for customers)	6d	26/09/2016	02/10/2016																																					
81	C.1 Customer Account Management Module	1d	26/09/2016	27/09/2016	Yang Shuanghe																																				
82	C.2 Deposit Account management Module	1d	27/09/2016	28/09/2016	Yang Shuanghe																																				
83	C.3 Loan Management Module	1d	28/09/2016	29/09/2016	Yang Shuanghe																																				
84	C.4 Billing and Payment Module	1d	29/09/2016	30/09/2016	Yang Shuanghe																																				
85	C.5 Card Management Module	1d	30/09/2016	01/10/2016	Yang Shuanghe																																				
86	C.6 Wealth Management Module	1d	01/10/2016	02/10/2016	Yang Shuanghe																																				
87	D. Mobile Web Application(for customers)	0d	09/08/2016	09/08/2016																																					
88	User Interface Design	1d	28/09/2016	29/09/2016	Lai Qing																																				
89	Naming and Package Conventions Used	1d	01/10/2016	02/10/2016	Han Fengwei																																				
90	Declaration of Open-source and/or Third Party Codes	1d	02/10/2016	03/10/2016	Han Fengwei																																				
91	Integration and Unit Testing Plan	1d	26/09/2016	27/09/2016	Zhou Jingyuan																																				
92	Project Management Plan	1d	27/09/2016	28/09/2016	Zhou Jingyuan																																				
93	Report Consolidation and Formatting	3d	15/10/2016	18/10/2016	Peng Yongxue																																				
94	Milestone: System Analysis and Design Report Finalisation	0d	20/10/2016	20/10/2016																																					
95	Deadline: System Analysis and Design Report Submission	0d	21/10/2016	21/10/2016																																					

The Gantt chart illustrates the project timeline across several phases:

- Phase 1 (Sep 25 - Oct 1 '16):** Includes tasks C.1 through C.6 (Customer Account Management, Deposit Account management, Loan Management, Billing and Payment, Card Management, and Wealth Management) and D. Mobile Web Application.
- Phase 2 (Oct 2 - Oct 8 '16):** Includes tasks User Interface Design, Naming and Package Conventions Used, and Declaration of Open-source and/or Third Party Codes.
- Phase 3 (Oct 9 - Oct 15 '16):** Includes Integration and Unit Testing Plan and Project Management Plan.
- Phase 4 (Oct 16 - Oct 22 '16):** Includes Report Consolidation and Formatting.
- Phase 5 (Oct 23 - Oct 29 '16):** Includes a Milestone: System Analysis and Design Report Finalisation.
- Phase 6 (Oct 30 - Nov 5 '16):** Includes a Deadline: System Analysis and Design Report Submission.

Resource assignments are indicated by names next to the task bars. Milestones and deadlines are marked with diamonds on the timeline.

	Name	Duration	Start	Finish	Resources	Aug 28 - Sep 3 '16	Sep 4 - Sep 10 '16	Sep 11 - Sep 17 '16	Sep 18 - Sep 24 '16	Sep 25 - Oct 1 '16	Oct 2 - Oct 8 '16	Oct 9 - Oct 15 '16	
						F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S	S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S	S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S	S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S	S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S	S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S		
96	First System Release	30d?	27/08/2016	26/09/2016									
97	Main Interface and Dashboard Design	5d	27/08/2016	01/09/2016	Zhou Jingyuan								
98	A.1 Common Infrastructure	14d?	29/08/2016	12/09/2016									
99	System User Account Management Module	7d	29/08/2016	05/09/2016	Han Fengwei								
100	External Communication Module	7d	05/09/2016	12/09/2016	Han Fengwei								
101	Security Module	1d?	01/09/2016	02/09/2016	Zhou Jingyuan								
102	A.2 Customer Management System	14d	30/08/2016	13/09/2016									
103	Customer Information Management Module	7d	30/08/2016	06/09/2016	Yang Shuanghe								
104	Customer Advanced Information Management	7d	06/09/2016	13/09/2016	Yang Shuanghe								
105	Enquiry Management Module	5d	02/09/2016	07/09/2016	Zhou Jingyuan								
106	A.3 Deposit Account Management System	10d	01/09/2016	11/09/2016									
107	Account Management Module	5d	01/09/2016	06/09/2016	Peng Yongxue								
108	Account Balance Module	5d	06/09/2016	11/09/2016	Peng Yongxue								
109	Interest Crediting Management Module	3d	05/09/2016	08/09/2016	Guo Ziyu								
110	C. Internet Banking Website(for customers)	10d	01/09/2016	11/09/2016									
111	C.1 Customer Account Management Module	7d	01/09/2016	08/09/2016	Lai Qing								
112	C.2 Deposit Account Management Module	3d	08/09/2016	11/09/2016	Guo Ziyu								
113	D. Mobile Web Application	6d	20/09/2016	26/09/2016									
114	Milestone: First System Release Package Finalisation	0d	24/09/2016	24/09/2016									
115	First System Release Presentation Preparations	5d	20/09/2016	25/09/2016	All								
116	Presentation: First System Release	0d	26/09/2016	26/09/2016	All								

	Name	Duration	Start	Finish	Resources	Sep 25 - Oct 1 '16					Oct 2 - Oct 8 '16					Oct 9 - Oct 15 '16					Oct 16 - Oct 22 '16					Oct 23 - Oct 29 '16					Oct 30 - Nov 5 '16						
						S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S				
117	Second System Release	27d	27/09/2016	24/10/2016																																	
118	A.1 Common Infrastructure	1d	28/09/2016	29/09/2016																																	
119	Internal Communication Module	1d	28/09/2016	29/09/2016	Zhou Jingyuan																																
120	A.4 Card Management System	4d	28/09/2016	02/10/2016																																	
121	Debit Card Module	1d	28/09/2016	29/09/2016	Lai Qing																																
122	Credit Card Module	2d	29/09/2016	01/10/2016	Lai Qing																																
123	Payment Module	1d	01/10/2016	02/10/2016	Lai Qing																																
124	A.5 Loan Management System	4d	28/09/2016	02/10/2016																																	
125	Loan Management Module	3d	28/09/2016	01/10/2016	Yang Shuanghe																																
126	Loan Repayment Module	1d	01/10/2016	02/10/2016	Yang Shuanghe																																
127	Mortgage Redemption Module	1d	29/09/2016	30/09/2016	Zhou Jingyuan																																
128	Bad Debt Management Module	2d	30/09/2016	02/10/2016	Zhou Jingyuan																																
129	A.6 Billing and Payment System	9d	27/09/2016	06/10/2016																																	
130	FAST Fund Transfer Module	2d	27/09/2016	29/09/2016	Peng Yongxue																																
131	GIRO Transfer Module	3d	29/09/2016	02/10/2016	Peng Yongxue																																
132	Billing Management Module	3d	28/09/2016	01/10/2016	Guo Ziyu																																
133	Cheque Management Module	3d	01/10/2016	04/10/2016	Guo Ziyu																																
134	SWIFT International Transfer Module	2d	04/10/2016	06/10/2016	Guo Ziyu																																
135	B. Simulated External Parties System	7d	28/09/2016	05/10/2016																																	
136	B.1 Card Management System	7d	28/09/2016	05/10/2016																																	
137	Merchant Management Module	2d	28/09/2016	30/09/2016	Han Fengwei																																
138	Acquirer Management Module	2d	30/09/2016	02/10/2016	Han Fengwei																																
139	Card Network Management Module	3d	02/10/2016	05/10/2016	Han Fengwei																																
140	B.2 Billing and Payment System	3d	02/10/2016	05/10/2016																																	
141	ACH Module	3d	02/10/2016	05/10/2016	Yang Shuanghe																																
142	MEPS Module	1d	02/10/2016	03/10/2016	Zhou Jingyuan																																
143	SWIFT Module	2d	03/10/2016	05/10/2016	Zhou Jingyuan																																

Name	Duration	Start	Finish	Resources	Oct 2 - Oct 8 '16	Oct 9 - Oct 15 '16	Oct 16 - Oct 22 '16	Oct 23 - Oct 29 '16	Oct 30 - Nov 5 '16	Nov 6 - Nov 12 '16	Nov 13 - Nov 19 '16	Nov 20 - Nov 26 '16	
					S S M T W F S	S S M T W F S	S S M T W F S	S S M T W F S	S S M T W F S	S S M T W F S	S S M T W F S	S S M T W F S	
□ C. Internet Banking System(for customers)	9d	02/10/2016	11/10/2016					C. Internet Banking System(for customers)					
C.3 Loan Management Module	1d	02/10/2016	03/10/2016	Lai Qing		C.3 Loan Management Module - Lai Qing							
C.4 Billing and Payment Module	2d	02/10/2016	04/10/2016	Peng Yongxue		C.4 Billing and Payment Module - Peng Yongxue							
C.5 Card Management Module	5d	06/10/2016	11/10/2016	Guo Ziyu			C.5 Card Management Module - Guo Ziyu						
□ D. Mobile Web Application(for customers)	18d	06/10/2016	24/10/2016					D. Mobile Web Application(for customers)					
Second System Release UI Integration	2d	06/10/2016	08/10/2016	Zhou Jingyuan				Second System Release UI Integration - Zhou Jingyuan					
Presentation: Second System Release	0d	24/10/2016	24/10/2016	All				◆ 24/10/2016 Presentation: Second System Release - All					
□ Final System Release	19d	26/10/2016	14/11/2016						Final System Release				
□ A.7 Wealth Management System	5d	26/10/2016	31/10/2016					A.7 Wealth Management System					
Wealth Management Planning Module	3d	26/10/2016	29/10/2016	Yang Shuanghe			Yang Shuanghe	Wealth Management Planning Module - Yang Shuanghe					
Portfolio Performance Reviewing Module	2d	29/10/2016	31/10/2016	Yang Shuanghe			Yang Shuanghe	Portfolio Performance Reviewing Module - Yang Shuanghe					
□ A.8 Portfolio Management System	4d	26/10/2016	30/10/2016					A.8 Portfolio Management System					
Portfolio Creation and Updating Module	2d	26/10/2016	28/10/2016	Zhou Jingyuan			Zhou Jingyuan	Portfolio Creation and Updating Module - Zhou Jingyuan					
Portfolio Valuation Module	2d	28/10/2016	30/10/2016	Zhou Jingyuan			Zhou Jingyuan	Portfolio Valuation Module - Zhou Jingyuan					
□ A.9 Customer Analytics and Business Intelligence System	3d	26/10/2016	29/10/2016					A.9 Customer Analytics and Business Intelligence System					
Customer Segment Module	2d	27/10/2016	29/10/2016	Guo Ziyu			Guo Ziyu	Customer Segment Module - Guo Ziyu					
Dashboard Module	2d	26/10/2016	28/10/2016	Han Fengwei			Han Fengwei	Dashboard Module - Han Fengwei					
Customer Insights Module	2d	26/10/2016	28/10/2016	Peng Yongxue			Peng Yongxue	Customer Insights Module - Peng Yongxue					
□ C. Internet Banking System(for customers)	1d	30/10/2016	31/10/2016					C. Internet Banking System(for customers)					
C.2 Wealth Management Module	1d	30/10/2016	31/10/2016	Lai Qing			Lai Qing	C.2 Wealth Management Module - Lai Qing					
□ D. Mobile Web Application(for customers)	9d	05/11/2016	14/11/2016					D. Mobile Web Application(for customers)					
Milestone: Final System Release Package Finalisation	0d	09/11/2016	09/11/2016					◆ 09/11/2016 Milestone: Final System Release Package Finalisation					
Final System Release Presentation Preparations	5d	05/11/2016	10/11/2016	All			All	Final System Release Presentation Preparations - All					
Deadline: Final System Release Submission	0d	10/11/2016	10/11/2016					◆ 10/11/2016 Deadline: Final System Release Submission					
Presentation: Final System Release(Rehearsal)	3d	10/11/2016	13/11/2016	All			All	Presentation: Final System Release(Rehearsal) - All					
Presentation: Final System Release	0d	14/11/2016	14/11/2016	All				◆ 14/11/2016 Presentation: Final System Release - All					

Name	Duration	Start	Finish	Aug 13 '16		Aug 14 - Aug 20 '16		Aug 21 - Aug 27 '16		Aug 28 - Sep 3 '16		Sep 4 - Sep 10 '16		Sep 11 - Sep 17 '16		Sep 18 - Sep 24 '16		Sep 25 - Oct 1 '16		Oct 2 - Oct 8 '16							
				T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T
Course Module Administration Deadlines	103d?	09/08/2016	20/11/2016																								
Peer Review 01	0d	05/09/2016	05/09/2016																								
Peer Review 02	0d	10/10/2016	10/10/2016																								
Peer Review 03	0d	14/11/2016	14/11/2016																								
Deadline: Project Log(Week 1)	0d	14/08/2016	14/08/2016																								
Deadline: Project Log(Week 2)	0d	21/08/2016	21/08/2016																								
Deadline: Project Log(Week 3)	0d	28/08/2016	28/08/2016																								
Deadline: Project Log(Week 4)	0d	04/09/2016	04/09/2016																								
Deadline: Project Log(Week 5)	0d	11/09/2016	11/09/2016																								
Deadline: Project Log(Week 6)	0d	18/09/2016	18/09/2016																								
Deadline: Project Log(Recess Week)	0d	25/09/2016	25/09/2016																								
Deadline: Project Log(Week 7)	0d	02/10/2016	02/10/2016																								
Deadline: Project Log(Week 8)	0d	09/10/2016	09/10/2016																								
Deadline: Project Log(Week 9)	0d	16/10/2016	16/10/2016																								
Deadline: Project Log(Week 10)	0d	23/10/2016	23/10/2016																								
Deadline: Project Log(Week 11)	0d	30/10/2016	30/10/2016																								
Deadline: Project Log(Week 12)	0d	06/11/2016	06/11/2016																								
Deadline: Project Log(Week 13)	0d	13/11/2016	13/11/2016																								
Deadline: Project Log(Reading week)	0d	20/11/2016	20/11/2016																								

	Oct 9 - Oct 15 '16	Oct 16 - Oct 22 '16	Oct 23 - Oct 29 '16	Oct 30 - Nov 5 '16	Nov 6 - Nov 12 '16	Nov 13 - Nov 19 '16	Nov 20 - Nov 26 '16	Nov 27 - Dec 3 '16																						
	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
Course Module Administration Deadlines																														

Deadline: Project Log(Week 7)	◆ 10/10/2016 Deadline: Project Log(Week 8)																													
		◆ 09/10/2016 Deadline: Project Log(Week 9)																												
			◆ 16/10/2016 Deadline: Project Log(Week 10)																											
				◆ 23/10/2016 Deadline: Project Log(Week 11)																										
					◆ 30/10/2016 Deadline: Project Log(Week 12)																									
						◆ 06/11/2016 Deadline: Project Log(Week 13)																								
							◆ 13/11/2016 Deadline: Project Log(Reading week)																							
								◆ 20/11/2016 Deadline: Project Log(Reading week)																						

[11. Conclusion](#)

Merlion Bank is an ambitious enterprise which aims to stand out from the major players in Singapore's financial industry with its direct bank services as competitive advantages. Kent Ridge Technology is honored to be on Merlion Bank's side as we analyze, construct, and deliver Merlion Banking System(MBS) which is composed of four main subsystems serving both internal and external users' needs.

After rigorous and comprehensive analysis of Merlion Banks's operations and business requirements, our team has designed MBS from the ground up. With the successful implementation of MBS, we are confident that the main concerns of Merlion Bank highlighted during meeting will be addressed through:

Accessibility & Automation

The MBS system enables data synchronization and flow across all business divisions, allowing staff to access real time information. The automation granted for components such as sending bank statement and reports, sending notifications help to reduce the amount of manual labour involved and corresponding manpower cost incurred.

Data Analytics & Business Intelligence

The adoption and usage of various metrics, analytics tools, and techniques tailored for the banking context ensures the accuracy and reliability of the data analytics results. It enables upper management of Merlion Bank to be always informed of the bank's overall performance, and therefore gain insights into developing effective business growth strategies.

Scalability & Sustainability

The proposed MBS system is incredibly scalable and sustainable. The exhaustive functionalities tailored for various business processes and adoption of advanced algorithms empower it to support the long-term usage of Merlion Bank as well as its global expansion in the future.

We at Kent Ridge Technology are excited to be a part of this momentous project. We are confident that Kent Ridge Technology's promise of excellence and outstanding track record makes us an ideal partner of Merlion Bank for this project, and we believe that the Merlion Banking System will be the solid foundation for the establishment, growth and expansion of Merlion Bank in Singapore and globally in the future.

12. References

- Deutsche Bank. (2015). *Digitalisation and the Future of Commercial Banking*. Retrieved from <http://cib.db.com/insights-and-initiatives/flow/35583.htm>
- Olanrewaju, T. (2014). *The Rise of the Digital Bank*. Retrieved from McKinsey.com: <http://www.mckinsey.com/business-functions/business-technology/our-insights/the-rise-of-the-digital-bank>
- Tan, C. (2005). *Financial Markets and Institutions in Singapore*. Singapore University Press. Retrieved from <https://books.google.com.sg/books?id=lAChksdNj0MC>

Table of changes

S/N	Page No. (Proposal)	Page No. (Report)	Change Type	Description of Change
1	7		Correction	Adjusted layout of business flow chart
2	25		Correction	Revised VTOC. Add functions for mobile web application.
3	34		Enhancement	Enhanced security of login process
4	37		Enhancement	Added in validation for updating mobile number.
5	8		Revision	Minor changes in roles distribution. Added in Enquiry Processors, Operation Department and Billing and Payment Department
6	47		Enhancement	Now provide alternative simplified account opening path for existing customers.
7	105		Correction	Moved portfolio performance report process from Wealth Management System to Portfolio Management System
8	41, 75, 88		Revision	Minor changes to activity diagrams
9	39		Enhancement	Enhanced enquiry process flow
10	42		Enhancement	Enhanced on advanced profile details and access permission restriction
11	72		Enhancement	Further elaborates on loan products.
12	72-78, 82-93, 101-106, 111, 115-117		Revision & Enhancement	Revised business process for Loan management, Billing and Payment, Wealth Management, Portfolio Management, and CABIS.
13	117		Enhancement	Added in Decision Support module in CABIS
14	54-56, 96-100		Revision	Revised functionalities and segmentation of modules of Deposit Account management system and Billing & Payment management system.