Early Warning System

Submitted in partial fulfilment of requirement for the degree of

MASTER OF COMPUTER APPLICATIONS

OF

UNIVERSITY OF MUMBAI

Submitted by

Pranjal Hiraman Pagar

ROLL NO – 30

M.C.A (2021-2023 Batch)

Under the Guidance of

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CERTIFICATE

This is to certify that **Ms. Pranjal Pagar**, Roll No. **30** of the Final year M.C.A., has successfully completed the project on **"Early Warning System"** as partial fulfilment of the requirements for the degree of '**Master of Computer Applications'** course as prescribed by the University of Mumbai during the academic year 2021-2023 and is being evaluated during the academic year 2021-2023 as per the guidelines of the University of Mumbai.

Project Guide	**HOD of MCA**
Dr. Anup Palsokar	**Dr. Anup Palsokar**
Signature:	**Signature:**
Date: / /2023	**Date: / / 2023**

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Internal Examinar **External Examinar**

Prof._____ **Prof.**_____

Date: / /2023 **Date: / / 2023**

Disclaimer

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Acknowledgement

I am grateful to Dr. Anup Palsokar my Project Guide, and Internal Mentor, who was a constant source of help and played an important role in the successful execution of the project.

I would like to thank CRISIL Limited for providing me a platform to learn. I am grateful to HR team, because of them this internship period went smoothly.

I would like to thank my reporting manager Mr. Dinesh Babu for his support, help and guidance throughout the project and for his continuous help by providing me with the right kind of work experience.

I would also like to thank my teammates who were always there to help me out while facing any difficulties or doubts throughout the project.

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EXECUTIVE SUMMARY

This report provides a short description of a six-month internship carried out as part of an MCA course at SIES College of Management Studies, University of Mumba; Worked as Intern at CRISIL Limited.

The report highlights the learning goals and how they were achieved through various tasks and activities during the internship.

The internship started with an induction program, where the company provided an overview of its areas of work and introduced the project and technologies to be worked on. Gained domain knowledge and technical skills through project work and FULKRUM training sessions. Task and exploration of Fulkrum Software.

Modern day Early Warning Systems are built to replace conventional lending practices that involve biased or subjective decision-making. These systems are far more effective in monitoring and detecting red flags, putting banks back in control of their data and decisions.

RBI has mandated on systems and processes including compliance requirements for early warning system. Early warning system includes periodic and detailed assessment of all borrowers as compared to quarterly or semi-annual review of borrowers in traditional monitoring systems.

1. **Company Profile Section:**
   Provides a brief description of the company where the internship took place.

2. **Chapter 1 - Project Introduction and Planning:**
   - Gives an overview of the project, including its objectives, limitations,advantages, and the software process model used.
   - Covers feasibility analysis and provides a schedule for the project.

3. **Chapter 2 - Project Analysis:**
   -Focuses on the requirements of the system, including functional, non-functional, hardware, software, and user-related aspects.
   -Explores the scope of the project.

4. **Chapter 3 - Project Design:**
   - Includes system flowcharts and data flow diagrams to illustrate the project'sdesign.
   - Describes the database design structure.

5. **Chapter 5 - Testing:**
   - Covers different types of testing employed for the project.
   - Demonstrates the testing process and includes test cases.

6. **Chapter 6 - Conclusion:**
   - Summarizes the internship project and its outcomes.
   - Discusses limitations encountered during the project.
   - Offers suggestions for future enhancements or improvements.

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   - Summarizes the internship project and its outcomes.

- Discusses limitations encountered during the project.
- Offers suggestions for future enhancements or improvements.

Key learnings from the internship include

- Working on internal projects
- Handling multiple tasks simultaneously within given timelines,
- Working both individually and as part of a team

The report aims to provide a comprehensive overview of the internship experience, company profile, project details, and the intern's reflections on thelimitations and future enhancements of the project.

CHAPTER1: INTRODUCTION

1.1 COMPANY PROFILE

CRISIL is a leading, agile and innovative global analytics company driven by its mission of making markets function better. We are India's foremost provider of ratings, data, research, analytics, and solutions. A strong track record of growth, culture of innovation and global footprint sets us apart. We have delivered independent opinions, actionable insights, and efficient solutions to over 100,000 customers. Our businesses operate from India, the United States (US), the United Kingdom (UK), Argentina, Poland, China, Hong Kong, Singapore, and the United Arab Emirates (UAE). We are majority owned by S&P Global Inc., a leading provider of transparent and independent ratings, benchmarks, analytics, and data to the capital and commodity markets worldwide. Our clients range from micro, small and medium companies to large corporates, investors, and top global financial institutions. We work with commercial and investment banks, insurance companies, private equity players and asset management companies globally. We also work with governments and policy makers in the infrastructure space in India and in other emerging markets. Our analyses, insights and solutions help lenders, borrowers, issuers, investors, regulators and intermediaries make sound decisions. We help clients manage and mitigate risks, take pricing and valuation decisions, reduce time to market, generate more revenue and enhance returns. By helping shape public policy on infrastructure in emerging markets, CRISIL helps catalyze economic growth and development in these geographies.

1.2 BUSINESSES

 Ratings CRISIL pioneered credit rating in India in 1987, and emerged a leader with our independent, analytical rigour and innovation. As a full-service rating agency, it rate the entire gamut of debt instruments, and provide a globally unique and affordable rating service for SMEs. Crisil have not only set business standards but also instituted several innovations with our best practices. Crisil serve lenders, investors, issuers, market intermediaries and regulators by covering manufacturing companies, banks, NBFCs, PSUs, financial institutions, state governments, urban local bodies, and mutual funds. Issuers and borrowers leverage our ratings for enhancing their access to funding, widening range of funding alternatives, and optimising cost of funds. Investors and lenders use our ratings to supplement their internal evaluation process and benchmark credit quality across investment options. Our ratings act as benchmarks for pricing and trading of debt instruments for markets at large.

 Business Intelligence & Risk Management Solutions(BIRS)

Our Business Intelligence & Risk Management Solutions help banks and financial institutions in their data and analytics needs. This includes all key functional areas such as Risk Management, Sales & Marketing, Financial Control & Reporting, Regulatory Compliance and Governance. With 200+ KPIs and custom templates our solutions provide advanced insights into data with an emphasis on actionable intelligence. Thereby enabling you to take data driven decisions to achieve your business objectives.

India Research

Crisil are India's largest independent integrated research house, providing insights, opinion and analysis on the Indian economy, industry, capital markets and companies. Our industry research covers 86 sectors and is known for its rich insights and perspectives. We play a key role in India's fixed income markets, being largest provider of valuation of fixed income securities to the mutual fund, insurance and banking industries in the country. We are also the sole provider of debt and hybrid indices to India's mutual fund and life insurance industries. Crisil access to proprietary and public data across economy and sectors gives us a distinct edge in developing analytics, which can be leveraged to provide deep and actionable insights to our clients.

CRISIL Coalition

Coalition is a leading business intelligence provider. Formed in 2002, we are a dynamic, high growth company firmly established as a premium brand in the Financial Services industry. We deliver deep and unique analytical research on Corporate and Investment Banks, their Institutional and Corporate clients as well as their local market sizes. We also analyze all the underlying performance drivers ranging from Headcount to Expenses and Capital.

At Coalition, we believe our fundamental mission is to enable and inform the strategic business development of the world’s most advanced commercial entities. Our approach to analytics and business intelligence is clear; we heavily leverage both technology and our staff’s deep knowledge of the financial services industry. By taking unstructured information, we organize disparate pieces of information into actionable intelligence.

1.3 DOMAIN

 Our solutions help clients identify, measure, and calibrate a comprehensive range of risks: credit risk, price and market risk, exchange and liquidity risk, operational risk, strategic and regulatory risk. Our software and service offerings include internal rating systems to assess the credit worthiness of borrowers, loan origination systems to automate the lending and administration process, automated capital computation processes for credit risk, market risk, and operational risk as per Basel II and economic capital modelling systems.

 Early Warning System is a framework for banks enabling them to detect and report frauds early and taking timely consequent actions like reporting to the Investigative agencies so that fraudsters are brought to book early, examining staff accountability and do effective fraud risk management.

 To identify these fraudsters banks maintain Red Flag Accounts (RFA).

 Some EWS including RBI RFA circular points with some additional functionality that Early Warning System Project covers are:

• Default in undisputed payment to the statutory bodies as declared in the Annual report.

• Bouncing of high value cheques.

• Frequent change in the scope of the project to be undertaken by the borrower.

• Foreign bills remaining outstanding with the bank for a long time and tendency for bills to remain overdue.

• Delay observed in payment of outstanding dues.

• Under insured or over insured inventory.

1.4 OPERATING ENVIRONMENT – Hardware and Software

Software Requirements: -

- Oracle SQL Developer
- Fulkrum
- Pentaho

Hardware Requirements: -

- 8 GB RAM
- 500 GB Hard Disk
- Core i5, i7 processor

1.5 Detail Description of Technology Used

Front End Development Tool: Fulkrum, AngularJS, JavaScript, HTML,CSS, Pentaho(Spoon)

Back End: Oracle

1) Fulkrum

Introduction:

Fulkrum is a CRISIL's in-house big data analytics platform which has been built on Java, AngularJS, frameworks such as Spring , Hibernate, Apache Spark.

Features:

Various features provide by fulkrum are as follows:

i)Report designer:

Design and create your own reports using drag and drop UI controls, define SQL queries to pull data from data source into the controls and use saved library objects.

ii)Lower Total cost of ownership:

To run on premise data analytics over huge data.

iii)Predictive analytics:

Big data analytics platform which enables for predictive analysis.

iv)Smart data tagging and search: Reduce number of reports to be maintained.

v)Provide user friendly development environment:

Provides an environment which enables easy production of reports, even client can also do some design level modifications without any help of developer.

Components used in Fulkrum:-

There are multiple components used in Fulkrum every component has its own unique features. Some of them are explained below:

1) Label and Button

Fulkrum labels and buttons can be used to perform multiple operations such as create tab, open popup and execute scripts. They can also be used to perform different actions based on the event performed on button or labels. We can create dynamic toggle buttons by using these components. It enables to click one button from another which enables different actions with the same click. Fulkrum enable us to add, delete and update rows in grid based on clicked event .

2) Enhanced Combo box and Multiselect:

It provides the facility to directly insert the connection and SQL query and get the result in a dropdown and to select multiple elements/options. It is used to take input from user among multiple options and we can perform any operation based on the selected option.

3) Container:

Container acts like a frame. Inside it various elements can be placed to secure the position and alignment.

4) HTML Component :

HTML component is one of the most flexible components; IT enables us to create any design with HTML and data which we will get from SQL component.

5) SQL Component :

SQL Component contains database connection and query. It enables to write sql query and used the result anywhere in the report.

6) GRID:

Grid is used to represent data in the form of table. Fulkrum enable us to show data in tree like structure in grid, it also provides great functionalities like pagination, vertical and horizontal scroll, Field search etc.

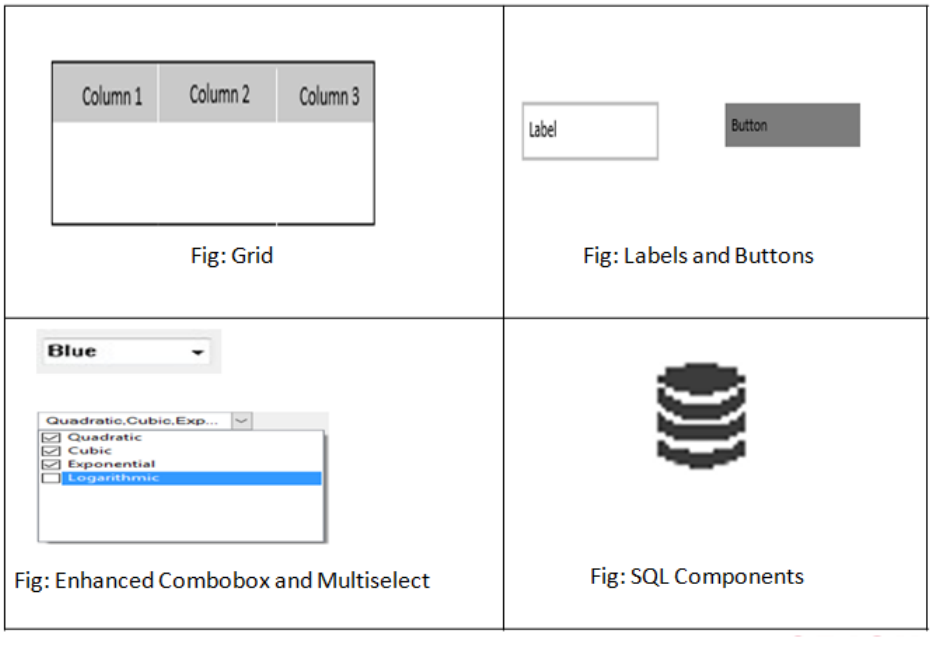

Fig 1. Grid Elements

Fig 2. Fulkrum 2.0 Charts and Containers

Fig 3. Fulkrum Report Wireframe

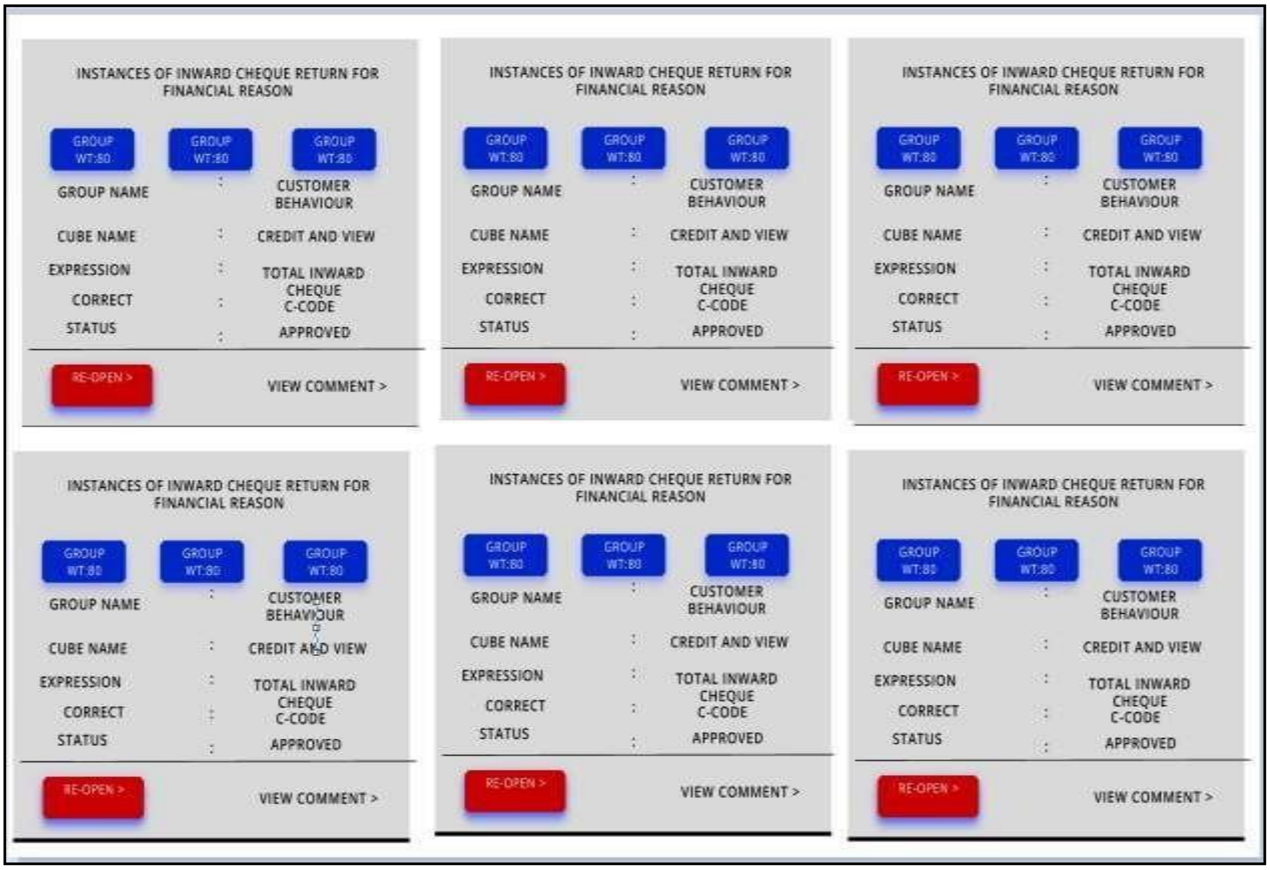

Fig 4. Demo screen 1

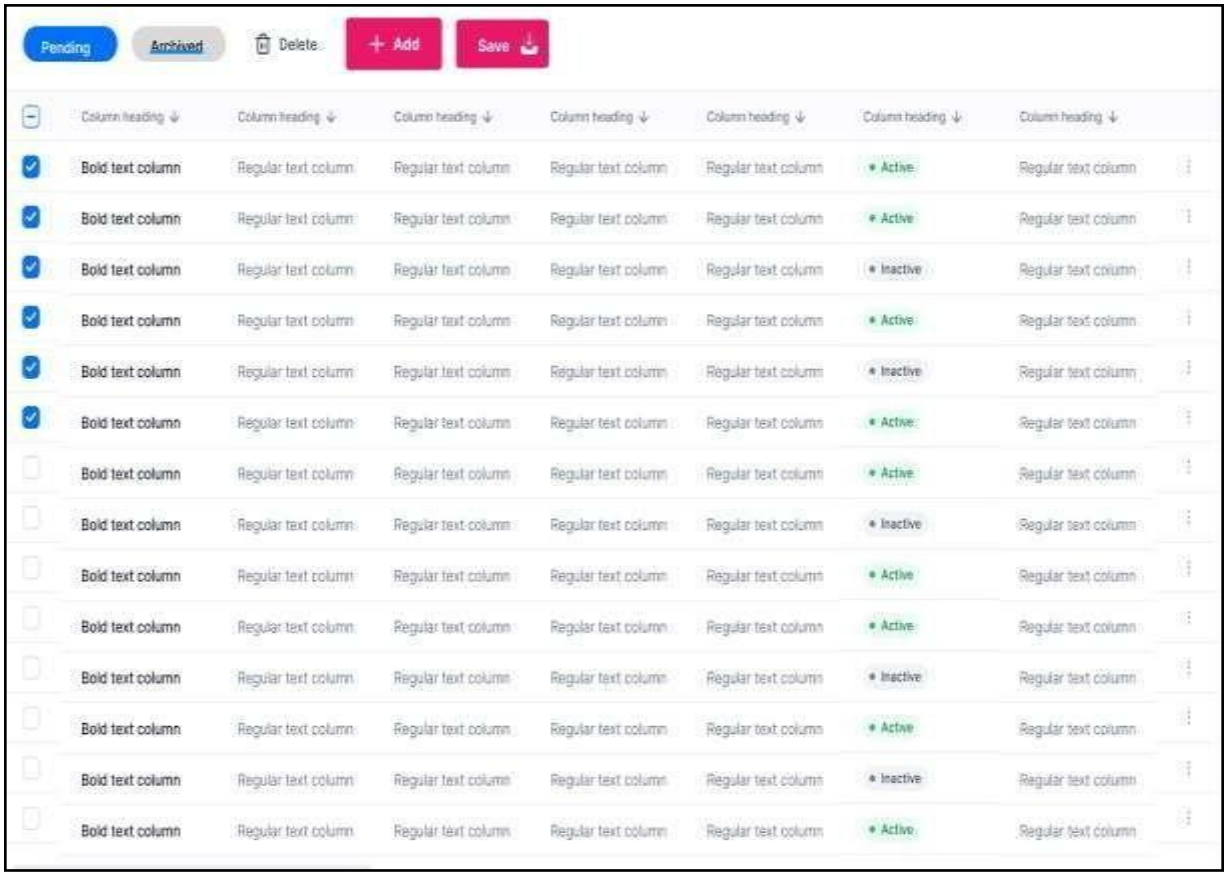

Fig 5. Demo screen 2

2)AngularJS

AngularJS is a structural framework for dynamic web applications. It lets you use HTML as your template language and lets you extend HTML's syntax to express your application components clearly and succinctly. Its data binding and dependency injection eliminate much of the code you currently have to write. And it all happens within the browser, making it an ideal partner with any server technology.

The advantages of AngularJS are −

 It provides the capability to create Single Page Application in a very clean and maintainable way.

 It provides data binding capability to HTML. Thus, it gives user a rich and responsive experience.

 AngularJS code is unit testable.

 AngularJS uses dependency injection and make use of separation of concerns.

 AngularJS provides reusable components.

 With AngularJS, the developers can achieve more functionality with short code.

 In AngularJS, views are pure html pages, and controllers written in JavaScript do the business processing.

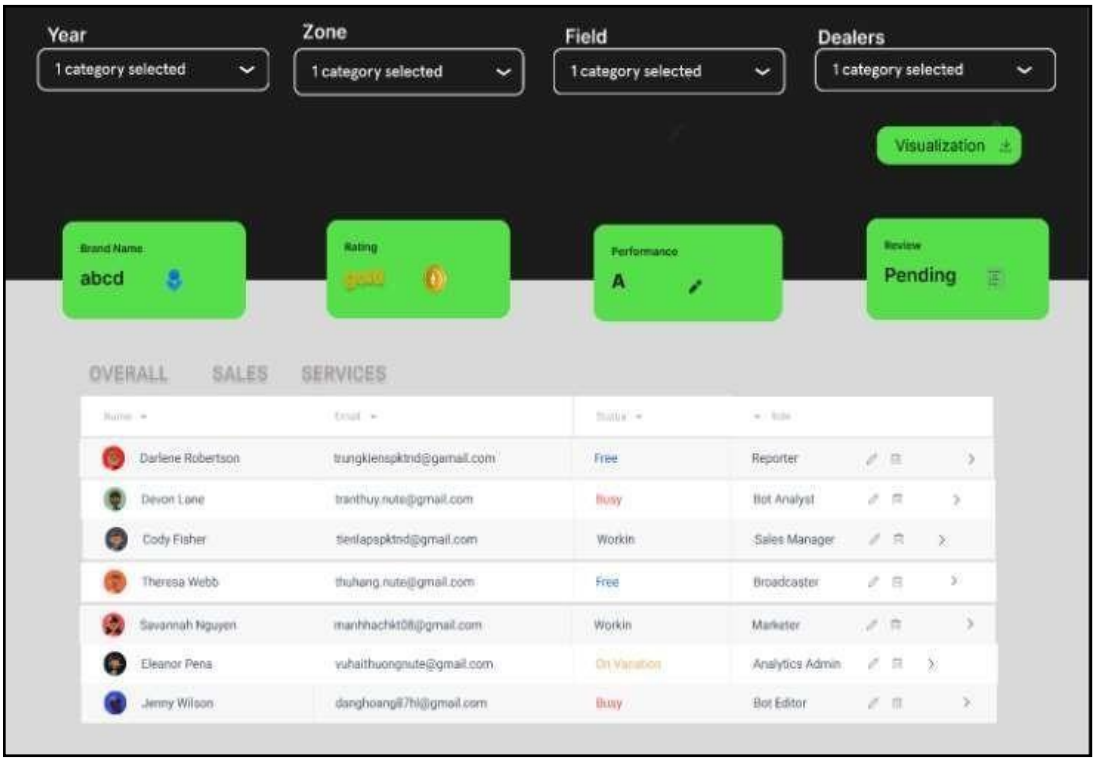

Fig 6. Angular Wireframe

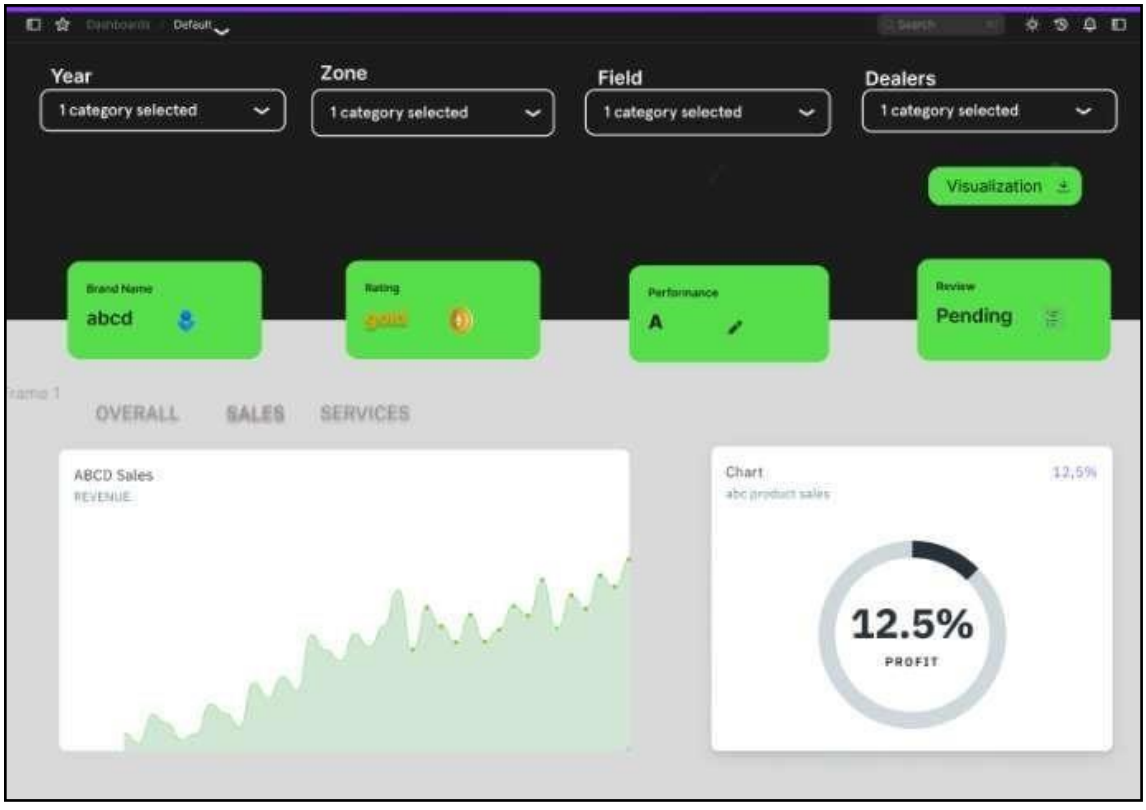

Fig 7. Charts created in Angular

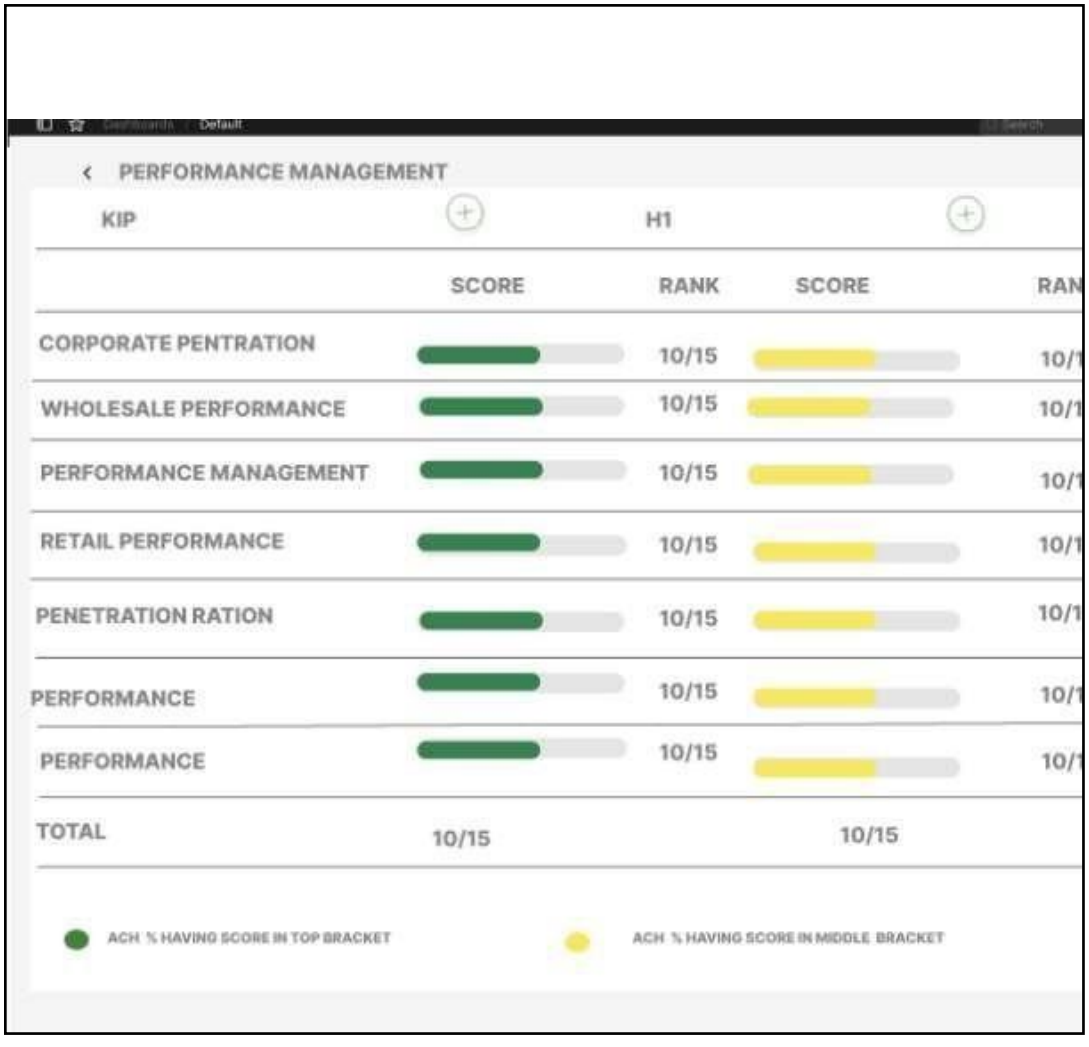

Fig 8. Parameter Table

CHAPTER 2: PROPOSED SYSTEM

2.1 Proposed System

Credit One View is software solution which shall assist banks in monitoring their credit portfolio using public information as well as data residing with bank's system. The end users of the application would be able to view the overall portfolio performance and also drill down to view each borrower's conduct and also identify any indicators of stress in the account. The system should also provide a facility to the users to take and track corrective actions through a work flow process.

2.2 Objectives of System

- To make a system through which user can maintain their customer's performance
- To drill down each customer
- Track their transaction activity
- To create an EWS system which generate alerts for default customers to avoid loss

2.3 Scope of project

It is an EWS (Early Warning System) system which is a set of guided processes for identifying risks at a nascent stage. A well designed EWS helps senior management to forecast impending events likely to negatively affect the organization.

The key applications of this system are as follows:

1) Predict possible loss from borrowers:

It helps to predict possible loss from borrowers that may adversely affect the institution, with the help of this system we can analyze and predict the customer lies under high risk who can create loss to the organization.

2) Limit the chances of borrower's default activities:

It helps to get a closer view of the customer portfolio on a regular basis so as to ensure that EMI and instalments are paid on time, thus maintaining a quality of borrowed loans. Based on certain parameters and analysis this system can alert senior management at an early stage.

3) To check borrower's repayment capacities:

It can also help to check borrower's repayment capacities and whether they will going to pay back. Based on analysis it can give a clearer picture for deciding upon whether to disburse a loan or deny it.

2.4 User Requirements

User requirements are as follows:

 Performance

The response time of system should be accurate, it should maintain all performance criteria.

 Reliability

Data should not be corrupted in case of system crash or power failure.

 Availability

All the data should be available to the user.

 Security

The bank systems contain highly confidential data, therefore this system should be secured against malicious deformations.

 Maintainability

System should be able to adapt any future enhancement and it should be maintainable for longer period of time.

2.5 Software Development Model (Lifecycle Model)

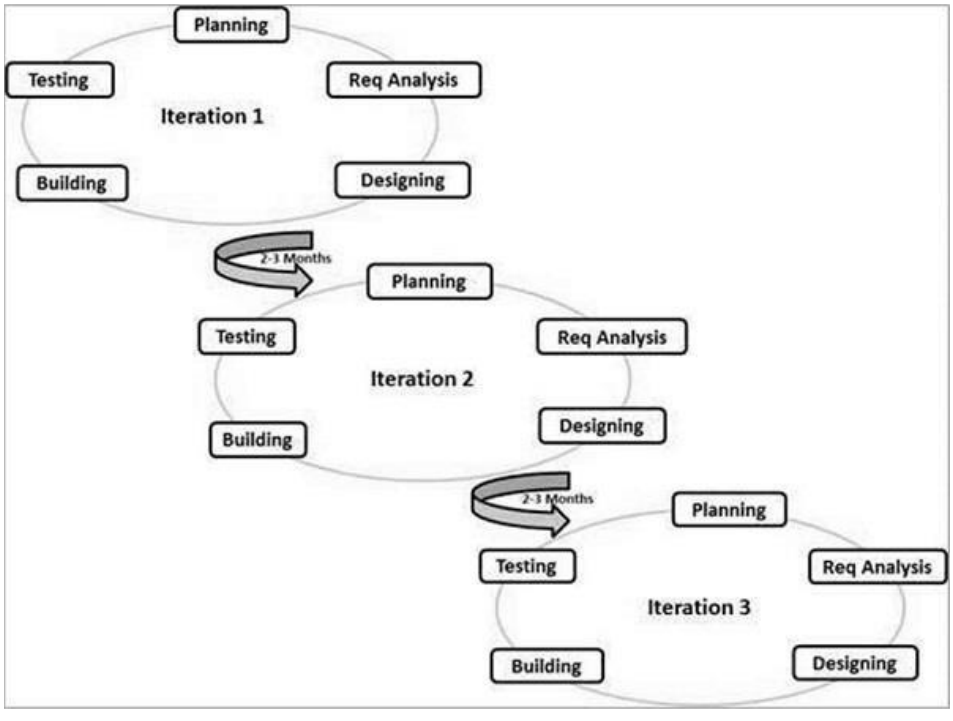

Fig 9. Software Development Lifecycle

Agile SDLC model is a combination of iterative and incremental process models with focus on process adaptability and customer satisfaction by rapid delivery of working software product. Agile Methods break the product into small incremental builds. These builds are provided in iterations. Each iteration typically lasts from about one to three weeks. Every iteration involves cross functional teams working simultaneously on various areas like:

- Planning
- Requirements Analysis
- Design
- Coding
- Unit Testing and
- Acceptance Testing.

At the end of the iteration, a working product is displayed to the customer and important stakeholders.

CHAPTER 3: SYSTEM DESIGN

3.1 Architecture Diagram

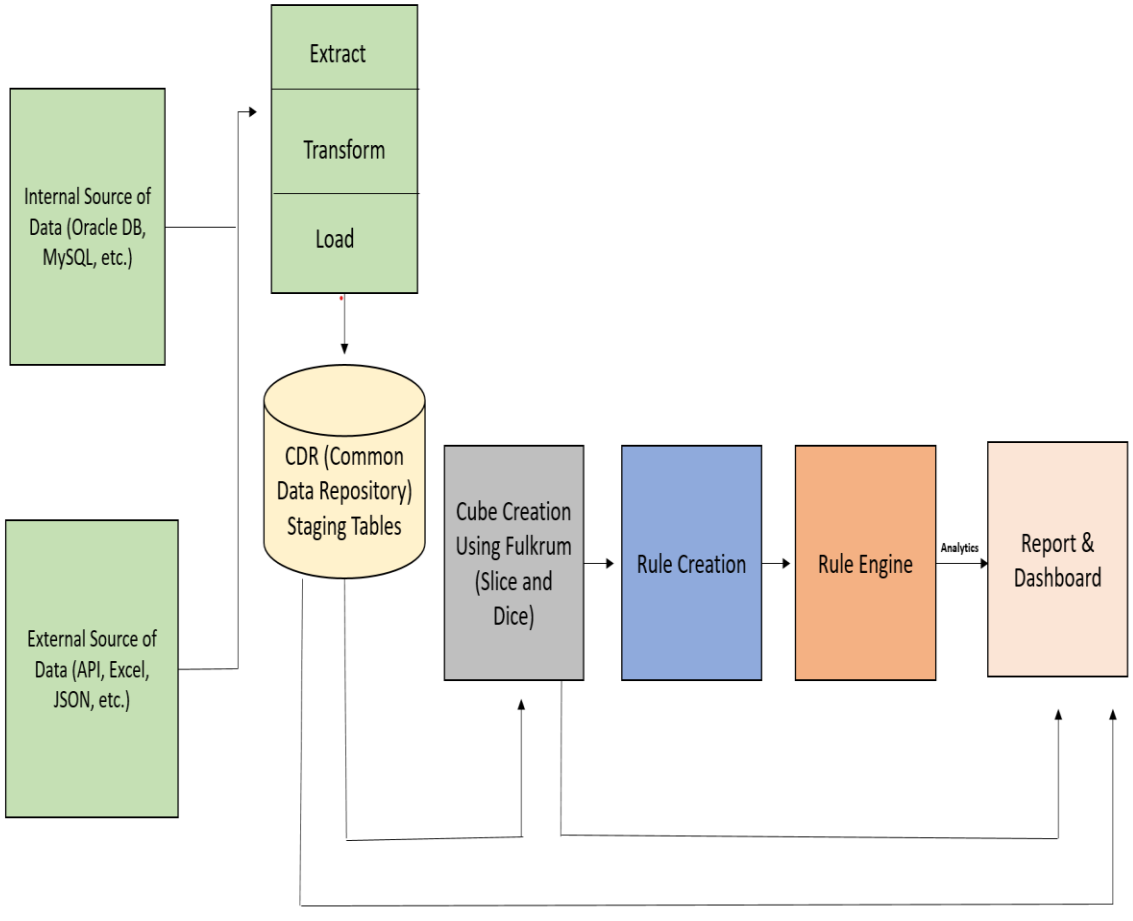

Fig 10. Architecture Diagram

The architecture of the system contains different modules as follows:

1) Data:

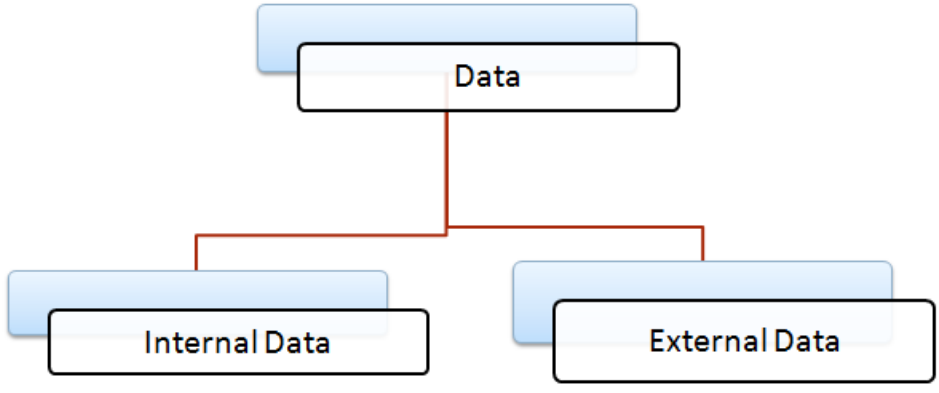

Fig 11. Types of data collection

Data can be collected from two types of sources they are categorize as internal and external data.

• Internal data can be collected from core banking systems for example: Oracle DB, Flat files

• External data can be collected in the form of API, Flat files, Excel, JSON.

2) ETL (Extract Transform Load)

ETL allows business to gather data from multiple sources and consolidate it on a single centralized location.

Features:

• Delivering a single point-of-view

• Providing historical context

• Improving efficiency and productivity

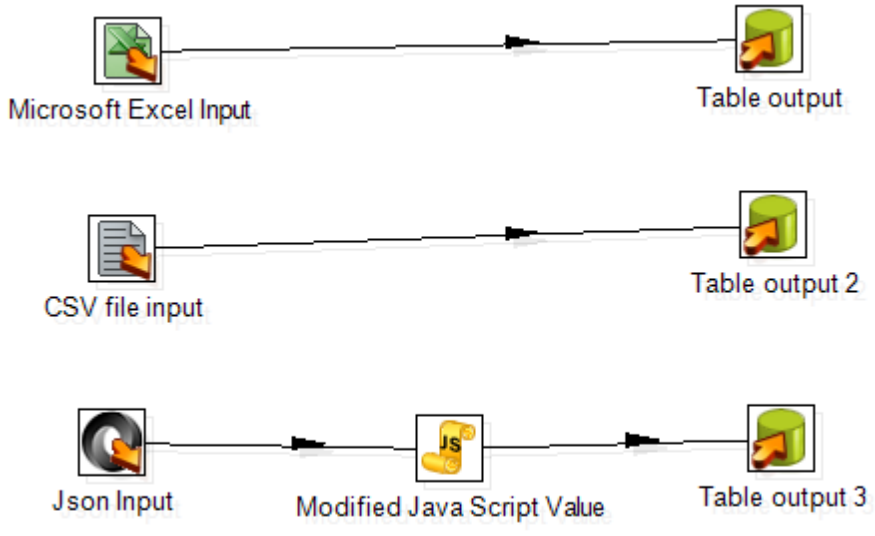

Fig 12. Example of ETL process

3) Cube Creation

 Cube is a multi dimensional array of data which contains dimension and fact.

 fulkrum provides slice and dice feature to create cubes.

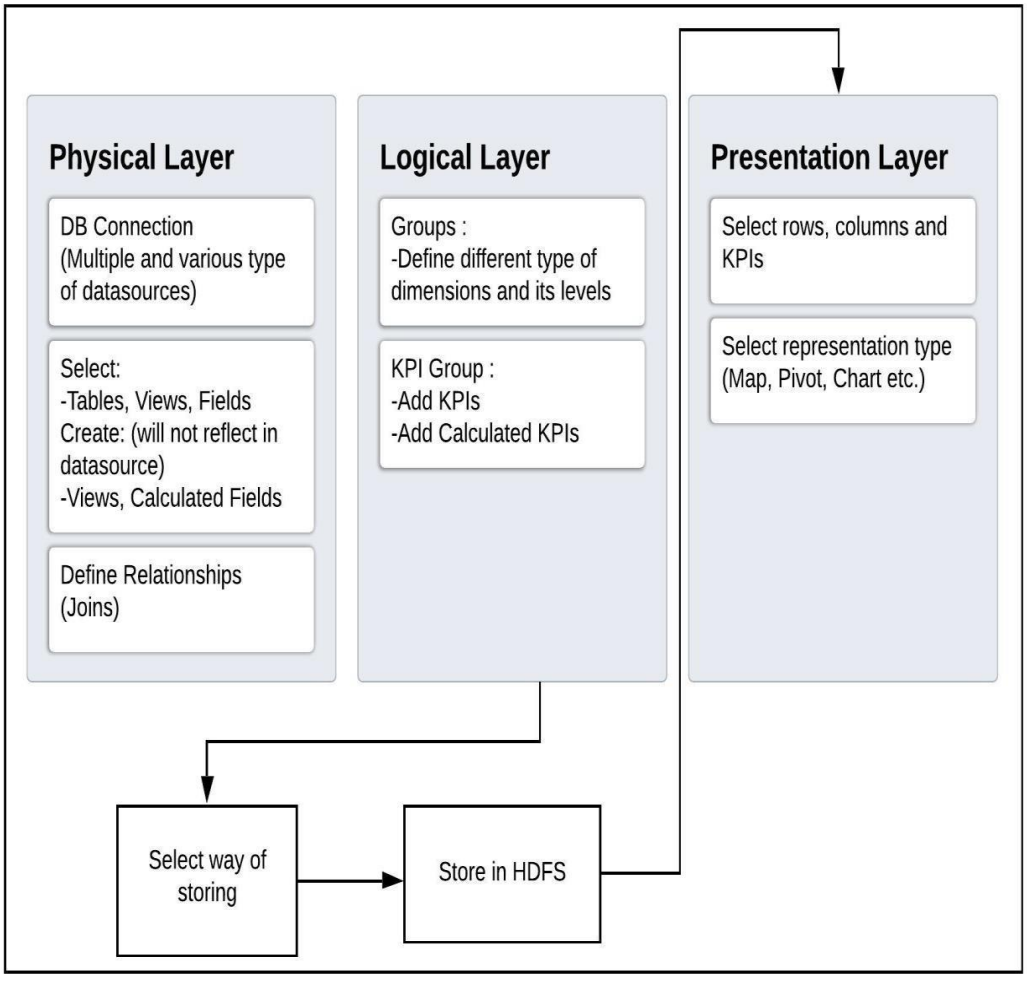

Fig 13. Cube Creation

Process of cube creation:

 It has three layers namely Physical layer, Logical layer and Presentation layer.

 Physical layer defines the database connections from multiple and various type of data source. Here in we select the tables,views,fields and define relationship between them.

 Logical layer has two parts i.e. Groups and KPIs.

 Group defines different types of dimensions and its level and KPIs are calculated fields.

 Once defining the logical layer way of storing i.e partial or complete has to be selected after which it is stored in HDFS.

 The final step is the presentation layer, It provides the drag and drop functionality. We can drag and select the Rows, Columns and KPIs as required.

 The query so formed can be presented in the form of Map, Chart, Pivot etc.

4) Rule Creation

• This module is done to set different thresholds and rules to categorize our customers into different categories like High , Medium and Low based on their

transaction activities.

• These rules help to identify default customers of the organization.

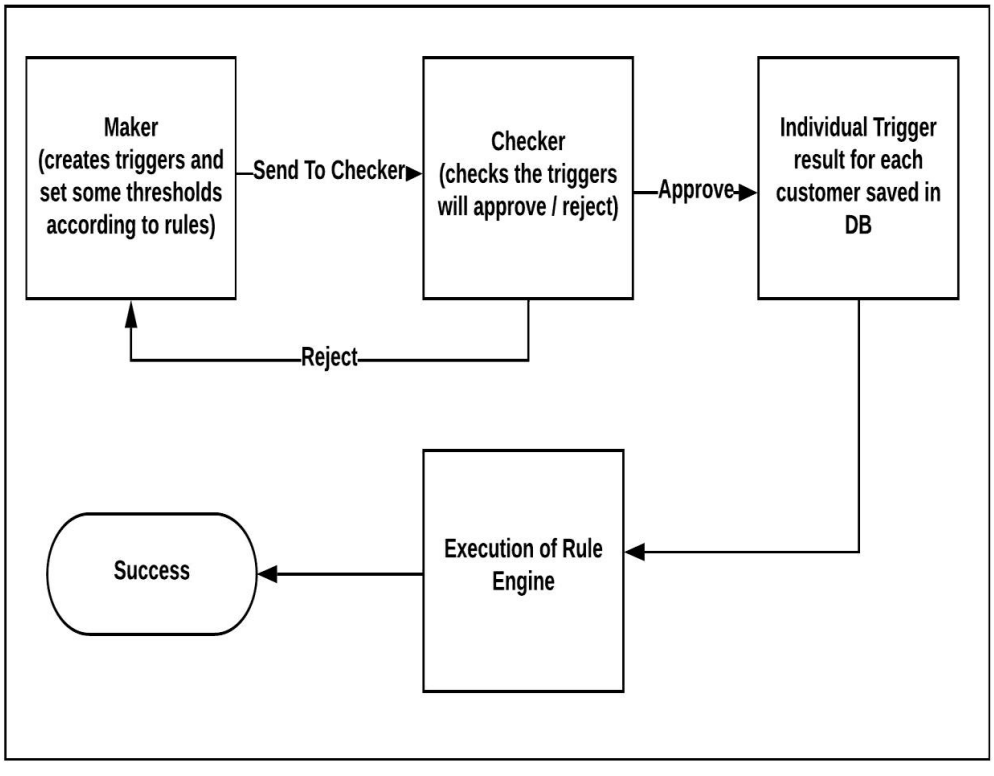

Fig 14. Rule Creation

Process of rule creation:

 Rule creation has maker and checker workflow.

 Maker created the trigger and set some thresholds according to rules, and send to checker.

 Checker checks the triggers and either approve or reject it.

 If the trigger gets rejected by checker then it is sent back to the maker for required changes specified by checker.

 If the trigger gets approved then individual trigger results for each customer is saved in database.

 Once the triggers has been successfully created, the rule engine is executed.

5) Rule Engine

• Rule Engine is a part of transformix which would run according to the rule created and fill the data in fact tables.

• ETL tools will be used to run rule engine.

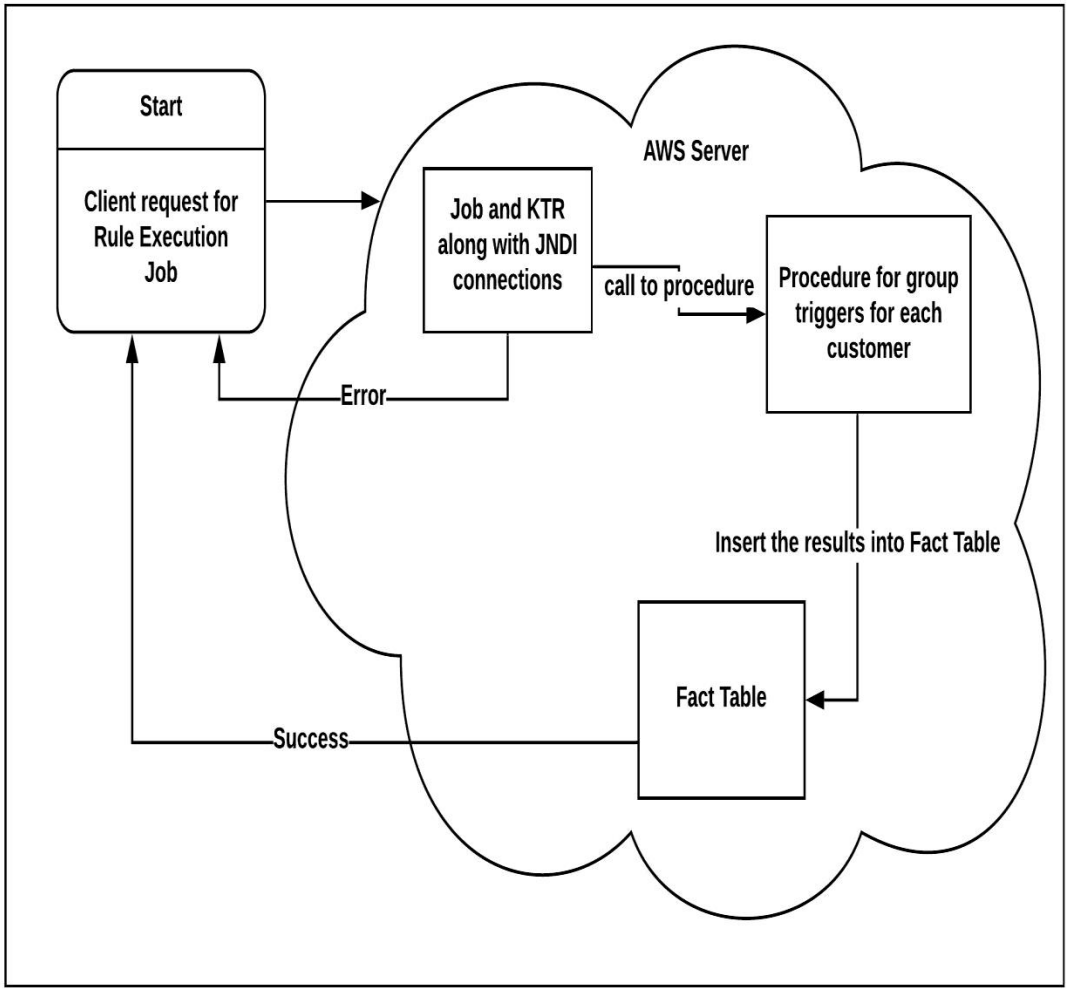

Fig 15. Rule Engine

Process of rule engine:

 Rule engine starts with the client request for the execution of rule execution job.

 Once the client has generated the request, KTR and JOB with appropriate JNDI Connection execute

 If this JOB and KTR are successfully executed it call the procedure defined in it or else it shows an error on the client screen.

 The procedure called on the execution of KTR and JOB is a procedure written for group triggers for each customers.

 After the procedure executes it inserts the results into the fact table.

 The data once inserted into the fact table the marks the successful execution of rule engine.

6) Reports and Dashboards

Once we get data after applying all transformations we can use them on reports and dashboards so that user can monitor their customers through these reports.

3.2 Use case Diagram

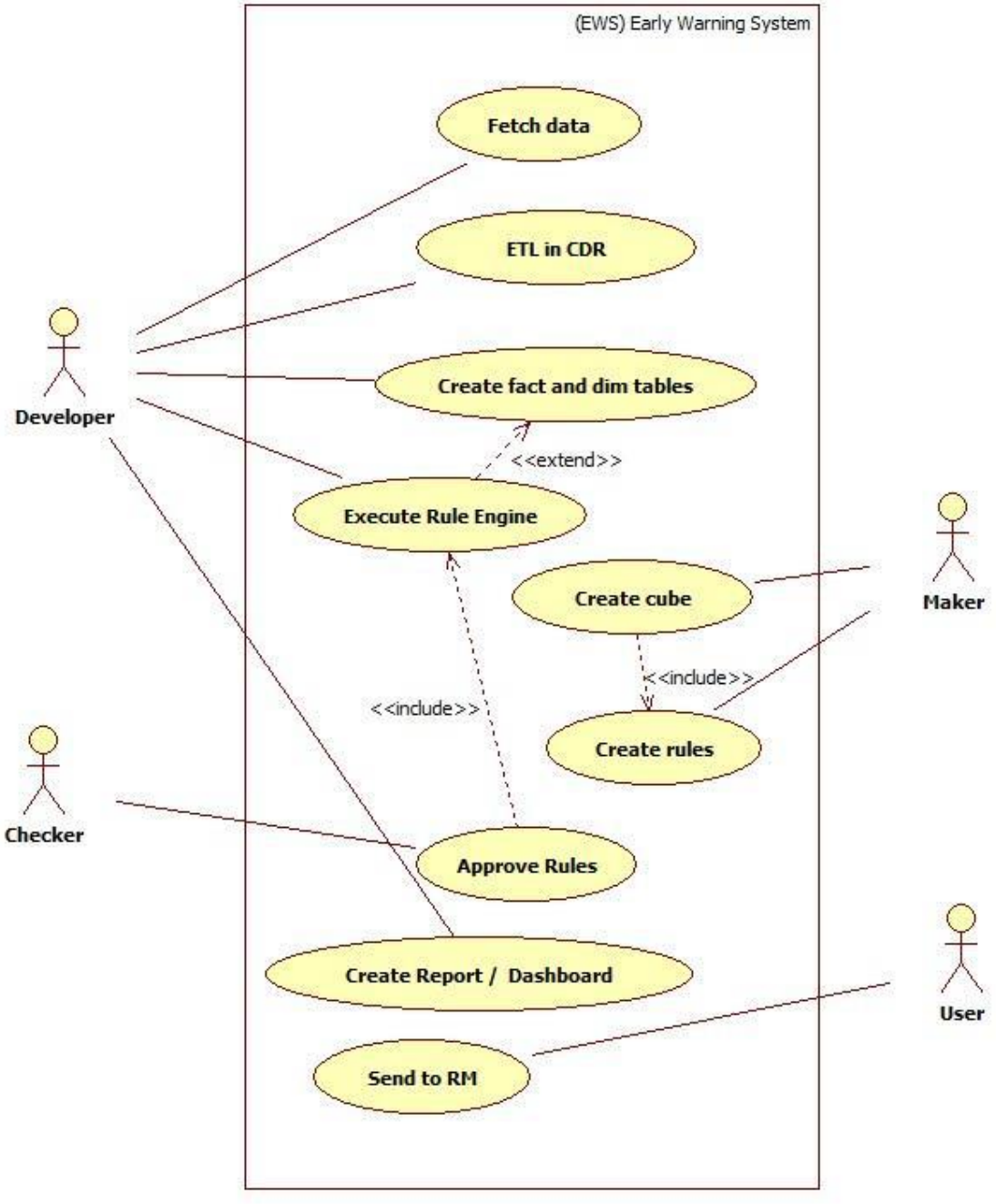

Fig 16. Use case

3.3 ER-Diagram

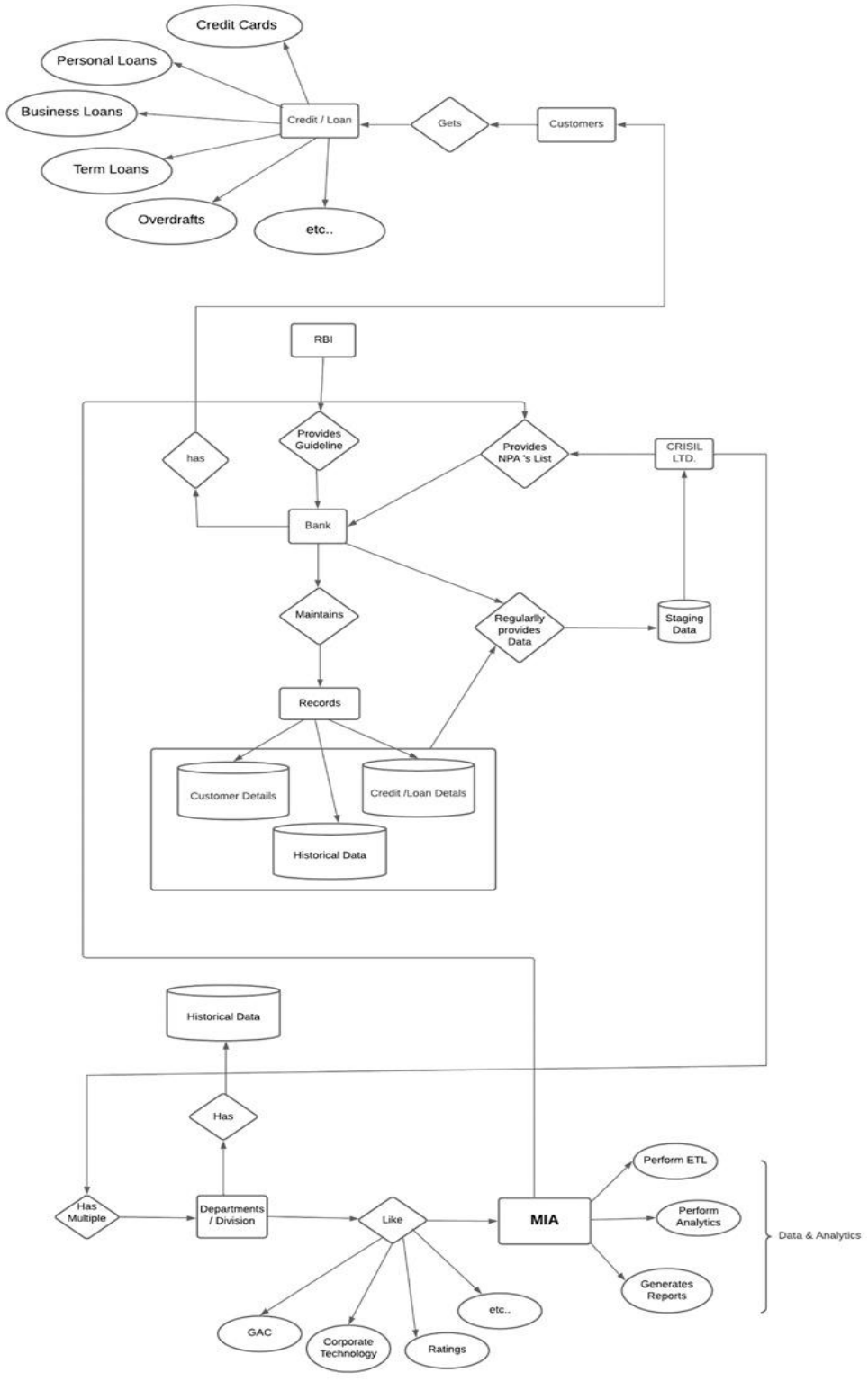

Fig 17. ER- Diagram

3.4 Activity Diagram

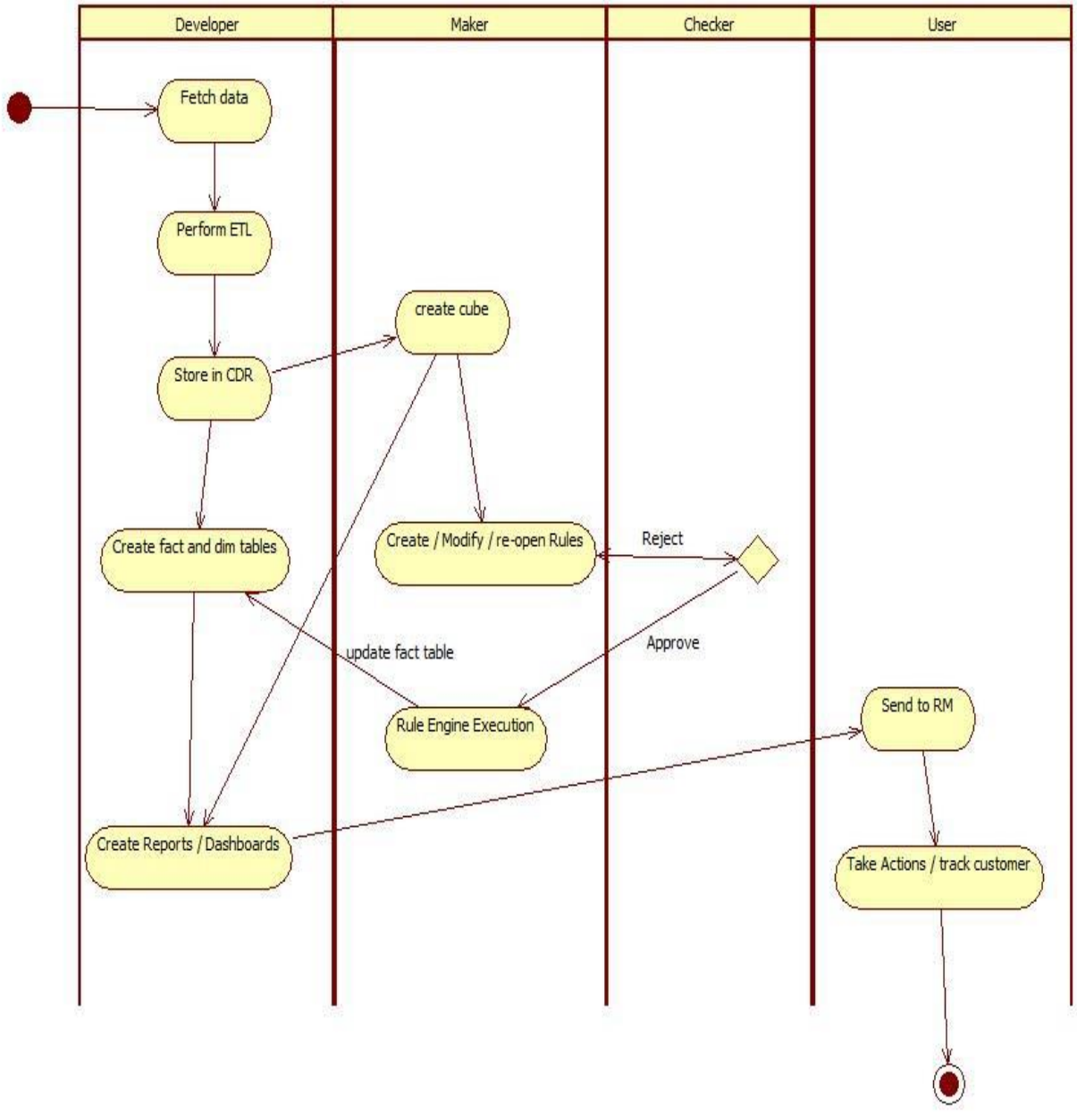

Fig 18. Activity Diagram

3.5 Estimation Planning for Project

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Phase - I Project Portfolio 360 Study	7 days	Wed 1/15/20	Thu 1/23/20	
2		Phase - I Portfolio 360 Requirement Analysis	7 days	Thu 1/23/20	Mon 2/3/20	1
3		Portfolio 360 UI and Functionality Development with Database	15 days	Mon 2/3/20	Mon 2/24/20	2
4		Portfolio 360 First Preview and Development Changes	5 days	Mon 2/24/20	Mon 3/2/20	3
5		Portfolio 360 Second Preview and Development Changes	5 days	Mon 3/2/20	Mon 3/9/20	4
6		Portfolio 360 Third Preview and Development Changes	5 days	Mon 3/9/20	Mon 3/16/20	5
7		Portfolio 360 Forth Preview and Development Changes	20 days	Mon 3/16/20	Mon 4/13/20	6
8		Portfolio 360 Testing of Phase - I	2 days	Mon 4/13/20	Wed 4/15/20	7
9		Portfolio 360 Minor Changes Development	5 days	Wed 4/15/20	Wed 4/22/20	8
10		Phase - I project Customer 360 study and UI	5 days	Wed 4/22/20	Wed 4/29/20	9
11		Phase - I project Customer 360 study and Functionality	5 days	Wed 4/29/20	Wed 5/6/20	10,9
12		Phase - I project Customer 360 study and Database	6 days	Wed 5/6/20	Thu 5/14/20	11
13		Phase - II Trigger Maintenance screens study	6 days	Thu 5/14/20	Fri 5/22/20	12,11
14		Phase - II Development of Trigger Screens UI , Functionality, Database	15 days	Fri 5/22/20	Fri 6/12/20	11,12,13
15		Phase - II development of Trigger screens minor changes and Portfolio Testing and minor changes	4 days	Fri 6/12/20	Thu 6/18/20	9,14
16		Phase - II development of Customer flags screens UI, Functionality, Database	4 days	Thu 6/18/20	Wed 6/24/20	9,14,15
17		ADF Project on Local Server UI correction, JSON bakup, Report formatting, DB queries correction	3 days	Wed 6/24/20	Mon 6/29/20	16,14
18		ADF Project on Local Server UI correction, JSON bakup, Report formatting, DB queries correction	6 days	Mon 6/29/20	Tue 7/7/20	17
19		Phase - II ongoing development	6 days	Wed 6/24/20	Thu 7/2/20	14,16

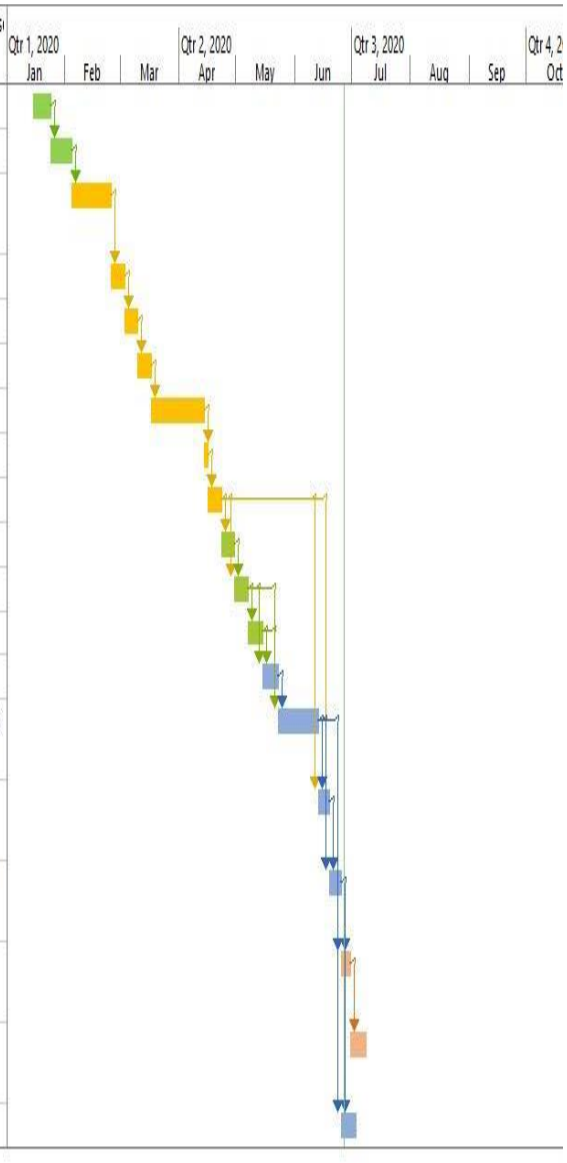

Fig 19. Estimation Planning for Project

CHAPTER 4: Development and Implementation

4.1 Modules Details:

1.Portfolio 360

2.Customer 360

3.Trigger Maintenance

4.Customer Flags

o Portfolio 360

 Overall summarized view of customers (Categorical view)

 Drill down to customer level

 Regular insights of customers

o Customer 360

 Data represented using charts and grid

 360 degree view about particular customer

 Patterns about customer performance in markets

o Trigger Maintenance

 Categorization of customers based on approved triggers

 Individual / group triggers

 Create / Modify /View triggers

o Customer Flags

 Provides individual customer details and number of triggers breach on them

 Allows to send the details to RM

 Helps RM to track the customers and take upon corrective actions based on individual trigger's result.

4.2 Test cases and Test Results

1) Test Cases:

We have tested four main modules of credit one view and the test cases with their outcomes are shown below:

a) Customer 360

Sr. No	Test Case	Expected	Output	Result
1	All data points in reports should mention correct data in tables and chart.	Correct representation of data.	Correct representation of data.	
2	Proper value should be pass from combo box to refresh data in chars.	Charts should represent data for the same value which is selected in combo box.	Proper data in charts for the corresponding value.	
3	Correct Graphs should be shown based on clicked toggle button.	Correct representation of corresponding graph for which toggle button has been clicked.	Proper representation of graph for each toggle button.	
4	All pop-up should mention their respective tiles details for which they have been clicked.	Pop-up data should mention corresponding tiles details.	All the data in pop-up for each tile are correct.	
5	Proper radio button option should be selected on on-load.	Correct radio button should be selected on on-load.	Proper radio button is selected while loading the page.	

b) Portfolio 360:

SR. No	Test Case	Expected	Output	Result
1	Correct parameters should be passed for each pop-up.	All pop-ups should represent correct data for the corresponding clicked on any data points.	All pop-ups represent correct data for the corresponding clicked on any data points.	
2	Correct groups of data should be displayed when some particular segment is clicked in chart.	Data representation should be correct with respect to clicked segment in chart.	Proper representation of data with respect to clicked segment in chart.	
3	All hyperlinks in tables should work properly with respect to their corresponding row data.	All hyperlinks in chart should work properly.	All hyperlinks in tables should work properly with respect to their corresponding row data.	
4	Every events of button, toggles, and labels should work properly.	Buttons, toggles and labels should work according to their corresponding events.	All the buttons, toggles and labels are working properly with their respective events.	
5	Each data point's values should be consistent everywhere on reports for each client.	Data should be consistent for each client.	Consistency of data for each client has been maintained.	

c) EWS Trigger Maintenance:

SR.No	Test Case	Expected	Output	
1	All the input fields and components should be allowed to edit only on the basis of respective authorization of maker and checker.	Only maker should be allowed to edit the input fields to create trigger and checker will only be able to give comment and approve those triggers.	Only maker is able to create and edit the triggers whereas checker can only comment and approve the triggers.	
2	All given inputs for the fields should be validated by the system.	System should give error message if data is not valid for a particular field.	System gives validation messages if data are not correctly filled in the fields.	
3	On creation of a new trigger, all the data fields should be loaded blank.	All data should be blank when maker wants to create a new trigger.	All the input fields are loaded blank when a new trigger need to be created.	
4	Correct data should be loaded in each field when a maker wants to edit or re-open already created triggers.	All data fields should be loaded with correct data for their respective triggers.	All data fields loaded with correct data for their respective triggers.	

CHAPTER 5: CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

The project is providing software solution which shall assist banks in monitoring their credit portfolio using public information as well data residing within bank's systems. The end users of the application would be able to view the overall portfolio performance and also drilldown to view each borrower's conduct and also identify any indicators of stress in the account.

5.2 Future Scope

The project is under development and is being develop with a user friendly interface considering the convenience of our customers and various features are been added to make it more effective and data to be free of any manual interference.

References

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Glossary

- EWS - Early Warning System
- Triggers – Set of rules and expressions that are used in actual DB triggers as parameters to categorize customers into Red, Amber and Green.
- Rule Engine – Executes a set of Jobs and transformations once triggers are approved that transforms and store data in database.