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Capstone Project Final Report

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DECLARARATION:

We, Group F, affirm that the attached work is entirely my own, except where the words or ideas of other writers are specifically acknowledged in accordance with accepted APA citation conventions. This assignment has not been submitted for any other course at Conestoga College or any other global institution. We acknowledge that we have revised, edited, and proofread this paper, and we certify that we are the author of this paper. Any assistance we received in its preparation is fully and properly acknowledged and disclosed. We have also cited any sources from which we used data, ideas, theories, or words, whether quoted directly or paraphrased. We further acknowledge that this paper has been prepared by ourselves specifically for this course.

VERSION HISTORY:

Version #	*Date*	*Changes*	*Created / Updated By*
1,0	23rd November 2023	Created the Document	Prashanth Patil
1,1	5th December 2023	Changes made to Database Design	Prashanth Patil
1.2	6th December 2023	Changes made to ROI Calculation	Prashanth Patil
1.3	7th December 2023	Changes made to Teams Roles and Responsibilities	Prashanth Patil
1.4	8th December 2023	Finalized the Document	Prashanth Patil

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1. EXECUTIVE SUMMARY

The MortgageBotX Project is an ambitious endeavor aimed to transform and streamline the Royal Bank of Canada's (RBC) mortgage services. This executive summary summarizes the project's essential elements, objectives, and recommendations based on a thorough investigation.

Project Justification:

RBC embarked the MortgageBotX Project in response to the changing financial services market and rising need for efficient mortgage solutions. The goal is to use cutting-edge technology, notably AI and chatbot capabilities, to improve the entire customer experience, reduce response times, and give specialized mortgage information.

1.1 Key Findings:

- ***Mortgage Services in the Present:***

RBC's present mortgage services have shown to be effective, but they are ready for improvement. A more efficient and responsive approach to customer contacts, particularly inquiry and application procedures, can benefit.

- ***Trends in the Industry and Competitive Analysis:***

An in-depth assessment of industry trends and a competitive analysis show that incorporating AI-powered chatbots into mortgage services is becoming the standard. RBC's MortgageBotX strives to not only meet but also exceed industry standards in customer-centric mortgage solutions.

- ***Customer-First Approach:***

The initiative prioritizes RBC's commitment to a customer-centered strategy. MortgageBotX is envisioned to give RBC consumers with a more customized, accessible, and efficient mortgage experience, rather than merely a technology improvement.

1.2 Recommendations:

- ***AI Chatbot Solution Implementation:***

The proposed approach is the creation and implementation of MortgageBotX, an AI-powered chatbot. This chatbot will be the initial point of contact for clients with mortgage-related questions, giving timely replies and helping them through the introductory phases.

- ***Integration with Mortgage Professionals:***

While MortgageBotX handles initial contacts, the initiative envisions a hybrid architecture in which AI effortlessly transfers more sophisticated questions to Mortgage Specialists. This maintains a healthy mix between automation and human skills.

- ***Benefits and return on investment:***

The anticipated benefits are improved client satisfaction, shorter response times, and operational efficiency. The ROI study predicts good consequences in the next years, owing to improved client interaction and faster mortgage procedures.

2. RBC COMPANY

ROYAL BANK OF CANADA

One of Canada's biggest banks, the Royal Bank of Canada (RBC), is regarded as a major player in the world of finance. It offers people, companies, and organizations a wide range of financial services. An overview of RBC's financial situation and market share is provided below: *(Helping Clients Thrive and Communities Prosper, n.d.)*

Total RBC Clients	$17 Million
Total RBC Net Banking Clients	$1.9 Million
RBC Market Capitalization	$172.2 Billion
AUM	$1.9 Trillion

RBC is renowned for its impressive financial success. RBC was the largest bank in Canada by total assets as of the end of 2020, with total assets of around CAD 1.68 trillion. The bank was profitable as evidenced by its CAD 12.8 billion net profits for the year.

Market proportion: RBC has a sizable proportion in several industries. In Canada, RBC is one of the top banks for personal banking and has a sizable client base. It has a vast network of branches and ATMs all throughout the nation.

RBC is a major player in the commercial banking industry as well. It serves the requirements of Canadian companies of all sizes, from microbusinesses to global conglomerates. In industries including real estate, manufacturing, technology, and resources, RBC is well-represented.

RBC is also a significant player in capital markets and investment banking. It provides a wide range of services, such as advice services, debt and equity financing, and mergers and acquisitions. RBC holds a substantial market share in trading and underwriting on both local and foreign markets.

RBC provides a wide range of financial services in addition to its traditional banking activities. It offers services for asset management, loans to individuals and businesses, and wealth

management. RBC is becoming more prevalent in the field of online banking and provides cutting-edge digital services to its clients.

Overall, the Royal Bank of Canada is a stable, financially sound organization with a sizable market presence in several industries. It is a significant participant in the Canadian and international banking sectors thanks to its wide variety of services, solid financial performance, and large network.

Here are Quarter-wise numbers:

QUARTERLY	NET INCOME	Change in percent YOY (year on year)
2023 Quarter 1	3.2 B	-22%
2023 Quarter 2	3.6 B	-14%
2023 Quarter 3	3.9 B	8%
2022 Quarter 1	4.1 B	6%
2022 Quarter 2	4.3 B	6%
2022 Quarter 3	3.6 B	17%
2022 Quarter 4	3.9 B	0%
2021 Quarter 1	3.8 B	10%
2021 Quarter 2	4.0 B	17.10%
2021 Quarter 3	4.3 B	34%
2021 Quarter 4	3.8 B	20%
2020 Quarter 1	3.5 B	11%
2020 Quarter 2	1.5 B	-54%
2020 Quarter 3	3.2 B	-2%
2020 Quarter 4	3.2 B	-1%
2019 Quarter 1	3.2 B	5%
2019 Quarter 2	3.2 B	6%
2019 Quarter 3	3.3 B	5%
2019 Quarter 4	3.2 B	-1%

3. COMPETITIVE ANALYSIS(SWOT)

3.1RBC (Royal Bank of Canada)-

STRENGTHS:	OPPORTUNITIES:
- Strong Financial Position - Diversified Business - Global presence - Innovation and technology - Strong Brand and reputation	- International Expansion - Wealth Management Growth - Development of Technology - New Client from Digital Strategy - Interest and Mortgage Rate
WEAKNESS:	**THREATS:**
- Customer service issues - Depend on Canada and US - Interest Rate Sensitivity - Cash Flow Problems - Dependence on Canadian Economy	- Cybersecurity Risks - Regulatory Changes - Geopolitical Risks - Competition

The Royal Bank of Canada (RBC) has a lot of resources, engages in a variety of commercial ventures, is well-known across the world, employs cutting-edge technology, enjoys a solid reputation, and has won honors. It does, however, have certain issues, such as not always providing excellent customer service, relying excessively on Canada and the United States, occasionally running out of cash, and being influenced by how well Canada's economy is performing.

RBC has the potential to develop by entering new markets, increasing its revenue from helping clients manage their wealth, utilizing cutting-edge technology, attracting more clients online, and profiting from fluctuations in interest rates.

However, RBC must also be on the lookout for hazards including cyberattacks, shifting government regulations, international political unrest, and fierce rivalry from other banks. RBC must carefully balance all these factors to remain strong.

3.2Comparison of SWOT Analysis:

	RBC	TD	Scotiabank	CIBC
STRENGTHS	**Strong Financial Position** Diversified Business **Global presence** Excellence in Innovation and technology	Widespread Network **Effective Digital Marketing Strategy**	**Excellent Financial Standing** Wider Variety of Services **World-wide presence Technology Innovation in the Digital Sphere**	**Historically Consistent Financial Outcomes** Expansion of Operations Outside of Canada New Developments in Online Banking
WEAKNESS	**Customer service issues** **Interest Rate Sensitivity** Cash Flow Problems	**Challenges for Restricted Expansion** Cash Streams Administration Concerns **Lack of Innovation Venture**	Reliance on Specific Markets **Interest Rate Sensitivity** **Small Market Share in Important Regions**	**Data Security Worries and Cybersecurity Risks** Quality Issues with Customer Service **UI/UX design for the Online Banking Website is not Optimal**
OPPORTUNITIES	**International Expansion** Wealth Management Growth **Development of Technology** Interest and Mortgage Rate	Growing and Extending Within the US **Advancement of Online Channels** **Recognizing Innovation Advancement**	**Growth in Digital Banking** Changing Client Needs **Greater Expansion**	**Introducing a Broad-based AI Chatbot for Client Support** An Expanding Need for Wealth Management Services **Expanding Internationally**
THREATS	**Cybersecurity Risks** Geopolitical Risks **Competition**	**Cybersecurity Risks** Regulatory Changes **Competition**	**The technological development of rivals** Changes to Regulation **Threats to cybersecurity**	**Competition** Costs of Compliance are Rising due to Regulatory Changes. **Ongoing Dangers to Cybersecurity and Data Breaches.**

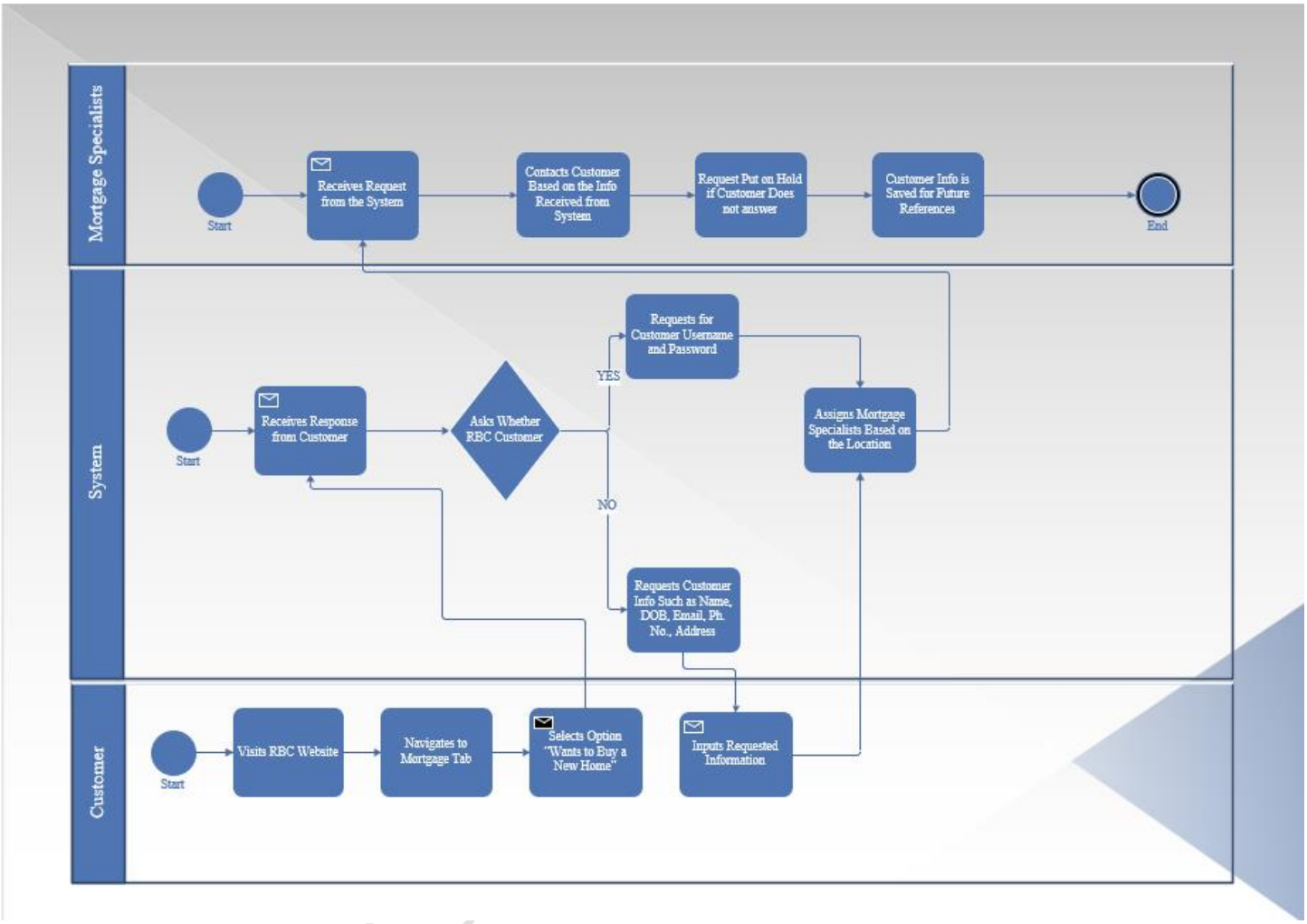
4. ASSUMPTIONS AND PREREQUISITES

The below table explains the Specific Requirements, Functionalities and Features of the MortgageBotX Project

FEATURES	FUNCTIONALITY
➢ AI Chatbot Capabilities	
Natural Language Processing (NLP)	For the solution to effectively comprehend and reply to customer enquiries, it needs have powerful NLP capabilities.
Contextual Knowledge	The capacity to keep context during a conversation to provide a smooth user experience
Adapting to Current Systems	Compatible for data processing and retrieval with RBC's present IT infrastructure
➢ User Experience and Interface	
Friendly User-Interface	A Customer-facing chatbot interface that is clear and easy to use
Personalization	The ability to customize suggestions and answers depending on user histories and profiles
➢ Mortgage Services	
Information about Mortgages	Give specific details on mortgage products, rates, and terms.
Application Support	Users should be guided through the mortgage application process,
Calculators for Mortgages	Provide interactive calculators for calculating affordability, mortgage payments, and other things.
➢ Data Analytics and Insights	
Data Gathering	To discover patterns and consumer behavior, gather and evaluate user data.
Dashboards and Reports	Create dashboards and reports for RBC to analyze customer interactions.

Forecasting Analysis	Predictive modeling with data may be used to enhance services and products
➢ Compliance and Security	
Data Privacy	Ensure adherence to data privacy laws, such as the CCPA and GDPR.
Security Precautions	To safeguard user information and transactions, use strong security measures.
The Audit Trail	Keep thorough audit records of chatbot interactions for compliance and oversight
➢ Scalability and Performance	
Scalability	To handle increasing user numbers and interactions, the system must be scalable.
Strong Availability	For continuous service, provide high availability and low downtime.
Performance Metrics	Keep tabs on chatbot performance and produce reports on response times and user satisfaction.
➢ Customer Support and Training	
Training and Documentation	Provide RBC personnel with training materials and documentation so they can administer and maintain the chatbot.
Support and Maintenance	Offer ongoing maintenance, support, and updates.
➢ Customization and Flexibility	
Configuration	To easily react to changing demands, make it possible to easily customize chatbot operations and replies.
Extension Capabilities	Offer choices for enhancing the functionality of the chatbot with unique modules or plugins
➢ Reporting and Analytics	
Strong Reporting	Provide extensive reporting tools to monitor performance metrics, customer happiness, and chatbot usage.
Dashboard for Analytics	Give a data visualization and real-time insights analytics dashboard

5. AS-IS PROCESS FLOW



5.1OUTLINE

The following groups or people are involved in or accountable for each phase of the RBC Mortgage Services AS-IS procedure for customer inquiries:

- **Customer Goes to RBC Website-**
  Customers start this process by going to the RBC website. (https://www.rbcroyalbank.com/personal.html)
- **Customer Navigate to RBC Mortgage Tab-**
  Customers access the RBC Mortgage Tab by navigating to it. (https://www.rbcroyalbank.com/mortgages/index.html)

- **Customer Clicks on the Selected Option-**
  Customers can choose whether they want to "Want to buy a new home" or "Want to buy a new home and sell their current home." These choices are based on their preferences.
- **As per selection, Systems ask whether the customer is an RBC Account holder or not-**
  The RBC website or system is responsible for this step, which involves displaying the appropriate follow-up questions based on the customer's selection.
- **If the Customer is an existing RBC customer, ask to enter the customer's Username and Password-**
  The RBC website or system handles this step, prompting existing customers to provide their login credentials.
- **If not, the system asks for Customer's Name, Customer DOB, Customer Email, Customer ph. no, Customer location-**
  The RBC website or system collects this information from non-existing customers.
- **Based on customer details, the system assigns a Mortgage Specialist to contact Customers and answer their inquiries-**
  The system, driven by backend algorithms, is responsible for the assignment of a Mortgage Specialist based on customer details.
- **If the Customer is busy, Mortgage Specialists will put the customer inquiry on hold-**
  Mortgage Specialists, as human agents, are responsible for recognizing when a customer is busy and placing the inquiry on hold.
- **Once contacted, the Customer decides whether to go with the RBC Mortgage Services or not-**
  The final decision rests with the customer, based on the information provided by the Mortgage Specialist.

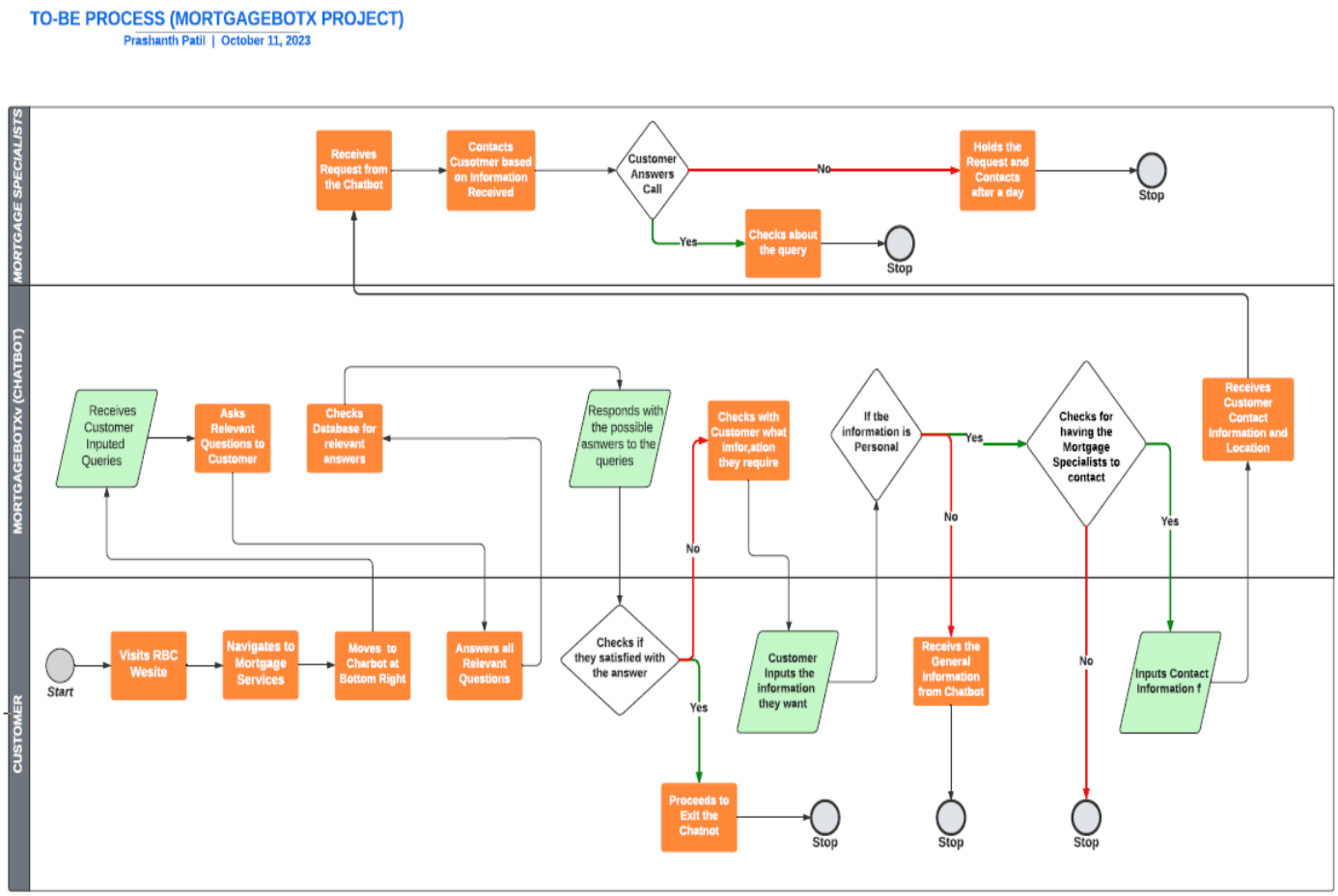
5.2DISADVANTAGES

The current RBC Mortgage Process has some drawbacks-

- **Manual Handling:** The existing procedure includes elements that must be performed manually, such as when clients submit their personal data and Mortgage Specialists respond to enquiries. This can take a lot of time and be error prone.
- **Limited Accessibility:** Customers may only contact RBC Mortgage Services during regular business hours, which restricts accessibility and help for individuals who require information outside of normal working hours.
- **Customer Disagreement:** Customers may have trouble while supplying personal information or login credentials, which might result in potential drop-offs.

Absence of real-time data: Customers may receive outdated or insufficient information due to the existing procedure's inability to give real-time information on interest rates or mortgage computations

6. TO-BE PROCESS (MORTGAGEBOTX PROJECT)



(*SOURCE: MortgageBotX – BPMN Process Flow Document*)

6.1OUTLINE

Following is the outline for the TO-BE Process of MortgageBotX Project:

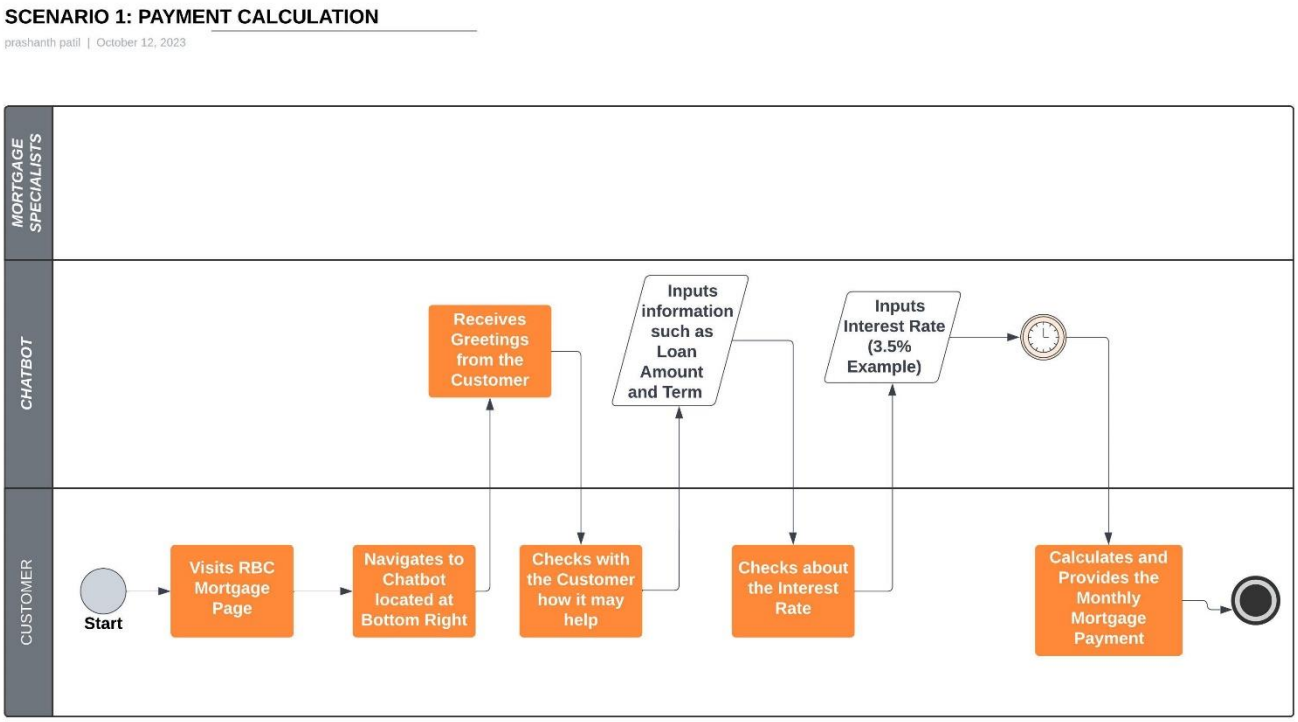
- **Customer Goes to RBC Website-**
  Customers start this process by going to the RBC website.
  (https://www.rbcroyalbank.com/personal.html)
- **Customer Navigate to RBC Mortgage Tab-**
  Customers access the RBC Mortgage Tab by navigating to it.
  (https://www.rbcroyalbank.com/mortgages/index.html)
- **Customer Navigates to AI Chatbot-**
  Customer moves to AI Virtual Chatbot at the Bottom Right of the page.

- **Customer Initiation:**
  Customers initiate the interaction by accessing the AI Virtual Chatbot for mortgage-related inquiries.
- **Chatbot Inquiry Reception:**
  The Chatbot receives customer inquiries related to various mortgage services.
- **Relevant Query Clarification:**
  The Chatbot seeks clarification by asking pertinent questions to better understand the specific nature of the customer's inquiry.
- **Customer Response:**
  Customers respond by providing answers to the Chatbot's relevant questions.
- **Real-time Data Retrieval:**
  The Chatbot accesses real-time data sources to provide accurate responses to the customer's inquiries.
- **Customer Satisfaction Check:**
  The Chatbot ensures customer satisfaction by verifying if their questions have been adequately addressed.
- **Customer Exit (If satisfied):**
  If the customer is content with the provided information, they exit the Chatbot interaction and the RBC website.
- **Customer Follow-up (If Dissatisfied):**
  In cases of customer dissatisfaction, the Chatbot seeks to understand the specific information they are seeking and how it can further assist.
- **Additional Information Input:**
  Unfulfilled customers input more details and await the Chatbot's response.
- **Non-Personal Information Queries:**
  For non-personal inquiries, the Chatbot attempts to address the customer's questions directly.
- **Personal Information Recognition:**
  If the inquiry involves sensitive personal data (e.g., salary, credit score), the Chatbot promptly asks if the customer wishes to be contacted by a Mortgage Specialist.
- **Contact Details Collection:**
  To facilitate contact by Mortgage Specialists, the Chatbot collects essential customer details, such as email, phone number, and name.
- **Query Transfer to Specialists:**
  The Chatbot transfers the collected information and inquiry to a suitable Mortgage Specialist based on the customer's location and initiates a support ticket.
- **Specialist Ticket Assessment:**
  Mortgage Specialists review the Chatbot-generated support ticket, examine the customer's query, and attempt to reach out to the customer using the provided contact details.
- **Customer Response (Answered):**

If the customer answers the call, Mortgage Specialists address their queries and maintain records in their database.

- **Customer Unresponsive (Unanswered Call):**
  In cases of customer unresponsiveness, Mortgage Specialists place the ticket on hold and make further contact attempts, typically on the following day.

6.2 SCENARIO 1: Payment Calculation



Scenario Context: Payment Calculation-

Prashanth, a prospective house buyer, discusses his alternatives for a new home's financing. He wants to know what his monthly mortgage payments will be based on various arrangements and has a certain loan amount in mind.

Chatbot Role:

Prashanth communicates with the chatbot, giving it information about the loan amount, the preferred loan period (for example, 15 or 30 years), and the current interest rate. Based on the information John has supplied, the Chatbot's job is to compute the expected monthly mortgage payments quickly and precisely for him.

Chatbot Communication:

Prashanth: "Hello, I'm looking to buy a new home, and I need to determine what my monthly mortgage payments might be," said Prashanth. I'm thinking about taking out a $250,000 loan with a 30-year term. What is the interest rate right now?

Chatbot: “Thanks, John. I'll need to know the current interest rate to calculate your estimated monthly payments. Give the current interest rate, please.

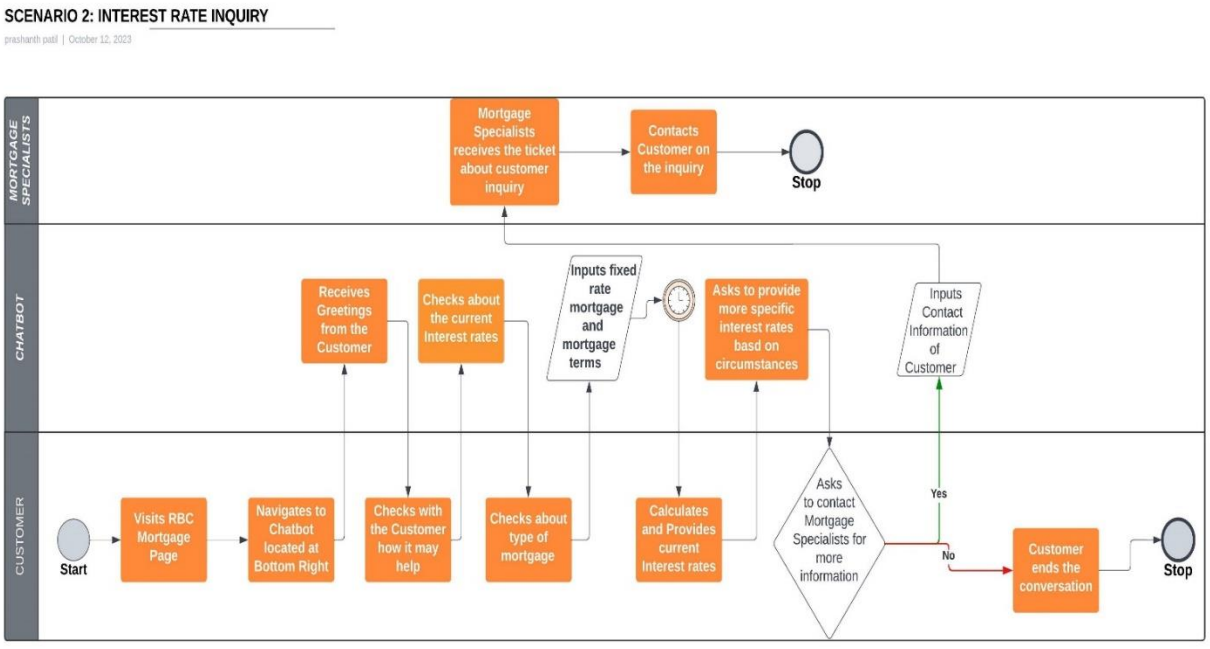
Prashanth: "I think it's around 3.5%,"

Chatbot: "Great, thanks for the information, Prashanth". Let me figure it out for you. For a $250,000 loan with a 30-year term and 3.5% interest, your approximate monthly mortgage payment is $1,122.61. Remember that this is only an estimate and doesn't account for possible expenses like taxes or insurance.

Benefits:

Prashanth receives prompt and precise information on his monthly mortgage payment, enabling him to plan his spending wisely and decide on a property with confidence. Potential homeowners like John benefit from the process' streamlining and useful financial advice provided by the chatbot. When examining mortgage choices, this efficiency aids people like John in making wise judgments by improving the whole customer experience.

6.3 SCENARIO 2: Interest Rate Inquiry



Scenario 2: Interest Rate Inquiry-

Sarah, a prospective home buyer, is just starting to think about getting a mortgage for her new house. To weigh her possibilities, she needs to comprehend the present interest rates being given by RBC.

Chatbot Function:

Sarah engages the chatbot and states that she would like to know the current interest rates for various mortgage options and periods. The Chatbot's responsibility is to quickly give Sarah the most recent information on interest rates and direct her to a Mortgage Specialist if she needs more individualized assistance.

Chatbot Conversation:

Sarah: I'm looking at financing choices for my future home, hello. Could you kindly let me know what interest rates RBC is now offering for their different mortgage packages and terms?

Chatbot: "Sure thing, Sarah. I'm here to help. Could you please describe the type of mortgage you are interested in (e.g., fixed-rate, variable-rate) and the desired duration (e.g., 15 years, 30 years) so that we can provide you with the most accurate rates?

Sarah: "I'm considering a fixed-rate mortgage, and I'd like to know rates for both 15-year and 30-year terms."

Chatbot: "Sarah, I appreciate you giving me those facts. I'm getting the most recent mortgage interest rates for fixed-rate loans with maturities of 15 and 30 years. These interest rates are based on the most recent data:

3.2% for a 15-year fixed rate

3.6% for a 30-year fixed rate

Please be aware that these rates are liable to fluctuate, and that speaking with one of our Mortgage Specialists about your unique situation is crucial if you want individualized guidance. Do you want me to put you in touch with a mortgage specialist?

Sarah: "Yes, please connect me with a specialist."

Chatbot: "Sure thing, Sarah. I'll need your contact information so I can help you further. I need your name, email, and phone number.

Sarah: "My name is Sarah Smith, and you can reach me at sarah.smith@email.com or 123-456-7890."

Benefits:

In this case, Sarah obtains prompt and precise information on the current interest rates for the mortgage products and terms she is considering. Because of the Chatbot's effectiveness, Sarah may choose her mortgage alternatives with knowledge. Additionally, the Chatbot makes sure that clients like Sarah have access to individualized support and professional advice based on their situation by establishing a connection with a Mortgage Specialist. The smooth transition from Chatbot to expert improves the customer experience and guarantees that clients can get specialized help when they need it.

7. POSSIBLE SOULTION 1 : AI CHATBOT (MortgageBotX Project)

7.1 High- Level Design:

The MortgageBotX Project's AI Chatbot solution is intended to provide a smooth and efficient client experience by giving rapid solutions to mortgage-related issues. The design includes the following main aspects at a high level:

- **AI Chatbot Architecture:** To interpret and reply to client requests, the chatbot employs a modular design that mixes natural language processing (NLP) and machine learning techniques.
- **Customer Interaction:** Customers may engage with the Chatbot via a simple online interface or a dedicated mobile application. The user interface provides usability and accessibility.
- **Database Integration:** To obtain up-to-date information on mortgage products, interest rates, and client data, the Chatbot is linked to the central RBC database.
- **Security Measures:** To safeguard sensitive customer data and maintain the privacy and confidentiality of interactions, robust security mechanisms are included.
- **Communication Channels:** For a complete consumer reach, the Chatbot is built to function on numerous communication channels, including web chat, messaging applications, and phone conversations.

Benefits-

- **Improved consumer Engagement:** The Chatbot responds quickly to consumer inquiries, increasing engagement and satisfaction.
- **Efficient Query Resolution:** Routine inquiry automation speeds up the query resolution process,
- **Data Security:** Strict security procedures ensure that client data stays private.
- **Access via Multiple methods:** Customers may communicate with the Chatbot via a variety of communication methods.
- **Integration with Backend Systems:** The Chatbot communicates with RBC's database to retrieve correct information.

7.2 Low-Level Design:

The low-level design goes into the AI Chatbot system's technological characteristics and component-level elements. It consists of the following elements:

- **Design of the Chatbot's Dialog Flow:** The Chatbot's dialog flow is methodically planned, laying out how it processes and responds to user inputs. This involves establishing conversational settings and responding to questions.
- **NLP Algorithms:** The low-level design describes the natural language understanding NLP algorithms, such as intent recognition, entity extraction, and sentiment analysis.
- **User Interface Elements:** Details about the visual design, user interaction aspects, and accessibility features of the online interface and mobile app are provided.
- **Database Structure:** The database structure is intended to store and retrieve customer data effectively, assuring peak performance.
- **Security Implementation:** The security protocols and encryption technologies are included in the low-level design.

Benefits-

- **User-Centric discussions:** The Chatbot's dialog flow guarantees that discussions are relevant and user-centric.
- **Understanding:** Advanced NLP algorithms improve the Chatbot's comprehension of user inputs.
- **Intuitive User Interface:** The design of the user interface encourages a smooth and intuitive consumer experience.
- **Efficient Data Management:** The database schema enables the storing of ordered and efficient data.
- **Strong Security:** Strict security measures safeguard consumer data and interactions.

7.3 Impact Analysis:

The Impact Analysis assesses the implications and repercussions of adopting the AI Chatbot solution as part of the MortgageBotX Project. It considers both good and negative consequences for various stakeholders, the organization, and operational procedures.

Positive Effects:

- **Improved Customer Experience:** Customers benefit from quick and precise replies, which leads to higher levels of satisfaction.
- **Operational Efficiency:** Automation of common inquiries decreases the stress on human agents and speeds up query resolution.
- **Cost savings:** By automating regular queries, the firm may better deploy resources.
- **Data Accuracy:** By integrating with the central database, clients are guaranteed to obtain correct and up-to-date information.

Negative Effects:

- **Expenditures of Initial Implementation:** The development and deployment of the Chatbot incurs initial expenditures.
- **Learning Curve:** It may take some time for employees to adjust to the new system and its upkeep.
- **Technical faults:** Any technical faults or downtime may have an impact on the customer experience.
- **Data Privacy Concerns:** It is critical to ensure data privacy and regulatory compliance.

Benefits:

- **Customer Satisfaction Increased:** Immediate inquiry answers and user-friendly design lead to happy consumers.
- **Streamlining Operations:** Reduced burden for human agents and effective resource allocation.
- **Cost-Efficiency:** Automation aids in the management of operating expenses.
- **Data Reliability:** Data correctness is ensured by integration with the central database.

7.4 Risks and Mitigation:

This section analyzes possible hazards related with the AI Chatbot solution's installation and outlines mitigating options.

Risks:

- **Technical challenges:** The Chatbot may encounter technical challenges, causing service outages.
- **Data Breach and Privacy problems:** Security flaws might lead to data breaches and privacy problems.
- **Customer Acceptance:** Customers may initially be hesitant to use the Chatbot, lowering adoption rates.
- **Regulatory Compliance:** It is vital to ensure that data protection regulations are followed.

Mitigation:

- **Technical Support:** A specialized technical support staff will monitor and respond to technical faults as soon as possible.
- **Strong Security Measures:** Strict security standards will protect consumer data.
- **User Training:** Chatbot adoption will be aided by user training initiatives.
- **Legal Compliance:** Data protection rules compliance is a high priority.

7.5 Out of Scope:

This section describes the AI Chatbot implementation's bounds. It specifies what is not included in the project scope, ensuring project objectives are met.

Elements Out of the Scope:

- Integration with services that are not linked to mortgages.
- Beyond data privacy, legal and regulatory compliance

8. POSSIBLE SOULUTION 2: SOCIAL MEDIA CHATBOT WITH MANUAL MONITORING

8.1High- Level Design:

The Social Media Chatbot's high-level concept comprises a collaborative approach in which early contacts with clients are automated using AI and subsequently Mortgage Specialists take over. Here are some major design elements:

- **Hybrid Chatbot Model:** The Chatbot operates in a hybrid approach, with AI addressing basic requests and human Mortgage Specialists taking more sophisticated issues during office hours.
- **Integration with Social Media sites:** The Chatbot is integrated with several social media sites, allowing consumers to communicate through their chosen methods.
- **Business Hour Availability:** Because the Chatbot is controlled by Mortgage Specialists, it is only available during ordinary office hours.
- **AI Assistance:** Based on client purpose and context, the AI component aids in directing questions to the right Mortgage Specialists**.**

Benefits-

- **Social Media Access:** Customers may interact with the Chatbot through their chosen social media sites.
- **Initial Automation:** Automation speeds up initial query processing.
- **Human Expertise:** Mortgage Specialists provide thorough and accurate replies.
- **Multichannel Engagement:** Engaging customers across different social media channels broadens their reach**.**

8.2 Low-Level Design:

The low-level design delves into the Chatbot system's technological aspects, concentrating on AI integration, social media interactions, and human-agent handover.

- **Design of the Chatbot's Dialog Flow:** The Chatbot's dialog flow describes how AI begins discussions, determines user intent, and transfers to Mortgage Specialists.
- **AI Integration:** Specifications for AI components such as intent recognition, entity extraction, and context management are provided.
- **Social Media APIs:** The connection with social media sites is detailed, allowing the Chatbot and consumers to communicate seamlessly.
- **Procedures for moving interactions from AI to human agents:** The design defines procedures for transferring interactions from AI to human agents, guaranteeing a smooth transition.

Benefits-

- **User-Centered Conversations:** The dialog flow encourages natural user engagement.
- Advanced NLP algorithms improve the Chatbot's understanding of user inputs.
- **Integration with Social Media Platforms**: Integration with social media platforms facilitates multichannel interactions.
- **Effective Handover**: Protocols guarantee that AI and Mortgage Specialists move smoothly.

8.3 Impact Analysis:

The Impact Analysis examines the consequences of deploying a Social Media Chatbot controlled by Mortgage Specialists:

Positive Effects:

- **Multichannel Engagement:** The Chatbot reaches out to consumers across social media channels, allowing for more connection.
- **Query Automation:** The first automation of ordinary inquiries decreases response times.
- Mortgage Specialists provide expert-level replies to complicated questions.
- **Social Media Visibility:** Increasing brand visibility via the use of social media channels.

Negative Effects:

- **Limited Availability:** The Chatbot is only available during business hours, which may affect clients outside of this time frame.
- **Allocation of Human Resources:** Mortgage Specialists demand specialized manpower and scheduling.
- **Transition Challenges:** To maintain a favorable user experience, the AI-to-human transition must be smooth.
- **Initial Development Costs:** The hybrid concept requires an initial investment.

Benefits:

- **Improved Customer Engagement:** Social media engagement strengthens customer connections.
- **Efficient Query Resolution:** Automation speeds up ordinary query resolution.
- Mortgage Specialists provide useful insights to customers.
- **Increased Brand Visibility:** Using social media expands the organization's online exposure.

8.4 Risks and Mitigation:

This section addresses potential dangers and techniques for mitigating them:

Risks:

- Potential clients may be put off by the Chatbot's limited business hours.

- **Human Resource Issues:** Hiring, training, and scheduling Mortgage Specialists may be time-consuming and expensive.
- **Technical failures:** AI and social media platform faults may cause service interruptions.
- Quality control is critical for ensuring consistent and high-quality replies across human agents.

Mitigation:

- **Extended Availability:** In the future, consider extending Chatbot hours to accommodate a larger consumer base**.**
- **Resource Management:** Create effective processes for hiring, training, and scheduling Mortgage Specialists.
- **Technical Support**: Create a support structure for quick problem response.
- Quality Control: For Mortgage Specialists, provide continual training and quality control procedures.

8.5 Out of Scope:

This section establishes the scope boundaries, stating what components of the project are not covered. It guarantees that the project's objectives are met.

Elements Outside of the Scope:

- Extended Chatbot Availability: Implementing 24/7 availability is outside the scope of the project.
- Complete Social Media Engagement: Complete social media campaigns and marketing are not included.
- Compliance that goes beyond data privacy rules is not addressed.
- Human Resources Expansion: This project does not include detailed HR processes for Mortgage Specialists.

9. POSSIBLE SOLUTION 3: DO NOTHING METHOD (CURRENT STATE)

9.1 High- Level Design:

The high-level design for RBC Mortgage Services' Current State depicts the existing system with no substantial modifications. Customer questions are still handled manually by Mortgage Specialists in a conventional style.

- **Manual Inquiry Handling:** In this system, client questions are handled manually by Mortgage Specialists who examine and reply to consumer queries.
- **Working Hours Operation:** The Mortgage Specialists' availability corresponds to conventional business hours, and client requests may be queued outside of these hours.

- **No AI Integration:** The design does not include AI Chatbot automation, and all customer contacts are handled by humans.
- **Status quo:** The major goal is to retain the current operating model with no substantial modifications to the procedures.

9.2 Low-Level Design:

Without any AI integration, the low-level design gives additional technical data about the existing operating model:

- **Human Resource Allocation:** The roles, duties, and allocation of Mortgage Specialists are detailed.
- **Scheduling Business Hours:** The working hours and availability of Mortgage Specialists are indicated.
- **Manual Inquiry Handling:** This section describes the method for manually handling client questions.
- **No AI Component:** The lack of an AI Chatbot is highlighted.

Benefits-

- **Established Model:** The current operating model is maintained to provide consistency.
- **Experienced Mortgage Specialists:** Expert human representatives address client questions.
- **Business Hours**: The business hour schedule provides dependability.

9.3 Impact Analysis:

The Impact Analysis examines the consequences of continuing RBC Mortgage Services in its current configuration without AI automation:

Positive Effects:

- **Human Expertise:** Mortgage Specialists respond to consumer inquiries at an expert level.
- **Personalization**: Customers are given individual attention.
- **Standard Business Hours:** Availability during business hours meets the expectations of customers.

Negative Effects:

- Customers may experience delays in receiving replies to inquiries outside of office hours.
- Manual handling requires a lot of resources, including hiring, training, and scheduling Mortgage Specialists.
- **Human Error**: Human agents may occasionally make mistakes or provide inconsistent replies.
- **Automation Benefits Are Overlooked:** The benefits of automation, such as speedier replies and 24-hour availability, are overlooked.

Benefits:

- **Human Expertise:** Mortgage Specialists offer valuable insights to customers.
- **Personalized Service:** A human touch enhances the customer experience.
- **Standard Business Hours:** Availability during business hours meets customer expectations.

9.4 Risks and Mitigation:

This section highlights possible dangers and proposes mitigating techniques to keep the existing state:

Risks:

- Inquiries received outside of office hours may result in consumer discontent.
- Resource Difficulties: Managing a big staff of Mortgage Specialists may be time-consuming.
- Quality control is critical for ensuring consistent and high-quality replies across human agents.

Mitigation:

- Inform consumers about company hours and establish clear expectations.
- **Resource Management:** Create effective processes for hiring, training, and scheduling Mortgage Specialists.
- **Quality Control:** For Mortgage Specialists, provide continual training and quality control procedures.

9.5 Out of Scope:

This section establishes the scope boundaries, stating what components of the project are not covered. It guarantees that the project's objectives are met.

Elements Outside of the Scope:

- **AI Integration:** This project does not include the implementation of an AI Chatbot.
- Extending operational hours or providing 24/7 availability is outside the scope of the project.
- **Comprehensive Automation:** Inquiry handling is not fully automated.
- **Marketing and promotion:** The project does not include marketing efforts or social media tactics.

10. COMPARING THREE POSSIBLE SOLUTIONS

We may build a comparative chart to illustrate the important differences and benefits of each option for the MortgageBotX Project's three Possible Solutions (AI Chatbot, Social Media Chatbot, Current State).

Aspect	AI Chatbot	Social Media Chatbot	Current State
High-Level Design	AI Chatbot automates inquiry handling, available 24/7.	Initial AI interaction with manual handover during business hours.	Manual inquiry handling by Mortgage Specialists during business hours.
Low-Level Design	AI-driven automation with real-time data access and chat history.	AI initiates conversations and transfers to human agents.	Human Mortgage Specialists manually handle inquiries.
Impact Analysis	Faster response times, 24/7 availability, reduced human errors.	AI-driven initial response, resource-efficient, but slower responses.	Consistent human expertise, personalized service, but limited hours of operation.
Risks and Mitigation	Requires AI training, potential issues with customer-AI interaction.	Human-agent hiring and training, slower inquiry resolution.	Resource-intensive human-agent management and potential for errors.
Out of Scope	Comprehensive automation, extended availability, and marketing efforts.	Comprehensive automation and extended hours beyond business hours.	AI integration, 24/7 availability, and automation beyond human agents.
Benefits	Enhanced customer experience, 24/7 availability, faster responses.	Initial AI interaction, resource efficiency, personalized service.	Human expertise, personalized service, resource-intensive operation.

10.1 Costs Comparison of Three Possible Solutions:

Here's a ballpark estimate for each possible solution:

Aspect	AI Chatbot	Social Media Chatbot	Current State
Development Costs	$20,000 to $100,000	$15,000 to $80,000	$40,000 t0 $80,000
AI Training Costs	$5,000 to $20,000	-	-
Maintenance and Updates	20-30%	20-30%	-
Infrastructure Costs	$10,000 to $30,000	`	$10,000 to $30,000
Marketing and Promotion	$10,000 to $50,000	$10,000 to $50,000	$10,000 to $50,000
Human Resources	-	$40,000 to $60,000	$40,000 to $60,000
Data Storage	$2,000 to $5,000	-	-
Staff Training	$2,000 to $5,000	$5,000 to $10,000	$5,000 t0 $10,000
Operational Costs	-	-	$10,000 to $30,000
Average Costs	$106,000	$132,000	$177,000

10.2 Benefits of MortgageBotX Project:

The MortgageBotX Project intends to automate and improve the customer experience in mortgage services. Among the advantages of this initiative are:

- **Enhanced Customer Experience:** MortgageBotX provides an enhanced customer experience by automating questions and providing faster replies.
- **24/7 Availability:** The AI Chatbot is available 24 hours a day, seven days a week.
- **Faster Responses:** Automation shortens response times, allowing consumers to get answers to their questions quickly.
- **Resource Efficiency:** The Social Media Chatbot achieves resource efficiency in terms of recruiting and training.
- **Individualized Service:** Through AI-initiated interactions, both the AI Chatbot and the Social Media Chatbot deliver individualized service.
- **Human Resources Expansion:** This project does not include detailed HR processes for Mortgage Specialists

While the Current State has its advantages, it lacks the benefits of automation and expanded availability that the MortgageBotX Project provides. Overall, the project's use of AI Chatbot

technology results in considerable gains in customer service and operational efficiency, making it the most favorable alternative.

11. SOLUTION RECOMMENDATION(MortgageBotX):

In conclusion, it is vital to underline the importance of this Solution Design Document for the MortgageBotX Project as a crucial blueprint for the effective deployment of the AI Chatbot solution. The paper is intended to assist stakeholders, such as project teams, developers, and decision-makers, in comprehending the proposed system's architecture, complexities, and possible effect.

This thorough paper contains crucial parts that offer a clear grasp of the project's background, goal, and system design complexities. The paper investigates existing functionality, outlining the connections between new needs and the existing system.

It gives a full description of required specifics, ensuring that all project stakeholders have a clear knowledge of the new needs, with detailed comments and conversations to clarify any misunderstandings.

The Assumptions and Prerequisites section is critical because it establishes a common foundation for the design. It ensures that everyone engaged understands the prerequisites and assumptions that underpin the project, allowing for a single vision and a well-coordinated approach.

The document also introduces the three possible MortgageBotX Project solutions, each with a high-level design, low-level design, impact analysis, risks and mitigation, and out-of-scope concerns. This knowledge is critical for making educated decisions.

Comparison tables make it easier to compare various options, highlighting the benefits of deploying the MortgageBotX Project as a superior solution that offers improved customer service, higher productivity, and a competitive advantage.

Furthermore, the paper includes anticipated prices for each option, giving stakeholders financial insight into the project's feasibility and possible return on investment.

Finally, this Solution Design Document serves not only as a reference for understanding the design and its consequences, but also as a compass for project execution. It promotes cooperation, openness, and a shared vision among stakeholders, allowing the MortgageBotX Project's aims to be realized successfully.

12. COST BENEFIT AND ROI CALCULATION

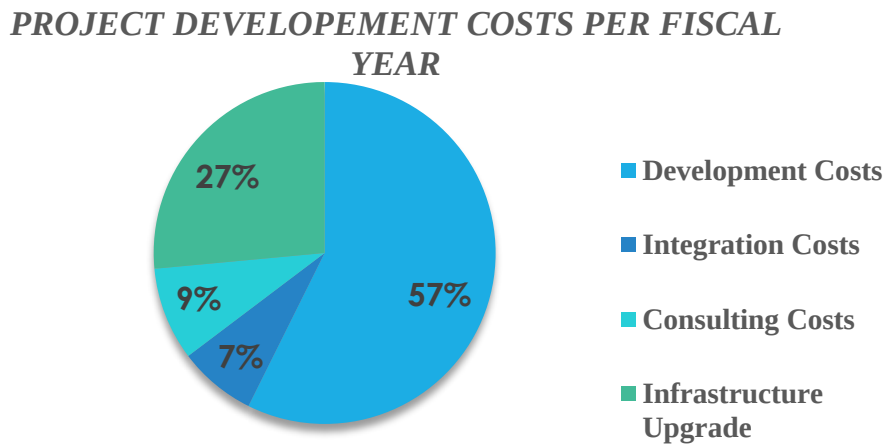
COST BENEFIT ANALYSIS DASHBOARD

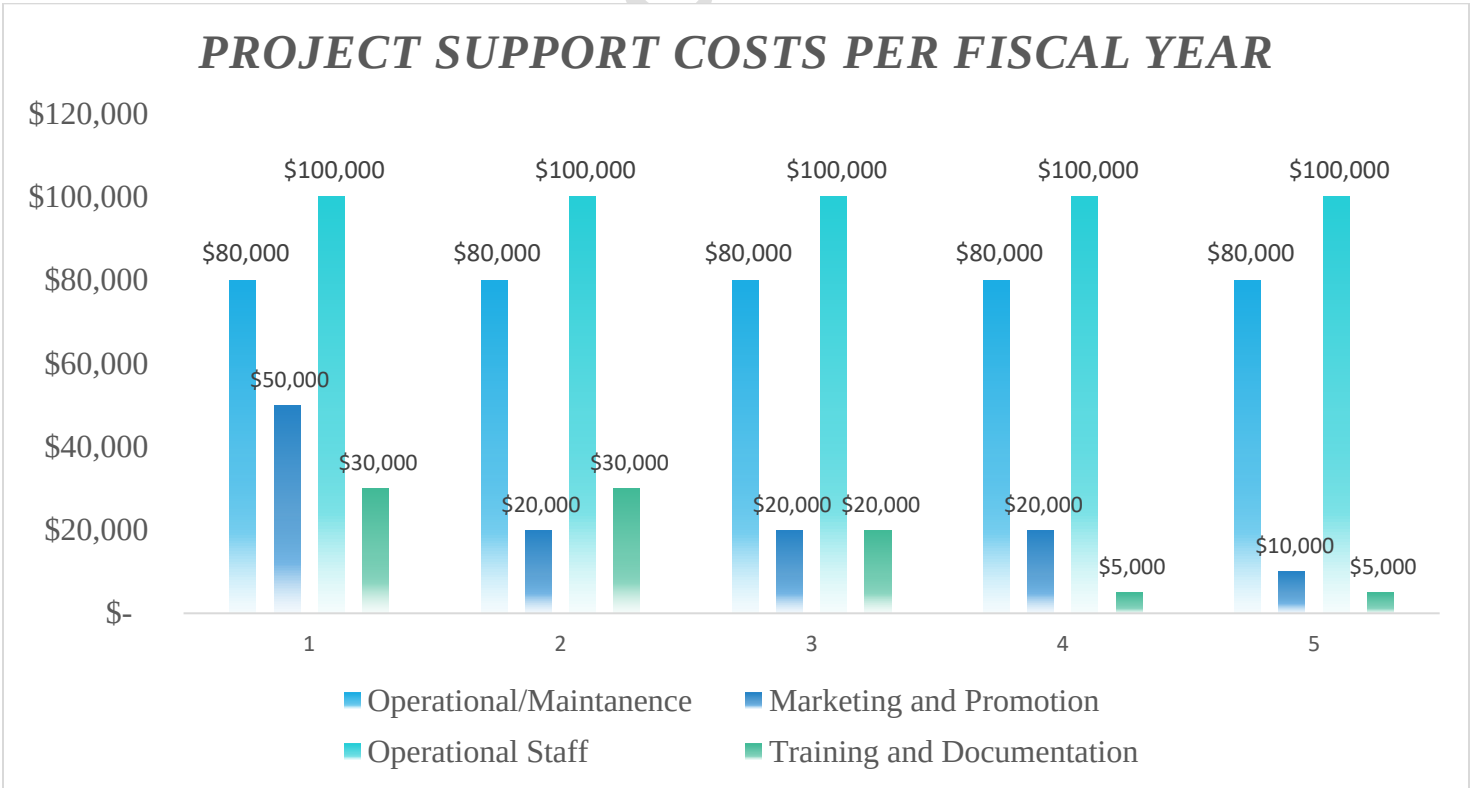
COMPANY NAME	Royal Bank of Canada	**COMPLETED BY**	Fanta5tic Solutions
PROJECT TITLE	MortgageBotX Project	**DATE UPDATED**	08th November 2023

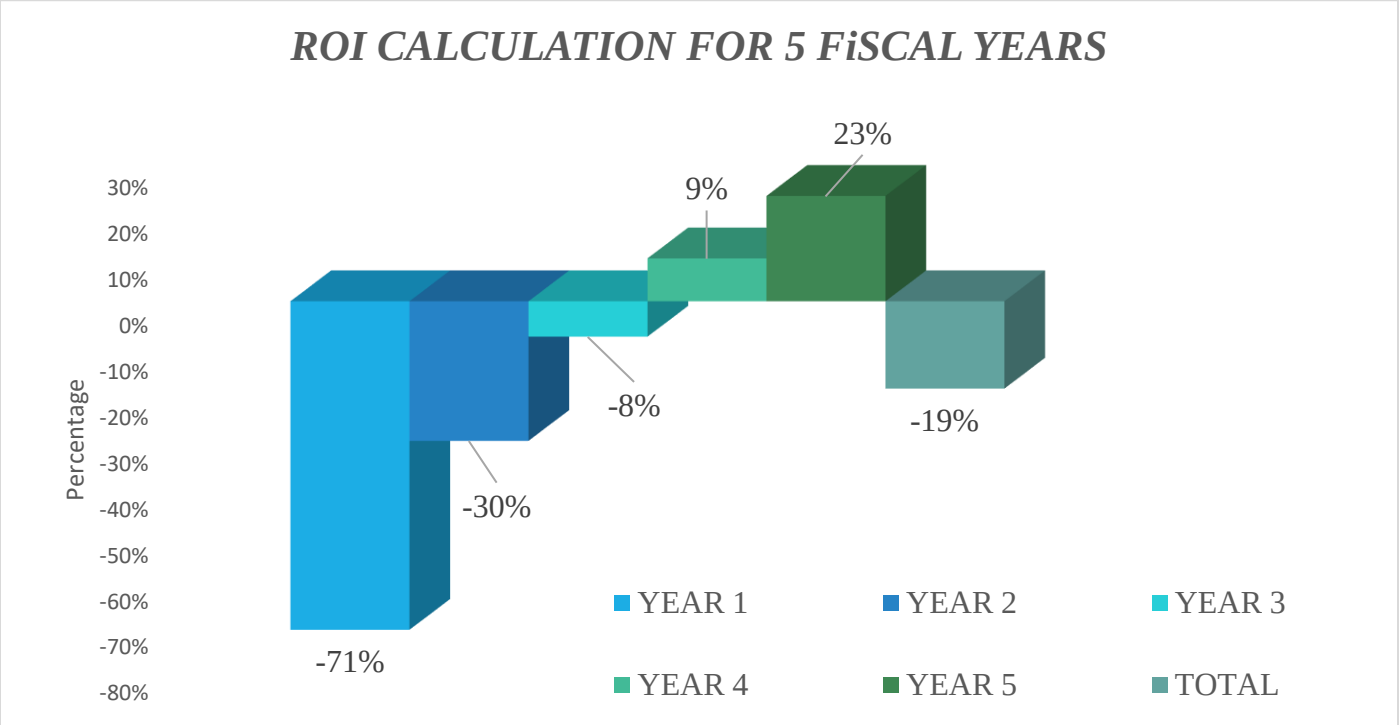
PROJECT COSTS						
DESCRIPTION	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
DEVELOPMENT						
Development Costs	$ 250,000	$ 50,000	$ 50,000	$ 25,000	$ 15,000	$ 390,000
Integration Costs	$ 30,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 50,000
Consulting Costs	$ 60,000	$ -	$ -	$ -	$ -	$ 60,000
Infrastructure Upgrade	$ 100,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 180,000
TOTAL DEVELOPMENT COSTS	$ 440,000	$ 75,000	$ 75,000	$ 50,000	$ 40,000	$ 680,000
SUPPORT/OTHER						
Operational/Maintenance	$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 400,000
Marketing and Promotion	$ 50,000	$ 20,000	$ 20,000	$ 20,000	$ 10,000	$ 120,000
Operational Staff	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 500,000
Training and Documentation	$ 30,000	$ 30,000	$ 20,000	$ 5,000	$ 5,000	$ 90,000
						$ -
TOTAL SUPPORT COSTS	$ 260,000	$ 230,000	$ 220,000	$ 205,000	$ 195,000	$ 1,110,000
TOTAL COSTS	$ 700,000	$ 305,000	$ 295,000	$ 255,000	$ 235,000	$ 1,790,000

BENEFITS / SAVINGS						
PROCESS	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
CURRENT						
TOTAL ANNUAL PRICE	$ 700,000	$ 305,000	$ 295,000	$ 255,000	$ 235,000	$ 1,790,000
NEW						
TOTAL ANNUAL PRICE	$ 305,000	$ 295,000	$ 255,000	$ 235,000		$ 1,090,000
ANNUAL SAVINGS	$ 200,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 700,000

CUMULATIVE SAVINGS	$ 200,000	$ 700,000	$ 1,200,000	$ 1,700,000	$ 2,200,000	$ 2,900,000
CUMULATIVE COSTS	$ 700,000	$1,005,000	$ 1,300,000	$ 1,555,000	$ 1,790,000	$ 3,580,000
CUMULATIVE TOTAL NET SAVINGS	$(500,000)	$(305,000)	$ (100,000)	$ 145,000	$ 410,000	$ (680,000)
ROI CALCULATION	**-71%**	**-30%**	**-8%**	**9%**	**23%**	**-19%**



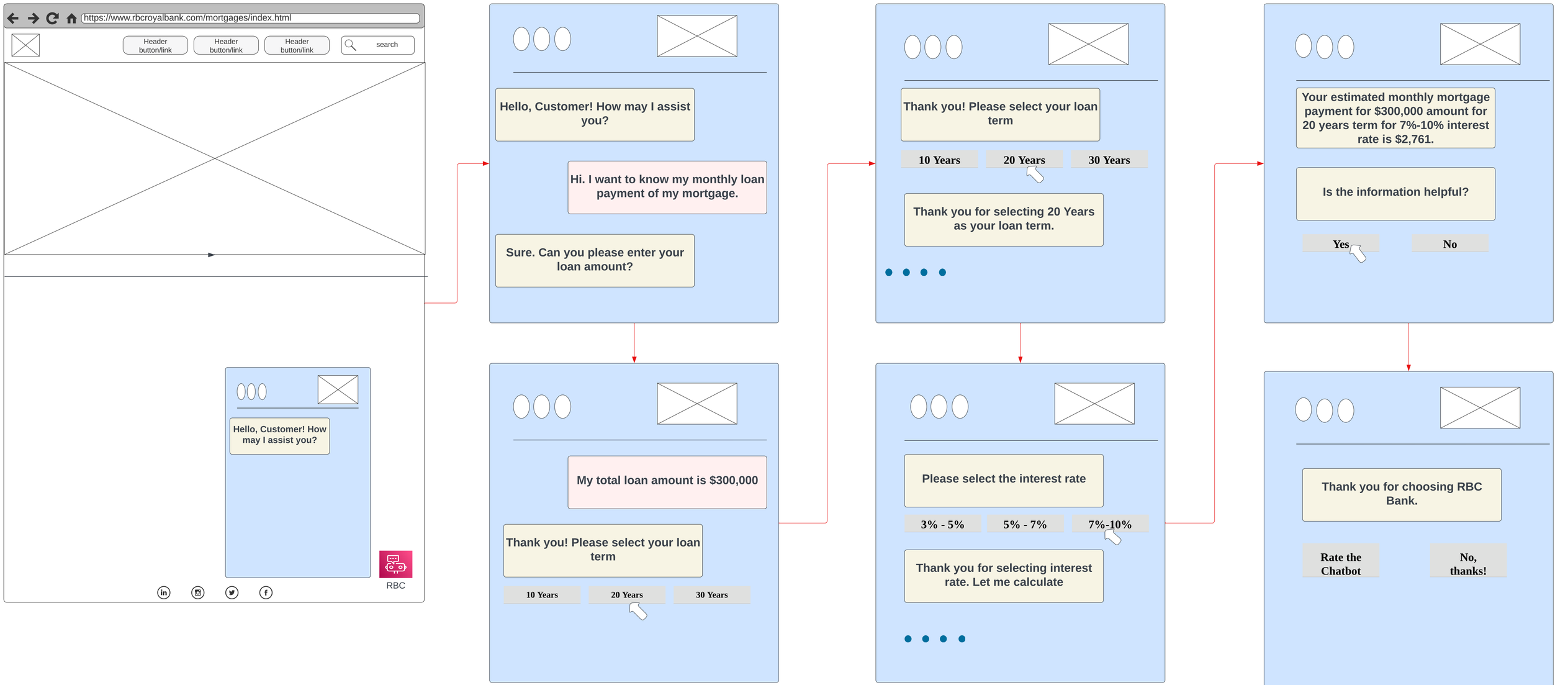




13. HIGH LEVEL DESIGN

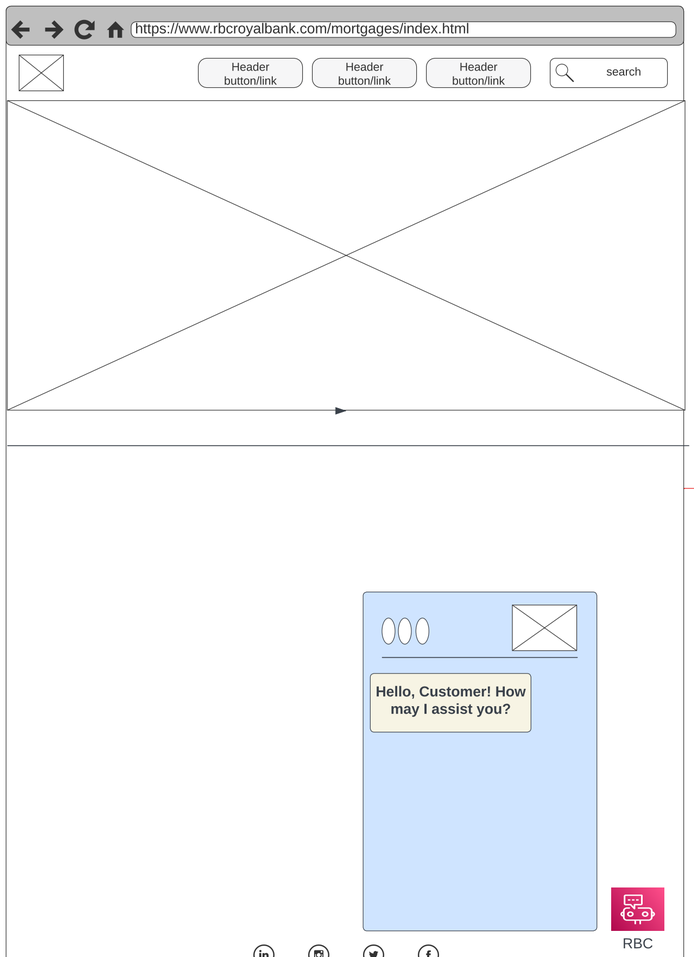
SCENARIO 1 (AI CHATBOT)

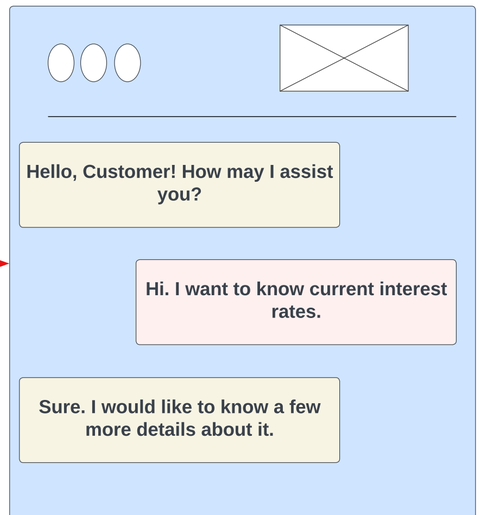
prashanth patil | November 7, 2023

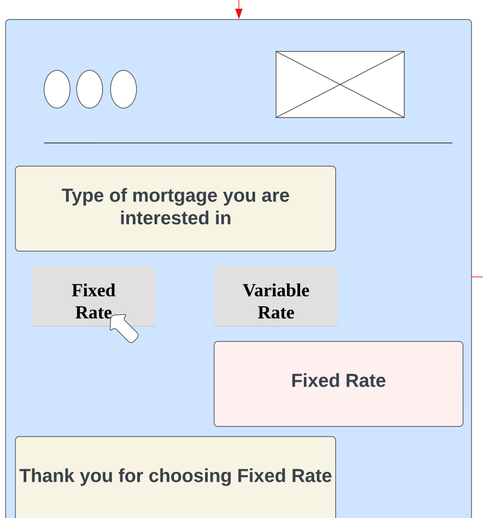


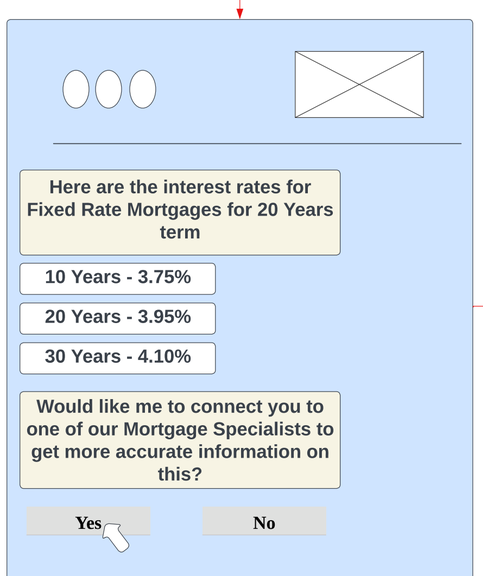
SCENARIO 2 (AI CHATBOT)

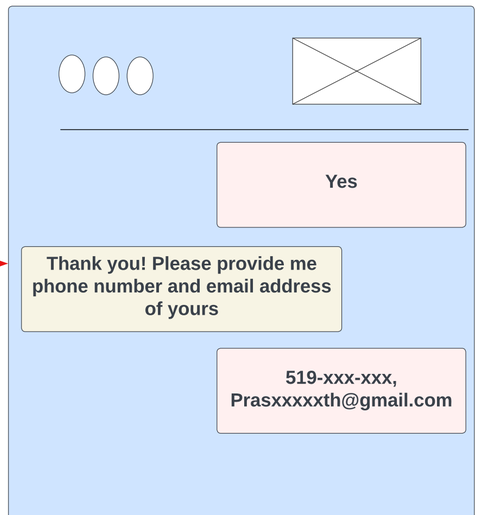
prashanth patil | November 8, 2023

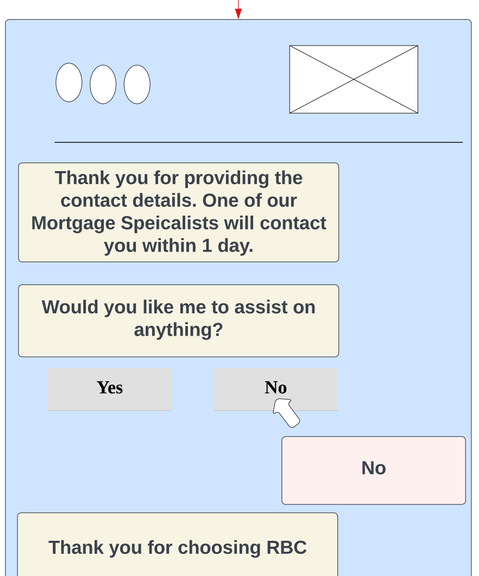












14. RISK LOG

ID No.	Rank	Risk	Category	Root Cause	Triggers	Potential Responses	Risk Owner	Probability	Impact	Status
1	High	Data Security and Privacy Concern	Security	Insufficient Encryption	Increased Data Transaction	Implement Robust Encryption, Regular Security Audits	IT Security Lead	Moderate	High	Open
2	High	Integration Challenges with RBC Systems	Integration	API Incompatibility	System updates by RBC	Close Collaboration with RBC IT, Flexible API Strategy	Integration Lead	High	High	Open
3	Medium	NLP Accuracy	Technology	Insufficient Training Data	User Feedback on inaccuracies	Continuous NLP Training, User Feedback Loops	NLP Engineer	Moderate	Medium	Open
4	Medium	User Acceptance Testing Issues	Testing	Inadequate Test Coverage	Stakeholder Feedback	Thorough UAT, Stakeholder Involvement	QA Lead	Low	Medium	Open
5	High	Regulatory Compliance Challenges	Compliance	Lack of Legel Expertise	Changes in Regulation	Stay Updated on Regulations, Legal Consultation	Legal Compliance Officer	Moderate	High	Open
6	High	Scalability and Performance Concerns	Performance	Inadequate Infrastructure	Increased User Volumes	Load Testing, Code Optimization	DevOps Led	High	High	Open
7	Medium	User adoption and change management	Adoption	Lack of Training	User Resistance	Comprehensive Training, Change Management	Project Manager	Low	Medium	Open
8	Medium	Incomplete or Inaccurate information provided by Users	User Input	Ambiguous Queriers	User Input Errors	Robust Conversation Flow, User Prompts	UX/UI Lead	Moderate	Medium	Open

15. EVALUATION CRITERIA

RISK CRITERIA	EVALUATION CRITERIA	JUSTIFYING SOLUTION SELECTION
CUSTOMER SATISFACTION	The main goal of the AI chatbot in the MortgageBotX project is to improve the customer experience. It's essential to evaluate solutions based on customer satisfaction. This can be measured through feedback, surveys, and tracking user engagement.	This solution increases customer retention and satisfaction through fast and accurate query responses. Modular architecture and NLP algorithms are designed to make interactions more user-centric and ensure a positive customer experience.
EFFICIENCY	One of the main benefits of chatbots is that they automate routine queries and speed up query resolution. The solution should be evaluated for its ability to reduce response times and optimize customer interactions.	This solution significantly increases operational efficiency by automating routine requests and streamlining the request resolution process. This is an important aspect to reduce response time and optimize resource allocation.
DATA SECURITY	Protecting customer-sensitive data and ensuring privacy is a crucial concern. Evaluation criteria should focus on the effectiveness of security measures, such as encryption and data protection compliance.	This solution includes robust security measures to protect sensitive customer data and ensure privacy. Data is retrieved from the central His RBC database, ensuring accuracy and reliability.
INTEGRATION	Because chatbots are connected to a central RBC database, evaluating their integration capabilities and accuracy of information retrieval is essential. The aim here is to assess the reliability of the obtained data.	Chatbots are tightly integrated with a central database, allowing you to provide up-to-date and accurate information to your customers. This integration is a crucial advantage of this solution.
USER-CENTRIC DESIGN	User interface and dialog flow design should be evaluated for ease of use. This is assessed through user testing and feedback to ensure that your chatbot provides an intuitive experience.	Low-level design emphasizes the importance of intuitive interfaces and user-centered interaction flows to ensure a smooth and satisfying customer experience.

OPERATIONAL EFFICIENCY	The solution's operational impact includes other aspects that should also be evaluated, such as reducing the workload of human agents and resource allocation. This includes cost reduction and resource optimization analysis.	Solution impact analysis shows that the solution results in operational efficiency and cost savings. By automating common requests, businesses can allocate resources more effectively.
RISK MITIGATION	The effectiveness of risk reduction strategies should be evaluated. This includes monitoring technical challenges, preventing data breaches, user adoption, and regulatory compliance.	Risk mitigation strategies are described in the solution. Something like this: Effectively address potential challenges and concerns, including technical support, strong security measures, user training, and regulatory compliance.

16. DATABASE DESIGN:

16.1 Purpose:

The database is the principal repository for storing and managing mortgage-related data, user interactions, and system configurations. It is critical to the chatbot's capacity to compute mortgage payments, deliver information, and keep track of user interactions.

16.2 Database Schema:

The MortgageBotX project employs a dimensional modeling approach, consisting of a fact table and several dimension tables to capture and analyze interactions between customers and the chatbot. Below is an overview of the tables and their relationships:

TABLE	DESCRIPTION	COLUMNS
FACT TABLE:		
		➢ **InteractionID**: Primary key for each interaction. ➢ **CustomerID**: Foreign key referencing the Customers dimension table.

CHATBOTINTERACTIONS	Represents interactions between customers and the chatbot.	➢ **InteractionDate**: Timestamp of the interaction. ➢ **InquiryText**: Content of the customer's inquiry. ➢ **ResponseText**: Chatbot's response to the inquiry. ➢ **LoanID**: Foreign key referencing the Loans dimension table. ➢ **SpecialistID**: Foreign key referencing the MortgageSpecialists dimension table. ➢ **StatusID**: Foreign key referencing the TicketStatus dimension table.
DIMENSTION TABLES:		
CUSTOMERS	Contains details about customers	➢ **CustomerID**: Primary key for each customer. ➢ **FirstName**: First name of the customer. ➢ **LastName**: Last name of the customer. ➢ **Email**: Customer's email address. ➢ **PhoneNumber**: Customer's phone number
LOANS	Contains details about loans	➢ **LoanID**: Primary key for each loan. ➢ **CustomerID**: Foreign key referencing the Customers dimension table. ➢ **LoanAmount**: Amount of the loan. ➢ **LoanTermID**: Foreign key referencing the LoanTerms dimension table.

		➢ **InterestRate**: Interest rate associated with the loan
MORTGAGESPECIALISTS	Contains details about mortgage specialists	➢ **SpecialistID**: Primary key for each mortgage specialist. ➢ **FirstName**: First name of the specialist. ➢ **LastName**: Last name of the specialist. ➢ **Email**: Specialist's email address. ➢ **PhoneNumber**: Specialist's phone number
LOANTERMS	Contains details about different loan terms	➢ **LoanTermID**: Primary key for each loan term. ➢ **TermDescription**: Description of the loan term.
TICKETSTATUS	Contains details about the status of tickets	➢ **StatusID**: Primary key for each status. ➢ **StatusDescription**: Description of the ticket status.

Relationships:

The ChatbotInteractions fact table references the Customers, Loans, MortgageSpecialists, and TicketStatus dimension tables through foreign keys.

Relationships are established to ensure data integrity and provide a comprehensive view of customer interactions and associated details.

16.3 Normalization:

Normalization is a database design approach used to arrange data in relational databases to eliminate redundancy and increase data integrity. It entails dividing big tables into smaller, related tables and establishing linkages between them. To attain these objectives, the method takes numerous standard forms (1NF, 2NF, 3NF, etc.).

Let's have a look at how normalization rules were applied to the MortgageBotX Project's tables:

Before Normalization:

- **Table**: ChatbotInteractions
  Attributes: InteractionID, CustomerID, InteractionDate, InquiryText, ResponseText, LoanID, SpecialistID, StatusID
- **Table**: Customers
  Attributes: CustomerID, FirstName, LastName, Email, PhoneNumber
- **Table**: Loans
  Attributes: LoanID, CustomerID, LoanAmount, LoanTermID, InterestRate
- **Table**: MortgageSpecialists
  Attributes: SpecialistID, FirstName, LastName, Email, PhoneNumber
- **Table**: LoanTerms
  Attributes: LoanTermID, TermDescription
- **Table**: TicketStatus
  Attributes: StatusID, StatusDescription

After Normalization:

- **Customers Table (Customers):**
  Attributes: CustomerID, FirstName, LastName, Email, PhoneNumber

- **Loans Table (Loans):**
  Attributes: LoanID, LoanAmount, LoanTermID, InterestRate
  Foreign Key: CustomerID (References Customers (CustomerID))

- **MortgageSpecialists Table (MortgageSpecialists):**
  Attributes: SpecialistID, FirstName, LastName, Email, PhoneNumber

- **LoanTerms Table (LoanTerms):**
  Attributes: LoanTermID, TermDescription

- **TicketStatus Table (TicketStatus):**
  Attributes: StatusID, StatusDescription

- **ChatbotInteractions Table (ChatbotInteractions):**
  Attributes: InteractionID, CustomerID, InteractionDate, InquiryText, ResponseText, LoanID, SpecialistID, StatusID
  Foreign Keys:
  CustomerID (References Customers (CustomerID))
  LoanID (References Loans (LoanID))

SpecialistID (References MortgageSpecialists (SpecialistID))
StatusID (References TicketStatus (StatusID))

Normalization Rules Applied:

First Normal Form (1NF):

- All tables have atomic values in each column.
- No repeating groups or arrays.

Second Normal Form (2NF):

- No partial dependencies in the tables.
- All non-key attributes are fully functionally dependent on the primary key.

Third Normal Form (3NF):

- Elimination of transitive dependencies.
- No non-prime attribute is transitively dependent on any super key.

Normalization ensures that data is stored efficiently without redundancy, reducing the chances of anomalies, and improving data integrity. Each table serves a specific purpose, and relationships between them are defined through foreign keys.

16.4 Indexing Strategy:

In the MortgageBotX database design, indexing decisions are crucial for optimizing query performance. Here's a specification of which columns are indexed and the rationale behind each decision:

Indexed Columns:

ChatbotInteractions Table:

- CustomerID:
  Rationale: Indexed to facilitate quick retrieval of interactions related to a specific customer. Improves performance when querying interactions for a particular customer.
- InteractionDate:
  Rationale: Indexed for date-based queries, such as retrieving interactions within a specific timeframe. Enhances performance for time-based analyses.
- LoanID:
  Rationale: Indexed to support queries related to specific loans. Speeds up access to interactions associated with a particular loan.
- SpecialistID:
  Rationale: Indexed to enable efficient retrieval of interactions handled by a specific mortgage specialist. Enhances performance when querying specialist-specific data.

- StatusID:
  Rationale: Indexed for quick access to interactions based on their status. Optimizes performance when filtering interactions by status.

Customers Table:

- CustomerID:
  Rationale: Primary key; automatically indexed. Enables rapid retrieval of customer-specific data. Essential for efficient customer-related queries.

Loans Table:

- CustomerID:
  Rationale: Indexed to support queries involving loans associated with a specific customer. Improves performance when retrieving customer-specific loan details.
- LoanTermID:
  Rationale: Indexed for efficient retrieval of loans based on their terms. Enhances performance when querying loans with specific terms.

MortgageSpecialists Table:

- SpecialistID:
  Rationale: Primary key; automatically indexed. Facilitates quick access to specialist-specific data. Essential for efficient specialist-related queries.

LoanTerms Table:

- LoanTermID:
  Rationale: Primary key; automatically indexed. Allows fast retrieval of loan term details. Essential for efficient loan term-related queries.

TicketStatus Table:

- StatusID:
  Rationale: Primary key; automatically indexed. Facilitates quick access to status-specific data. Essential for efficient status-related queries.

Additional Considerations:

Indexing decisions are made based on the frequency and nature of queries expected in the system.

Primary keys are automatically indexed and serve as the main reference points for relationships between tables.

These indexing decisions aim to strike a balance between query performance optimization and the overhead associated with maintaining indexes during data modifications.

16.5 Referential Integrity:

Foreign key constraints are used in the normalized tables for the MortgageBotX Project to maintain referential integrity. Referential integrity denotes the preservation of relationships between tables, and any foreign key values must match primary key values in the referenced table. This is critical for ensuring data uniformity and correctness. In normalized tables, foreign key restrictions are applied as follows:

1. **Loans Table (Loans):**

   Foreign Key: CustomerID

   References: Customers(CustomerID)

```
ALTER TABLE Loans
ADD CONSTRAINT FK_Loans_Customers
FOREIGN KEY (CustomerID)
REFERENCES Customers(CustomerID);
```

2. **ChatbotInteractions Table (ChatbotInteractions):**

   Foreign Keys:

   CustomerID References: Customers(CustomerID)

   LoanID References: Loans(LoanID)

   SpecialistID References: MortgageSpecialists(SpecialistID)

   StatusID References: TicketStatus(StatusID)

```
ALTER TABLE ChatbotInteractions
ADD CONSTRAINT FK_ChatbotInteractions_Customers
FOREIGN KEY (CustomerID)
REFERENCES Customers(CustomerID);
```

```
ALTER TABLE ChatbotInteractions
ADD CONSTRAINT FK_ChatbotInteractions_Loans
FOREIGN KEY (LoanID)
REFERENCES Loans(LoanID);
```

```
ALTER TABLE ChatbotInteractions
ADD CONSTRAINT FK_ChatbotInteractions_MortgageSpecialists
FOREIGN KEY (SpecialistID)
REFERENCES MortgageSpecialists(SpecialistID);
```


```
ALTER TABLE ChatbotInteractions
ADD CONSTRAINT FK_ChatbotInteractions_TicketStatus
FOREIGN KEY (StatusID)
REFERENCES TicketStatus(StatusID);
```

Foreign key constraints, such as the ones given above, ensure that the CustomerID in the Loans database exists in the Customers table. Foreign keys in the ChatbotInteractions table are similarly connected to primary keys in the referenced tables, ensuring referential integrity.

The database system prohibits scenarios in which a record in one table refers to a nonexistent record in another table by enforcing these restrictions, ensuring that connections between tables remain legitimate and consistent.

16.6 Interoperability with User Interface:

To guarantee smooth interaction between the backend database and the frontend user interface, the MortgageBotX Project's database design is aligned with the data models utilized in the user interface. This alignment is essential for the system to work properly and give a pleasant user experience. Here is how the database design corresponds to the data models:

Data Structures That Are Consistent:

The data models utilized in the user interface are reflected in the database tables. For example, if the user interface displays customer information in fields such as FirstName, LastName, and Email, the associated database table (Customers) will include columns with comparable names and data types.

Foreign Keys and Primary Keys:

The main keys in the database tables correspond to the data models' unique IDs. These primary keys are then used as foreign keys in related tables to construct relationships between entities, mimicking the user interface associations.

Normalization:

The modular structure of data models in the user interface is aligned with the normalization of the database architecture, which entails structuring data to reduce redundancy and dependency. Each normalized table correlates to a single object or notion in the user interface, making data retrieval and changes more efficient.

Integrity of Reference:

Foreign key restrictions ensure table referential integrity. This corresponds to the linkages and associations depicted in the user interface. For example, if the user interface displays a customer's loan data, the Loans table's foreign key link with the Customers table assures that the loan relates to a genuine customer.

Data Types and Restrictions:

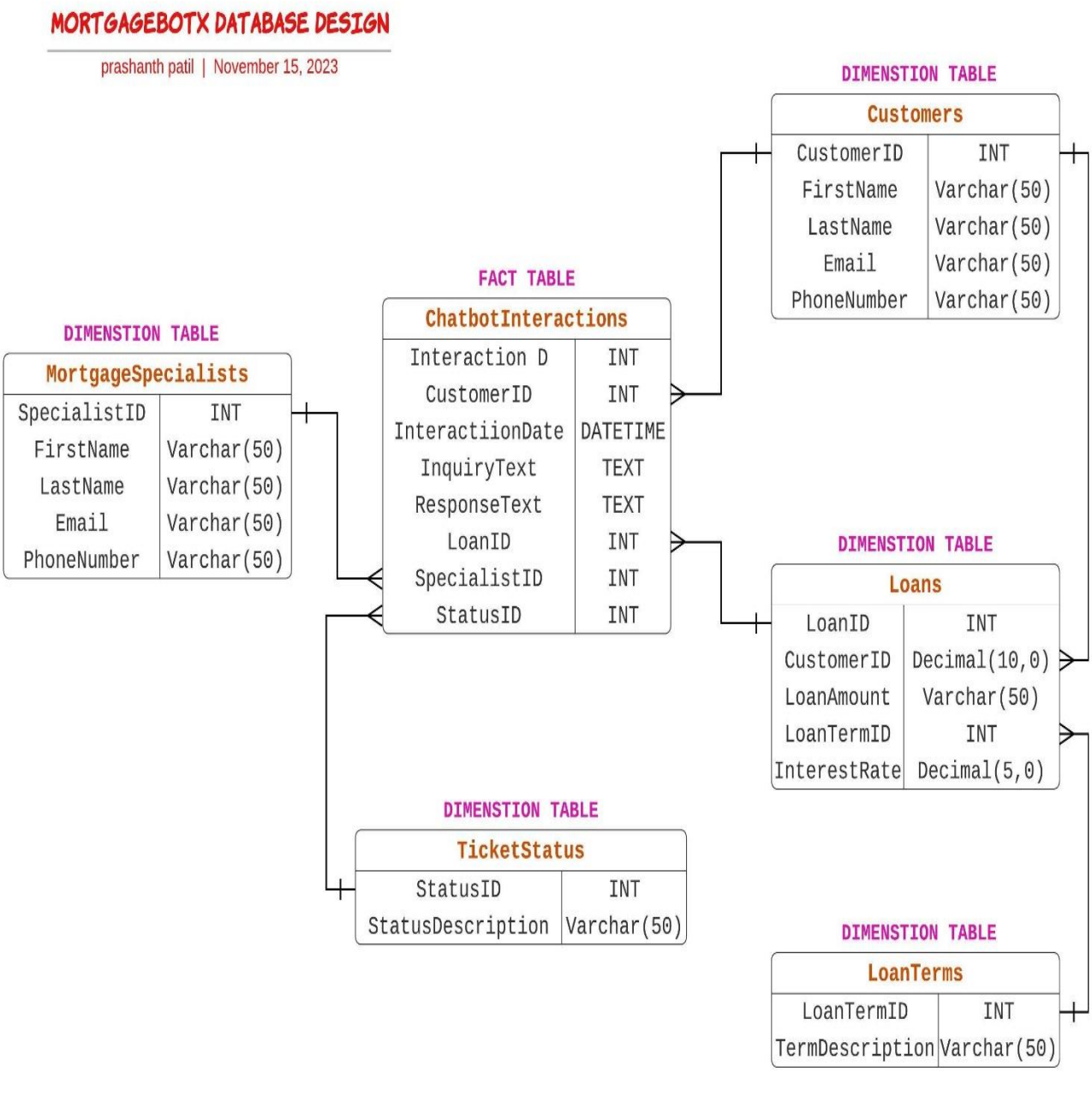
The data types and restrictions applied to database columns correspond to the expected data formats and limits in the user interface. For example, if a date of birth is entered into the user interface in a specified manner, the associated column in the database is set up with the proper data type and format.

Naming conventions that are consistent:

The database naming conventions (table names, column names) are compatible with the language and labeling used in the user interface. This uniformity improves clarity and comprehension for developers working on both the frontend and backend components.

The MortgageBotX Project guarantees that information flows fluidly between the user-facing application and the underlying data storage by ensuring alignment between the database architecture and the data models utilized in the user interface. This results in a unified and responsive system.

16.7 Database Diagram:



16.8 Technical Details:

Database Management Systems:

PostgreSQL was chosen as the database management solution for the MortgageBotX Project. PostgreSQL is recognized for its powerful features, capability for sophisticated queries, and dependability, making it suited for the MortgageBotX system's requirements.

Data Types for Different Columns:

ChatbotInteractions Table:

- InteractionID: INT
- CustomerID: INT
- InteractionDate: DATETIME
- InquiryText: TEXT
- ResponseText: TEXT
- LoanID: INT
- SpecialistID: INT
- StatusID: INT

Customers Table:

- CustomerID: INT (Primary Key)
- FirstName: VARCHAR(50)
- LastName: VARCHAR(50)
- Email: VARCHAR(100)
- PhoneNumber: VARCHAR(15)

Loans Table:

- LoanID: INT (Primary Key)
- CustomerID: INT
- LoanAmount: DECIMAL(18, 2)
- LoanTermID: INT
- InterestRate: DECIMAL(5, 2)

MortgageSpecialists Table:

- SpecialistID: INT (Primary Key)
- FirstName: VARCHAR(50)
- LastName: VARCHAR(50)
- Email: VARCHAR(100)
- PhoneNumber: VARCHAR(15)

LoanTerms Table:

- LoanTermID: INT (Primary Key)
- TermDescription: VARCHAR(20)

TicketStatus Table:

- StatusID: INT (Primary Key)
- StatusDescription: VARCHAR(20)

Constraints and Triggers:

Foreign Key Constraints:

Appropriate foreign key constraints have been applied to maintain referential integrity between tables. For example, the CustomerID in the Loans table is a foreign key referencing the CustomerID in the Customers table.

CHECK Constraints:

Check constraints ensure that data entered a column meets specified conditions. For instance, the InterestRate column in the Loans table may have a CHECK constraint to ensure that interest rates are within a reasonable range.

Key Data Elements:

CustomerID (Customers Table):

- Purpose: Uniquely identifies customers.
- Acceptable Values: Positive integers.
- Primary Key: Yes.

LoanID (Loans Table):

- Purpose: Uniquely identifies loans.
- Acceptable Values: Positive integers.
- Primary Key: Yes.

SpecialistID (MortgageSpecialists Table):

- Purpose: Uniquely identifies mortgage specialists.
- Acceptable Values: Positive integers.
- Primary Key: Yes.

LoanTermID (LoanTerms Table):

- Purpose: Uniquely identifies loan terms.
- Acceptable Values: Positive integers.

- Primary Key: Yes.

StatusID (TicketStatus Table):

- Purpose: Uniquely identifies ticket statuses.
- Acceptable Values: Positive integers.
- Primary Key: Yes.

These key data elements play a crucial role in establishing relationships between tables and ensuring data integrity within the MortgageBotX database.

17. TEAMS ROLES AND RESPONSIBILITIES:

Company Name: Fanta5tic Solutions – Turning Imagination into Innovation

Company Logo: Fanta5tic Solutions

Client Name: Royal Bank of Canada (RBC)

Project Manager: Prashanth Patil, 519-731-8565, Ppatil9714@conestogac.on.ca

Roles:

Name	*Role*	*Contact Information*
Prashanth Patil	Project Manager	Ppatil9714@conestogac.on.ca
Chetan Dashrathlal Patel	Subject Matter Expert-SME	Cpatel8015@conestogac.on.ca
Parth Arvindbhai Patel	Business Analyst	Ppatel6910@conestogac.on.ca
Prabhjeet Singh	Business Analyst	Psingh3689@conestogac.on.ca
Vedika Singh	Business Analyst	Vsingh5316@conestogac.on.ca

Responsibilities:

Prashanth Patil, Manager-

- Leading and managing the entire project.
- Defining the project's goals, deliverables, and scope.
- Creating and managing the project timeline and plan.
- Managing resources and keeping an eye on the project's development.
- Sharing project status with stakeholders and communicating.
- Making sure the project is finished on schedule.

Chetan Dashrathlal Patel, SME-

- Offering knowledge around the project that is pertinent (mortgage services).
- Helping define the objectives and needs of the project.
- Providing advice and insights.
- Ensuring alignment with industry best practices by working with the project team.
- Checking the project deliverables for correctness and industry compliance.

Parth Arvindbhai Patel, Business Analyst-

- Examining the needs of the virtual mortgage assistant from a commercial perspective.
- User stories and approval criteria should be defined in collaboration with stakeholders.
- Keeping track of corporate procedures and processes.
- Aiding in locating potential areas for process improvement.

Vedika Singh, Business Analyst-

- Joining forces with Parth to compile and evaluate the business needs.
- Creating and keeping up-to-date project documentation.
- Helping in the execution of usability tests and customer interviews.
- Checking that the project's deliverables match the established criteria.
- Aiding the Project Manager, Prashanth, in monitoring the status of the project.

Prabhjeet Singh, Business Analyst-

- Working together with Vedika and Parth to compile and evaluate business needs.
- Helping with the documentation of acceptance criteria and user stories.
- To collect input, organize and communicate with stakeholders.
- Aiding with project reporting and documentation upkeep.

Conduct Guidelines:

- We promise to always treat each member of the project team with professionalism and respect.

- Our goal is to create a friendly, cooperative work atmosphere where each team member's ideas are highly valued, and their efforts are appropriately acknowledged.
- Any private information discussed among our team members will be always kept secret.

Participation:

- The value of teamwork is strong, and each member's active participation is essential to the project's success.
- We are steadfast in our resolve to foster an inclusive environment where every team member—regardless of history, identity, or perspective—feels welcomed, respected, and appreciated.
- Responsibility is essential, and each team member is accountable for achieving their own deadlines and carrying out their given tasks. If difficulties emerge, we urge prompt contact so that we can cooperate to discover solutions.

Communication:

- We encourage politeness and helpfulness when communicating ideas, worries, or comments. We also advocate open and honest communication.
- A fundamental notion is active listening, which involves paying close attention and refraining from interjecting when someone is speaking in order to make sure that all ideas are heard and understood.
- To prevent misconceptions and give pertinent information, we try for clear and succinct communication using suitable channels including meetings, chats, and emails.

Problem Solving:

- When faced with obstacles, we adopt collaborative strategies, working together to find answers rather than placing blame, putting an emphasis on discovering the underlying problems and creating workable solutions.
- Data-driven decision-making relies on facts and evidence to remove biases and promote unbiased problem-solving.
- We see obstacles as chances for progress, and after putting solutions in place, we evaluate their success and make the necessary modifications for ongoing improvement.

Academic Integrity Affirmation

We confirm that this work is our own and we have not copied from internet, other student(s), or any other sources. We followed the individual/group work guidelines specified for completing this project. Our work is in complete adherence with Conestoga College's academic integrity policy.

Name	*Signature*	*Date*
Prashanth Patil	*Prashanth Patil*	10th September 2023
Chetan Dashrathlal Patel	*Chetan Dashrathlal Patel*	10th September 2023
Parth Arvindbhai Patel	*Parth Arvindbhai Patel*	10th September 2023
Vedika Singh	*Vedika Singh*	10th September 2023
Prabhjeet Singh	*Prabhjeet Singh*	10th September 2023

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