

# Evaluating the Effectiveness of a Rule-Based WhatsApp Chatbot in Automated Query Resolution

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**Abstract:** Conversational chatbots have become integral to automated query resolution across industries to enhance customer service efficiency. However, their effectiveness in accurately addressing diverse customer queries remains a critical area of evaluation. This study examines the performance of a rule-based WhatsApp chatbot deployed by a South African telecommunications service provider, focusing on its ability to resolve customer queries effectively. This paper analysed chatbot interaction reports and quantifies success, failure, and abandonment rates across various query types. This study adopted a quantitative research approach with interpretivism as a philosophical paradigm. Furthermore, document analysis was employed for the analysis of TELCO X WhatsApp Chat's extracted reports to examine and evaluate human-chatbot interaction. This method allowed the researcher to determine, from the interactions, resolved and unresolved queries. The findings indicate that the chatbot achieves high success rates for routine and structured queries, such as Frequently Asked Questions (FAQs) and retrieving account-related information. However, the chatbot's performance declines significantly in handling complex, multi-step, or context-dependent queries, including SIM swaps and product purchases. The chatbot exhibits lower success rates, with a significant number of customer interactions resulting in unresolved queries or user abandonment. The analysis highlights key performance limitations, including natural language understanding, contextual retention, and the inability to process multi-step interactions effectively. Additionally, the absence of seamless escalation mechanisms to human agents contributes to customer frustration when the chatbot fails to provide satisfactory resolutions. The study provides recommendations for optimising chatbot performance, particularly in enhancing AI-driven response mechanisms, refining intent recognition, and using advanced dialogue management techniques. Additionally, integrating seamless escalation pathways to human agents is proposed to improve resolution rates for complex queries. In conclusion, the study emphasizes the importance of continuous performance monitoring and iterative improvements. Identifying key performance gaps and improvement areas provides valuable guidance for organisations looking to optimise chatbot functionality.

**Keywords:** Chatbots, Query Resolution, Artificial Intelligence (AI), Whatsapp, Customer Queries.

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## 1. Introduction

Artificial Intelligence (AI) is a transformative technology that has profoundly impacted numerous industries, such as healthcare and financial services, since the advent of the Fourth Industrial Revolution (4IR) (Nyongesa, Omieno, & Otanga, 2020:106). Organisations continually embrace change to leverage technologies that enhance business operations and customer service. One prominent outcome of this technological evolution is the rise of chatbots, which serve as live communication interfaces enabling real-time customer support and direct interaction between organisations and their customers across various frontline services (Pillai & Sivathanu, 2020:3199). Chatbots have found applications in diverse sectors, including financial services and insurance, where they play a crucial role in addressing customer queries. Realising the full potential of chatbots necessitates that organisations develop chatbot systems that align with industry standards and customer service expectations, and chatbot effectiveness in resolving customer queries remains a critical area of evaluation due to limitations in contextual comprehension and constrained natural language processing (Adam, Wessel, & Benlian, 2020:427; Følstad & Taylor, 2021:1). Organisations therefore need to enhance their capabilities for assessing and monitoring customer interactions with chatbots. This study examines the performance of a rule-based WhatsApp chatbot deployed by a South African telecommunications service provider (alias "TELCO X") to assess its ability to address diverse customer queries accurately. The analysis uses chatbot use case reports collected over four months (December 2022 to March 2023) to quantify key performance metrics, including success, failure, and abandonment rates, across various query types to provide insights into the chatbot's strengths and limitations in automated customer service.

The main objective of this research study was to evaluate the effectiveness of a rule-based WhatsApp chatbot that handles customer queries for a South African telecommunications provider. The research proposed the following research questions:

- What is the success rate of a rule-based WhatsApp chatbot in resolving different categories of customer queries?
- How do failure and abandonment rates vary across the different query types especially between simple and complex requests.

## 2. Chatbot Adoption for Customer Service

Nyongesa et al. (2020:106) provide a business-and-customer-focused definition of chatbots as application programs that are powered by AI and use natural processing language to automate internal business processes, customer interactions, and support computer-human communication through voice and text. As a result of businesses going digital, companies develop tools for information retrieval and customer query resolution. Chatbots can understand and respond to customer queries accurately and efficiently by incorporating AI, natural processing language algorithms and machine learning techniques. These intelligent systems enable businesses to provide instant and personalised support, improving customer satisfaction and loyalty (Chen, Lu, Gong, Xiong, 2022:2; Hsu & Lin, 2022:4). Chatbot adoption presents challenges that organisations need to consider. One significant challenge is ensuring the chatbot can handle complex or ambiguous customer queries effectively (Chen et al., 2022:8). Research by Li (2022), highlights the importance of robust intent recognition and dialogue management techniques to understand and respond to customer queries accurately. Human language complexity and the diverse range of customer queries can pose difficulties in achieving high accuracy rates and make it crucial to invest in advanced natural processing algorithms and machine-learning models to improve the chatbot's ability to comprehend and generate appropriate responses (Olujimi & Ade-Ibijola, 2023:3).

Finding the right balance between automation and human intervention is critical in adopting chatbots for customer service. While chatbots can handle a significant volume of customer interactions efficiently, there are instances where human intervention becomes necessary. An article by Conversational AI (2022), highlights the importance of human resource management in chatbot implementation to ensure seamless transitions between automated responses and human support. Organisations must define clear escalation paths and train customer service representatives to intervene when necessary. The ability to seamlessly transfer complex or sensitive queries from the chatbot to a human agent contributes to maintaining service quality and customer satisfaction (Hsu & Lin, 2022:2). Furthermore, organisations must establish effective monitoring systems to identify situations where chatbots may struggle and promptly provide human support (Chen et al., 2022:7). Within the South African telecommunications sector, rule-based chatbots are widely deployed for customer self-service, including balance inquiries, billing issues, Subscriber Identity Module (SIM) card related services, and account management (MyBroadband, 2021). While these chatbots perform well in structured interactions, their performance deteriorates when handling queries that require extended dialogue, nuanced understanding, or real-time decision-making (Caldarini, Jaf & McGarry, 2022:8). This study draws on existing literature by analysing chatbot effectiveness using case reports from TELCO X's WhatsApp chatbot. By assessing chatbot interaction data over four months, this research provides empirical insights into chatbot performance trends, challenges, and potential areas for optimisation in automated customer service. Methodology

The 'Research Onion' model developed by Saunders, Lewis and Thornhill (2007) guides the researcher in this study by providing a systematic approach to structuring the research and elaborates on the research philosophy, research approach, research strategy, research choices and research techniques. This study adopted a quantitative research approach under the interpretivism paradigm. The primary data collection method consists of chatbot use case reports, which include extracted logs of customer-chatbot interactions.

This research study followed a primarily quantitative research strategy that relied on the analysis of chatbot use case reports that were collected over a four-month period. Even though brief qualitative insights are presented, they are exploratory in nature and do not form part of the formal research design. The data set includes categorized interaction records that tagged by outcome types such as success, failure and abandonment. Descriptive statistics were used to measure query completion rates across ten predefined query types. Metrics such as resolution rate, escalation instances and abandonment frequency were analysed.

### 2.1 Interpretivism as a Research Philosophy

The study adopted the interpretivism paradigm, which emphasizes the subjective nature of the research and the researcher's interpretations (Sanders et al, 2007:108). This approach is essential in understanding "effectiveness" as shaped by users' experiences and expectations and thus aligns with TELCO X's customer service objectives. The researcher analysed chatbot-user interactions and applied objectivism to evaluate the

chatbot's performance from an observable, measurable perspective and gain a comprehensive understanding of the performance.

## **2.2 Inductive Research Approach**

The study adopted an inductive approach to assess the chatbot's functionality and how data from human-chatbot interactions can improve the customer experience. According to Thomas (2006:238), this approach uses quantitative data to generate theories from raw data analysis (Soiferman, 2010:7). The inductive approach allows for theory development grounded in real data from customer interactions and facilitates the construction of an evaluative framework by using collected data to explore how chatbot effectiveness might be theoretically improved to meet customer needs and enhance service.

## **2.3 Quantitative Method Research Strategy**

This study primarily relied on quantitative data and focused on the analysis of use case reports to assess the chatbot's performance. These reports provided numerical data on successful and unsuccessful queries, offering a comprehensive view of the chatbot's effectiveness. This quantitative approach enabled the researcher to evaluate query resolution rates and identify patterns in chatbot performance to contribute to a deeper understanding of how the chatbot meets customer service goals. Document analysis in this study involved the examination of chatbot use case reports, which consist of extracted logs from customer-chatbot interactions. The chatbot is rule-based and offers a standard menu selection for queries, therefore the analysis focused on quantifying the success, failure, and abandonment rates across different query types. This approach allowed the researcher to assess the chatbot's performance by analysing the frequency of successful query resolutions and identifying areas where the chatbot failed to meet user needs. The analysis of these logs provided a quantitative basis for evaluating the chatbot's effectiveness in resolving customer queries.

## **2.4 Ethical Considerations**

All applicable ethical considerations were addressed by obtaining a permission letter from TELCO X's Information Privacy Office to grant the researcher authorisation to collect primary data. The letter was subsequently submitted to the UJ Ethics Committee for formal approval and documentation. This research study adhered to all the ethical guidelines of The University of Johannesburg's Ethics Committee. An alias (TELCO X) is used to maintain anonymity for the telecommunications service provider.

## **3. Findings and Discussion**

The chatbot achieved a 55% success rate which is consistent with the findings from Adams (2021). Adams (2021) reported that there is a moderate performance amongst rule-based systems on context-specific tasks. Whereas complex queries such as SIM swaps have a higher failure and abandonment rate. This reaffirms prior research conducted by Hsu and Lin (2020) regarding task complexity affecting chatbot usability. The researcher obtained chatbot conversation reporting from TELCO X for analysis. The dataset spans four months (December 2022 to March 2023) and contains information on crucial chatbot performance metrics across different use cases. Each month's data is structured in terms of the following variables:

- Use Case – The task or query type the chatbot addresses.
- Abandoned – The number of instances where users abandoned their interaction with the chatbot.
- Failed – The number of instances where the chatbot could not resolve the query or task.
- Success – The number of queries or tasks successfully resolved by the chatbot without further intervention.
- Grand Total/Total – The total number of interactions for each use case, representing the sum of abandoned, failed, and successful cases.

Key findings provide insight into the chatbot's performance across various use cases and highlight strengths and areas for improvement. The analysis focuses on success, abandonment, and failure rates over four months and examines trends to identify opportunities for enhancing the chatbot's design and functionality.

### **3.1 Success Rates**

"Frequently Asked Questions" (FAQs) and "Get PUK" have a score of 100% and the highest success rate in all months compared to other use cases. This finding demonstrates that the chatbot effectively answers frequently

asked questions and provides subscribers with PUK numbers, suggesting that these use cases are well-suited for automation and that the information retrieval process works efficiently. “See Balance”, “Targeted Collection”, and “TC-Pay Invoice” consistently show a significant success rate, with an average of 85%, 98%, and 78% of queries successfully resolved, respectively. However, there is also a notable portion of abandoned and failed interactions for “See Balance” in January and March and “TC-Pay Invoice” in March. This indicates that while the chatbot can resolve many users' balance and invoice payment queries, some find the process challenging or incomplete. “Rate Service”, “Invoice and Statement”, “Buy Airtime”, and “Cancel Subscription” show moderate success rates between 50% and 78% on average. Though no failures are reported for “Rate Service”, the relatively high abandonment rate suggests that users may not be experiencing technical failures but rather abandon the interaction due to perceived irrelevance or lack of interest. “Buy Data”, “SIM Swap”, “Change Spend Limit”, “TC-Promise to Pay”, and “Block and Unblock” have the lowest success rates and the highest failure and abandonment rates, with success rates between 7% and 40% on average. These use cases are likely more complex or involve more detailed steps that may not be easily handled by the current design of the chatbot.

### 3.2 Abandonment and Failures

As previously examined, “Buy Data”, “SIM Swap”, “Change Spend Limit”, “TC-Promise to Pay”, and “Block and Unblock” have the lowest success rates and the highest failure and abandonment rates. The combined failure and abandonment rates for these use cases in December, January, February, and March are 21%, 32%, 41% and 56%, respectively. “SIM Swap” and “Buy Data” have a significant number of failed and abandoned interactions recorded each month. Consequently, both use cases have the highest failure rates; notably, 53% and 44% were recorded in February and March for “SIM Swap” and “Buy Data”, respectively. The high failure rates could indicate that the chatbot experiences technical limitations in handling SIM swaps and data purchases or that the user is dissatisfied with the steps involved. “Change Spend Limit”, “TC-Promise to Pay”, and “Block and Unblock” show a high percentage of abandonment rates each month. However, the recorded number of total interactions (success, failed, abandoned) for each use case is below 400. This number is insignificant relative to an average total of 85 550 interactions for the chatbot for the four months. The number of interactions may reflect user service plans because some use cases are limited to post-paid customers. “SIM Swap” and “Buy Data” show abandonment rates between 31% and 52% across the months. This suggests that users may begin the transaction process of purchasing data or requesting a sim swap but fail to complete the tasks due to confusion, technical issues with the chatbot, or overall dissatisfaction.

### 3.3 Monthly Trends

Success rates across all use cases generally remain stable over time. However, March shows a slight improvement in success rates across the use cases and indicates possible incremental improvements in the chatbot's performance or better user understanding of the chatbot. Buy Data and SIM Swap have more volatility in their success and failure rates. As a result, the trend of abandonment and failure for these use cases fluctuates monthly, suggesting the two use cases as priority areas for improving the chatbot design and functionality.

#### 3.3.1 December 2022

The highest success rates were recorded for “See Balance” and “FAQs,” with both use cases showing high user engagement and effective resolution. “Rate Service” also displayed strong success metrics, although the significant number of abandoned sessions suggests that while users are interested, some might exit the chat before completion. Low success rates were observed in “SIM Swap,” indicating potential challenges with this service, possibly due to complex processes or unmet use expectations.

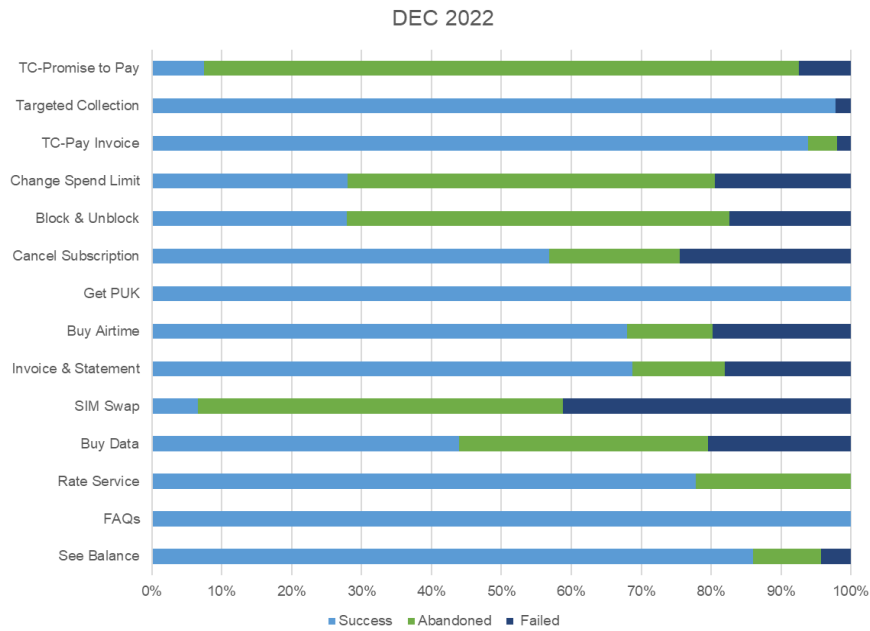


Figure 1: Stacked bar chart depicting December 2022 customer-chatbot interactions for use case analysis.

### 3.3.2 January 2023

“FAQs” and “See Balance” remained popular queries and showed high success rates, though there was a slight reduction in success rates compared to December. “Buy Data” saw a slight reduction in abandoned cases, but “SIM Swap” maintained high abandonment and failure rates and indicated ongoing user difficulties with this process. An improvement was noticed in “Invoice & Statement” with a slight increase in successful chatbot performance, possibly due to backend adjustments or user familiarity.

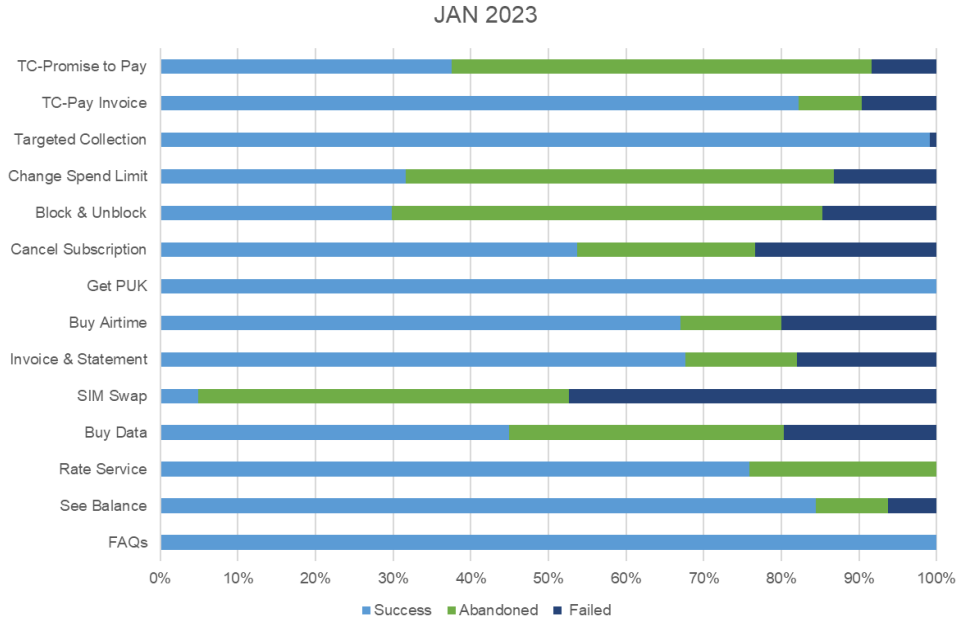


Figure 2: Stacked bar chart depicting January 2023 customer-chatbot interactions for use case analysis.

### 3.3.3 February 2023

User engagement with “FAQs” remained consistently high, maintaining its position as the most frequently used service with high success rates. “Rate Service” and “See Balance” maintained high success rates, although “SIM Swap” and “Buy Data” indicate a trend of high failure and abandonment rates. Increased success rates in “Invoice & Statement” and “TC-Pay Invoice” suggest a gradual improvement, but these still displayed a notable number of failures and indicate the need for additional enhancements.

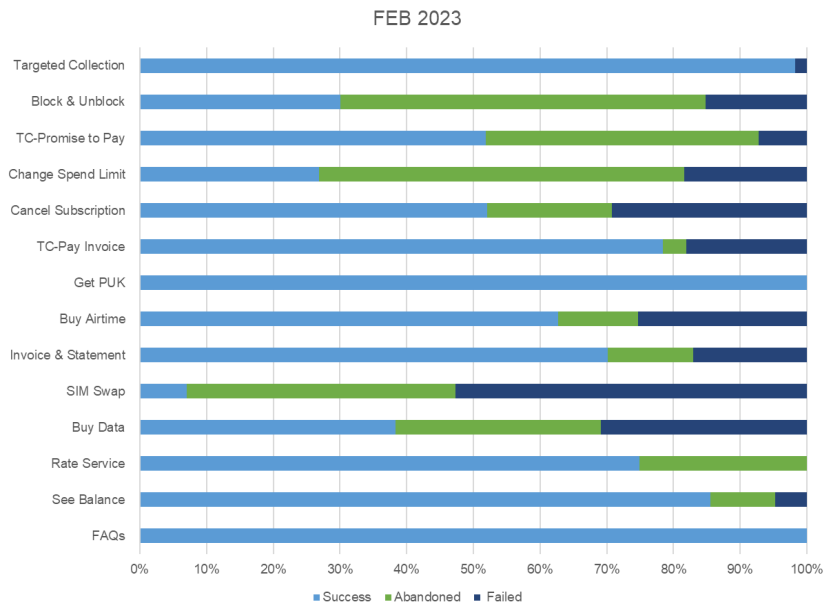


Figure 3: Stacked bar chart depicting February 2023 customer-chatbot interactions for use case analysis.

### 3.3.4 March 2023

“FAQs” indicate an increase in usage once again by maintaining high success rates and affirming its role as a key support feature. “See Balance” indicates a slight reduction in success but maintained high user engagement. “Rate Service” usage and success rate remained stable, while “Invoice & Statement” and “SIM Swap” continued to experience high failure and abandonment rates and indicate ongoing issues that could benefit from user interface adjustments or support resources. Notably, "Targeted Collection" saw an increase in successful resolutions in March, which could be due to process improvements or targeted interventions.

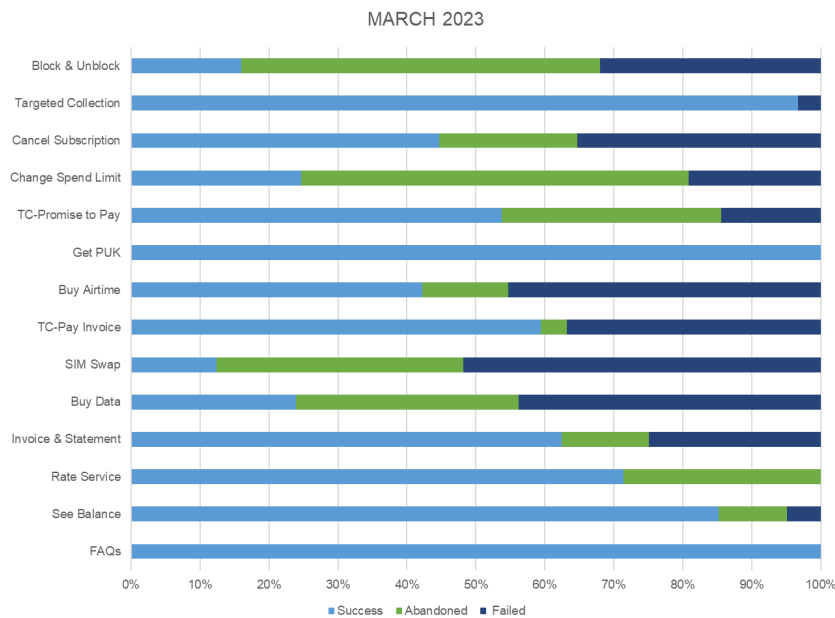


Figure 4: Stacked bar chart depicting March 2023 customer-chatbot interactions for use case analysis.

## 3.4 Qualitative Insights

While the provided data is primarily quantitative, the following qualitative insights can be inferred based on performance patterns:

- User Frustration or Complexity in Certain Tasks: The high abandonment and failure rates for select use cases suggest that these tasks may be too complex for the chatbot to execute or that users

experience challenges in the interaction process. This could be because of poor natural language understanding or unclear instructions from the chatbot.

- **Efficiency in Routine Queries:** The high success rate for use cases such as “FAQs” and “See Balance” suggests that the chatbot effectively handles routine, straightforward queries. Users can get the information they need promptly and without human intervention, consequently improving user satisfaction in these cases.
- **Potential for User Dissatisfaction in Complex Use Cases:** The more complex queries, such as buying data and doing a SIM swap, lead to higher failure and abandonment rates and could signal user dissatisfaction. Users may require additional support or explicit guidance from the chatbot or human intervention in these use cases.

### 3.5 Categorisation of Findings

The researcher categorises the research findings based on the chatbot's performance in handling different tasks. This categorisation highlights routine and complex tasks, with each category presenting the chatbot's success, failure, and abandonment rates. The researcher interprets user engagement, chatbot effectiveness, and actionable insights to improve functionality, particularly in managing complex queries.

**Table 1: Categorisation of Findings**

Category	Use Case	Key Metrics	Interpretation	Action/Insight
<i>Routine Tasks</i>	See Balance; FAQs; Rate Service; Get PUK; Targeted Collection; TC-Pay Invoice.	Success Rate: <b>High</b> Failure Rate: <b>Low</b> Abandonment Rate: <b>Low</b>	These simple tasks follow predictable patterns, allowing the rule-based chatbot to provide accurate responses efficiently.	The chatbot is well-optimised for these tasks, and minimal adjustment is needed.
<i>Complex Tasks</i>	SIM Swap; Buy Data; Change Spend Limit; TC-Promise to Pay; Block and Unblock.	Success Rate: <b>Low</b> Failure Rate: <b>High</b> Abandonment Rate: <b>High</b>	These tasks involve multi-step processes or require a more nuanced interaction. The chatbot needs help managing these tasks effectively due to the limitations of its rule-based design, which needs more flexibility to adapt to dynamic or multi-step queries.	The chatbot may require redesigning or additional rules to handle complexity and reduce task abandonment and failure. High abandonment and failure rates also indicate a need for more precise instructions or smoother navigation through complex tasks.

## 4. Recommendations

Based on the findings and the identified gaps in query resolution, the following recommendations are proposed to enhance the chatbot's effectiveness:

### 4.1 Enhance AI and Linguistic Capabilities

The chatbot's natural language processing capabilities need improvement to understand user intent better and handle diverse phrasing. For complex queries, the chatbot should be equipped with more advanced AI capabilities to guide users through multi-step processes seamlessly. This includes recognising the context of user inputs and offering tailored responses.

### 4.2 Redesign Interaction Flows for Complex Tasks

The chatbot's current design for complex tasks requires a more intuitive flow. Simplifying the steps and providing more explicit instructions will help reduce user confusion and abandonment. Ensuring that users receive step-by-step guidance will improve task completion rates.

### 4.3 Integrate Human Assistance More Effectively

Complex queries often require human intervention, and the chatbot should offer a seamless transition to a human agent when necessary. The current system does not consistently provide this option, which can lead to frustration. By incorporating a more accessible and timely escalation process, the chatbot can ensure that users are supported when automated solutions fall short.

### 4.4 Improve Information Retrieval for Complex Queries

The chatbot's information-retrieval process needs to be enhanced for use cases with high failure rates. Users can be better supported throughout the interaction by expanding the chatbot's knowledge base to cover more complex queries and provide more detailed responses. This will reduce the need for manual intervention and increase the likelihood of task completion.

### 4.5 Leverage Customer Feedback and Behaviour Insights

To improve the chatbot's functionality, continuous analysis of customer behaviour data, including common drop-off points and failure patterns, should be used. Regular updates to chatbot flows based on customer feedback will help address gaps in task performance and lead to a more efficient system.

### 4.6 Expand and Optimise Task Capabilities

The chatbot's current strength is in handling routine tasks. To increase its overall effectiveness, the system should be expanded to cover a broader range of use cases, especially those that involve complex decision-making. By optimising the chatbot's capabilities to handle these tasks, TELCO X can reduce customer frustration and improve satisfaction.

## 5. Conclusion

This research study analysed how a rule-based WhatsApp chatbot resolves different categories of customer queriers. The chatbot was effective in addressing simple transactional tasks but consistently underperformed in more complex queries. The originality of this study lies in its application of real-world usage logs and query classification to assess rule-based chatbot limitation in customer service contexts. The WhatsApp-based chatbot proves effective in resolving routine customer queries but struggles with complex tasks, which require significant improvements in AI capabilities, information retrieval, and user guidance. While the chatbot demonstrates its potential for handling frequent and straightforward queries with high accuracy and speed, its limitations in addressing intricate customer needs highlight areas where enhancements are critical. To fully realise the potential of conversational chatbots in customer service, the recommendations provided will help TELCO X address the identified resolution gaps and deliver a more comprehensive and satisfying user experience. Implementing these improvements will ensure the chatbot evolves into a more versatile and reliable tool, capable of effectively resolving both simple and complex customer queries.

## Ethics Declaration

Ethical Clearance has been obtained for this study and has been reviewed by the School of Consumer Intelligence and Information Systems at the University of Johannesburg.

## AI Declaration

No AI tools were used in the creation of this paper.

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