Impact of Chatbot Service on Bank Performance Based on a Case Study of IBM Corporation

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Abstract. Exploring the impact of chatbot on bank performance helps to identify the potential of this technology to revolutionize the bank's business model and enhance customer experience, while it can improve employee efficiency and provide a scientific basis and guidance for bankers to effectively respond to the increasing competitive market and achieve bank performance growth and sustainable development. This paper delineates the definitions of chatbot and business performance, provides an overview of current research, and examines the influence of chatbots on bank performance. Furthermore, it utilizes IBM's chatbot as a case study to investigate its impact on banking performance, focusing primarily on cost reduction, enhanced customer satisfaction, and improved employee efficiency. At the same time, the banking industry also faces the negative risk impact of chatbot, which mainly includes perceived risk, security threat and moral risk. The paper also concludes with recommendations on the negative risk impacts of smart customer service. This study links chatbot with bank performance to fill the research gap. It also provides an outlook and suggestions for the future development prospects of chatbot in the banking industry.

Keywords: Chatbot; Bank performance; Risk management; Mechanism of action.

1. Introduction

In the digital era, the banking industry is facing the challenges of increasing competition and changing customer needs. In order to maintain a competitive edge and improve banking performance, the banking industry has to continuously innovate and improve its service models. Among them, the introduction of chatbot technology has become one of the key trends in the development of the banking industry. A chatbot, driven by AI, acts as a customer service tool, mimicking human conversation to grasp user queries and offer quick, accurate responses. IBM, an AI frontrunner, excels in chatbot tech. By blending advanced methods like natural language processing, machine learning, and data analytics, IBM's chatbots cater to banking clients, improving their experience. Efficient services to bank customers, greatly improving the user experience.

This paper will define chatbot and bank performance, and then take IBM's relevant practice as a case for in-depth analysis, to explore the impact of its chatbot on bank performance, to confirm the importance and necessity of chatbot in the development of the bank and its practical application in the banking industry and the role of the mechanism. In addition, this paper will also explore the risks and future development trends of chatbot in the banking industry and put forward relevant recommendations. Through in-depth research into the performance impact of chatbots on the banking industry, this thesis aims to provide feasible references and lessons for the banking business, promote the wide application of chatbot technology in the banking industry, and promote the performance and development of the banking business.

2. Definition of Relevant Concepts and Research Status

2.1. Definition of the Concept of Chatbot

Based on a thorough examination of literature and the current state of chatbot development, chatbots can be viewed as customer service systems that blend Artificial Intelligence (AI) technology with Natural Language Processing (NLP) algorithms, which can automatically deal with customer problems and provide solutions, with 24/7 availability, fast response and cost-effectiveness, but may

require the intervention of a human customer service representative to deal with complex problems [1-4].

2.2. Conceptual Definition of Enterprise Performance

Enterprise performance refers to the indicators and metrics that assess the performance and achievements of an organization in reaching its business objectives and executing its strategic plans. It typically covers a variety of aspects, including market performance, operational performance, financial performance, and employee performance. Business performance assessment is an important tool for managers and stakeholders to understand the health and trends of their organizations, which helps to guide decision-making, improve business processes, and ensure that the organization achieves long-term sustainable growth [5-7].

2.3. Current State of Research

In 1950, Alan Turing introduced the Turing test, which popularized the concept of chatbots [8]. Subsequently, in 1966, Eliza emerged as the first recognized chatbot, designed to function as a psychotherapist by responding to user input with questions [9]. Eliza employed basic pattern-matching and template-driven response mechanisms. Following technical advancements, PARRY was created in 1972 as a personalized chatbot [10]. In 1995, ALICE was developed, winning the annual Turing Test Loebner Award in 2000, 2001, and 2004 [11]. ALICE utilized an intelligent Simple Pattern Matching algorithm based on the Artificial Intelligence Markup Language (AIML), enabling developers to define the chatbot's knowledge base [12]. By 2001, Smarter Child, an early virtual assistant, could assist users in finding stocks, checking the weather, and engaging in instant messaging via AOL [13]. Presently, numerous chatbot systems have been developed, including Amazon Alexa, Apple Siri, Google Assistant, Microsoft Cortana, and IBM Watson [14-16].

For business performance, influencing factors can be categorized into two groups. The first category is quantifiable data, such as cost, productivity, and customer satisfaction, etc [17-19]. This category can be used to visualize the determinants of enterprise performance and is an indispensable factor in measuring enterprise performance. The second category comprises unquantifiable data, including corporate culture, access to scarce resources, management skills, and luck, etc., and these intangible factors are also pivotal determinants of business success [20].

Chatbot as a customer service system for businesses also has an impact on business performance. Innovative implementation of chatbots is crucial in fostering business agility, with both internal and external agility of chatbots showing a positive correlation with customer service performance [21]. In addition, the implementation of AI customer service chatbots in a business generates an abnormal stock return of 0.22% [22]. Chatbot as one of the influencing factors of business performance usually results in a positive impact.

3. Development of Chatbot Service

3.1. The Development History of Chatbot Service Technology

The development of chatbot technology has gone through several stages, each accompanied by specific technological advances and algorithmic applications. In the early 2000s, chatbot systems mainly relied on rule-based autoresponder systems that used simple pattern matching and rule engines to generate responses [9]. As natural language processing techniques advanced, chatbot systems started incorporating statistical machine learning algorithms like plain Bayesian classifiers [23]. These algorithms enhance semantic comprehension and text categorization, thereby improving the system's capability to recognize user intent. By the 2010s, with the rise of deep learning techniques, chatbot systems began to use deep neural networks, such as Recurrent Neural Networks (RNN), for more accurate and smooth dialogue generation [24]. In addition, emotion recognition algorithms are beginning to be applied to chatbot systems to identify and understand users' emotional states and adjust response strategies, accordingly, improving dialogue personalization and user experience [25].

Over time, chatbot technologies will continue to incorporate and apply more advanced algorithms and techniques, such as augmented learning, transfer learning, and pre-trained models, to achieve more intelligent and efficient customer service.

3.2. Origin and Development of Chatbot Technology in IBM

International Business Machines (IBM) is a global technology and consulting company founded in 1911. The company started as a manufacturer of mechanical plus computing equipment and later achieved excellence in the field of computers and information technology. IBM stands as a leader in the computer industry, wielding significant influence across various fields.

The roots of chatbot technology within IBM can be traced back to the early 1990s when the company initiated research and development endeavors in Natural Language Processing (NLP) and Artificial Intelligence (AI) technologies, with a focus on their application in the customer service domain. With the popularity of the Internet and the development of online business, IBM realized that providing efficient and chatbot was critical to the competitive advantage of the business.

Against this backdrop, IBM began to roll out early chatbot products, which included rules-based auto-responder systems and simple question-and-answer engines. These systems can automatically answer some common questions but are limited by their fixed rule sets and pattern-matching algorithms, and the dialogue effect is relatively limited.

As technology evolved and market demands shifted, IBM consistently ramped up its investment in chatbot technology, progressively integrating more advanced natural language processing and machine learning capabilities. A significant milestone in this trajectory is IBM Watson, a cognitive computing system unveiled in 2011. This cutting-edge platform is adept at comprehending natural language and delivering intelligent dialogue services.

The IBM Watson chatbot system harnesses advanced technologies including deep learning, natural language processing, and semantic understanding to grasp the user's intent and context. It then furnishes precise responses and solutions leveraging real-time data and knowledge bases. Furthermore, it possesses the capability to learn iteratively, refining and enhancing its answering strategies over time.

In addition to the cloud-based IBM Watson service, IBM has also launched customized chatbot solutions on-premises and industry-specific to meet different customer needs and scenarios. These solutions not only include technology platforms but also involve industry expertise and support from domain experts to ensure the best possible customer experience and solution.

Overall, IBM has played a pivotal role in the advancement of chatbot technology, continuously promoting technological innovation and application to provide customers with intelligent and personalized service solutions.

3.3. Advantages of Chatbot Technology in IBM

First of all, IBM, as a leading global technology company, has strong technical strength and rich experience in research and development. Its technical team constantly promotes the innovation of chatbot technology to provide customers with more advanced and reliable solutions. Secondly, the chatbot solution provided by IBM is comprehensive, covering multiple fields such as big data analysis, machine learning and natural language processing. This comprehensive solution can meet the needs of different industries and enterprises and provide customers with more choices, which in turn improves the customer experience.

In addition, IBM focuses on data security and privacy protection, integrating advanced security technologies and controls for chatbot solutions. This allows clients to use IBM's chatbot technology without worrying about data leakage or security breaches. In addition, IBM's chatbot solutions are highly customizable and can be custom-developed to provide personalized solutions based on clients' specific needs and business scenarios. This flexibility makes IBM's chatbot technology applicable to a wider range and can better meet the needs of customers.

Finally, IBM has a large partner ecosystem and a global customer service network, which can provide customers with a full range of technical support and service guarantees. This implies that customers can receive timely support and assistance while utilizing IBM's chatbot technology, thereby ensuring the stability and reliability of the system.

In summary, IBM has a strong technical strength, safe and reliable, and flexible and customized enterprise, its chatbot technology in the banking industry has obvious advantages and value.

4. Case Study

IBM Chatbot is widely used in major industries, of which the financial and banking industry accounts for 23.5% (Fig.1). The impact of its chatbot system, Watson Assistant, on the performance of the banking industry is mainly reflected in the reduction of operating costs, improvement of customer satisfaction and loyalty, enhancement of business efficiency, and strengthening of risk management. By providing more efficient and smarter customer service, it enables banks to achieve business growth and sustainable development.

Fig. 1 Distribution of IBM Watson assistant customers by industry

4.1. Cost Reduction

Cost reduction and revenue growth are key indicators of increased bank performance. Whether the implementation of smart customer service reduces operational costs and increases efficiency is one of the influential mechanisms that affect bank performance.

Chatbot technology in the financial sector has a positive impact on net profit and helps save transaction and administrative costs [26]. IBM Watson Assistant was implemented in a composite company comprising 4 representatives and 30 C-level executives and managers. According to Table 1, the system's customer containment, defined as its ability to interact without human intervention, led to tangible benefits, resulting in savings amounting to $22,151,292. Over three years, Watson Assistant's handling of voice interactions increased from 45% to 55%. Chatbots prove effective in benefiting banks and financial institutions by offering real-time solutions to customer inquiries and complaints [27]. In the first, second, and third years, Watson Assistant addressed 60%, 75%, and 90% of blocked interactions, respectively, as it continued to accumulate experience. Chatbots in the banking sector can alter the communication interface between banks and customers, potentially reducing costs [28]. The avoided cost per interaction, calculated as the difference between human and digital responses, is $6. The capability to swiftly train and refine Watson Assistant contributes to escalating containment rates each year, resulting in ongoing cost reductions.

Assuming the discount rate is 10%, the three-year total value is $27,712,125 and the present value is $22,151,492 (Table 1).

Table 1. Cost savings from customer containment.

Period	Year 1	Year 2	Year 3
Total annual customer interactions	9,000,000	9,000,000	9,000,000
Avoided cost of human response (before Watson)	$6.00	$6.00	$6.00
Percentage of interactions trained	45%	50%	55%
Interactions deflected to Watson	1,417,500	2,250,000	3,217,500
Effective rate for Watson response	60%	75%	90%
Percentage of interactions regarding product lines covered by Watson	35%	50%	65%
Conversation volume successfully contained by Waston	850,500	1,687,500	2,895,750
Customer interaction containment savings	$5,103,000	$10,125,000	$17,374,500
Risk adjustment	15%	15%	15%
Customer interaction containment savings (risk-adjusted)	$4,337,550	$8,606,250	$14,768,325

4.2. Increased Customer Satisfaction

High satisfaction and positive customer feedback may indicate that smart customer service improves customer experience which helps in attracting and retaining customers. Customer experience is also one of the important mechanisms that affect bank performance.

Chatbot in the banking industry can improve customer satisfaction and potentially reduce costs by automating communication and resolving customer requests [28]. In addition, chatbot can improve user experience and service in banks by resolving queries in simple language, reducing query times, and improving customer service [29].

Fig.2 shows that consumers focus on good customer service at 40%. Bank customers exhibit a positive and significant correlation between their attitudes and behavioral intentions towards AI-powered chatbots. Moreover, AI-powered chatbots in the banking sector can enhance retention and customer satisfaction by promptly addressing requests and delivering personalized services.

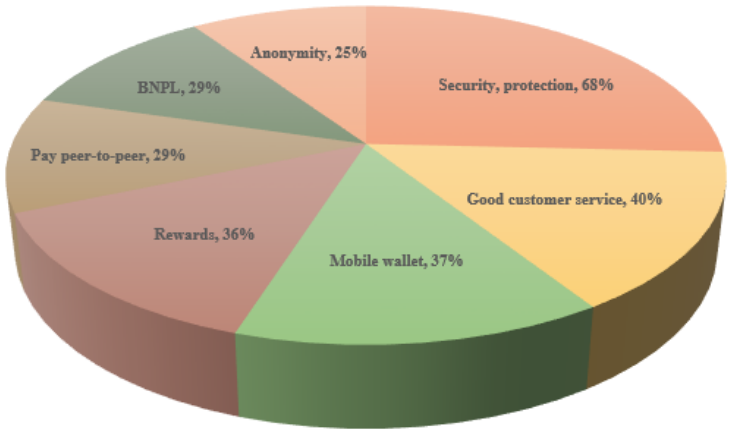

Fig. 2 Customer Needs and Expectations for Using Banking Software.

Watson Assistant significantly enhances the customer experience by offering a dependable virtual chatbot that furnishes consistent and prompt answers with accuracy. Banks have the flexibility to deploy Watson Assistant across various scenarios, encompassing customer service, human resources, and marketing. By adeptly managing customer queries, searching solution knowledge bases, and delivering solutions, the chatbot can streamline a bank's operations, reducing manpower and ultimately bolstering customer satisfaction [30].

Watson Assistant leverages market-leading Large Language Modeling (LLM), Natural Language Processing (NLP), and machine learning technologies to precisely comprehend common inquiries and offer seamless self-service capabilities to customers. With the capabilities of Watson Assistant, IBM furnishes banks with a fully scalable and flexible solution for handling high-traffic customer

service [31]. This enables employees to engage in more meaningful interactions with customers, as they have the time to focus on delivering optimal customer experiences. Consequently, customer satisfaction increases, and existing customers take note of the enhanced service quality, thereby attracting new customers and bolstering the bank's performance while also facilitating the scaling of the bank's operations.

4.3. Improving Staff Efficiency

The implementation of the Chatbot System has improved the efficiency of the bank's staff, thereby accelerating customer service response and optimizing operational processes to support the enhancement and growth of the bank's business.

Watson Assistant has been trained on 62 products and successfully handles 283,000 questions monthly with 95% accuracy, requiring further assistance for only 5% of queries. Some response times have been cut from 10 minutes to seconds [32].

Watson Assistant seamlessly integrates with business systems like CRM and CCaaS platforms, eliminating the need for complex coding or technology stack migration [31]. It's also compatible with the bank's IVR system, allowing customers to check loan status and make payments based on estimates from other banks' IVR systems. Chatbot have positively impacted bank performance by handling small banking transactions and saving transaction and administrative costs [26]. Simultaneously, the smart customer service industry transforms the communication interface between banks and customers, potentially boosting efficiency and meeting customer expectations [28]. In addition, chatbot reduced interaction processing time by 30% [33]. It can be concluded that banks using chatbots to interact with users and answer queries can reduce manpower and increase the efficiency and adaptability of the actual dialogue [1].

Table 2. Gains from the increased efficiency of sales agent employees after using Waston Assistant.

Period	Year 1	Year 2	Year 3
Number of internal sales agents	150	150	150
Performance improvement of sales call interactions with Watson Assistant	2%	7%	15%
Impact on agent productivity (avoided future hires)	3	10.5	22.5
Fully burdened annual cost of internal sales agent	$100,000	$100,000	$100,000
Increased efficiency from sales agent assist	$300,000	$1,050,000	$2,250,000
Risk adjustment	15%	15%	15%
Increased efficiency from sales agent assist (rak-adjusted)	$255,000	$892,500	$1,912,500

As can be seen in Table 2, assuming the discount rate is 10%, the three-year total value is $3,060,000 and the present value is $2,406.311. After balancing the risks, the use of Watson assistant makes the sales agent employees more efficient and gets $2,406,311 profit. Also, organizations using Watson Assistant are most likely to achieve an increase in revenue (50%) due to faster customer service compared to the previous environment [33].

5. Negative Impact

Firstly, there is a perceived risk associated with chatbot. Perceived risk is a concept that consists of perceived risk and uncertainty Chatbot systems may trigger perceived risk, for example, customers may believe that their problems are not fully understood or resolved, which reduces their trust in the bank [34]. In addition, automated responses from chatbot systems may result in customers feeling that there is a lack of personalized and humanised service experience, which in turn affects customer satisfaction and loyalty. Bank chatbots improve customer experience and brand likability, but perceived risk plays a moderating role in their success [35]. Perceived risk negatively affects the relationship between user satisfaction and continued use of bank chatbots, so it is important to reduce perceived risk [36].

Secondly, chatbots entail information security risks. Queries range from specific goods and services to financial and personal advice, offering simplicity and speed but also access to sensitive data and personal information [37]. A survey indicates that 6.29% of chatbots transmit users' chats insecurely in plain text [38]. Furthermore, some heavily rely on cookies for tracking and advertising, with over two-thirds (68.92%) of identified cookies in chatbot iFrames used for such purposes. Despite assurances of privacy, security, and anonymity, many users may unwittingly face inadequate security measures from chatbot service providers.

Thirdly, there is a moral hazard associated with chatbot [39]. The widespread use of chatbot systems may raise ethical risks, such as the risk of privacy leakage when handling sensitive information. In addition, due to the limitations of algorithms, chatbot may not be able to understand and handle certain situations correctly, leading to misleading or inappropriate responses and damaging customer trust and reputation. While it is true that chatbot can improve performance by creating content faster and improving research and customer service, ethical considerations are crucial to avoid potential harm to stakeholders [40]. Chatbots, acting as non-ethical and non-independent agents, handle inauthentic conversations with consumers, raising concerns about the automation of online conversational processes and their integration with AI, which can present ethical challenges [38].

6. Conclusion

Chatbot has an inaccessible role in bank performance improvement. Through literature analysis and IBM case study, it is found that its important role mechanism lies in the following three points. First, chatbot can enable bank performance improvement through cost savings. Secondly, chatbot can increase customer retention rate by improving customer satisfaction and attracting new customers, which makes the bank's performance improved. Finally, banks can improve the efficiency of work through chatbot, so that the bank's performance can be improved. However, there are also negative impacts of chatbot, and negative risk impacts mainly include perceived risk, security threat and moral risk. Perceived risk involves a decline in customer trust and service experience, information security risk may lead to data leakage and malicious attacks, and moral risk involves problems such as privacy leakage and misleading customers. Therefore, banks need to carefully consider these risks when implementing chatbot systems and take appropriate measures to minimize their impact. Banks ensure that they balance automation and human intervention when implementing smart customer service systems to provide a service experience that is more relevant to customer needs in order to mitigate perceived risks. Simultaneously, stringent security measures, such as encrypted data transmission, regular vulnerability scanning, and continuous monitoring, are implemented to uphold the security and reliability of smart customer service systems. In addition, the use of chatbot requires strict compliance with ethical guidelines and laws and regulations to ensure customer information security and service quality.

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