Customer Intent Modelling and Contextual Product Recommendation: Deep Learning Approaches to Personalised Banking Service Delivery

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1. Introduction

The banking and financial services sector in India has been growing at a rapid pace, posing a challenge to both regulatory authorities and service providers. As banks face the challenge of attracting and retaining customers due to intensified competition, technology is proving to be a crucial advantage in developing personalized banking services based on customer information. To effectively manage customer demands and operational efficiency, the banking sector has been increasingly turning to the implementation of AI models to make strategic and operational decisions. Integration of artificial intelligence technologies in banking holds the potential to enable operational efficiency, cost reduction, and enhanced customer experience. Artificial intelligence could be used to leverage existing customer data and gain insights to develop customer-centric banking products and services. Furthermore, AI technologies, such as machine learning and predictive modeling, could assist in predicting customer behavior to customize and personalize the offerings based on the customer's preferences. Rapid changes in the technological landscape and focused efforts in AI and big data technologies have made it possible to propose AI models for personalized banking services, which would use customer data such as behavioral and demographic data to a large extent. For individual banks, it is imperative to understand how to use AI to design personalized banking services, retain existing customers, and attract new clients. The question that arises is how AI can be designed and made effective to provide personalized banking services in India and how advanced AI-based personalized banking services could increase the percentage of banked people in India. The proposed

study will help banks understand the significance of AI in proposing personalized banking services.

1.1. Background and Significance

All over the world, corporations are striving to offer personalized banking services. The custom of customer service in banking has a long historical record. In ancient times, emperors established eye contact with ministers until the salesman says, "they know me" – a personalized card is being developed successfully. The history of personal service in the banking industry has transformed to the current level from the belief that each individual member is to be defined personally. Today, every customer looks for individual attention in the offering of products and services according to their individual profile. So they shop for services that are tailored to their needs and requirements specifically. The term used to denote the special offering of different products to different individuals based on need is mass customization. The development of mass customization is driven by the increasing need for a tailored product and service. This has been particularly intense in the financial service sector. The demand for personalization is increasing in the banking industry as well, with growing expectations that banks will sell them not just a mass market product, but a product that suits their personal needs better than what competitors can offer.

Those who customize are likely to provide a competitive advantage and end up being profitable. As a result, the findings of this piece are critical to the banking industry. Technology has produced not just sophisticated and alert individuals but those who are more knowledgeable. Consumer behavior is bound to change in line with the rise of new technology. Artificial intelligence helps in promoting assessment and execution of peer interactions, specifying business processes, their complete integration, including all internal divisions, both with external scenarios and with surrounding systems. There is a need for greater customer focus and long-term customer relationship banking. Aligned with this, there is a greater requirement to be intimately linked with the customer to provide for all of their needs. The expenditure on customer acquisition is significant, thus making every customer very important. Organizations have to invest more in terms of money and effort into retaining good customers. There is a demand for marketing concepts and tools that are capable of creating profitable relationships with customers. Accordingly, the concept of customer lifetime value entails a comprehensive

understanding of the customers and long-term customer value to the bank. The services offered to attract or retain them are provided when.

1.2. Research Objectives

The main aim of the study is to develop a new concept and approach for AI use in personalized banking services in commercial banking that is relevant for each client. For this aim, research objectives were established as follows: Objective 1: To identify the key AI technologies that are applicable in personalized banking services. Objective 2: To explore the impact of these AI technologies on customer satisfaction and loyalty, as well as the possibilities to use collected data for expanding the range of banking products. Objective 3: To assess AI challenges from the bank's perspective and to explore AI opportunities in retail banking. Objective 4: To review and investigate the current practice of applying AI technology in personalized banking services, what we have and what we could have. A comprehensive review of all available approaches to customer segmentation at both retail and commercial banks in general, and especially the concept of personalized services, has not been done so far. Two general book topics on personalized banking services mainly refer to concepts of financial customer portfolio optimization from the clients' point of view. Bank management problems are generally not considered. The thesis written on the need for evaluation of mass customization in banking from an internal bank process refers to more relevant concepts of this paper and this research, such as CRM, personalization tools, bank customer loyalty, and market segmentation. Therefore, the realization of the present research objectives was the main guide to research design, research method, area, and methodology as well, which is the focus in the subsequent sections.

2. Machine Learning in Personalized Banking Services

Machine learning, a branch of artificial intelligence (AI), has become increasingly important for improving banking services. It finds patterns and builds a predictive model based on data. The rise of machine learning enabled the emergence of a new subfield of computer science, also known as data mining, which was necessary for handling large amounts of raw data and creating algorithms for sifting through the information it contained. An increased capacity for sifting through large volumes of structured, unstructured, and semi-structured data in shorter time frames than traditional data processing systems has made machine learning especially relevant to the

finance industry, a sector where excessive volumes of data are generated on a daily basis.

The finance industry contains valuable, yet hidden, information about its clients' habits, preferences, expenditures, purchases, etc. Capturing, measuring, and understanding this information is crucial for promoting successful personalized banking services. In general, there are various applications pertaining to personalized banking services, for example, credit scoring, risk assessment, fraud detection, and so on. Machine learning has evolved over the years and is widely used in areas with high volumes of data. Whether unlabeled, partially labeled, or fully labeled data is provided, the ML system can simultaneously identify, observe, and analyze the vast number of data points. Banks will be able to optimize personalized, up-to-date customer services by adopting technologies like machine learning acting on big data. Marketing products more accurately towards a customer's personal tastes, interests, age, and location has been a general, successful practice.

2.1. Overview of Machine Learning

Despite important historical first steps towards using computer technologies for banking operations, in recent years there has been significant improvement in this field, derived from the increased availability of data. Machine learning is behind many of these new solutions, including automation, fraud detection, client segmentation, and personalized services. This section aims to provide a brief discussion about the landscape of machine learning approaches typically applied in the banking sector. Below, we provide a conceptual overview of machine learning. We outline the main subgroups of algorithms and discuss both the main stages in the process as well as the key inputs.

The starting point for any machine learning model or approach is the availability of large data samples. Ideally, in the supervised learning approach, we need samples of the variable(s) to predict. For example, if the task at hand is to predict the probability of default in a financial contract, then a set of previous financial contracts with their respective default status should be available to calibrate the model. In unsupervised learning tasks, labeled data is not as crucial, but it is always a positive asset if the final solution is expected to be validated. In the learned model, these are the parameters to optimize on the data sample, and the so-called Decision Function (e.g., how much to lend a particular individual). The most important insight in machine learning is this

concept of learning, or of searching over a search space. In a world with many observations with which to calibrate, undoubtedly a simple linear model may present the same default risk predictions as a regularized boosted-tree method.

2.2. Applications in the Banking Sector

Machine learning has been applied in a variety of fields, including genetics, finance, agriculture, and physics. In the banking sector, it is used to automate processes such as evaluating loan applications and handling the risk of particular companies. Furthermore, machine learning has been used to make predictions for developing new and improving existing services. Through customer segmentation developed with machine learning models, it is possible to better target customers with new personalized products or services.

The use of machine learning models and analytics in the banking sector is extensive. It can be used for future predictions, customer segmentation based on historical data, product personalization based on market data, and risk level prediction based on lending data. In recent years, due to the increasing importance attributed to the area of analytics, artificial intelligence and machine learning, different types of banking services have adopted models based on predictive analytics, and machine learning has been extensively used in various processes of the banking sector. It can optimize decisions regarding costs, operations, and customer segments in various areas of banks, such as prediction probability analysis for cross-selling and upselling product offerings to customers, creating more opportunities. Combating fraud is also one of the most important activities under predictive processes and comprehensive strategies by banks. Banks monitor their credit and debit card transactions in real-time with complex algorithms to quickly flag suspicious transactions. It is expected that the ability to combat fraud will improve with predictive and real-time monitoring of transaction data. Overall, the basic idea is to protect lost revenue and company reputation. Anticipating customer behavior with analytic and SWOT analysis benefits sales and marketing teams in the banking industry. It is a critical part of bank marketing, sales, and operations. In the banking sector, the benefit of predictive SWOT analysis helps strategically identify opportunities and competitor approaches in the market. It is also an efficient tool to answer all questions. A way to differentiate between predictive and normative forecasting in SWOT analysis has been developed with a collaborative approach. It is

expected that the deployment of extensive SWOT analysis for the banking industry will be an efficient tool for making wise decisions in the short and long term. Machine learning models can enhance the generalization of a problem, and at the same time, improve the performance of banks that address the problem in a timely and cost-effective manner, based on specific data. Although it can be successful with loans in a few seconds, it usually takes days to arrive at a correct automated credit scoring decision. If banks use AI and ML-powered customer evaluation, they can make well-informed decisions quickly. It is time for banks to reach out with ML into a new sales strategy of customer-oriented micro-marketing research. With the help of a proposal that integrates customer needs and profiles, special items and services are introduced and explained, humanizing and adding value. Finally, bankers may wish to reset a long-standing error-focused campaign. By fulfilling customer priorities instead of merely offering financial products, AI and ML will create promotional efforts aimed at increasing demand for financial institutions' products and services.

3. Challenges and Opportunities

Personalized banking in general and AI-based personalized financial services in particular remain untested waters. Their testing and implementation raise various challenges, several of which are discussed in this section. Data integration is crucial; fortunately, banks hardly bear any problems with the diversity of the data required for personalized financial services. Disparate data sources, whether from customers or other entities or generated by using or exploiting banks' operations and services, lay the foundation for a range of personal financial and optimization decisions. That said, combining and integrating such data can be a real challenge due to considerable technical and consumption diversity. Because customer data constitute sensitive personal information, banks often struggle with issues related to data aggregation and personal data use, such as data protection, privacy, and security.

Increasingly, consumers are demanding transparency in algorithms and enhancing the space for their control. The use of machine learning and AI adds a further level of complexity to this matter because of the algorithmic interconnections. Therefore, banks should not see their AI deployment exclusively as a technological challenge, as it cuts across various management aspects and challenges managers in recognizing the balance between innovation and acceptable business risks as defined by a value and ethical

framework. The latent dual interests in innovation and appropriateness, as the primary motivations for banking AI, reflect the challenge associated with synthesizing risks and opportunities and call for a proactive and forward-thinking strategy that seeks to minimize unacceptable risk without losing sight of achievable gains from the use of AI. The logical overarching approach, and the stance taken in this analysis, is to adopt AI within an all-risk harmful approach. Above all else, the ethical considerations emphasized throughout are encouraged by the emergence we examine. It is now widely accepted that building AI competence is largely beyond the capability controls typically seen in banks, being a question of ability – and is increasingly determining future success. However, banks should not adopt AI through a trade-off lens, whereby ethical considerations are seen as a brake on doing business responsibly. Instead, management should emphasize the practice of responsible AI and evidence that such use can be controlled, checked, and proved by means of testing, then monitored and retargeted if necessary. As a result, we position AI within the control risks and harms set, which allows banking firms to adopt AI responsibly while retaining 'protection in reserve' against unethical AI practice.

3.1. Ethical Considerations

The wider and newer use of artificial intelligence (AI) in banking can result in ethical implications. If the algorithms applied in AI are influenced by data, they can be biased and contribute to biases in algorithms. For example, when predicting someone's ability to repay a loan based on data analysis using historical data on loan takers, it could very well be that women are treated as more likely to fail to repay. This could be because they are, on average, more often single parents with a loan request. The bigger picture is that there might be an overall inequality, which could be due to unequal pay for women. If data-based AI applications reveal discriminatory practices, they must be addressed. This underlines the urgency of further advancing the techniques, understanding, and interpretation of AI.

It is not only the result of algorithmic decisions (a discriminatory practice) that is important, but also the transparency towards the customer regarding how decisions are made. It is the 'right to explanation'. This means that the complexities of the smart algorithms and their outcomes should be translated into a customer-understandable manner. More automation implies less human involvement, where the banker is no

longer part of decision loops. Where should we draw the line on when to leave a decision to smart algorithms or when to have a banker in the loop? Responsible use of AI in society will affect the accountability of banks. What are the implications of fully relying on smart systems? Are the AI programs directly reviewing these, or is there always an accountable person reviewing the outcomes of smart AI applications to judge if the results are fair and responsible? There is a risk that automation further leads to an accentuated lack of accountability. There is a danger of perpetuating the socio-economic divide. Ethical concerns surrounding AI in banking raise questions that focus on responsible innovation and inclusive societies. AI technology is neither good nor bad, but rather depends on how we use it. Once morals and ethics are known, codes can be implemented. Indeed, responsible innovation follows a certain 'function-per-behaviour' approach. It requires a series of ethical protocols, specific frameworks, and systems, carefully configured, checked, and double-checked, to ensure that technology is used as intended, is effective, and, importantly, is not used to the detriment of society. It is a 'mature' approach to responsible innovation. As AI matures, setting such ethical frameworks and guidelines can also be part of creating a mature AI society. Technologies can advance relatively quickly, and society's understanding and reflection need to keep pace to maximize the positive potential while mitigating the risks. This can be an important societal discussion needed, in addition to improving understanding and critically reflecting on the further potential of AI. Before addressing Herculean ethical challenges, we must also comply with the existing rules and laws. In the EU, at least in the banking context, the focus of regulatory authorities and the Commission is shifting towards new technologies. This requires skills and a culture that prioritizes both compliance with today's rules and a strong focus on the capacity to innovate. More opportunities will arise with regulation, which will be there to protect consumer rights. Altogether, this will also speed up the level playing field for the entire industry, helping to avoid uncontrolled monopolization. Altogether, we refrain from solely making the banker or API economy point or a solely ethics-driven point. It is a mixed balance of risks and opportunities in our view.

3.2. Data Privacy and Security

The primary data privacy and security issue for personalized banking applications driven by artificial intelligence is the unauthorized access to sensitive personal and financial data, since the size and depth of customers' personal data can cause more

significant harm if it is leaked or maliciously used. Therefore, it is critical to ensure that the data used for personalization is secure and only accessible by permitted personnel. Protecting customer data is essential for banking, as financial data needs different permissions for each group of bank staff. It is also necessary to avoid possible fluctuations in bank policies and to remain up to date with regard to regulatory compliance. Data protection regulation is now more favored with the introduction and enforcement of regulations across the European Union. Although protection regulations and data sharing limitations offset the chance for banks to expand because they rely on AI-guided data analytics, they are seen as an appealing place for those looking for investment tools and solutions to provide for such investing public.

Practical risk minimization initiatives should include data classification and framing, vulnerability anticipation, threat modeling, and the design and adoption of technically enforceable policy mechanisms. Consumer trust in top data protection may be high to switch potentially in favor of banking in a centralized knowledge industry. In realistic personalized service settings, big data-driven AI initiatives require consumer trust not only at a human-to-machine level, such as solid cybersecurity mechanisms, but also in algorithmic decision-making steps in protection and realistically checkable justifications of their results. Large cohorts of labeled data, when compared to few labeled data cohorts, such as money, and tremendous deep learning by CNN. Many standard strategies can be rendered inapplicable in the context of customized banking because algorithmic (as well as human) biased training statistical grounds do not always compromise the optimizing features of the algorithm to boost predictive performance and also separate and better protect personal information. Only the law can also agree with spurious proxies along with openly suspect-based forecasts. That said, when protecting a user's privacy runs counter to the business objectives of banks, it remains a costly exercise. This polymorphism is of particular importance in cases of customers' rights to be forgotten and data minimization in banking applications.

4. Case Studies

Over the years, there have been several developments and new technologies that have been brought into the banking sector from various industries. The use of artificial intelligence has already begun in big banks, often concentrated on trying to enhance the quality and speed of their customer services - typically once a customer has interacted

with the bank or a chatbot. However, few banks are directly offering retail banking customers personalized banking services. Customers seek value but often find banks lacking. User case studies include banks that have successfully implemented open banking and artificial intelligence to improve customer acquisition and management.

A major UK bank has become the first big UK bank to offer, on a regional basis, a 'personal financial coach'. Customers will be directed to value-for-money products and services after a 15-minute free financial health check discussion. This service has been developed with a focus on using AI technology and predictive analytics to offer tailored financial guidance and support 24/7. The bank uses a mix of solutions from other vendors and in-house resources: a conversational application integrated with connected RPA, along with a variety of in-house models and data analytics tools, to offer a personalized service that enables users to understand and pay off debts quicker, make the most of their savings, and much more. Another bank has predominantly been providing customer relations and credit services to primarily individuals and SMEs in the center-north of Italy. In 2021, they launched an app-built personal banker service, which uses technology from a fintech company. In addition to current account operations, another service now uses the platform in-app to offer invoice payments, automatic loan installment quotes, access P2P financial transactions between customers, chat, and transaction services. A more dynamic system for merchant cash advances and real-time bill payment monitoring is promised for the immediate future. A similar offer also supports the Brazilian market. The platform now supports Spanish, and the team will continuously invest in the most comprehensive banking and payment conversation models to support clients in the Spanish-speaking markets.

4.1. Successful Implementations in Banking

In the banking industry, there is growing interest in using AI for personalized services. While AI could be useful in delivering financial and wealth management, excessive financial offering messages from digital channels are also a leading cause of user churn. Banks have been utilizing AI for engaging customers and service delivery. One bank has deployed a proactive customer support assistant using AI to cope with customer inquiries outside office hours. Other banks have established AI engines for providing financial or insurance scores and investment clues. This bank has developed joint AI initiatives. AI projects well-aligned with business strategies can provide banks with

competitive and sustainable growth. However, not all AI projects are successful. Challenges converting AI from feasibility to scaled applications are due to latent costs, potential benefits, and not scaling solutions to the businesses they serve.

One key challenge for implementing AI systems in the banking sector is to match the technical requirements with the business requirements. Once realized, it is critical to showcase the success of your implementation. In this section, we present examples of successful implementations of AI technology in the banking sector. By connecting IT policy and business strategy, a large French bank has successfully disposed of cryptocurrency transactions by API in a cost-effective manner. Before going public, challenges included decisions about linking crypto transactions to known essential personnel and determining how detailed to make the compliance alert mechanism. Funding requests for this AI policy are backed by the company's governance subdivision. It is one of the earliest AML systems in the banking industry to adopt AI. Now dubbed "project CRA," short for Compliance Rules Assistant, the AI system also incorporates customer profile documents submitted by the cryptocurrency exchanges themselves. Loans increase customer satisfaction and retention rates due to AI underwriting. Shallower PAYG users have the greatest potential for quick growth. With further algorithmic refinement, the possible offering may be extended to consumer investment.

5. Future Directions

Future trends to watch for are the advent of non-touch interfaces like gesture, audio, and gaze control for digital activities like payments and mobile apps. Computer vision and augmented reality will play a major role in offering real-time personalized assistance. Nanobots and biometrics could provide better customer service and banking options to the elderly and disabled. Chatbots and other AI assistants have largely acted on a reporting and insight delivery function, but industry players are working on ways to allow customers to take meaningful actions based upon their financial health insights. In many cases, AI would take actions on behalf of the customers based on their financial position. It is not just access to services but actual management of money that would be revolutionized with AI. Advances in data analytics and machine learning are giving rise to a data-driven banking revolution. In such a world, banks can effectively assess risk and prevent fraud in real-time while creating highly personalized customer experiences.

Banking transformation in many areas has produced a 10% to 20% ROE increase within three years and an operating efficiency increase in the range of 20% to 40%. There are several customer interaction and service delivery areas that AI is being used to change the traditional model, such as robo-advisors. All of these new service delivery models have lifetime value implications for companies. Banking success in the future will heavily involve technology and initiate new areas of frictionless and complete financial service outsourcing. Traditional and neo-banks will be expected to tailor and personalize AI-driven income generation approaches connected with things that matter to the customer. Customers will increasingly judge the effectiveness of AI by the results and benefits provided, and they will reject disjointed AI approaches. Thus, the comfort of the customer is assumed, along with trust. As with all transformative change, ongoing innovation is the key. Agile and regulatory processes are required. It is entirely possible for a large bank to have a tech cooker that is used by many, tailored to their high-volume, low-risk base, but works well. A totally seamless AI-led collaboration.

5.1. Emerging Trends in AI and Personalized Banking

5.1. Emerging Trends in AI and Personalized Banking. Conversational AI, in the form of chatbots and virtual assistants, has become increasingly common in a variety of industries and functional domains. In the banking and finance sector, AI is increasingly being used to improve customer engagement and experience, answering customer queries and providing information 24/7. Traditional interactions with customer service do not always provide a positive experience: customer queries are often not answered immediately and must be directed to the relevant department. The moving trend will facilitate conversational AI to handle queries and other routine administrative work, allowing human employees to concentrate on more complex and urgent cases while providing a positive customer experience. Technological innovation continues to drive the industry: the banking and finance sector has now begun to exploit big data and data analytics to achieve hyper-personalized services. Customers and banking product consumers are unique, with completely different responses to the same marketing message, and thus traditional mass advertising is losing its appeal. Hyper-personalization, enabled by big data techniques, allows banks and fintech startups to create tailor-made products for customers for a more personalized experience. Research is emerging in customer behavior, focusing on how to replicate this decision-making process to understand how banking stakeholders evaluate their loyalty drivers.

Prediction AI is also a major trend. Now, with increasing computational capacities and data streams, we can move from simpler decision rules to complex AI predictive models. There are additional trends toward integration with other technologies, such as the recent merging of AI and blockchain in DeFi, a move we are excited to watch as it develops. We should continue to monitor banking intrapreneur capacities in technology decision-making and integration. We need research like this to stay in sync with changing AI trends in the industry. Current trends in AI have major applications within personalized banking. Bots have become a major customer service pain point and principle, increasing the appeal of conversational AI to big banks and startups.

6. Conclusion

In conclusion, AI technologies have revolutionized banking services by personalizing customer experiences, identifying new market opportunities, and assisting customers with financial planning. The availability of large amounts of data has enabled banks to identify new ways of value addition, provide tailored tools, and give personalized advice to create real customer propositions that meet mobility, personalization, and convenience needs. Nevertheless, AI-based banking services present an array of difficulties, such as concerns about the ethics of AI-based systems, the privacy of customer data, and potential criticism from regulators. So far, insights and case studies have suggested a number of ways to ameliorate the barriers and risks associated with AI-based personalized banking services. Therefore, the banking industry has the necessary impetus to move forward, aware that the public is aware of the increased sophistication and power of technology. This awareness in turn requires the responsible and ethical development, handling, and application of technological advancements. This text has addressed the current conversations and debates surrounding AI-based personalized banking services by highlighting findings from a number of case studies and emerging trends. These are signals that demonstrate the direction of travel and the possibilities associated with the rapid development and implementation of AI technologies on the customer-centric personalized services envisaged. Furthermore, both the developments and insights discussed have addressed an interest and need for further research and collaboration within the industry itself. The improved alignment of AI technologies with customer-focused strategy facilitates further innovations in the pursuit of facilitating the most appropriate and needed personalized offerings.