Channel Intelligence and Customer Interaction: Leveraging Data Analytics and AI in Modern Banking

Praneeth Reddy Amudala Puchakayala

Data scientist, Regions Bank
appraneethreddy01@gmail.com

Abstract
The advent of advanced data analytics and artificial intelligence has transformed customer interaction and channel intelligence in modern banking. This paper explores the multi-channel strategies employed by U.S. banks, emphasizing the integration of AI to optimize customer experiences and operational efficiencies. The study highlights the role of real-time data analytics in understanding customer preferences, fostering engagement, and enhancing channel utilization. It also delves into challenges such as data silos, regulatory compliance, and legacy system integration while proposing innovative AI-driven solutions. By leveraging key performance indicators and actionable insights, the paper underscores the strategic significance of channel intelligence in driving loyalty, personalization, and profitability in a competitive banking landscape.

Keywords: Banking, Multi-channel, Artificial Intelligence, Automation, Data Analytics.

I. INTRODUCTION

The value of 'Channel Analytics' lies in selecting the appropriate mode of distribution. Jon Voorhees, while discussing 'Distribution Planning Analytics,' emphasized Branch Distribution Analytics, primarily focusing on the question of how many branches are required to have an efficient distribution system in the market, including distribution concepts, the impact of over-branding, and the consequences of too much distribution. Competitive Saturation refers to the overall number of households and branches. The more competition in a certain region, the lower everyone's fair share becomes.

Branch Density refers to the number of branches in each region. There must be sufficient branches to be perceived as competitive and handy, but too many result in excessive overlap and inefficiency. The goal should be to become a major player in that specific market; the more competitively saturated it is, the more branches are required [1].

- Fair Share means that the branch shares are equal to the deposit shares.
- The S-curve depicts the reality in which smaller branch banks rarely receive their fair share.
- The Power Ratio is the deposit or branch share that indicates distribution efficiency or efficacy.
- The Net Effect is characterized by the Efficiency Ratio, which is the amount of money spent for each dollar spent to obtain it.

Retail banks want to be 50% more efficient, with the problem being to identify areas of excess. Branch Trade Area is unique in that it can be tailored to recent sales activity or predicted using local daytime population density. Except in crowded urban downtowns, branches can also be determined by drive times. Overall, some overlap is necessary for member convenience, but too much causes inefficiency [2].

Next comes 'Using Mobile Location Data to Improve Marketing Effectiveness,' in which Ron Shevlin emphasizes four critical pieces of information: device ID, geographic location, dwell time, and frequency. This information can be used to track the members' whereabouts at any one time, as well as to develop a mobile behavioural trajectory by providing the members' location, persistence, period, and path. To increase marketing strategy and intelligence, certain concepts must be understood, including customer profile enhancement, customer segmentation, campaign management, competitive intelligence, and branch performance. The specific issues addressed by marketers are:

Credit unions do not know their members as well as they believe they do. They don't know who their members bank with, where they work, how far they commute, where and when they shop and bank, all of which are important factors to consider. Marketing campaigns are rigid. The offers must be tested to determine which branch benefits from them, so that changes can be made to the campaign and, ultimately, performance can be tracked. Financial institutions possess limited competitive intelligence. This includes the percentage of members who visited other bank branches as well as the percentage of customers who visited two or more locations. The crucial issue is to shift the data strategy from defence to offence. The defensive purposes are regulatory and compliance, whereas the attacking purposes are marketing and offers. The success factor for mobile location data is adding new data sources into the marketing strategy, which requires more workers to develop and integrate.

Finally, Adam Hass presented 'Mobile App Analytics to Make Data-Driven Decisions'. Mobile app analytics is the process of gathering user behaviour data, determining intent from those metrics, and taking action to achieve the desired outcome. Common goals include retention, engagement, and conversion. It is beneficial to analyze how users interact with your app, capturing behaviours that can help you improve their user experience and continue to engage and delight members. Mobile analytics can help create better apps [3]. According to one research, 65% of members downloaded mobile banking apps, while another found that 47% prefer to utilize Financial Institution mobile apps. The goal of analytics is to measure outcomes from any aspect. Success can be measured against the current approach, and the results can be used to fine-tune the strategy even more. Mobile Banking Analytics can assess the effectiveness of promotions and goods, track offers that monetise the channel, identify the most popular feature, decrease fraud through behavioural trends, and highlight issue areas.

The Maturity Model of Sophistication of Mobile Banking Apps provides information to consumers by allowing transactions, interacting, managing lifestyle, and engaging in primarily non-financial activities. Important metrics or key performance indicators can be used to predict app success, provide insight into why an app is operating in a specific way, and determine how to improve a low-performing region. These indicators include the number of downloads and users, which may provide an inaccurate image, the retention rate and active users, crash analysis and the number of users during the early stage, user journeys and conversions, service penetration, promotion or shopping, and geographical iiformation.

A. MULTI CHANNEL APPROACHES:

In its most basic form, the multichannel notion is the employment of two or more techniques (channels) to fulfill a specified task. This multi-channel approach gives businesses more ways to communicate with their customers, with each channel having the power to reinforce another. Because about 75% of consumers use more than one channel, the multi-channel approach is thought to be advantageous [4].In this study, "multi-channel" refers to the use of more than one banking channel. This does not imply that several channels are used to perform the same transaction at the same time, but rather that more than one channel can accomplish the same task. Usage would depend on which channel the consumer chooses to use at any given time. The use of different channels allows banks to broaden their reach and engage with more customers. To sustain consumer trust, give a familiar environment and consistent service across all channels.
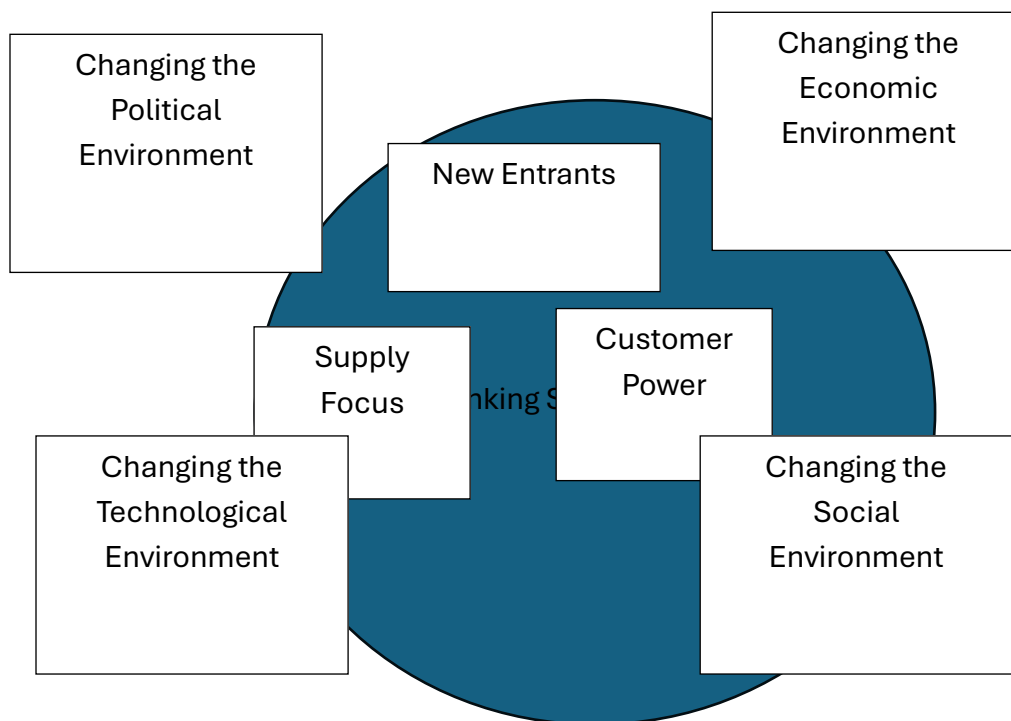

Figure 1. Banking Services Sector and its interaction

The introduction of additional channels may result in varying consumer attitudes and intents regarding a banking channel when they determine which channel(s) to use as in Figure 1. Investigating the multi-channel strategy will provide a better knowledge of the potential accessible to both consumers and service providers. Marketing research has already shown that a multi-channel approach benefits both consumers and providers. Benefits include quality services, cost reductions, and market growth, as well as satisfied and inventive customers [5].

A bank's strategic approach to multichannel customer experience begins with an analysis of customers' channel behaviour across segments and products, followed by the definition of channel value propositions for different customer segments and the design of high-level sales and service processes across channels to enable seamless customer experience. Every bank must develop its own tailored multichannel strategy; there is no one-size-fits-all approach. However, commonalities do exist. Before commencing on any strategy, banks must address the following questions.

- How do our customers perceive and utilize our channels?
- What is the value proposition of each channel to our customers?
- How can we position and handle all channels in a consistent and easy manner?

Understanding the needs and expectations of each bank's specific clients allows banks to develop a multichannel strategy for diverse customer categories based on consistent, pleasant customer experiences in preferred channels, resulting in increased loyalty and profitability. To do this, Peppers & Rogers Group recommends handling multichannel banking with a strategy that prioritizes channel value propositions, the distribution model, and the development of principles around the plan.

B. DATA ANALYTICS:

Buildsoc has established a new Central Retail Operations Division to handle customer engagement via call centres and the internet. Buildsoc is a vast and complex organization with multiple branches. The central unit has minimal control over client interactions. Several Buildsoc respondents highlight issues for staff working with clients across several goods and channels [6].

In this organizational model, the focus is on managing products and channels rather than consumers. Internatco, an insurance company, presents the second example. Internatco's current structure presents significant obstacles when implementing a central direct unit for client management. Historically, Internatco has believed that each channel "owns" its clients. The Internet and contact centres provide direct access to the company, yet channel fragmentation may hinder consistent and coordinated customer interactions. Internatco's current structure of functional and divisional silos is hindering direct client interactions, necessitating considerable modifications. According to the Internatco sales manager, integrating CRM is challenging due to the various business components tugging in different directions.

Interviews with respondents from various functions reveal that traditional structures centred on departments and distribution channels hinder efficient cross-functional collaboration. Effective customer management typically necessitates integrating corporate strategies. Interbank displays responsive customer management by starting from scratch and hiring new people. New processes and systems can help to foster the development of a new culture. Adding more channels to existing operations may require personnel and managers to adopt new approaches, as seen in the multi-channel scenarios. Consider the situation at Buildsoc. The centralization of transactions and regular queries may significantly affect branch personnel functions. According to Buildsoc's retail operations manager, to be cost-effective, branch staff should shift from being primarily transactional to adding value by developing relationships and advising customers.

C. AI DRIVEN INSIGHTS:

Artificial intelligence (AI) has emerged as a critical force in sales and marketing, radically altering client interactions. The incorporation of AI into sales operations represents more than just a technology advancement; it is a paradigm shift with far-reaching ramifications for customer pleasure, experience, and loyalty. AI's impact on sales is most seen in its ability to provide highly tailored experiences to clients. AI-driven customization makes use of large data sets to tailor interactions and recommendations to individual tastes and behaviours [8-9]. This level of customisation is made possible by clever algorithms that evaluate client data, such as prior purchases, browsing history, and social media activity, to predict future wants and desires. For example, AIf enables dynamic pricing strategies in which prices vary in real time based on consumer characteristics and market conditions [7].

This dynamic pricing makes clients feel valued and understood, which considerably increases their satisfaction. Additionally, AI-powered chatbots and virtual assistants provide personalized advice and help, ensuring that clients receive timely and relevant information. Such individualized interactions improve the purchasing experience and strengthen the emotional tie between clients and the business [15–16]. The incorporation of AI technologies has transformed Customer Relationship Management (CRM) systems.While previous CRM systems largely served as customer information repositories, AI-powered CRM systems offer predictive insights and automate regular operations. These systems use machine learning algorithms to evaluate customer data, identifying patterns and trends that influence strategic decision-making.

CRM systems with I enhancements can forecast client turnover, recommend appropriate times for follow-up calls, and automate the production of individualized marketing campaigns. By providing sales teams with actionable insights, AI enables them to focus on high-value opportunities and tailor their approaches to specific customer demands. This not only improves efficiency but also assures that consumers receive tailored and attentive service, which increases overall happiness. Customer experience (CX) has emerged as a significant difference in today's competitive industry. AI is critical to boosting CX because it enables businesses to create smooth, consistent, and engaging experiences across many touchpoints. AI-powered systems can assess consumer input in real time, allowing firms to solve issues quickly and enhance service quality. Conversational AI, such as chatbots and virtual assistants, is an important use of AI in improving customer experience. These AI solutions handle a wide range of client requests and concerns around the clock, giving rapid responses while freeing up human workers to perform more difficult duties. This increases efficiency and guarantees that clients receive immediate support, thus improving their overall experience [8].
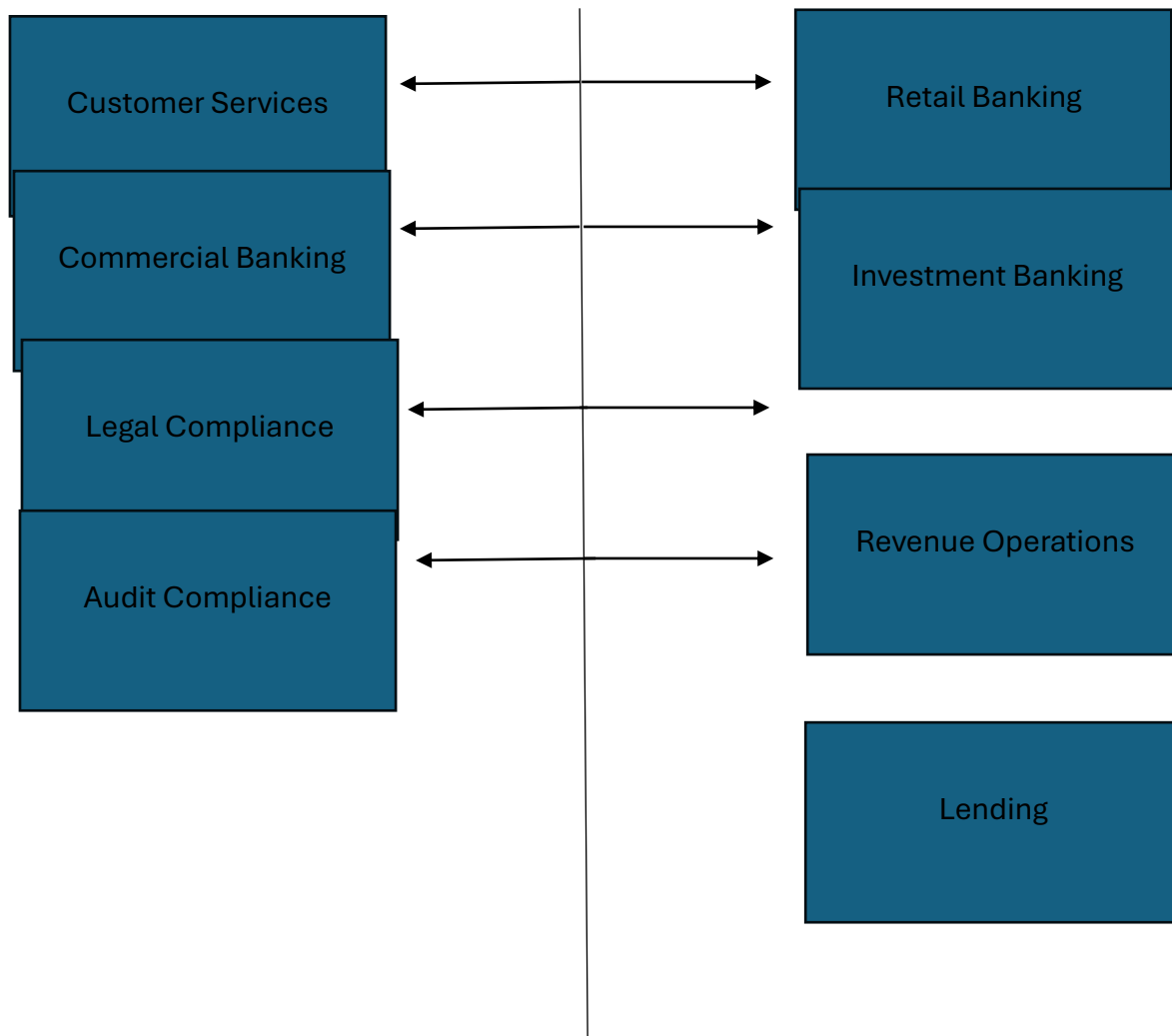
Figure 2. AI based Financial Enterprise

Furthermore, AI may personalize the user experience by tailoring content and recommendations to real-time interactions. For example, an AI-powered recommendation engine can propose things that a consumer may be interested in based on their browsing history and previous purchases. This level of customisation makes clients feel valued and understood, which increases their pleasure and loyalty in Figure 2.

Customer loyalty is an important driver of business success, and AI improves loyalty by providing a more tailored and enjoyable customer experience. Businesses that use AI acquire a better understanding of their customers' behaviours and preferences, allowing them to create more targeted and effective loyalty programs. Businesses can use AI to uncover variables that contribute to customer loyalty and anticipate consumers who are likely to churn. This enables proactive issue response and the adoption of retention initiatives for key consumers. For example, AI may assess consumer feedback and sentiment to discover common pain spots and opportunities for development. Addressing these challenges increases client happiness and fosters stronger relationships. Additionally, AI improves loyalty programs by providing individualized rewards and incentives. By evaluating customer data, AI predicts which rewards are most likely to encourage specific customers and tailors the loyalty program accordingly.

This improves program effectiveness and makes clients feel appreciated and valued, hence increasing their loyalty [9].

II. AI AND CHANNEL INTELLIGENCE IN THE U.S. BANKING SECTOR

We have seen enormous investments in the banking industry in the United States during the previous decade. This is especially true when banks are required to meet the stringent regulatory standards imposed following numerous financial disasters. Competitive banks, which prioritize growth, are progressively implementing AI solutions with the assistance of top artificial intelligence businesses. AI has the potential to alter the banking business by addressing competitive challenges, improving the client experience, and creating operational efficiencies. This explores the growth of artificial intelligence in banking, including a look back at the history of AI that has fueled this progress and innovation to build usable AI solutions that aid and drive the banking industry. It also explores how quickly US banks are embracing AI to improve customer experience and drive revenue, with a focus on chatbots and fraud detection products.

Banking is a data-intensive industry. A human brain is incapable of analyzing and interpreting the massive, complicated data patterns included in each transaction that occurs on a minute scale in the banking business. Artificial intelligence can easily recognize these data patterns and draw appropriate connections much faster. AI also increases consumer customisation, which is why the banking industry continues to use this technology. AI can provide real-time answers to a wide range of banking-related concerns. Banks and other financial institutions are most likely to adopt AI/ML technology for risk assessment (49%), financial research/analysis (45%), and investment/portfolio management (37%). Apart from that, banks will implement AI/ML technology in trading (33%), credit approval (29%), KYC and anti-money laundering (29%), regulation and compliance (26%), administration (17%), and sales (17%) [10] as in Table 1.

Table 1. Areas Where AI is Implemented in Banking

Areas Where AI is Implemented in Banking	Percentage of Adaptation
Risk Assessment	49%
Financial Research/analysis	45%
Investment/portfolio management	37%
Trading	33%
Credit Approval Process	29%
KYC and Anti Money Laundering	29%
Regulation and Compliance	26%

Administration	17%
Sales	17%

The introduction of novel platforms and engagement channels for customers to contact and transact with banks has increased the likelihood and opportunities for complex fraud. Next-generation technologies such as AI and Machine Learning (ML) assist banks in spotting common fraud trends. Banks have realized that in order to detect and prevent fraud, they must eventually leverage the full capability of AI, which includes Machine Learning (ML), Natural Language Processing (NPL), Natural Language Understanding (NLU), Artificial Neural Networks (ANN), and Pattern Recognition.

The FBI uncovered a massive phishing case in 2009, stealing account credentials from several victims and transferring approximately $1.5 million into bogus accounts they controlled. This is only one example that emphasizes the need of using Nuvento AI for fraud detection. Let us briefly discuss the two main types of financial fraud and how AI can detect and prevent them. Identity Theft. This occurs when an unauthorized person obtains a customer's login information and logs into their account. AI is extensively used to detect and prevent such frauds by including biometrics into the login module to identify customers via voice and facial recognition technology.

AI Implemented in US banks as mentioned below,

- Risk Assessment
- Financial Research Analysis
- Portfolio Management
- Trading
- Credit Approval process
- KYC
- Regulation and Administration
- Sales

Whenever a customer's transaction pattern deviates from the usual, warnings can be sent to detect the instance utilizing AI and ML technology. Banks are focused heavily on creating differentiated experiences to their clients, who are always spoilt for choice. Customers sought advanced product recommendations and sophisticated financial guidance from a trustworthy bank. Contextual decision making is crucial, and chatbots can help improve conversational banking by proactively providing information. Chatbots interact with clients extensively by utilizing powerful speech and natural language processing skills, as well as sentiment analytics to gauge emotions, tone, and voice accent in order to offer tailored products/solutions based on the specific context under discussion. Nuvento AI Chatbots are successful at controlling expenses and reducing resolution errors by minimizing user intervention, hence increasing client loyalty.

A. Mobile banking adoption vs. traditional branch visits

Mobile banking has grown dramatically in popularity over the last decade, altering how consumers engage with their financial institutions. The convenience and time-saving benefits of mobile banking, which allows users to complete transactions from anywhere and at any time using a smartphone or

computer, have fueled this transition. As a result, more bank clients prefer mobile banking over traditional branch visits [12]. While online banking acceptance has been particularly high in East Asia and Europe, the penetration rate in the United States is also expected to rise rapidly, accompanied by an increasing number of digital banking customers. This increased trend is also evident in the growing number of mobile banking customers at major U.S. institutions. JPMorgan Chase, for example, saw its active mobile customer base treble between 2013 and 2023.

B. Detecting customer channel preferences and tailor Services:

Banks are increasingly understanding the transformative power of individualized encounters. According to a Boston Consultancy Services report, a bank with $100 billion in assets may increase its revenue by up to $300 million through tailored customer interactions. Personalization in banking not only improves the overall client experience but also generates significant revenue increase. Banks with data-driven insights are altering their services and products to better serve individual clients. Let's look at how banks are developing a more specialized and responsive approach to meeting individual consumer needs through customisation [13].

III.CUSTOMER INTERACTION AND EXPERIENCE ANALYSIS IN U.S. BANKS

Banks are personalizing services to match the demands of individual consumers, especially via the use of data analytics and artificial intelligence (AI).

I. Strategies for Implementing Personalization:

Successful personalization efforts extend beyond simply including a customer's name in marketing correspondence. It entails gathering and thoroughly analyzing client data, both demographic and transactional. Create more effective tailored client experiences by:

- Using modern analytical techniques and technology such as AI/ML.
- Understanding the customer's preferred communication routes
- Creating interactive consumer journeys through tailored website landing pages and personalized promotions and offers.
- Open banking initiatives gather data from external sources.
- Giving customer privacy equal weightage.
- Continuously modifying and upgrading their strategies to changing times and customer needs.

II. Real Time-Based Multi-Channel Strategies:

The revenue of the United States Digital Banking Multichannel Solution Market is projected to experience robust growth from 2024 to 2031, achieving a compound annual growth rate (CAGR) of XX%. The expansion in this market is propelled by several variables, including technology developments, heightened consumer expenditure, regulatory changes, and other significant elements. Thus, the market is anticipated to attain XX billion dollars by 2031.

III. United States of America Market for Digital Banking Multichannel Solutions According to Application

Mobile Banking Mobile applications facilitate access to financial services, allowing users to execute transactions, monitor balances, and manage accounts conveniently. Features often encompass bill payments, money transfers, and customized notifications for users. Digital Banking Web-based services

enabling users to oversee their accounts via computers, encompassing fund transfers, statement downloads, and account administration. Advanced security measures, including two-factor authentication and encryption techniques, are frequently utilized.

Automated Teller Machine Solutions Incorporation of digital banking functionalities into Automated Teller Machines (ATM), offering services like cardless withdrawals and mobile check deposits. Automated teller machines are progressively being enhanced with sophisticated features like as video banking and customer service assistance [13].

Point of Sale (POS) Systems Digital banking technologies that enable transactions at retail establishments, merging payment processing with customer accounts. Features may encompass mobile payment alternatives, loyalty program linkages, and real-time transaction monitoring. Call Centre Solutions Support systems enabling clients to obtain banking services and help over telephone, incorporating digital tools for effective service delivery. Frequently incorporates functionalities such as interactive voice response (IVR) systems, chatbots, and customer relationship management (CRM) integration [14].

The most significant distinctions between these two categories of service Settings have been emphasized as follows:

- The absence of physical tangibles and human interaction in the context of Internet services.
- Consequently, the quality of the website becomes the 'moment of truth.'
- The customer possesses increased control over the service delivery process when the transaction is conducted online, owing to the absence of front-line people.

The potential for Internet services to be accessible 24/7, without geographical limitations. Conversely, traditional services function during designated hours and typically appeal to local clientele. The reduced switching costs for customers of an Internet service, when competition is merely a few keystrokes away. The requirement for internet service customers to possess a degree of computer literacy, which is not necessary in traditional service environments. Research indicates that satisfaction with standard banking service delivery may support the adoption of new or alternative delivery channels. Recent advancements in banking delivery channels underscore the necessity of comprehending how customers select a particular delivery method.

Numerous online users are inactive or utilize online banking infrequently, mostly for verification purposes rather than for more intricate operations. The qualities of financial services—intangible, non-standardized, and complex—combined with the uncertainty and perceived risk associated with the Internet, underscore the necessity of strong marketing efforts to facilitate customers' decisions regarding the adoption of online banking services. indicate that the integration of the service (financial product) and the channel (Internet) renders online financial services distinctive. Identifying the primary factors hindering adoption has emerged as a pertinent issue for the banking sector, as substantial cost savings can only be achieved with a considerable shift of users to Internet banking. Research on customer acceptance of Internet banking has enhanced the knowledge of the ideas that drive customers to utilize the service and illustrates how these beliefs affect the behaviour of Internet banking users [15].

A. FRICTION POINTS WITH PROACTIVE SOLUTIONS:

Friction in customer experience refers to interactions that obstruct individuals from effortlessly and intuitively accomplishing their objectives within a digital interface. Don Peppers, an author and

marketing thought leader, asserts that when customers describe an amazing experience, they are referring to it as "frictionless." He elucidates the concept of frictionless experience by reducing it to four key attributes:

- Reliability: The product must function as asserted without malfunctioning customer must obtain equitable value for the price paid.
- Relevance: The provider must acknowledge the unique demands and preferences of each customer.
- Reliability: The provider must be proactive in releasing information and prioritize consumer interests.

Before banks can create seamless customer experiences, they must ascertain the origin and site of friction. Who better to consult for assistance than the customer? Banks can acquire insights into customer friction through dialogue and involvement, as well as by observing the customer journey.

Employing communication and engagement to determine friction points:

Relevance constitutes one of the four fundamental elements of a seamless experience. Contemporary clients anticipate that their banks would acknowledge their individuality and provide products, services, and experiences tailored to their specific needs. As digital interfaces, including mobile applications, increasingly facilitate experience delivery, they must be flexible, personalized, and contextual. Applications must continuously engage customers in dialogue across various channels, gather insights from these interactions, update individual customer knowledge accordingly, and respond with contextual, personalized, and relevant offerings [16].

The Australian financial services firm, Macquarie, employs a direct method by administering a "propensity survey" to ascertain the factors in the engagement experience that prompt clients to endorse their services. In addition to implementing such programs, banks should identify friction areas in every client engagement. If a consumer with exemplary financial conduct repeatedly requests a temporary increase in their credit card limit, the bank should recognize this pattern and permanently elevate the amount.

B. U.S. CUSTOMER INTERACTIONS WITH CLV:

Customer Lifetime Value (CLV) is an essential indicator for assessing the long-term value that customers contribute to a firm. It denotes the cumulative economic value produced by a consumer throughout their entire association with a company, including both their first purchase and subsequent transactions. client Lifetime Value (CLV) offers insights into client profitability, informing marketing strategies and resource allocation decisions. CLV comprises numerous essential components that collectively influence its computation and interpretation. One such component is the customer acquisition cost (CAC), which denotes the expenses paid in gaining a customer. It includes marketing and sales expenses related to lead generation, advertising, promotional activities, and sales initiatives.

The Customer Acquisition Cost (CAC) is a crucial element in assessing the profitability of obtaining new customers and should be evaluated in relation to their Customer Lifetime Value (CLV).The notion of client Lifetime Value (CLV) originates from marketing theory, functioning as a core indicator for evaluating the long-term profitability of client relationships.Customer Lifetime Value (CLV) is based on the economic theory of customer valuation, which asserts that consumers provide differing degrees of value to a corporation throughout their lifetime, influenced by their purchasing behaviour, loyalty, and

profitability (Berger & Nasr, 1998). From a strategic marketing viewpoint, CLV is essential for devising efficient client acquisition, retention, and development strategies [17] .

Strategic marketing theories offer critical insights into the determinants of customer lifetime value (CLV) and the formulation of marketing strategies designed to optimize CLV. The Resource-Based View (RBV) of the firm underscores the significance of utilizing firm-specific resources and skills to establish and maintain competitive advantage. In the context of customer lifetime value (CLV), resource-based value (RBV) indicates that enterprises can augment customer value by allocating resources that boost customer pleasure, loyalty, and retention. Moreover, relationship marketing theory underscores the need of establishing enduring, mutually advantageous connections with clients via individualized interactions, trust cultivation, and value co-creation.

$$Customer\ Lifetime\ Value\ (CLV)$$
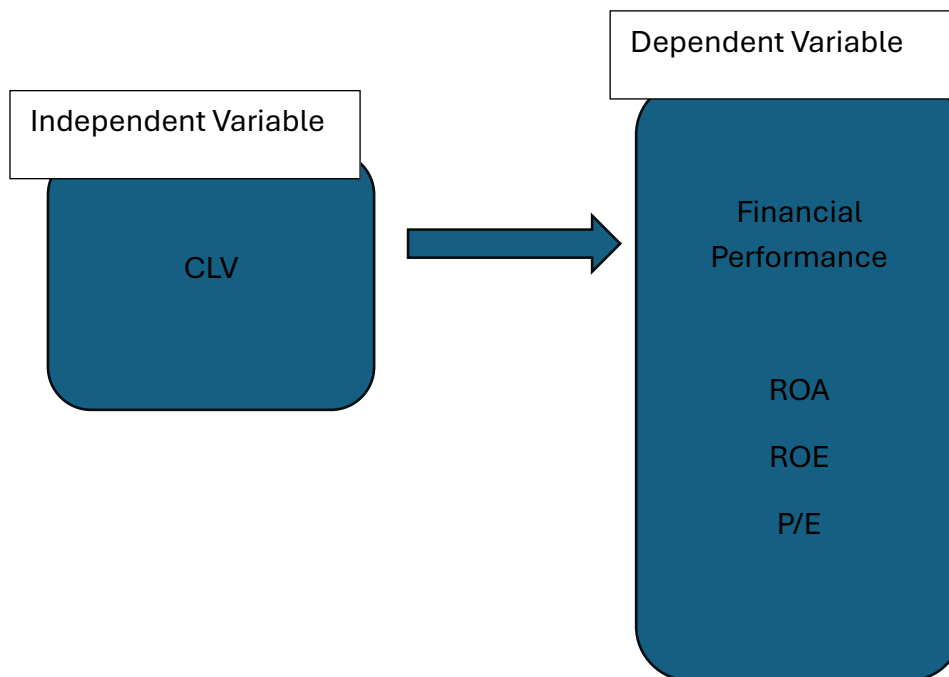$$= Cusotmer\ Lifespan * Number\ of\ Trasaction * Average\ Gross\ Margin$$

Figure. 3. Financial Performance

Moreover, financial theories elucidate the financial ramifications of CLV on organizational performance. The Market-Based View (MBV) of the company emphasizes the influence of market conditions and investor perceptions on firm value. In the context of CL V, MBV posits that enterprises exhibiting elevated CL V may attain higher market valuations owing to their capacity to generate sustainable cash flows and realize superior financial performance.Utilization these theoretical foundations, our conceptual framework incorporates essential elements such as customer value, loyalty, satisfaction, and retention to clarify the determinants and consequences of customer lifetime value (CLV). By merging ideas from marketing, finance, and strategic management theories, our study seeks to provide a thorough understanding of the intricate relationship between customer lifetime value, strategic marketing strategies, and organizational financial performance as in Figure 3.

This theoretical framework directs the formulation of our research hypotheses and informs our empirical analysis, so contributing to both theoretical advances and practical consequences in the domains of CLV and strategic marketing [18]. The retention rate is a vital element of CL V. It assesses the probability that a customer will maintain their association with the company throughout a designated timeframe. Elevated retention rates signify enhanced client loyalty, enduring relationships, and augmented customer lifetime value. By concentrating on enhancing client retention, firms can foster lucrative, enduring customer relationships and improve customer lifetime value (CLV).

IV. Real-Time Data Analytics for U.S. Banks:
Real-time monitoring represents not merely a technology advancement but a strategic transformation within the banking sector. This document examines five specific cases in which real-time monitoring technologies significantly improve certain facets of banking operations.

A. Improving Call Centre Efficiency and Regulatory Compliance
Application: Enhancing Agent Efficiency and Customer Contentment
The technology use speech analytics to evaluate live calls for tone, speed, and adherence to the script. It reveals critical instances where agents can enhance interactions or diverge from established protocols.A prominent financial institution utilizes a real-time surveillance technology throughout its call centres. Effect: Agents obtain prompt feedback and guidance, leading to enhanced customer service, less complaints, and increased adherence to laws [20].

B. Improving Customer Experience via Tailored Interactions
Application: Customization of Client Engagements
The technology evaluates consumer data instantaneously to deliver tailored service recommendations and guidance throughout customer engagements.A financial institution incorporates real-time surveillance into its client relationship management systems. Effect: Clients obtain customized guidance and service options, improving their entire experience and elevating the probability of product upselling.

C. Real-Time Compliance Monitoring Case: Guaranteeing Ongoing Regulatory Adherence
The technology perpetually monitors transactions, communications, and processes against a database of regulatory requirements, promptly notifying compliance officers of suspected violations.The financial institution employs a real-time surveillance system to monitor all compliance-related procedures and transactions. This proactive strategy mitigates the risk of regulatory penalties and reputational harm, ensuring the bank consistently upholds stringent compliance standards.

D. Strategic Automotive Selection
Optimize productivity with the Automated Coaching Solution. Enhance efficiency through Automated Coaching. Resolution The method proposes sympathetic responses and effective questioning strategies to soothe the customer and address the inquiry efficiently.
Focus: Delivers real-time, data-informed coaching to banking personnel based on their performance indicators and the quality of customer interactions. The resolving of client issues with greater efficacy results in elevated satisfaction ratings and increased loyalty. A customer support professional addresses a difficult grievance concerning fraudulent purchases. Use Case: As the dialogue advances, the system evaluates the tone, speech tempo, and client stress indicators, providing immediate coaching suggestions

to the representative.For instance, adhering to the system's directives, the representative effectively assuages the customer's concerns, so ensuring their ongoing loyalty and confidence.

V. CHALLENGES IN CHANNEL INTELLIGENCE FOR U.S. BANKS

To comply with GDPR, organizations in the United States must meet many essential standards, including:

- Data protection principles include lawfulness, fairness, openness, data minimization, accuracy, storage limitations, and integrity and secrecy.

Legal Basis for Processing: Identifying lawful reasons for processing personal data, such as consent, contract, legal requirement, vital interests, public job, or legitimate interests. Individual Rights: Respecting and facilitating individuals' rights, including the right to access, rectify, erase, and restrict processing of their data, as well as the right to data portability and objection [19].

- Data Protection Officers (DPOs): Appointing a DPO if the primary activities entail large-scale processing of sensitive data or routine surveillance of individuals.
- Data Protection Impact Assessments (DPIAs): Conducting DPIAs for processing activities that pose significant hazards to persons' rights and freedoms.

Processing Activity Records: Maintaining complete records of all processing actions that include personal data. Businesses in the United States have various hurdles when it comes to GDPR compliance. These issues are frequently caused by variances between legal regimes, the complexity of GDPR standards, and the technical safeguards required to secure personal data.

To address these issues, firms can implement practical solutions:

Appointing a Data Protection Officer (DPO): A DPO ensures that the organization meets GDPR regulations and acts as a liaison between data subjects and regulatory authorities.

- Employee Training: Regular training on data protection policies and GDPR compliance helps to reduce risks and ensure that workers understand their duties.
- GDPR Compliance Software: Using specialized software can help businesses streamline compliance activities, automate data protection processes, and provide continuous monitoring and reporting capabilities.

The CCPA requires every firm to undertake the following:

- Notify customers in advance when their personal information will be gathered.
- Make it easy for customers to opt out of having their information sold.
- Respond to consumers exercising their rights under the legislation within a defined deadline.
- Verify the identity of customers making requests under the statute.
- Please disclose any financial incentives for collecting and selling the data. Furthermore, they must explain how the value of the data was calculated and why these incentives should be permitted under the act.
- Keep a record of any requests and answers from consumers exercising their rights under the act.
- Maintain an inventory of data and track its flow.
- Disclose any data privacy policies and how they are implemented in practice.

As you can see, politicians and consumers take data privacy very seriously. The breadth of the restrictions is sure to grow, so taking an effective strategy to data privacy is the best way to secure your organization while remaining compliant with current regulations. All banks have access to

valuable consumer data such as assets, income, anticipated life events, and credit scores. However, because this information is not housed in a single location, providing clients with the high-quality service they want might be difficult. These segregated data silos lead to a disconnected and incomplete view of client information. The data within each silo is not easily accessed or shared across the firm, which impedes collaboration, decision-making, and providing a comprehensive understanding of the client [20].

Furthermore, information data silos can cause data duplication, discrepancies, and errors. When distinct departments or systems keep separate versions of client data, updates or modifications made in one silo may not be mirrored in others. This lack of synchronization can lead to confusion and errors, ultimately affecting the overall client experience. Banks must recognize and address information data silos to provide a full and unified view of consumer information, allowing for better decision-making, personalized services, and an improved customer experience. Data integration can be extremely complex and difficult due to variances in data formats and quality across several sources (apps, systems, cloud services, databases, and so on), as well as security and governance issues.

Many companies require access to real-time data, which is constantly updated and synced across systems. This necessitates a strong infrastructure, effective change data capture systems, and well-defined data replication and synchronization processes. As data grows in quantity and complexity, it can strain system resources, degrade performance, and necessitate robust architecture and scalable solutions to handle the load effectively. Another key problem is coordinating and managing collaboration among numerous stakeholders, including as IT teams, data owners, business users, and external partners. This requires excellent project management, communication, and goal alignment. Data integration necessitates careful planning, data mapping, and data cleansing to assure the correctness, dependability, and consistency of the combined data [21].

VI. KPI (KEY PERFORMANCE INDICATORS)

Your campaign, channels, and goals will determine which engagement metrics you need to track. We purposefully chose only a few metrics that should be relevant to almost any campaign, but you'll probably want to add more to this list based on your individual campaign goals [22].

I. Conversion Rate

At its foundation, a campaign's conversion rate is the percentage of people who take an action related to your campaign goal. Some examples of conversion targets are:

• Downloading eBooks or whitepapers from your website
• Sign up for your email newsletter.
• Sign up for a free product trial.
• Clicking on a Facebook advertisement.
• Visiting your website's pricing or product page
• Net Promoter Score®(NPS)

Net Promoter Score is a metric used to assess customer loyalty, or more specifically, how likely your customers are to suggest your brand to others. This measure is crucial for assessing how well your product meets your customers' needs. The most frequent technique to calculate NPS is to poll your customers. Customers are often asked to score their experiences using a sliding numerical scale. Consider the following: "On a scale of 1-10, how likely are you to refer our products to a friend?"

- You can also ask more open-ended inquiries to learn why your clients react the way they do. Just keep in mind that these survey questions are tough to quantify.
- If you need help getting started with your NPS survey, look at Retently's list of sample questions, which include:
- "How likely are you to recommend our product to a friend or a colleague?"
- "What was missing or disappointing in your experience with us?"
- "How can we improve your experience?"
- "What features do you value/use the most?"

II.   Average session duration.

For marketers, session time often refers to how long a website visitor spends on a blog post or landing page in a single visit.Long session times on landing pages can help your team identify which products and features your audience is most interested in learning about. With this data, you can create new campaigns that highlight the specific pain points those products or features solve—which could yield higher conversion rates.As B2B marketing writer Dann Albright explains in their blog post about benchmarking average session duration, session time is one of the most-tracked engagement metrics, and there's an important reason.

III. Customer satisfaction rating by channel

Looking at CSAT ratings by channel can help you determine which customer service channels your customers prefer to engage with your brand, and which ones may not be meeting their needs. Collect this metric by sending out customer satisfaction surveys that ask customers to rank their recent support experience on a scale of 1 to 5 or to rate it as "good" or "bad."

To gain more context about CSAT scores, also include open-ended survey questions that prompt customers to give more details about their interaction. For example, you can ask, "In ways did this experience meet your expectations?" to find out what your support team is doing right. You can also state, "Tell us what we can do better" to identify areas of improvement.

 IV. Ticket volume by support channel

Ticket volume by support channel is another metric that can help you determine which service channels have the highest customer engagement. Taking it a step further, you can look at which channels have the highest engagement based on issue type and query. For example, you might find that your customers prefer the phone for higher-stakes issues while they tend to reach out over social media for simple questions. Or, if you find that most of your customers want support via SMS or email, you might plan a marketing campaign over that channel since you know that's where your customers already are [23]

Channel preference can also vary by customer segment. Gen Z customers value the ability to solve issues on their own while both Millennials and Gen Z are more comfortable interacting with chatbots compared to older generations.Being able to track channel usage is vitally important to optimize the efficiency of your support team, the quality of each resolution, and where you may need to move, train, or hire staff [23].

V. social media listening metrics

Track both positive and negative social media mentions to help you understand what's been said about you publicly. This includes Twitter, Facebook, your Instagram account, and product review sites. Using social media-monitoring tools, you can easily collect and analyze customer feedback. Use this feedback to determine the following:

- How many comments appear to be written in moments of frustration, perhaps after a poor customer experience in person or online?
- How many are technical or account-specific questions?
- How many comments provide feedback, positive or negative?
- How many questions can be answered using links to existing help content?
- How many brand mentions require, or would benefit from, a response?
- What time of day are your customers most active on social media?

VI. Customer lifetime value

Customer lifetime value is a measure of the projected revenue a customer will generate for a company over the entirety of their relationship. While customer retention focuses on how to keep customers loyal, lifetime value is about how much a customer spends with your company.Customer lifetime value helps companies determine customer groups that are most valuable and make sure the investment required to get new customers pays off. Increasing customer satisfaction and customer engagement has been shown to have a positive influence on lifetime value. For example, customer support teams help reduce churn by providing great service while customer engagement programs like loyalty rewards help to retain and upgrade customers [24].

VII. Customer retention rate

Customer retention refers to a company's ability to turn customers into repeat buyers and prevent them from switching to a competitor. It indicates whether your product and the quality of your service please your existing customers. It's also the lifeblood of most subscription-based companies and service providers.Customer retention rate measures the number of customers a company retains over a given period of time. It's expressed as a percentage of a company's existing customers who remain loyal within that time frame. Monitoring retention metrics is critical for a business to quantify the efficacy of its marketing strategy and customer service program [25].

VIII. Churn rate

Customer churn rate is the percentage of a company's total customers that stop doing business with the company over a specified period of time. When evaluated alongside other key customer engagement metrics, churn rate is a powerful way to assess what a brand is doing well and where it needs to improve.Depending on the nature of the business, churn rate may be monitored on an annual, quarterly, monthly, or weekly basis. Fast-moving SaaS companies—with user bases that fluctuate rapidly and dramatically—might even look at this data daily [24].While all companies strive to have a loyal customer base and a churn rate of zero, the reality is that customers come and go. But that doesn't mean churn isn't worth tracking. Once businesses determine their customer churn rate, they can determine why customers are leaving and identify customer engagement strategies that could help.

VII. PROACTIVE CUSTOMER SEGMENTATION AND REAL-TIME INSIGHTS

AI for consumer segmentation is currently required for market segmentation analyses. AI is capable of deeply analyzing big datasets. This allows us to comprehend consumer behaviour analysis and improve tailored marketing more effectively than previous ways. AI can forecast who will become your customers and what they will purchase. This ability stems from AI's involvement in daily marketing tasks. It eliminates the guesswork that 49% of marketers used to rely on. This thorough study improves marketing strategy. It also keeps tactics aligned with consumer and market developments [25].

- Improved ROI on marketing spending through effective targeting and prediction of high-intent customers, resulting in increased conversions and retention.
- Improved understanding of client churn, enabling for proactive measures to increase customer loyalty and reduce losses.
- Identification of high-value clients or segments allows for more targeted marketing efforts and resource allocation.
- AI does more than just evaluate data. It analyzes data from several sources to provide detailed segmentation and targeted marketing.

Advanced methods such as k-means clustering improve this. They enable us better understand consumer profiles. This allows businesses to anticipate and meet customer demands and preferences. Moving from reactive to proactive marketing significantly increases marketing success and consumer satisfaction.AI enables highly tailored marketing methods. They are founded on a thorough, data-driven understanding of customer demographics. AI-based customer segmentation focuses on minor details. This leads to more effective marketing changes and upgrades. Your brand may stay ahead of the competition in terms of innovation by utilizing artificial intelligence to forecast market trends or make immediate judgments. Your marketing plan becomes more relevant, predictable, and adaptable [26].

VIII. PROPOSED FRAMEWORK AND METHODOLOGY FOR U.S. BANKS

Phase one: data preprocessing.

In this phase, we use three data preprocessing approaches (see "Data preprocessing methods" section) to prepare the dataset for model training. Each preprocessing procedure relates to a specific operational stage, as described below.

Step 1: FE Preprocessing

Most churn models rely on features that aren't readily available in the dataset. Furthermore, the original feature set may not be useful enough to anticipate client attrition. As a result, adding new features via FE is crucial for increasing the number of prospective predictor candidates. In the first step of the proposed framework, we develop new features based on RFM that summarize consumers' purchasing behaviour and are substantially associated to turnover in the banking business. Recency is the time of the most recent purchase; frequency is the number of previous purchases; and monetary value represents the average purchase amount per transaction [27].
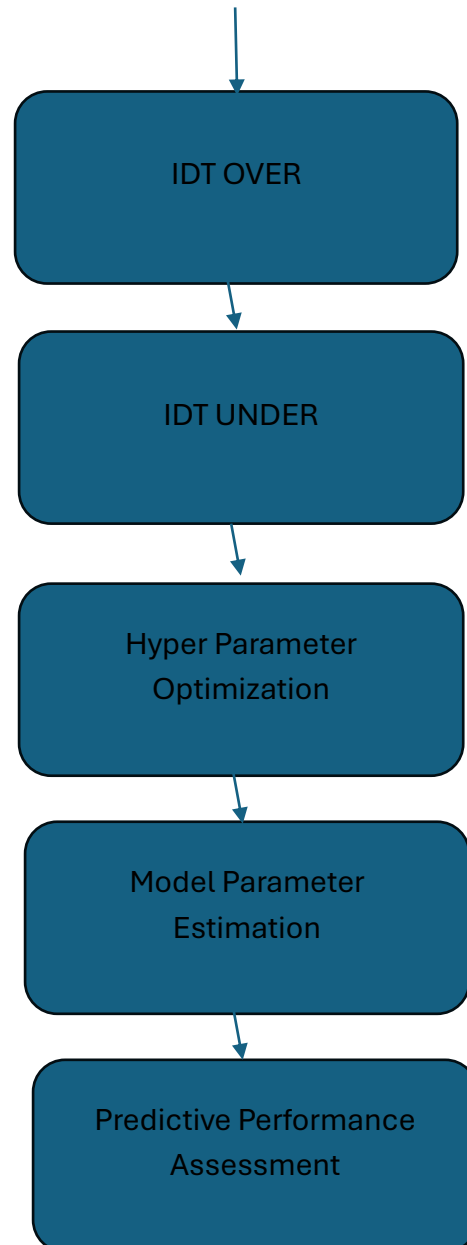
Feature Engineering

Figure 5. Channel Intelligence based on Customer Interaction

In our propositions, we analyzed the classic RFM technique and disaggregated by product category (RFM/P). We divided the categories into credit cards, general credits, and investments. We presented new characteristics based on the original data and linked them with the concept of recency, which includes overall recency, recency by product category, and recency by channel. We also offered new features based on frequency, either overall or for each product category. We tracked the number of periods with at least one transaction. During each period, we recorded the total number of transactions, the overall binary indicator of purchase incidence, the binary indicator of purchase incidence, and the binary indicator of channel usage. Finally, in line with the monetary value notion, we presented new

characteristics such as the overall contribution margin, overall revenue, and total value transacted by product category [28].

Step 2: IDT-over Preprocessing

In the second step of the architecture, we generated synthetic churned customers that act on gaps in the decision boundary between the classes using the ADASYN algorithm, with the goal of balancing data. Because such artificially churned consumers must not modify the data distribution, we used the Kolmogorov-Smirnov test to account for substantial differences between the original uncommon class distribution and the new data distribution. The KS test is a popular nonparametric test that compares the distance between two cumulative distribution functions. The null hypothesis states that both samples come from the same distribution.

Step 3: IDT-Preprocessing

The third stage, after adding artificially churned consumers, uses the NEARMISS algorithm to remove noisy and redundant retained customers. We did this to balance the remaining amount of kept and churned customers. Once again, we utilized the KS test to ensure that data removal did not affect data distribution. The ADASYN algorithm creates false instances of the uncommon class in places where examples of this class are more common, hence increasing class distinction. To eliminate noise and redundancy, the NEARMISS algorithm removes examples from the majority class that are closer to the uncommon class (for example, difficult-to-classify specimens). The suggested framework begins by reinforcing the class boundary with the ADASYN algorithm. Following that, the NEARMISS method provides more precise information about the best candidate instances of the majority class to delete in the next stage. We implemented NEARMISS and ADASYN using the R programming language's "themis" package [29].

Phase 2 includes model training and testing.

In the final preprocessing phase, we perform Step 4 using the R package "tune" for Bayesian hyperparameter optimization of the classification approaches. We used XGBoost to optimize

- o the number of trees in the ensemble,
- o the minimum number of data points in a node required for further splitting,
- o the maximum depth of each tree,
- o the rate at which the boosting algorithm adapts from iteration to iteration,
- o the oss function reduction required for further splitting, and
- o the amount of data exposed to the fitting routine.

We then used the elastic net to maximize alpha (the mixture parameter between a pure ridge model and a pure lasso model) and lambda (the regularization penalty). Using a tenfold cross-validation technique, the optimization algorithm optimized the average PR-AUC [30 - 34].

In the fifth phase, we calculated the model parameters for the XGBoost and elastic net classification algorithms based on the hyperparameters obtained from the Bayesian optimization in phase 4. We performed the technique on samples from the training set. In the sixth step, we assessed the model's predictive performance using the following metrics:

- o Accuracy, which is the proportion of churned and retained customers correctly classified.

- o Specificity, which depicts the proportion of correctly classified retained customers against the total retained customers.
- o PR-AUC, which represents the area under the curve of a plot with recall and precision in the axes; and
- o Recall, which denotes the model's capacity to correctly classify retained customers

IX. CONCLUSION

Channel intelligence, powered by data analytics and artificial intelligence, has become a cornerstone of modern banking strategies in the U.S. By integrating multi-channel approaches and real-time data, banks can effectively tailor services to customer preferences, fostering deeper engagement and loyalty. This research identifies the critical role of AI in predictive analytics, fraud prevention, and customer segmentation, which not only enhances operational efficiency but also drives long-term profitability. Despite challenges like data privacy, regulatory complexities, and system integration, innovative solutions such as AI dashboards, real-time monitoring, and KPI tracking pave the way for a more customer-centric banking experience. As banks continue to evolve in the digital age, channel intelligence will remain a pivotal element in achieving sustainable growth and customer satisfaction.

References:

1. Chen, Sh-C., & Li, Sh-H. (2010). Consumer adoption of e-service: Integrating technology readiness with the theory of planned behavior. *African Journal of Business Management, 4*(16), 3556-3563.
2. Citrin, A.V., Sprott, D.E., Silverman, S.N., & Stem, D.E. (2000). Adoption of Internet shopping: The role of consumer innovativeness. *Industrial Management & Data Systems, 100*(7), 294-300.
3. Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.
4. Dauda, Y., & Santhapparaj, A.S. (2007). The impact of e-commerce security, and national environment on consumer adoption of Internet banking in Malaysia and Singapore. *Journal of Internet Banking and Commerce, 12*(2).
5. DeYoung, R., & Duffy, D. (2002). The challenges facing community banks: Straight from the horses' mouths. *Federal Reserve Bank of Chicago Economic Perspectives, 26*(4), 2-17.
6. Flier, B., Van den Bosch, A.J., & Volberda, H.W. (2003). Co-evolution in strategic renewal behavior of British, Dutch, and French financial incumbents. *Journal of Management Studies, 40*(8), 2163-2187.
7. Floh, A., & Treiblmaier, H. (2006). What keeps the e-banking customer loyal? A multigroup analysis of the moderating role of consumer characteristics on e-loyalty in the financial service industry. *Journal of Electronic Commerce Research, 7*(2), 97-110.
8. Gounaris, S., & Dimitriadis, S. (2003). Assessing service quality on the Web: Evidence from business-to-consumer portals. *Journal of Services Marketing, 17*(5), 529-549.
9. Grabner-Krauter, S., & Faullant, R. (2008). Consumer acceptance of internet banking: The influence of internet trust. *International Journal of Bank Marketing, 26*(7), 483-504.
10. Hernandez, J.M.C., & Mazzon, J.A. (2007). Adoption of internet banking: Proposition and implementation of an integrated methodology approach. *International Journal of Bank Marketing, 25*(2), 72-88.

11. Ho, Sh.H., & Ko, Y.Y. (2008). Effects of self-service technology on customer value and customer readiness: The case of Internet banking. *Internet Research, 18*(4), 427-446.

12. Howcroft, B., Hamilton, R., & Hewer, P. (2002). Consumer attitude and the usage and adoption of home-based banking in the United Kingdom. *The International Journal of Bank Marketing, 20*(3), 111-121.

13. Hollebeek, L.D., Srivastava, R.K., & Chen, T. (2019). S-D logic–informed customer engagement: Integrative framework, revised fundamental propositions, and application to CRM. *Journal of the Academy of Marketing Science, 47*(1), 161-185.

14. Nguyen, T., & Dang, T. (2018). Digital banking in Vietnam: Current situation and recommendations. *International Journal of Innovation and Research in Educational Sciences, 5*(4), 418-420.

15. Soltani, M., Jandaghi, G., & Forouzandeh Shahraki, P. (2016). Investigating co-creation intention and its correlation with perceived value and positive Word-of-Mouth. *New Marketing Research Journal, 6*(3), 127-146. https://doi.org/10.22108/nmrj.2016.21076

16. Kumar, V., & Reinartz, W. (2016). Creating enduring customer value. *Journal of Marketing, 80*(6), 36–68. https://doi.org/10.1509/jm.15.0414

17. Jasek, P., Vrana, L., Sperkova, L., Smutny, Z., & Kobulsky, M. (2019). Predictive performance of customer lifetime value models in e-commerce. *Prague Economic Papers, 28*(6), 648–669. https://doi.org/10.18267/j.pep.714

18. Lemon, K. N., & Verhoef, P. C. (2021). Understanding customer experience throughout the customer journey. *Journal of Marketing, 85*(3), 1–20.