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Chapter 2: Strategically integrating artificial intelligence and machine learning into banking processes to enable data-driven innovation

2.1. Introduction

Artificial Intelligence (AI) and machine learning (ML) are branches of innovations in computer science that seek to replicate or simulate human thought processes and actions in an automated fashion. In recent years, AI and ML have spurred the interest of academics and practitioners alike, owing to their prevalence and success across various disciplines. The advents of improved computational capabilities afforded by advanced computer architectures and quantum computing, the proliferation of big data enabled by the Internet and wireless access, and the advancements in theoretical foundations of AI have culminated in transforming the practice of operating businesses; these now include norms of increasing reliance on data-driven decisions enabled by AI and ML capabilities. Given the operational characteristics of the banking sector, such as their reliance on heavily rules-based and risk-averse practices, banks and financial institutions are investigating the feasibility of effectively integrating AI into their systems (Arner et al., 2017; Bughin et al., 2019; Chen et al., 2019).

While we acknowledge that the academic research on AI applications in finance and banking is nascent, we find the task of identifying and prioritizing bank processes that could be enabled by AI-assisted decision-making and data learnings to be a crucial additional step in their journey towards unleashing the transformative and generative powers of AI. Towards this suggestion, we provide a structured way for banks to evaluate their processes in determining the transformative adoption strategy.

The banking process landscape contains various operational activities, such as credit risk analysis, mortgage underwriting, anti-money laundering, fraud detection, transaction reconciliation, client relationship building, and product distribution. Each of these activities has a distinct decision-making mechanic that could derive particular benefits

from being enabled by AI adoption. For a number of such activities that have undertaken some modified version or fragment of AI in their operations, banks have reaped benefits by establishing the feasibility of these tasks being powered by AI, such as generating cost and time savings through process effectiveness improvements (Gomber et al., 2018; Philippon, 2020).

Fig 2.1: Strategically Integrating Artificial Intelligence and Machine Learning into Banking Processes

2.1.1. Background and Significance

It is difficult for banks to estimate how big and how fast-gathering share of their business will be disrupted by FinTech start-ups and non-financial-service organizations in coming years. However, there is little doubt that the collaborative bank ecosystem and its associated business models are facing highly disruptive change as a result of digital innovations being pioneered by these non-traditional players. Some estimates conclude that the value of banking credit and payment services is at least $800 billion; it estimates that more than 25% of this contribution is at risk from disruption in coming years. Many traditional banks must urgently innovate in order to retain their core customer bases and

associated revenues in coming years if they are to progress successfully to Open Banking and beyond.

The banking sector has a highly limited track record of successful innovation. Banks are increasingly describing their aim as to be Digital First and Innovative Organizations, as they seek to leverage digitalization to fundamentally enrich the lifetime value of banking customers and deepen the relationship banks can monetize. These customer-centric aims can only be achieved by changing how banks are structured and what they do when they are digitally transformed into Intelligent Banking Organizations with Artificial Intelligence and Machine Learning as their engines of innovation. AI has the potential to challenge some of the most basic concepts of banking. It challenges banks to rethink the amount of physical presence they need to maintain in local communities and in customer digital relationships. It leads them to rethink their risk policies, their forecasting models and their skill requirements in back offices, as increasingly common technological innovation cycles reduce the demand for human support for, and interaction with, bank software solutions and services.

2.2. Understanding Artificial Intelligence and Machine Learning

Artificial intelligence (AI) is a multidisciplinary field that seeks to tackle problems similar to those that achieve "intelligence" in a human being. It is broadly defined, from computers solving math problems or playing games, to accompanying robots performing household chores. It has its origins in philosophy, cognitive science, neuroscience, computer science, operations research, mathematics, psychology, linguistics, sociology, and mathematics itself: AI conceptually consists of the intersection of logic, which allows formal modeling and verification of a process, and knowledge, that is the way nature solved a task according to Bayesian probability theory. Theoretical AI remains an almost exclusive study of computer scientists and mathematicians, considering the complexity of knowledge description and algorithms for the intelligent management of this knowledge. However, providing solutions to practical problems is at the heart of the goals of all research in AI, and other scientific disciplines have contributed both to the algorithms and knowledge databases theory, reasoning mechanisms, and the support of specific applications, although most applications have only recently become useful. Elements from various disciplines, mainly cognitive science and neuroscience, have contributed to our understanding of human reasoning, specifically about the memory structure, language, visual perception, social interactions, and ability to carry out multiple tasks simultaneously.

Machine learning (ML) focuses on research in computational properties of learning and supervised, unsupervised, and reinforcement learning strategy design and experimental validation for learning tasks. A supervised machine learning model involves two phases.

The first phase is a training procedure, where the model generates a program from a corpus of examples.

2.2.1. Definitions and Key Concepts

Artificial intelligence (AI) is a collective term that strives to create intelligent machines. Theoretical researchers, at its origin, wished to replicate or simulate aspects of human cognition or intelligence and thereby write programs that could generate intelligent responses to different stimuli. Thus, AI may be understood as computer programs that aim to exhibit human-like characteristics in some limited areas of intelligence (speech, vision, sensorimotor control, reasoning). Others are more concerned with the intelligent use of knowledge and information, no matter whether it is encoded in a manner similar to human cognition or in a vastly different form. The primary goal of that recognizable subset of artificial intelligence, known as "expert systems", is to simulate human tests of expertise. Expert systems aim to replicate the responses of domain experts to questions posed in a limited but specialized area of human endeavour. Creation of an expert system requires the encoding of expert knowledge in a manner that allows the computer to generate similar responses to the expert with access to the same data, information, and potential solutions.

Machine learning (ML) is just one method under the AI umbrella. Machine learning researchers have been inspired by the manner in which learning occurs in humans and animals. They have constructed algorithms that can discover patterns in data that make it possible to forecast future events or deduce unknown facts. While ML has been around for six decades, in the last 15 years, new algorithms, advancing computational power, increasing volumes of actual data, and access to sophisticated big data management have rejuvenated the field.

2.2.2. Historical Context and Evolution

Despite the computational power available to support the Artificial Intelligence field, it was only in the 1980s that it regained prominence. The availability and decreasing cost of computers shaped a growing interest for real-world applications, especially for Expert Systems in business. The long AI Winter, during most of the 1970s, brought research to the conclusion that Progress for Progress' sake cannot be done in a field that was so expensive. The research had to focus on problems with value. The Expert Systems wave of the 1980s generated a Tech Bubble and companies invested massively in its development, despite the complexity inherent to the end-user having to code the know-how into the computer itself.

The first popular use of AI happened through expert systems coding human decision rules. It was only in the 1990s that both AI and people began to realize the need to include Data - and lots of it - in order to build truly useful systems. This fourth wave after the 1990s was about natural language processing, generating a new Tech Bubble. Internet and Extranets generated masses of Data, and Transformation of the data generated during the 2000s a Tech Bubble. With the rising sophistication of consumers and the deep cultivation of Data Mining methods, companies were required to market products and services more efficiently. The automation of basic communication and customer service tasks via intelligent agents/chatbots, combined with predictive agents that proactively trigger an action - such as Dynamic Pricing, Fraud Detection, Products or Credit and Insurance Scoring, Payments and Credit Collections - became a huge competitive advantage and were key to the rapid adoption.

2.3. Current Trends in Banking

The banking industry is witnessing unprecedented change, driven by rapidly evolving consumer expectations, digital financial technology innovations, increased competition, and significant regulatory changes. Public trust in financial institutions shattered by the global financial crisis continues to recover slowly, while consumer expectations for what was once a sleepy industry are higher than in any other service industry – banks have been roundly criticized for lagging behind their retail counterparts in delivering sophisticated digital experiences. Today's banking consumers where previously loyal have turned to the promising innovation of disruptive new entrants in search of the digital services experience they have come to expect from companies for the increasingly digital-first aspects of their lives. At the same time, competition is heating up on both sides, making it harder than ever for traditional banks to differentiate and innovate their way to the experiences and prices that keep customers.

Accelerating the pace of change is the emergence of banking-as-a-platform – hosting open source software technology on which create innovative new applications and services available from a bank's one-stop-shop digital channel. In response, many banks have taken a "platformization" approach, partnered with tech firms, or utilized one or both to modernize behind-the-scenes processes and systems or create their own platforms. There's little question that digital transformation is necessary, but the how and why are difficult questions – technology for technology's sake looks eerily reminiscent of the all-things-digital craze that swept through boardrooms during the boom and bust.

2.3.1. Digital Transformation in Banking

Digital transformation is a significant challenge for banks. Currently, banks are being severely pressured to undergo digital transformation by a "perfect storm" of change donors: 1) FinTech startup companies that are introducing innovative new technologies; 2) technology companies that are invading the banking sector; 3) regulatory mandates and operating cost constraints; 4) changing consumer expectations and behaviors for digital products and services that are driving disintermediation; 5) business dislocative impacts of the pandemic; and 6) legacy operating environments including systems, skill sets, cultures, and physical infrastructures. In fact, many industry observers argue that the BAU paradigms for banking are being dismantled. Although this sentiment may have lost some of its earlier intensity, the momentum towards digital transformation in the sector has clearly accelerated.

Fig 2.2: Digital Transformation in Banking of Strategically Integrating Artificial Intelligence

Faced with these external pressures plus the internal pressures for organic growth and revised earnings expectations, the reality is that banks do not have the luxury of option whether or not to undertake digital transformation. Digital transformation is a priority

for every bank, and in the current environment, achieving shareholder value in the banking sector means to be agile and able to move quickly towards data-transparent, cloud-scalable, and digitally-invasive digital operations. Banks have no time to waste. Consumer tolerance for business disruption is nonexistent. Banks must understand the strategic thrusts of digital transformation, and why those thrusts compel new thinking about operations. They also need to hear and heed the warnings about "keeping the change" effort and investment in digital transformation aligned with overall strategic objectives, else risk being caught up in the stampede to establish a digital presence.

2.3.2. Consumer Expectations and Behavior

The digital revolution shaped by innovative technologies changed the way consumers connect with banking services. Over the last two decades, a structural shift occurred in how consumers access banking and financial services, especially among digital-native generations accustomed to using their smartphones and computers for different tasks. These now-peaking Millennials and Gen Zers — salary workers in the early stages of their careers, entrepreneurs managing a side hustle, and college students — represent a fast-growing part of the consumer banking services market in developed and developing economies. Their current behavior and future expectations, influenced by the prevalence of digital technology in their everyday lives, become the new standard for all future bank customers.

The digital touchpoints established by companies in other industries become the template for the premier customer experience: user-friendly apps and websites; ease of data transfer; quick turnaround; seamless on- and off-line experiences. Disruption and contactless everything accelerated by the pandemic generated a sense of urgency for banks and financial service firms to offer similar digital efficiency and experience. The increasingly complex personal and professional lives of financial service consumers generate unmet demands for value-added products and services that current banking offerings do not address. Non-traditional companies are leveraging customer-centric business models built around creating ease and convenience in humans’ busy lives to metaphorically disintermediate banks.

Consequently, banks face the growing threat of losing consumer interaction and relationship to other players, who are rushing to fill the perceived shortfalls of banking services. Financial service firms must understand the new expectations created by the behaviors of current and future bank consumers to design appropriate products and services to reclaim desired levels of interaction and relationship.

2.4. The Role of Data in Banking

The emergence of Artificial Intelligence (AI) and Machine Learning (ML) technologies has ushered in the "Data Economy" phase of the digital evolution paradigm, characterized by the targeted use of data in conjunction with advanced technologies to deliver profound improvements in customer services and direct organizational efficiencies. Data has rapidly become the underlying asset of economic and digital ecosystem strategies. The modern banking sector is both a cornerstone of the traditional economy and a leader in the Data Economy phase of the digital evolution paradigm, disrupting traditional business and revenue models as it focuses on utilizing vast quantities of structured and unstructured transactional data combined with advanced data analytics capabilities to drive the future of the sector. Banks are investing in data science, ascending business intelligence and decision support systems to develop new Business/IT Alignment capabilities that create a competitive edge from newly derived customer insights embedded in personalized offerings.

The banking sector utilizes a range of different types of data in delivering services, which vary according to each bank's particular corporate, consumer, and community customer and niche subject focus. These include internal data, which comprise banks' financial, operational, and risk datasets; external data, which include third-party market reference datasets; customer and intermediary producer data, either directly acquired by banks or generated from interactions by banks, their customers, and ecosystem participants; and service usage and delivery data, which are captured by banks from their omnichannel product delivery contact points. The value that data possesses as an internal asset is contingent upon three critical qualities. High-quality data with linkage by a context-aware governance process enables banks to comply with regulations, reduce customer churn, improve sales conversions, optimize business processes, reduce fraud and credit risk, manage and reduce costs, and improve overall performance.

2.4.1. Types of Data Utilized

This section focuses on what types of data are used in the banking industry today, and in particular, what types of data are being effectively utilized within an Advanced Data and Analytics program leveraging Artificial Intelligence and Machine Learning. Data is categorized into Internal - the data generated by the Bank as part of its day-to-day business operations and External - data generated outside of the Bank. Internal Data: Data generated internally by the Bank, and stored in Data Lakes or Data Warehouses becomes the basis of AI and ML initiatives and solutions. Such data consists of dozens of data silos which need to be accessed and integrated to make the data useful for insight generation, and for durable prediction. Internal data consists of structured data such as transactional data, loan review and underwriting data and unstructured data or alternative

data such as text descriptions for customer transactions, unstructured text data from customer complaints, account opening or loan underwriting reviews, or from other areas of the Bank. External Data: Various forms of data can be utilized for AI and ML use cases within a Bank. Such external data is often related to improving prediction accuracy for customer behavior-based analyses which may be done internally and these models for customer behavior estimates are often utilized in customer decisioning as well as in day-to-day business operations. Balanced Internal and External data can also drive Market Benchmarking and Competitor Analysis solution areas as well as a variety of Credit Information or Fraud Risk factors in Credit and True Fraud-related Investigations, Reviews or in Underserved Market or Anti-money laundering initiatives or investigations where External Data may play a bigger role.

2.4.2. Data Quality and Governance

Although all cited aspects are important to taking full advantage of the available data to foster a digital transformation, we focus on data quality management as the foundation of decision-making. Quality is a broader but a more loosely defined concept. Data is said to have quality when it is believed by the decision maker that it fits the purpose of the application, which could be for instance constructing segments, predicting response rates, estimating values, detecting suspicious behavior, and so on. To achieve a high quality of ethos, business rules should be defined to express clear requirements about all dimensions of quality. The quality of different types of data used vary widely. Regarding data that can be contained in a customer profile, a minimal set of fields is name, address, and date of birth. The name and address are user inputs, and mistakes in both are common. The birth date is a crucial sine qua non needed to construct and update customer profiles, and is minimally sufficient to discriminate between customers. This data is usually self-reported during the process of account opening. Age and approximate location are critical for many business decisions, from KYC to marketing. However, educated guesses based on inexpensive external databases may sometimes be preferable to incomplete self-reported information. Moreover, financial institutions control the place of transactions, as banks have branches or ATMs everywhere people go. The location of transactions reflects the residence of customers accurately, along with time of transaction. KYC regulation also nudges the bank to update the address with more frequency than obtaining it through self-reporting.

2.5. Integrating AI and ML into Banking Processes

In this section, we explore the various AI and ML-enabled applications that banks can use to transform their enterprise architecture and improve the customer experience.

Making this technological change has many advantages. Traditional approaches that banks conducted manually require laborious, multi-step, interdepartmental, orchestrated engagements to mine and mobilize data from sufficient trusted sources. Not only are they costly and time-consuming, but they have significant lag times that make them irrelevant or inaccurate for achieving desired outcomes. AI-driven approaches enable banks to get real-time insights and a continuous cycle of actions to minimize these costs, while also personalizing products, services, and pricing, optimizing business processes in order to improve customer satisfaction, and increasing enterprise quality. Less often highlighted is the major catalyst effect that banks can have on the global economy in expanding the use of AI and ML in the banking sector to stimulate growth by integrating these technologies into core banking processes.

Operational Efficiency

Banks have adopted AI and ML in a variety of ways to reduce costs and inefficiencies in back office, mid-office, and front office functions. In these areas, a combination of semi-autonomous digital laborers that can continuously perform relatively high-volume activities without errors throughout the workday, in combination with the capability of human workers to dynamically shift work to more complex and unpredictable activities that require managing emotional and customer interactions are gaining traction. For example, intelligent robotic process automation bots have rapidly taken over traditional business process automation functions for discrete process actions and are increasingly being used for multi-step workflows that previously required many teams to take action, incorporating error-prone manual activities.

2.5.1. Operational Efficiency

Artificial intelligence (AI) and machine learning (ML) technologies are fundamentally transforming banking across multiple directions, enabling unprecedented transformation in innovation-driven areas like automation and democratization. Advances in high-powered computing, cloud storage, and big data analytics are enabling banks to embrace AI and machine learning for creative solutions to diversely distinct business problems in risk management, cybersecurity, product authentication, marketing prediction, regulatory compliance, and algorithm trading. These technologies are also transforming banking processes by automating analytically driven backend processes for achieving operational efficiency while leaving face-to-face customer-oriented processes untouched in their human interaction-driven form. From expanding existing capabilities to exposing new business opportunities, intelligent banking is characterized importantly with scaling traditional rules-based determination and narrow band computing capabilities to a new era of intelligence-based forecasting and ubiquitous and high-powered computing capabilities. Specifically, AI and machine learning approaches are successfully being

explored in banking for improving technology savvy and organizational efficiency in operational areas including process automation, business risks assessment and mitigation, optimization strategy, data-driven operations, operational management, transaction risk and fraud detection, information security and cybersecurity support, Chatbot-driven customer service, and user-experience driven customization. Standalone hosting capabilities enabled by cloud technology are providing significant boost to banks for investment in big data analytics and predictive modeling, which are requiring resource commitments and infrastructure hardening historically random for smaller banks to host internal business intelligence and data warehousing businesses. Additionally, as whole banking operation systems are hosted and managed by large IT application developer service providers, new opportunities and possibilities are also being opened for banks to rethink business model focus and relationship management on choices of IT service providers and providers who are patenting solutions to such vertical industries.

2.5.2. Customer Service Enhancement

Machine systems today such as chatbots, automated fraud detection systems, customer service robots, and oral question-answering systems have already greatly improved the ability of banks to serve their customers. These AI-based systems enhance customer service by leveraging artificial intelligence to solve customer problems via chatbots, individually tailor products to client needs, detect fraud in seconds and give immediate feedback to customers with the highest chances of being fraudulent, and provide personalized recommendations to improve customers' financial health. What are the most impactful customer-facing banking processes that can be enhanced using intelligent systems that draw on AI/ML technology? The plurality of potential processes can be grouped into six capabilities: first, assist customers with their immediate needs. Bank clients often seek assistance with mundane tasks such as executing a transaction, resetting a password, or understanding the status of a recent deposit or claim. In fact, the sheer volume of responses to FAQs – from password resets to bank account management questions – fills call centers 24/7, adding to operational costs for banks. Intelligent assistants such as chatbots, which leverage natural language processing and machine learning, have begun to come to the rescue, enabling banks to automatically complete or assist with a myriad of routine customer needs. Not only can chatbots provide clients with immediate responses to simple text queries, they also allow banks to provide personalized service experiences by analyzing banks' existing client profiles and determining how best to assist customers.

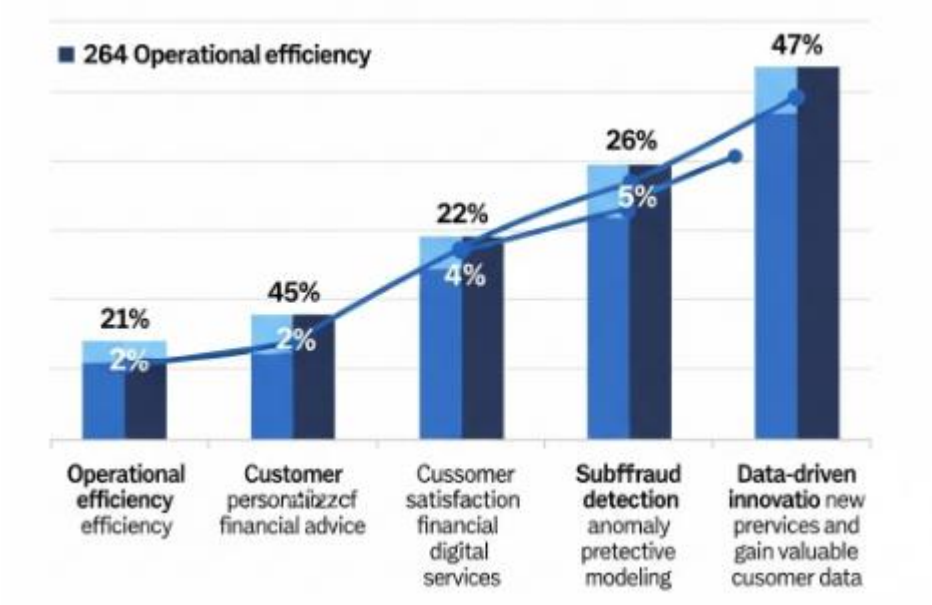

Fig : Banking Processes to Enable Data-Driven Innovation

2.6. Conclusion

The impact of AI on banking performance is still relatively low; however, it seems that AI and ML capabilities could become a sustained source of heterogeneity in financial performance improvement. Experimenting with AI applications – whether through a legacy system upgrade, a combination with other technologies, early-stage investments in specialized vendors, or directly working with hyper-scale platforms – will undoubtedly help banks better understand their expected benefits.

The present workflow will evolve towards the orchestrated combination of domain knowledge with AI models capable of "continuous learning". This will open new data dimensions for deep personalization, under greater profitability pressure than currently, and develop risk methodologies engendering target pricing differentiation. Most processes – credit, collection, compliance – will see greater data use and scoping, plus model library investments.

2.6.1. Emerging Trends

The technologies of AI and ML are advancing rapidly and continue to disrupt processes across all sectors. The acceleration of changing data management requirements and technological landscape is evident. Virtualization will expand the data management

ecosystem, while analytics at the edge and independent data ecosystems become increasingly embraced. In addition, cloud will serve as the backbone, even for on-premises data management technologies. Hence, organizations looking to modernize data management must rethink their approach and strategies.

This shift is being seen across banking firms. One major bank conducted a survey with customers of large financial institutions and leading officers from various departments. This research revealed that bank customers are using AI and intel to optimize their banking experiences and expect a bigger push in the future. Recent trends show that customers demand a smarter banking experience where technology can accelerate and augment human communication, anticipate needs, and even drive 24/7 bank engagement using face recognition and voice technology. These expectations, along with the commitment to security, elevate the need to set strong principles when deploying AI among banking firms.

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