



CONCEPTS OF FINTECHS AND ARTIFICIAL INTELLIGENCE

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LEARNING OBJECTIVES

The unprecedented technological advancement of the last two decades, impacting all segments of the economy, particularly caused a revolution in the financial services industry. Incumbent financial institutions lag in innovative solutions to changing customer needs. They are facing great competition and collaboration opportunities from an army of FinTech and AI-based startups. In Europe, these startups emerged due to open banking regulations, and neobanks are challenging the established bricks-and-mortar business model. The COVID-19 pandemic has further accelerated the growth of FinTech companies that offer agile, transparent, efficient, cost-effective, and innovative solutions to tech-savvy customers in cross-border payments, online purchases, wealth management, and lending. Thus, FinTechs are transforming financial institutions using technologies such as AI, data analytics, and blockchain.

Students will have a comprehensive overview of FinTech and AI, learn about the FinTech ecosystem, open banking regulation in Europe, contemporary developments in banking technologies, and practical application of FinTech and AI. This course aims to critically discuss the contemporary issues related to FinTech and AI, such as regulatory reforms, creativity and innovation challenges, customer data protection, ethical issues, and green tech financing. Students will also discuss the future of applications of FinTech and AI in banking and finance and critically evaluate the evolution of cryptocurrencies and central bank digital currencies. The course allows students to debate and discuss how tech companies are shaping the finance world, what lessons can be learned from past crises, the future of branch banking, and what impact FinTech and AI starts can make on financing ESG and sustainable projects.

UNIT 1

INTRODUCTION OF FINTECHS

STUDY GOALS

On completion of this unit, you will be able to ...

- comprehend the definitions and fundamental concepts of FinTech and artificial intelligence (AI).
- provide a detailed explanation of the FinTech ecosystem and the different groups involved.
- examine the influence of FinTech and AI on the financial services industry.
- acknowledge the importance of open banking regulation in promoting the expansion of startups in the financial service industry.

1. INTRODUCTION OF FINTECHS

Introduction of FinTechs and AI

Case Study




Juggling academics, part-time work, and a social life leaves you little time and energy to effectively manage your finances. You often struggle to keep track of your expenses, find affordable financial services, and stay updated with the ever-evolving financial landscape. But then you discover the power of financial technology (FinTech) and artificial intelligence (AI) solutions. Intrigued by their potential, you incorporate them into your daily life, hoping they can improve your financial journey.

You start by downloading a budgeting app that utilizes AI algorithms. The app automatically categorizes your transactions, provides real-time spending insights, and sends notifications whenever you exceed your allocated budget for specific categories. This app gives you a newfound sense of control over your finances. It empowers you to make informed decisions and helps improve your financial management skills. Not stopping there, you also turn to an AI-powered robo-advisor. This innovative tool analyzes your financial situation, preferences, and goals to offer personalized investment advice. Through this AI-driven service, you gain access to tailored investment strategies that align with your risk tolerance and future aspirations. With the robo-advisor's guidance, you can make smarter investment decisions, even with limited knowledge and experience in the financial markets. The AI-driven platform assists you in building a diversified portfolio and provides regular updates on its performance.

As you delve deeper into FinTech and AI, you discover additional benefits. You find digital payment platforms that offer convenience and security, allowing you to make hassle-free transactions with just a few taps on your smartphone. Integrating biometric authentication methods, such as fingerprint or facial recognition, ensures the safety of your financial transactions. Furthermore, you encounter AI-powered chatbots on banking websites and mobile apps. These virtual assistants provide instant customer support, answering your queries 24/7. They can assist with account inquiries, help you understand complex financial terms, and even provide recommendations for the best financial products tailored to your needs.

Intrigued by the possibilities, you explore the world of open banking. This innovative concept allows you to securely integrate various financial accounts and services within a single platform. By enabling data sharing through secure application programming interfaces (APIs), you gain a comprehensive overview of your finances, empowering you to manage multiple accounts and track your financial health more efficiently. Embracing the financial revolution driven by FinTech and AI, you notice a significant improvement in your daily life. Your financial decision-making becomes smarter and more informed, thanks to the personalized insights and recommendations provided by AI-powered solutions. With a better understanding of your spending patterns, you effectively manage your expenses, ensuring they align with your financial goals. The convenience and efficiency offered by FinTechs and AI enhance your overall financial experience. You no longer need to wait in

long queues at a bank or spend hours manually tracking your expenses. Instead, you have a suite of digital tools at your fingertips that simplify and automate your financial tasks. As a result, you feel more confident and empowered in your financial journey. The combination of FinTech and AI has transformed how you interact with and manage your money. By leveraging these technologies, you are able to overcome the daily challenges that come with being a busy student, ensuring your financial well-being and paving the way for a brighter financial future.

In this unit, you will learn about the definitions of FinTechs  AI, as well as the factors driving the financial revolution. The FinTech ecosystem, including the various players and their roles, will also be covered. This unit will provide a foundational understanding of these technologies and their impact on the financial sector.

1.1 Definition of FinTechs and AI

FinTech's origins can be traced back to the introduction of the telegraph in 1838 and the establishment of the first transatlantic cable in 1866. However, the intersection of technology and finance began with the advent of the ATM in the 1960s, pioneered by Barclays Bank in Enfield, UK. In the wake of the global financial crisis of 2008, two additional factors bolstered the growth of FinTech. Firstly, there was a notable lack of trust in traditional financial institutions, as surveys consistently ranked public trust in these entities at low levels. Secondly, the rise of the Millennial generation in the financial markets brought skepticism toward financial institutions and demand for alternative sources of financial guidance (Gromek, 2018).

Despite the increasing awareness and discourse surrounding FinTech, defining the term remains challenging. Generally, FinTech refers to startups that act as intermediaries between financial services and technology providers. The growth of FinTech has attracted substantial investments and generated significant public interest. However, the lack of a universally accepted definition of FinTech has led to discrepancies in industry reports and studies, making it difficult to accurately measure and analyze the size and impact of the industry. The absence of a standardized codification of FinTech and the inclusion criteria for different business branches further contribute to the variations in reported data (Gromek, 2018).

We define FinTech, a term derived from combining “financial” and “technology,” as the application of technology in financial services, processes, and products. Its primary objective is to enhance the efficiency, accessibility, and affordability of financial services by utilizing cutting-edge technologies such as data analytics, blockchain, and AI. Moreover, FinTech serves as an encompassing term for a wide range of technology-driven financial innovations. It involves transforming traditional financial services into digital formats, streamlining existing processes, opening access to untapped markets and customers, and creating novel financial products and services. For example, platforms like PayPal revolutionize digital payment systems, while Betterment acts as a robo-advisor, streamlining investment processes with automated guidance. FinTech represents a disruptive force in the financial industry, driving the convergence of finance and technology to reshape how

people perceive and interact with financial services. By leveraging modern technologies, FinTech aims to redefine the financial landscape, offering convenient, efficient, and innovative solutions for individuals and businesses (Chiu & Deipenbrock, 2021; Pável, 2021).

As a result, the FinTech industry has experienced significant growth, offering a wide range of services that were once only available from traditional financial institutions. These advancements in technology have not only increased competition within the industry but have also fostered greater innovation. FinTech companies are continuously developing new and improved solutions to meet the growing demand for convenient and accessible financial services. The demand has resulted in a shift toward more customer-centric approaches, focusing on providing personalized and tailored solutions for individuals and businesses. While the term may be relatively new, the importance of innovation in the financial sector has always been recognized. However, the recent explosion of FinTech companies has been primarily driven by three key factors (Chiu & Deipenbrock, 2021; Pável, 2021).

Reasons for the Growth of FinTech

Firstly, the widespread availability of mobile devices and communication networks has made connectivity an integral part of our day-to-day lives. This development has created an environment where accessing financial services through mobile banking apps or making payments through digital platforms has become the norm. Secondly, the affordability of computing and data storage has made it possible for smaller companies to enter the market and develop innovative financial solutions. In the past, only large financial institutions had the resources to invest in advanced technology. With lower costs associated with computing and data storage, smaller FinTech companies can compete and thrive, bringing new ideas and competition to the industry. This disruption has heightened competition and fostered innovation and a customer-centric approach within the industry (Pável, 2021).

According to Pável (2021), the third reason for the rise of FinTech is the growing cohort of ambitious entrepreneurs. They bring fresh perspectives, innovative ideas, and a strong drive to disrupt the traditional financial services landscape. Their entrepreneurial spirit and determination to challenge the status quo have led to the development of new and groundbreaking financial solutions. Entrepreneurs in the FinTech industry are often driven by a desire to address unmet customer needs, enhance convenience, and provide more accessible and inclusive financial services. Entrepreneurs in the FinTech space have successfully attracted venture capital and other forms of investment, which has further fueled the industry's growth. The financial support and resources investors provide have enabled these entrepreneurs to turn their ideas into reality, scale their businesses, and compete with traditional financial institutions.

Classification of FinTech

FinTech companies prioritize efficiency in providing existing services rather than introducing new ones. The categorization of FinTech services closely mirrors those offered by traditional banks, ensuring a seamless transition for customers. First, FinTech companies can be organized into five classes (Gromek, 2018):

1. **Business-to-consumer** (B2C) enterprises primarily deliver services to individual users.
2. **Consumer-to-consumer** (C2C) companies facilitate seamless services between individual users.
3. **Consumer-to-business** (C2B) enterprises empower consumers to transact on behalf of companies.
4. **Business-to-business** (B2B) companies explicitly cater to legal entities.

AI Definition

AI encompasses learning, problem-solving, and decision-making. Within the financial sector, AI is progressively employed to automate operations, enhance decision-making processes, and personalize customer interactions. Various techniques used in AI include machine learning, natural language processing (NLP), computer vision, and more (Chishti et al., 2020).

AI machines' capability to carry out tasks that typically necessitate human intelligence

Researchers first began exploring the concept of creating intelligent machines in the 1950s. This journey has seen significant milestones, inventors, and breakthroughs, shaping the field of AI as we know it today. In 1950, mathematician and computer scientist Alan Turing proposed the Turing Test, a benchmark to assess a machine's ability to exhibit intelligent behavior. This concept laid the foundation for AI research and set the stage for future advancements. In the late 1950s, psychologist Frank Rosenblatt developed the perceptron, the first artificial neural network capable of learning from data. This breakthrough sparked interest in machine learning and inspired further research. During the 1970s, computer scientist Edward Feigenbaum developed the first expert system, MYCIN, which used a knowledge-based approach to diagnose bacterial infections. This system marked a significant milestone in AI applications and demonstrated the potential of AI in specialized domains (Negnevitsky, 2011; Russell & Norvig, 2021).

In the 1980s, **machine learning** gained momentum with the introduction of algorithms like backpropagation and the support vector machine (SVM) invention by Vladimir Vapnik and Alexey Chervonenkis. These developments improved the performance of AI systems and paved the way for more advanced applications. In the 1990s, advancements in AI technology continued with the advent of probabilistic reasoning and Bayesian networks. Scientists such as Judea Pearl made significant contributions in this area, enabling AI systems to handle uncertainty and make decisions based on probabilistic models. The early 2000s witnessed milestones in machine learning and data-driven AI approaches. Inventors such as Geoffrey Hinton, Yann LeCun, and Yoshua Bengio laid the groundwork for deep learning, a subfield of machine learning that utilizes neural networks with multiple layers. Their work revolutionized various AI applications, including computer vision, NLP, and speech recognition (Negnevitsky, 2011; Russell & Norvig, 2021).

Machine learning a subfield of AI that entails teaching algorithms to identify patterns based on data

Various types of machine learning algorithms exist (Negnevitsky, 2011):

- **Supervised learning** involves training an algorithm on a labeled dataset in which the desired output is already known.
- **Unsupervised learning** involves training an algorithm on an unlabeled dataset with unknown desired output.

- **Reinforcement learning** involves training an algorithm through trial and error, with the algorithm receiving rewards for successful actions and punishments for unsuccessful ones.

Natural language processing (NLP)
a subfield of AI that focuses on the capability of machines to process and comprehend human language

NLP enables machines to interpret and analyze human language similarly to how humans do. It has diverse applications, such as language translation, text classification, and sentiment analysis (Russell & Norvig, 2021):

- **Language translation** entails machines' ability to convert text or speech from one language to another. This work is valuable for tasks like website content or real-time conversation translation.
- **Text classification** refers to machines' ability to categorize text based on its content or meaning. It can be utilized for tasks such as organizing emails or identifying spam.
- **Sentiment analysis** involves machines' ability to analyze the sentiment or emotion expressed in text or speech. This skill can be applied to tasks like analyzing customer reviews or evaluating the sentiment of social media posts.

For instance, BERT (Bidirectional Encoder Representations from Transformers) is an AI model created by Devlin et al. (2018). It is a machine learning model that has undergone extensive training on vast datasets to comprehend and dissect human language. BERT excels in language translation, text classification, and sentiment analysis, making it a prevalent choice in numerous NLP applications.

FinBERT is a specialized variant of the BERT model that has been fine-tuned for financial domains. It is designed to understand and analyze text data related to financial news, reports, and other financial documents. FinBERT has been trained on large amounts of financial text data, allowing it to capture domain-specific nuances and terminology. This training makes it particularly effective for tasks such as sentiment analysis, financial document classification, and stock price prediction in the context of financial markets (Yang et al., 2020).

Computer vision
a subfield of AI that focuses on the capability of machines to interpret and comprehend visual data

Computer vision algorithms are developed to analyze and understand visual data like human visual perception. This subfield of AI finds application in diverse tasks, such as object recognition, facial recognition, and image classification (Russell & Norvig, 2021):

- **Object recognition** refers to machines' ability to identify and categorize objects in images or videos. This ability is helpful for tasks like recognizing products in online shopping images or detecting pedestrians in video footage.
- **Facial recognition** involves machines' ability to identify and recognize specific faces in images or videos. It has applications in tasks such as identifying individuals in security footage or unlocking devices using facial recognition.
- **Image classification** involves machines' ability to classify images based on their content or meaning. This ability can be employed to categorize images on social media or identify the content of images in a search engine.

AI Specific to Finance

The financial industry is increasingly adopting AI to automate tasks, enhance decision-making, and deliver personalized customer experiences. A few examples of AI applications in finance are defined below.

Fraud detection

AI algorithms can analyze large volumes of financial data to identify patterns and detect fraudulent activities, such as unauthorized transactions or identity theft (Cao, 2022).

Risk assessment

AI models can analyze historical data and market trends to assess and predict potential financial risks. This ability can help make informed investment decisions, manage portfolios, and determine insurance premiums (Cao, 2022).

Trading and investment

AI-powered trading systems can analyze vast amounts of financial data in real-time to make faster and more accurate trading decisions. AI algorithms can identify trading patterns, predict market fluctuations, and automate trading processes (Cao, 2022).

Customer service

AI chatbots and virtual assistants can provide personalized recommendations, answer customer inquiries, and help with basic financial transactions. This offering enhances customer service and improves overall user experience (Cao, 2022).

Credit scoring

AI algorithms can analyze a wide range of data, including credit history, income, and spending patterns, to assess creditworthiness and determine credit scores. This ability helps make more accurate lending decisions and reduces the risk of defaults (Cao, 2022).

Financial planning

AI-powered financial planning tools can analyze individual financial data, goals, and risk tolerance to provide personalized investment advice and create optimized financial plans. These tools assist individuals in managing expenses, saving for retirement, and achieving their financial goals (Cao, 2022).

Regulatory compliance

AI systems can analyze and monitor financial transactions to ensure compliance with regulations and detect any suspicious activities. Financial institutions benefit from adhering to regulatory requirements and preventing money laundering or other illicit activities (Cao, 2022).

1.2 FinTech Ecosystem

The FinTech Ecosystem refers to the complex, interconnected network of various players that leverage technology to enhance or innovate financial services. This ecosystem encompasses a wide range of businesses, technologies, products, and regulatory frameworks, all working together to disrupt and improve the traditional financial landscape. Key elements of the FinTech Ecosystem are identified and described below.

Startups and Companies

This group includes a broad spectrum of companies that specialize in different areas of finance, like mobile payments, digital banking, personal finance, blockchain and cryptocurrencies, insurtech (insurance technology), and robo-advisors, among others (astro et al., 2020; Lee & Shin, 2018).

Regulatory Bodies, Policy Makers, and Regulatory Technology (RegTech)

Policymakers have a dual role in encouraging innovation in the financial sector and ensuring that it doesn't compromise the integrity of the financial system or consumer protection. Regulatory technology, or RegTech, has emerged as a subset of FinTech aimed at facilitating compliance with financial regulations through technology. It includes solutions for fraud detection, compliance reporting, risk management, and identity management. RegTech helps FinTech companies and traditional financial institutions comply with complex regulatory environments and enables regulators to monitor and enforce compliance more effectively (Castro et al., 2020; Lee & Shin, 2018).

Traditional Financial Institutions

Banks, insurance companies, and other traditional financial institutions are integral to the FinTech ecosystem. Many of these entities collaborate with FinTech startups through partnerships, acquisitions, or internal innovation programs to integrate new technologies and approaches into their existing offerings. These collaborations help them stay competitive, expand their customer base, and improve service delivery (Castro et al., 2020; Lee & Shin, 2018).

Investors and Venture Capitalists

The growth and sustainability of the FinTech ecosystem heavily rely on investments from venture capitalists, angel investors, private equity firms, and corporate venture arms. These investments enable startups and scale-up companies to develop and refine their technologies, scale operations, and expand to new markets (Castro et al., 2020; Lee & Shin, 2018).

Customers and End-Users

At the heart of the FinTech ecosystem are the consumers – individuals and businesses. Their evolving needs, preferences, and adoption of technology-driven financial solutions drive innovation and competition within the industry. The ecosystem aims to offer more personalized, accessible, and affordable financial services to these users (Castro et al., 2020; Lee & Shin, 2018).

Technology and Service Providers

The ecosystem leverages cutting-edge technologies such as blockchain, AI, machine learning, big data analytics, and cloud computing to enhance efficiency, security, and customer experiences in financial services. Beyond core financial technologies, the ecosystem is supported by a range of service providers offering ancillary services such as cloud hosting, cybersecurity, compliance solutions, and data analytics. These services are crucial for the operation, security, and scalability of FinTech solutions (Castro et al., 2020; Lee & Shin, 2018).

Educational Institutions and Research Organizations

Universities, technical schools, and research institutions contribute to the FinTech ecosystem by fostering innovation through research, incubating startups, and training the next generation of FinTech professionals. They often collaborate with industry players on research projects and offer specialized courses and programs in FinTech, blockchain, data science, and other relevant fields, thereby enriching the talent pool within the ecosystem (Castro et al., 2020; Lee & Shin, 2018).

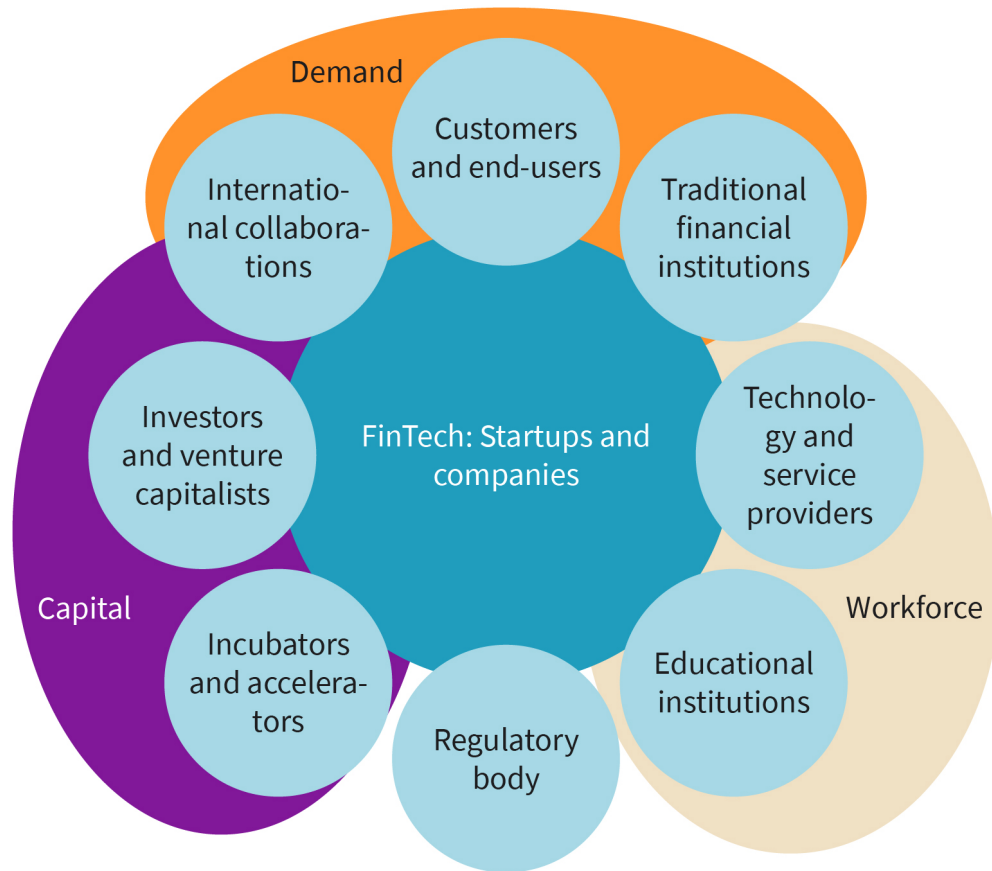
International and Cross-Border Collaborations

The FinTech ecosystem is increasingly global, with cross-border partnerships, regulatory cooperation, and international investment flow playing a significant role. Innovations and regulatory frameworks in one region can influence developments elsewhere, and FinTech companies often aim to expand their solutions across borders to tap into new markets (Castro et al., 2020; Lee & Shin, 2018).

Incubators and Accelerators

These entities are crucial in nurturing early-stage FinTech startups by providing them with resources, mentorship, networking opportunities, and sometimes seed funding. Incubators and accelerators can be standalone organizations or part of larger financial institutions, technology companies, or universities. They help startups fine-tune their business models, navigate regulatory requirements, and connect with potential partners and investors (Castro et al., 2020; Lee & Shin, 2018).

Figure 1: The FinTech Ecosystem



Source: Manuela Ender (2024).

Alternative text:

The finance sector is typically cautious, prioritizing risk avoidance because of the high stakes associated with failures in this field. Banks and insurance companies, for instance, operate under tight regulatory scrutiny. They are bound to follow rigorous rules and standards aimed at safeguarding consumers and maintaining the financial system's integrity. Consequently, these entities often lag in adopting novel technologies, necessitating a thorough evaluation of potential risks before any new implementations can be made.

On the other hand, FinTechs navigate with greater flexibility, innovative capacity, and a willingness to embrace risks, benefiting from comparatively lax regulatory demands and reduced concern over potential negative publicity. This freedom positions them well to devise and introduce innovative products and services, leveraging cutting-edge technologies to fill voids left by traditional financial institutions – which may either overlook or deliberately steer clear of such opportunities. Nevertheless, as FinTech companies grow

and their offerings reach more consumers, they eventually encounter more stringent regulatory oversight, bringing them closer to established financial entities in terms of compliance obligations. Let's take a closer look at three essential components of the ecosystem.

Traditional Financial Institutions

Traditional financial institutions have three main strategic options:

1. Develop technology internally
2. Forge partnerships with FinTech companies
3. Acquire a FinTech company that already has a successful technological solution in place

Each avenue offers distinct advantages and challenges, and the optimal path for an institution will hinge on its unique circumstances, objectives, and risk tolerance. Pursuing internal development allows a financial institution to maintain full control over its technological innovations, ensuring they are tailored to fit its strategic goals. However, this route can be fraught with high costs, substantial risks, and lengthy development times. Forming a partnership with a FinTech firm can grant quick access to cutting-edge technology with less upfront investment, although it might also mean less control over the technological solution. On the other hand, acquiring a FinTech provides immediate access to technology and expertise, which come at a steep price and involve complex integration processes. A more established bank or financial institution might prioritize managing reputational risks over acquisition costs. Conversely, hedge funds or proprietary trading firms might lean toward developing technological solutions internally to maintain competitive edge and innovation control (Blakstad & Allen, 2018).

Regulators

In the FinTech ecosystem, regulatory bodies are pivotal in framing the regulations and norms that FinTech enterprises and financial institutions must adhere to. Their role is vital in upholding the financial system's integrity and stability and safeguarding consumers against financial adversities. To this end, regulators may institute standards concerning data security, financial disclosures, and risk management.

Lately, there has been an enhanced regulatory focus on the FinTech sector due to its capacity for significant innovation and disruption, alongside the introduction of novel risks. For instance, the U.S. Securities and Exchange Commission (SEC) has initiated efforts to interface with FinTech startups, aiming to remain abreast of emerging technologies and business frameworks. Beyond establishing regulatory frameworks, authorities also extend guidance and assistance to aid FinTech firms in traversing the regulatory milieu. This support might encompass educational and training initiatives, resources and tool provision, and a commitment to open dialogue with FinTech entities, facilitating a deeper understanding of their needs and concerns. In the UK, the Financial Conduct Authority (FCA) has innovated a regulatory "sandbox" that permits FinTech startups to pilot their offerings in a regulated yet flexible setting prior to full-scale launch (Bains & Wu, 2023).

These regulatory endeavors are designed to cultivate innovation while ensuring that emerging products and services align with established regulatory precepts, protecting consumers from undue risk. Conversely, inadequate regulatory oversight can precipitate significant challenges, as evidenced by the downfall of the UK-based peer-to-peer lending platform, Lendy, in 2019. An inquiry by the Financial Conduct Authority (FCA) uncovered that Lendy had breached several regulatory standards, exposing its investors to substantial financial losses (Lakhotia, 2021). This incident underlines the necessity of rigorous regulatory supervision to guarantee that FinTech firms operate within the boundaries set by regulatory bodies, adhering to legal and ethical norms. Regulators must find a middle ground between excessive regulation – which might inhibit innovation and limit the growth potential of FinTech companies – and self-regulation, which might not sufficiently safeguard consumers or preserve the financial system’s integrity. Regulation of open banking, by contrast, has the potential to stimulate innovation and competition while ensuring essential consumer protections are in place.

Investors

Investors such as venture capital (VC) firms and angel investors are integral to FinTech, supplying the capital necessary for startups to develop and expand their operations. This financial backing enables numerous FinTech companies to commercialize their innovative products and services. Beyond capital investment, these investors also contribute strategic advice and support to aid FinTech startups in their path to success. This support may involve help with formulating business strategies, facilitating connections with potential partners and clients, and granting access to vital networks and resources.

In recent years, FinTech startups have successfully secured substantial funding, a trend particularly notable among smaller, private, and independently managed VCs, especially in nations without prominent financial hubs. This tendency seems to correlate with the selective application of financial regulations, which are more rigorously enforced upon large financial entities rather than startups. Consequently, FinTech startups in these countries are more apt to secure considerable funding yet face a higher risk of failure. These observations may indicate regions where venture capital investments are not being optimized globally.

After the financial crisis 2007 to 2009s, the average size of syndicates for FinTech-related venture capital investments has expanded, suggesting, under normal circumstances, a positive outlook for FinTech ventures. However, current data reveal a decreased likelihood of FinTech companies being acquired post-crisis, with an increased tendency toward liquidation. This pattern suggests an overenthusiasm in FinTech venture capital investments, reminiscent of prior cycles of boom and bust in the venture capital sphere.

Venture capitalists should exercise caution against overinvestment in trending sectors, potentially driven by media hype, which risks diluting the overall quality of investments. Policymakers need to recognize how differential enforcement of financial regulations can divert economic activity outside regulatory surveillance. There is documented evidence of public policy influencing venture capital investment trends; however, the interplay between regulatory enforcement and government initiatives warrants further investigation. Given the burgeoning nature of FinTech VC investment – propelled by regulatory

focus on large institutions – there’s an opportunity to broaden regulatory attention. This broadening would safeguard consumer interests and ensure that innovations and new technologies emerge from efficient development rather than merely reactions to uneven regulatory landscapes. (Cumming & Schwiendbacher, 2021)

1.3 Revolution in the Financial Services Industry

The financial services industry has witnessed a significant transformation over the past decade, largely fueled by the emergence and proliferation of FinTechs. These entities leverage technology to innovate and provide streamlined financial services, challenging traditional banking and financial sectors. We explore whether **FinTechs have caused a revolution** in the financial service industry by exploring their impact’s pros and cons.

FinTechs have played a pivotal role in **democratizing access** to financial services. Through mobile banking, peer-to-peer lending platforms, and digital wallets, they have made financial services more accessible to underserved communities and regions with limited traditional banking infrastructure. Companies like **M-Pesa in Kenya** revolutionized mobile money, significantly impacting **financial inclusion** (Hughes & Lonie, 2007).

The FinTech revolution is marked by unparalleled levels of innovation and efficiency. FinTechs have introduced groundbreaking products and services – from robo-advisors in investment management to real-time cross-border payments. These innovations have **enhanced customer experience and increased operational efficiencies, reducing costs for providers and consumers.** FinTechs have injected competition into the financial services sector, challenging the complacency of traditional banks. The competitive pressure has pushed conventional financial institutions to innovate, leading to broader product offerings and better customer service. This competition ultimately benefits consumers, who now have more choices, better prices, and improved service quality.

However, the digital nature of FinTech services increases vulnerability to cyber-attacks. FinTech companies, like traditional financial institutions, deal with sensitive financial data, making them attractive targets for cybercriminals. High-profile data breaches can lead to substantial financial losses and erode customer trust. While FinTechs are at the forefront of employing cutting-edge cybersecurity measures, the constantly evolving cyber threat landscape remains a significant challenge. The proliferation of FinTech services can lead to market fragmentation, where customers use multiple services for different financial needs. This fragmentation can complicate financial management for consumers and make it harder for regulators to monitor the financial activities of individuals and entities. Additionally, the overwhelming number of choices can lead to decision fatigue among consumers, potentially impacting their ability to make informed financial decisions. While FinTechs have increased access to financial services for many, there remains a risk of widening the digital divide. Individuals without access to the necessary technology



Financial inclusion facilitates equal access for individuals and businesses to affordable financial products and services like loans, payments, savings, and insurance, promoting economic equality

or those who are not digitally literate may be further marginalized. This digital divide raises concerns about equitable access to financial services, especially in regions with low internet penetration.

The FinTech transformation is not without its challenges. Regulatory gaps, cybersecurity concerns, market fragmentation, and the potential to widen the digital divide highlight the complexities of the FinTech revolution. The future of FinTechs in revolutionizing the financial service industry hinges on addressing these challenges through robust regulatory frameworks, enhanced cybersecurity measures, and efforts to ensure digital inclusivity. As the industry continues to evolve, collaboration between traditional financial institutions, FinTechs, regulators, and other stakeholders will be critical in harnessing the benefits of FinTech innovations while mitigating their downsides (Blakstad & Allen, 2018)

1.4 Open Banking Regulation

open banking banking practice facilitated by digital technology, where banks open up their data and infrastructure to third-party financial service providers through the use of APIs

In the rapidly evolving landscape of financial services, **open banking** has emerged as a pivotal innovation, reshaping how banks, FinTech companies, and consumers interact with financial data. This paradigm shift is underpinned by fostering innovation, enhancing competition, and improving consumer choice in financial services. The genesis of open banking regulation can be traced back to various legislative and regulatory initiatives globally, with the European Union's Revised Payment Services Directive (PSD2) and the UK's Open Banking Standard being notable benchmarks.

The PSD2 is a European Union (EU) directive administered to regulate payment service providers throughout the EU and European Economic Area (EEA; EU, 2015). Implemented on January 13, 2018, PSD2 aimed to modernize Europe's payment services to benefit consumers and businesses, promoting innovation, making payments safer, and further integrating Europe's payment systems. PSD2 introduces strict security requirements for initiating and processing electronic payments, which aims to reduce the risk of fraud. These requirements include strong customer authentication (SCA), which mandates a two-factor authentication process for electronic payments, enhancing the security of online transactions. PSD2 opens the banking sector to new players, breaking the monopoly traditional banks had on their customer payment services. It allows third-party providers (TPPs) to enter the market with innovative financial services, such as initiating payments and accessing account information. This expansion stimulates competition, leading to better products and services for consumers.

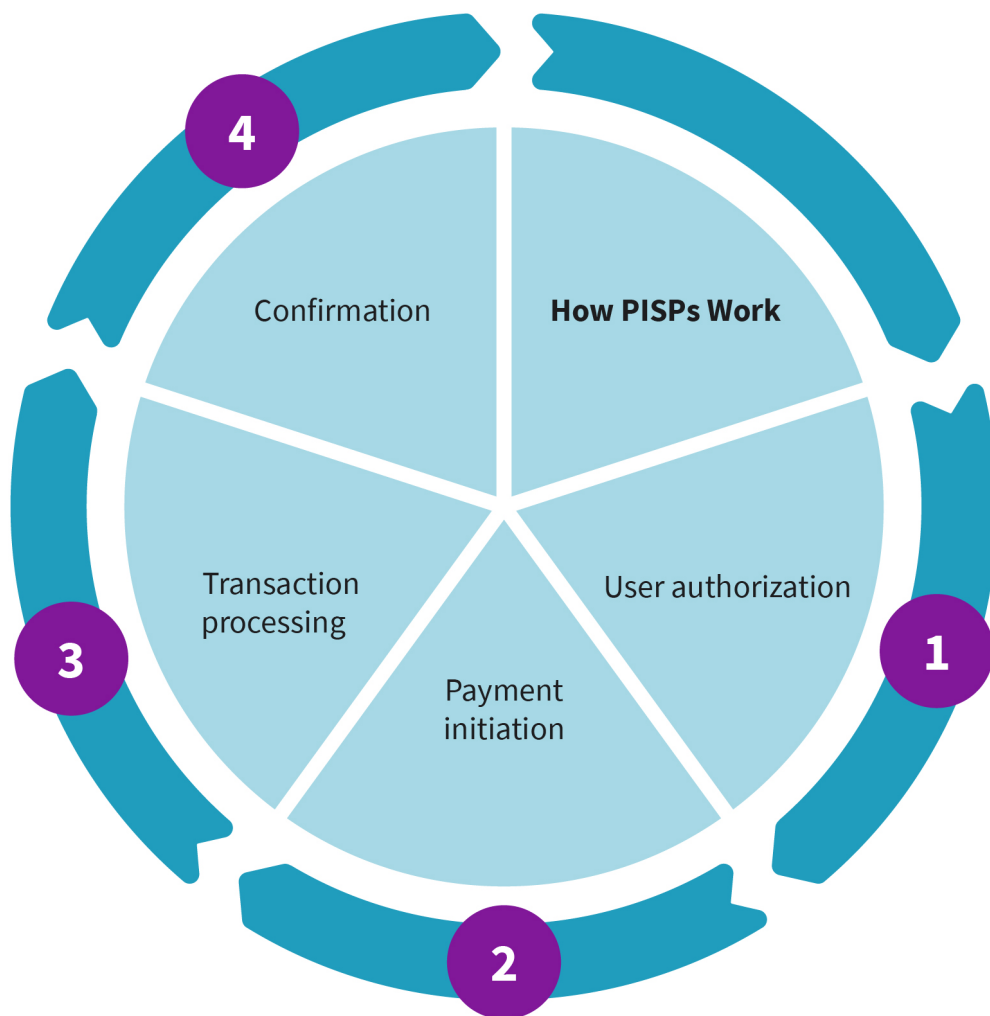
Open banking is at the heart of PSD2, which compels banks to provide TPPs access to their customer accounts with customer consent. This access must be granted in a secure, standardized, and efficient manner. PSD2 introduces two types of TPPs.

Payment Initiation Service Providers

Payment initiation service providers (PISPs) are third-party financial service providers that, with the consent of the customer, are authorized to initiate online payments on behalf of the customer from their bank account to the merchant's account. This process

occurs without the customer needing to interact directly with their bank during the transaction. PISPs offer an alternative to traditional payment methods like credit cards and direct bank transfers, giving consumers more options for paying. PSD2 requires strong authentication measures for payment services, including those initiated by PISPs, enhancing the security of online transactions. The emergence of PISPs fosters innovation in the payment services industry, leading to the development of new financial products and services that cater to consumer needs more effectively (Sadowski, 2021).

Figure 2: How PISPs Work (1)



Source: Manuela Ender (2024).

Alternative text:

Figure 3: How PISPs Work (2)

1

The customer must authorize the PISP to initiate a payment from their bank account. This authorization process is secured through Strong Customer Authentication (SCA) measures

2

Once authorized, the PISP communicates with the customer's bank through a secure channel (API). The PISP sends a request to the bank to initiate the payment transaction.

3

The customer's bank processes the payment initiation request. If the customer has sufficient funds and the request fulfills all security checks, the bank executes the transaction, transferring the amount from the customer's account to the merchant's account.

4

After the transaction is processed, the bank confirms to the PISP that the payment has been initiated successfully. The PISP relays this confirmation to the merchant and the customer, completing the transaction process.

Source: Manuela Ender (2024).

Alternative text:

Account Information Service Providers

Account information service providers (AISPs) are financial service providers that aggregate information from different bank accounts and financial institutions, offering a consolidated view of a user's financial data through a single digital platform. The services offered by AISPs can include the following.

Financial aggregation



AISPs provide customers with a unified view of their financial positions across multiple accounts and institutions. This information can help users better manage their money, track expenses, and understand their spending and saving habits.

Personal financial management (PFM)

AISPs offer tools that help individuals set budgets, save money, and plan for future financial goals. Personal financial management (PFM) services often utilize aggregated account information to provide tailored advice and insights.

Credit scoring and lending support

Some AISPs analyze financial data to offer insights into creditworthiness, potentially helping users access better lending rates or financial products.

Fraud detection and security

By monitoring transactions across different accounts, AISPs can help identify unusual or suspicious activities, potentially offering an additional layer of security against fraud.

Bill tracking and payment services

AISPs assist in tracking bills and subscriptions, ensuring that users are aware of upcoming payments, and identifying opportunities to save money by changing service providers or negotiating better terms.

Investment insights

For users with investments spread across different platforms or accounts, AISPs can aggregate this information, providing a comprehensive view of their investment portfolio, performance analytics, and personalized recommendations.

AISPs must comply with stringent regulatory requirements regarding data protection, security, and customer consent to operate. In the EU, for instance, they need to be authorized by the relevant national financial authority and adhere to the PSD2's regulatory standards (Sadowski, 2021).

While the objectives of PSD2 are ambitious in promoting more open, secure, and competitive payment environments, its implementation has not been without challenges. Banks, TPPs, and other financial institutions have had to invest significantly in updating their technical systems to comply with the standards. Moreover, there have been concerns about privacy and data protection, especially regarding the extent and security of third-party access to sensitive financial data (Preziuso et al. 2023).

To conclude, implementing open banking regulation has led to a surge in innovation within the financial sector. Consumers now enjoy unprecedented control over their financial data, benefitting from personalized financial products and services, including but not limited to budgeting tools, financial management platforms, and streamlined lending processes. For traditional banks and FinTech startups alike, open banking has opened new avenues for collaboration and competition, driving the development of innovative solutions and business models.

As open banking continues to mature, its potential extends beyond the boundaries of banking and payment services. The concept is gaining traction, broadening the scope to include a wider array of financial products such as insurance, investments, and pensions. In this expanded ecosystem, the principles of data sharing and interoperability could further revolutionize consumer finance, leading to more cohesive and comprehensive financial solutions.



SUMMARY

The FinTech industry revolutionizes traditional financial services by introducing digital payments, automated investment guidance, and more, targeting a wide range of services that were once exclusive to banks. This surge is primarily attributed to advancements in mobile technology, affordable computing and data storage, and a wave of innovative entrepreneurship. With these developments, FinTech has made strides in efficiency, customer focus, and creating novel financial products, indicating a shift toward more customer-centric solutions.

FinTech has also been characterized by its evolution within various sub-domains such as AI, where applications range from fraud detection and credit scoring to trading and customer service enhancements. The emergence of technologies like blockchain and big data analytics has paved the way for breakthrough solutions in payments, lending, and financial planning, among others.

The regulation of open banking has further catalyzed this transformation. Initiatives like the EU's PSD2 directive and the UK's Open Banking Standard have democratized access to financial data, enabling third-party providers to offer competitive and innovative services previously dominated by traditional banks. Despite the potential benefits, this shift also brings challenges, including regulatory complexities, concerns over data privacy, and the technical burden of implementing new systems.

The FinTech revolution has significantly altered the financial services industry by leveraging technology to provide more accessible, efficient, and affordable services. While the journey of FinTech is marked by remarkable achievements and potential, it also faces significant hurdles that require collaborative efforts from industry stakeholders, regulators, and innovators to overcome.

UNIT 2

APPLICATION OF FINTECHS IN BANKING AND FINANCE

STUDY GOALS

On completion of this unit, you will be able to ...

- understand the various applications of FinTech in retail banking.
- analyze the role of FinTech in facilitating payment transactions, including methods such as e-wallets, peer-to-peer payments, and mobile payments.
- describe the use of FinTech in wealth management, including robo-advisors and automated investment platforms.
- evaluate FinTech's use in financing, including crowdfunding, peer-to-peer lending, and online lending platforms.
- recognize the potential of FinTech to promote financial inclusion.

2. APPLICATION OF FINTECHS IN BANKING AND FINANCE

Case Study

In the swinging sixties, amidst the rise of rock and roll, space exploration, and burgeoning technological advancements, an innovation quietly emerged that would fundamentally transform everyday life: the automated teller machine (ATM). While John Shepherd-Barron is celebrated for the installation of the first operational ATM in 1967, an intriguing precursor and a cast of innovative characters set the stage for this banking revolution. (Konheim, 2016)

In 1959, a visionary named Luther Simjian filed a patent for what could be considered the first ATM, the Bankmatic. Simjian convinced the City Bank of New York (now Citibank) to undertake a six-month field test of his invention. Despite the groundbreaking nature of his machine, the trial was discontinued due to an apparent lack of demand. According to Simjian, the primary users of the machine were a small number of sex workers and gamblers who preferred the anonymity of the ATM to the personal interaction with bank tellers. This anecdote sheds light on the social dynamics and needs that early ATMs inadvertently catered to (Konheim, 2016)

Not deterred by the vacuum left by Simjian's Bankmatic, John Shepherd-Barron, managing director of De La Rue Instruments in London, envisioned a system that built on these initial ideas but with a more practical and secure implementation. His breakthrough came with the support of Barclays Bank, leading to the launch of the De La Rue Automatic Cash System (DACS) at a North London branch in Enfield in 1967. This event marked the beginning of the ATM as we know it, shaping the future of banking accessibility. Ensuring security was paramount for these machines that dispensed money on demand. The ATMs required users to provide two vital pieces of information: a personal account number (PAN) as proof of bank account ownership, and a personal identification number (PIN) as proof of identity (Konheim, 2016).

Initially, the ATM's target audience was broader than one might expect, encompassing anyone who needed cash outside banking hours. However, there was a particularly intriguing subset of early users: gamblers. In post-war Britain, gambling was a popular pastime, yet the constrained banking hours posed a problem for those needing to settle bets or requiring cash for a late-night flutter at the casinos. The ATM presented a solution, offering round-the-clock access to funds, thereby inadvertently catering to the nocturnal habits of the betting and gambling community (Konheim, 2016).

The introduction of the ATM wasn't without its hurdles. Public skepticism and the novelty of self-service banking meant adoption was gradual. Yet, acceptance grew as more people began to see the utility and security of accessing their money on their terms. The gambling community, with their unorthodox hours and urgent cash needs, proved not just to be early adopters but also advocates for this new mode of banking. Their reliance on the

ATM, especially during hours when traditional banks lay dormant, underscored the machine's value proposition and demonstrated its potential to a broader audience (Konheim, 2016).

2.1 Retail Banking

Retail banking is a segment of the banking industry that deals directly with individual consumers and small businesses, offering a wide range of financial services. These services typically include checking and savings accounts, personal loans, credit cards, mortgages, auto loans, and other banking and financial products. The core objective of retail banking is to provide consumers with a convenient and accessible way to manage their finances, save, invest, and borrow money.

Traditionally, banks have been crucial in meeting the financial needs of their customers around the globe. However, their business strategies differed widely between countries and across different periods. In the wake of banking crises during the late 1920s and early 1930s, the United States and Japan imposed strict regulations on banks, most notably separating commercial and investment banking activities. In central Europe, in contrast, banks were permitted to offer a wide range of financial services, including asset management and payment processing, except for insurance (Omarini, 2022).

Up to the early 1970s, various factors, such as local regulations that limited competitive practices, fixed foreign exchange rates, and the nascent stages of capital markets, put limitations on the operations of Central European banks. Nonetheless, the economic boom post-World War II, coupled with a high reliance on bank financing and savings, ensured a thriving business environment. This era is often called the "production" phase, characterized by banks' focus on converting savings into loans and offering basic payment services, with little attention given to sales due to the strong demand for these services. The scene started to shift in the 1970s following the collapse of the fixed exchange rate system, a slowdown in economic growth, and the start of deregulation in capital markets and interest rates, leading to heightened competition. In response, banks started improving service quality and recognizing the importance of catering to customer needs, marketing, and promoting their products. (Omarini, 2022)

Entering the 1980s, the drive toward a market-oriented approach intensified amidst rising competition within and outside the finance sector. The evolution of retail banking varied among countries, yet all moved toward emphasizing market focus. Countries with less regulation, such as the UK, advanced toward a phase where marketing played a central role in operational strategy, focusing heavily on customer satisfaction and service quality. Technological progress, regulatory reforms, and shifts in consumer preferences converted the traditionally supply-driven financial sector into a competitive, market-driven arena, a change further hastened by the global financial crisis of 2007/2008 and the subsequent Eurozone crisis starting in 2010. These shifts influenced the competitive landscape and the internal dynamics of banks and their approach to service delivery, challenging the traditional confines of retail banking. The COVID-19 pandemic has accelerated the shift toward

Retail banking

a segment of the banking industry that deals directly with individual consumers and small businesses, offering services like checking and savings accounts, personal loans, credit cards, mortgages, auto loans, and various other banking and financial products

digital banking, with more consumers adopting online and mobile banking channels. This digital shift is likely permanent, posing a challenge to traditional banks that fail to adapt to the digital landscape (Omarini, 2022).

As the banking sector evolves, banks are pressured to focus on operational efficiency and product quality and explore new avenues for innovation and customer engagement. The rise of digital platforms and open banking fosters a more interconnected and cooperative business ecosystem. This ecosystem enables reduced transaction costs and promotes more integrated and agile operations, heralding a shift from the traditional banking model toward a more customer-centric paradigm. In this new model, the focus shifts to understanding and meeting customer needs rather than merely selling products. The banking sector navigates through this competitive landscape reshaped by the emergence of FinTech companies by responding to these challenges through four main approaches (Borah & Tellis 2014):

1. Holding
2. Making/building
3. Allying
4. Mergers and acquisitions (M&A)

The “hold” strategy involves banks continuing their operations with minimal changes but with a focus on revitalization to address potential threats. This entails updating existing products’ design, performance, and features to extend their life cycle and keep them relevant in the face of new FinTech alternatives.

Under the “make” or “build” strategy, traditional banks opt to internally develop new products, services, or solutions to directly compete with FinTech innovations. This route is viable for banks with the necessary resources, capabilities, and expertise to innovate independently.

The “ally” strategy sees incumbent banks collaborating with FinTech firms to leverage technological advancements while operating as separate entities. This strategy is particularly appealing when banks face high technological disruption but retain a strong and loyal customer base that is not immediately at risk. Alliances allow banks to access new technologies and FinTechs to benefit from the banks’ substantial customer base and regulatory expertise, creating mutual benefits.

The fourth strategy, M&A, involves banks acquiring FinTech companies outright, thereby integrating these challengers into their organizational structure. This response is chosen when banks confront significant disruption, both in terms of market competition and technological innovation, and find themselves unable to independently replicate FinTech’s advancements. Acquisitions enable banks to assimilate new technologies and innovations quickly, though they require substantial financial resources and strategic planning.

By adopting these strategies, particularly the ally and M&A approaches, banks aim to harness the strengths of FinTechs – like agility, innovation, and technology – to enhance their product offerings and service delivery. This collaborative approach mitigates the competition faced by FinTechs and opens up new avenues for growth and innovation within the

banking sector. The choice between strategies, such as allying with FinTechs or undertaking M&As, is influenced by a bank's resources and digital capabilities. While regional banks might lean on partnerships due to resource constraints, larger banks are more inclined to alliances or direct investments in FinTechs, seeking product-related collaborations over financial engagements. This reality suggests a preference for less institutionalized partnerships that offer minimal influence over FinTech's product development.

Analyzing specific banks like J.P. Morgan Chase & Co., Citi, and Banco Santander reveals varied approaches to tackling FinTech threats. While J.P. Morgan adopts a mixed strategy encompassing in-house development and acquisitions, Citi invests in FinTechs predominantly through its venture arm, Citi Ventures. Banco Santander primarily focuses on internal development to enrich its services or create new solutions. Despite these differences, a common thread is emphasizing technology investment as a priority and responding to the rapidly evolving customer needs with agile, personalized, and technologically advanced offerings (Omarini, 2022).

Despite the apparent mutual benefit of bank-FinTech partnerships, reality presents a more complex picture. Reports such as the World Retail Banking Report 2019 and the World FinTech Report 2020 highlight significant hurdles in these relationships (Capgemini, 2019, 2020). A minority of banks possess dedicated innovation teams with autonomy, encountering difficulties in integrating FinTechs, engaging with external mentors, and achieving agile collaboration. From the FinTech perspective, cultural and organizational discrepancies with banks, along with the banks' cumbersome processes, hinder efficient collaboration. The discrepancies often lead to frustration among FinTech firms, with many failing to identify suitable bank partners or fully comprehend banks' operations and scalability, occasionally resulting in failed projects.

Collaborations between banks and FinTechs are further encouraged by evolving regulatory environments that support open banking, digitalization, and advanced analytics. Successful partnerships require clear strategic objectives, a shared vision, and well-defined governance structures to ensure mutual benefits and achieve collective goals.

2.2 Payment Transactions

The origins of electronic payments can be traced back to the 1960s, with the emergence of the first ATM and the development of early electronic payment systems. A foundational element of modern electronic payment systems, the ATM allows customers to withdraw cash from their accounts outside traditional bank hours. Simultaneously, efforts were underway in the United States to develop electronic payment systems to handle credit card transactions more efficiently. In 1972, the Automated Clearing House (ACH), an electronic network for financial transactions, was established in the US. The network facilitated the processing of credit transfers, direct deposits, and other electronic payments between banks (Konheim, 2016).

Payment by Card

Moreover, the introduction of the magnetic stripe on credit cards in the early 1970s was another significant milestone. This technology enabled cards to store account information electronically, paving the way for the electronic systems appearing later in that decade. Electronic funds transfer at point of sale (EFTPOS) and point of sale (POS) systems enable electronic payment transactions while purchasing goods and services. EFTPOS is a specific technology or system that facilitates electronic payments directly from a customer's bank account to the retailer's bank account. It requires using a debit or credit card and a PIN for authentication. The system processes the card through a terminal, connecting to the customer's bank to authorize the transaction and transfer funds from the customer's account to the merchant's account, typically in real-time.

POS refers to the broader system or setup where sales transactions are made, which can include hardware (like cash registers, computers, and card readers) and software (for managing the sales process, inventory, customer data, etc.). While POS systems include the capability to process EFTPOS transactions, they encompass a much broader range of functionalities beyond payment processing. POS systems are capable of processing various payment methods, including EFTPOS, credit cards, contactless payments, and sometimes even mobile payments and traditional cash. They integrate sales data with inventory management, customer relationship management (CRM), and accounting software. The system provides detailed reports on sales, customer behavior, and inventory levels, aiding in business analysis and decision-making (Goldfinch, 2019)

A traditional credit card issuer is typically a financial institution, such as a bank or credit union, that offers credit card products to consumers and businesses. These issuers enter into agreements with payment processing networks like Visa, MasterCard, or American Express to allow cardholders to make purchases on credit. The role of a traditional credit card issuer encompasses evaluating applications, setting credit limits, issuing cards, billing for purchases, charging interest on balances, and collecting payments. They rely on extensive credit risk assessment and use historical financial data to make lending decisions, often resulting in a lengthy and paperwork-intensive application process. Traditional credit card issuers operate within a strict regulatory framework and are subject to oversight by financial authorities, ensuring the security and fairness of credit transactions. Traditional issuers often have a physical presence in the form of branches where customers can apply for cards, make payments, or resolve issues. Revenue is primarily generated through interest on outstanding balances, annual fees, late payment fees, and transaction fees from merchants. Beyond issuing credit cards, they typically offer a broad range of financial products and services, including banking accounts, loans, and investment products (Goldfinch, 2019).

Contactless Payment

Near field communication (NFC) technology facilitates contactless payment solutions by allowing two devices to communicate when they are nearby, typically within a few centimeters. It has become increasingly popular for making quick and secure transactions in various retail and public transport systems worldwide. NFC is a form of radio communication technology that operates at the 13.56 MHz frequency. It enables two-way communi-

cation between electronic devices. In the context of payment, these devices are usually payment terminals equipped with NFC capability and an NFC-enabled credit card, smartphone, or wearable device like a smartwatch. The NFC-enabled device of the customer could be a smartphone, a smartwatch, or an NFC-enabled credit/debit card. Smartphones and smartwatches often use a mobile wallet app (e.g., Apple Pay, Google Pay, Samsung Pay) where users can add their credit/debit card information. The NFC payment terminal is the POS system equipped with NFC technology to receive payment information from the NFC-enabled device (Giese et al., 2019).

Near field communication (NFC)
technology that facilitates contactless payment solutions by allowing two devices to communicate when they are in close proximity

The customer initiates a payment by bringing their NFC-enabled device close to the NFC payment terminal. For smartphones and smartwatches, this usually involves unlocking the device and opening the mobile wallet app if not automatically prompted. In the case of an NFC-enabled credit card, the card is tapped or waved near the terminal. When the NFC-enabled device and the payment terminal are close (usually less than 4 cm apart), an electromagnetic field is created, allowing encrypted data transfer. These data include payment credentials such as the card number, expiry date, and a one-time code or token generated for the transaction, enhancing security. The payment terminal receives the necessary information and processes the payment through the merchant's acquirer to the relevant financial networks for authorization. The issuing bank receives the payment request, verifies the transaction details, including the one-time code or token, for security purposes, and either approves or declines the transaction. This authorization communication happens almost instantaneously, with the whole process from tapping to approval taking just a few seconds. Once the transaction is authorized, the payment terminal confirms the successful payment to the merchant and the customer. The transaction amount is debited from the customer's account linked to the NFC-enabled device. The secure, quick nature of NFC payments contributes to a seamless transaction experience, reducing the need for physical contact, entering PINs, or signing receipts (Giese et al., 2019).

E-Wallets

An **e-wallet** is a digital platform for storing and managing payment information. They serve as a virtual wallet that can replace physical cards and cash. E-wallets often incorporate various technologies, including but not limited to NFC, to facilitate transactions. Using an e-wallet, users can complete purchases easily and quickly with online retailers and in physical stores. E-wallets can store credit card numbers, debit card information, and login credentials, enabling users to make cashless transactions or even peer-to-peer transfers. Examples of e-wallets include PayPal, Google Pay, Apple Pay, and Samsung Pay.

E-wallet
a software-based system that securely stores users' payment information and passwords for numerous payment methods and websites

In essence, while an e-wallet is a digital container of payment methods and other personal information, NFC communicates payment information stored in an e-wallet to a payment terminal. E-wallets rely on technologies like NFC to securely and quickly complete transactions without physical cards or cash (Blakstad & Allen, 2018).

Peer-to-Peer payments

Peer-to-peer (P2P) payments represent a modern technological advancement in financial transactions, allowing individuals to transfer funds from their bank account or credit card to another individual's account via the internet or a mobile device. This innovation in pay-

ment processing leverages digital platforms to facilitate direct transactions between peers, bypassing traditional banking procedures and intermediaries. P2P payment systems have gained significant traction due to their convenience, speed, and ease of use, fundamentally changing how people manage personal transactions (Perea-Khalifi et al., 2024).

P2P payments are executed through digital applications or platforms that require users to create accounts linked to their banking or credit card information. Users can send money to anyone within the same network by entering the recipient's email address, phone number, or a unique identifier provided by the payment service. The transactions can be funded from a bank account, credit card, or available balance within the P2P platform. Upon initiating a transfer, the funds are immediately deducted from the sender's account and credited to the recipient's account, who can then transfer the funds to their bank account or keep them in their digital wallet for future transactions. Examples are PayPal, Venmo, CashApp, or Zelle.

While P2P payment platforms incorporate rigorous security measures, including encryption and fraud monitoring, users must remain vigilant. It's crucial to only transact with known and trusted parties due to the difficulty of reversing payments once they are sent. Moreover, users should employ strong, unique passwords and enable two-factor authentication (2FA) to enhance account security. The future landscape of P2P payments appears promising, driven by continuous technological advancements and increasing consumer demand for digital financial solutions. Innovations such as blockchain and cryptocurrency are poised to further transform P2P payments, offering greater efficiency, reduced costs, and enhanced security (Perea-Khalifi et al., 2024).

2.3 Wealth Management

Wealth management
a comprehensive approach to handling an individual's or a family's financial, investment, tax, legal, and estate planning

Wealth management is a subset of private banking that involves creating a tailored strategy to manage a client's wealth, considering its growth, preservation, and distribution, often across generations. Wealth management services are typically aimed at high-net-worth individuals (HNWIs) and ultra-high-net-worth individuals (UHNWIs). However, the democratization of finance through technology is rapidly changing its accessibility and scope (Santos, 2021).

Wealth management, in various forms, has been around for centuries, tracing its origins back to the need for secure storage of valuables. In ancient times, wealth was predominantly stored in physical assets like gold, land, and livestock. The concept of wealth management evolved significantly in the Renaissance period when wealthy European families began seeking strategies to manage their finances, leading to the emergence of private banking services in cities like Florence and Venice. The 19th and 20th centuries witnessed the establishment of family offices, private banks, and investment firms in financial capitals such as London and New York. These institutions offered various services, including investment advice, estate planning, and, later, tax advisory services, increasingly resem-

bling today's wealth management practices. The latter half of the 20th century saw wealth management services become more structured, leveraging emerging financial theories and models to optimize portfolio returns against risks.

Traditionally, wealth management has been a high-touch, personalized service characterized by one-on-one relationships between advisors and their clients. Advisors leveraged their expertise and market access to advise on investments, manage portfolios, plan for estates, mitigate taxes, and sometimes address more niche needs like philanthropy. These services were typically fee-based, often calculated as a percentage of assets under management (AUM). Despite its bespoke nature, traditional wealth management faced criticisms for lack of transparency in fees, potential conflicts of interest, and a perception of exclusivity that left out emergent affluent individuals and mass-market customers. The rise of FinTech companies in the last two decades has profoundly impacted wealth management. Driven by technological advancements, data analytics, and online platforms, FinTech has democratized access to wealth management services, making them available to a broader audience beyond the traditional HNWI demographic (Paxmann et al., 2017).

Robo-Advisors

One of the most notable developments has been the emergence of **robo-advisors**. Platforms like Betterment and Wealthfront debuted in the early 2010s, offering low-cost investment advice based on clients' goals and risk tolerance, assessed through online questionnaires. The appeal of robo-advisors has grown significantly in recent times, attributed to their user-friendly interfaces, affordability, and straightforward access. Nevertheless, these digital platforms come with challenges and limitations, such as security concerns and a lack of the personalized advice and human interaction from traditional financial advisors (Scholz, 2021).

Robo-advisors
automated platforms that provide algorithm-driven, personalized investment management with minimal human intervention

Established in 2008, Betterment has emerged as a leading robo-advisor in the market. It provides a variety of investment portfolios tailored to suit the unique needs of its users. Utilizing sophisticated algorithms, Betterment assists investors in devising investment plans that align with their objectives, risk appetite, and time frames for investment. Additionally, it offers strategies aimed at enhancing tax efficiency and features automatic portfolio rebalancing, aiming to optimize investor returns (Scholz, 2021).

Launched in 2011, Wealthfront stands out as another prominent robo-advisor offering automated investment management solutions. Like Betterment, Wealthfront presents multiple investment portfolio options that align with individual investor requirements. Its algorithms guide users in tailoring investment strategies that match their financial goals, tolerance for risk, and investment durations. Moreover, Wealthfront automatically aggregates tax-loss harvesting and portfolio rebalancing, seeking to augment investors' returns (Scholz, 2021). Both platforms signify the shift toward digital investment management, underscored by the use of advanced algorithms to offer tailored, strategic investment solutions. (Scholz, 2021).

Wealth Management and Technology

Integrated platforms

FinTech firms have also developed integrated wealth management platforms that offer services from investment management to financial planning, estate planning, and real-time analytics, all accessible via smartphones or computers. These platforms provide greater transparency, allowing users to actively monitor and manage their financial well-being.

Blockchain and cryptocurrency

Blockchain technology and cryptocurrencies have introduced new asset classes and enabled innovative ways of managing and transferring wealth. FinTech is at the forefront, exploring decentralized finance (DeFi) and tokenization as investment, diversification, and estate planning tools.

Big data and artificial intelligence

Artificial intelligence (AI) and big data analytics are increasingly used to enhance client profiling, personalize financial advice, optimize portfolio management, and automate operational processes in wealth management. The technology improves service delivery and enables more sophisticated risk assessment and management.

Social Responsibility and Impact Investing

Modern investors, especially millennials and Gen Z, show a growing interest in socially responsible and impact investing. FinTech platforms are leading the charge in providing access to investment opportunities that align with personal values regarding environmental, social, and governance (ESG) issues (Blakstad & Allen, 2018).

While FinTech innovations have expanded access and added efficiency to wealth management, they also bring challenges such as data security concerns, regulatory compliance issues, and the need for continuous technological updates. Moreover, the personalized nature of traditional wealth management still holds value for clients who prefer human interaction, especially for complex financial planning and advisory services. The future of wealth management likely lies in a hybrid model that combines FinTech's efficiency and accessibility with the personalized touch of traditional advisory services.

Wealth management firms are increasingly adopting AI to improve their services and streamline their operations. AI can identify market trends, suggest portfolio composition, automate tasks such as investment research, and improve client engagement, experience, and productivity. Wealth managers can target potential clients and customize pitches by micro-segmenting prospects based on social media, news items, and public data sources. In addition, AI can help financial institutions invest strategically, with potential benefits including reduced client costs and improved risk management.

2.4 Financing

Financing plays a crucial role in the development and sustainability of any business activity or project. It involves acquiring or providing funds necessary for business functions, enabling the purchase of assets, maintenance of operations, and seizing growth avenues. Financing varies widely in its forms, each presenting unique benefits and potential drawbacks.

Equity financing allows investors to share proportionately in the company's profit (or loss) to their investment. Key forms of equity financing include

- venture capital. Typically sourced from specialized firms or investment funds, venture capital targets small, burgeoning companies with the potential for significant growth.
- angel investors. Individual investors who provide capital for startups and small ventures believed to have long-term growth prospects.
- initial public offerings (IPOs). A privately owned company offers shares to the public for the first time, transitioning to a publicly-traded entity.

Equity financing

trading a portion of a company's ownership, such as shares or stock, in exchange for capital from investors

Debt financing can come from various sources, including financial institutions and bond issuance, encompassing

- line of credit. These agreements allow businesses to borrow up to a predetermined limit for operational purposes.
- bonds: Fixed-income securities representing a loan from an investor to a borrower, often a corporation or government, repaid at a fixed interest rate by a specified date.
- bank loans. In traditional lending, companies borrow from banks, committing to pay back the loan amount plus the interest.

Debt financing

borrowing funds to be repaid, with interest, at a fixed future date

Crowdfunding Platforms

FinTech has redefined financing, offering new avenues for funding that are efficient and often less costly. Crowdfunding represents a revolutionary method of raising capital, harnessing the power of the collective to support projects, businesses, and personal endeavors. It leverages the internet and social media to gather small amounts of money from a large number of people, effectively democratizing access to funding. Unlike traditional financing methods that rely on a few investors or institutions, crowdfunding taps into the broader public, allowing creators, innovators, and entrepreneurs to pitch their ideas directly to potential backers worldwide (Bock et al., 2022). Crowdfunding manifests in several distinct forms, each with its unique attributes and purposes.

Donation-based crowdfunding

This altruistic form allows individuals to donate to causes and projects without expecting anything in return. It's often employed for charitable initiatives, disaster relief, medical expenses, or community projects. Websites like GoFundMe epitomize this type, facilitating fundraising for personal and social causes (Bock et al., 2022).

Rewards-based crowdfunding

Backers contribute funds in exchange for tangible rewards or products proportional to the amount pledged. This model is prevalent among startups and creative projects, where supporters might receive early versions of a product, acknowledgments, or exclusive experiences. Kickstarter and Indiegogo are iconic platforms in this domain, helping bring innovative products, films, music albums, and art projects to life (Bock et al., 2022).

Equity-based crowdfunding

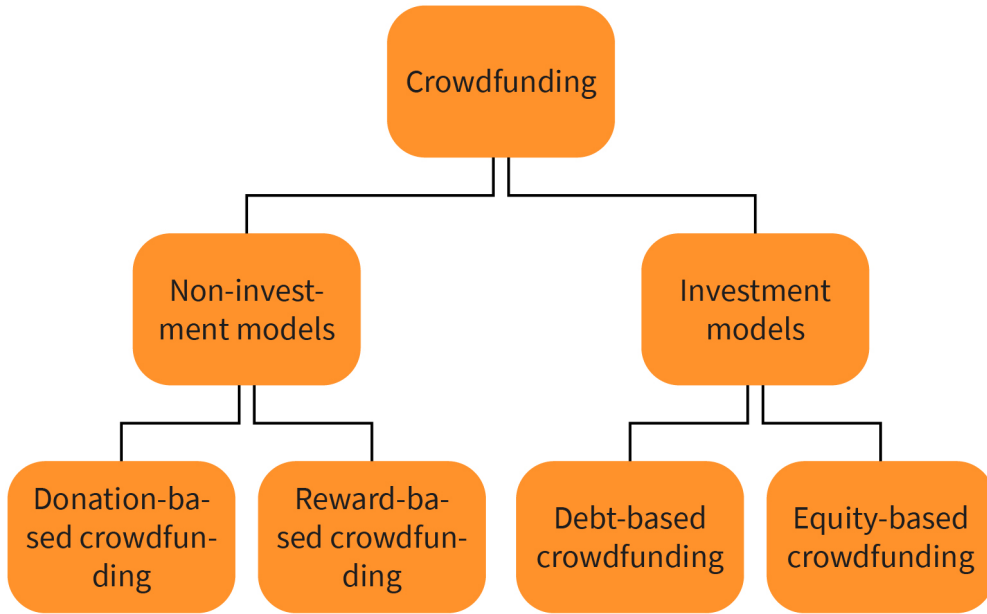
In this model, contributors invest capital in a startup or business in exchange for equity shares. It enables investors to own a portion of the company, participating in its potential success and financial returns. This crowdfunding type is facilitated by platforms like Crowdcube, which gives early-stage companies a pathway to access public funding (Bock et al., 2022).

Debt-based crowdfunding

Also known as P2P lending, this format connects borrowers with individual lenders online, bypassing traditional financial institutions. Borrowers receive loans they must repay with interest, while investors earn returns on the lent amounts. Prosper and LendingClub are notable examples, offering loans for various purposes, including personal, business, and debt consolidation. P2P lending proposes several advantages, such as accelerated approval and funding, reduced paperwork, and competitive interest rates, albeit sometimes presenting higher costs for those with lower credit scores (Lakhotia, 2021).

The connection of the different crowdfunding models is illustrated in the following figure.

Figure 4: Crowdfunding Models



Source: Manuela Ender (2024).

Alternative text:

Despite the conveniences brought by FinTech, potential risks like fraud, hacking, and algorithmic bias warrant caution. The shift toward digital financing, while making capital more accessible, calls for carefully considering the limitations and risks of these new tools.

2.5 Scope of FinTech in Financial Inclusion

Over the past ten years, we have witnessed remarkable advancements toward establishing an efficient and sustainable energy infrastructure. This progress includes an escalation in renewable energy sources, strides in energy efficiency, collectively mitigating reliance on imported fossil fuels, and aiding in the systematic decrease of greenhouse gas emissions. Aiming for substantial carbon reductions by 2050, all countries are now urged to amplify their commitment to low-carbon technologies, address institutional and regulatory hurdles, and intensify competition within the energy sector.

The financial arena has emerged as an indispensable catalyst in the transition toward low-carbon energy solutions. Aligning with the United Nations Sustainable Development Goals (United Nations, n.d.) and the Paris Climate Agreement's climate mandates (United Nations Framework Convention on Climate Change, 2015), an estimated global investment of around \$100 billion is necessary. Specifically, fostering efficient energy systems free from adverse climate impacts will require an annual investment ranging from \$1.6 to \$3.8 trillion from 2020 to 2050. Given the importance of energy efficiency and the shift toward low-carbon energy systems, these figures underscore the urgent need for focused efforts in this domain (Liu et al., 2022).

Recent developments in FinTech are poised to enhance financial inclusivity and overall well-being significantly. FinTech's transformation of financial operations and services has merited academic interest, showcasing its role in alleviating poverty, reducing economic instability, and spurring urban development. FinTech promises ecological advantages by promoting renewable energy through innovative financing methods. Collaborative efforts involving multilateral financial institutions and community organizations illustrate how renewable energy financing can be effectively mobilized, with technological advancements playing a crucial role in accelerating energy efficiency improvements. The synergy between FinTech and green finance is increasingly recognized as a driver for green finance accessibility and investment. By leveraging data analytics and AI, FinTech initiatives enhance the transition toward a green economy, highlighting the potential of technology to address market barriers and reshape energy systems for enhanced efficiency. The issuance of green bonds, highlighted as a mechanism to boost capital flow for energy efficiency projects, further illustrates the intertwined roles of FinTech and green finance in promoting sustainable solutions (Liu et al., 2022).

Financial inclusion refers to equal opportunities for individuals and businesses to access financial products and services. These services include but are not limited to, savings accounts, loans, insurance, and payment services, which should be accessible, convenient, and affordably priced. Financial inclusion aims to remove the barriers that exclude people from participating in the financial sector, thus contributing to poverty reduction and economic growth. FinTech companies leverage technology to break down traditional barriers to financial services. They extend financial services to remote or underserved areas lacking physical banking infrastructure through mobile banking and digital platforms. This accessibility ensures that more people can participate in the financial system, even those living in rural or less economically developed regions. FinTech innovations often operate at lower costs than traditional banking institutions. By employing advanced technologies such as AI and blockchain, FinTech firms can offer lower transaction fees, reduced loan rates, and minimal account maintenance fees. This cost-effectiveness encourages wider usage among individuals who might otherwise be unable to afford these services.

Big data analytics allows FinTech firms to deeply understand their customers' needs and behaviors. This insight enables the development of personalized financial products and services suited to diverse customer segments, including microloans, pay-as-you-go insurance, and tailored savings plans, thus fostering inclusivity. Many FinTech companies provide educational resources and tools to their users, promoting financial literacy. Enhanced understanding of financial products and services increases individuals' confidence in

using these services more effectively, further fostering financial inclusion. FinTech solutions streamline complex financial processes, making them more user-friendly. Features like one-click payments, simplified loan applications, and real-time transaction notifications contribute to a more approachable financial environment for the broader populace (Blakstad & Allen, 2018).

The effectiveness of FinTech in promoting financial inclusion depends on the availability of internet connectivity and smart devices. In regions where such technology infrastructure is lacking or where access to electricity is inconsistent, FinTech's reach is significantly limited. While FinTech aims to simplify financial transactions, a certain level of digital literacy is required to navigate these platforms effectively. Populations unfamiliar with digital technology or those uncomfortable with non-traditional banking methods may find it challenging to engage with FinTech services. The digital nature of FinTech services raises concerns regarding data privacy and security. Users may hesitate to adopt FinTech solutions due to fears of cyberattacks, fraud, or misuse of personal information, which can hinder financial inclusion efforts. In many regions, the legal and regulatory frameworks have not kept pace with FinTech innovations, creating uncertainty around the legality and stability of FinTech operations. This uncertainty can deter individuals from using these services, impeding financial inclusion initiatives. While FinTech has the potential to democratize access to financial services, there is also a risk that it could widen existing socioeconomic disparities. Those without access to the necessary technologies or the skills to use them may be further marginalized from the financial system (Blakstad & Allen, 2018).

In conclusion, while FinTech presents a transformative opportunity to advance financial inclusion, realizing its full potential requires addressing the existing digital divide, enhancing cybersecurity measures, and developing supportive regulatory frameworks. Balancing innovation with inclusivity will be crucial in ensuring FinTech benefits all sections of society, especially the most vulnerable.



SUMMARY

Retail banking has evolved to include digital and personalized services due to regulatory changes, competition, and technological advancements. The sector faced disruption from the 2007/2008 financial crisis and digital acceleration during COVID-19, prompting a pivot toward online, customer-focused solutions. Banks are now leveraging technology, forming alliances with FinTech firms through partnerships and acquisitions to stay ahead despite challenges in aligning different corporate cultures and operations.

Payment systems transformed with the advent of ATMs, credit card enhancements, and electronic transaction methods, leading to the convenience of contactless and digital payments. Once exclusive to the affluent, wealth management is now accessible through FinTech innovations like robo-advisors, blockchain, and AI, offering personalized invest-

ment strategies to a broader audience. Financial support for businesses has evolved from traditional equity and debt financing to include FinTech-driven solutions like crowdfunding and peer-to-peer lending, providing diverse funding alternatives.

FinTech significantly contributes to financial inclusivity and the promotion of green finance by introducing creative methods for renewable energy funding, making financial services more accessible, and fostering wider economic participation.

UNIT 3

FINTECH AND AI UNDERLYING TECHNOLOGIES

STUDY GOALS

On completion of this unit, you will be able to ...

- understand the contemporary developments in banking technology.
- evaluate the benefits and drawbacks of cloud banking.
- analyze the potential of blockchain, DLT, and smart contracts to transform financial transactions.
- examine the role of machine and deep learning in fraud detection and risk management.
- explore the potential applications of neuroscience in finance and its customer behavior analysis.

3. FINTECH AND AI UNDERLYING TECHNOLOGIES

Case Study

In the fast-evolving world of finance, where traditional banks grapple with the relentless pace of technological innovation, JPMorgan Chase & Co., one of the oldest financial institutions, embarked on a transformative journey. This journey led to the creation of the COIN (Contract Intelligence) program, an initiative that epitomizes how artificial intelligence (AI) can not only streamline complex processes but also redefine operational efficiencies in the banking sector. The genesis of COIN was rooted in a rather mundane yet critical legal task: the review and interpretation of commercial loan agreements. Previously, this task was performed manually by skilled legal staff, consuming an astonishing 360,000 hours of work each year. Given the complexity and voluminous nature of loan agreements, the process was time-consuming and prone to human error (Jain, 2023; Kumari et al., 2021).

JPMorgan Chase & Co., recognizing the need for a more efficient and accurate solution, turned to the burgeoning field of AI. The bank sought to leverage technology to enhance its operational effectiveness, reduce staff workload, and, importantly, secure a competitive edge in the technologically driven banking landscape. The COIN program utilizes advanced natural language processing (NLP) algorithms and machine learning techniques to dissect, understand, and analyze the text within thousands of legal documents. This AI-driven system can quickly interpret the vast and complex language of commercial loan agreements, identifying relevant clauses and extracting critical data points with precision unmatched by human efforts (Jain, 2023; Kumari et al., 2021).

The impact of the COIN program on JPMorgan Chase & Co.'s operations was immediate and profound. By automating the review process, COIN drastically reduced the time spent analyzing loan agreements from thousands of human hours to mere seconds. This automation represented a remarkable efficiency leap, significantly cutting operational costs and minimizing the risk of human error. The time savings allowed legal and financial experts at JPMorgan Chase & Co. to redirect their focus toward more strategic tasks that required human insight and expertise, thereby enhancing overall productivity and job satisfaction. Moreover, COIN's success demonstrated the potential for AI and technology to transform traditional banking operations. It became a testament to how adopting innovative technologies could directly contribute to a bank's competitive advantage (Jain, 2023; Kumari et al., 2021).

3.1 Contemporary Developments in Banking Technology

In the era of digitization, contemporary developments in banking technology are focusing on enhancing customer experience, securing transactions, and improving operational efficiency. This revolution is driven by advancements in AI, blockchain, digital payment systems, and the emergence of FinTech companies challenging traditional banking paradigms.

Blockchain, the underlying technology behind cryptocurrencies, offers unparalleled security and transparency for financial transactions. It enables the execution of transactions without a central authority, reducing the possibility of fraud and errors. Blockchain's potential has led to its application beyond cryptocurrency into cross-border payments, identity verification, and smart contracts. One prominent example is Ripple, a blockchain-based digital payment protocol used by various financial institutions for quick and cost-effective international money transfers (Chiu & Deipenbrock, 2021).

Cloud banking refers to using cloud computing technology to deliver services and solutions. Banks can achieve unprecedented scalability, flexibility, and efficiency by leveraging the cloud, transforming how they manage data, run applications, and serve customers. Cloud-based platforms enable financial institutions to rapidly deploy new services, enhance security protocols, and achieve cost efficiencies by reducing the reliance on physical IT infrastructure.

AI and machine learning are at the forefront of transforming banking operations. Banks harness these technologies for personalized banking experiences, enhancing customer service through chatbots and virtual assistants and improving security measures. AI algorithms can analyze vast amounts of data to predict customer behavior, tailor financial products, and detect fraudulent activities in real time (Chiu & Deipenbrock, 2021).

Fares et al. (2023) focus on understanding how AI influences the journey of banking customers. Within the context of AI's integration in banking, especially in areas like credit applications and granting decisions, the authors found significant implications for customer accessibility and engagement. Their model delineates the customer's journey into four key segments: the customer's pathway, the front-stage interactions, the back-stage support, and the overarching support processes. The initial phase of this journey commences with acquiring the customer, transitioning through to the decision on credit and post-decision support. This part of the journey starts with strategies to attract potential customers to bank websites, with the ultimate goal of converting them into active clients.

The front-stage processes include personalized advertising and leveraging AI technologies like the multi-armed bandit approach to optimize ad performance and enhance customer acquisition. Support processes at this stage utilize AI to discern and cater to customers' banking preferences, with machine learning algorithms refining customer segmentation and adoption strategies. During the subsequent phase of the journey, where customers visit a bank's website and apply for a credit solution, AI plays a transformative role. Robo-advisors guide customers in selecting appropriate credit options based on their financial

data and instant credit checks. AI enriches the service offering and personalizes the banking experience. Its task-oriented and problem-solving capabilities further enhance this experience by optimizing data collection and application processes. However, this stage also underscores the importance of trust, as customers' willingness to share personal information hinges on their confidence in the banking institution. Upon application submission, AI-driven data mining and machine learning processes promptly analyze customer information to render swift and accurate credit decisions. This innovative approach drastically reduces the traditional waiting period for credit approval, empowering customers with immediate feedback. This stage necessitates a delicate balance between minimizing risk for the bank, maximizing profitability, and promoting financial inclusion and credit scoring enhancements (Fares et al., 2023).

When a manual review or human intervention is required, the relationship between customers and AI evolves. While AI offers numerous advantages in streamlining processes and enhancing decision-making, cases involving complex decision-making or potential errors by AI algorithms highlight the indispensable role of human oversight. The blend of AI with human judgment not only addresses the limitations of AI but also preserves the essence of relationship banking, which remains a competitive edge for financial institutions. Banks can further optimize this collaborative framework by leveraging AI to schedule appointments efficiently and reduce service time, thus maximizing customer satisfaction and operational efficiency.

From personalized advertising and robo-advisory services to sophisticated data analysis for credit decisions, AI significantly influences each stage of the customer experience. However, the blueprint also emphasizes the critical role of human-AI collaboration in maintaining trust, ensuring accuracy, and fostering a relationship-driven banking environment. As the banking sector continues to evolve with AI advancements, this blend of technology and human expertise will remain pivotal in enhancing customer journeys and driving the future of banking innovation (Fares et al., 2023).

3.2 Cloud Banking

Cloud banking refers to using cloud computing technology in the banking sector to deliver various financial services such as core banking, digital banking, and payment systems. The emergence of cloud computing has marked a significant shift in how activities and organizational processes are managed, enabling swifter and more efficient modes of communication. Fundamentally, cloud computing signifies the progression of numerous preexisting technological methodologies and theories. It achieves this by abstracting the storage of information and application resources from the underlying frameworks and mechanisms responsible for their delivery. This abstraction facilitates enhanced collaboration, scalability, availability, and agility, all while offering financial benefits to individual consumers and businesses. Essentially, cloud computing enables the utilization of diverse applications, data storage solutions, and infrastructures, allowing for distributed services (Vinoth et al., 2022).

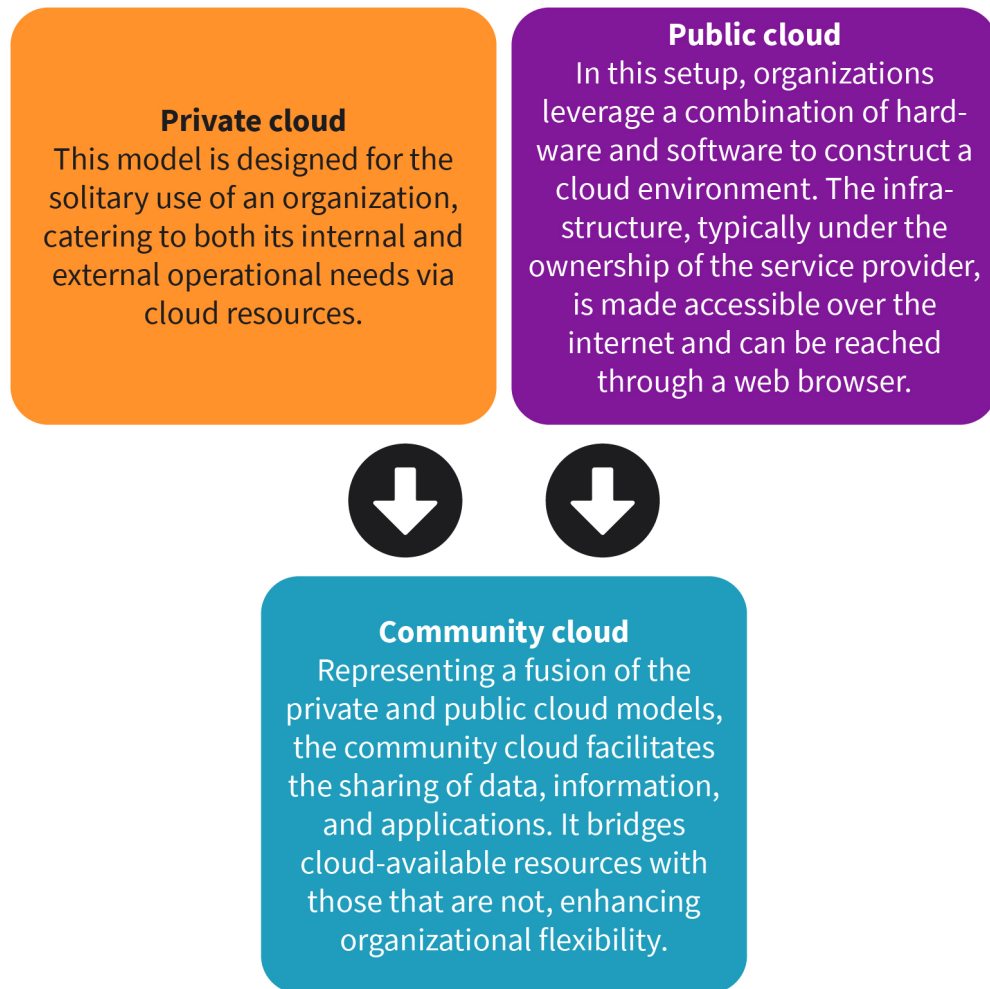
Defined by its ability to provide computing resources and services on demand over the network without the limitations of local resources, cloud computing encompasses storage, applications, and various servers. It is heralded for its capacity to offer instantaneous network access to data and resources from any location. Cloud computing's relevance extends beyond large corporations to individuals, offering benefits on a personal level as well. Key attributes of cloud computing include (Al-Malahmeh, 2023):

- **on-demand self-service.** Users can autonomously access data and resources on the cloud without human intervention.
- **broad network access.** Resources are accessible over the network using various devices, such as tablets, smartphones, and laptops.
- **resource pooling.** Computing resources are aggregated to serve multiple users in a multi-tenant model, dynamically allocated based on demand.
- **rapid elasticity.** The system's capacity to quickly scale resources up or down in response to workload changes distinguishes cloud computing from other models, such as grid computing.
- **measured service.** Usage of cloud services is measurable through various metrics, allowing for a pay-as-you-go pricing model based on actual consumption levels.

These characteristics underscore the transformative impact of cloud computing on organizational activities and individual behaviors, illustrating its pivotal role in the broader technological landscape.

As highlighted by Al-Malahmeh (2023), cloud computing encompasses a variety of models and deployment strategies, the most prominent of which are shown in the following figure.

Figure 5: Deployment Strategies of Cloud Computing



Source: Manuela Ender (2024).

Alternative text:

Models

Cloud computing services evolved based on organizational requirements, leading to numerous models and architectures over time (Al-Malahmeh, 2023).

Infrastructure as a Service (IaaS)

This foundational model provides organizations access to infrastructure elements located in data centers, such as servers, storage systems, and virtual simulators, on a rental basis, eliminating the need to invest in physical infrastructure (Al-Malahmeh, 2023).

Platform as a Service (PaaS)

Built upon the IaaS model, PaaS offers additional resources, including hardware tools and software necessary for application development, and essential infrastructure components and operating systems. This model is typically subscription-based (Al-Malahmeh, 2023).

Software as a Service (SaaS)

With SaaS, the service provider is responsible for hosting and managing the entire infrastructure in the cloud on behalf of the end user. Organizations opting for this model have the convenience of accessing applications directly without the need for installations. Users can log in and immediately engage with the cloud-based applications run on the provider's infrastructure (Al-Malahmeh, 2023).

Applications

Cloud computing has found substantial applications in the banking sectors, significantly reshaping their landscape (Vinoth et al., 2022).

Open-access commercial online banking portals

A leap into the future generation of online banking, this application allows commercial users to access a comprehensive suite of offerings, including services, products, and information. While some of these offerings are provided directly by the banks, a considerable portion is sourced from third-party providers (Vinoth et al., 2022).

Widget-based internet banking applications

Primarily tailored for the retail banking industry, these innovative online banking solutions enable customers to personalize the user interface of their internet banking platform and the manner and substance of the goods and information they access. This personalization is achieved by adopting widget- or gadget-based technologies (Vinoth et al., 2022).

Benefits

Vinoth et al. (2022) identified the benefits of adopting cloud computing in the banking sector.

Cost efficiency and usage-based billing

Banks can capitalize on cloud computing to convert substantial upfront capital expenditures into manageable operating costs. This approach negates the need for hefty investments in new hardware or software. Additionally, the pay-as-you-go nature of cloud computing allows financial institutions to utilize services as needed (Vinoth et al., 2022).

Business continuity

With cloud computing, the service provider assumes responsibility for the technological upkeep, enhancing data protection, fault tolerance, and disaster recovery processes. This approach offers greater redundancy and backup solutions at a lower cost than traditional systems (Vinoth et al., 2022).

Enhanced business agility and focus

The agility afforded by cloud-based operations can significantly shorten product development cycles, allowing financial institutions to swiftly meet the evolving needs of their clients. The on-demand nature of the cloud reduces infrastructure investments and accelerates the initiation of new projects. By outsourcing non-essential tasks like maintenance and software updates to the cloud, businesses can concentrate more on financial services than IT concerns (Vinoth et al., 2022).

Environmental sustainability

By transitioning services to a virtual setup, IT firms can reduce energy use and minimize their carbon footprint associated with physical infrastructures. Efficient use of processing power and minimized idle time further contribute to sustainability (Vinoth et al., 2022).

Many large-scale enterprises remain unconvinced about the safety of transmitting and storing their extensive datasets via the internet. The successful deployment of cloud computing within an organization demands meticulous planning, awareness of potential emerging threats, and a solid understanding of possible solutions. A key challenge lies in creating secure applications from potentially unsecured components, marking an essential aspect of cloud computing security. While cloud computing promises cost savings for businesses, the associated security risks warrant careful consideration. Owing to the inherent vulnerabilities of cloud computing architecture, there is an immediate need to pinpoint specific security threats. Ensuring safety entails a comprehensive evaluation of cloud networks to uncover vulnerabilities and attacks, followed by identifying and implementing suitable measures to bolster security and privacy within cloud environments. Some security concerns associated with cloud banking technology are (Vinoth et al. 2022):

- **multi-tenancy.** The shared access to physical or virtual resources among various users and banks raises concerns about data privacy and access control.
- **analysis risks.** The analysis of sensitive information in the cloud can pose security threats, especially when monitoring critical activities such as new process executions or file creations.

- **semantic gap.** Deriving meaningful insights from low-level data challenges maintaining relevance and utility.
- **loss of control.** Storing data in the cloud implies relinquishing physical ownership of that information, leading to potential security risks and uncertainty regarding the complete deletion of data even when files are removed from the cloud.
- **trust issues.** Removing physical control over data necessitates building trust among users, with companies striving to achieve this through compliance with established security standards.
- **attack vulnerability.** Due to its virtual architecture, this environment faces heightened risks of information-driven buffer attacks.
- **performance and security trade-offs.** Maintaining optimal performance while ensuring robust security is crucial for user and administrator satisfaction in the dynamic digital ecosystem.
- **regulatory compliance.** Financial institutions are required to comply with various regulations and standards, such as the Payment Card Industry Data Security Standard (PCI DSS), the General Data Protection Regulation (GDPR), and the Federal Financial Institutions Examination Council (FFIEC) guidelines. Outsourcing data and operations to a third-party provider can create compliance issues if the provider fails to meet the regulatory requirements.
- **vendor lock-in.** Financial institutions may become reliant on the third-party provider's services, making it difficult to switch to another provider in the future. This restriction may lead to increased costs and reduced flexibility, especially if the provider raises prices or changes its terms and conditions.

To summarize, cloud computing ranks among the most significant technological breakthroughs, capturing the attention of professionals across the globe. It offers numerous benefits, such as scalability, rapid expansion capabilities, and measurable services, with cost efficiency being a particularly appealing feature for organizations. However, it's also accompanied by a plethora of security challenges that cannot be overlooked. These concerns stem from a wide array of vulnerabilities within any cloud computing architecture. Without robust security measures, organizations, especially financial institutions, might hesitate to adopt cloud computing.

3.3 Blockchain, DLT, and Smart Contracts

Blockchain technology allows individuals to securely send money and other assets over the network through advanced security measures. It employs encryption techniques similar to those found in other internet applications but recombines these in novel ways. We start with a focus on cryptographic hash functions, which are crucial to blockchain functionality – especially for the proof of work (PoW) algorithm. However, hash functions find their application in several other domains, like digital signatures.

Blockchain technology decentralized ledger technology for secure, transparent, and tamper-proof transactions

Hash function
algorithm generating
fixed-size output from
variable-size input data
securely

A cryptographic **hash function** produces a fixed-length string from any size of data input in a predictable manner, whether the data are single words, sentences, numbers, or files. This resultant string, also known as a hash, digital fingerprint, or message digest (MD), is generated through one-way functions, making it exceedingly difficult to deduce the original input from the output (Swan, 2015).

Blockchain operates on diverse cryptographic methods in financial applications such as digital cash, a sector transformed by digitization and predominantly managed by central intermediaries such as banks. This centralization, exemplified by credit card transactions primarily processed by Visa, MasterCard, and American Express, stems from the absence of a decentralized solution addressing digital currencies' principal challenge: double-spending, the risk of the same digital currency being spent more than once due to data's easy replicability.

Ledger
record-keeping system for
financial transactions,
tracking debits and credits

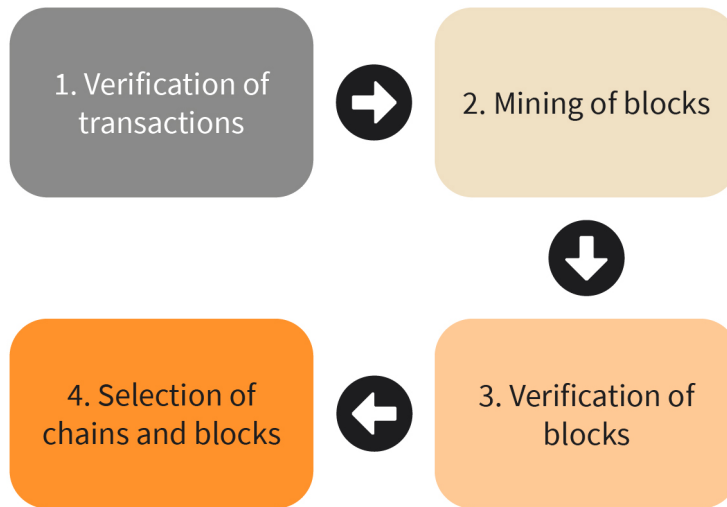
Imagine a world where currencies are entirely digital. Here, every individual managing digital money keeps a digital **ledger** recording all transactions. If Alice starts her day with 10 digital euros and purchases a book for 8 digital euros from Bob, both update their respective ledgers accordingly. However, if Alice attempts to spend her remaining euros with another merchant, the issue of double-spending arises. How can we ensure Alice hasn't already exhausted her funds with unknown parties? The involvement of a bank negates this issue through sophisticated interbank systems like SWIFT and a central bank maintaining synchronization and scrutiny over transactions (Singhal et al., 2018).

Distributed ledger
a decentralized database
managed by multiple participants
across different locations,
enhancing transparency and security

With the introduction of Bitcoin in 2008 through the Bitcoin Whitepaper (Nakamoto, 2008), a breakthrough emerged, addressing the double-spending predicament without central oversight. This model supplants the functions traditionally performed by trusted central entities like banks with a decentralized network of anonymous nodes. These nodes collectively manage a secure **distributed ledger technology** (DLT) and reach a consensus on transaction sequence, making it always clear who possesses what amount. This distributed ledger manifests as a blockchain, a sequence of transaction-aligned blocks, forming the backbone of Bitcoin's infrastructure. Creating new blocks, achieving consensus, and minting currency (Bitcoins) involves mining and is intimately tied to the PoW algorithm.

In Bitcoin's protocol, participants can execute transactions, transferring value from one account to another through double-entry bookkeeping. This system trails each Bitcoin's movement, backed by a digital signature authorizing expenditures. Only by successfully solving a computationally demanding problem (PoW) can the blockchain ward off double-spending assaults and assorted fraud. The continual expansion of the blockchain is a four-stage emergent consensus process, spanning transaction verification, block mining, block verification, and, ultimately, selecting the most credible chain of blocks. The generation of these blocks, achieving consensus, and creating new digital currency units, or Bitcoins, are accomplished through mining, a method fundamentally linked with the PoW algorithm (Singhal et al., 2018). The following figure illustrates the four stages of the consensus process.

Figure 6: Four-stage Emerging Consensus Process



Source: Manuela Ender (2024).

Alternative text:

Participants can transact, transmit, and receive Bitcoins through double-entry bookkeeping within the Bitcoin ecosystem. These transactions channel value from the sender to the recipient, earmarking the original transaction outputs as the source of funds. The transaction's output, in turn, apportions the monetary values to new owners tagged to their Bitcoin accounts, typically amounting to slightly less than the inputs due to transaction fees. The sequenced transactions form a verifiable chain, identifying the ownership and quantity of Bitcoins per account. Essential to these transactions is the digital signature of the spender, which confers validity. Bitcoins available for spending, termed unspent transaction outputs (UTXOs), are subject to aggregation and division within transactions, activated by the owner's digital endorsement. A new transaction's execution is contingent upon validation by the majority of the network's nodes, which involves a provisional period in an unverified transaction pool before undergoing the mining process. This procedure ensures the integrity of the blockchain against double-spending, with each block entailing a hash of its predecessor, cryptographically linking blocks into a cohesive chain (Singhal et al., 2018).

Nodes are tasked with resolving a computationally demanding problem known as Proof-of-Work to safeguard against malicious activities like double-spending. Following successful verification, blocks affirm their place within the blockchain, cementing their sequential order and collective acceptance. The blockchain's continuous growth and transaction verification hinge on a multipart consensus process entailing transaction checks, block min-

ing, block validation, and the definitive selection of block chains. This verification framework, active among mining nodes, underscores the decentralized protocol's efficiency and security, setting a standard for future blockchain technology developments.

Bitcoin, established as the inaugural blockchain, was primarily designed to transfer Bitcoins within its utility scope. Following this, advancements in blockchain and distributed ledger technologies facilitated many functionalities beyond mere transactions with the network's inherent cryptocurrency. In 2014, Ethereum expanded upon Bitcoin's foundational concepts with the introduction of Smart Contracts (Szabo, 1997), fostering the creation of a myriad of decentralized applications. Ethereum (Wood, 2014) is now recognized as a decentralized platform for peer-to-peer applications. These Smart Contracts consist of Turing-complete programming logic that is processed by the entire network on a distributed virtual machine (the Ethereum Virtual Machine, EVM).

Smart contract
automated, self-executing contracts with terms directly written into lines of blockchain code

Smart contracts are capable of encompassing intricate programming logic. As an illustration, a smart contract can be programmed to outline the parameters of a crowdfunding initiative, stipulating that the initiator may access the gathered funds only upon achieving the set campaign goals. Contrary to Bitcoin's UTXO-based architecture, Ethereum features two account types: External Owned Accounts (EOAs), utilized by external entities and systems, and Contract Accounts, which operate under the directive of the Smart Contract's programming logic. The initiation of a Smart Contract begins with a transaction. A distinguishing feature of Smart Contracts is their accessibility by every network node for parallel execution, which ensures the integrity of the programming logic autonomously, without reliance on a centralized mediator. Comparing traditional centralized crowdfunding platforms to decentralized implementations via Smart Contracts demonstrates key differences. In a centralized framework, a donor's €100 contribution to an escrow-managed central platform, contingent upon achieving crowdfunding objectives, lacks transparency and enforceability regarding fund allocation to the campaign manager. Conversely, within a decentralized context, a central hub is absent. Contributions are directly routed to the Smart Contract through transactions, with each network node asynchronously executing and validating the stipulated programming logic (Singhal et al., 2018; Szabo, 1997; Wood, 2014).

The Smart Contract explicitly codifies the conditions under which the campaign's financial goals are considered met, granting the campaign manager access to the funds. This entire process is transparent and auditable due to the blockchain's immutable transaction record. Smart Contracts thus facilitate the decentralized execution of complex logic, granting blockchain participants the ability to verify occurrences and adhere to the defined programming logic. While Smart Contracts empower the representation of virtually any logic, it's pertinent to acknowledge the potential privacy complications stemming from the network-wide availability of related information. Moreover, constraints exist to curtail the complexity of Smart Contract executions, ensuring network efficiency is maintained.

3.4 Machine and Deep Learning

Introduced by Arthur Samuel in 1959, **machine learning** is a domain that enables computers to learn autonomously without specific programming for each task. It is closely linked to AI due to its self-learning capabilities. In contemporary times, machine learning has found a broad spectrum of applications ranging from finance to social networking, bug detection in software, data extraction, e-commerce, bioinformatics, online searching, healthcare, robotics, space exploration, recommendation systems, among others, driven by the principle that machines can learn from data. As an ever-evolving field of study, machine learning has made substantial contributions to the industry, leading to innovations, enhanced processes, and increased automation (Shyam & Singh, 2021).

Machine learning
domain focused on enabling computers to learn autonomously without specific programming for each task

Machine learning methodologies aim to identify patterns and make data-driven intelligent decisions. For instance, a common challenge within the field involves machines recognizing handwritten postal codes from emails by learning from sets of examples. Though rooted in the 1950s, machine learning gained significant momentum at the start of the 21st century with the development of new hardware capable of efficiently processing algorithms, thereby enabling its practical application. Recognizing the potential for disruption and innovation, numerous companies are investing in intensive research to outpace their competitors.

Machine Learning Algorithms

Machine learning encompasses various algorithms, each designed to tackle distinct problems. Moving forward, we will explore four types of machine learning algorithms and their applicability, particularly in revolutionizing the financial sector and exploring the opportunities within FinTechs. Machine learning operates on a unique principle compared with traditional programming. In traditional setups, data and a set program input into a computer yield an output. In contrast, machine learning inputs data and expected output to either a model or computer, which then generates the “program” or model. This model theoretically adapts the data’s properties into a transferable framework through specified learning patterns. The algorithms are categorized based on the model generation method: supervised, unsupervised, and reinforcement learning (Shyam & Singh, 2021).

Supervised learning

Supervised learning trains a model with input data and corresponding outputs, proving effective for multimedia content processing. Its hallmark is labeled data, guiding the learning process under a metaphorical “supervisor.” These algorithms use the training data to generate models that can classify or make predictions about new data. Regression methods in supervised learning forecast a single output value from the training data, such as predicting house prices using parameters like location, size, and year of construction, employing techniques like linear, logistic, or Bayesian regression.

Unsupervised learning

Unsupervised learning algorithms learn from unlabeled data to perform tasks without supervision, which is especially useful for clustering or segmenting information when explicit labels aren't available. This approach identifies patterns and similarities in data sets to generate clusters.

Reinforcement learning

Reinforcement learning allows an agent to learn optimal behaviors through trial and error within a given environment, enabling applications in any FinTech product development with sufficient data for model training.

Deep Learning

Deep learning, a specialized area within machine learning, leverages neural networks that are designed to simulate how the human brain operates. This advanced technology has shown considerable promise in financial contexts, most notably in algorithmic trading, by analyzing large sets of market data to inform trading decisions. Long short-term memory (LSTM) networks, a specialized form of recurrent neural network (RNN), are engineered to tackle long-term dependencies, a common limitation with conventional RNNs. Traditional RNNs tend to lose their ability to link current information with past data as they process sequences, a problem known as the “vanishing gradient problem.” In contrast, LSTMs are adept at maintaining information over extended periods, which is essential for understanding tasks that rely heavily on past context, like text analysis or voice recognition. This capability is facilitated by a series of gating mechanisms within each LSTM cell, consisting of input, forget, and output gates. These gates respectively manage the absorption of new information, the preservation of existing cell data, and the degree to which this information influences the LSTM's output. Hence, LSTMs excel in retaining or dismissing data throughout lengthy sequences, making them exceptionally useful for sequential tasks, such as analyzing time series data and processing natural languages (Ozbayoglu et al., 2020).

These technologies play pivotal roles in fraud detection, risk management, and analyzing market sentiments in finance. By scrutinizing data to spot irregularities and patterns, they contribute to forecasting future market behaviors. Risk management leverages AI models and techniques like Monte Carlo Simulation and LSTM and supports vector machines to evaluate and foresee investment risks. Similarly, for sentiment analysis, models including NLP and deep learning sift through various data sources like social media or news articles to understand market inclinations.

Nonetheless, employing machine and deep learning in financial sectors is challenging. These technologies might struggle with unexpected or rare events that could drastically affect the financial sector. Moreover, ethical and privacy issues are concerning, given their capability to process extensive sensitive data. Hence, their application in finance must be approached with caution, acknowledging these limitations and potential threats. The foundation of machine and deep learning lies in algorithms adept at spotting patterns within vast data volumes. Through methods like clustering, classification, and regression,

these algorithms discern patterns and forecast outcomes. Algorithms continually evolve, refined by diverse data sets, including historical market data and customer behaviors. This evolution is largely automated, allowing algorithms to update and learn from fresh data.

Financial Applications of Deep Learning

Ozbayoglu et al. (2020) identified the following financial applications of deep learning.

Algorithmic trading

Defined by algorithm-driven buy-sell decisions, algorithmic trading has embraced deep learning, especially in the last two decades with the advent of electronic trading platforms. Most deep learning applications in algorithmic trading focus on market timing through price prediction models, with some studies also delving into the dynamics of transactions themselves.

Risk assessment

This area addresses the overall insecurity of various entities (assets, firms, etc.), with a significant focus on credit scoring and financial distress classification, among other problems.

Fraud detection

Financial fraud detection is a critical area with applications such as credit card fraud and money laundering detection aiming for robust anomaly detection and classification techniques.

Portfolio management

Portfolio management studies using deep learning primarily deal with optimization problems, seeking the best-performing assets for a specified period. It has shown potential in improving portfolio management, particularly with the rise of robo-advisory services.

Asset pricing and derivatives market

Although relatively unexplored, this field holds potential for deep learning models to assist in accurate asset pricing and valuation as well as in developing models for options, futures, and forward contracts pricing.

Financial sentiment analysis and behavioral finance

Advances in text mining have enabled effective sentiment extraction from social media, contributing to financial forecasting and model development.

Financial text mining

The proliferation of instant text-based information has propelled financial text mining, focusing on content retrieval and analysis rather than sentiment analysis alone.

Despite the broad utilization of deep learning across financial applications, persistent challenges exist, such as handling unexpected market events and managing privacy concerns.

3.5 Neuroscience in Finance

Neurofinance
the study of the brain's
role in financial decision-
making and investing
behaviors

Neuroscience in finance, often termed **neurofinance**, represents an interdisciplinary field that marries the insights of neuroscience with the principles of finance to understand how humans make financial decisions. This innovative approach combines the study of the brain's structure and function with economic behaviors, offering groundbreaking insights into the cognitive and emotional processes driving financial choices. By examining how various brain regions activate in response to financial risks, rewards, and uncertainties, neurofinance seeks to demystify the complex psychological underpinnings of economic activity, potentially leading to more accurate predictions of market trends and investor behavior (Kuhnen & Knutson, 2005).

At the core of neurofinance is the premise that financial decision-making is not solely a rational process, as traditional economic theories have suggested. Instead, decisions often involve a complex interplay between cognitive reasoning and emotional reactions. Neurofinance utilizes technologies such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) to observe real-time brain activity, enabling researchers to identify the neural correlates of financial decision-making. For instance, the amygdala's role in processing fear can inform understanding of how investors react to market downturns. In contrast, the nucleus accumbens, associated with reward processing, may shed light on responses to potential financial gains.

One of the key contributions of neuroscience to finance is the exploration of risk tolerance. Traditional finance models assume that individuals make investment choices based on a rational evaluation of risk versus reward. However, neurofinance research indicates that emotional and psychological factors influence risk-taking behavior. For example, studies have shown that individuals' risk tolerance is linked to activation levels in specific brain areas when they face uncertain outcomes. This finding suggests that personal experiences, biases, and emotional states significantly influence financial decision-making processes (Kuhnen & Knutson, 2005; Srivastava et al., 2019).

Furthermore, neurofinance offers insights into phenomena like market bubbles and crashes, which traditional models struggle to explain fully. The herd behavior seen in financial markets, where investors collectively move in the same direction, can be better understood by examining the neural mechanisms underlying social influence and conformity. Neuroscientific research has highlighted how social information and perceived norms activate brain regions associated with reward anticipation, which drives individuals

to conform to group behaviors, even when they deviate from rational investment strategies. Behavioral finance, a related field, integrates psychology with finance to explain deviations from expected utility theory and market efficiency. Neurofinance extends this work by providing a biological basis for behavioral finance phenomena, such as overconfidence, loss aversion, and framing effects. By identifying the neural circuits involved in these biases, neurofinance corroborates behavioral finance findings and deepens understanding of their origins and mechanisms (Srivastava et al., 2019).

The potential applications of neurofinance are vast, ranging from improving financial decision-making and personalizing investment strategies to developing policies that enhance market stability. Financial advisors, for instance, could use neuroscientific insights to understand clients' risk profiles better and tailor advice accordingly. Meanwhile, policymakers might employ knowledge of mass psychological and neural reactions to design regulations that mitigate systemic risks posed by irrational market behaviors. By bridging neuroscience and finance, neurofinance provides a novel lens through which to view the intricacies of financial decision-making. While the field is still in its infancy, its interdisciplinary approach holds the promise of unraveling the complex tapestry of cognitive and emotional factors influencing economic behaviors. As research progresses, neurofinance is poised to revolutionize our understanding of finance, offering theoretical insights and practical tools to navigate the ever-changing landscape of financial markets.



SUMMARY

The rapid advancement of technology has significantly transformed the banking industry, focusing on enhancing customer experience, securing transactions, and improving operational efficiency. This transformation is driven by developments in AI, blockchain, digital payment systems, and the emergence of FinTech companies.

Cloud banking leverages cloud computing to offer unprecedented scalability, flexibility, and efficiency in banking services. By moving to cloud-based platforms, banks can rapidly deploy new services, enhance security, and achieve cost efficiencies by reducing physical IT infrastructure dependence. AI and machine learning are revolutionizing banking operations by providing personalized banking experiences, enhancing customer service through chatbots and virtual assistants, and improving fraud detection.

Blockchain and DLT have introduced a secure way of conducting transactions through encryption techniques. Blockchain technology, the backbone of cryptocurrencies, offers unmatched security and transparency for financial transactions by allowing transactions without a central authority. This capability has led to the development of smart contracts on platforms like Ethereum, which would enable the execution of complex decentralized applications beyond simple transactions.

Neurofinance combines neuroscience and finance to understand the cognitive and emotional processes behind financial decisions. It utilizes techniques like fMRI and EEG to observe brain activity in response to financial risks and rewards. Neurofinance reveals that financial decision-making involves an interplay between cognitive reasoning and emotional reactions, offering insights into phenomena like market bubbles and investor behavior.

UNIT 4

AI APPLICATIONS IN THE FINANCIAL SERVICES INDUSTRY

STUDY GOALS

On completion of this unit, you will be able to ...

- assess the impact of artificial intelligence (AI) on deposit and lending processes and understand its potential for streamlining and enhancing customer experiences.
- explore how chatbots in banking improve customer service and engagement.
- analyze the role of AI in developing advanced credit scoring.
- examine the applications of AI in the insurance sector.
- understand the significance of AI in Know Your Customer (KYC) and Anti-Money Laundering (AML) processes.

4. AI APPLICATIONS IN THE FINANCIAL SERVICES INDUSTRY

Case Study

The new normal:

Alex [human]: Hi there!

BankBot [chatbot]: Hello, Alex! How can I assist you today?

Alex: I'm thinking about opening a new savings account. Can you help me with that?

BankBot: Absolutely, I'd be glad to help you with opening a new savings account. Do you have any specific features you're looking for in a savings account?

Alex: I'm primarily interested in the interest rates and minimum balance requirements.

BankBot: Got it! Our High-Yield Savings Account offers an attractive interest rate of 2.5% annually. This account requires a minimum balance of \$500 to maintain, or there is a \$5 monthly fee. Does this sound like what you are looking for?

Alex: Yes, that sounds pretty good. Are there any fees for opening the account?

BankBot: There are no fees for opening a High-Yield Savings Account with us. All you need to do is provide some personal information, and you can start enjoying the benefits in no time.

Alex: Great! Can I open it right now through this chat?

BankBot: Certainly, Alex. I can help you get started. May I have your full name and email address to begin the application process?

Alex: My full name is Alex Johnson, and my email is alex.johnson@email.com.

BankBot: Thank you, Alex! I also need to confirm if you're an existing customer with us. Are you already banking with us?

Alex: No, this will be my first account with your bank.

BankBot: No problem at all. I'll need a bit more information to set up your new account. Do you consent to sharing personal information for the purpose of opening your savings account through this secure chat?

Alex: Yes, I consent.

BankBot: Thank you for your consent. Please provide your date of birth and social security number. Feel free to call our secure hotline if you're uncomfortable sharing it here.

Alex: I'll call the hotline for that. What's the number?

BankBot: You can reach our secure hotline at 1-800-555-1234. Our customer service team is available 24/7 to assist you.

Alex: Great, I'll give them a call. Can I do anything else here?

BankBot: While you're on the call, I can guide you through the benefits of our online banking platform, which you can use to manage your new savings account. Would you like to learn more about this?

Alex: Yes, please tell me more.

BankBot: With our online banking platform, you can

- Monitor your account balance in real-time.
- Transfer money between accounts instantly.
- Set up automatic savings plans.
- Access your account statements anytime.
- Get alerts for all your transactions.

and much more – all from the comfort of your home or while on the go.

Alex: That sounds very convenient. How do I access the online banking platform?

BankBot: Once your account is set up, you'll receive an email with instructions to set up your online banking login. You can access it via our website or through our mobile app, which is available on both Android and iOS devices.

Alex: Sounds good! I'll go ahead and call the hotline now. Thanks for all your help!

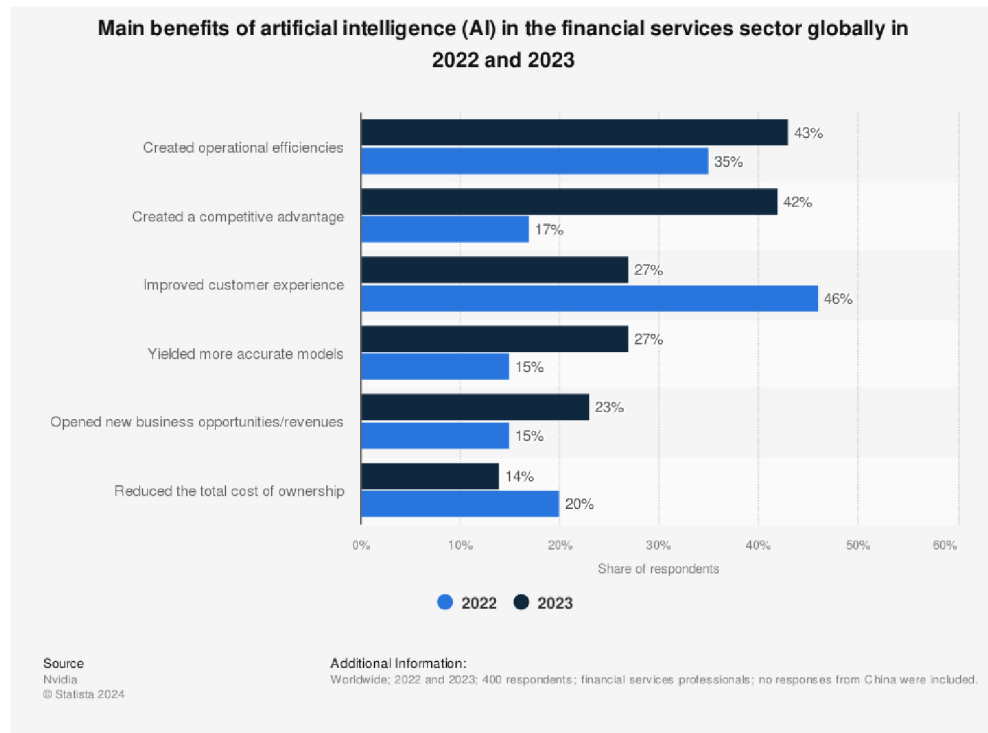
BankBot: You're welcome, Alex! Feel free to reach out if you have more questions after setting up your account. We're here to help 24/7. Have a wonderful day, and welcome to the bank!

4.1 AI in Deposits and Lending

In 2023, the primary advantage of implementing artificial intelligence (AI) in financial services was the enhancement of operational efficiencies, as shown in the figure below. The survey revealed that 43% of 400 participants worldwide, excluding China, reported increased operational efficiencies due to AI integration, marking a notable rise from the previous year. Conversely, the customer experience, highlighted as the foremost benefit of

AI in 2022, saw a decline in priority, with just 27% of respondents citing it as the main advantage. Other benefits included gaining a competitive edge, the development of more precise models, and a decrease in the overall cost of ownership (Nvidia, 2024).

Figure 7: Benefits of AI in the Financial Services Sector Globally in 2022 and 2023



Source: Nvidia (2024).

Alternative text:

Deposits and lending are pivotal functions within the financial services industry, playing crucial roles in the economy's dynamism and individual financial stability. These foundational banking services have evolved significantly with technological advances, particularly through digital banking platforms, enhancing accessibility and convenience for consumers. **Deposits** form the core of banking operations, providing the capital that banks require to fund their lending activities. They represent the money that customers place into their accounts, trusting their bank to keep it safe and, in many cases, to grow it over time through interest earnings. Modern banking has introduced various deposit products, from basic savings accounts to more complex certificates of deposit (CDs), each offering different terms, interest rates, and access levels to meet diverse consumer needs (Casu et al., 2022).

Deposits
money placed into bank-
ing accounts, available for
withdrawal or earning
interest

Lending, the counterpart to deposits, fuels economic growth by providing individuals and businesses with the necessary capital for consumption, investment, and development projects. It encompasses a wide range of products, including personal

loans, mortgages, and business loans. Financial institutions assess borrowers' creditworthiness to manage risk, employing increasingly sophisticated models that incorporate traditional financial metrics and, more recently, alternative data to extend credit more inclusively. The lending process by banks is a critical aspect of financial intermediation, enabling economic growth by facilitating credit for consumers and businesses alike. However, this process inherently involves risk, necessitating banks to implement robust risk mitigation strategies to safeguard their interests and maintain financial stability (Casu et al., 2022).

The lending process begins with the loan application, where potential borrowers submit their financial information, including income, employment history, and existing debts. The bank then thoroughly assesses the borrower's creditworthiness, evaluating their ability to repay the loan. This underwriting process involves analyzing credit reports, credit scores, and financial statements, among other documents. Once approved, the loan terms, including the interest rate, repayment period, and monthly payment amounts, are set and communicated to the borrower. Upon agreement, the funds are disbursed, and the repayment phase begins, during which the borrower makes regular payments until the loan is fully repaid (Casu et al., 2022).

Banks' primary risk in the lending process is credit risk – the probability that borrowers will default on their loan obligations. Factors contributing to credit risk include economic downturns, unemployment, and individual circumstances affecting the borrower's financial stability. Banks also face interest rate risk, which occurs when fluctuations in interest rates affect the value of loans or the bank's margin between its lending and deposit rates. Operational risk is associated with the bank's internal processes, people, and systems or external events that could disrupt the lending process. Further, banks must navigate a complex regulatory environment, where failure to comply with laws, rules, or regulations can result in fines, penalties, and reputational damage. Finally, market risk involves losses due to changes in market conditions, such as a decrease in the property market that affects collateral values for mortgage loans (Casu et al., 2022).

To manage these risks, banks have developed several mitigation strategies. Banks conduct detailed assessments of potential borrowers' creditworthiness using advanced analytic tools and credit scoring models. Diversifying the loan portfolio across different sectors, geographic regions, and borrower types helps banks spread and manage their risk exposure, reducing the impact of a potential default. Banks can mitigate risk by securitizing loans, converting them into marketable securities that can be sold to investors. This process transfers some of the credit risk to investors. Banks use financial derivatives, such as interest rate swaps and options, to manage interest rate risk, allowing them to hedge against adverse changes in interest rates. Banks can also impose financial and operational restrictions on borrowers by including loan covenants in the loan agreement, minimizing the risk of default. Finally, requiring collateral provides an added layer of security. Banks ensure compliance with regulatory requirements through rigorous internal controls and audit processes, reducing the risk of legal and reputational consequences. Continuous

Lending
funding provided by
financial institutions to
borrowers; repayment
includes interest over an
agreed period

monitoring of the financial health of borrowers and the performance of loans throughout the loan's lifetime enables early identification of potential issues and timely intervention (Casu et al., 2022).

Managing the inherent risks of the lending process is crucial for the sustainability and profitability of banks. Through a combination of rigorous credit assessments, risk diversification, technological innovations, and adherence to regulatory standards, banks strive to mitigate the diverse risks associated with lending. As financial markets evolve and new types of risks emerge, banks must continually adapt and enhance their risk management practices. In doing so, they protect themselves and contribute to the overall stability and health of the global financial system.

In the realm of deposits, AI is helping to personalize banking experiences and optimize savings strategies for customers. Financial institutions use AI algorithms to analyze customer data, including spending habits, transaction histories, and financial goals. This analysis enables banks to offer personalized savings recommendations and automatically adjust deposit rates based on the customer's unique financial situation and market conditions.

One application of AI in deposits is predictive analytics for customer behavior. AI models can forecast future deposit trends based on historical data, helping banks anticipate liquidity needs and adjust their strategies accordingly. This predictive capability can enhance cash management and interest rate optimization, ensuring financial institutions remain competitive and financially stable. Another innovative application is chatbots and virtual assistants, powered by AI, to assist customers with their deposit accounts. The assistants can provide 24/7 customer support, answer account balances, interest rates, and deposit options queries, and guide customers through transactions, enhancing the overall customer experience (Bhattacharya & Sinha, 2022).

The lending sector has witnessed profound changes with the integration of AI, particularly in underwriting processes, risk assessment, and customer service. AI algorithms can process data from credit scores, income data, employment history, and even social media activity, to assess a borrower's creditworthiness more accurately and efficiently. One significant benefit of AI in lending is the automation of the underwriting process. Traditional underwriting is a labor-intensive process requiring significant human intervention. AI can automate much of this process, analyzing applicant data to assess risk and make lending decisions in a fraction of the time. These technological developments speed up the loan approval process and reduce the potential for human error, leading to more consistent and fair credit decisions.

AI-powered risk assessment models offer another significant advancement. These models use machine learning to analyze traditional and non-traditional data sources, providing a more holistic view of a borrower's financial health. By incorporating data points such as utility bill payments, rental history, and even educational background, AI can help lenders identify creditworthy individuals who may have been overlooked by traditional credit scoring models. This approach can expand access to credit for underserved segments of the population, enhancing financial inclusivity.

Chatbots and AI-driven customer service tools also play a crucial role in lending. These tools can guide prospective borrowers through the loan application process, answer frequently asked questions, and provide personalized loan recommendations. By improving customer engagement and making the lending process more accessible and understandable, AI can help financial institutions attract and retain customers. Moreover, AI systems are being used to continuously monitor loan portfolios, identify at-risk loans early, and recommend proactive measures to mitigate potential losses. This capability enables lenders to manage their loan portfolios more actively and reduce the likelihood of defaults (Bhattacharya & Sinha, 2022; Sachan et al., 2020).

The integration of AI in deposits and lending is just the beginning. From more sophisticated risk assessment models that evaluate a wider range of data points to AI-driven personal finance advisors that offer customized investment and saving advice, the potential for AI to revolutionize financial services is immense. However, the deployment of AI in financial services also raises important considerations related to data privacy, security, and ethical use of AI. Financial institutions must navigate these challenges carefully, ensuring compliance with regulations and maintaining the trust of their customers.

4.2 Chatbots in Banking

Chatbots stand out among the possibilities of AI applications because they can simulate human conversation, offering an interactive communication experience through text or voice commands. These advanced software systems are engineered to retain suitable responses on a server, continuously enhance their response accuracy through customer interactions, adeptly manage anomalies, and deliver precise answers. Through intricate computer programming and sophisticated mathematical algorithms, chatbots evolve a self-learning framework, striving to furnish responses and relevant information that align as closely as possible with user inquiries in real-time. A chatbot serves as a pivotal interface for businesses, facilitating essential customer information and executing marketing strategies through robust engagement with financial consumers. A notable pioneer in the financial sector's adoption of chatbot technology was Bank of America, with the introduction of Erica in May 2017, a service initially mirroring the functionalities of Apple's Siri but offering both textual and voice command responses. Responses ranged from transaction summaries and account queries to more complex tasks such as credit score improvement applications, financial product introductions, loan processing, and personalized banking advice by leveraging machine and deep learning technologies. This technology assimilates various data points, including customers' financial histories, geolocation, and habitual patterns, to offer tailored and precise services, enhancing the customer experience by providing swift and tailored financial services. The incorporation of chatbot services has become a widespread practice among commercial banks and diverse financial institutions, marking a significant evolution in customer service and interaction in the financial industry (Hwang & Kim, 2021).

Chatbot
a blend of "chatting" and "robot," referring predominantly to text-based communication platforms

AI-driven assistants are designed using natural language processing (NLP), machine learning, and data analytics technologies, enabling them to understand, learn from, and respond to user queries in real-time. The core technology behind chatbots, NLP, allows

them to parse human language, grasp context, and generate responses that closely mimic human interaction. Machine learning enables chatbots to learn from interactions, improving their accuracy and relevance over time. Chatbots can securely access and process customer information by integrating with banking systems and databases, delivering personalized banking experiences. Advances in AI have also enabled the development of more sophisticated chatbots that can handle complex queries and perform a range of transactions, making them an invaluable tool for modern banking.

Chatbots diverge into two frameworks based on their operational mechanics within web or mobile platforms: the retrieval and generative models. The retrieval model operates on a rule-based algorithm, delivering predefined responses to specific queries or topics. Initially, this rule-centric model was the backbone of chatbot deployments across financial entities. Yet, as the depth and breadth of industry-specific data burgeoned, leveraging advanced machine learning techniques became a tangible reality, elevating the commercial deployment of chatbots to new heights. Conversely, the generative model leverages deep learning, dynamically refining its response accuracy by continuously analyzing and learning from accumulated customer interaction data. This state-of-the-art deep learning paradigm enables the chatbot to accurately decipher the essence and intent behind customer inquiries, facilitating immediate, pertinent responses and the capability to offer bespoke product suggestions. Current research endeavors are channeling efforts to empower these models to intuit current user emotions by analyzing user routines and profiles, despite the significant data requisites and associated costs for their ongoing adaptive evolution (Hwang & Kim, 2021).

Use Cases

Chatbots in banking provide a range of services (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

Customer service

Chatbots are revolutionizing customer service in banking. They handle inquiries related to account balances, transaction histories, loan applications, and more, freeing human agents to tackle more intricate issues. Chatbots improve customer satisfaction and engagement by offering round-the-clock support and rapid responses. The personalized assistance chatbots provide enhances the customer experience, making banking more accessible and convenient. Chatbots can handle numerous inquiries simultaneously, reducing the need for a large customer service team, which thus significantly cuts operational costs. Automating routine tasks allows human agents to focus on more complex customer needs, improving productivity (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

Personal financial assistance

Some chatbots serve as personal financial advisors, offering recommendations based on transaction trends and financial goals. They can help customers set budgets, save money, and make informed investment decisions. Chatbots can collect valuable data from cus-

customer interactions, providing banks with insights into customer preferences and behavior. These data can inform product development, marketing strategies, and customer service improvements (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

Fraud detection and alerts

Chatbots can play a crucial role in security by monitoring account activity and notifying customers of unusual transactions, potentially preventing fraud. Customers can also report lost or stolen cards directly to the chatbot for immediate action (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

Automated transactions

Advanced chatbots can facilitate various banking transactions, such as fund transfers, bill payments, and mobile check deposits, directly through the chat interface, providing a seamless banking experience. Chatbots can quickly scale to handle an increase in customer inquiries without the need for additional resources, making them particularly useful for handling peak periods or supporting promotional campaigns (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

Loan decisions

Customized information provided by chatbots assists borrowers in making quick decisions. They can also escalate queries to human agents for further assistance (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

Bill payment

Chatbots facilitate bill payments for utilities such as phone, water, electricity, and rent. Additionally, they enable fund transfers between accounts (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

Reminders about credit card and transaction patterns

Chatbots send timely reminders to customers for credit card payments. They can analyze historical data regarding spending habits, credit history, and transaction history for personalized insights (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

Onboarding and education

Chatbots assist in onboarding, guiding new customers through account setup, document submission, and explaining banking products and services. They also serve as educational tools, explaining banking terms and processes to enhance financial literacy (Alt et al., 2021; Bhattacharya & Sinha, 2022; Hwang & Kim, 2021).

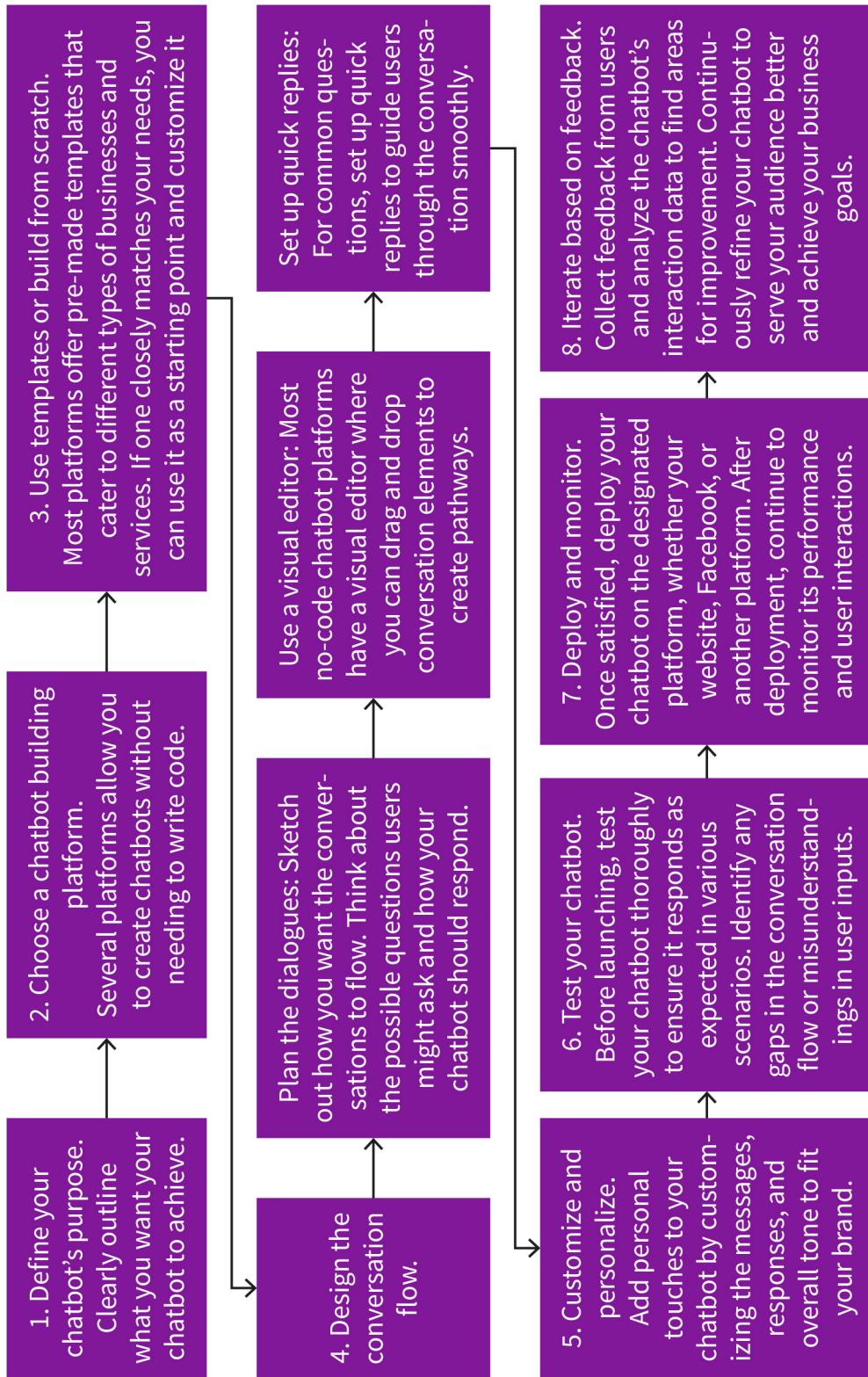
Challenges

Despite their benefits, chatbots come with their challenges. First, chatbots in banking sometimes struggle to comprehend complex queries or slang, leading to irrelevant or incorrect responses. Their replies can frustrate customers and may require human intervention to resolve the issue. Given the access to sensitive customer data, there are valid concerns about data privacy and security. Ensuring that chatbots are secure and comply with data protection regulations is paramount. While chatbots offer efficiency, they cannot fully replicate the nuances of human interaction. Some customers may still prefer the personal touch and empathy of human customer service agents, especially for sensitive financial matters. Developing, implementing, and maintaining advanced chatbots requires significant investment in technology and expertise. Ensuring chatbots remain effective and up-to-date with banking systems and regulations can be resource-intensive (Alt et al., 2021; Hwang & Kim, 2021).

Chatbots in banking represent a significant step forward in harnessing AI to enhance customer service and operational efficiency. They provide customers instant access to information and services, contributing to a more engaging banking experience. Despite the challenges, the benefits chatbots offer in terms of cost reduction, scalability, and customer insight are substantial. As AI technology evolves, chatbots are poised to become an even more integral part of the banking landscape, further transforming how banks interact with their customers.

Building a chatbot with minimal or no coding skills has become increasingly accessible thanks to various platforms offering user-friendly interfaces and drag-and-drop functionalities. The following figure shows several steps to create a chatbot without extensive coding knowledge.

Figure 8: Create a Chatbot Without Extensive Coding Knowledge



Source: Manuela Ender (2024).

Alternative text:

Creating a chatbot without coding has never been easier, thanks to the multitude of platforms designed for users with little to no programming experience. By leveraging these tools and following best practices in chatbot design, you can implement an effective conversational agent that enhances user engagement and supports your business objectives.

4.3 AI Use in Developing Credit Scoring Models

Credit scoring models a statistical tool developed by financial institutions to evaluate the creditworthiness of potential borrowers

Credit scoring models use a variety of factors from an individual's financial history to predict the likelihood that the person will repay a loan or meet credit obligations. The data involved in these models typically include credit history, outstanding debts, repayment history, and more, gathered from credit reports provided by credit bureaus. The FICO score is the most widely recognized credit scoring model in the US. Developed by Fair Isaac Corporation, the FICO score ranges from 300 to 850, where a higher score indicates a lower risk for the lender. Another well-known model is the VantageScore, created through collaboration between the three major credit bureaus: Experian (UK, US), TransUnion (US), and Equifax (UK, US; Casu et al., 2022).

Credit scoring models employ complex algorithms that assess various aspects of financial behavior. Payment history, credit utilization ratio (the amount of credit used compared to available credit), length of credit history, types of credit used (such as credit cards, mortgages, automotive loans), and recent inquiries for credit all influence a credit score. Each factor carries a different weight in the calculation of the credit score. The primary purpose of these models is to assist lenders in making informed decisions regarding loan approvals and terms. A higher credit score can lead to better interest rates and loan conditions for the borrower. Conversely, a lower score may result in loan denials or higher interest rates (Casu et al., 2022).

As the financial industry evolves with advancements in data analytics and technology, these scoring models continuously improve, incorporating a broader set of data points and more sophisticated statistical techniques. This evolution seeks to make credit evaluation more accurate, fair, and reflective of an individual's true credit risk. Traditional credit scoring systems, while effective, have been limited by their reliance on historical financial data, such as credit history, loan repayments, and income levels.

The use of AI in lending involves leveraging non-traditional data points. AI's capability to sift through alternative data sources, such as rental and utility bill history, mobile phone usage habits, or social media patterns, offers a broader lens through which to assess a borrower's reliability. This shift allows financial institutions to offer loans to those lacking a traditional credit history yet demonstrating the ability to manage loan repayment ade-

quately, widening the pool of qualified borrowers. By integrating these additional insights, banks and lending institutions can refine their credit decision-making process, uncovering a segment of borrowers previously invisible under conventional evaluation methods (Sadok et al., 2022).

The benefits of incorporating AI into credit scoring models are manifold. Firstly, it enhances decision-making accuracy. AI algorithms can process complex datasets at incredible speeds, enabling more precise credit risk assessments. The improved accuracy benefits lenders (by reducing default rates) and borrowers (by ensuring fair access to credit). Secondly, AI-driven models can significantly speed up the credit decision process. Traditional credit scoring can be time-consuming, often requiring a manual review of applicant data. In contrast, AI models can evaluate applications in near real-time, improving customer experience and allowing quicker credit access. Thirdly, by utilizing a wider array of data points, AI enables more inclusive credit scoring. This inclusivity can help bridge the gap for underserved demographics, such as gig economy workers or those in developing countries with limited access to conventional banking services. By capturing a fuller picture of an individual's financial behavior, lenders can extend credit to those they would otherwise overlook.

Despite the advantages, using AI in credit scoring models raises ethical considerations and challenges. Data privacy and security are paramount concerns, as these models require access to a vast amount of personal information. Ensuring that data are collected, stored, and processed securely and with consent is crucial. Moreover, the issue of **algorithmic bias** in AI systems, especially in credit scoring models, has garnered significant scrutiny in recent years. The fundamental principle is that AI models, including those powered by machine learning, inherit the characteristics of the data on which they are trained. If the training data reflect historical inequalities or biases, there's a high likelihood that the AI system will replicate or even amplify these biases in its predictions and decisions (Langenbucher & Corcoran, 2022).

Algorithmic bias

AI models inherit the characteristics of the data on which they are trained. If the training data reflects biases, it is likely that the AI system will replicate or even amplify these biases in its predictions and decisions.

4.4 AI in the Insurance Sector

The insurance sector, a cornerstone of the global financial services ecosystem, is no exception. By its most fundamental definition, **insurance** is a means of protection from financial loss. The industry operates on models that assess and predict risks, determine pricing policies, process claims, and prevent fraud, among other functions. Traditionally, these tasks have been carried out through manual processes or with the support of basic statistical modeling techniques. Traditional models in insurance have relied heavily on historical data and statistical analysis. Actuaries, professionals in the insurance industry, use these data to evaluate the likelihood of certain events and their potential financial impact on the insured party. This process involves extensive data collection and analysis, requiring significant time and resource investment. Moreover, these traditional models often operate on generalized assumptions about risk, which might not accurately reflect individual cases, leading to inefficiencies and potential inaccuracies in premium determination, underwriting processes, and claims management.

Insurance

a form of risk mitigation primarily used to hedge against the risk of a contingent or uncertain loss

Telematics
the remote delivery of
expert recommendations
and data using telecom-
munications technology
across distances in real-
time

The advent of AI in the insurance sector brings forth an array of applications poised to enhance these traditional models. At the core of AI's value proposition is its ability to process and analyze vast quantities of data at unparalleled speeds, learning and adapting from the data processed. This capability facilitates more nuanced and individualized risk assessments, dynamic pricing models, automated claims processing, and sophisticated fraud detection mechanisms. For instance, AI algorithms can analyze driving habits data collected from **telematics** devices in vehicles to tailor auto insurance premiums to an individual's driving behavior, offering safer drivers lower premiums. Similarly, in the health insurance domain, wearable health tracking devices can provide insurers with real-time health data, enabling them to offer personalized health plans and preventive health suggestions to policyholders. Moreover, AI-driven chatbots and virtual assistants have revolutionized the insurance sector's customer service, similar to the banking industry. These AI tools can handle a wide range of customer inquiries 24/7, from policy details clarification to guidance on claim filing processes, significantly enhancing customer experience and operational efficiency. Additionally, AI applications in claims management automate and expedite the claims-handling process, sometimes reducing processing times from days to hours. This automation is achieved through AI's ability to quickly sift through claim documents, assess damages through images or videos using computer vision, and even predict fraudulent claims with a high level of accuracy (Chishti et al., 2020; Stanković & Stanković, 2022).

Despite AI's promising advantages to the insurance sector, its implementation is not without challenges. One of the primary concerns revolves around data privacy and security. The extensive collection and analysis of personal data by AI systems raise significant privacy concerns, requiring robust data protection measures to ensure policyholder information is secure and used ethically.

Furthermore, the potential for algorithmic bias exists in AI models, mirroring societal biases present in the data they are trained on, like in banking. If unchecked, these biases could lead to unfair policy pricing or claims decisions, necessitating transparent AI systems and continuous oversight to mitigate such risks.

The introduction of AI in the insurance industry also entails substantial initial investment costs in technology acquisition and integration, coupled with the need for ongoing maintenance and updates. These financial hurdles might be significant, especially for smaller insurance firms.

Additionally, the shift toward AI-driven processes requires significant workforce transformation, with employees needing retraining to adapt to new technologies and methodologies. This transition may encounter resistance from within organizations, adding a layer of complexity to AI adoption in the sector.

Another critical aspect of integrating AI into insurance is the regulatory landscape. As AI applications within the industry expand, regulatory bodies face the challenge of keeping pace with technological advancements to ensure adequate consumer protection, data privacy, and ethical AI use. This evolving regulatory environment necessitates that insurance companies remain agile, constantly adapting their AI applications to comply with new regulations and guidelines (Chishti et al., 2020).

The integration of AI into various sectors continues to raise questions about its impact on employment. Richard Hartley, CEO and Co-founder of Cytora, suggested that AI can potentially create additional jobs within the industry. He emphasized that AI could significantly enhance the size and influence of the re/insurance sector worldwide. He highlighted that AI technologies could free up existing teams in the re/insurance industry to accomplish more, thereby providing greater value to customers and increasing industry profits. Hartley further pointed out the importance of training and updating staff on AI advancements to fully leverage its benefits across the sector. He observed the growing use of large language models (LLM) in everyday scenarios worldwide, anticipating similar widespread application within the re/insurance industry for tasks such as summarizing information and answering questions. He underscored the particular usefulness of AI in insurance due to the sector's interpretive nature, which involves analyzing dense, varied information to extract insights. The conversation also covered the emergence of generative AI in the industry, noted for its ability to streamline tasks and generate risk insights. Hartley voiced a strong belief in the positive impacts of generative AI, noting its capacity to transform analog processes into more streamlined, automated operations. This shift allows for more efficient use of time, enabling focus on developing new products for underserved risks and expanding the industry. However, Hartley acknowledged challenges with AI in the past, including lengthy training times for AI models and the slow implementation of platforms. Yet, he pointed out that generative AI significantly reduces training times, enhancing the scalability of AI solutions. This advancement holds particular promise for large, globally distributed insurers, offering them transformative business value (Global Data Point, 2023b).

4.5 KYC and AML

Money laundering is the process of concealing the true origin of assets and income derived from criminal activities, making them appear legitimate through what looks like legal transactions and documentation. This illegal practice is typically executed in three stages: placement, layering, and integration. In the placement stage, cash gained from unlawful activities such as fraud, drug trafficking, or human trafficking is deposited into bona fide financial institutions, separating the criminal proceeds from their origin. The subsequent layering phase involves complex financial transactions that make it difficult to trace the origins of these illicit funds, often by blending them with legitimate money or repeatedly moving the funds. Integration marks the final step, where the now-disguised funds are used to purchase assets that, once sold or invested, reintegrate the illicit money into the economy as seemingly legitimate earnings (Wang & Hsieh, 2023). Assessing the global economic impact of money laundering is challenging due to undetected cases and varying legal definitions across jurisdictions. However, the United Nations (2023) estimates that money laundering accounts for 2% to 5% of global gross domestic product (GDP).

A crucial strategy for financial institutions and other entities in the fight against money laundering is the Know Your Customer (KYC) protocol. These detailed reviews

verify customer identities and understand their financial behavior and risk profiles thoroughly. KYC processes include collecting and verifying identification documents and proof of address. Implementing KYC enables institutions to confirm customer identities, ensure a transaction's legitimacy, and manage associated risks effectively (Hannan et al., 2023).

The U.S. Department of the Treasury (2022) notes that while the use of virtual assets in money laundering remains relatively low compared to traditional currencies, there has been a marked increase in their use for illicit online transactions, including drug sales, money laundering from drug proceeds, fraud, cybercrime, and other illegal activities. The burgeoning user base and market capitalization of virtual assets, increasingly incorporated into traditional financial services, pose challenges. Virtual assets, which include cryptocurrencies and other digital assets considered securities, commodities, derivatives, or other classifications, facilitate immediate transactions, including cross-border payments, outside the purview of traditional financial institutions with anti-money laundering (AML) and counter-financing of terrorism (CFT) mechanisms.

AI has progressively become a critical asset in improving AML and KYC processes. Its capability to analyze large volumes of data rapidly, identify patterns, and learn from these patterns makes it a potent tool for financial institutions aiming to combat financial crimes and enhance compliance processes. AI can sift through vast amounts of transactional data in real-time to detect activities that could indicate money laundering. Unlike traditional rule-based systems, AI algorithms can learn and adapt, improving their detection accuracy over time. This improvement reduces false positives, saving time and resources in AML investigations.

KYC processes often involve substantial manual verification of customer documents to ensure compliance with regulatory standards. AI, including optical character recognition (OCR) and NLP, can automate document verification, extracting and validating information from identity documents quickly and accurately. These automations accelerate the onboarding process and enhance the overall customer experience. AI models can more precisely assess the risk presented by individual customers by analyzing their transactions, behaviors, and the network of individuals and entities they transact with. This dynamic profiling allows banks and other institutions to tailor their AML and KYC procedures based on actual risk, focusing resources where they are needed most. Through advanced analytics and machine learning, AI can identify complex, hidden patterns and connections between transactions and actors that might indicate sophisticated criminal networks. Techniques like network analysis can reveal relationships and behaviors that are not immediately apparent, providing deeper insights into potential risks. AI can predict potential future risks by analyzing trends and patterns in data. Predictive analytics can forecast shifts in criminal behavior or emerging threats, allowing financial institutions to proactively adjust their AML and KYC strategies. AI can aid in maintaining regulatory compliance by keeping track of changing regulations and automatically updating compliance procedures. Moreover, AI can streamline reporting processes, automatically generate reports on suspicious activities, and ensure their filing within regulatory deadlines (Hannan et al., 2023, Pavlidis, 2023; Wang & Hsieh, 2023).

A current example is Hawk AI, a leader in deploying AI for AML surveillance across banking, FinTech, and payment sectors. It entered into a strategic partnership with Fourthline, a company known for its innovative AI-based KYC and AML compliance solutions. This collaboration aims to enhance AML and KYC processes. The partnership integrates Fourthline's advanced customer onboarding practices with Hawk AI's transaction monitoring expertise to address and prevent fraud and money laundering. Their combined efforts are designed to streamline AML procedures, improve the customer experience, strengthen barriers against financial crimes, and increase operational efficiency.

Fourthline, which was established in 2017, provides a technology platform that adheres to regional KYC, AML, and GDPR standards for financial services providers in Europe and beyond. Its technology, built entirely in-house, employs ethical AI for efficient process automation and real-time fraud and crime prevention. Hawk AI utilizes AI and machine learning to detect suspicious transactions promptly, improving the accuracy of financial crime detection and reducing false alarms. The partnership allows both companies to enhance their service offerings (Global Data Point, 2023a).

While AI offers significant advantages in improving AML and KYC processes, there are also challenges. These include concerns about data privacy, the potential for algorithmic bias, the high initial investment in technology and expertise, and the need for ongoing training and updating of AI models to ensure they remain effective. Additionally, reliance on AI necessitates balancing automation and human oversight to ensure that decisions are ethical, transparent, and accountable.



SUMMARY

The integration of AI within the financial services industry, particularly in the banking and insurance sectors, signifies a transformative shift toward more innovative, efficient, and inclusive services. Deposits and lending are central to the financial industry's functioning, driving economic dynamism and individuals' financial well-being. Technological advancements, especially digital banking, have substantially enhanced the convenience and accessibility of these foundational services. Lending supports economic expansion by offering capital for personal, investment, and business growth. The assessment of borrowers' credit-worthiness has grown more sophisticated, incorporating both traditional financial metrics and alternative data, making credit more accessible.

The advent of AI notably advances these areas by enabling highly individualized risk assessments, dynamic pricing, and automated claims processing. For example, AI can tailor auto insurance premiums based on driving data or offer customized health plans through wearable device data. Moreover, AI-driven chatbots and advanced analytics significantly enhance customer service and fraud detection, underscoring AI's capacity to reshape the financial services landscape for the better.

However, the deployment of AI in financial contexts is not without its challenges. Concerns regarding data privacy, security, and the potential for algorithmic bias necessitate careful navigation. These considerations include ensuring ethical AI use, maintaining transparency, and managing the substantial initial investments required for technology integration. Furthermore, transitioning to AI-driven processes demands significant workforce adaptation and continuous regulatory compliance, adding complexity to AI adoption in financial sectors.

The strategic incorporation of AI in financial services underscores a commitment to leveraging technology for enhancing AML and KYC protocols. As AI evolves, its broad application highlights its potential to mitigate risks and foster growth, inclusivity, and innovation in the financial industry.

UNIT 5

TRUST AND ETHICAL ISSUES RELATED TO AI AND FINTECH

STUDY GOALS

On completion of this unit, you will be able to ...

- understand the potential for bias and algorithmic discrimination in artificial intelligence (AI) applications and evaluate methods to minimize these issues in financial services.
- analyze the implications of different directives in Europe for AI and FinTech applications and assess the impact on data privacy and security.
- explore contemporary regulatory landscapes in other jurisdictions and examine how different countries and regions address the ethical challenges and risks associated with AI and FinTech in the financial services industry.

5. TRUST AND ETHICAL ISSUES RELATED TO AI AND FINTECH

Case Study

Jasmine, a young African American woman pursuing her graduate studies in financial technology, encountered firsthand the biases sewn into the fabric of AI applications in the financial services industry. Her journey through personal banking, credit scoring, insurance, and investment revealed the revolutionary potential of AI and the critical need for fairness and inclusivity.

Jasmine's interaction with an AI-driven personal banking app marked her first brush with AI bias. Although she was optimistic about receiving personalized financial advice, the app did not cater to her specific financial activities, including freelance work and scholarship stipends. The advice skewed toward a demographic with a traditional, steady income, neglecting the financial realities of many students and gig workers. This experience opened Jasmine's eyes to the representational bias in AI systems, where diverse income sources and financial behaviors weren't adequately recognized.

Curious about the broader implications, Jasmine explored AI's role in credit scoring. She learned that AI algorithms often factor in variables contributing to historical inequalities, such as considering credit history length and asset ownership, which could unfairly disadvantage younger individuals and underrepresented people. This indirect bias alarmed Jasmine, highlighting how AI systems might inadvertently cement societal disparities by prioritizing traditional financial indicators.

Delving into the insurance sector, Jasmine noted AI's benefits in streamlining claim processes and personalizing premiums. However, she also observed a geographical bias where individuals in certain areas, often with higher populations of underrepresented people, faced steeper premiums based on historical claim data, not considering individual risk profiles. This realization underscored how AI could exacerbate existing inequalities, penalizing communities based on their locality rather than personal behavior or risk.

In her venture into AI-assisted investment, Jasmine found the technology's potential to democratize trading and investment advice intriguing. Yet, she noted a prevalent confirmation bias – the AI's tendency to favor mainstream, established market trends, echoing the majority sentiment. This limitation in offering diverse, potentially counter-mainstream investment advice seemed to be another layer of bias, potentially stifling unique insights and opportunities for investors from different backgrounds.

Through her experiences, Jasmine became a passionate advocate for recognizing and addressing biases in AI financial services. In her master's thesis, *Equity in AI: A Personal Journey Through Financial Technology*, she outlined several solutions. She emphasized training AI on diverse, inclusive data sets reflecting a wide array of financial behaviors and situations to ensure the technology serves all users adequately. She advocated for regular

audits to identify and mitigate biases within AI systems, alongside enhancing the transparency of AI decision-making processes for users. Acknowledging the role of regulations, Jasmine argued for stringent guidelines to ensure AI applications in finance adhere to principles of fairness and nondiscrimination. Finally, she called for educational initiatives to raise awareness among users and developers about AI biases and their implications.

Jasmine shared her thesis and personal anecdotes at conferences and within her university, aiming to spark a dialogue on the ethical use of AI in finance. Her commitment illuminated the path for more inclusive financial technologies that recognize and value the diversity of user experiences and histories. Jasmine's journey, reflective of her resilience and insight, stands as a testament to the potential for change when individuals are empowered to question and reshape the technologies intended to serve them. Her deeply personal yet universally relevant case study calls for a future where AI in financial services champions equity and inclusivity, ensuring no one is left behind due to AI bias.

5.1 Bias and AI Algorithmic Discrimination

Ethics encompasses a wide array of moral principles and values that govern individual and group conduct. It is concerned with the justification of what is moral and the pursuit of “the good life,” affecting how people make decisions and lead their lives. The term “ethics” derives from the Greek word *ethos*, which can mean custom, habit, character, or disposition. Ethical considerations are critical in various sectors, including business, medicine, law, and technology, guiding professional conduct and decision-making processes. In professional settings, ethics is often codified in formal guidelines and enforced through regulatory bodies. It is essential for fostering trust, cooperation, and peace within societies by providing a common framework for understanding what constitutes good or acceptable behavior. Ethics helps individuals navigate moral dilemmas and make choices that contribute to the well-being of others and society (Boddington, 2023; The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, 2017).

Ethics
moral principles and standards that guide our behavior, determining what is right and wrong

AI ethics refers to the philosophical and regulatory framework that outlines the moral behavior and decision-making guidelines for creating, deploying, and managing AI technologies. It encompasses a set of principles aimed at ensuring that the development and application of AI systems are performed in a manner that respects human dignity, rights, freedoms, and cultural diversity while promoting fairness, transparency, and accountability. AI systems should be understandable by humans, with clear explanations for their decisions, allowing for accountability and understanding of AI operations. AI systems must avoid bias in their processes and outputs, ensuring they do not perpetuate or exacerbate unfairness or discrimination against individuals or groups. AI technologies must safeguard personal privacy and ensure robust data protection, managing personal data ethically and complying with applicable regulations. There should be clear lines of responsibility for AI systems' behavior and decisions, ensuring that humans remain ultimately accountable for AI outcomes. AI systems should be developed and deployed in ways that ensure their safety and reliability, preventing harm to humans and the environment. AI ethics also

AI ethics
philosophical and regulatory framework that outlines the moral behavior and decision-making guidelines for the creation, deployment, and management of AI technologies

involves critical considerations about the long-term impact of AI on society, including the potential for job displacement, the digital divide, and the existential risks associated with advanced AI technologies. AI ethics is a rapidly evolving field, responding to ongoing technological advancements and societal debates about the role of AI in our lives (Chishti et al., 2020; Boddington, 2023; The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, 2017).

Machine learning models, which depend on datasets classified by human moderators, encounter issues due to the inconsistency and often insufficient training of these moderators, notably in areas requiring sensitive analysis, such as online hate speech. Though training is provided in some cases, the variability in standards can significantly influence the biases inherent to automated content moderation systems. Furthermore, algorithms tend to reinforce preexisting biases, which can disproportionately impact underrepresented groups and complicate efforts to rectify these biases. The risk of algorithmic bias, derived from both the data utilized for their creation and the models employed, has the potential to deepen ingrained prejudices. This risk is particularly important in bias against certain racial groups or dialects in the identification of hate speech, with attempts to address these biases frequently proving inadequate (Boddington, 2023).

Historical bias occurs when the training data reflect past prejudices or societal inequalities. For example, if a credit scoring model is trained on data from a period when certain demographic groups were unfairly denied loans, the model may learn to associate these groups with higher credit risks unjustly. Sample bias arises when the training data do not represent the broader population. If certain groups are underrepresented in the dataset, the AI model may perform poorly in assessing individuals from those groups, leading to unfair credit decisions.

Measurement bias occurs when the data collection tools or processes introduce inaccuracies. For instance, if financial records systematically undervalue incomes for certain occupations or demographics, AI models trained on these data may inaccurately assess the creditworthiness of individuals in these categories. Biases can lead to unfair and discriminatory outcomes, particularly in sensitive areas such as credit scoring, where the implications directly affect individuals' financial well-being and access to opportunities (Langenbacher & Corcoran, 2022).

To tackle these challenges, for example, hatecheck.ai offers a set of tests designed to evaluate the efficacy of hate speech detection models across 29 different factors, and it has identified substantial issues and limitations within these models. These issues often involve misinterpreting specific keywords, phrases, or contexts, resulting in biased misclassifications toward certain demographics. The difficulty of defining online hate in a manner conducive to reliable algorithmic detection, as well as the challenges of interpreting natural language online, raises questions about the feasibility of AI solving these problems effectively (Boddington, 2023).

The use of AI to identify and address online harms has led to reconsidering existing ethical frameworks, emphasizing the complex relationship between technology and societal norms. The dependency on AI technologies for shaping ethical perspectives may challenge established ethical paradigms, possibly resulting in a more uniform approach that

could fail to account for cultural variance. There is concern that a focus on algorithmic precision might diminish the role of human judgment, potentially fostering an ethical environment that lacks cultural sensitivity. Investigations into the relationship between technological development and ethical evolution suggest that technological capabilities could influence how individuals perceive ethical issues, particularly those arising within digital contexts. This perspective raises considerations about the impact of viewing ethical dilemmas through a technological lens on societal attitudes (Boddington, 2023).

The digital sphere's emergence as a central communication medium has brought ethical challenges that resemble those faced in non-digital environments, including discrimination and harassment. Recognizing these challenges is crucial for conducting thorough analyses in contexts where technology, such as algorithms, might unintentionally affect the ethical landscape. Algorithms designed to reduce online harm may introduce a level of formalism that potentially alters outcomes or confines ethical considerations within a strict framework, thereby affecting the prioritization of values. The effort to apply algorithmic approaches to complex and sometimes ill-defined concepts like online hate reveals the challenges in establishing definitions that resonate with both legal and philosophical interpretations, often complicating the pursuit of clear and universally applicable solutions.

The contrast between the determinism offered by algorithms and the discretion typically exercised by humans highlights significant questions regarding the ability of machines to replicate detailed human judgment. Content moderation serves as a notable example of this tension. Human moderators, faced with quick decision-making and adherence to specific guidelines, may find their ability to apply individual judgment restricted, illustrating the challenges of automating inherently human-centric processes. This situation has prompted some scholars to argue for maintaining human decision-making alongside increasing automation (Boddington, 2023).

Combatting algorithmic bias is a multifaceted challenge that requires concerted efforts from data scientists, regulators, and industry stakeholders. Some strategies include ensuring that the datasets used to train AI models are diverse and representative of the entire population, which can mitigate the risk of sample bias. This requirement results from targeted efforts to include underrepresented groups in the data. Researchers have developed various algorithmic approaches to identify and correct biases in AI models. Techniques such as re-weighting training examples, modifying the learning algorithm, or post-processing predictions can help reduce bias in AI systems (Jammalamadaka & Itapu, 2023).

Making AI models more transparent and explainable can help identify potential sources of bias. If stakeholders understand how a model makes its decisions, they can spot and rectify biases more easily. Governments and regulatory bodies play a crucial role in establishing guidelines for AI fairness. Guidelines might require regular audits of AI models for bias, mandating transparency in AI decision-making processes, and enforcing accountability for discriminatory outcomes. Furthermore, the reliance on non-traditional data sources can be a double-edged sword. While it can promote financial inclusion, it raises questions about relevance and privacy. For instance, the implications of using data from social media or other non-financial activities in credit assessments need to be thoroughly con-

sidered and regulated. Regulatory frameworks should include guidelines on data usage, privacy protections, and measures to mitigate bias and ensure fairness (Chishti et al., 2020).

This analysis aims to promote a thoughtful examination of the consequences associated with delegating ethical decisions to AI and algorithms. It advocates for a prudent approach that acknowledges technology's potential to resolve intricate issues while emphasizing the need for careful consideration of the ethical principles underpinning its use. Such an approach warrants a balance between leveraging technological advancements and safeguarding the essential human aspects crucial to ethical judgment.

5.2 GDPR Directive in Europe

General Data Protection Regulation
directive that enforces data protection and privacy for individuals within the European Union and European Economic Area

The **General Data Protection Regulation** (GDPR), which came into effect on May 25, 2018, represented a significant milestone in the history of data protection laws in Europe. Its primary aim was to give individuals more control over their personal data while simplifying the regulatory environment for international business by unifying the regulation within the EU. Before the GDPR, data protection in Europe was governed by the Data Protection Directive of 1995, which was less stringent and allowed for varied interpretations by member states. The GDPR, however, is a regulation that directly applies to all EU member states without needing to be transposed into national law, ensuring a higher level of uniformity in data protection standards across the EU. The GDPR introduced several fundamental changes and provisions that directly affect the use and development of AI systems. For instance, it enhanced individuals' rights by strengthening their consent for data processing, as well as granting them the right to access their data, to be forgotten, and to data portability. It also introduced the principles of data minimization and purpose limitation, which mandate that only the necessary data for a specific purpose should be collected and processed (IT Governance Privacy Team, 2020; Kejriwal, 2023).

These provisions have a significant relevance for AI ethics, particularly in the context of transparency, accountability, and privacy. AI systems, by their nature, consume vast amounts of data, including personal data, to learn and make decisions. The GDPR's emphasis on consent, data minimization, and purpose limitation thus directly impacts how AI systems can be designed and used. For instance, under GDPR, an AI system trained on personal data must have the explicit consent of the individuals whose data it uses, and the data collected should be strictly necessary for the specific purpose. This requirement raises challenges in developing and deploying AI systems, particularly those relying on big data analytics, which might necessitate rethinking their design to ensure compliance with the GDPR (Kejriwal, 2023).

Moreover, the GDPR introduced the concept of "privacy by design and by default," which mandates that data protection measures should be integrated into developing business processes and systems from the ground up. This principle is particularly pertinent to AI ethics: It requires considerations of privacy and data protection to be integral in developing AI technologies rather than being an afterthought. However, the GDPR does not explicitly address AI technologies, leading to debates about its effectiveness in the context of AI

ethics. Critics argue that the regulation's focus on individual rights and consent may not be fully adequate to address the collective and societal implications of AI technologies, which can impact beyond the individual level, including bias, discrimination, and threats to democratic processes. Compared to jurisdictions with less stringent data protection laws, the GDPR's requirements may impede the innovation and development of AI technologies in Europe (IT Governance Privacy Team, 2020; Kejriwal, 2023).

As an example, we will look closer at the use of AI in healthcare dealing with rare disease identification, patient management, clinical decisions, and pathology. The use of AI raises ethical, practical, and legal dilemmas, especially regarding the GDPR. Key ethical concerns include clarity on AI's role in decisions, ensuring algorithm transparency, addressing biases, and fostering stakeholder trust. Ethical AI use requires a comprehensive approach that respects community needs and socio-technical aspects, with a focus on equitable healthcare access. Particularly in the Global South, AI must aim to democratize health services, addressing biases stemming from narrow data sets and promoting inclusive medical AI instruction for long-term change. Practically, AI integration faces technical challenges and needs interdisciplinary consideration of both technical and legal aspects, highlighting the importance of technology skills in educational settings and underlining the importance of ethical guidance in designing cyber-physical systems (CPPS). Legally, AI's role in healthcare underscores the necessity for GDPR-compliant data handling and the importance of open-source health data curation, emphasizing ongoing issues about consumer privacy and enforced regulations (Amini et al., 2023).

To conclude, GDPR provides a framework for addressing some of the ethical challenges posed by AI. Its emphasis on transparency, for example, aligns with the need for explainable AI, where AI systems should be able to explain their decisions in a manner that is understandable to humans. The regulation also empowers data protection authorities to enforce compliance, which can include AI systems that process personal data.

5.3 Contemporary Regulatory Landscapes in Other Jurisdictions

As the growth and integration of AI into societal and industrial spheres accelerates, its ethical implications increasingly come to the forefront. Despite the impressive volume of recent research in this area, AI ethics is still developing. The emergence of AI ethics – and its practical counterpart, AI policy – has been spurred by numerous instances where AI systems have caused harm, sometimes due to inherent design flaws or, in other cases, through misuse or exploitation. Examples include biases within AI algorithms leading to unfair outcomes like loan denials or medical misdiagnoses, as well as instances of voter manipulation, the creation of “deepfakes,” and surveillance tactics (Kejriwal, 2023).

In their notable report, Larson et al. (2016) highlighted that the Correctional Offender Management Profiling for Alternative Sanctions (COMPAS) system, utilized to forecast recidivism rates in Broward County, Florida, wrongly labeled African-American defendants as “high risk” at nearly double the rate of White defendants. Additionally, research has

shown that certain algorithms reinforce stereotypes. For instance, disparities in facial recognition technologies' accuracy across race and gender have been reported, and a study revealed that using a "CEO image search" yielded only 11% female images, despite women constituting 27% of U.S. CEOs at the time. Moreover, the U.S. government recently warned that AI-based hiring software could potentially discriminate against candidates, underlining concerns that such technology, while promising in theory, could perpetuate discrimination against people with disabilities or other marginalized groups due to biases in speech recognition or physical assessments.

These instances underline the necessity for some oversight to keep AI technologies in check and protect individual rights. This need is especially pressing considering that some AI-related issues may not receive widespread media attention or may be dealt with off the record, escaping public scrutiny. From a regulatory perspective, AI's applications and ethical concerns should be addressed at national, regional, and global levels (Kejriwal, 2023).

European Union

EU AI Act
a risk-based regulatory
framework for AI, classify-
ing systems with various
obligations within the
European Union and
European Economic Area

In April 2021, the European Commission proposed an EU-wide regulatory framework to govern AI. This draft **AI Act** marks the first comprehensive effort to create a cross-sectoral regulation for AI at the EU level. The proposed legal structure intends to address the unique challenges and hazards of deploying AI systems. It suggests implementing a technology-agnostic description of AI systems under EU law and introduces a categorization system for AI applications, assigning specific requirements and responsibilities based on a "risk-based approach." Under this proposal, certain AI technologies deemed to pose "unacceptable" risks would be banned. Moreover, a broad spectrum of "high-risk" AI technologies would be allowed entry into the EU market, albeit with stringent conditions and obligations. AI systems classified as having "limited risk" would only be subject to minimal transparency duties (Madiega, 2023).

By December 2021, the Council confirmed the general stance of the EU Member States on this matter. Subsequently, the EU Parliament articulated its position in June 2023. The next step involves EU legislators commencing discussions to finalize this emerging law, which includes substantial modifications to the original draft by the Commission. These changes encompass redefining AI systems, expanding the list of banned AI technologies, and laying down specific mandates for general purposes and generative AI models like ChatGPT (Madiega, 2023.)

The proposed AI Act adopts a risk-based strategy, offering legal measures proportionate to the identified risk levels. This Act differentiates AI technologies into four categories with regulatory measures scaled accordingly: unacceptable, high, limited, minimal risk.

Unacceptable risk

Unacceptable risk entails an outright ban on certain AI practices deemed dangerous due to their significant threat to individual safety, livelihoods, and rights. It explicitly forbids AI tools from employing harmful manipulative techniques, exploiting vulnerable groups, using AI for social scoring by public authorities, and using real-time remote biometric identification for policing in public spaces, with few exceptions. AI systems that manipu-

late human behavior to cause harm fall into the “unacceptable risk” category. For example, a hypothetical AI application that uses subliminal messages to exploit individuals with addictions, pushing them to make unhealthy choices, would be prohibited under the EU AI Act. These systems are considered to pose a direct threat to people’s safety, livelihoods, and fundamental rights. The Act explicitly bans these technologies because they undermine personal autonomy and can lead to significant societal harm, making any potential benefit vastly outweighed by their negative impacts (Madiega, 2023).

High risk

For high risk, the Act outlines regulation for AI systems that potentially jeopardize people’s safety or rights. Distinguished are two categories of high-risk systems: those as safety components in various sectors like medical devices or cars, and those in eight specific fields like biometric identification or law enforcement. These would be subject to rules including a pre-market conformity assessment, with most relying on self-assessments; AI for biometric identification would need third-party evaluation. High-risk AI systems are those integral to critical infrastructure, or that significantly influence essential public services. An example of this would be an AI-driven diagnostic tool used in healthcare settings to analyze patient data and recommend treatments. Given its potential impact on patient health outcomes, strict compliance with the AI Act’s requirements would be mandatory. Compliance includes ensuring data accuracy, implementing transparency about the AI’s decision-making process, and providing a clear avenue for human oversight. The purpose is to mitigate safety and fundamental rights risks while allowing beneficial technology deployment. An other example is facial recognition and biometric technologies. These technologies are addressed with prohibitions on real-time facial recognition in public spaces for law enforcement, barring exceptions by Member States for public security reasons and with necessary authorizations. Other uses of facial recognition could be allowed, ensuring conformity and safety checks before EU market entry (Madiega, 2023).

Limited risk

AI systems that interact directly with individuals and could affect personal choices without causing significant harm are considered to pose a limited risk. This category includes AI that engages with humans, emotion recognition, and content-generating AI like deep-fakes. A chatbot designed for customer service, providing users with product information and purchasing support, falls under this category. While it does not present severe risks, it must adhere to transparency obligations to ensure users are aware they are interacting with an AI system. These obligations include disclosing that a conversation is AI-generated, enabling consumers to make informed decisions about engaging with the technology (Madiega, 2023).

Minimal risk

Lastly, AI systems assessed as low or minimal risk are exempt from these legal obligations. Still, they could voluntarily adhere to high-risk AI systems’ mandatory guidelines through codes of conduct, promoting best practices in AI development and application across the EU.

Most AI applications are slated in this category; thus, they are subject to the fewest regulations under the EU AI Act. An example could be an AI-powered virtual pet app that learns from user interactions to provide more personalized engagement. Such applications are intended for entertainment, pose negligible risk to user safety or rights, and do not necessitate stringent compliance measures. Developers are encouraged, however, to voluntarily adopt the ethical standards outlined for higher-risk applications to foster trust and promote wider AI acceptability (Madiega, 2023).

Authorities in the EU

Under the proposal, each EU Member State is mandated to appoint one or multiple authorities, including a national supervisory body, charged with overseeing the enforcement and execution of the Act. This structure is complemented at the European level by the European Artificial Intelligence Board, comprising representatives from the Member States and the European Commission. National authorities tasked with market surveillance will evaluate whether operators fulfill the stipulated duties and standards for high-risk AI technologies. These authorities will be permitted to access sensitive data, such as the AI systems' source code, under strict confidentiality requirements. They are empowered to enforce corrective actions, including the prohibition, limitation, withdrawal, or recall of non-compliant AI systems or those posing risks to public health, safety, rights, or interests. In instances of ongoing defiance, Member States are obligated to employ all necessary actions to remove the offending high-risk AI systems from the market. Violations of the Act could lead to administrative penalties, with fines reaching up to €30 million or 6% of the total annual global turnover, based on the infraction's severity. Member States are required to establish penalty regulations, including fines, ensuring their effective implementation. To bolster innovation, the proposal suggests Member

regulatory sandbox
a safe testing environment for innovative AI, fostering development within legal boundaries

States or the European Data Protection Supervisor could create a **regulatory sandbox**. This framework provides a secure testing environment for developing, examining, and approving pioneering AI technologies, allowing the use of personal data for AI advancement in alignment with GDPR mandates. Additional support measures are proposed specifically for smaller entities and startups, fostering their growth in the AI sector (Madiega, 2023).

While originating from the European Union's legal framework, the EU AI Act is a worldwide pioneer in AI regulation, transcending the EU's geographical limits. This act represents a noteworthy attempt at shaping a foundational framework for ethical AI development and governance on an international scale, thereby influencing global norms and practices in AI. The EU AI Act's broad impact is built upon its all-encompassing ethical foundation and potential to sway global policies. Integrating ethical principles, such as prohibitions on certain high-risk AI practices and stringent control over biometric surveillance, the Act reflects values and human rights ideals that are universally acknowledged.

In tackling ethical quandaries linked to AI, the Act harmonizes with global principles, contributing to a broader dialogue on ethical AI governance. Moreover, the Act's capacity to influence worldwide stems from the EU's significant role as both a market and a regulatory powerhouse. Given its substantial market presence, companies outside the EU aiming to participate in this market are motivated to adhere to the Act's requirements or face the

possibility of market exclusion. Therefore, the regulatory framework of the Act incentivizes AI developers and operators globally to align their practices with the Act's ethics and regulations, further extending its reach beyond European borders. This global dimension also comes with its challenges, as the Act's provisions may encounter hurdles with respect to the diverse legal and cultural frameworks across different jurisdictions. Although based on universal ethical principles, applying these principles in a context-sensitive manner requires thoughtful adaptation to non-EU countries' legal systems (Musch et al., 2023).

Initiatives Beyond the EU

Nevertheless, there are many other initiatives worldwide. Since its establishment in 2020, a key highlight of the Organization for Economic Cooperation and Development (OECD, n.d.) OECD.AI Policy Observatory has been its comprehensive Database of National AI Policies & Strategies. This repository has expanded swiftly alongside the rapid progress in AI governance, showcasing more than 1,000 policy initiatives from 70 countries globally.

United States

Under President Biden's directive, the United States is set to spearhead global advancements in AI by marrying the technology's potential with robust risk management. This Executive Order introduces rigorous AI safety and security protocols, safeguards the privacy of Americans, enhances fairness and civil rights, advocates for the rights of consumers and workers, encourages innovation and market competition, and reinforces the position of the US as a global leader in AI, among other goals. It is designed to implement stringent benchmarks for AI's safety and security, uphold privacy rights, promote social equity and justice, champion consumer and labor rights, foster technological innovation and competitiveness, and bolster the international standing of the US in AI leadership, alongside pursuing additional objectives (The White House, 2023).

United Kingdom

In the United Kingdom, the AI Council, formed in 2019, serves as an authoritative source of counsel for the government and plays a pivotal role in overseeing the AI ecosystem. This body is a manifestation of a commitment outlined in the AI Sector Deal and includes esteemed professionals from various sectors, including industry, academia, and the public sphere. The council convenes quarterly to offer strategic insights to the Office for AI and the wider government on prevailing AI policies, identifying opportunities and challenges. In January 2021, the AI Council released its *AI Roadmap* consisting of 16 pivotal recommendations for the government regarding AI's strategic future. The primary emphasis was on urging the government to craft a National AI Strategy that capitalizes on the investments from the AI Sector Deal and is flexible enough to accommodate upcoming technological shifts. Following this publication, the Council initiated a series of interactions with the broader AI community, contributing to shaping the National AI Strategy. This Strategy signifies a continuation of the UK's forte in AI and marks the beginning of a transformative phase in the country's approach toward AI. It acknowledges AI's potential to enhance resilience, productivity, growth, and innovation throughout private and public realms while safeguarding the public interest and core values (HM Government, 2021).

China

China's AI governance, started in 2017, is expressed through its Next Generation Artificial Intelligence Development Plan, emphasizing state control and compliance with government standards. This plan of the State Council for the People's Republic of China embarks on several initiatives aiming at advancing research and development (R&D), pushing the boundaries of AI industrialization, nurturing talent, enhancing education and skills, establishing standards and regulations, advocating for ethical norms, and bolstering security measures. The strategic goals are to achieve parity with global AI competitors by the year 2020, to attain global leadership in select AI domains by 2025, and to establish China as the foremost hub for AI innovation by 2030, fostering an AI industry valued at RMB 1 trillion (EUR 130 billion), and elevating related industries to RMB 10 trillion (EUR 1300 billion). The Chinese government is also collaborating with domestic technology firms to spearhead research and industrial preeminence in specific AI arenas. Part of this strategy includes the development of a USD 2.1 billion (EUR 1.8 billion) AI research technology park in Beijing (Department of International Cooperation, Ministry of Science and Technology, 2017).

Brazil

Launched in 2021, the Brazilian Strategy for Artificial Intelligence (EBIA) is directed by the Ministry of Science, Technology, and Innovations (Ministério da Ciência, Tecnologia e Inovações, MCTI). This strategy is designed to guide the Brazilian government's efforts in nurturing research, innovation, and the development of AI solutions, focusing on the ethical and conscious use of AI technology for a promising future. The underlying philosophy of the EBIA aligns with the OECD's five principles for responsible AI management. These include fostering inclusive growth, sustainable development, and well-being; prioritizing human-centered values and fairness; ensuring AI systems are transparent and explainable; guaranteeing robustness, safety, and security; and maintaining accountability in AI's application and development. The strategic objectives aim to establish ethical guidelines for AI, encourage continuous investment in AI research and development, remove innovation barriers, educate AI professionals, promote Brazilian AI innovation internationally, and foster collaboration between the public and private sectors.

The EBIA confers several benefits across the AI ecosystem. It sharpens policy frameworks and governance for AI, establishes standards for policy monitoring, and promotes international cooperation. This initiative positions Brazil to benefit from global public policy networks, drawing on successful practices and evidence-based management for economic and scientific advancement. Another key aspect is its role in facilitating cultural transformation within public data governance, emphasizing transparency and collaboration for social and economic benefits.

Furthermore, the EBIA aims to standardize essential AI-related terminologies for international communication, enhancing Brazil's dialogue with the global community. It underscores the significance of cohesive public policies that nurture innovation, trust, and a culture of responsibility within AI. Additionally, the strategy recognizes the value of data in the digital economy and promotes careful policy formulation and practice in data access and sharing, reflecting the strategies outlined in the EBIA (MCTI, 2021).



SUMMARY

Ethics refers to customs and character, and it guides our moral decisions by outlining what's right or wrong. Ethical principles are vital in establishing professional conduct across various sectors, including technology, where the burgeoning field of AI ethics becomes particularly pertinent. AI ethics, primarily focused on ensuring AI development and application uphold human dignity and fairness, is responding to the assorted moral challenges posed by AI, such as bias, privacy breaches, and accountability issues.

AI's potential for harm demands oversight. For example, the COMPAS system incorrectly assessed recidivism risks, and facial recognition technologies exhibited racial and gender disparities. Such biases underline the necessity for regulatory frameworks, which can be found in initiatives like the EU AI Act. The Act proposes a risk-based categorization for AI technologies, aiming to mitigate potential threats to safety and rights while fostering innovation.

Globally, various jurisdictions are taking steps to regulate AI ethically. The EU AI Act is a pioneering regulatory effort that proposes a comprehensive framework that identifies four risk categories of AI technologies, from unacceptable to minimal risk. This act underscores the importance of adapting AI practices to ethical standards, enhancing transparency, and ensuring accountability. In the US, President Biden's Executive Order focuses on managing AI risks, while the UK's AI Council and China's Next Generation Artificial Intelligence Development Plan reflect national efforts toward ethical AI governance. The EBIA aims to ensure responsible AI use in Brazil, guided by OECD principles.

These developments signify a global movement toward the ethical management of AI, highlighting the necessity of balancing technological progress with moral considerations to ensure AI contributes positively to society.

UNIT 6

FUTURE OF FINTECH AND AI

STUDY GOALS

On completion of this unit, you will be able to ...

- assess the lessons learned from past events to build trust and improve FinTech and artificial intelligence (AI) solutions adoption in the financial services industry.
- identify new collaboration opportunities between traditional financial institutions and FinTech companies.
- explore the emerging trends and potential developments in banking technology.
- examine the role of FinTech and AI startups in promoting sustainable and ESG (Environmental, Social, and Governance) financing.
- investigate the future of banking, cryptocurrencies, and central bank digital currencies (CBDCs).

6. FUTURE OF FINTECH AND AI

Case Study

Envision a day in 2030 for Jordan, a middle-class individual. As morning breaks, Jordan is gently roused not by the abrasive beep of an alarm but by the soothing strains of classical music emanating from their bedroom speakers. The shower awaits at the perfect temperature, coffee simmers in the kitchen, and a holographic screen offers real-time updates on their bank and investment accounts, including fluctuations in a cryptocurrency portfolio. A summary of their overnight health data reveals a steady heart rate with a hint of dehydration.

During Jordan's slumber, their smart home system efficiently managed utilities, settling the next two-month electricity bill in advance to capitalize on forecasted price increases. Throughout the day, their cloud-based financial assistant, refined by machine learning and adjusted to their unique preferences and risk profile, discreetly orchestrates a multitude of transactions. These maneuvers boost their financial health and strategically position them in a better tax situation. After reviewing imminent bills and confirming adequate savings for a vacation, Jordan commands a chatbot to secure flight bookings and trip insurance in a single action. Further, they arrange for accommodation and a prepaid entertainment bundle for their destination, effortlessly sharing all pertinent details with their travel partner, maintaining a bank-free interaction (Sieber & Guibaud, 2022)

Though the intricacies of Jordan's interaction with various financial services appears vague, they remain acutely aware of their monthly expenditure. This obliviousness toward the operational mechanics of their financial tools is akin to their understanding of their car's engine or the refrigeration cycle – unnecessary for their day-to-day.

Jordan begins their workday by wearing a headset, diving into a virtual office space for a brief four-hour stint before logging off. Subsequently, while out shopping, their vehicle suggests restaurant options for lunch and handles the payment for tolls encountered during peak traffic – all facilitated through their digital wallet. At a preferred store, facial recognition brings up Jordan's wish list, highlighting a desired chair. Despite attractive financing offers, their AI advisor, keeping Jordan's financial ambitions in check, declines but agrees to prompt a reconsideration later. Clothes, when decided upon, are billed as Jordan exits, without engaging in a physical payment process. Once home, Jordan reassesses their vacation gear, pondering over a surfboard. The steep price, heightened by their flight expenses, becomes manageable with an interest-free installment proposition. Upon agreement, the surfboard's design is quickly relayed to their 3D printer, preparing it just in time for the trip (Sieber & Guibaud, 2022).

Throughout the day, Jordan conducts several financial operations – from withdrawals and currency swaps to new investments – without manual input. These activities perfectly align with their predefined guidelines and preferences, illustrating a day marked by fluid, autonomous financial navigation.

Twenty years later, in the year 2050, the fusion of AI and FinTech has revolutionized how Jordan conceives financial transactions and the spaces in which these interactions occur. Welcome to a world where the metaverse and outer space are no longer frontiers of imagination but pivotal arenas for financial innovation and operations.

Amid this backdrop, we see AstroFinTech Inc. – a pioneering firm that has seamlessly integrated AI with FinTech, extending its operations from the metaverse to lunar colonies. In the metaverse, AstroFinTech has introduced Virtual Wealth Management Assistants (VWMAs), AI entities capable of providing personalized financial advice and executing transactions instantaneously. These VWMAs, equipped with sophisticated algorithms, analyze vast amounts of data from a user’s virtual and real-life financial activities, offering insights and managing assets with unprecedented precision. Transactions in the metaverse, powered by blockchain, ensure security and transparency, creating a round-the-clock financial ecosystem. The Metaverse also hosts “Digital Asset Exchanges” where users trade virtual assets, from non-fungible tokens (NFTs) representing digital art to virtual real estate. These platforms, regulated by AI algorithms, have democratized wealth and minimized the risk of fraud, assuring a safe trading environment for all users.

Transitioning from the virtual to the cosmic, AstroFinTech has extended its influence on humanity’s settlements on the Moon. AstroWallets – a novel financial product in these extraterrestrial colonies – facilitate the seamless transfer of currencies between Earth and the Moon. Traditional currencies and cryptocurrencies converge in these wallets, enabling settlers to conduct transactions in a lunar economy intricately linked to Earth’s financial systems. In outer space, AI plays a crucial role in managing the unique challenges of space commerce. With variable communication delays and the need for transactions to be validated across vast distances, AstroFinTech’s AI systems ensure that trade between Earth, lunar colonies, and space stations remains fluid and uninterrupted. AI’s predictive capabilities are also employed to anticipate and manage the economic implications of space travel, such as fluctuating demand for resources and the valuation of space-mined minerals.

Moreover, AstroFinTech has introduced Interstellar Investment Portfolios, allowing individuals on Earth to invest in space exploration and development projects. These portfolios are managed by AI algorithms that assess risks, forecast returns based on space exploration advances, and adjust investments in real time to maximize profitability. AstroFinTech’s success lies in its ability to harness AI to create inclusive, efficient, and adaptive financial ecosystems that transcend the physical boundaries of Earth. In this future, financial inclusion reaches a new zenith, with digital identities and AI ensuring that even the most remote settler or virtual entity can access sophisticated financial services.

As we explore this possible future, it becomes clear that the fusion of AI and FinTech holds the key to democratizing wealth and opportunity across frontiers. The fabricated journey of AstroFinTech Inc. symbolizes a leap into the future of finance, where boundaries dissolve, creating a unified financial ecosystem that’s inclusive, innovative, and boundless.

6.1 Building Trust from Past Events

The financial services industry stands at the precipice of a transformation fueled by advancements in FinTech and AI. However, the journey of integrating these technologies into the broader financial ecosystem has been punctuated by successes, challenges, and critical lessons. By reflecting on past events, the industry can chart a course toward greater trust, wider adoption, and realizing FinTech and AI's full potential. This section explores vital lessons learned and outlines strategies for fostering trust and accelerating the adoption of these technologies.

One of the first lessons from the early days of FinTech's integration into financial services is the critical importance of transparency. The 2008 global financial crisis, albeit not directly linked to FinTech, underscored the dangers lurking in complex, opaque financial instruments and practices. In the aftermath, there was a heightened call for clearer, more transparent dealings, which FinTech could potentially answer. Yet, as AI and FinTech applications become more complex, it becomes crucial to ensure these systems are transparent and their workings understandable to the average user. For users to trust the new technology, financial services must ensure that AI algorithms' decisions can be explained and understood by their customers. The European Union's General Data Protection Regulation (GDPR) introduces the right to explanation, by which a user can ask for an explanation of an algorithmic decision that was made about them. Adopting similar standards, industry-wide, could foster trust between financial institutions and their customers (Goodman & Flaxman, 2017).

Financial services are inherently data-driven, and in the era of big data, ensuring the privacy and security of customer information is paramount. The infamous Equifax breach of 2017, which exposed the personal information of approximately 147 million people, serves as a stark reminder of the vulnerabilities present in the digital infrastructure of financial institutions (Federal Trade Commission, 2022). Incorporating AI into financial services amplifies these concerns, as AI systems often require access to vast amounts of data to function effectively. To mitigate these risks, financial services must prioritize developing and implementing robust cybersecurity measures and adhere to the highest data protection standards. Techniques such as federated learning, which allows AI models to be trained on-device without exposing raw data, could provide a way forward.

With their capacity to analyze and make decisions on large datasets, AI systems can inadvertently perpetuate biases present in the data or their programming. Incidents like the Apple Card gender bias controversy, where the credit limit algorithm was accused of offering lower credit limits to women, reveal the critical need for ethical considerations in AI development and deployment (Telford, 2019). Financial institutions adopting AI must ensure that these systems are efficient, fair, and unbiased. These systems require adopting a multi-disciplinary approach to AI development, involving ethicists and sociologists in the design of algorithms, and conducting regular audits for bias and discrimination.

The regulatory landscape for FinTech and AI in financial services is continually evolving. Adhering to current and future regulations is crucial for meeting legal requirements and establishing trust with clients and stakeholders. For example, the Revised Payment Services Directive (PSD2) in Europe is designed to enhance competition across Europe and

encourage involvement in the payment sector from entities outside the traditional banking industry. At the same time, it ensures strict security requirements for electronic payments and the protection of consumers' financial data. Collaboration between regulatory bodies and financial institutions can facilitate the development of coherent standards and guidelines that ensure the safety, efficacy, and fairness of FinTech and AI solutions. Initiatives like the UK's Financial Conduct Authority (FCA) sandbox provide a controlled environment for testing innovative financial services before facing regulatory obligations (Bains & Wu, 2023).

For FinTech and AI solutions to be widely adopted, they must address real customer needs and offer tangible benefits over traditional services. The success stories of mobile banking in Africa, such as M-Pesa in Kenya, highlight how technology-driven financial solutions can achieve widespread adoption by offering unbanked populations access to financial services (Hughes & Lonie, 2007). Financial services adopting AI and FinTech must maintain a customer-centric approach, focusing on enhancing customer experience, convenience, and accessibility. Engaging customers through education about the benefits and potential risks of these technologies can also aid in building trust and encouraging adoption. In conclusion, the path toward widespread trust and adoption of FinTech and AI in financial services is multifaceted, involving a concerted effort to enhance transparency, prioritize security and privacy, address ethical considerations, comply with regulations, and maintain a focus on customer needs. By learning from past events and applying these lessons, the financial services industry can navigate the challenges and harness the potential of these transformative technologies to create a more inclusive, efficient, and resilient financial ecosystem.

6.2 New Collaboration Opportunities

In the fast-evolving landscape of financial services, the collaboration between FinTech companies and traditional banks has morphed from a novel idea into a necessary strategy for staying competitive and meeting the increasingly complex demands of consumers. Initially, the relationship between these two entities was viewed through a lens of competition rather than cooperation. However, as the industry has progressed, the benefits of collaboration have become undeniable. This progression from old to new collaboration opportunities has set the stage for a future where FinTechs and traditional banks work hand-in-hand to drive innovation and enhance customer experience.

The first wave of collaboration between FinTechs and traditional banks largely focused on leveraging technology to improve the efficiency of existing financial processes. One early example was in payment processing, where FinTechs provided banks with advanced solutions to reduce transaction costs and processing times. Companies like Stripe and PayPal revolutionized online payments, prompting banks to either partner with these companies or develop similar technologies to retain customers. Another significant area of collaboration was in cybersecurity. FinTechs, with their agile development processes and cutting-edge technologies, offered banks advanced solutions to combat fraud and secure online transactions. Tools such as biometric authentication, encryption, and blockchain were adopted to enhance the security infrastructure of traditional banks (Hodges, 2023).

As the financial ecosystem continues to evolve, so do the opportunities for collaboration between FinTechs and traditional banks. Recent trends indicate a shift toward deeper integration and more innovative synergies. Modern customers expect personalized banking experiences tailored to their specific needs and preferences. FinTechs, with their expertise in big data analytics and AI, are well-equipped to analyze consumer data and generate insights that banks can use to offer bespoke financial products and services. The advent of open banking regulations, such as the PSD2 directive in Europe, provides a regulatory foundation for banks and FinTechs to share data securely with each other's consent. This environment fosters innovative services and products, such as consolidated financial dashboards, easier account switching, and more competitive lending rates. By collaborating within this ecosystem, banks and FinTechs can extend their market reach and offer more comprehensive services (Hodges, 2023).

Collaborations are increasingly exploring the use of blockchain technology to streamline cross-border payments. Traditional banks are partnering with FinTech firms to harness blockchain to reduce the cost and time associated with international transactions. The company Ripple's partnerships with numerous banks around the world demonstrate the potential of blockchain to enhance the efficiency of cross-border payments, making them almost instantaneous and significantly more affordable (Hodges, 2023).

Banking as a Service (BaaS)

facilitates integration of banks' services directly into non-bank business models via an application programming interface (API)

Banking as a Service (BaaS) platforms represent a frontier of collaboration, where banks offer their financial infrastructure as a platform on which FinTechs can build their own products. BaaS is the foundation that allows these third parties to leverage the existing regulatory and financial infrastructure of traditional banks to offer their services. This infrastructure could include anything from payment processing to credit offerings. BaaS acts as an intermediary framework providing the tools and connections necessary for FinTechs and other non-banking companies to offer financial services without needing to become banks. The collaboration helps FinTechs launch financial services quickly and compliantly, enabling banks to tap into innovative applications and customer segments they might not reach otherwise (Hodges, 2023).

Embedded finance

financial services within non-financial companies' platforms or ecosystems via technology

Looking ahead, the concept of **embedded finance**, where financial services are seamlessly integrated into non-financial customer journeys, presents a vast potential for collaboration. Customers can access financial services like payments, lending, insurance, or investing directly within the user experience of another non-financial service. For example, when shopping online, a customer might be offered the option to pay in installments at checkout without leaving the retailer's website or app. Banks can partner with FinTechs and other companies to embed banking services directly into the customer's shopping, travel, or healthcare experience. This integration can significantly enhance the customer experience, opening up new revenue streams for both banks and FinTechs. (Sieber & Guibaud, 2022).

Embedded finance and BasS are closely related concepts, but they serve different purposes and fulfill distinct roles in the integration of financial services with non-financial businesses. Embedded finance focuses on the end-user's experience, ensuring that financial services are available seamlessly and conveniently within other services. BaaS is focused on the backend, supplying the technology and banking infrastructure necessary for companies to develop and launch their financial services. Embedded finance targets

end-users, aiming to provide them with financial services in the context of other activities. BaaS targets businesses (FinTechs or otherwise) that want to offer financial services without the overhead of establishing a bank. Both concepts are crucial in today's financial ecosystem, offering diverse ways to reimagine how financial services are delivered and consumed (Hodges, 2023; Sieber & Guibaud, 2022).

The symbiotic relationship between FinTechs and traditional banks has moved from cautious engagement to strategic partnerships. By combining the agility, innovation, and technological prowess of FinTechs with the customer base, regulatory expertise, and financial knowledge of traditional banks, these collaborations are set to redefine the financial landscape. The future will likely see an even greater convergence of services as both sectors seek to leverage their unique strengths in a competitive and rapidly changing environment.

6.3 Future of Banking Technology

Looking into the distant future of banking technology beyond the immediate horizon of blockchain, artificial intelligence (AI), and open banking, we venture into realms that could redefine our understanding of financial services. Innovations such as quantum computing, advanced biometrics, decentralized autonomous organizations (DAOs), and the integration of financial services into the Internet of Things (IoT) present exciting challenges and opportunities. These nascent technologies hold the potential to further enhance security, efficiency, and personalized banking experiences, ushering in a new era of financial inclusivity and innovation.

Quantum computing represents a revolutionary leap in computing power with profound implications for the banking sector. Unlike classical computers, quantum computers leverage the principles of quantum mechanics to process information at speeds unimaginable today. This leap in computational ability promises to transform areas from risk assessment to fraud detection and from portfolio management to encryption security. The application of quantum computing in cryptography, for instance, could render current encryption methods obsolete, necessitating the development of quantum-resistant encryption to secure banking transactions and customer data. As banks grapple with increasingly complex data sets and financial models, the computational prowess of quantum computing could enable real-time, global financial risk analysis, potentially safeguarding against future financial crises. However, the adoption of quantum computing also presents significant challenges, including substantial costs, the need for new skill sets, and profound cybersecurity implications (Horowitz & Grumbling, 2019; Mosca & Munson, n.d.).

As digital banking continues to evolve, so too does the sophistication of cyber threats. In response, future banking technologies may leverage advanced biometrics to ensure unparalleled security and user authentication. Beyond fingerprints and facial recognition, emerging biometric technologies include vein pattern recognition, heartbeat analysis, and brainwave identification. These methods offer a higher degree of security due to the unique and complex nature of the biometrics involved, significantly reducing the potential for identity theft and fraud (Jain et al., 2004).

The IoT's expansion into everyday objects offers transformative potential for embedding financial services into virtually any device. Financial transactions and management could be deeply integrated into our homes, vehicles, and wearables. Imagine smart homes that manage utility bills autonomously and optimize household expenditures and investments in real time. Vehicles could negotiate and transact insurance premiums based on driving behavior, while wearables could manage health insurance policies by monitoring the wearer's physical activity and health metrics (Perera et al., 2015).

As we look further into the future, it is evident that the banking sector must navigate a rapidly evolving technological landscape. The potential for these technologies to disrupt traditional banking models is significant, promising enhanced efficiency, security, and personalized customer experiences. However, this future also calls for carefully considering ethical, regulatory, and privacy concerns. Integrating such advanced technologies into banking services must be balanced with ensuring data protection, user consent, and transparency.

6.4 Role of FinTech and AI Start-ups in Sustainable and ESG Financing

In recent years, the intersection of FinTech and AI start-ups with sustainable and ESG (Environmental, Social, and Governance) financing has become increasingly prominent. One of the start-up's primary contributions to ESG financing is enhancing transparency and accountability in investment processes. By utilizing advanced data analytics, AI algorithms, and blockchain technology, these firms can provide investors with real-time insights into the ESG performance of their investments. For instance, blockchain-based platforms can offer immutable records of a company's environmental impact, ensuring investors make informed decisions aligned with their ESG criteria. FinTech solutions also democratize access to sustainable investment opportunities by developing platforms that assess and aggregate ESG scores of companies and investment funds, making it easier for retail and institutional investors to allocate capital toward sustainable initiatives.

AI and FinTech start-ups play a pivotal role in facilitating the issuance and trading of green bonds and impact investing products. Green bonds, used by corporations and governments to fund environmentally friendly projects, require rigorous assessment and verification of their environmental benefits. AI algorithms can automate and enhance the accuracy of this vetting process, streamlining the issuance of green bonds and reinforcing investor confidence in their environmental contributions.

Impact investing
directs capital to ventures
generating social or envi-
ronmental benefits along-
side financial returns

Impact investing represents a fundamental shift in how capital is directed toward achieving financial returns and generating positive social and environmental impacts. FinTech startups, with their innovative platforms, are pivotal in facilitating this shift, especially in promoting investments in projects and ventures that have specific ESG goals. These goals can range from renewable energy projects that reduce carbon footprints to clean water

initiatives that ensure access to safe drinking water for underserved communities and affordable housing projects that address the urgent need for secure and accessible housing options.

Central to their role, FinTech platforms offer the necessary infrastructure that simplifies the process of impact investing for both seasoned investors and those new to the concept. These platforms provide detailed information on various projects through user-friendly interfaces, including their objectives, potential impacts, and financial returns. By doing so, they demystify impact investing, making it more accessible to a broader audience. Additionally, some platforms incorporate advanced analytics and AI to offer personalized investment suggestions based on the user's interests, risk tolerance, and desired impact, further streamlining the investment process. Moreover, by aggregating a wide array of impact investment opportunities on a single platform, FinTech startups enable investors to diversify their portfolios, spreading their investments across different sectors and regions. Diversification mitigates risk and maximizes the potential impact of their investments. Furthermore, the transparency these platforms provide ensures that investors can trace the outcomes of their investments, reinforcing the tangible benefits of their contributions toward sustainable development (Hebb, 2013; Fatica et al., 2021).

The application of IoT technology has been pivotal in advancing real-time environmental monitoring and ESG reporting. Organizations can obtain granular, actionable data by deploying a network of sensors capable of tracking a wide array of environmental parameters – from air and water quality to greenhouse gas emissions. This technological advancement improves the scope and accuracy of ecological assessments and drives corporate strategies toward more sustainable practices. Such detailed monitoring supports companies in making data-driven decisions that align with their sustainability goals, ensuring a positive impact on the planet. Furthermore, by integrating IoT with blockchain technology, there is a significant leap toward enhancing the transparency, security, and credibility of ESG reporting. Blockchain's immutable ledger provides a verifiable, tamper-proof record of environmental data, thereby addressing the skepticism around greenwashing and the authenticity of ESG claims. The combination of IoT and blockchain technology streamlines the reporting process and empowers stakeholders to hold organizations accountable for their environmental impact, marking a significant step forward in corporate sustainability efforts (Saxena et al., 2023).

Blockchain technology's influence extends beyond providing a secure ESG reporting platform. It offers a decentralized and transparent framework that can revolutionize asset management, facilitating seamless data exchange and fostering participant trust. Blockchain mitigates the inconsistencies and complexities prevalent in traditional ESG reporting systems by enabling a standardized reporting mechanism. This standardization is crucial for comparing and assessing the sustainability performance of different entities, thereby guiding investors toward making informed, ethical investment choices. Moreover, blockchain's capability to automate data collection and reporting processes through smart contracts simplifies and expedites the evaluation of a firm's adherence to ESG criteria. This automation reduces the time and resources needed for manual reporting and enhances the accuracy and reliability of sustainability assessments (Saxena et al., 2023).

AI's capability to process vast amounts of unstructured environmental, social, and governance data, coupled with its predictive analytics, enables a deeper understanding of ESG impacts and investment opportunities. By employing natural language processing and machine learning, AI can sift through extensive datasets to uncover insights into corporate sustainability practices, governance standards, and social contributions. Furthermore, AI algorithms are critical in identifying and mitigating potential risks associated with ESG factors. They offer a nuanced analysis that captures the interconnectedness of various ESG aspects, facilitating a holistic approach to sustainability. AI's predictive capabilities are instrumental in forecasting future trends, enabling investors and companies to make proactive, informed decisions that align with long-term ESG goals (Saxena et al., 2023).

Regulatory uncertainty and the lack of standardized ESG metrics can hinder the widespread adoption of FinTech solutions in ESG financing. Additionally, there are concerns regarding data privacy and the ethical use of AI in financial decision-making processes. Addressing these challenges requires concerted efforts among regulators, industry stakeholders, and start-ups to establish clear guidelines and ethical frameworks for applying these technologies in sustainable finance.

6.5 Future of Banking: Cryptocurrencies and CBDCs

The vulnerabilities of traditional currencies have spurred the development of new forms of payment, such as cryptocurrencies. Unlike conventional transactions, those done with cryptocurrencies do not require banks as intermediaries, thereby diminishing the direct influence of financial institutions on these decentralized units of money. To keep pace, central banks soon began to develop their systems, adapting to the new technologies that paved the way for their iteration of digital currencies. The term **central bank digital currency (CBDC)** often causes confusion, mistakenly

equated with the concept of cryptocurrency.

Recognizing the demand for alternative financial transaction methods, 95% of countries have initiated CBDC projects, with three countries launching digital currencies – the Bahamas, Jamaica, and Nigeria. China has also launched a similar project, reaching 260 million people (Atlantic Council, n.d.).

CBDC represents a novel monetary system exclusively utilized in digital form. Similar to cryptocurrencies, CBDCs are digital tokens, with the crucial difference being their issuance by a central bank. Instead of distributing physical notes and coins, central banks circulate digital currencies, utilizing digital means to facilitate access to financial resources.

Initially introduced as banknotes and coins, today's fiat money is still used for transactions and purchasing goods and services. However, many people seek alternatives to fiat currency, prompting financial institutions to create credit-based models where transactions are recorded and processed on digital platforms. This model simplifies financial transac-

Central bank digital currency (CBDC)
a digital form of fiat money issued and regulated by a country's central bank (Blakstad & Allen, 2018)

tions for customers, making them more accessible. Central banks have recognized the advantages of new technologies and are incorporating them into their systems. Nevertheless, new digital platforms introduce risks associated with security and value fluctuations. Unlike cryptocurrencies, CBDC money is supported by the government and issued by the central bank, making it more stable without the expected volatility on the platform (Blakstad & Allen, 2018).

It is often challenging to discern how central banks intend to approach cryptocurrency. Central banks adhere to strict regulations concerning a country's or region's currency system, whereas cryptocurrencies like Bitcoin face minimal regulation. Central banks issue physical and digital currencies, while cryptocurrencies are purely virtual. Despite these differences, many central banks are evaluating the benefits of issuing a government-controlled digital currency as an alternative to national fiat money. Central banks consider introducing CBDC for several reasons, including ensuring access to banking services for disadvantaged population segments, providing secure access to banking services, strengthening the domestic payments industry, making transactions more efficient, and minimizing transaction costs. The COVID-19 pandemic led to an increase in digital transactions. Online shopping allows internet users to make purchases and transfers digitally. Digital payment systems with cryptocurrencies are becoming more sophisticated, serving as a template for central banks to develop their stable digital currency. Several instances of CBDC in circulation include the following (Atlantic Council, n.d.):

- **digital yuan (China).** Launched in 2020, the digital yuan is the People's Bank of China's first earnest attempt to introduce CBDC, existing alongside physical money to reduce its usage within the country.
- **e-krona (Sweden).** Issued by Riksbank, the Swedish central bank, the e-Krona is a digital alternative to cash, primarily for transactions in remote rural areas with limited access to cash.
- **digital euro (European Union).** The European Central Bank (ECB) is considering introducing a digital Euro to complement physical cash, providing a secure and available option for digital payments in the EU.
- **sand dollar (Bahamas).** Launched in 2020 by the Central Bank of the Bahamas, the sand dollar is the world's first digital state currency, aiming to enhance financial integration and reduce dependence on traditional banking services.

Digital central bank money, issued by central banks, falls under these authorities' purview. CBDCs can exhibit characteristics of cryptocurrencies, such as facilitating cross-border transactions. With CBDCs, central banks can better meet their stakeholders' needs. One significant advantage is their programmability, making them potentially more predictable than the highly volatile cryptocurrencies. Further advantages of CBDCs over cryptocurrencies include the following (Blakstad & Allen, 2018):

- They can be utilized to settle tax liabilities at national or regional levels.
- CBDCs enhance the availability of financial transactions.
- The money supply is controlled.
- Exchange rates are based on fiat money, making them simpler to predict, with current issuance by central banks allowing for better control.
- Central banks or authorized groups retain all control mechanisms related to issuance.

- Individuals can open accounts directly with the central bank.

As more people access digital services via laptops or smartphones, the crucial goal of financial inclusion – digital central bank money’s ultimate aim – becomes achievable. Cryptocurrencies are often viewed less as a medium of exchange and more as a store of value. Commercial organizations and currency guardians issue stable cryptocurrencies and digital central bank money as solutions for mass payment transactions. Innovations in digital central bank money offer new opportunities to the entire banking system and relevant stakeholders. Many actors in the economy recognize the need to introduce digital central bank money, citing various reasons for its deployment (Blakstad & Allen, 2018):

- **Central banks** guarantee economic stability by issuing banknotes, controlling the money supply, and setting monetary policy.
- **Governments** design fiscal policy in alignment with the financial system.
- **Commercial banks** must comply with regulations developed by authorities while striving to achieve their revenue goals.
- **Corporate clients**, including charities, educational institutions, and nongovernmental organizations (NGOs), require a bank for business transactions.
- **Investors** purchase stable government bonds to generate a reasonable return.

Digital currencies are poised to replace traditional monetary models like banknotes and coins. The COVID-19 pandemic has demonstrated that a shift toward digital payment methods is inevitable. It was one catalyst for faster advancements in digital central bank money. Today, CBDC is more than just a digital replica of past transactions with banknotes and coins. Instead, it is programmable money that addresses financial efficiency and integration challenges.

SUMMARY

The financial industry is undergoing a significant transformation, driven by advancements in FinTech and AI. This demand for transparency is addressed by FinTech, with the adoption of standards like the GDPR in the European Union, which encourages clarity, especially in AI-driven decisions. The sector is navigating an evolving regulatory landscape, emphasizing compliance to foster trust and facilitate innovation.

Furthermore, the collaboration between FinTech companies and traditional banks has shifted from competition to partnership, leveraging technology to enhance efficiency, security, and customer experience. Open banking regulations like PSD2 promote data sharing and innovation, paving the way for integrated solutions like BaaS and embedded finance. These collaborations aim to tailor financial services to customer needs, highlighting initiatives like mobile banking in Africa’s M-Pesa as benchmarks for successful technology-driven financial solutions.

Looking ahead, the future of banking technology delves into uncharted territories with promising but challenging innovations like quantum computing, advanced biometrics, DAOs, and the IoT. These advancements offer the potential to enhance security, efficiency, and personalization but also require careful consideration of ethical and regulatory implications.

In sustainable and ESG financing, FinTech and AI startups are instrumental in offering transparency, efficiency, and novel opportunities for green bonds and impact investing. Integrating technologies like IoT and blockchain improves ESG reporting and accountability, aiding in adopting sustainable practices.

State-backed, stable, and programmable, Central Bank Digital Currencies (CBDCs) are distinct from cryptocurrencies. They aim to improve financial inclusivity, efficiency, and security. This evolving landscape presents a future where digital currencies complement traditional financial systems, driven by consumer needs, regulatory support, and technological innovation, aiming for a more inclusive, efficient, and resilient financial ecosystem.