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BANKING DEVELOPMENT PECULIARITIES: BLOCKCHAIN, ARTIFICIAL INTELLIGENCE (AI) AND CYBERSECURITY ISSUES

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Abstract. The banking sector is seeing an epochal shift underpinned by the incessant march of technology, specifically financial technology. These innovations have dramatically improved operational efficiency and customer experience. That said, they have also opened up vast cybersecurity and compliance problems. This publication overlooks a methodical approach to the banking innovation trends that take shape over increasing frequency and provides one strong critical reflection on how many challenges traditional financial institutions face. Strategic adaptability is essential as a long-term, dynamic strategy consistent with the concepts of evolution through comprehensive analysis and synthesis.

Keywords: Finance; innovations; AI banking; cybersecurity; financial technologies; blockchain; FinTech

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1. Introduction

The potential future of banking is approaching a new age, thanks to the rapid advances in FinTech, artificial intelligence (AI) and blockchain technologies. This evolution of financial institutions potentially marks the beginning of a new era in the global financial system, in which traditional financial institutions are applying innovative technologies to simplify operations and reduce the risks associated with cybersecurity and institutional regulatory compliance (Gomber, Koch & Siering, 2017; Adeniran, Jadah & Mohammed, 2020). The emergence of rather unconventional FinTech companies that take advantage of technological innovations more closely related to conventional banking and payment infrastructures has increased the competitive challenges in financial services. These FinTech companies are partially changing the environment of financial activity, creating new challenges for traditional banking models and possible new financial services (Hornuf et al., 2021).

A fundamental change in this FinTech is integrating aggregated data and artificial intelligence into financial services. This direction is evident in FinTech lending services that use artificial intelligence and digital development technologies to improve decision-making processes, tailor services to individual needs, and improve operational efficiency (Jagtiani & Lemieux, 2019; Mugunzva & Manchidi, 2024). Classical banks are increasingly adopting open banking strategies and working with FinTech companies to maintain their competitive edge in the new digital financial services environment (Omarini, 2018).

However, this advance in FinTech poses new challenges, in particular by creating institutional regulatory frameworks that can foster innovation while protecting consumer interests and ensuring the stability of the overall financial system (Zetzsche et al., 2019).

The primary purpose of this article is to study the impact of innovation changes on the banking sector. The article provides a detailed review of the existing literature, partially supplemented by a comparative analysis based on reliable scientific sources. This study's main focus areas are blockchain, artificial intelligence, and cybersecurity.

The rapid pace of digital innovation is revolutionising the banking sector. Since financial institutions use these newly emerging technologies, this not only increases the efficiency of the activities of organisations but also changes the behaviour of customers and the business methods of commercial banks. According to Gomber, Koch and Siering (2017), the fusion of FinTech and digital finance significantly changes financial institutions' activities, improves services' availability, speeds up the conclusion of transactions and reduces operating costs. Such progress by financial institutions is promoted by artificial intelligence technologies that allow banks to provide personalised services, detect possible fraud and optimise risk management strategies.

Digital learning has achieved a lot in the field of FinTech. Platforms like LendingClub use alternative data to offer more personalised borrowing solutions that match the findings of authors Jagtiani and Lemieux (2019). The emergence of a new style of banks is exacerbating these trends and correlating with digital banking models, which often overtake the already-known physical infrastructures of the banking business.

Hornuf et al. (2021) explore how already well-known traditional banks work with financial institutions and new startups to adapt to the rapidly changing digital banking environment. Given the frequent flexibility of FinTech companies, so-called conventional banks are often forced to adopt new strategies to remain competitive in such an environment. Omarini (2018) highlights the growing importance of digital, openly accessible banking, which has become a key strategy for banks to maintain relevance in this rapidly changing environment.

More importantly, new digital technologies also play an important transitional role, especially in settling and financing payments and trade transactions. The ability to increase transparency, security and efficiency, notably through new technologies, is transforming these essential banking functions (Chen & Bellavitis, 2019). As Zetzsche et al. (2018) noted, blockchains' decentralised and controlling nature can disrupt traditional financial systems. However, significant challenges remain, such as changing the mindset of transactions, the need for energy consumption, and the need for unified regulatory frameworks.

As this innovative development continues to evolve, cybersecurity and the critical need for regulatory compliance have potentially become the main problems of the next generation of digital banking. The increasing dependence on interconnected digital platforms often exposes financial institutions to higher risks related to data privacy and cybersecurity threats. Therefore, to protect against cyber-malicious attacks, strong protective measures should be implemented (Sullivan, 2019).

In an additional overview of the regulation of activities in financial institutions, some authors advocate a more balanced regulatory approach that promotes innovation. Ensuring this balance is essential for the development of an operating environment in which both progress in financial activities and regulatory oversight can successfully exist.

These ongoing changes in technology and oversight partly reflect the crucial role of artificial intelligence, blockchain and FinTech in shaping the future of new banking. This article looks at how these innovations are transforming financial institutions and creating new standards for consumer service and regulatory compliance in financial activities.

2. Research methodology and methods

The method of scientific literature analysis helps to develop new ideas and helps to understand how much the area of interest to the researcher has been studied. Literature analysis helps to get acquainted with the works of predecessors and research methods, find material confirming or contradicting the facts of the study, and plan work. As stated by Kardelis (2002), literature analysis describes the situation and achievements of the selected research area. Literature review realises several goals: it introduces the reader to the results of other studies closely related to the specific study, encourages dialogue with already published material, fills gaps, and expands the studies conducted. According to Žydžiūnaitė (2011), literature analysis makes it possible to structure the basis of the relevance of the study and the criteria according to which it will be possible to compare the results of the study with the results of other studies.

According to Tidikis (2003), comparative method – sociological research, when information obtained: a) in various periods of historical development is combined; b) from various social systems (institutes, groups, territories, administrative units, countries, etc.); c) from different authors or research teams; d) by various collection or measurement methods. Tidikis (2003) stated that the comparative method can be used to achieve various methodological or methodological solutions to problems: descriptive (identification of similarities or differences) or analytical (interpretation, prediction, practical recommendations). These circumstances determine the implementation of comparative methods, actions, analysis and organisation of the study. While analysing scientific literature, 82 articles were selected and found in the EBSCO, Scopus, and Web of Sciences databases. Databases were identified, and keywords such as finance, innovations, AI banking, cybersecurity, and financial technologies were selected based on the literature review. Databases such as Web of Science (WoS), Scopus, and EBSCO were used for the study. These databases were selected to complement each other and provide access to scientific articles, which was also the first step in ensuring the inclusion of high-quality articles. The selected articles were mainly from the years 2020-2025.

3. Theoretical Aspects of Innovations

The FinTech Revolution

FinTech corporations are disrupting the traditional banking panorama by leveraging new technology to provide services inclusive of payments, loans, and wealth management with decreased operational expenses (Zhang, 2021). The rise of mobile banking, P2P lending, and virtual wallets has prompted elevated financial inclusivity, especially in growing countries (Philippon, 2016; Gomber et al., 2017). Banks should select between participating with or competing in opposition to those new entities to maintain marketplace relevance (Lee & Shin, 2018).

Blockchain Technology and Decentralised Banking

Blockchain holds the promise of enhancing banking efficiency and decreasing transaction prices. Its distributed ledger machine presents a transparent and secure framework for numerous domain names, collectively with move-border payments and alternate finance (Tapscott & Tapscott, 2016). Demanding situations together with chronic regulatory ambiguity (Pinna & Ruttenberg, 2016) and technological integration within cutting-edge banking infrastructure (Zohar, 2015) ought to be overcome to recognise its complete capacity (a summary of the current literature is provided in Table 1 below).

Table 1. Blockchain Technology and Decentralised Banking

Author	Highlights
Polyviou et al. (2019)	Blockchain technology was initially used as a public ledger of cryptocurrency transactions. However, many other applications have recently used cryptocurrencies and blockchain technology. In addition to greater security, decentralisation increases recorded KYC/KYB information consistency.
Stoica et al. (2021)	Advanced online and mobile banking platforms are constantly improving and can surprise customers.
Habib et al. (2022)	Blockchain has moved beyond using cryptocurrencies to find implementations in other real-world applications.
Jena (2022)	Blockchain technology is focused on decentralisation, a tool that is open to all users and easily accessible to build trust in an insecure environment without an intermediary.
Kitsantas et al. (2022)	Typically, private blockchains are centralised, while public blockchains are decentralised.

Coutinho et al. (2023)	Bitcoin is a decentralised payment network that independently handles accounting, clearance, and settlements.
Wenhua et al. (2023)	provided a decentralised, trustless solution without third-party guarantees
Tse et al. (2024)	One of the most well-known use cases of blockchain – cryptocurrencies – has attracted significant interest from social media users and customers.
Alamsyah et al. (2024)	In addition, blockchain technology, as a powerful tool, boosts anti-corruption efforts and adds another layer of societal significance.
Theodorakopoulos et al. (2024)	Third parties are no longer required to act as intermediaries in a blockchain system, making the blockchain decentralised.
Bhumichai et al. (2024)	Blockchain technology increases the security and transparency of transactions through cryptographic algorithms, decentralisation, and consensus mechanisms.
Prokopenko et al. (2024)	Decentralisation eliminates the need for intermediaries, reducing the risk of fraud and manipulation.
Kotey et al. (2024)	Decentralisation is a key feature of blockchain.
Almarri et al. (2024)	Decentralisation is one of the most essential advantages of blockchain systems, as it increases the security of IoT.

Summarising the opinions of researchers about blockchain technology can be used in many other applications recently because it has unique properties, including decentralisation, security, transparency and protection against counterfeiting. Advanced online and mobile banking platforms are constantly evolving and can surprise customers. Desirable properties of blockchain systems include decentralisation, integrity, immutability, verification, fault tolerance, anonymity, verifiability, and transparency. Blockchain technology is focused on decentralisation, a tool that is open to all users and easily accessible to create trust in an insecure environment without an intermediary. According to the opinion of scientists, one of the most famous use cases of "blockchain" - cryptocurrencies - has attracted a lot of interest from users and customers of social networks. Blockchain offers many gains, including transparency, accessibility, and cost-effectiveness, making it a viable solution to the ongoing financial inclusion challenge faced by the unbanked population. Blockchain technology is widely used in various sectors such as education, healthcare, and finance, and cryptographic algorithms, decentralisation, and consensus mechanisms demonstrate its versatility and relevance.

AI in Banking: Possibilities and Issues

AI is more and more essential to banking operations, optimising customer support through chatbots and digital assistants, and enhancing credit score danger assessment; but it additionally introduces disturbing conditions inclusive of algorithmic bias and moral issues regarding facts usage. The integration of AI wants to be approached with warnings to preserve transparency and defend stakeholder pastimes (an overview of the latest literature is provided below in Table 2).

Table 2. AI in Banking

Author	Highlights
Ghandour (2021)	Massively deploying AI systems in the banking sector means greater automation of various tasks, so employees affected by task reallocation and job cuts may react hostilely and resign.
Noreen et al. (2023)	The use and application of artificial intelligence have helped financial institutions to protect themselves from fraud and work competently.
Mytnyk et al. (2023)	To ensure banks' effectiveness and ethical work in the financial sector, the resistance associated with the use of artificial intelligence in fraud detection needs to be addressed.
Radenković et al. (2023)	The usage of artificial intelligence in the financial sector can help banks achieve balance and maintain the current level of trust.
Aleksandrina et al. (2023)	Artificial intelligence is used in the financial sector to control process administration and information management, improve customer service, increase customer satisfaction, and promote financial inclusion.
Shiyyab et al. (2023)	AI increases process speed, reduces cost issues, reduces operational risk, and improves customer experience through chatbots and robo-advisor services.
El Hajj et al. (2023)	Artificial intelligence can sometimes be helpful in creating long-term strategies.
Lazo et al. (2023)	The application of Artificial Intelligence in banking shelters several functional areas of a bank's operations, such as client service, customer relationship management (CRM), fraud detection, risk management, marketing, payment services, back-end operations, and data collection.
Tulcanaza-Prieto et al. (2023)	The appeal of AI-enabled financial institutions is based on lesser operating costs, better customer alignment, and higher revenues.
Fares et al. (2023)	Implementing AI in banking is wide-ranging: voice assistants and biometrics, anti-fraud risk monitoring, legal and compliance workflows, and credit underwriting using smart contract infrastructure.

Ridzuan et al. (2024)	Artificial intelligence (AI) has exploited its ability to analyse large amounts of data, recognise trends, and make insightful decisions.
Mei et al. (2024)	Artificial intelligence can redefine banking services to improve operational efficiency.
Naik (2024)	AI allows banks to assess customer satisfaction levels and proactively address issues, reducing customer service time.
Hidayat et al. (2024)	Implementations of artificial understanding include algorithmic buying and selling, threat management, fraud detection, credit evaluation, and customer service.
Abdulsalam et al. (2024)	AI supports various banking systems, particularly those related to consumer behaviour, but there are also challenges, such as limited access to advanced technologies, inadequate infrastructure, and insufficient digital literacy, that hinder the implementation of artificial intelligence.
Addula et al. (2024)	Artificial intelligence allows simulation of cognitive functions such as knowledge, reasoning, and problem-solving.
Nobel et al. (2024)	Reliable sham detection systems based on automatic learning algorithms can adapt to changing fraud patterns, reduce false negatives, and detect fraudulent behaviour.

Summarising the opinion of researchers about the application of artificial intelligence technologies has helped banks to protect themselves from fraud, have efficient operations, reliability and accuracy, and high speed.

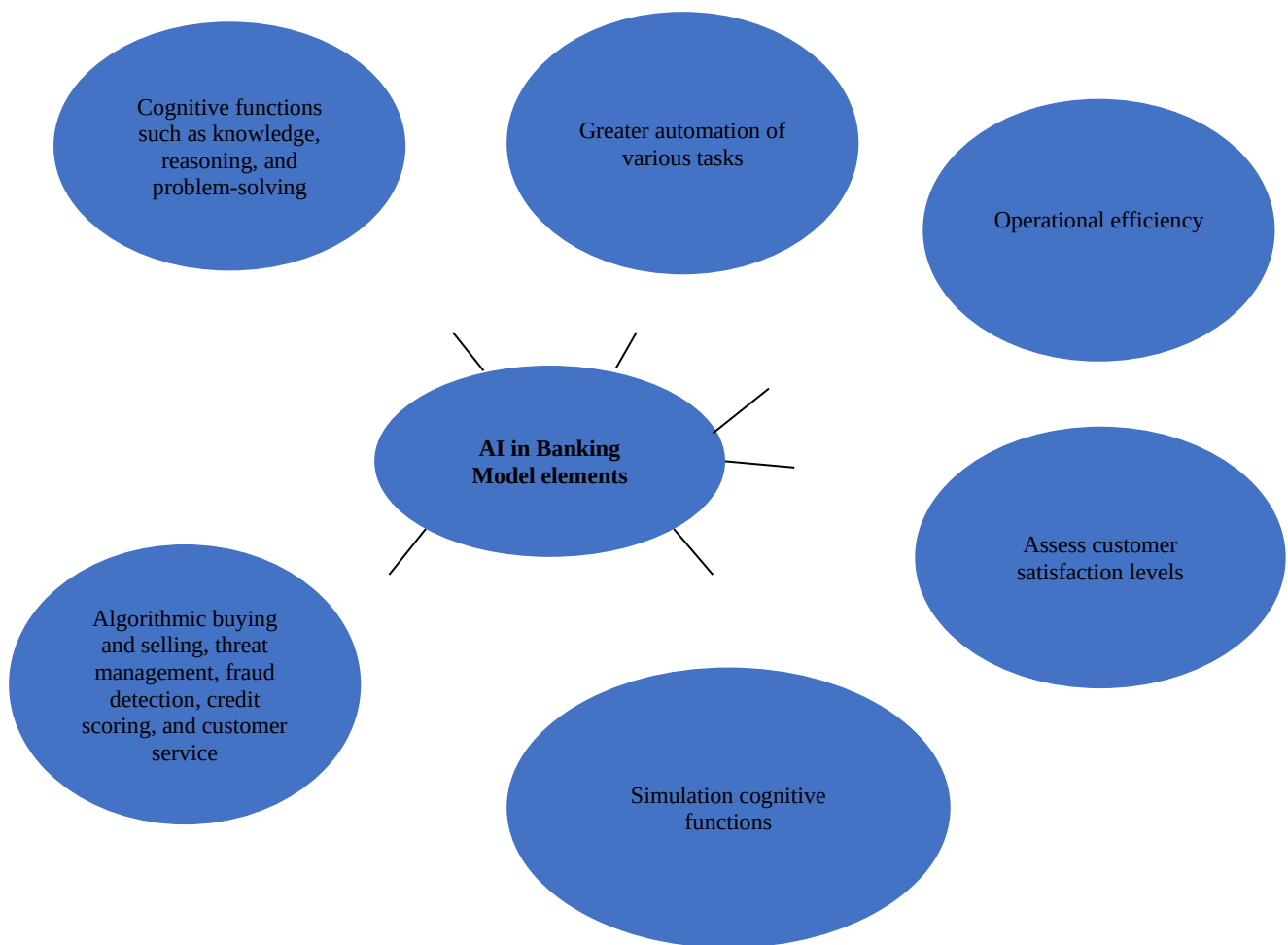


Figure 1. AI in Banking Model elements

Figure 1 presents AI in the banking model, which consists of greater automation of various tasks, lower operating costs, better customer alignment, higher revenues, operational efficiency, ability to analyse significant amounts of data and make insightful decisions, algorithmic buying and selling, threat management, fraud detection, credit scoring, and customer, cognitive functions such as knowledge, reasoning, and problem-solving.

Cybersecurity inside the digital banking generation

The shift towards virtual banking has amplified the significance of cybersecurity. Banks remain liable to cyber-intrusions regardless of the sophistication of artificial intelligence and cryptographic ledger. We need an adaptable and long-term solution to confront these issues. We have to find solutions that can challenge new threats sufficiently and remain within legal standards (Bonneau et al., 2015).

Moreover, in the fiercely competitive contemporary economy, regulatory hurdles once more come—good material for another conversation. Consequently, banking was just about to dive headfirst into disruptive technology such as AI, blockchain, and FinTech. It is a conversion, and it goes more or less without saying that this requires re-evaluating our trust in the regulatory mechanisms we took for granted. Financial institutions have a hard time ahead as they try to fit these digital innovations within and around an existing legal framework that, let's face it, typically moves a bit slower than technology (Arner et al., 2017). This paper will delineate the many challenges that arise at the intersection of disruptive innovation and legacy governance frameworks. Overview of cybersecurity facets is provided below in Table 3.

Table 3. Cybersecurity inside the digital banking generation

Author	Highlights
Zabala Aguayo et al. (2020)	The digitalisation of banks is an essential economic process.
Shulha et al. (2022)	IT security innovations to ensure personal data security, information leakage prevention, data storage, and backup.
Sahi et al. (2022)	Due to deficiencies in data protection regulations, it is becoming increasingly difficult for customers to exercise their rights in e-commerce. This increases customer concerns due to regulatory uncertainties in mobile payments. Despite technological improvements, e-commerce still faces significant concerns about trust and perceived risk and their relationship to consumer satisfaction.
Saeed et al. (2023)	Cybersecurity can protect data.
Mishra (2023)	Cybersecurity is fundamental to protect systems, networks and technology from unauthorised access.
Tariq et al. (2023)	"The Internet of Things" (IoT) has become an essential technology with significant implications for cybersecurity.
Dawodu et al. (2023)	Planning for responding to cybersecurity incidents in banking with a well-developed cyberattack response plan minimises damage.
Ahmed et al. (2024)	Defends customers from various risks related to digital banking.
Metin et al. (2024)	Financial institutions must ensure that any digitalisation process is related to cybersecurity risks.
Dang et al. (2024)	An effective regulatory framework is needed to ensure sufficient customer confidence to share their data with the bank.
Lund et al. (2024)	Deploy cyber security systems and environments without trust.
Lamey et al. (2024)	Banks should adapt to advanced FinTech.
Trim et al. (2024)	New technologies protect against criminals.
Asmar et al. (2024)	Cybersecurity continues to be a serious issue for financial institutions, and adequate security measures must be adopted to protect sensitive financial data and customers from potential harm.
Daah et al. (2024)	Zero trust is a strategic cybersecurity tool that can ensure an organisation's security by eliminating blind trust and constantly verifying every step of digital interaction.
Vourganas et al. (2024)	Cybersecurity strategies emphasise the importance of technologies, raising consumer awareness, and implementing proactive threat detection and mitigation measures.
Dakić et al. (2025)	A hybrid approach to ZTA in the financial sector is inspected, and the blockchain system is integrated to ensure a more resilient security architecture.
Regueiro et al. (2025)	EMERALD is a safety system based on a continuous and automated evidence collection and evaluation process to ensure a safe operational service that would be certified using a specific conformity assessment method.

To sum up, the scientific opinion on cybersecurity mainly includes secure payment, online user privacy, antivirus firewalls, mobile phone security, security locks, data protection, computer protection and specific universal shields. Digital banks must manage challenges and focus on safeguarding clients to establish trust and encourage the widespread use of digital banking.

4. Regulatory Challenges in a Financial Landscape

The wave adopting new applied sciences such as artificial intelligence (AI), blockchain, and financial technology (FinTech) is a game changer, forcing reconsidering current regulatory frameworks. In this challenging environment, these financial bodies are now forced to attempt an impossible task: reconciling their digital transformations with dilapidated institutional infrastructure that regularly struggles to remain current (Arner et al., 2017). This paper will explore the layers of regulation issues compounded within banks due to the marriage between innovation and traditional governance.

This is particularly true of FinTech agencies, which frequently exist on the margins of conventional regulatory constructs and lift sizable purchaser safety issues and monetary balance worries. The concerns illustrate the tension between innovation and regulatory imperatives. To combat such challenges, governments and regulatory bodies must formulate new forms of regulation (regulatory paradigms) that may tackle the emerging problems. One good illustration is the European Union's General Data Protection Regulation (GDPR), which protects data privacy and impacts how personal information is handled in banking. Everything is changing with all new regulations and the rise of crypto & digital assets. The blockchain era that underlies those digital currencies makes transactions expedient and handy. However, some problems are also money laundering, fraudulent activities, and marketplace volatility. Governments are trying to create new regulatory paradigms that can protect citizens from harm and help aid innovation in a coordinated fashion. This balance is significant to ensure that the digital asset space does not become a locus for illicit activity while still allowing financial innovation" (Tapscott & Tapscott, 2016). To account for the complexity of this relational dating, we group the demanding situations into four excellent domains:

I. Collaborative engagement between established banks and FinTech companies — Technological progress in the banking field naturally dictates an integration strategy for digitalisation systems to operate within the conditions of traditional financial institutions, strengthening innovation. Decently, these associations could also mean more prominent administration-related offers, such as those with portable banking and advanced instalments. This does not mean that regulations are easily "compliant", especially concerning data protection and money laundering (Lee & Shin 2018), but FinTech solutions have got to respect them.

II. The Promised Disruption in Financial Offerings: Although the pace of blockchain adoption has been more rational than many hoped a year ago, it nonetheless promises to overhaul every enterprise. That will enable real-time agreement mechanisms and decorate transparency throughout many verticals such as cross-border bills, exchange finance, asset management, etc. Yet the approval of the blockchain system is burdened with problems due to underdeveloped regulatory frameworks and challenges posed by aligning it with existing infrastructure (Zohar, 2015).

III. The role of substitute intelligence in optimising the banking transaction in operations and customer relations: Banking operations can gain tremendously out of AI practically through automation, thereby enhancing revenue and lowering costs, including the many ways AI can effectively identify frauds and handle risks. However, with the increase in the application of artificial intelligence, there are some ethical concerns and privacy issues with transparency; caution has to be taken to ensure algorithmic decision-making is fair and sensitive data is secured.

IV. AI can flourish by automating work processes within banking operations, yielding more significant revenue and lower costs. However, AI projects suggest that industries must be wary of ethical concerns and privacy issues and ensure the security of sensitive data.

As a result, the baking industry is currently at a crossroads. It's being influenced by how swiftly technology develops and how easily customer behaviour can shift. FinTech, or financial technology, has grown in popularity, and other technologies like blockchain and artificial intelligence (AI) have also gained traction. These are all upending the established banking business and posing many opportunities and difficulties.

Banks must approach innovation more carefully if they want to survive and grow in this shifting environment. They must carefully balance incorporating these new solutions while keeping an eye out for any potential problems that may arise. It's not enough to get on the latest tech bandwagon.

When you look at how FinTech, blockchain, and AI are coming together in banking, it's clear that we're on the brink of some significant changes in the financial services industry. Suppose traditional banks want to stay ahead of the game and make advancements. In that case, they can't just use these technologies—they need to figure out how to integrate them to respond to the market while being mindful of various risks, especially regarding cybersecurity, regulations, and adapting their models.

A primary strategy employed by banks is partnering with FinTech companies. These collaborations promote an inventive way of thinking. Together with developing and integrating blockchain technology, they'll also need to manage resource allocation to effectively and adequately use AI. Harasim (2021) mentioned that studies on this topic can be divided into two main directions: i.e., related to reasons for cooperation between banks and FinTech, its benefits, and their scope, areas, and forms. Fang et al. (2024) stated that it has become difficult for commercial banks to develop FinTech applications and innovations relying on their resources and capabilities. Le et al. (2021) examine the causal relationship between the recent development of FinTech credit platforms and the banking system. Noreen (2024) considered that FinTech enables and helps create a stable and technologically enriched financial ecosystem. Oh et al. (2024) mentioned that open banking API technology is changing the distribution structure of the financial market, separating the production and distribution of financial products and intensifying competition between traditional financial institutions and FinTech companies. Hommel et al. (2020) stated that for conventional financial institutions, FinTechs can be a great source of new competitive innovations, and FinTechs can also create technical processes for banks to improve their data security and privacy. Professionals must navigate intricate regulations to ensure compliance with evolving legal frameworks associated with these technologies. Additionally, the ethical dimensions cannot be overlooked; employing these tools necessitates adherence to integrity, transparency, and accountability principles. Balancing these responsibilities is undoubtedly challenging, reflecting the complexities of the modern technological landscape.

All in all, the relationship between innovation and governance in the banking world is quite complex. Banks need to have a well-thought-out strategy for integrating technology. Only by doing this can they hope to establish a strong foothold in the future financial ecosystems, ensuring they remain relevant and viable as technology keeps pushing forward.

Conclusions

Based on the analysis of scientific literature, it can be stated that:

1. Blockchain technology provides greater security, transparency, and efficiency. The blockchain allows for safe and reliable transactions without intermediaries, and due to its decentralised nature, users can better control their data.
2. Cybersecurity is an important area for banks, and it is also one of the most important conditions for maintaining customer trust and successful operations. In the era of digital advancements, cybersecurity has become more relevant, starting from storing money in accounts or online transactions and ending with ensuring the confidentiality of information.
3. Artificial intelligence helps detect fraud in banking.

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