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UNCOVERING OF FINTECH COOPERATION IN POLISH BANKS

| Abstract

- *Goal* – The aim of this article is to examine how banks listed on the Warsaw Stock Exchange disclose cooperation with FinTech firms and technological innovations in their financial and non-financial reports between 2022 and 2024. The purpose is to assess the frequency, scope, and form of such disclosures and to verify whether technological narratives are explicitly linked to FinTech partnerships.
- *Research methodology* – A mixed-method design was employed: quantitative content analysis based on keyword frequency and a technological diversity index (DIM_FT), combined with qualitative assessment of narrative elements in reports.
- *Score/results* – Two distinct disclosure strategies were identified. In the tech-first model, banks emphasised digital transformation and internal technological solutions, while in the ally-first model they highlighted partnerships with FinTechs, accelerators, and ecosystem initiatives. The most frequently reported areas were digital payments, open banking, cybersecurity, artificial intelligence, and big data, with blockchain and robo-advisory remaining marginal. No direct correlation was observed between the intensity of technological reporting and FinTech mentions, indicating that disclosures primarily reflect communication strategies rather than the actual scale of innovation.
- *Originality/value* – The study provides novel insights into how Polish banks construct technological narratives in their disclosures. It highlights the divergence between communication and practice, offering a framework for evaluating the role of FinTech partnerships in shaping banks' innovation strategies.

| **Keywords:** FinTech, bank FinTech cooperation, disclosure practices, innovation, digital transformation

1. Introduction

Over the past several years, financial services have undergone radical transformation, mainly as a result of technological development driven by advances in telecommunications, information technology, and financial practices [Elsaid, 2021; Gomber et al., 2017; Lee & Shin, 2018; Vives, 2019]. The Global Financial Crisis of 2008–2009 was a trigger, accelerating the emergence of a new group of entities providing technology to companies offering financial services [Ajambo et al., 2023; Arner et al., 2015; Buckley et al., 2022; Haddad & Hornuf, 2019; Pandey et al., 2024; Philippon, 2019]. Technological progress fostered financial innovations that have transformed many products and services in the sector, as well as the processes and organisational structures of these institutions [Elsaid, 2021; W. Frame et al., 2018].

The term FinTech is used in various business contexts, often inconsistently and ambiguously [Schueffel, 2016; Sharma et al., 2024]. No uniform definition of this concept has yet been established, and a review of the literature highlights its elusive nature, which complicates research [Gomber et al., 2017; Lee & Shin, 2018; Milian et al., 2019; Schueffel, 2016]. In a broad literature review, FinTech is generally understood as an umbrella term encompassing innovative financial solutions and business models enabled by information technologies, often referring to start-ups providing such solutions [Yan, 2025]. The concept is closely linked to technological progress in the financial sector and the implementation of technological innovations in banking services [Drago et al., 2025]. The literature emphasises that FinTech firms are typically technology-oriented financial start-ups, while the term FinTech itself refers to new financial instruments, innovative technologies, and business models delivering financial services outside the traditional banking sector [Le et al., 2024; Puschmann, 2017]. In other words, FinTechs are innovative entities employing, among others, digital assistants, chatbots, mobile applications, blockchain, and big data, which enable fast, remote, and convenient execution of financial operations [Kloba, 2024]. To summarise, the term FinTech serves as a collective designation for firms that provide technological solutions to the financial sector [Kou & Lu, 2025].

In the early stage of FinTech market development, these entities were primarily perceived as a disruptive force to the traditional banking system [Barberis & Arner, 2016; Philippon, 2019; Puschmann, 2017]. Today, however, FinTechs are increasingly regarded by banks as natural partners in the modernisation of financial services [Drago et al., 2025]. Traditional banking institutions face pressure

from new digital players and, as a result, are increasingly entering into partnerships with technology firms and FinTech start-ups in order to modernise their offerings and remain competitive in the era of digital transformation [Drago et al., 2025; Drasch et al., 2018; Jakšič & Marinč, 2019]. Collaboration with providers of financial innovations has thus become an integral part of many banks' strategies, enabling them to benefit from the latest technologies without the need to develop them in-house [Klus et al., 2019a].

Despite the dynamic development of FinTech innovations and the growing popularity of this topic, the literature points to numerous research gaps. Drago et al. [2025] highlight the lack of research devoted to bank–FinTech partnerships from a microeconomic perspective (the level of firms and specific alliances). Moreover, banks still rarely disclose their expenditures on cooperation with FinTechs in a transparent manner – while many financial institutions include descriptive information on FinTech-related initiatives in their annual reports, detailed financial data on this subject remain scarce [Drago et al., 2025; Drasch et al., 2018; Hornuf et al., 2021; Jakšič & Marinč, 2019]. The literature also lacks extensive empirical evidence on the impact of cooperation between banks and FinTech firms on banks' performance outcomes [Le et al., 2024].

The aim of this article is to map, document, and quantify disclosures concerning the cooperation of banks with FinTech firms, as well as the implementation of FinTech solutions in the financial and non-financial reports of the Polish banks listed on the Warsaw Stock Exchange (WSE) in the years 2022–2024, with particular emphasis on the frequency, forms, and context of such communication.

In light of the above, the following research questions are posed:

- RQ1: With what frequency and in what manner do the Polish banks listed on the Warsaw Stock Exchange (WSE) communicate: in their non-financial reports (2022–2024), cooperation with FinTech firms as well as the issues of technology and innovation [BIS, 2024; Drago et al., 2025; Loew & Schröder, 2021]?
- RQ2: Which categories of financial technologies are most frequently disclosed in these reports, and which banks demonstrate the broadest approach [Xie & Wang, 2023; Zou et al., 2024]?
- RQ3: Is the intensity of technological disclosures (scope, number of categories) related to the disclosures of cooperation with FinTechs in the non-financial reports of these Polish banks [Bian et al., 2023; Wu et al., 2024]?

The article follows a classical structure. After this introduction, a literature review is presented, discussing the existing research on the adoption of FinTech in the banking sector and the various models of cooperation between banks and the FinTech industry. The subsequent section outlines the research method and database, including a description of the applied measures and the analytical techniques employed to extract information from the annual reports of the listed banks in Poland in the years 2022–2024. This is followed by the presentation of the results of the empirical analysis, covering, among others, the frequency of occurrences of terms related to FinTech, technology, and innovation in the reports, comparisons of disclosures across individual banks, and the identification of the most frequently described technological areas. The article concludes with a summary section, which presents the key findings of the study, discusses its limitations, and offers suggestions for future research directions.

2. Theoretical framework of Bank-Fintech cooperation

Contemporary regulations on non-financial disclosures and ESG (Environmental, Social, Governance) reporting indirectly encourage banks to include information on technological innovations and digital transformation in their reports as elements of strategy and corporate governance. It has been demonstrated that digital transformation significantly increases the scope of ESG disclosures among enterprises [He et al., 2024]. Research on the links between financial technologies and the concept of sustainable development remains limited, making this a novel and increasingly significant area [Galeone et al., 2024a; Liu et al., 2022].

Digital transformation is redefining the paradigm of competition in the financial sector, shifting the focus of rivalry from traditional products and distribution channels to the capacity for rapid acquisition, adaptation, and scaling of new technologies [Verkhoglyadova et al., 2024]. The implications of these theoretical approaches are reflected in EU regulatory requirements (e.g. legal acts such as DORA – the Digital Operational Resilience Act – concerning digital resilience, or guidelines on ICT management).

2.1. Open Innovation in the Bank-FinTech relationship

The theory of Open Innovation assumes that enterprises can utilise both internal and external sources of knowledge. This enables them to combine their own

resources with those of partners through alliances, technology licensing, and other forms of collaboration [H. Chesbrough, 2010; H.W. Chesbrough, 2003; Laursen & Salter, 2006; Pandey et al., 2024; West & Bogers, 2014]. Partnerships between banks and technology firms (FinTechs) fit within this logic, facilitating mutual transfer of competences [Fasnacht, 2018; Martovoy et al., 2015]. Banks gain access to modern solutions (e.g. artificial intelligence, blockchain, big data) [Feyen et al., 2021], while technology providers benefit from access to an extensive client base, strong brand reputation, payment infrastructure, and the established knowledge of the regulatory requirements of the financial sector [BIS, 2024; FED, 2023].

Empirical confirmation of the adoption of an open innovation strategy can be found in the purchase of technological solutions, outsourcing of technological services, acceleration programmes, innovation laboratories, technology hubs, and acquisitions of firms with specific technologies. These initiatives appear in banks' reports as pillars of digital transformation [Drasch et al., 2018]. This transformation has a direct impact on the organisational structures of technology and innovation departments, shaping technology strategies and transforming operational processes, business models, and, at times, the entire logic of value creation [Vial, 2019]. At the same time, the dynamic development of FinTechs, InsurTechs, and BigTechs has redefined their role from "disruptors" to partners filling the competence gaps of banks [Cosma & Pennetta, 2024; Jaksic & Marinc, 2019]. As a result, the flow of technology-related knowledge has become bidirectional: banks learn about new solutions, while technology providers gain insights into the specifics of banks' client bases, regulatory challenges, and advanced risk management practices [Nicoletti, 2017].

2.2. Transaction Cost Economics and cooperation forms

The theory of transaction costs has become the dominant theoretical model for explaining decisions concerning organisational boundaries, originating from very early theories [Coase, 1937; Williamson, 1975]. Coase [1937] argued that the choice between the market mechanism and hierarchy (the internal structure of the firm) depends primarily on differences in transaction costs. Williamson [2007], in turn, demonstrated that testable hypotheses can be formulated by linking the relative efficiency of alternative governance structures with the observable dimensions of transactions, namely asset specificity, uncertainty, and transaction frequency.

From the perspective of Transaction Cost Economics (TCE), the decision to acquire technological innovations follows one of the three classical paths:

make (internal development), *buy* (acquisition), or *ally* (partnership) [Drago et al., 2025; Geyskens et al., 2006]. In practice, the *ally* option dominates, in the form of equity and non-equity alliances, white-label licences, open API interfaces, or acceleration programmes [Elsaid, 2021; Salmasi et al., 2024]. At the same time, hybrid variants are emerging, whereby banks simultaneously develop their own solutions (e.g. digital subsidiary banks) and invest in start-ups through corporate venture capital funds [Le et al., 2024].

The first option, *make*, means that a bank independently builds and implements technological solutions within its own organisation instead of relying on external providers. This strategy gives the institution full control over the development of innovations, although it may prove costly and time-consuming. An example may be the establishment of in-house R&D teams or proprietary digital platforms instead of purchasing ready-made solutions [Drago et al., 2025; Kloba, 2024].

The available literature further distinguishes a wide spectrum of *ally*-type (partnership) cooperation models and intermediate forms between partnership and acquisition. Table 1 provides a synthetic overview of the most frequently described models of cooperation between banks and FinTechs, together with their characteristics.

Table 1. The model of cooperation between banks and technology providers

The Model of Cooperation Strategic Partnership*	Characteristics
	A form of cooperation between a bank and a technology entity without equity ties. The parties exchange resources and competences: the bank provides licences, infrastructure, and clients, while the partner provides innovative technology. Together, they deliver financial services [Elsaid, 2021; Ngo & Nguyen, 2022]. An example may be SME lending, where the bank provides financing and the FinTech operates the online platform [Cosma & Pennetta, 2024]. Partnerships between banks and large technology firms (BigTech) involve bank integration through the provision of payment infrastructure within the BigTech ecosystem, thereby expanding the digital offering and increasing the reach of both parties [Salmasi et al., 2024]. Banking-as-a-Service (BaaS) is gaining critical mass as a distinct model, whereby the bank sells licences and back-end services via APIs, while the partner is responsible for the front-end [Agarwal & Assenova, 2024; Pineda, 2025; Prashant Bansal, 2024].

The Model of Cooperation Strategic Partnership*	Characteristics
Bank–Telecommunications Operator Partnership (MNO))	The essence of bank–operator cooperation in mobile finance lies in the division of roles between the party that holds the funds and bears the regulatory risk (a bank, operator, or FinTech) and the party that provides network coverage and the mobile channel (the operator). In practice, four variants emerge: bank–led, FinTech–led, operator–led, or hybrid – with the choice depending on local regulations and infrastructure [Agarwal & Assenova, 2024; Ky et al., 2024; Panday et al., 2024].
Licensing Partnership	A model in which a FinTech firm operates on the basis of a banking licence granted by a partner bank. This allows the FinTech to provide quasi-banking services without holding its own licence, under the supervision and involvement of the licensing bank. Example: an Iranian digital banking provider operating under the licence of a state-owned bank [Salmasi et al., 2024].
Project-Based Partnership	A model in which a bank and a FinTech cooperate on the implementation of a specific project or product from start to finish. Such temporary collaboration enables the combination of expertise (e.g. the bank provides regulatory compliance and a client base, while the FinTech contributes technology) in the deployment of innovations [Kloba, 2024; Verkhoglyadova et al., 2024]. The joint go-to-market strategy may take the form of: • co-branding – a service branded by both partners, • co-lending – the FinTech provides scoring algorithms, while the bank finances the portfolio. The sharing of risk and profits enables rapid access to new segments, leveraging the strengths of both parties [Roy et al., 2025]. Pro-financial inclusion partnerships occur when a bank commissions FinTechs to deliver projects targeting unbanked segments (microfinance, low-value payments). The institution focuses on key premium products, while the partner develops solutions that extend the reach of services, thereby supporting the goal of inclusion without excessively burdening the bank's resources [Chernoff & Jagtiani, 2023; Panday et al., 2024].
Cross-Sector Partnership	A strategic alliance with multiple FinTechs specialised in different segments (e.g. payments, InsurTech, IT infrastructure). The bank engages in numerous partnerships simultaneously in order to comprehensively digitalise its offering. Example: banks in Vietnam cooperating with FinTechs across various sectors (digital payments, comparison platforms, e-banking, etc.) [Le et al., 2024; Lien et al., 2020].

The Model of Cooperation Strategic Partnership*	Characteristics
Ecosystem Partnership	A broad, non-exclusive network-based cooperation model – the bank establishes a network of relationships with multiple partners simultaneously (FinTechs, IT providers, InsurTechs, etc.). Partners may collaborate in parallel with several banks (no exclusivity). The bank gains a portfolio of diverse innovations that can be integrated into its offering. Such a partnership ecosystem enables faster scaling of new ideas and services [BIS, 2024; Roy et al., 2025; Yıldırım & Erdil, 2024].
Digital Bank within a Bank	The establishment by a traditional bank of a separate digital banking brand (digital bank) operating like a FinTech within the banking group. This enables the bank to compete with FinTechs on their own ground while simultaneously retaining the advantages of a bank. Example: Blubank created by Saman Bank in Iran as an internal digital subsidiary [Papathomas & Konteos, 2022; Salmasi et al., 2024].
FinTech Acquisition	The acquisition of a FinTech by a bank involves the purchase of a majority or 100% shareholding in the company. The bank integrates the acquired firm and its technologies into its own structure, which enables the rapid large-scale adoption of innovations. A wave of such acquisitions is predicted as a result of competitive pressure from FinTechs [Elsaid, 2021]. The acquired FinTech becomes part of the bank, replacing less efficient internal solutions [Drago et al., 2025; Kloba, 2024; Kwon et al., 2024; Mao & Zheng, 2022].
Equity Investment (Minority Stake)	A model in which a bank invests capital in a FinTech company without full acquisition, by acquiring a minority stake, establishing its own corporate venture capital (CVC) fund, forming a joint venture partnership, or acting as a co-founder of a start-up. This enables the bank to gain access to the FinTech's innovations and know-how while maintaining the autonomy of both parties [Cosma & Pennetta, 2024; Drago et al., 2025; Li et al., 2023; Riikinen & Pihlajamaa, 2022; Verkhoglyadova et al., 2024].
Incubation/ Acceleration Programmes	Banks establish their own incubators or accelerators to support the development and incubation of FinTech start-ups. They provide resources (financing, mentoring, infrastructure, data), often in exchange for equity stakes or priority access to the start-ups' technologies. This allows banks to stimulate innovation in their environment, while FinTechs can accelerate their growth [Hornuf et al., 2021; Roy et al., 2025; Verkhoglyadova et al., 2024].

The Model of Cooperation Strategic Partnership*	Characteristics
Technology Outsourcing	A model in which a bank commissions an external provider (a FinTech or an IT company) to deliver a specific solution instead of developing it internally. This allows for the rapid implementation of a new product or service without the need to build in-house competences [Enriques & Ringe, 2020; Galeone et al., 2024b; Yıldırım & Erdil, 2024]. The white-label model enables the FinTech to provide the bank with a ready-made platform or technology, which the bank subsequently offers under its own brand [Roy et al., 2025].
Adaptive Model	A cooperation model that emphasises the flexible adaptation of the bank–FinTech relationship to the dynamic changes of the market environment, as well as the role of the state in supporting innovation. Within this framework, banks and their technology partners continuously adjust the scope and form of their cooperation in response to emerging new technologies, customer needs, or regulations, with active support and coordination from regulators [Enriques & Ringe, 2020; Kálmán, 2025; Panday et al., 2024].

* non-equity alliance

Source: the authors' own elaboration based on the literature.

The guidelines of the European Banking Authority (EBA) also emphasise the importance of technological innovations in banks' strategies and their transparent communication. The EBA Guidelines on the management of ESG risks [2025] require banks to identify, measure, and manage these risks in the short-, medium-, and long-term perspective, and to integrate them into business plans. In practice, this compels banks to disclose in their reports which technologies (e.g. AML tools, cloud solutions) support the resilience of the business model and corporate governance of the institution [EBA, 2025].

Similarly, the EU Corporate Sustainability Reporting Directive (CSRD) of 2022 significantly broadens the scope of reporting – it obliges companies to disclose, among other things, their “strategy and business model resilience” in the context of sustainable development and requires them to present plans for adaptation to climate and technological change. Digital transformation, automation, and investments in FinTechs are among the typical elements of such adaptation plans [European Parliament; Council of the European Union, 2022].

Moreover, the EBA published guidelines on ICT risk management and security [2020], indicating, *inter alia*, how to describe business models, strategies, and

key risks and opportunities in banking activities. If digital transformation and cooperation with FinTechs are important to a bank, these regulations, in effect, mandate their disclosure in the bank's periodic reports [EBA, 2019].

2.3. Link to the identified research gaps

Relatively few studies focus on the micro-perspective of bank–FinTech cooperation, as most existing works are macroeconomic or conceptual in nature [Alaassar et al., 2023; Harasim, 2021; Klus et al., 2019b]. Drago et al. [2025] point to a shortage of empirical analyses examining specific bank–FinTech alliances at the level of financial institutions and their impact on banks' operations. Similarly, Le et al. [2024] note that while there is some initial evidence of positive effects of cooperation with FinTechs (e.g. improved efficiency or enhanced bank performance), there is still a lack of broad generalisations and multi-market studies, particularly in the context of emerging markets – hence the Polish financial sector appears to be an important area for investigation.

Secondly, the literature highlights the scarcity of disclosures provided by banks themselves, regarding their engagement in financial innovations [Birindelli et al., 2020; W.S. Frame & White, 2004]. As emphasised by Drasch et al. [2018] and Hornuf et al. [2021], banks relatively rarely communicate directly the expenditures related to cooperation with FinTechs or the detailed outcomes of such initiatives. While annual reports do include descriptive references to innovations, detailed and comparable data remain limited, which hampers the assessment of the actual scale and forms of such activities [Cosma & Pennetta, 2024; Jaksic & Marinc, 2019].

Thirdly, there is a lack of research on banks' communication and informational transparency in the area of digital transformation. Previous studies on disclosures in reports have mainly concentrated on regulatory [Loew & Schröder, 2021] or ESG-related topics [Galeone et al., 2024b], while overlooking technological issues. Consequently, the literature underscores the need to examine how banks report on their innovativeness and cooperation with FinTechs [Milian et al., 2019; Sharma et al., 2024].

2.4. Conceptual assumptions and direction of analysis

In light of the above research gaps, a conceptual framework for analysis has been formulated, linked to the research questions presented in the introduction. Drawing on the theory of open innovation, it is assumed that banks actively cooperating

with FinTechs will explicitly communicate this in their reports, as firms that share knowledge with external partners tend to emphasise such alliances as part of their innovation strategy [H. Chesbrough, 2010; H.W. Chesbrough, 2003]. It may therefore be expected that banks with a culture open to innovation will report more frequently and extensively on FinTech-related initiatives.

At the same time, banks that prioritise internal development [Geyskens et al., 2006; Williamson, 2007] may focus in their reports on their own technological projects rather than explicitly using the term *FinTech*. Such institutions may emphasise the description of the implemented technologies (AI, cloud solutions, etc.) without referring to external partners. From the perspective of transaction cost theory [Coase, 1937; Williamson, 1975, 2007], it is assumed that the choice between internal development and alliances will be reflected in the structure of disclosures. Banks employing multiple technologies and diverse forms of cooperation should communicate a broader range of FinTech-related issues.

Accordingly, the scope of disclosed categories of financial technologies (e.g. AI, blockchain, open banking, etc.) is expected to vary from very narrow (where some banks mention only individual solutions) to very broad (covering most of the key trends), which will allow Research Question 2 to be addressed. The interdependence between the intensity of general technological initiatives and the propensity to cooperate with FinTechs can be verified by examining how banks demonstrating higher digital maturity (reflected in the frequency of technology- and innovation-related keywords) approach such disclosures. This is consistent with the intuition that institutions investing in digital transformation seek external partnerships to accelerate development [Klus et al., 2019b]. The present study will test this relationship through an analysis of technological disclosures alongside references to FinTechs. In addition, an in-depth qualitative analysis of FinTech-related disclosures in banks' reports will be carried out (Research Question 3).

3. Methodology

The study covers all the Polish banks listed on the Warsaw Stock Exchange (WSE). These institutions publish consolidated financial statements that also include a non-financial section, available for the years 2022–2024. In the first stage, a complete list of entities meeting this criterion will be compiled, excluding UniCredit and Banco Santander, as their securities reflect the activities of capital groups based in Italy and Spain. Getin Bank will also be removed from the sample, as

following restructuring and resolution proceedings its sound assets were transferred to a bridge bank and subsequently sold to a strategic investor, resulting in the exclusion of Getin from the study.

For the qualifying banks, consolidated annual reports (including financial reporting) for the years 2022–2024 will be collected and used as the text corpus for analysis. To develop a set of variables describing FinTech disclosures, the study will draw upon findings from the literature and reporting practice. Table 2 presents the proposed indicators together with their definitions, theoretical justification, and recommended best practices regarding the disclosure of each information category.

Table 2. Data description

Skrót	Variable Name	Description
KW_FT	KeyWords_FinTech	Number of occurrences of the word “fintech”
KW_T	KeyWords_Technolog*	Number of occurrences of the word “technolog*”
KW_I	KeyWords_Innowac*	Number of occurrences of the word “innowacj*”
W_T	Words_Total	Number of words in the report
KW_FT_norm	$\text{wsk KW_FT_norm} = \frac{\text{KeyWords_FinTech}}{(\text{Words_Total} / 10000)}$	Indicator of “FinTech” occurrences in the report (per 10 000 words)
KW_T_norm	$\text{wsk KW_T_norm} = \frac{\text{KeyWords_Technolog*}}{(\text{Words_Total} / 10000)}$	Indicator of “technolog” occurrences in the report (per 10 000 words)
KW_I_norm	$\text{wsk KW_I_norm} = \frac{\text{KeyWords_Innowac*}}{(\text{Words_Total} / 10000)}$	Indicator of “innovat” occurrences in the report (per 10 000 words)

Source: the authors’ own elaboration based on the literature.

Variables based solely on the number of “FinTech” mentions indicate the intensity of the narrative but do not reflect the breadth of technologies employed. Therefore, following Drago et al. [2025], an additional indicator DIM_FT is introduced, defined as the number of distinct technology categories mentioned at least once in a bank’s report.

Table 3. categories of financial technologies (dim_ft) with example services, typical keywords, and literature review

Category (DIM_FT)	Key technologies / services	Typical search terms / synonyms (Proceegir)	Literature review
AI / ML	Artificial intelligence, machine-learning models, conversational AI (chatbots, NLP)	artificial intelligence, machine learning, conversational AI	[BIS, 2024; Drago et al., 2025]
Blockchain / Crypto / Tokenization	Blockchain and DLT solutions, smart contracts, tokenisation, DeFi platforms, crypto-assets	blockchain, distributed ledger, smart contract, tokenization, crypto-assets, DeFi	[Chen et al., 2021; Dashottar & Srivastava, 2021]
Cloud & DevOps	Public/private cloud, SaaS / PaaS / IaaS, serverless computing, container orchestration (e.g. Kubernetes), micro-services	cloud, SaaS, PaaS, IaaS, serverless, Kubernetes, micro-services	[Farrow, 2020; Hon & Millard, 2018; Prashant Bansal, 2024]
Big Data & Analytics	Data warehouses and lakes, business intelligence, predictive analytics, data science	data lake, data warehouse, analytics, predictive	[Hung et al., 2020; Nobanee et al., 2021; Wang et al., 2021]
Digital Payments / Embedded finance	Digital wallets, mobile payments, Buy-Now-Pay-Later (BNPL), domestic instant-payment schemes	digital wallet, mobile payments, BNPL, blik	[BIS, 2024; Omarini, 2018; Pramani & Iyer, 2023]
Open Banking / API	Open-banking frameworks, PSD2 compliance, API management, embedded finance interfaces	open banking, API management, embedded finance	[Farrow, 2020; Hornuf et al., 2021; Najaf et al., 2021; Rodrigues et al., 2022]
Cybersecurity & Digital Identity	Biometric authentication, multi-factor authentication (MFA), digital identity (eIDAS), fraud detection	cybersecurity, biometrics, MFA, digital identity	[Najaf et al., 2021; Rodrigues et al., 2022]
RegTech / SupTech / Compliance	Automated AML/KYC, transaction-monitoring, regulatory reporting, supervisory tech	RegTech, AML, KYC, compliance technology	[Anagnostopoulos, 2018; Arner et al., 2017]
RPA / Automation	Robotic process automation (RPA), OCR bots, low-/no-code workflow automation	robotic process automation, RPA, OCR bot, workflow automation, low code	[BIS, 2024]
Robo-advisory / WealthTech	Algorithmic portfolio managers, digital investment advisers, wealth-management platforms	robo-advisory, digital advisory, wealth tech	[Aw et al., 2023]

Source: the author's own elaboration based on the subject literature.

Table 3 presents the set of key variables used for the quantitative and qualitative description of disclosures concerning FinTech, technology, and innovation. In the subsequent stage of the study, the reports will be analysed in terms of ten identified technology categories, which form the dictionary for the DIM_FT indicator.

After collecting data from the consolidated reports of the Polish banks, for each of them we calculate the technological diversity indicator DIM_FT, defined by the following formula:

$$DIM_FT_{i,t} = \sum_{k=1}^{10} 1(h_{i,t,k}=1)$$

where:

i – bank identifier,

t – reporting year,

$k \in \{1, \dots, 10\}$ – technology category (e.g., AI/ML, blockchain, cloud, etc.),

$h_{i,t,k}$ – binary variable equal to 1 if bank i in year t mentions at least once a technology from category k in its report (0 otherwise),

1 – indicator function that returns 1 if the condition in parentheses holds and 0 otherwise.

The DIM_FT indicator takes values from 0 to 10. A value of 0 indicates that the bank did not refer, in the given year, to any of the ten distinguished technology categories. Conversely, a score of 10 shows that the institution mentioned each of these categories at least once in its report. The higher the value of the indicator, the broader the declared diversity of FinTech technologies in the reports, which makes it possible to capture the aspect of variety and thus complements measures based solely on the number of mentions.

In addition, a qualitative analysis of FinTech-related disclosures was conducted. For this purpose, all fragments of the reports containing the word “*FinTech*” were identified and then interpreted in terms of context and content. The qualitative analysis makes it possible to determine how banks present their cooperation with FinTechs – whether they highlight specific partnerships and projects, or whether they refer to FinTechs more generally within their digital strategies. This qualitative approach enriches the quantitative results and reveals the narrative behind the number of mentions, showing how banks seek to communicate and construct their image as innovators to stakeholders.

4. Results

Below, a coherent narrative description of the quantitative results (Tables 4 and 5 and Figure 1) is presented, followed by a summary of the qualitative study (Table 6).

Table 4 shows the disclosures of the words FinTech, Technology, and Innovation across the entire study period. The highest intensity of references to technology (KW_T_norm, per 10 000 words) is recorded by ING (8.17), PKO BP (6.65), and BNP Paribas (6.53), followed by mBank (5.51), Santander (4.12), Citi Handlowy (3.83), Pekao (3.75), and Millennium (3.06). Mentions of innovation (KW_I_norm) are most frequent at ING (2.30), PKO BP (1.81), Pekao (1.76), and BNP Paribas (1.49). At the same time, the highest average intensity of the term FinTech (KW_FT_norm) occurs at Alior (0.83) and mBank (0.62), while some institutions do not use this word at all in the analysed corpus (BOŚ, Citi).

The comparison of these measures suggests two distinct styles of communication in the banks' published reports: an ally-first profile (high KW_FT_norm with moderate KW_T_norm – Alior, mBank) and a tech-first profile (high KW_T_norm with low or zero KW_FT_norm – ING, PKO BP, BNP Paribas, Pekao, Santander). Millennium, despite demonstrating lower technological intensity than the leaders, also fits into the second category (KW_FT_norm = 0.04; KW_I_norm = 1.33).

Table 4. Indicators of the intensity of disclosures of the terms “FinTech” (KW_FT_norm), “Technology” (KW_T_norm), and “Innovation” (KW_I_norm) in the annual reports (financial and non-financial) of Polish listed banks (values normalised per 10.000 words), average for the sample 2022–2024

Bank	KW_FT_norm	KW_T_norm	KW_I_norm
Alior	0.83	2.96	0.91
BNP PARIBAS	0.29	6.53	1.49
BOŚ	–	2.51	0.42
Citi	–	3.83	0.35
ING	0.18	8.17	2.30
mBank	0.62	5.51	1.12
Millennium	0.04	3.06	1.33
Pekao	0.08	3.75	1.76
PKO BP	0.54	6.65	1.81
Santander	0.16	4.12	1.09

Source: the authors' own calculations based on the banks' annual reports.

The annual dynamics (Table 5) refine these profiles. Alior, from 2022 to 2024, clearly shifts towards a “high-FinTech” orientation (KW_FT_norm: 0.21 → 1.28 → 1.01), while simultaneously strengthening its technological (2.47 → 3.57) and innovation layers (0.11 → 1.74). mBank maintains a balanced, high level of technology (5.35–5.90–5.26), relatively frequent FinTech mentions (0.65–0.75–0.45), and increasing references to innovation (0.74–0.83–1.80). PKO BP is characterised by a FinTech “peak” in 2023 (0.10 → 1.26 → 0.25) alongside a strong upward trend in technology (4.83 → 8.64), while ING exhibits a stepwise reduction in the intensity of all three indicators (e.g. KW_T_norm 9.73 → 5.98; KW_I_norm 3.59 → 1.15; KW_FT_norm 0.26 → 0.12) – albeit from a still very high base.

Table 5. Indicators of the intensity of disclosures of the terms “FinTech” (KW_FT_norm), “Technology” (KW_T_norm), and “Innovation” (KW_I_norm) in the annual reports (financial and non-financial) of individual banks in 2022–2024 (values normalised per 10 000 words)

Bank	KW_FT_norm			KW_T_norm			KW_I_norm		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Alior Bank	0.21	1.28	1.01	2.47	2.85	3.57	0.11	0.88	1.74
BNP PARIBAS	0.18	0.40	0.29	6.58	5.70	7.31	1.49	1.28	1.68
BOŚ	–	–	–	1.00	3.67	2.84	0.10	0.28	0.89
Citi	–	–	–	3.49	2.96	5.05	0.19	0.28	0.59
ING Bank	0.26	0.17	0.12	9.73	8.80	5.98	3.59	2.16	1.15
mBank	0.65	0.75	0.45	5.35	5.90	5.26	0.74	0.83	1.80
Millennium	–	0.09	–	2.74	2.29	4.15	1.52	0.71	1.76
Pekao	0.10	0.08	0.08	2.69	3.42	5.14	1.92	1.79	1.56
PKO BP	0.10	1.26	0.25	4.83	6.49	8.64	1.77	2.16	1.48
Santander	0.38	0.09	–	2.88	3.65	5.83	1.53	0.43	1.31

Source: the authors’ own calculations based on the banks’ annual reports.

Pekao and Santander expand their technological narrative (from 2.69 → 5.14 and 2.88 → 5.83, respectively) while maintaining consistently low FinTech mentions. At Millennium, the growth in technology (2.74 → 4.15) and a rebound in innovation (1.52 → 1.76) are confirmed. BOŚ and Citi, despite the absence of

references to “FinTech”, systematically strengthen their technological layer and, to a lesser extent, communicate innovation.

These time series may suggest that the openness of cooperation with FinTechs (KW_FT_norm) represents a communication strategy distinct from the intensity of technology-related reporting (KW_T_norm).

The technological diversity indicator (Table 6) suggests a broad, often close-to-maximum, range of technology categories in the reports of some banks: BNP Paribas (9–9–8), mBank (9–9–7), ING (9–8–7), PKO BP (8–9–8), and Pekao (8–7–8). Alior makes a significant jump from 5 → 9 and maintains 9 in 2024, which may indicate a shift towards an “ally-first” communication style. BOŚ expands its spectrum (3–4–5), despite the absence of the word “FinTech” in its reports. In turn, the slight decline of the DIM_FT indicator in 2024 at mBank (9–9–7) may suggest a more selective description of categories in its reports.

The analysis of the DIM_FT indicator reinforces the conclusion regarding RQ2 that banks display two reporting models with respect to technology: “tech-first” and “ally-first.” Banks may disclose an equally broad set of technologies, differing mainly in the level of transparency about partnerships, or they may prefer to emphasise internally developed technologies.

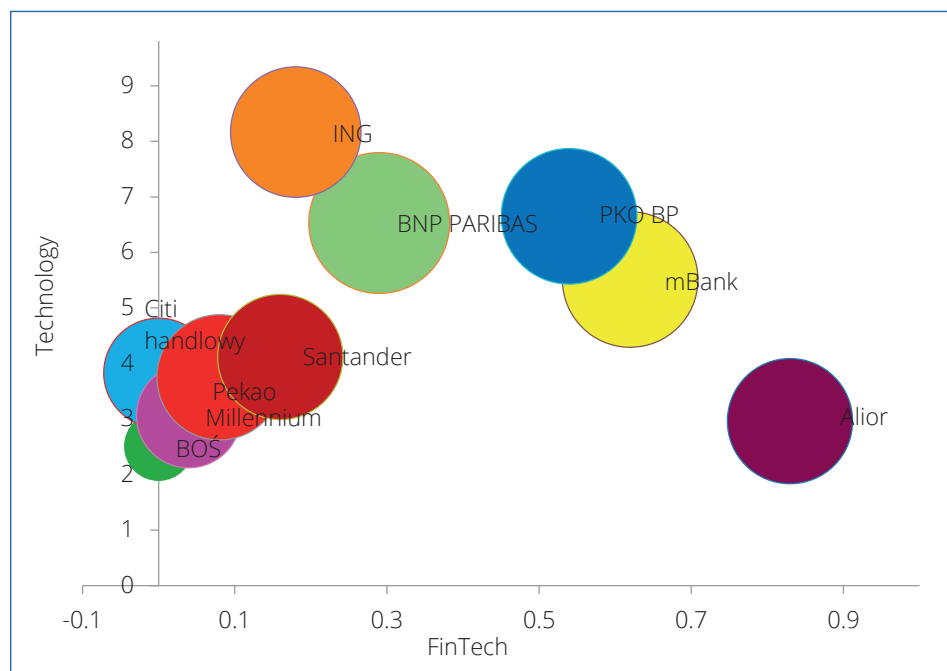
Table 6. Technological diversity indicator (DIM_FT) in the annual reports of the Polish listed banks in 2022–2024

DIM FT	2022	2023	2024
Alior	5	9	9
BNP PARIBAS	9	9	8
BOŚ	3	4	5
Citi	6	7	7
ING	9	8	7
mBank	9	9	7
Millennium	7	6	6
Pekao	8	7	8
PKO BP	8	9	8
Santander	6	9	8

Source: the authors' own calculations based on banks' annual reports.

Chart 1 synthesises the findings from Tables 4–6, comparing the intensity of technological disclosures (KW_T_norm) with the frequency of references to FinTech (KW_FT_norm). ING, PKO BP, and BNP Paribas are positioned high on the technology axis, with relatively low levels of FinTech disclosures. A different communication profile is presented by Alior and mBank, which are shifted to the right side of the chart due to more frequent use of the term “FinTech” combined with moderately high values of KW_T_norm. The bubble size reflects technological diversity (DIM_FT), showing that the breadth of disclosed categories is not directly correlated with the frequency of either “FinTech” or “technology” mentions. Consequently, with respect to RQ3, no straightforward positive relationship between KW_T_norm and KW_FT_norm was confirmed. The results suggest that the form and intensity of technological narratives are the outcome of the bank’s chosen communication strategy rather than a by-product of the actual scope of the applied technologies.

Chart 1. FinTech (X) vs Technologia (Y), size = DIM Relationship between the intensity of “FinTech” disclosures (X-axis) and “technology” disclosures (Y-axis) in annual reports of Polish listed banks; bubble size reflects the FinTech diversity index (DIM_FT)



Source: the authors’ own elaboration based on indicator calculations from banks’ annual reports.

The qualitative perspective is presented in the thematic matrix in Table 7, which outlines the modes of communication and disclosure of the term *FinTech* in the financial and non-financial reports of the Polish banks.

Table 7. Thematic matrix of qualitative disclosures on FinTech in the annual reports (financial and non-financial) of the Polish listed banks in 2022–2024 – number of identified cases based on the cited report excerpts

Category	Topic	2022	2023	2024
Ecosystem, awards, memberships	Ecosystem membership/partnership (e.g., FinTech Poland)	1	4	3
	Awards and distinctions	3	5	2
	Visibility/positioning in the ecosystem	0	2	3
Human capital and expertise (competence proxy)	Bio/expertise (FinTech/banking)	3	4	5
Disclosure metrics and KPIs	"Number of initiatives" / volume of activities	1	1	0
Named partnerships and implementations	Partnership: LeaseLink/Paynow	0	2	1
	Partnership: Monevia (factoring/leasing))	0	1	2
	Partnership: Plenti (subscriptions)	0	1	1
	Solution: UNHCR/BLIK (cash assistance))	1	0	0
Collaboration programs and accelerators	Acceleration program/innovation laboratory	3	2	2
Strategy	Innovation strategy – benchmarking	3	3	5
	Strategy – general narrative	1	1	1
Structures and organisational governance for innovation	Description of organizational unit	0	0	2

Source: the authors' own elaboration based on qualitative analysis of banks' annual reports.

The qualitative analysis reveals two main approaches. The first is the growing emphasis on ecosystem building and affiliations (an increase in references

to FinTech Poland and various FinTech-related events: $1 \rightarrow 4 \rightarrow 3$), with banks legitimising their position through visibility ($0 \rightarrow 2 \rightarrow 3$) and awards ($3 \rightarrow 5 \rightarrow 2$). Moreover, there is a strengthening reliance on benchmarks and maturity metrics: ING's reports highlighted that "the score is higher than 90% of the organisations surveyed globally... median OHI = 70 points, compared to our group's result of 84 points", reinforcing a transformation narrative backed by organisational validation. At the same time, ING links these elements to specific implementations: "We also use big data and artificial intelligence... we have launched the *imoje* payment gateway." This mode of description is typical of the "tech-first" profile, where reports focus extensively on technology while devoting less attention to potential partnerships or cooperation.

On the *ally-first* communication side, banks indicate the names of projects and partners. Alior reports: "The Bank actively cooperates with the FinTech ecosystem... in 2024 the Bank signed five agreements with FinTech partners and actively tested solutions within pilot projects", which explains the high level of KW_FT_norm and the jump in DIM_FT ($5 \rightarrow 9$). mBank, in turn, highlights product synergies: "LeaseLink and Paynow... started cooperation... the customer journey is intuitive, convenient, and fast"; at the same time, "LeaseLink... introduced deferred payments for companies... (the only entity)... with such a broad payment ecosystem... leasing, installments, and BNPL". Such examples of "named implementations" (Table 6: $0 \rightarrow 2 \rightarrow 1$ for LeaseLink/Paynow) precisely explain the elevated FinTech indicators in ecosystem banks. The partnership theme is complemented by BNP Paribas, which, in addition to a broad technological spectrum, communicates specific value propositions: "cooperation... with the FinTech Monevia – leader in online microfactoring... free factoring limit up to PLN 100 000... no commission... no penalties up to 30 days", as well as "cooperation with Plenti... users... can now use electronics for two years."

Visibility and ecosystem positioning are reflected, for example, in PKO BP's activities: "Singapore FinTech Festival... more than 60 000 participants from 130 countries... generated PLN 1.8 million AVE", while memberships materialise through cooperation with FinTech Poland ("Joining the FinTech Poland community... PKO Bank Polski was the project's strategic partner"). Similar references appeared in the reports of BNP Paribas and Alior. This "soft" communication may aim at strengthening the image of an innovator through emphasis on ecosystem engagement, awards, and memberships.

Collaboration programs are reported as permanent infrastructures for absorbing innovation: at Alior, "RBL_START is an acceleration program... a pathway

for a solution to enter the Bank”; PKO BP develops “Let’s Fintech”; Bank Pekao operates an “Innovation Laboratory... continuous monitoring of the innovation market”; while on the investment side, mBank uses “mAccelerator.” In some reports, Alior stresses a shift from recruitment in the form of editions to a continuous process, which fits well into broader process-building around such cooperation. Similarly, Bank Pekao emphasises the process-oriented nature of activities: “The number of initiatives... requires continuous monitoring of the innovation market, cooperation with FinTechs, and testing of solutions in the implementation phase.” On the social side, Santander reports a project on “the distribution of aid funds... using BLIK cheques... in cooperation with UNHCR,” showing that selected FinTech implementations also serve as tools of financial inclusion.

5. Discussion

The aim of the article is to map, document, and quantify disclosures regarding banks’ cooperation with FinTech firms as well as the implementation of FinTech solutions in the financial and non-financial reports of the Polish banks. The interpretation of patterns in the use of the terms *FinTech*, *Technology*, and *Innovation* indicates that, in quantitative terms, the notion of “technology” (KW_T_norm) appears in the narrative significantly more often than “FinTech” (KW_FT_norm) or “innovation” (KW_I_norm). This is typical of digitalisation reporting presented at a high level of generality [BIS, 2024]. In turn, the DIM_FT indicator (technological diversity) shows a relatively high degree of diversification in the sector: the average value for all banks in 2024 is 7.3, suggesting that the communication is not limited to individual threads but covers a broad spectrum of technological topics [Loew & Schröder, 2021].

5.1. Frequency and manner of communicating disclosures of the terms FinTech, Technology, and Innovation [RQ1]

In quantitative terms, *Technology* (KW_T_norm) remains far more frequent in the narrative than *FinTech* (KW_FT_norm) or *Innovation* (KW_I_norm). In qualitative terms, however, the years 2023–2024 show that several banks (including Pekao, Alior, mBank, and BNP Paribas) explicitly highlight partnerships, discuss implementation cases, and describe collaboration pathways (accelerators, open calls for solutions, brand-level partnerships) in their reports. This is confirmed by the

disclosure matrix, where the number of “documented” cases increases from 16 → 26 → 27. This pattern supports the observation from the literature that, as digital transformation matures, financial institutions shift from a broad technological rhetoric toward evidence-based disclosure grounded in concrete projects and collaborations [BIS, 2024; Drago et al., 2025; Loew & Schröder, 2021].

5.2. Most frequently disclosed categories of financial technologies in annual reports [RQ2]

The breakdown of disclosures by DIM_FT categories indicates that, in the years 2022–2024, banks most frequently communicated topics related to digital payments / embedded finance, open banking / API, and cybersecurity & digital identity. These areas are directly tied to the client experience, diversity of access channels, and the bank’s security posture. AI/ML and big data & analytics also belong to the most visible categories in the analysed reports. The role of AI/ML has increased alongside the growing adoption of decision automation in banking processes and the prioritisation of personalised customer services. Cloud & DevOps appears as the enabling layer, ensuring scalability and implementation speed. RegTech/SupTech and RPA/automation are disclosed at a moderate level, often in the context of compliance and process efficiency, whereas blockchain / crypto / tokenization and robo-advisory / wealthtech appear only sporadically and not across all banks.

This profile is consistent with findings from comparative studies: financial institutions tend to highlight categories that are less invasive for their IT architecture and deliver easily communicable customer-facing outcomes (such as payments or digital identity) before moving toward more capital-intensive or regulatory-uncertain areas (such as tokenization or robo-advisory) [Gomber et al., 2017; Thakor, 2020; Xie & Wang, 2023].

5.3. FinTech disclosures (scope, number of categories) in reports [RQ3]

The breadth of disclosures is measured by the number of DIM_FT categories indicated by each bank in a given year. For the examined sample of banks, the values are as follows: 2022: mean 7.0, median 7.5 (min–max 3–9); 2023: mean 7.7, median 8.5 (min–max 4–9, the broadest range in the period); 2024: mean 7.3, median 7.5 (min–max 5–9), accompanied by a decline in dispersion (standard deviation from approx. 1.90 to 1.10). This pattern suggests thematic expansion in 2023, followed

by the maintenance of a broad yet more balanced spectrum of technological topics in 2024. Such a trajectory corresponds to the transition described in the literature from the phase of expanding the scope of disclosures to their stabilisation and standardisation, which fosters comparability and reliability of non-financial information [Bian et al., 2023; Loew & Schröder, 2021; Wu et al., 2024].

6. Conclusions

6.1. Theoretical contribution and managerial implications

This study makes a theoretical contribution to the literature on bank–FinTech collaboration by combining the perspectives of Open Innovation [H. Chesbrough, 2010; H.W. Chesbrough, 2003; West & Bogers, 2014] and Transaction Cost Economics [Coase, 1937; Williamson, 1975, 2007] with an empirical analysis of disclosure practices. The findings confirm that banks pursuing an open innovation strategy are more likely to highlight partnerships with FinTechs in their reports as a component of building competitive advantage [Drasch et al., 2018; Fasnacht, 2018], while institutions favouring internal development focus on technological narratives without explicit references to external alliances [Geyskens et al., 2006; Kloba, 2024].

The study addresses the gap in the literature regarding micro-level analyses of bank–FinTech collaboration [Drago et al., 2025; Le et al., 2024], complementing prior work predominantly oriented towards the macro perspective [Alaassar et al., 2023; Harasim, 2021]. The findings also confirm earlier observations that transparency in reporting financial innovation remains limited, with banks rarely disclosing detailed data on the scale and outcomes of cooperation [Hornuf et al., 2021; Jakšič & Marinč, 2019].

The analysis of technological diversity (DIM_FT) shows that a broad spectrum of the reported technology categories can be observed both among institutions investing in external partnerships and among those developing solutions internally. This suggests that the choice of disclosure narrative is a matter of competitive strategy rather than solely a function of innovation intensity [BIS, 2024; Klus et al., 2019a].

From a managerial perspective, the results imply that decisions about communication – whether emphasising partnerships or focusing on proprietary solutions—should be aligned with the bank’s market positioning and innovation acquisition model. Banks can leverage acceleration programs, innovation labs, and partner ecosystems [Hornuf et al., 2021; Roy et al., 2025] not only as vehicles for

technology absorption but also as instruments of reputation-building. At the same time, benchmarking and the use of maturity metrics (e.g., OHI) may reinforce the credibility of digital transformation narratives, consistent with observations that institutions often legitimise their strategies through references to external standards [Galeone et al., 2024a; Loew & Schröder, 2021].

6.2. Limitations

The study is based on a content analysis of annual reports (financial and non-financial) of banks listed on the Warsaw Stock Exchange (WSE) for the years 2022–2024, which means that the findings reflect only the information that institutions chose to disclose publicly. The lack of access to detailed financial data limits the ability to precisely assess the scale and outcomes of cooperation with FinTechs. Another potential limitation stems from the heterogeneity of reporting standards, resulting from individual banks' communication policies, which may affect the comparability of data.

6.3. Future research

Future research should incorporate additional sources of information – including interviews with bank representatives, press materials, and market data – to more fully capture the actual scale and outcomes of bank–FinTech cooperation. An important direction is the analysis of how disclosure strategies affect banks' financial performance, innovation levels, and competitive positioning. Further studies should also examine the impact of regulations such as CSRD [European Parliament; Council of the European Union, 2022] and DORA on the scope and form of reporting technological partnerships. In addition, comparative analyses across other markets – particularly in the context of emerging economies – could provide broader insights into bank–FinTech collaboration models under different institutional conditions.

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