sciendo
Economics and Business Review
https://www.ebr.edu.pl
Vol. 9 (3), 2023: 98–123
https://doi.org/10.18559/ebr.2023.3.926

New technologies in the financial industry: Case of Poland

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Abstract

This study evaluates the scope and consequences of the application of new technologies (NTs) within the Polish banking and insurance sectors and thus contributes to the knowledge of CEE financial market development. The goal is to understand the implementation of particular NTs in two different sectors and identify the motivations, strategies, phases of realisation and cost efficiency depending on the institution's size. The detail of the study requires the use of qualitative research methods. In-depth interviews are employed to figure out the criteria based on which decisions to implement NTs are made. The findings indicate that the primary objective of NT implementation is to respond to customers' needs, followed by cost-cutting and achieving more efficient internal processes. The application of artificial intelligence (AI) and machine learning (ML) in risk

Keywords

- innovation
- new technologies
- artificial intelligence
- cloud computing

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management areas is still a work in progress. In the next five years cloud computing is expected to become the most important NT and thus will have to meet numerous regulatory requirements.

JEL codes: G21, G22, O33

Article received 6 February 2023, accepted 31 August 2023.

Funding: This study has been financed by the Collegium of Management and Finance in SGH—Warsaw School of Economics in 2022 (KZiF/S22/1.19).

Suggested citation: Iwanicz-Drozdowska, M., Cichowicz, E., Cicirko, M., Kawiński, M., & Nowak, A. K. (2023). New technologies in the financial industry: Case of Poland. *Economics and Business Review*, *9*(3), 98–123. https://doi.org/10.18559/ebr.2023.3.926

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Introduction

Banks and insurers operate in competitive markets where BigTech and FinTech companies are eager to enter with the direct intention to either compete or cooperate (e.g., Boot et al., 2021; Harasim, 2021). Therefore, to remain attractive regulated financial institutions "go with the flow" and implement new technologies (NTs) in line with applicable laws and regulations. This implementation is aimed at improving the productivity and efficiency of internal processes, providing high-quality products and services to customers and improving risk management techniques.

To date academic literature has represented a rather fragmented view of the application of NTs including artificial intelligence (AI) and machine learning (ML). A more comprehensive view has been offered by those studies based on the macroeconomic traits of countries to identify the factors that are important for the Fourth Industrial Revolution (e.g., Wang, Qiao et al., 2021).

Some of the literature has focused on the customer value of the application of NTs starting with Hu (2005) who investigated, with the use of big data, customer attrition among retail banks (single-bank data). Later Durkin et al. (2008) explored how banks (in a single-bank United Kingdom (UK) study) should evaluate customers' willingness to use NTs according to their level of complexity. Moreover, Miguel-Dávila et al. (2010) in a sample of Colombian customers analysed the quality of the banking services when accounting for the physical presence of bank branches, digital channels and face-to-face inte-

ractions, and also demonstrated the role they play in customer loyalty. Wang, Cho et al. (2017) investigated how important the personalisation of banking services and the segmentation of bank customers are for bank customers in China (approximately 180 customers of a commercial bank). Furthermore, Steiner and Maas (2018) asked an interesting question about the willingness of customers to disclose specific data to an insurance company; based on questionnaires from ten countries these authors found that customers may disclose data if they receive more attractive insurance policy pricing. Therefore, openness is based on the reward that may be offered by the insurer.

At the same time the role of NTs has been analysed from an organisational perspective. Cata and Lee (2008) showed the scope of the application of web-based solutions for insurance companies in the United States (US) not only as a communication channel but also as a sales channel. The above study was based on questionnaires distributed among US insurance companies.

Some studies on NTs have explored the willingness of customers to use new solutions and the barriers to their application. Digital exclusion should be identified as one of the main barriers (e.g., Solarz & Adamek, 2022, for the Polish market) to the use of NTs. Moreover, based on a survey of German customers Jünger and Mietzner (2020) identified the determinants of customers' willingness to use financial services offered by FinTech companies. Overall, a low level of trust in banks, a good level of financial education and a preference for transparency were shown to be significant in terms of the use of FinTech.

Finally, the exploration of the application of AI/ML for risk management purposes (e.g., Metawa et al., 2023, for a multifaceted view) is focused on credit risk (e.g., Altman et al. 2021; Barboza et al., 2017; Trivedi, 2020) and specifically on dividing customers into "good" and "bad" (i.e. not meeting commitments), on operational risk and money laundering (e.g., Faridpour & Moradi, 2020; Prisznyak, 2022), and—to a lesser extent—on market risk (e.g., Menendez & Hassani, 2021). These studies referred to the direct use of AI/ML for analytical purposes (a "tool" perspective), showing in many cases the superiority of NTs in detecting risk. In the present study a "tool" perspective is not taken but rather an institutional perspective and asks whether AI/ML can be used for risk management purposes.

The above studies are mostly single-country or single-entity studies based on data collected from customers or from a given entity to explore certain aspects of the adoption of a specific NT. This study attempts to present a different perspective since it takes a broader view of the use of NTs in the financial industry covering a wide variety of NT applications. As it is still not possible to identify the aspects related to NTs using data and information from financial statements a qualitative research tool is applied, namely, in-depth interviews (IDIs), conducted among financial institutions in Poland. The present work is a single-country study as is most of the literature on the use of NTs (e.g., Jünger & Mietzner, 2020; Miguel-Dávila et al., 2010; Wang, Cho et al., 2017).

The Polish financial industry is regarded as technologically advanced although in size it is much smaller than the Western European average. As Poland is a transitioning country (from a socialist to a market economy) it is an interesting case to investigate in Europe since its market is large due to the country's population and thus it has a large number of customers.

According to *The map of Polish FinTech* over 300 companies in that year and most of which were established in the last four to five years were in operation, thus exhibiting rapid development (Cashless, 2021). Early on NTs were considered a threat to the well-established financial sector but today they are seen as a source of cooperation to overcome competitors and an opportunity to develop new products more efficiently. FinTech companies are mostly low-capital entities and hence require support. Financial institutions invest, buy up or even create their respective FinTech companies. Because of these links with financial institutions startups not only usually receive financing and legal protection but are also introduced into the company structure. Thus, these startups have a unique opportunity to test their solution. Financial companies also launch special cooperation programmes with startups to implement innovations in various business areas.

One of the most important challenges faced by the financial industry is the implementation of NTs in line with strict regulations which slowly react to market changes. The Polish Financial Supervision Authority (Komisja Nadzoru Finansowego (KNF)) issued recommendations regarding the use of cloud solutions and communication on information processing by supervised entities using public or hybrid cloud computing services. The financial industry has criticised these quasi-regulations (soft law) as being a barrier to development. However, European Union (EU)-level regulations are also vital as they can be considered primary regulations many of which occur during the legislative process (e.g., Digital Operational Resilience Act (DORA)).

Based on the literature and observed use of NTs the following hypothesis is proposed:

H1: NT realisations in the Polish financial services industry are fragmented within business processes due to the use of efficiency criteria. The implementation of NTs is largely targeted at:
H1a meeting customers' needs,
H1b improving the productivity of internal processes,
H1c improving risk management practices.

The contribution to the literature consists of showing the real-life application of a wide scope of NTs in the financial industry based on a set of IDIs with representatives of banks (9), insurance companies/groups (6), financial infrastructure companies (2), a FinTech company and an external actuary expert. The goal is to understand the following:

- which of a wide variety of NTs and in which areas have they been or are they being implemented by the financial industry in Poland? (focusing on internal processes, customers' needs and risk management);
- why present realisations are fragmented within business processes?;
- the main determinants of NT implementation.

The above findings help build a theoretical framework for CEE financial market development which enriches financial market theory.

The remainder of the paper is structured as follows. In Section 1 the methodology applied in this study is presented. In Section 2, the results are presented, while in Section 3 discussion is provided. The last Section concludes the paper.

1. Methodology

Although the use of NTs is widespread in the economy and advertised frequently the sources of comparable data and information are very limited. A quantitative survey based on a questionnaire with predefined answers cannot provide detailed information on the motivations, strategies, phases of realisation and cost efficiency. Furthermore, a number of companies make statistical reasoning questionable. The potential representativeness of a quantitative study does not bring us closer to the aim of the present study.

Therefore, a qualitative tool is applied such as IDIs frequently used in social sciences. With the targeted characteristic of respondents it is possible to cover the most essential options. Answers cannot be considered representative and the outcome cannot be easily generalised. However, more than half of banks (according to the value of assets) and insurers (according to gross written premiums) are covered in this case. The respondents were selected according to the position and size of the institution. Moreover, the representatives of those market institutions which are regularly contacted by banks and insurers are included. Furthermore, an interview with an actuarial expert is carried out to better understand the involved processes.

The research team prepared an IDI scenario which is presented in the Appendix. The questions were divided into six parts devoted to the evaluation of different aspects of the application of NTs. The first part was focused on the purpose of and rationale for the use of NTs. In the second part questions were targeted at the identification of the most significant technologies including the emerging technologies of the future. The third part was devoted to the actual usefulness of the NTs as well as the barriers to their implementation. These three parts were treated as the most important content of the scenario and of this study. Furthermore, the next three parts allowed the col-

lection of opinions on the digitalisation of the Polish financial industry, public and private databases and the open finance concept.

Altogether nineteen interviews were conducted by the research team from July to November 2022 and from April to June 2023. The average time of each interview was 70 minutes and interviews were conducted using MS Teams. The representatives of nine banks, six insurance companies (or capital groups), two institutions providing informational infrastructure to the financial sector, one FinTech company and one external expert of the insurance sector were interviewed. Regarding the organisational leve, eleven interviewees represented the executive level (C level), while seven represented the expert level. The banks interviewed by the team accounted for approximately 57% market share (in terms of assets) while the insurance companies accounted for approximately 52% (in terms of gross premium written) and 50% for non-life and life insurance, respectively.

Based on interview transcripts a text mining analysis was conducted which presented the overall interview content. Three different analyses were performed. The first one (Figure 1) the word map showed that interviewees focused on implementation, customers, database and costs suggesting a pragmatic, business-oriented approach. The Insurance Guarantee Fund (UFG) was mentioned most frequently as a specific database provider.

Then items were clustered by word similarity (Figure 2). Banks and insurance companies were mostly grouped separately. Institutions that provided informational infrastructure were closer to the banking industry. The FinTech representative was close to an insurer. Large and small insurance companies had different compositions (together or apart) thus underlining the gap between the banking and insurance industries. Within the banking industry the group of small and medium-sized banks was often within one cluster. The above analysis suggested differences between banking and insurance groups in terms of their focus on NTs. However, large banks are closer to large insurers.

Figure 1. Word map

Sorce: Based on interview transcripts.

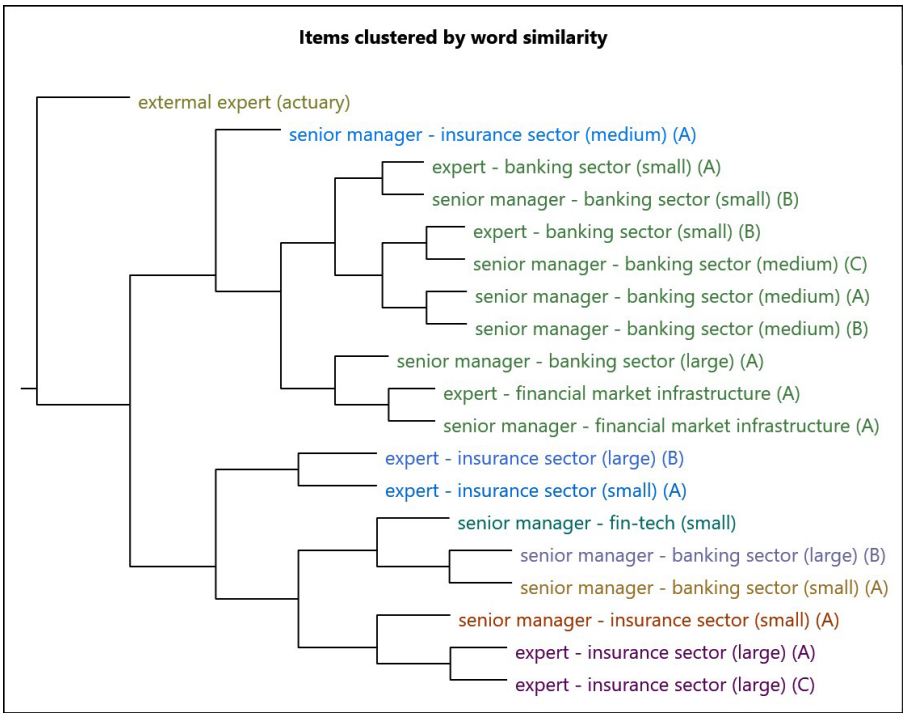

Figure 2. Entities clustered by word similarity

Sorce: Based on interview transcripts.

A word tree based (Figure 3) on a text search query showed two dimensions of risk concerning NTs. The first dimension focused on the customer and technologies suggesting that the consumer-oriented approach is leading. The second dimension concentrated on processes and technical issues. The third dimension was more oriented towards risk, costs and security. A word map suggested that interviewees face opportunities that involve some level of risk which is quite natural for public interest sectors.

2. Results

In this part a summary of the responses given by interviewees is presented. The presentation follows the parts and specific questions included in the scenario. Overall, the level of advancement of banks and infrastructure institutions is—based on the interviews—higher than in the insurance industry. One exception is pricing in which the largest insurers using NTs try to reflect customer behaviour based on “modern” data sources.

artificial intelligence in the analysis of		risk	of fraud, influence on AML
(chatbots, voice bots), matching the profile of			and CRM
(disruptive innovation) a new way of pricing of			mainly operational risk—human error
(ad hoc), also, within the evaluation of			(image recognition)
will be exposed to new kinds of			i.e., cyber-attacks, growing dependence
because insurers do not want to take the			or even investigation processes
Facebook profile is matched with the profile of			of using big data
mitigation of			speed and efficiency of operation or
it can be a database of events and			(ML Loops—Google tool), that
new products/services/more in-depth analysis of			of underwriting; there is always a risk of unverifiability
legal departments (exception—scoring)	assessment of		[claims assessment] mobile technologies, bots
with the help of machine learning—dynamic			operational—human error
			operational—ZORO
and claims (to save) and			increase the quality of data; cyber risk
critical for the development of business,			of policyholder, automatic loss assessment
sales of products but also			of using new technologies
it is all about the improvement of			
ensures data collection, verification			
increased security and	mitigation of		
and thus			
improving customer service,			
decrease in costs, an increase in profitability			
client's personal data; more			
acquisition of data from the satellite of			
robots/chatbots, dynamic pricing of			
sales, new algorithms for matrices of			
beyond the context of risk			
such needs, possibility of estimation of			

Figure 3. Text search query for "risk"

Sorce: Based on interview transcripts.

2.1. Purpose of and rationale for NT introduction

The first part of the conducted interviews concerns the purpose of and rationale for introducing NTs especially from the perspective of financial sector development. The research team also asked about the essential advantages of introducing NTs as well as the associated possibilities. Interviewees indicate a wide range of objectives when asked directly about the purpose of using modern technology in financial institutions. As a primary objective interviewees mention the need to meet the expectations of customers (who expect digital financial services with 24/7 access). Because of the use of NTs there has been a clear reduction in service times and faster responses to current customer needs (real-time and time to market); these needs have been further accelerated by the pandemic as traditional service has not been possible at the time and partly due to the war in Ukraine showing the role played by NTs in business continuity. The application of NTs helps not only to retain existing customers (improved and/or new products can be offered to them) but also to attract new customers. Financial institutions using NTs are able to reduce risk which is mostly cyber risk and counterparty risk for individuals as well as increase security (by identifying customers more accurately and securing their identity) and thus gain a sustainable competitive advantage. For example, in the case of insurance companies the use of big data has resulted in a greater ability to create personalised insurance offers. It is also important to note that through the use of NTs it has been possible to significantly reduce costs (e.g., automation of processes and elimination of traditional customer service outlets) and increase the possibility of redeploying staff resources to other areas. One interviewee also points to the reduction in the time of information technology (IT) system implementations due to NTs (the faster scalability of such implementation). In the case of one of the largest financial institutions an interviewee emphasises that NTs are the "DNA" of a given financial institution as NTs have been in use for over twenty years and their use is a permanent part of their strategy.

At the same time it should be noted that interviewees stress that the use of NTs is not an end in itself. Their use is enforced by business and by the competition. Without the use of NTs a financial institution does not meet standards; therefore such a company finds itself in a "self-perpetuating circle".

According to all interviewees, a financial institution that does not have NTs and does not develop them has no future primarily because the Polish financial market is very competitive. With the increased use of NTs some new services have emerged which customers do not fully need. These services are offered to encourage and retain customers. Hence, banks in Poland use NTs to a large extent and definitely more than do those in Western Europe (e.g., compared to those in France or Germany). Technology is embedded in financial services; thus financial institutions in Poland are sometimes regarded as technology com-

panies with a licence (e.g., a bank is now an application in a mobile phone). At the same time Polish consumers are very open to and searching for NTs. In addition to customer expectations the growth of cashless transactions (including digital money transfers, e.g., BLIK) and cybersecurity issues are also highlighted.

First and foremost and with the use of NTs opportunities to increase financial performance occur. NTs allow the offering of new services that had not previously existed. For example, to estimate and value the damage in a claim it is enough for the customer to take a photo with a smartphone and send it to the insurance company or to estimate the insurance premium for drivers accounting for the number of hours spent behind the wheel (e.g., apps used by Uber drivers). Moreover, it is also possible to generate new solutions that had not previously existed, e.g., a sensor for collecting information in the car to determine the insuree's liability for damage.

The application of NTs allows the financial industry to "delocalise" the provision of financial services due to various apps and the use of the internet. It is noted that customers prefer chatbots instead of human staff because of the greater certainty of professional secrecy inherent in the former. Regarding staff, due to automation (especially for simple, repetitive activities) the effect of staff shortages has been reduced. NTs also help improve risk management practices by being able to create more accurate predictive models thereby increasing the speed of data access and improving data quality.

With that said two interviewees note that the legitimacy of NTs should depend on their usefulness and financial efficiency. An example of negative legitimacy is blockchain technology which initially seemed to be a very useful type of NT for banks but is now used mainly for "speculation and terrorist financing". Similar scepticism exists concerning cryptocurrencies.

Interviewees were asked to indicate the advantages of introducing NTs by considering two perspectives, i.e. financial institutions and customers. From the perspective of financial institutions interviewees refer mainly to the points mentioned in responses to the above questions, i.e. the possibility of gaining a competitive advantage (to retain current customers and to acquire new, especially young, customers), the cutting of operating costs (due to the increase in automation, e.g., in bulk, increase in repetitive processes, and the possibility of remote work of employees and remote customer service) and thus a reduction in the costs of the offered products, improved security and risk reduction. For example, in moving data to the cloud it increases their security as has been underlined especially after the outbreak of the war in Ukraine. NTs significantly increase the variety of tools, products, processes and distribution channels and thus allow for branding, attracting new customers and staying ahead of the competition. On the customer side NTs make life easier and more convenient as customers look for new services (value added services (VASs)). One interviewee noted that the financial industry is a pioneer and that similar solutions are implemented by other entities or economic sectors.

Interviewees identified a number of the disadvantages of introducing NTs with the high cost of implementing and maintaining products or channels using NTs at the top of the list. With a high degree of innovation business risk (e.g., the lack of acceptance and a too low demand among customers) increases. While introducing specific NT solutions it is sometimes difficult to find an economic justification. At the same time NTs are "new", underdeveloped, immature and untested, i.e. unstable. These technologies have to "undergo childhood diseases" to become "immune", which instead of improving worsens the quality of services provided to customers. For example, in the case of using facial biometrics incorrect or poor-quality photos block the service to the inconvenience of the customer. The risk faced by companies of being the first on the market therefore increases.

NTs due to the transfer of a large amount of confidential data (e.g., with cloud solutions) increase the risk of cyberattacks (e.g., on money and personal data) or failures (e.g., some divisions of the bank may not work) and the risk of fraud and the threat of money laundering. As criminals have also moved into the digital world one observed a "race between good and evil".

Interviewees highlight that NTs have led to a change in business models due to the increasing use of outsourcing (e.g., for cloud solutions), leading to a loss of control over data and processes and an increased reliance on external providers in the case of critical business functions. At the same time rules and regulations have not kept the pace with rapidly evolving NTs; thus regulators have taken such a restrictive approach to vetting the providers of these services.

NTs also require adequate competence among employees (they need to be IT experts) and with a rapidly changing environment acquiring new competencies becomes costly. However, NTs contribute to a lower demand for human capital (necessary lay-offs of employees). Moreover, the disparity in salaries between employees familiar with and those unfamiliar with NTs is noticeable.

Despite the apparent trend towards personalised services and customer care in financial institutions NTs contribute—as perceived by customers—to the dehumanisation of financial services. It is impossible to return to the days in which agents manually wrote insurance policies. The financial industry is increasingly using NTs and digitally excluded customers therefore need to be supported.

NTs have become an everyday part of our lives. Customers use NTs daily and demand them from financial institutions. Hence it would be very difficult to stop creating and using NTs. This situation also denotes a self-reinforcing, unstoppable progress. For example car rental using mobile apps means that new services have to emerge and that NTs are required. Financial institutions need to go with the flow to remain competitive (against FinTech companies) and to maintain and attract new customers. In addition the pandemic and the outbreak of the war in Ukraine have further accelerated and deepened the degree to which NTs are used in finance. Thus, interpenetration between the financial sector and the use of NTs can be considered.

According to one interviewee who declared that his institution has been using NTs for more than twenty years, the most important revolution in the financial industry involving NTs has already taken place. The value added of NTs is already clearly visible. Those NTs that are currently in use and if properly implemented can be used for a long time. According to an interviewee, in financial institutions rather than additional NTs being implemented those NTs already in use will be improved.

2.2. Examples of NTs

Following those questions concerning the rationale behind the employment of NTs the research team tries to identify the most important and promising NTs and the way in which they are developed. Although there are many NTs they are very often interconnected. Interviewees after being asked to list the most important NTs stress that such prioritisation is very difficult because various NTs may "overlap". As in the above case these aspects can be identified from the standpoints of both financial institutions and customers. From the point of view of financial institutions among the most frequently mentioned aspects are AI and ML, which are closely related. AI/ML allows for working with various data sources to diagnose customer preferences and better product positioning. Other important NTs are big data (the ability to process large datasets) and cloud solutions (which can further reduce energy consumption), behavioural biometrics (which support anti-fraud measures and facilitate the personalisation of the offer to the customer's needs), cybersecurity solutions and robotisation (chatbots and voice bots) and digital collaboration in view of the need to develop online and group working.

From the point of view of customers the following NTs should be particularly noted:

- chatbots using neural networks which are increasingly able to recognise and analyse customer statements;
- followed by ML used for dynamic risk assessment by comparing images and image recognition techniques (disruptive innovation) which makes it possible to carry out automatic damage assessment or fraud detection;
- web-based applications, which are used for insurance policy handling to report claims or applications that allow for the location of weather anomalies (by analysing disaster-prone areas it is possible to offer insurance against bad weather on holiday);
- user based insurance (UBI)-telematics which helps offer a type of insurance tailored to the person's driving style and using neurolinguistic programming (NLP) to price personal damage.

Regarding the most relevant NTs for industry in the near future (next five years), interviewees indicated primarily cloud solutions—both private and public (because of the possibility of moving data and applications to the cloud and the use of large computing capacities as well as the efficient use of energy due to environmental and social and governance (ESG)). AI/ML and big data are next on the list due to the possibility of their application in managing risks and customer expectations. Additionally, representatives of large financial institutions highlight the computational power of quantum computers and the concept of metaverses which are currently not yet considered mature NTs but are expected to be promising in the next five years.

The interviewees' list of the most innovative/pioneering/function-changing aspects of organisations is comparable to the responses presented in the previous question. Interviewees most frequently mention AI/ML and big data as well as cloud solutions and behavioural biometrics (e.g., identification by recognising the way a smartphone keyboard is touched or the way a mouse is moved which are individual to each person and can help improve cybersecurity). Attention is also drawn to the concept of the metaverse which is currently not very advanced but still promising. Moreover, a forward-looking perspective exists. An experienced respondent from the banking sector mentioned the limitations of big data processing and found concepts of small data, containerisation and micro-services compelling. An external expert talking about risk models found data preparation leading to the limitation of data to be the most time-consuming process within the modelling data themselves.

At the same time it is noted that it is difficult to identify those NTs that make the most difference in terms of the functioning of financial institutions because they have been in use and intensively developed in these institutions for many years (i.e. at least five years). Functioning without NTs now seems impossible or at the very least, inefficient.

The types of those NTs being employed in specific institutions vary widely reflecting the heterogeneous degree of development of financial institutions and the stage of implementation of NTs. The most cutting-edge financial institutions have been developing NTs for more than twenty years while others have been developing them for approximately ten years. Each NT is implemented at different times (some many years ago and others one or two years ago) and at different speeds (on average NT implementation takes twelve to fifteen months). It is also highlighted that the implementation of NTs in many financial institutions is an ongoing process. An example of this is the back office where although process automation has been taking place for more than ten years it is still being refined as it requires integration with a wide variety of IT systems. The latest NT is the metaverse concept which is a pilot programme began by one institution in June 2022.

Conversely it seems that it is not so much how long NTs have been implemented/used that is important but rather the extent to which they are being used and this is growing exponentially and there is still unlimited potential for growth.

The types of standard NTs, i.e. NTs which are no longer treated as new, mentioned by interviewees vary significantly. The most frequently mentioned standard NTs include centralised information systems, data warehouses, customer relationship management (CRM), Excel (i.e. based on models running in an Excel environment), online and mobile banking, contactless payments, decision-supporting systems, sales on remote channels, digital marketing, call centre automation, classic robotic process automation (RPA), decision automation and workplace digitalisation (digital collaboration) as 95% of employees in financial institutions can perform tasks from virtually anywhere and process data. The exceptions to the above types of NTs are AI and ML which are not yet considered standard NTs.

A broad identification of technologies is still missing in financial organisations according to interviewees. Such identification varies widely and depends on the degree of digitisation of the respective institutions, i.e. interviewees indicate both a lack of quantum computers and metaverses and a lack of chatbots and fully automated ways of remote identity confirmation (as human intervention is needed). Most interviewees point to the lack of AI/ML, cloud computing and blockchain (e.g., as a permanent storage media for documents).

Financial organisations develop NTs in house or in collaboration with FinTech companies. Interviewees most often indicate a mixed development model, i.e. the development of NTs both in collaboration with external suppliers and in house. Collaboration with external companies is most often indicated when purchasing a ready-to-use product so as to benefit from the provider's expertise. Those external companies selected for collaboration range from large professional providers (Microsoft and Amazon) and payment organisations to startups and FinTech companies. Large financial institutions often acquire promising startups and thus benefit from their solutions. Small institutions without extensive IT expertise often work with external partners in purchasing proven solutions. Internal experts are used as part of the implementation process through which other staff members can gain knowledge and experience. The decision to implement in house or with the support of external companies depends on the effectiveness of the solution and the cost and availability of specific experts in the organisation (in house).

2.3. Usefulness of NTs

The next area of the survey is dedicated to efficiency especially that concerning expenses and outcomes, the distribution of costs over time, the most and least promising areas of development and finally issues and employees' attitudes. The cost efficiency of NTs is critical for the assessment of utility. There is a group of products or services that are necessary due to intense

market competition (mobile banking apps in which clients compare services as they frequently use more than one particular type of product simultaneously), market standards (cloud computing) or regulations (statutory credit holidays applied for mortgage credits due to the sharp rise in the amount of instalments during harsh macroeconomic conditions). In such cases, cost efficiency is limited or not required at all. In the case of standard implementation based on business needs, pilots and tests proceed together with in-depth efficiency analysis based primarily on net present value (NPV). The time horizon for such analysis is three to five years; if the outcome exceeds this period then such effects are not considered business driven. Few interviewees raised the problem of the accountability of cost projections especially within the initial phases and some outcomes, such as client satisfaction. Nevertheless projects with poor potential effects are abandoned. Final approval of implementation is provided by the management board.

There are three main phases, i.e. design, implementation and maintenance. However, practitioners often combine the first two phases. The distribution of costs over time varies considerably due to the different types of projects and methodologies (e.g., waterfall and agile). According to interviewees, the waterfall methodology brings more expense at the beginning (creation and implementation phases)—from 65% to 80% (creation and implementation with six years of maintenance) of total expenses—and the rest during maintenance. Design is much more expensive than is implementation. The agile methodology provides a more even distribution of costs but the division among creation, implementation and maintenance is also less clear under this methodology. One of the interviewees offers a diverse stratification of costs with 20% for design, 5% for implementation and 75% for maintenance as the maintenance process is never passive and requires costly modifications.

A considerable part of costs is the knowledge of employees and infrastructure especially in large-scale projects. Pricing for specific solutions (tools) is based more frequently on subscriptions. Costs start with high volume but the dynamic is much slower later whereas outcomes steadily increase in terms of success. There are different possible outcomes which are mostly the reduction in other costs due to decreased fraud, a decreased number of employees (in banks), a lesser burden placed on administration focusing on following regulations or supervisory expectations and risk reduction. Possible outcomes can be opportunities to keep existing clients or attract new ones.

Generally the highest utility from engaging in NTs comes from large-volume operations and can be stratified accordingly: income, cost and security oriented. Regarding income-oriented utility it is easy for some interviewees to identify technologies that increase income or at least keep it at the previous level. Most of these technologies are linked to distribution (selling) such as digital marketing, CRM and the automatization of call centres. Interviewees also mentioned areas related to product creation and post-sale services but

do not provide examples. Cost-oriented technologies such as RPA and big data, dominate the back office. Finally, big data dominates within security-oriented areas allowing for the speeding up of end-to-end processes, the sharing of data with other financial institutions and the scoring or underwriting of processes.

It is worth mentioning that one interviewee questioned all positive outcomes; this individual cannot identify an increase in sales and can at best identify an increase in client quality and/or satisfaction. Additionally, overall spending does not change, as NTs are quite costly to implement and maintain. As cyber risk increases the security does not change significantly if at all. In other words, business with NTs has changed but not the outcome.

According to an external expert, ML in risk assessment provides an advantage compared to GLM (generalized linear model). Still ML is highly significant due to considerable improvements in classical regression analysis in recent years. Profitability then depends on the scale of processes. The data used for ML in risk management covers approximately the last three years. Hence only big institutions can provide sufficient information.

This external expert also mentioned that the random elements within ML algorithms make the identification of risk determinants less clear. An enormous number of variables increases only the problems of clients' perception of risky and safe behaviour (however, the latter feature is common to GLM as well). Furthermore, there is a pending risk of potential discrimination and financial exclusion.

Few interviewees identify the lowest usefulness of NTs as being in accounting because of constantly changing rules and compliance due to the small volume of processes. Usually most of such activities can be somehow improved by NTs but priority is given to higher-utility changes.

There are several reasons for the use of NTs not growing faster one of which is an area of regulations that are not up to date or very tough (such as cloud computing recommendations). There is also a problem with compliance as nobody is sure about the interpretation. Moreover, a lack of legal security is considered an actual problem, as are cyberattacks which make institutions vulnerable. Interviewees frequently mentioned costs as being problematic mainly in two contexts, unknown and known actual costs. High expenses are often a significant burden for small entities. Two persons also mentioned the unknown effects of half-baked technologies as a concern. A highly qualified IT staff also generates costs; it is expensive and challenging to keep such staff employed due to intense local and worldwide competition. Hence the need to maintain such staff lowers stability.

The implementation of NTs requires the involvement of not only IT specialists. Almost all processes are business oriented and hence need different skills. According to interviewees, employees' attitudes can be driven by enthusiasm, reluctance and fear. Attitudes differ depending on specific technologies. Enthusiasts are eager to participate in the development and implementation

of NTs due to potential facilities. Reluctant people do not see any or limited advantage of NTs just more challenges and effort; such employees do not notice when they gain new competencies. Fear results from possible employment cuts with some interviewees confirming the materialisation of employment cuts of low-skilled employees in the banking industry. However, in the insurance industry there have also been attempts to shift such employees to activities that increase service quality. One interviewee noted that reluctance and fear can effectively jeopardise any action towards implementing NT.

2.4. Digitalisation of the Polish financial sector

During the next part of the interview the interviewees were asked about the digitalisation of the financial sector in Poland and especially the level of development, the dynamics and clients' attitudes towards NT employment. Interviewees generally considered the digitalisation of the Polish financial market considerable compared to that in Western Europe due to the late start, newer technologies , and high technological standards of banking noting this as the reason for the relatively low popularity of FinTech. NT development exemplifies the volume of cashless transactions and underwriting processes within insurance companies. Moreover, one interviewee put Poland among countries such as Spain and Turkey. Few persons considered Asian countries as leaders in this regard primarily because of the available scale that makes NTs efficient in more business processes. Furthermore, one interviewee mentioned the lack of openness in public administration as an essential barrier to NT implementation.

Generally the perception of the Polish financial market is positive due to the high volume of cashless transactions. However, BLIK, a direct payment system introduced by banks, is assessed very differently as an example of the Polish financial sector's superiority or a lack of competitive advantage in the Polish financial market.

Interviewees were unanimous with regard to the differences among groups of clients. Demographic features play an essential role in profiling NTs. Age, level of education and place of living stratify groups of clients. The most promising yet sometimes difficult to follow clients are young, well-educated students from large cities. This group is not very loyal and compares various offers, thus stimulating development. The opposite group consists of low-educated older people from small towns and villages. This first group hardly ever visits bank branches. NTs are not helpful and are inappropriate for the latter group as customers need significant backup from traditional banking. Due to digital exclusion as for most clients hybrid solutions are prospective. Furthermore, some interviewees underlined the role of education in making NTs safe for both parties—customers and banks.

The COVID-19 pandemic has been a trigger unleashing the potential of NTs. However, the development dynamic in NTs is decreasing primarily due to tight regulations. Some interviewees pointed out that with regard to NTs a segment of corporate clients stands out significantly from retail clients. However, it is a matter of scale which is much smaller for the latter.

2.5. Databases and open finance

Finally, interviewees were asked about the availability of databases and the idea of open finance. In the part of the questionnaire dedicated to databases interviewees underline that access to information is fundamental for any activity. A malfunction of the UFG (an insurance guarantee fund) database forces insurers to halt motor insurance distribution. A similar situation takes place within the banking market. Interviewees mentioned primarily private and public databases. Financial institutions develop their databases and build them as an industry together with a banking association or guarantee fund. Private databases are assessed to be better than are public databases because of the data and modern infrastructure of the former, which is costly. Interviewees criticised public databases for their outdated information and old infrastructure. One interviewee also mentioned that public databases are developed dynamically but very often with the information provided by financial institutions. Financial institutions use and create their own databases.

The outlook of databases shows a very pragmatic approach. Through generalisation interviewees provide many examples of particular databases with detailed assessments. For example the BIK (database of borrowers) is updated but provides static functionalities and a costly pricing model (per request not per sold product). Moreover, the REGON (database of business entities) database is outdated and based on old technology, which makes the know your customer (KYC) and anti money laundering (AML) processes more tiresome.

Interviewees also mention legal limitations, the threat of breaching banking/insurance secrecy and restrictions on merging information from different databases. Interviewees are aware of the risk concerning data protection or misuse. Here one interviewee mentioned the banking association as an example of the "guard" (organising ZORO database, a database of operational risk events). However, only one interviewee notes the risk of the presence of too much individualisation with regard to risk assessment. Concerning future development interviewees frequently mention EU regulations such as DORA and Network and Information Security Directive 2 (NIS2).

Interviewees consider open finance a new opportunity but with an unspecified potential mainly for a new business model. This strategy can speed up cooperation between large and small players as it allows the provision of more

user experience (UX) services and products or the introduction of new services without building new competencies within the organisation. A few interviewees mention that NTs such as photo identification (ID/PID) can ensure the better identification of clients which is essential for developing digital financial services. Due to open finance the data owner can offer additional services. However, there are also problems such as database breaches, unauthorised data usage, fraud and customer takeovers. Much work is needed concerning data standardisation but regulations like Payment Services Directive 2 (PSD2) could help in this respect. One interviewee noted that some open finance services are already available such as account information services (AISs) and payment initiation services (PISs) but are not yet popular (i.e. they account for less than 3% of the market).

3. Discussion

There are several issues from this qualitative (Polish) research that should be compared with existing literature. The first is the attitudes and skills of financial sector employees. The Greek quantitative research (Kitsios et al., 2021) finds a positive attitude towards NTs among banks' employees. The level of potential reluctance was not mentioned. Within Polish research it is interesting that managers and experts consider the threat against NTs among employees as an essential factor that can make NTs' implementation more problematic. Both pieces of research find non-IT skills vital for the effective implementation of NTs. The development of software makes it easier to engage non-IT employees but according to Greek research banking staff and customers should be trained or educated in NTs. Selimović et al. (2021) confirm that employees of the financial sector expect involvement and support in digital work. Such an approach fosters digital transformation.

The education of customers does not appear in Polish research. Respondents perceive only a different willingness and ability to cope with NT among clients, indirectly mentioning potential financial exclusion if NTs spread more widely. The main reason is an intellectual capacity linked to the level of education and familiarity with NTs correlating somehow with age. The place of living is also noticed. Many pieces of research (e.g., Solarz & Adamek, 2022) deal with financial exclusion due to NTs in financial services echo these findings. However, at the same time other research finds NTs helpful in strengthening financial inclusion (Lee-Ying et al., 2022; Siddik & Kabiraj, 2020). NTs are considered very differently often as a barrier or opportunity. It can be a matter of perspective. It seems the closer the perspective is to business the more of a challenge it becomes. The closer it is to policy, the more it seems an opportunity.

The respondents in Polish research frequently mentioned a more intense business risk as an important drawback of NTs. Business risk is a clear outcome of any new tool or method incorporated into daily practice such as privacy (Piotrowski, 2023). Every new technology in the past brought similar risks. But not all NTs prove their usefulness. Interestingly blockchain is mentioned in this context as a business failure. Technology that promised revolutionary changes (Aashima & Mohanty, 2022) has not pleased the financial market. It was seen to be too complex and costly for market participants. The features provided by blockchain will probably be copied in the future within other, more available technologies.

Dehumanisation mentioned by respondents within Polish research is a more philosophical constatation, however, the frequently mentioned AI/ML copies human behaviour in many aspects. It creates the risk of copying discriminatory practices from the past mainly within insurance (Eling et al., 2022). In Polish research this risk was also identified primarily within the insurance industry. At the same time AI/ML feeds algorithms of robo-advisors taking the role of distributors and helping to optimise insurance coverage. It should be mentioned that the activity of robo-advisors is not fully regulated (Marano & Li, 2023). The Polish research reveals that the economic efficiency reached by AI/ML in Poland up to now is relatively small and can be profitable only on a large scale which is hardly available in the Polish market.

The scale of potential processes is a key driver of NTs development. The respondents in Polish research point to China (Muganyi et al., 2022) and India (PwC, 2022) as world leaders. These countries are characterised by large volumes, lower standards of data protection and very limited other regulations. Poland was placed with Spain and Turkey ahead of other Western European countries. The lower popularity of fintech in Poland compared to Western Europe is explained by a higher level of technological development. However, the literature also points to regulatory barriers (Shala & Perri, 2022) and poor financing programmes (Kliber et al., 2021).

Conclusions

In this study the scope of the application of NTs is identified. The analysis is based on interviews conducted with top-level managers and experts from Polish financial services' industry. Interviews (nineteen) were conducted from July to November 2022 and from April to June 2023. The hypothesis H1 was proposed stating that those NTs implemented in the Polish financial services industry are largely targeted at a) meeting customers' needs, b) improving the productivity and efficiency of internal processes and c) improving risk management practices.

Based on the interviews supporting evidence is found for two components of hypothesis H1 (H1a and H1b) while the last component (H1c) is expected to be one of the key implementations in the future. It should be noted that cybersecurity and AML now play a significant role in the abovementioned objectives. As interviewees underlined the implementation of NTs is customer and business driven and should be effective in terms of their impact on entity performance. NTs may be divided into income-oriented (e.g., NTs meeting customers' needs), cost-oriented (e.g., RPAs in the back office) and security-oriented (e.g., fraud detection systems) NTs all of which are important for entity performance from various perspectives. In the case of income-oriented solutions there is strong market pressure to offer attractive services including VASs, to keep or attract new customers which is especially important for the younger generation composed of digital natives. In the case of risk management big data AI/ML solutions are used widely in AML and fraud detection as well as for cybersecurity. Although their application for the evaluation of credit risk including credit scoring has a good background in academic literature the use of such solutions in business is still not significant. However, AI/ML algorithms are in use in credit processes to e.g., promptly verify the customer's identity in various (public and private) databases. Additionally, insurers try to use NTs in evaluating underwriting risk in motor insurance. All of the above factors show that this approach is not yet a market standard but rather an emerging approach.

As evaluated by industry representatives some NTs can be treated as standards on the market and include digital distribution channels, contactless payments, decision-supporting systems, digital marketing, call centre automation, classic RPA, decision automation and workplace digitalisation. It is worth noting that blockchain which is not a standard NT in the financial sector is not regarded as a prospective NT either. As a technology that is important for the near future cloud computing and the wider use of AI/ML are mentioned while in the distant future quantum computing and metaverses are mentioned. The extensive use of AI/ML also requires improvements in public and private databases to fit into the modern IT infrastructure of the financial industry.

The implementation of NTs is a process operated with in-house resources or, more frequently, in cooperation with specialised companies including FinTech companies. Barriers to implementation which are the deficit of human resources with NT qualifications, the rising costs of IT and IT staff and the nonacceptance of NTs by some staff should be mentioned; however, entities try to remove this barrier by using informational campaigns and outplacement opportunities.

Overall, the financial industry in Poland is advanced in the application of NTs especially in customer- and cost-oriented areas with prospects and visions for future development paths. In the coming years the use of AI/ML in risk management areas should be expanded to catch up with the degree of advancement in other areas.

This study adds to the literature an extensive analysis of the application of NTs in a transition EU country based on real-life examples. Furthermore, this work is a single-country and single-industry study the results of which may be used as a benchmark for other markets in further explorations.

Appendix

In-depth interview scenario

I. Purpose and rationale for introducing new technologies	1	In your opinion what is the purpose of using new technologies in financial institutions?
	2	To what extent is the use of new technologies justified from a financial sector development perspective?
	3	What are the main advantages of introducing new technologies?
	4	Do you see any disadvantages of the introduction of new technologies?
	5	Can you imagine the development of the financial sector without new technologies?
II. Types/examples of new technologies	1	Please list, starting with the most important, the new technologies (at least five) used in your industry.
	2	Which technology(s) will be most relevant to your industry in the next five years, or the so-called ‚technologies of the future'?
	3	Which technologies (at least three) do you consider to be the most innovative/pioneering/changing the operation of your organisation (or industry) to the greatest extent?
	4	When were (are) the abovementioned new technologies tested and when will be used (or since when have they been in use)?
	5	What can currently be considered a standard rather than a new technology?
	6	Which technologies are still lacking in your organisation?
	7	Are the new technologies being developed in your organisation in-house or in collaboration with FinTech companies?

III. Actual usefulness of new technologies	1	How do you assess the ratio of inputs to outputs of using new technologies?
	2	How do the costs of using new technologies break down by phase, creation-application (implementation)-maintenance?
	3	In which areas of the organisation's business are the above technologies most useful (e.g., distribution channels, sales, after-sales, back-office, risk management, compliance, internal audit)
	4	In which areas of the organisation's operations does the use of the new technologies provide the greatest benefits (e.g., cost reduction, improved process efficiency)?
	5	In which areas have the new technologies performed the least well? What is the reason for this?
	6	What are the largest problems or barriers to implementing new technologies?
	7	What is your organization's employees' attitude towards implementing new technologies (see the added value/do not see the added value/negative attitude)?
IV. Digitalisation of the Polish financial sector	1	How do you assess the degree of digitalisation of the Polish financial sector compared to other European/world countries?
	2	Is the pace of digitalisation adequate? Can the sector and customers keep up with the pace of digitisation?
	3	Can certain customer groups in Poland be distinguished in terms of the degree of their digitalisation characteristics, e.g., in terms of age or place of residence?
V. Databases	1	How do you assess the availability and development of public, public-private and private databases?
	2	Should other open databases be developed? If so, which ones and why?
	3	How do you assess the usability of sectoral applications, e.g., UFG fraud application, and solutions offered by BIK?
VI. Open finance concept	1	How do you assess the concept of open finance? Is it a utopia or is it the near future? What opportunities and threats do you perceive about such openness?

Sorce: own work.

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