



FINTECH AND DIGITALISATION REPORT



2023
JULY

*“It would appear that we have reached the limits
of what it is possible to achieve with computer technology,
although one should be careful with such statements,
as they tend to sound pretty silly in 5 years.”*

John von Neumann (1949)



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Without prejudice to its primary objective - to achieve and maintain price stability - the Magyar Nemzeti Bank shall support the maintenance of the stability of the financial intermediary system, the enhancement of its resilience, its sustainable contribution to economic growth; furthermore, the MNB shall support the economic and environmental sustainability policy of the government using the instruments at its disposal.

A high level of digitization and financial innovation contributes to achieving these goals, therefore the MNB considers it especially important to develop the digitalisation of the financial system and support the market introduction of innovative financial services in a secure way.

The MNB favours a financial intermediary system that offers competitive and safe financial services to domestic consumers. To this end, the central bank is actively involved in developing an efficient incumbent segment that implements advanced technologies, a vibrant FinTech ecosystem, a supportive environment and a modern regulatory background, while maintaining market integrity.

The MNB's annual FinTech and Digitalisation Report seeks to provide insight into recent domestic and international developments in financial innovation, digitalisation and their underlying technologies, which are becoming increasingly dominant in the Hungarian financial markets. In this way, the MNB intends to contribute to strengthen the digitalisation level of the domestic financial system, to which it intends to provide active support.

The analyses in the Report was prepared under the direction of Aniko Szombati, Executive Director for Digitalization and FinTech development and Chief Digital Officer in the coordination of Digitalization Directorate. The Report was prepared by staff at the MNB's Digitalization Directorate, Sustainable Finance and Supervisory Coordination Directorate, Directorate Credit Institutions Supervision, Insurance and Pension Funds Supervision Directorate, Financial Infrastructures and Payments Directorate, Directorate Financial System Analysis and Prudential Modelling and IT Supervision Directorate. The main content of the publication was approved by the Financial Stability Council.

The Report incorporates valuable input from other areas of the MNB and the comments of the Financial Stability Council.

The Report is based on information available for the period ending 10 June 2023.

Contents

Executive summary	7
1 International developments	9
1.1 The impact of the post-pandemic realignment on digitalisation and the FinTech sector	9
1.2 Service trends	10
1.3 Financing of FinTech firms	13
1.4 Landscape on banking digitalisation and FinTech cooperation	16
1.5 Cybersecurity challenges	20
1.6 Regulation of the FinTech sector, its development, and further regulatory efforts	22
2 Domestic FinTech sector	33
2.1 Analysis of the domestic FinTech sector by company size and number of employees	33
2.2 Sales revenue and profitability of the domestic FinTech sector	35
2.3 Venture capital investment in the domestic FinTech sector	37
3 Digitalisation level of the Hungarian banking sector	40
3.1 Digitalisation of the domestic banking system	40
3.2 Digitalisation of interactions with external stakeholders	41
3.3 Preparedness of management and employees	49
3.4 Digitalisation of internal operations	52
4 Digitalisation level of the Hungarian insurance companies	56
4.1 Digitalisation of domestic insurance companies	56
4.2 Digitalisation of interactions with external stakeholders	57
4.3 Preparedness of management and employees	59
4.4 Digitalisation of internal operations	61
List of boxes	
Box 1: Crypto contagions between 2021 and 2022	15
Box 2: Crypto-assets in the focus of regulators' attention – not only in the European Union	25
Box 3: Change of paradigm on the European Digital Identity	31
Box 4: The MNB at the Singapore FinTech Festival	37
Box 5: The Innovation Hub, the MNB's regulatory support platform has been in operation for five years	39
Box 6: The rise in contactless and mobile wallet payment technologies	48
Box 7: The first retail central bank digital currency pilot project in the EU: The MNB Student Safe Initiative	51
Box 8: CyberShield – Protection in finance	55

Executive summary

The MNB publishes its fourth FinTech and Digitalisation Report, an annual review and analysis of the international and Hungarian trends in the digital and innovative solutions that increasingly dominate the operation and development of the financial system, as well as in the advanced technologies underlying them, which are collectively known as financial digitalisation processes. Financial innovation is not only associated with the incumbent players in the financial market, because new market participants are also more and more involved in the development of digital financial channels, services and products, whether they are start-ups, dedicated to FinTech services, or tech giants from other industries, entering the financial services market by diversifying their products and services. FinTech is experiencing a steady rise in Hungary, too, and besides the incumbent players in the Hungarian financial market, there are more than 170 firms registered in Hungary with a specific FinTech focus. In this report, we consider the latter, individually identified group of companies to be the domestic FinTech sector.

The FinTech and Digitalisation Report focuses on four main areas. The first chapter provides an overview of international financial digitalisation processes and major global developments affecting the global FinTech sector. Following that, we provide a comprehensive analysis of the domestic FinTech sector, based on publicly available data. In the third and fourth chapters of the report, we summarise the results of the digitalisation survey currently conducted among Hungarian commercial banks and in the insurance sector — also comparing them with the results of previous years — and highlighting the areas where further progress is needed, either through internal, or external developments, or through cooperations with FinTech companies, to provide better, more accessible and more competitive digital financial services.

Globally, the pandemic has opened the doors to the use of digital solutions, and this has become the norm in the past period. Even though most people mainly conduct their finances through digital channels, service providers will have to keep offering both physical and online channels in the future, as older generations have returned to taking care of their finances in person. At the same time, there is a growing trend in consumer trust regarding FinTech, even surpassing traditional financial institutions in certain age groups. The global FinTech sector has continued its dynamic growth in 2022, partly on the back of a rising trend in digital payment solutions, but the changing interest rate environment and economic situation will test how future-proof certain, previously promising business models are. The significance of RegTech solutions that effectively mirror the dynamic changes in the regulatory environment is expanding, and the facilitation of companies' ESG compliance is an increasingly important segment. In terms of investments in the global FinTech sector, the peak in 2021 was followed by a steep fall in 2022, and the uncertain macroeconomic environment reshuffled geographical distribution and focus areas. With new service providers coming in, digital transformation urges banks to continuously develop their services, and FinTech partnerships are now a major part of this. However, the rise in financing costs, especially IT costs related to digital transformation poses an enormous challenge. Cybersecurity and fending off cyberattacks remains crucial in digital developments, and solutions relying on artificial intelligence are becoming indispensable in this. As regards the regulation of the sector, European Union legislation has culminated in the adoption of the digital finance package, and the establishment of a robust crypto-asset framework, the tokenisation of financial assets, the improvement of the digital operational resilience of the financial sector, and the regulatory responses to new technologies, in particular artificial intelligence are expected to foster a more innovative and competitive single market in the EU.

The Hungarian FinTech ecosystem has continued to strengthen. A review of the latest available annual accounts shows that at the end of the 2021 financial year micro and small businesses continued to dominate in terms of the distribution of the Hungarian FinTech sector by company size. The development of the FinTech ecosystem is on a steady path, and it is also balanced, because most FinTech services under review showed an increase. Nevertheless, a large portion of Hungarian FinTech firms remained to have a B2B (business-to-business) focus, with financial software development and system integration, payment services, data analysis and business intelligence among the most sought-for activities. In the period under review, the number of people employed in the Hungarian FinTech sector increased at an exceptional rate across all segments, so no major changes were observed in the distribution of services compared to previous years. Despite the dominance of small start-ups and the uncertainty in the market during the pandemic, sales revenue was up

considerably in 2021, the latest year with a closed balanced sheet. And for the first time in years, the number of businesses with rising sales revenue was also expanding, and at the same time, the efficiency of the companies in the market also improved from previous years. Analysis on the life cycle and ownership structure of Hungarian-owned companies shows that one-third of FinTech businesses have received venture capital investment. At the beginning of their life cycle, such firms have a longer preparatory period with lower profits, followed by a dynamic growth in profitability and the headcount.

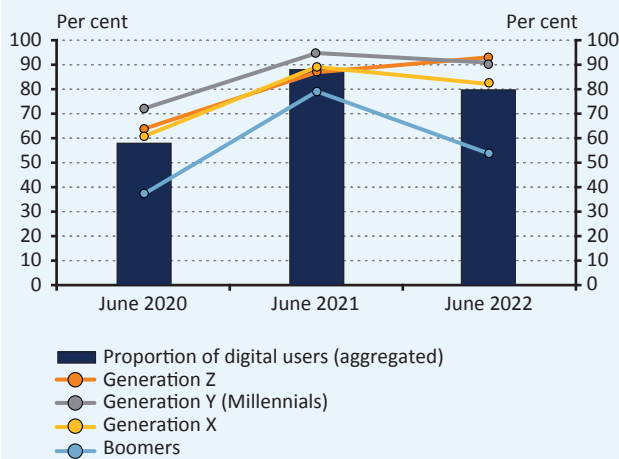
According to the results of the MNB's digitalisation survey covering more than 90 per cent of the Hungarian banking sector in terms of the balance sheet total, the digital maturity of Hungarian banks continues to improve, albeit at a slower pace than in previous years. Despite the steady development in the digital maturity of individual institutions, the banking sector as a whole has been unable to break out from the medium development level. Out of the 7 pillars that cover the typical areas of banking operation as a whole, and that were examined by the MNB, the management pillar continues to show the best results; this indicates the continued and high commitment of the institutions to digitalisation, which is also reflected in the quality of banks' digitalisation strategies. The greatest year-on-year progress can be seen in the workflow and client pillars, meaning that banks mainly prioritised the client-side digitalisation developments and internal workflows in 2022. For example, the automation of data management processes improved more than in earlier years, and following the stagnation in earlier times, great strides have been made in the popularity of solutions reflecting an innovative approach to workflows. As a result of the continued development of banks' products, at the end of 2022, besides opening a current account, personal loan application was also available digitally in all credit institutions offering such products, although there seems to be considerable room for improvement in the digitalisation of corporate products. As regards payment solutions, partly as a result of the rise in the already dominant mobile and online banking, virtual cards have become widely available, and contactless payments and the integration of bank cards into mobile wallets is being rapidly adopted. Hungarian institutions place great emphasis on improving financial awareness, which helps customers in more carefully planning their finances and also promotes the use of digital solutions. Along with the information materials, advertisements, and social media content targeting the improvement of financial literacy, an important tool for this has been the access to digital account statements and notifications: in 2022 a significant proportion of Hungarian customers received their monthly statements digitally. In addition to products, another area that is in dire need of improvement in digital maturity, as confirmed by the self-declaration of the institutions, is the modernisation of internal systems and equipment, and these pillars could be key in ensuring long-term digital competitiveness.

According to the results of the digitalisation survey of the domestic insurance sector, covering 90 per cent of the sector in terms of gross premium income, the level of digitalisation of domestic insurance companies showed a gradual improvement over the last period. The sector's commitment to digitalisation is attested by the fact that a major portion of players have a digital transformation strategy, but not all insurance companies have a long-term, high-level digital transformation approach yet, and senior management positions related to digitalisation are still very much underrepresented in the sector. Among insurance products, retail property insurance is the most commonly available digitally, but digital access has improved in liability insurance and corporate property insurance as well. Last year, insurance companies focused on user experience-based operation and workflow optimisation. In the latter, innovative process management solutions and further automation efforts could significantly improve organisational efficiency and competitiveness. More efficient utilisation of the data assets available to institutions, and the automation of handling customer data could facilitate an increased customer experience.

1 International developments

The pandemic has opened the doors to the use of digital solutions, and this has become the norm in the past period. At the same time, there is a growing trend in consumer trust regarding FinTech service providers. Even though most people mainly conduct their finances through digital channels, service providers will find it important to offer both physical and online channels in the future. The international FinTech sector has continued its dynamic growth in 2022, partly on the back of a rising trend in digital payment solutions. However, the changing interest rate environment and the deteriorating economic situation will test the sustainability of certain business models. The RegTech subsegment showed a continuous and considerable improvement to effectively adapt to the dynamic changes in the regulatory environment. Such solutions are increasingly dominated by the promotion of companies' ESG compliance, where bigger challenges are especially prominent in social factors. In global FinTech investment market, the peak in 2021 was followed by a steep fall in 2022, and the uncertain macroeconomic environment reshuffled the structure and the geographical distribution of investments. Digital transformation encourages banks to develop their services, and FinTech partnerships are a major part of this phenomenon. Within digital transformation and in the context of the current interest rate environment, the rise in financing costs, and in particular IT costs, poses a major challenge, and from an operational perspective, cybersecurity and fending off cyberattacks remains crucial in the sector, and solutions relying on artificial intelligence are becoming indispensable in this. As regards regulation, the long legislative process has culminated in the implementation of the European Union's digital finance package, and the establishment of the first uniform regulatory and supervisory crypto-asset framework, the tokenisation of financial assets, the improvement of digital operational resilience of the financial sector, and the regulatory responses to new technologies, in particular artificial intelligence are expected to foster an innovative, efficient, secure and competitive single market in the EU.

Chart 1
Evolution of usage of financial applications over time



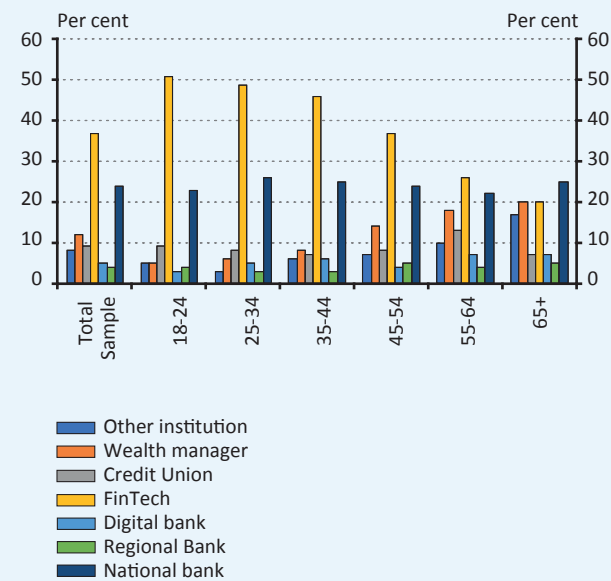
Note: The survey was conducted in the US and the UK and based on 4010 respondents.

Source: Plaid, *The Harris Poll (2022): The Fintech effect Stability, impact, and building for the future*

1.1 THE IMPACT OF THE POST-PANDEMIC REALIGNMENT ON DIGITALISATION AND THE FINTECH SECTOR

The use of digital channels that became widespread during the pandemic remained robust even after the pandemic receded, but older generations partly returned to conducting their finances in person. The use of digital solutions that became popular due to Covid-19 remained steady in the financial sector, as in 2022 four-fifths of consumers used some kind of digital device for conducting their finances. Most people mainly deal with money digitally, even after the pandemic has abated, which shows that digital devices have become the primary channel for managing finances. Although there seem to be no major differences across those using digital finance solutions in terms of income and gender, there are significant differences between generations. The use of digital channels has become more widespread than prior to 2020, but many so-called baby boomers have partly returned to administration in branches in person, despite their increasing digital awareness (Chart 1). Users mainly expect branches to help them solve their problems, but older generations also need a personal touch related to their simpler, regular financial transactions, therefore in the

Chart 2
The most reliable financial service providers by age groups



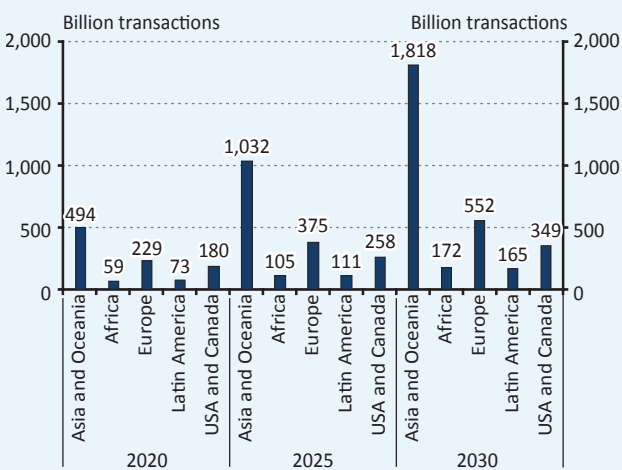
Note: Based on a survey conducted in the US involving 5368 people. Percentage of respondents who trust each company type the most when it comes to financial services.

Source: EY (2021): NextWave Consumer Financial Services research, How financial institutions can win the battle for trust

future both offline and online channels will be important, and service providers will have to take this into account.

The digital inclusion triggered by the pandemic strengthened the need for a comprehensive user experience, and in certain regions the focus of younger consumers' trust in financial institutions has shifted from traditional financial actors to FinTechs. With digital money management solutions on the rise, the customer experience is becoming a crucial aspect of financial services, and consumers have a growing need for customer service options that are available around the clock, both online and offline. To ensure a comprehensive service, financial service providers that operate digital channels because of user preferences need to offer a hybrid contact option that blends self-service digital platforms and the personal interactions with customer service agents. At the same time, there is a growing trend in consumer trust regarding FinTech, even surpassing traditional financial institutions in certain areas. Among 18–34-year-olds, half of the respondents picked a FinTech when asked about the most reliable financial service provider in their opinion, although older generations, who have more experience in day-to-day banking and money management, and probably have larger savings, still prefer commercial banks as their financial service providers (Chart 2).

Chart 3
Number of cashless transactions globally



Note: Data for 2025 and 2030 are based on projections.

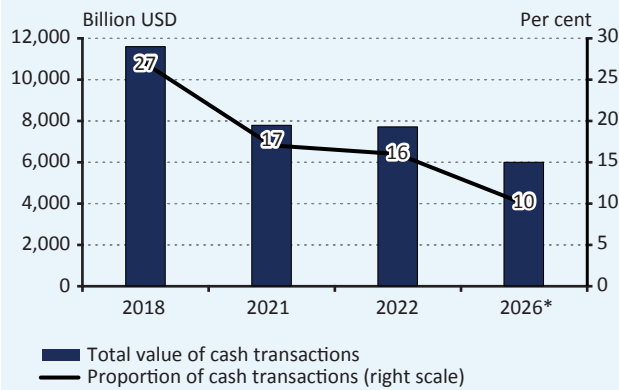
Source: PwC Strategy & global payments model, 2021

1.2 SERVICE TRENDS

The international FinTech sector has continued its dynamic growth in 2022, partly on the back of the steadily rising trend in digital payment solutions. Globally, the number of digital transactions continues to rise, and it is expected to more than double between 2020 and 2030 (Chart 3). At the same time, on account of the seemingly lasting impact of Covid-19 and the easier access to, and convenient use of, payment solutions, the cash demand for transactional purposes is gradually declining (Chart 4). This is mainly because the development level of digital payment systems, where innovation has been significantly accelerated by the appearance of FinTech firms, provides more opportunities for conducting transactions, making users' lives simpler, convenient and secure. Nevertheless, economic uncertainties have boosted the demand for cash as a precautionary reserve, consumption decreased during the pandemic, and liquid asset holdings increased.¹

¹ ECB | Cash still king in times of COVID-19

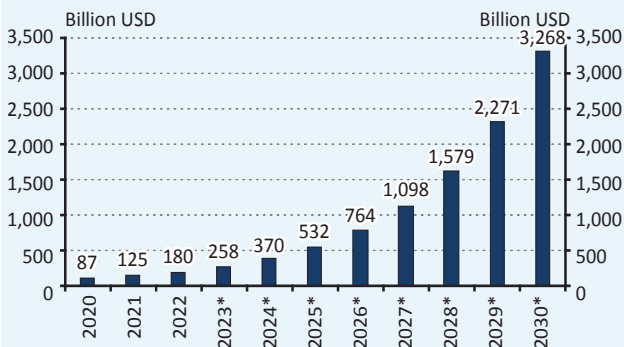
Chart 4
Evolution of global cash usage



Note: Value marked with * is based on an estimate.

Source: Worldpay from FIS, The Global Payments Report, 2023

Chart 5
BNPL market size (June 2022)



Note: Values marked with * are based on an estimate.

Source: Precedence Research, 2022

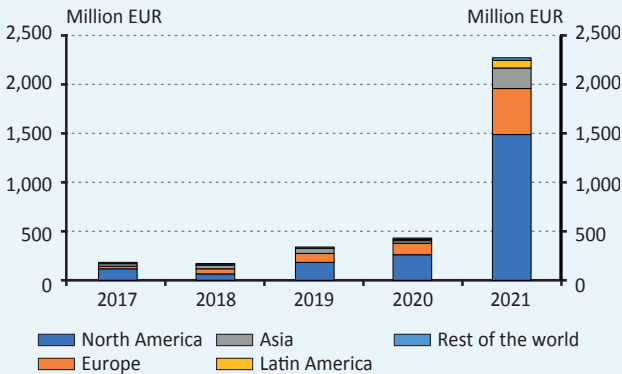
The BNPL or buy now, pay later solution has become increasingly popular, which not only encourages buyers to make instant purchases but also facilitates more purchases being completed by making the process smoother and faster (Chart 5). BNPL is a FinTech solution that enables buyers to purchase a product right away but pay for it later, usually in instalments, but in a relatively short timeframe. This novel approach is based on the fact that buyers are willing to spend more, if payment terms are more flexible and convenient. With BNPL, buyers usually get a fixed credit line that they can use to make purchases, however, the long-term viability of this scheme has come under pressure from various angles. On the one hand, growing defaults caused by the changes in the interest rate environment and the deterioration of the economic situation challenge the sustainability of this business model, and, on the other, the risk of overindebtedness, meaning that users of BNPL increasingly make their day-to-day purchases with deferred payments enabled by BNPL, has drawn authorities' attention to consumer protection risks, and this has induced regulatory changes.

The so-called embedded finance solutions help popularise BNPL. With such solutions, financial services are integrated into the apps of commercial platforms, so that the website does not need to be left during payment, and the transaction can be completed with a single click. This allows users to employ these services instantly and conveniently. Since this makes the buying process quicker, and only the first instalment of the purchase price needs to be paid upfront, users are more likely to spend more.

Since the regulatory authorities' requirements are becoming more complex, and the regulatory environment is changing dynamically, the RegTech subsegment is continuously growing. RegTech firms use advanced technologies to help their customers, financial institutions, in real-time compliance with regulatory and supervisory requirements. In this respect, the greatest challenge in the operation of the financial system is horizon scanning, monitoring the constantly expanding and changing regulatory environment.² RegTech solutions are best suited to support their clients' operations in this dimension, and to improve service providers' efforts at enhancing their efficiency.

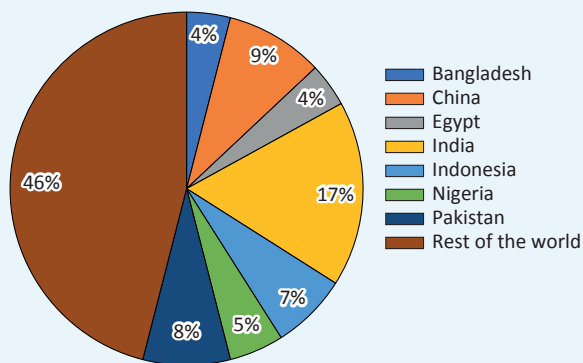
² What is set to change in RegTech in 2023? - FinTech Global

Chart 6
Investments in FinTech companies with ESG focus



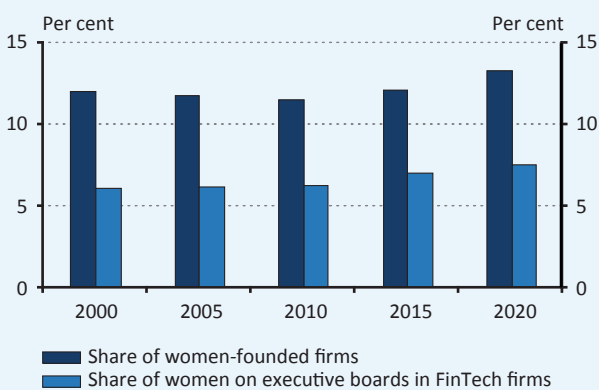
Source: KBV Research, Market Research Report, 2022

Chart 7
Distribution of unbanked adults worldwide



Source: World Bank: The Global Findex 2021

Chart 8
Proportion of female company founders and FinTech executives between 2000 and 2020 at international level



Source: IMF (2022): The digital gender gap

Facilitating ESG compliance comprises a growing share in RegTech companies' portfolio, and more and more businesses require such services. ESG (Environmental, Social and Governance) considerations need to be taken into account during business activities. In the EU, the regulatory changes related to ESG compliance define new pathways for RegTech firms. The Corporate Sustainability Reporting Directive (CSRD) adopted by the European Commission entered into force at the beginning of 2023. Pursuant to the directive, beyond a certain company size, firms will be required to collect and report ESG data from themselves, and their partners, starting from 2024.³ RegTechs in the EU operate along these lines, helping their customers meet CSRD requirements.

Investment in ESG FinTechs is growing year by year, especially in North America and Europe (Chart 6). FinTechs play a vital role in sustainability, such as fundraising with an ESG objective, ESG analytics, ESG investments, and monitoring and neutralising the carbon footprint. Innovations may reduce the approximately USD 275 trillion required for achieving a net zero economy.⁴

While ESG investments are becoming widely popular, there are global challenges regarding the social factors within ESG objectives, especially in terms of financial inclusion. 54 per cent of the world's unbanked adults live in seven countries (Chart 7). Two thirds of unbanked adults said that even if they open an account at a financial institution, they cannot use it without help. Inexperienced account holders, who need to turn to their family or a bank teller when using their account, may be more vulnerable to financial fraud. User behaviour and the lack of knowledge need to be taken into consideration while designing products, and consumers' confidence in financial service providers need to be strengthened to improve financial inclusion.

The underrepresentation of women in management positions in the FinTech sectors remains a serious challenge. Women account for less than 13 per cent in senior management, either as founders or as members of the board at FinTech firms, and this is less than at traditional banks and tech companies⁵ (Chart 8). At incumbents, this ratio is around 24 per cent. A statistical relationship can be observed between the composition of the members of the board and the financing of firms: if there are more female executives, businesses usually generate more revenue,

³ EC | Corporate sustainability reporting

⁴ McKinsey | A net-zero economy: The impact of decarbonization

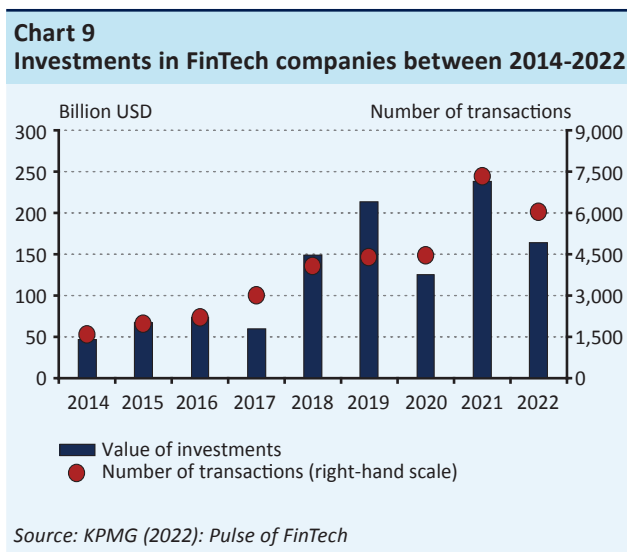
⁵ IMF (2022) | The digital gender gap

and are more likely to get financial support.⁶ However, the companies founded by women commonly make less money, and receive less financing than those established by men. Female executives routinely employ more women, offer more training opportunities to employees, and achieve higher ESG scores.

The greater use of FinTech solutions is closely related to the reduction of social, wealth and income disparities. The growing adoption of FinTech solutions can best support the reduction of wealth and income differences and the urban-rural divide. Interestingly, though, the popularisation of FinTech solutions has not narrowed the gender gap yet. The results suggest that the introduction of FinTech solutions in itself is not sufficient to remove the barriers to women's access to financial services. To improve this, besides developing FinTech solutions in general, consumers' needs and problems have to be assessed more precisely, also regulatory and incentive frameworks dedicated to the gender gap and for shaping social norms are required.

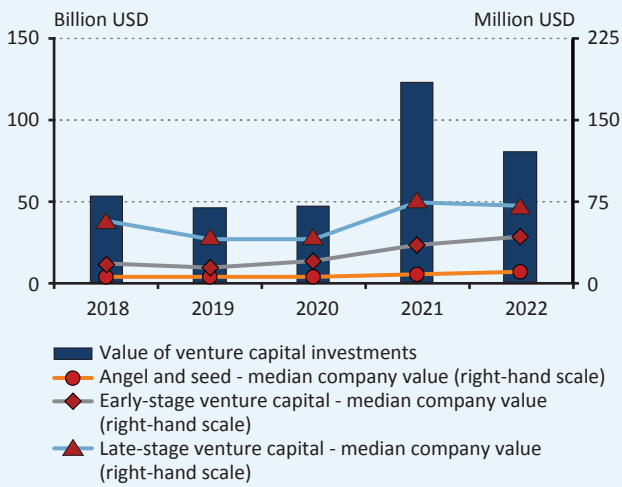
1.3 FINANCING OF FINTECH FIRMS

After record investments in 2021, 2022 saw a significant decline in the international FinTech sector. Towards the middle of the year, FinTech investments started to reflect the impact of geopolitical uncertainties, growing inflation and interest rate environment, the pressure on valuations related to this, and the drying up of the IPO market. This is confirmed by the fact that in the second half of 2022, investment value dropped by 50 per cent, compared to the first half of the year. Due to the changing economic environment, investors cancelled several mega-deals, and decision-making also slowed down, while investors started to focus on profitability and cash flow. Nonetheless, despite the more than 30-per cent contraction year-on-year, the sector ended its third best year since 2014, and the fall in financing in 2022 was smaller than in 2020, characterised by Covid-19, compared to the year preceding it (Chart 9).



⁶ EIB (2022) | Support for female entrepreneurs

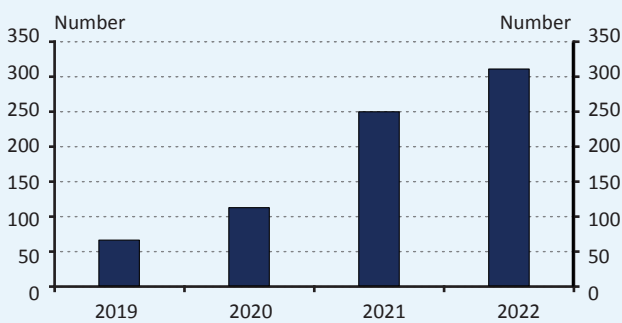
Chart 10
Venture capital investments in FinTech companies and median enterprise values at each maturity stage globally between 2018 and 2022



Source: KPMG (2022): Pulse of FinTech

The number of large investments dropped due to the uncertain macroeconomic situation, and investors either cancelled or postponed investments in firms at a mature stage. While the valuation of mature businesses came under intense pressure in the high interest rate environment, investor focus shifted towards seed capital and early venture capital investments (Chart 10). In other words, despite the uncertainty in the market, a growing trend can be observed at the early stage of maturity, which is attested by the fact that 2022 had the second largest number of transactions in recent years. While large-volume investments diminish, the shift towards smaller, encouraging investments continues to ensure the renewal of the FinTech sector by financing more smaller and new enterprises.

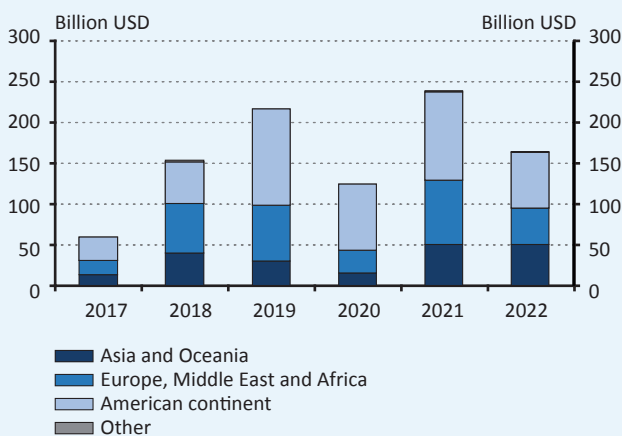
Chart 11
Number of FinTech Unicorns between 2019 and 2022



Source: CB Insights (2022): State of Fintech

The number of FinTech unicorns continued to increase in 2022, albeit at a slower pace. After the record year of 2021, the number of FinTech unicorns declined last year, and in the fourth quarter only 5 firms reached the valuation level of USD 1 billion, required to earn this distinction, which is an 87-per cent drop from 2021 Q4 (Chart 11). In terms of geographical location, the United States continues to have the most unicorns, more than in all the other regions combined. The number of mega-deals over USD 100 million also decreased by 60 per cent compared to the previous year, but in this aspect Asia and Europe together surpassed the US.

Chart 12
Global FinTech investments by regions between 2017 and 2022

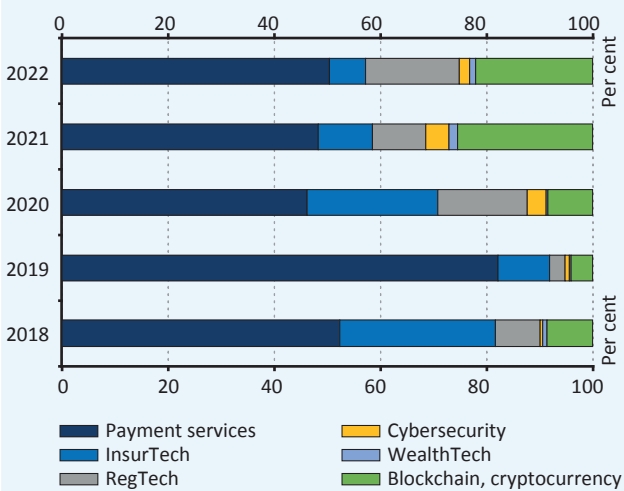


Source: KPMG (2022): Pulse of FinTech

FinTech investments reached record highs in Asia, while the Americas and the EMEA region faced a considerable decline. 90 per cent of the investments on the American continent are concentrated in the US, predominantly in seed and early-stage firms. Late-stage (mainly pre-IPO) investments were down, due to the flattening of the IPO markets (Chart 12). This trend is expected to remain unchanged as long as the global interest rate environment persists. The EMEA region, including Europe, was home to six mega-deals (worth at least USD 100 million) in the first half of the year, and none in the second. Half of the investments in the Asia-Pacific are attributable to a single transaction, the acquisition of Afterpay (for around USD 28 billion), while most investments occurred in the first half of the year here, too. Due to the tightening regulatory environment, China had its lowest volume of FinTech financing since 2013, at only USD 700 million.

When it comes to fund-raising by FinTech companies, the payment services market continues to dominate globally. Still, one of the winners of 2022 were RegTech firms, a segment where the investments almost doubled (Chart 13). Within this category, the focus is on real-time, smooth compliance solutions, which shows that businesses are looking for assistance to manage the challenges in

Chart 13
Investment in FinTech companies by segment
between 2018 - 2022



Source: KPMG (2022): Pulse of FinTech

the constantly evolving regulatory environment. Also, those RegTech solutions are spreading that are consistent with ESG compliance, and climate change objectives. A breakdown by regions shows that investments were driven by GDPR compliance in Europe, by automation and cybersecurity in the US. Crypto sector investments took a tumble in May 2022, after the crash of Terra (LUNA), and this, together with the FTX default in November (for more information on these, see Box 1), make it unlikely that crypto firms will receive significantly more investments in 2023, as many investors are working to reassess and improve due diligence and governance processes related to investments in the crypto space. The WealthTech sector also had a strong year, although there was a drop from the record highs in 2021, but investments were still worth six times what was seen in 2020.

Box 1

Crypto contagions in 2021-2022

Crypto contagion is a chain reaction of negative events in the crypto-asset market, which could trigger a wave of crashes, potentially covering the entire market. This contagion effect arises because the sudden contraction of individual crypto-assets is not limited to a given asset, as it impacts other assets, or even the entire crypto market, which entails a loss of trust in the crypto ecosystem as a whole. Crypto contagions reduced the capitalisation of the crypto market from USD 3,000 billion to USD 820 billion in a year from November 2021, an adjustment of more than 70 per cent.⁷

The first incident in the contagion was the failure of Terra blockchain, where a crypto ecosystem worth of more than USD 60 billion collapsed.⁸ The value of Terra's stablecoin pegged to the dollar (UST) was provided by a related token, LUNA, with the help of an algorithm, but when trust was undermined in the operation of the mechanism, the price of both assets suddenly crashed. The fall of one of the largest projects in the crypto market fundamentally eroded trust in the market, thereby spreading the contagion to several companies operating in this market.

The next huge falling star was Celsius, which, despite having advertised itself as a decentralised bank, was neither decentralised, nor a bank. Celsius was a crypto firm imitating the business model of a commercial bank and a crypto lending platform, where users could earn interest of up to 18% on their deposited crypto-assets, or take out a loan using their crypto-assets as collateral. These deposited crypto-assets, and those owned by users but employed as collateral, were not managed separately by the company, but instead used directly and in an unpledged form to maintain and popularise the interest rate conditions that were favourable to many people, paying the yields promised to other users from these assets, so the whole arrangement was basically a Ponzi-scheme. When the overall trust in the crypto market was undermined, this sentiment also reached the Celsius platform, and investors started to save their assets and withdraw their crypto-assets deposited at Celsius. But unlike traditional banks, Celsius was not subject to liquidity and capital allocation rules that would have ensured the funds necessary for

⁷ Coingecko: Global Cryptocurrency Market Cap

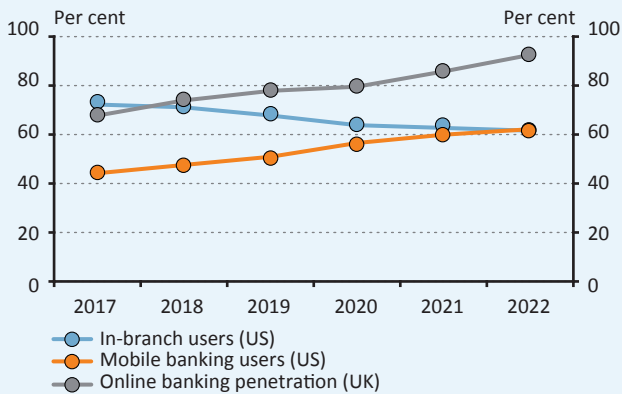
⁸ Forbes: What Really Happened To LUNA Crypto?

making the payments. Hence, the pyramid scheme collapsed, and the company filed for bankruptcy, with liabilities of USD 4.7 billion to users.⁹

The next in the wave of defaults was FTX, one of the world’s largest crypto-asset trading platforms. FTX, which, incidentally, operated by flaunting even basic accounting and corporate governance rules, lent crypto-assets worth USD 10 billion to the Alameda Research fund, whose CEO and main shareholder was the same person, but, in a fraudulent manner, the loan was financed from crypto-assets owned by the users of the crypto exchange.¹⁰ The collateral behind the loan was their own FTT token, which was considered illiquid when it comes to market trading, and which, according to their illegal accounting, was worth more than the entire market capitalisation of the crypto-asset, so it seemed as if the loan had adequate collateral. When a wave of withdrawals - similar to what was seen at Celsius - arose at the FTX platform, the value of the crypto-asset used as the collateral for the loan declined sharply, and users lost a major portion of their own assets, even before their redemption attempts. As in traditional markets brokers are required to separate customer assets from the company’s other assets, such withdrawal or exchange waves are usually manageable, but, in the absence of an appropriate crypto-asset regulation, there were no such restrictions for FTX.

The wave of crashes was influenced by several factors, including cross-contagion between various actors and markets, a loss of confidence, huge leveraged transactions, and straight-out fraud. Many companies went bankrupt, and millions of investors lost their savings. Although the young age of the crypto market suggests that these bankruptcies are novel, they actually resemble well-known features from the financial market (e.g. bank runs, securitisation), where the materialisation of potential risks can be mitigated by the regulations in place. In the absence of a crypto-asset regulation, the market’s self-regulation proved to be insufficient. This shows that this new asset class needs to be regulated. This approach would not only protect investors but also could promote the development and stability of an innovative market.

Chart 14
The proportion of users of digital banking and bank branch services



Note: In-branch banking users include bank account holders who visit a bank and see a representative in person at least once per year; mobile banking users include those who use a mobile phone to access their bank account at least once per month.

Source: Insider intelligence (2022), Finder (2023): Digital banking statistics

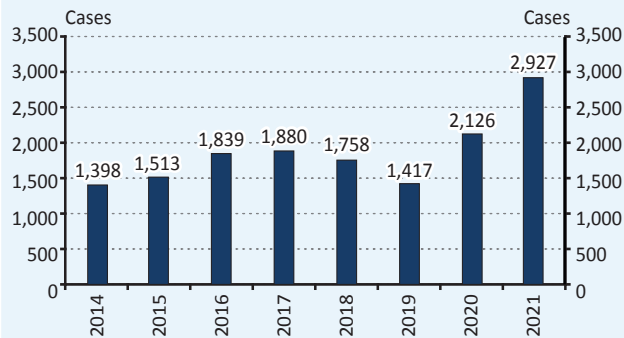
1.4 LANDSCAPE ON BANKING DIGITALISATION AND FINTECH COOPERATION

Digitalisation is on the rise among bank channel users. In the US, 2022 was the first year when the share of bank customers using mobile banking at least once a month (62.1%) was higher than those visiting a branch for administration at least once a year (61.5%). The penetration of online banking also shows a growing trend, with 93% of the population in the UK affected in some form (Chart 14).

⁹ Coindesk: The Fall of Celsius Network: A Timeline of the Crypto Lender’s Descent Into Insolvency

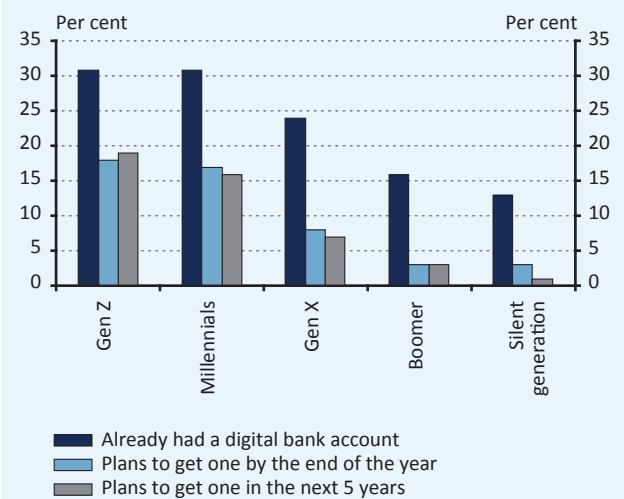
¹⁰ NYTimes: Why Did FTX Collapse? Here’s What to Know.

Chart 15
US bank branches' net closings



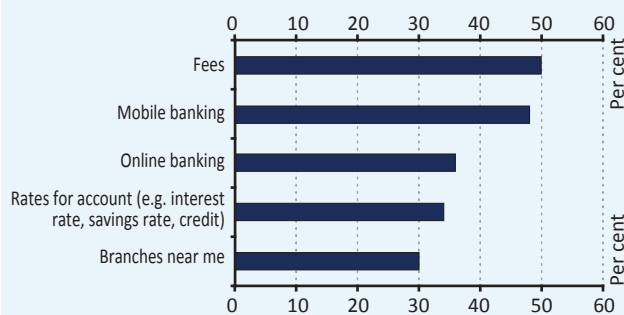
Source: S&P Global Market Intelligence (2022)

Chart 16
Clients with digital bank accounts by age groups



Source: Finder (2023): Digital banking statistics

Chart 17
Main Factors taken into account when choosing a financial service provider

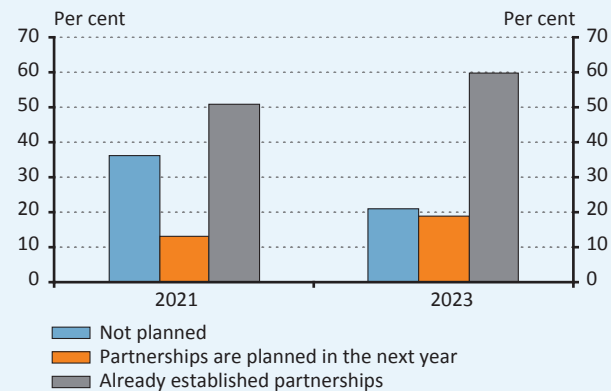


Source: Insider Intelligence (2022)

The change in the habit of visiting bank branches as mobile banking channels are on the rise can also be observed in the evolution of the number of branches. Also in the US, the diminishing number of branches suggests that banks are responding to the changes in demand, and start to focus on servicing customers digitally. In 2021, there were net 2,927 branch closures, which is the highest figure since 2014, 38% higher than in the previous year, marking another record (Chart 15). The closures and the changing way how customer needs are met is probably attributable to the realignment caused by the pandemic and cost optimisation. This also means that the demand for digital-only accounts has increased, although customers are motivated by other factors than institutions. In the UK survey, the main motivating factors behind opening a digital-only account were opening a secondary account (besides an existing one), the convenience offered by the full range of services available digitally, and better pricing. Of course, the digital-only account was not equally important across all age groups, with the youngest, Generation Z and Y (the latter also referred to as the Millennials) the most affected (31% each), and they are also the ones who are most likely to choose this option in the years to come. The older, so-called silent generation is also worth mentioning, because they are the most sensitive to branch closures, and currently 13 per cent have some kind of digital-only account (Chart 16).

The shift to digital services can also be traced in banks' strategies. As a result, the role of branches is being reviewed, and new branches are mostly opened in locations where banks believe that this caters to a specific need, as a form of marketing activity, or a means for acquiring new customers. In existing branches, the focus is shifting towards VIP customers, where personal administration is a way to build customer trust. The change in branch use behaviour can also be detected in another aspect: in the US, half of the respondents believe that the fees for account keeping and related services are the most important when choosing a bank, while the proximity of branches is less of a defining factor (Chart 17). At the same time, the activities of bank branches are shifting to services relating to digital availability and administration supported by digital devices other than just account opening and basic administrative tasks.

Chart 18
Evolution of partnerships between banks and FinTech companies



Note: The survey was carried out by executives from financial institutions globally.

Source: Digital Banking Report (2023)

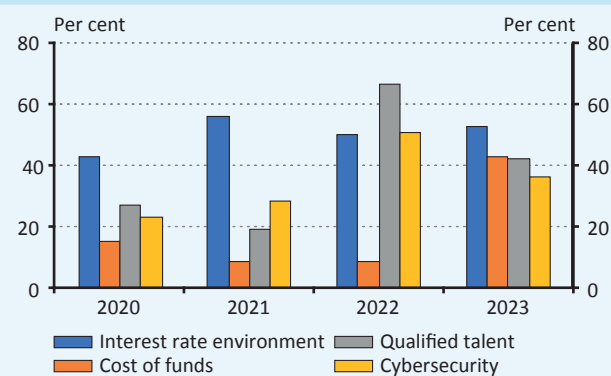
Chart 19
Main areas of FinTech and banking cooperations



Note: The survey was carried out by executives from financial institutions globally.

Source: Digital Banking Report (2023)

Chart 20
General challenges banks faced with



Note: The survey was carried out by executives from financial institutions globally.

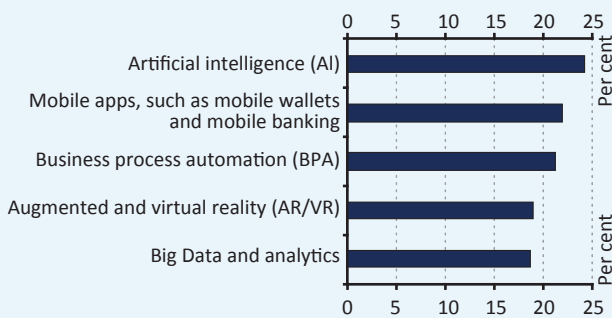
Source: Cornerstone Advisors (2023)

Digital transformation encourages banks to develop their services, and FinTech partnerships are a part of this. Digitalisation challenges reveal development needs that banks cannot fully meet in-house, and third-party businesses offering innovative solutions can also be of assistance in identifying needs. In 2021, 51% of participating banks had a FinTech partner,¹¹ while in 2023 60% did so, and institutions openness towards creating new partnerships is gradually increasing (Chart 18). Three main strategies can be identified in connection with these third-party partnerships, depending on banks’ motivation for collaboration. Operational efficiency-improving technology partnerships are the most widespread, where banks plan to develop existing processes, such as account opening or lending, based on the infrastructure already in place. There are also customer-oriented partnerships, where the main motivation behind the collaboration is to improve customer interactions and the user experience (UX). Here, banks develop their services in cooperation with third-party players, and FinTech firms only come into contact with customers indirectly (through banks). The third approach comprises frontend partnerships, referring to forms of collaboration where the frontend platform is developed by the FinTech firm, which also acts as the point of contact for the customers, while banks are responsible for providing the banking infrastructure. This includes banking-as-a-service (BaaS) solutions, although this is not as dominant yet as the other two.

Using their FinTech partnerships, banks focus on allowing customers to initiate more services digitally. This is consistent with the finding of a bank executive survey that account opening and lending are the most threatened by the lack of digitalisation, and the loss of customers is the highest where a subsegment of the service is not available digitally. And there is a considerable push from customers for personalized offers and financial management that banks assess with data-driven marketing activities (Chart 19).

¹¹ Digital Banking Report (2023) Retail Banking Trends and Priorities 2023

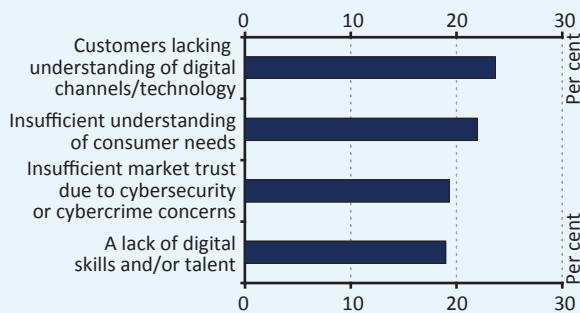
Chart 21
Main technological development areas expected by bank executives in the next two years



Source: Economist Impact (2022): Threat Assessment 2022

Note: Based on a survey of 300 bank executives

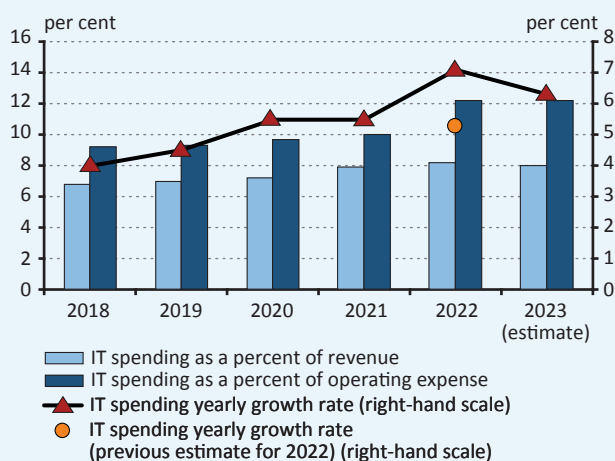
Chart 22
Barriers to technological development according to bank executives



Note: Based on a survey of 300 bank executives

Source: Economist Impact (2022): Threat Assessment 2022

Chart 23
Development of banking IT costs by year



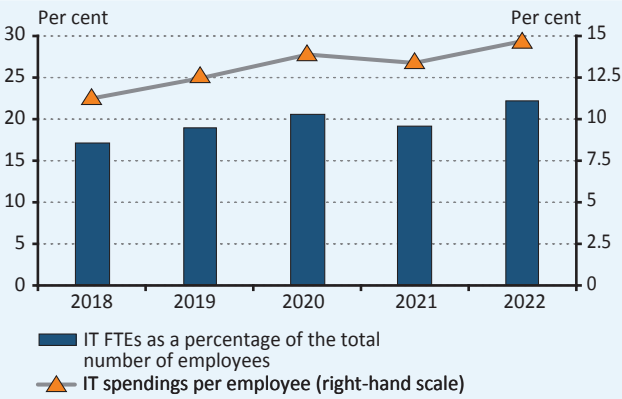
Source: Gartner (2022): IT Key Metrics Data 2022:

However, the digital transformation is hampered by various factors, and from banks' perspective the main challenges of the near future are the rise in financing costs and the interest rate environment (Chart 20). Growing financing costs generally impede the costly technological developments of the FinTech sector as well, and this is compounded by the difficulties in attracting the appropriate IT expertise. Cybersecurity threats are also on the rise, which may put pressure on institutions from the cost side.

The main technological development directions are connected to artificial intelligence, digitalisation, automation and data analysis (Chart 21). However, the implementation of these innovative solutions involves several obstacles, mostly comprising customers' limited competencies in IT solutions, and the insufficient knowledge about customer needs. Moreover, the implementation of IT solutions also entails rising cybersecurity threats and the recruitment and retaining of IT experts that can manage these challenges (Chart 22).

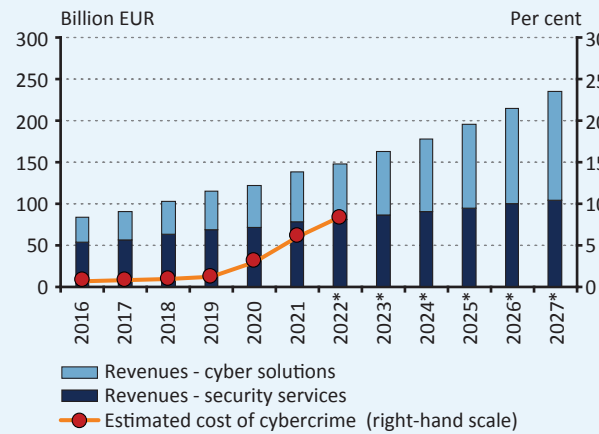
Digital transformation also affects banks' cost structure by making IT areas and developments more and more resource-intensive. IT costs are increasingly growing within operating costs, with 2022 marking an outlier, as the growth rate of global IT costs climbed from the 5.3 per cent planned in the previous year to 7.1 per cent, and the financing needs of IT areas rose more than expected. After this outlier figure in 2022, slower growth was projected for 2023, but IT costs will continue to represent a large share of operating expenses (Chart 23). The focus on IT areas generated a greater need for employing experts. After lower headcount demand in the pandemic, 2022 saw a renewed increase in employee numbers, the share of the cost per employee was also up, and overall, a rising cost ratio can be detected in the IT area (Chart 24).

Chart 24
Evolution of costs related to banking IT resources



Source: Gartner (2022): IT Key Metrics Data 2022

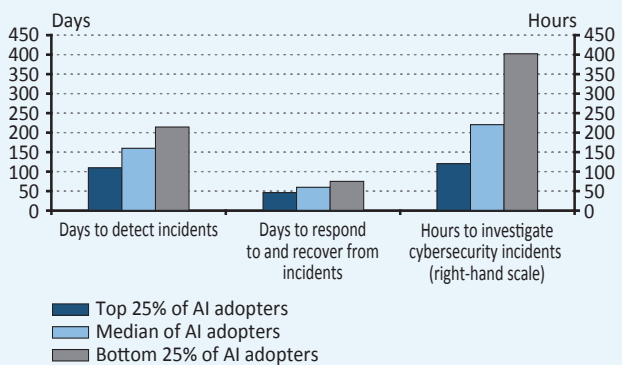
Chart 25
The revenues of the global cybersecurity industry and estimated cost of cybercrime in proportion of global GDP



Note: Years marked with * are based on estimates. The right-hand scale is in proportion of world GDP.

Source: ECB Financial Stability Review

Chart 26
Recovery time from cyber-attacks by AI adopter cybersecurity services



Source: IBM - AI and automation for cybersecurity, 2022

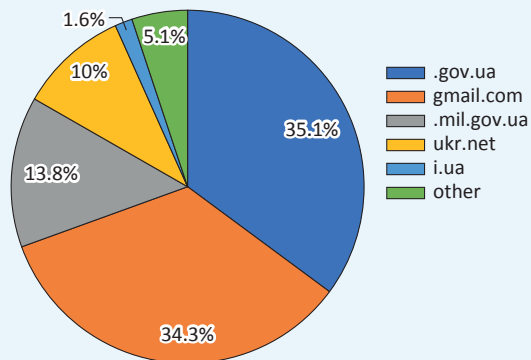
1.5 CYBERSECURITY CHALLENGES

If cybercrime was a national economy, it would be the third largest in the world, which could pose an enormous threat to the stability of the financial system. The intensity and complexity of cybercrime activities is growing, which places pressure on financial institutions to develop processes and systems preventing attacks, to detect potential threats in a timely and appropriate manner, and to introduce mitigation mechanisms and measures. The rising trend in cybercrime is also reflected in the increase in the estimated costs related to the sector, which amounted to 8.44 per cent of world GDP in 2022 (Chart 25).

AI solutions are widely used in cybersecurity operations, and 93% of cybersecurity executives already use or consider using artificial intelligence. Automated, AI-based security models can detect irregular behaviour, assess vulnerabilities and pinpoint harmful activities (Chart 26). The use of AI entails considerable cost savings and more efficient protection, as it can reduce data leaks, which lowers costs by at least 18%. Furthermore, the return on security investments is 40 per cent higher in the case of AI-based solutions.¹² Since AI solutions are also widely used by attackers with malicious intent, continuously implementing developments and automating certain processes related to cyber protection are key, when it comes to AI-based security solutions to ensure more secure and cost-effective cybersecurity processes.

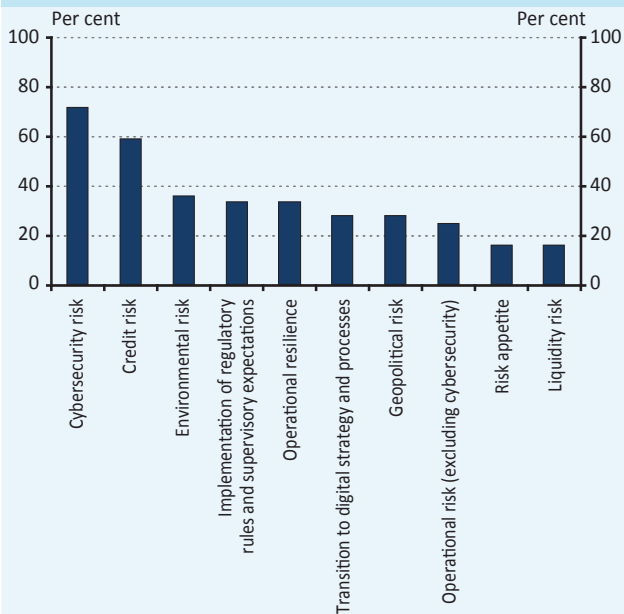
¹² IBM (2022) AI and automation for cybersecurity

Chart 27
The most frequently cyberattacked domains in Ukraine



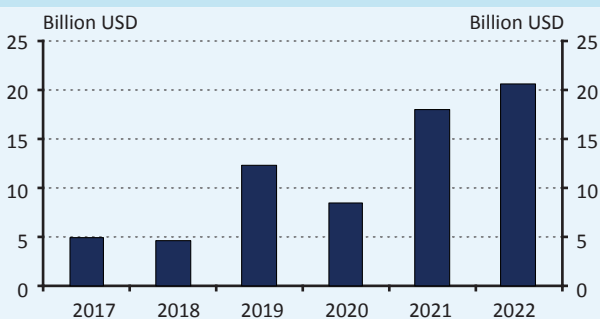
Source: Threat Analysis Group: Fog of War, 2023

Chart 28
Top 10 risk priority for 2023 by CRO-s



Source: IIF (2023): 12th Annual EY-IIF Bank Risk Management Survey

Chart 29
Total crypto-asset value received by illicit addresses



Source: Chainalysis (2023): Crypto Crime Report

In Eastern Europe, the line between financially and

politically motivated cyberattacks is increasingly blurred related to the Russia–Ukraine conflict. In the past year, Russian criminals have significantly increased the number of attacks against Ukrainian users (Chart 27), and more than tripled their attacks against users in NATO countries. Between 2021 and 2022, Russia targeted more than 150 military, government and diplomatic organisations and critical infrastructures.¹³

According to the latest data, banks' risk officers (CROs) consider cybersecurity risk as their most important challenge (Chart 28). Banks have spent billions of dollars on the cybersecurity of core systems and vital data assets, but cyberthreats are still among the top concerns. Nevertheless, most risk management officers at European banks pointed to geopolitical risks as the number one threat for 2023, as they can significantly affect banks' business activities and profitability, and entail further cybersecurity risks.

Further heightening geopolitical tensions, the illicit use of crypto-assets increased by 13% in 2022, with 43% of this comprising digital wallets used for money laundering¹⁴ sanctioned by OFAC¹⁵ (Chart 29). In connection with the money laundering use of crypto-assets, special attention is paid to mixer smart contracts, which conceal the origin and owners of individual crypto-asset balances by mixing users' assets.

¹³ Fog of War How the Ukraine Conflict Transformed the Cyber Threat Landscape (2023)

¹⁴ Chainalysis (2023) The 2023 Crypto Crime Report

¹⁵ Office of Foreign Asset Control

	Type	Description
Stablecoins	electronic money token	a type of crypto-asset that purports to maintain a stable value by referencing the value of one official currency
	asset-referenced token	a type of crypto-asset that is not an electronic money token and that purports to maintain a stable value by referencing another value or right or a combination thereof, including one or more official currencies
	other crypto-assets	other crypto-assets not falling into the above categories, in this context MiCA mentions the utility token which is a type of crypto-asset that is only intended to provide access to a good or a service supplied by its issuer

Source: MNB based on MiCA.

financial instruments (including crypto-assets qualifying as financial instruments, e.g. tokenised securities)
deposits, including structured deposits
funds, except if they qualify as e-money tokens
securitisation positions
certain insurance products
certain pension products
unique and non-fungible crypto-assets (i.e. NFTs)
tokenised central bank digital currencies
decentralised finance (DeFi) protocols
decentralised autonomous organisations (DAOs)
lending of crypto-assets

Source: MNB based on MiCA.

1.6. REGULATION OF THE FINTECH SECTOR, ITS DEVELOPMENT, AND FURTHER REGULATORY EFFORTS

In the European Union, the modernisation of the uniform digital financial regulation started in September 2020, and resulted in the adoption of three major laws regarding regulation of crypto-assets and digital financial instruments using the distributed ledger technology, and the strengthening of the digital operational resilience of the financial sector: MiCA, DLT Regulation and DORA.

The first, cross-jurisdictional, uniform European Union regulation on markets in crypto-assets (MiCA)¹⁶ entered into force in the second quarter of 2023, as part of the Digital Financial Package. The aim of the Regulation is to create the long-awaited uniform legal framework and the rule of law in the European market for crypto-assets, ensure consumer protection and market integrity, and mitigate risks threatening financial stability. In addition, it seeks to support innovation entailed by the new asset class, thereby improving the competitiveness of the EU. Certain stipulations of MiCA will apply from 12 months after it entered into force, and following the 18-month preparatory period, from the end of 2024, the Regulation will be binding in its entirety, being directly applicable in all Member States.

The Regulation covers a major part of the crypto-assets issued, and crypto-asset services offered in the European Union, but not all of their types. It defines a crypto-asset as a digital representation of a value, or of a right, that can be transferred and stored electronically, using distributed ledger technology, or similar technology, and defines three categories thereof (Table 1). Besides the introduction of these categories, it should be noted that although MiCA significantly reduces the regulatory uncertainty related to instruments using distributed ledger technology, it does not cover the full range of innovative solutions, as many popular crypto-assets and Web3 solutions with a growing user base fall outside the scope of the Regulation as of now (Table 2). As regards the classification of the individual crypto-assets under MiCA, the European Securities and Markets Authority will develop guidelines within 18 months of the Regulation's entry into force, and by the same deadline, the Commission will prepare a report on the latest developments in crypto-assets, examining, among others, the necessity of regulating issues currently not covered by the Regulation.

¹⁶ Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on markets in crypto-assets, and amending Regulations (EU) No 1093/2010 and (EU) No 1095/2010 and Directives 2013/36/EU and (EU) 2019/1937

Table 3
Authorisation requirements to offer crypto-assets to the public and to seek their admission to trading

Type	Authorisation requirements
asset-referenced token	authorisation by the competent authority of the home member state is required or no further authorisation is required for credit institutions complying with Article 17 of MiCA, however, notification to the competent authority and the approval of the crypto-asset white paper by the competent authority is required or other persons upon the written consent of the issuer
electronic money token	only credit institutions or electronic money institutions, and notification of a crypto-asset white paper to the competent authority and publication of the crypto-asset white paper is required or other persons upon the written consent of the issuer
other crypto-asset	no authorisation required

Source: MNB based on MiCA.

Table 4
Main elements of a crypto-asset white paper

- information about the offeror or issuer
- the description of the project
- information about the related rights and obligations
- information on the underlying technology
- description and call for attention about the risks of the crypto-asset
- information regarding the negative impacts on the environment and climate
- a statement of completeness regarding the document

Source: MNB based on MiCA.

MiCA places a substantial regulatory and preparatory burden on market participants with respect to the issuance, public offering, and admission to trading of crypto-assets, as well as to the provision of crypto-asset services. Offerors and persons seeking admission to trading can only be legal persons, and the authorisation requirements of the public offering or admission depends on the asset type concerned (Table 3). Due to their significance, issuers of asset-referenced tokens face stringent prudential and governance requirements, and in addition to general rules, e-money tokens and their issuers are also subject to extra requirements. Furthermore, the Regulation lays down special requirements for asset-referenced and e-money tokens that are classified as significant based on their user base, market capitalisation, or the number of transactions conducted.

Crypto-asset service providers, wishing to provide services in the European Union, may only do so with a licence, following the transitional period determined in MiCA. In their case, in addition to the guarantee rules similar to those discussed at the issuers of asset-referenced tokens, strict requirements apply to the custody of clients' assets, outsourcing activities, and orderly wind-down. Similarly to "traditional" financial services, licensed service providers need to register with the competent authority of their home Member State, and may passport their licence, so they can offer their services cross-border in all European Union Member States. Beyond the general requirements, the Regulation stipulates additional unique conditions for the provision of certain crypto-asset services, such as different requirements pertaining to the operation of crypto-asset trading platforms, and the provision of advice on crypto-assets, and the portfolio management of crypto-assets.

Providing appropriate information to future crypto-asset holders as consumers is treated as a priority in the Regulation. As a general rule, issuers need to prepare a fair and clear, readily understandable white paper, covering marketing communications, and the topics determined in the Regulation (Table 4), and it also has to be published and notified to the competent authority of the home Member State. In certain cases, the Regulation does not require the preparation and publication of the white paper for general crypto-assets, for example, when the crypto-assets are offered for free, generated automatically as a reward for maintaining the distributed ledger, or the number of users affected by the offering or the total value of crypto-assets offered is below the limits stipulated in the Regulation.

Table 5 Obligations of crypto-asset service providers	
Originator	Beneficiary
<ul style="list-style-type: none"> – The crypto-asset service provider of the originator shall ensure that the transfer is accompanied by the following information on the originator: <ul style="list-style-type: none"> – the name of the originator – the originator’s distributed ledger address/ account number (if applicable) – the originator’s address, official personal document number and customer identification number, or the originator’s date and place of birth – the name of the beneficiary – the beneficiary’s distributed ledger address/ account number (if applicable) – Prior to the execution of transfer, the crypto-asset service provider verifies the accuracy of data. 	<ul style="list-style-type: none"> – The crypto-asset service provider of the beneficiary shall implement effective procedures in order to detect whether the information on the originator and the beneficiary is included in, or follows, the transfer of crypto-assets. – The crypto-asset service provider shall verify the accuracy of the information on the beneficiary prior the execution of the payment. – The crypto-asset service provider shall apply effective risk-based procedures in order to determine whether to execute, reject or suspend the incomplete transactions and what follow-up actions are needed to be performed (e.g. request for data) – In case of repeated failure to provide the necessary information, the crypto-asset service provider, among others, may send a warning, rejects the future transfers and reports to the competent authority.

Source: MNB based on TFR.

MiCA also contains special provisions on preventing market abuse related to crypto-assets. The Regulation enacts the prohibition of market manipulation as well as insider trading tailored to the features of crypto-assets. Besides that, it requires the persons professionally arranging or executing transactions in crypto-assets to have in place systems and procedures to prevent and detect market abuse. With respect to the supervision of the activities that fall under the scope of the Regulation, national competent authorities (NCAs) work in close cooperation with the European Banking Authority and the European Securities and Markets Authority, and have broad rights, ranging from conducting on-site inspections to the suspension of trading in crypto-assets violating the Regulation.

To prevent fraud related to crypto-assets, and especially money laundering and terrorist financing, the regulation on the information accompanying transfers of funds (TFR)¹⁷ was also reviewed. The revised provisions are designed to ensure the traceability of crypto-asset transactions, and will become directly applicable in all Member States at the same time as MiCA. Similarly to transfers of funds, transfers of crypto-assets will also be subject to the so-called “travel rule”, as referenced in the recommendations of the Financial Action Task Force (FATF), which requires that if any of the crypto-asset service providers initiating or receiving transfers on behalf of customers is established in the EU, information on the originator and beneficiary must be collected and verified, and when suspicious transactions are detected, they shall be made available to authorities (Table 5).

In a certain sense, the monitoring of crypto-asset transfers will be subject to more stringent requirements than transfers of funds. In the case of crypto-asset transactions, the travel rule will apply without a threshold, which is a significant difference for this asset class compared to general transfers of funds, where this rule is only applicable above EUR 1,000. But if the crypto-asset transfer is received in or originates from the private, unhosted (i.e. not hosted by a provider), crypto wallet of the user, the transaction value becomes important, because above EUR 1,000, service providers need to verify whether the wallet is actually controlled by the user. The Regulation allows only a few exceptions to these requirements, for example the travel rule does not apply to the payment of taxes with crypto-assets, transfers between private wallets without using a service provider as an intermediary, or to own transfers between crypto-asset service providers.

¹⁷ Regulation (EU) 2015/847 of the European Parliament and of the Council of 20 May 2015 on information accompanying transfers of funds and repealing Regulation (EC) No 1781/2006

Box 2**Crypto-assets in the focus of regulators' attention – not only in the European Union**

Although the negative events affecting crypto-asset service providers from the past year have not yet spread to the traditional financial system or the real economy, decentralised finance (DeFi) and traditional finance (TradFi) are increasingly closely linked to each other, and potential risks can reach unprecedented levels. Therefore, quick and comprehensive action is needed from global regulators regarding crypto-assets, and a supervisory framework needs to be established.

When it comes to the regulation of crypto-assets, there are three potential solutions at the international level: prohibiting certain activities with crypto-assets, the isolation of crypto-assets from TradFi and the real economy, and the regulation of the sector similar to TradFi. These three directions are not mutually exclusive, they can be implemented alongside each other to mitigate the risks arising from activities involving crypto-assets. The main consideration when deciding which solution to apply is the enforceability of the existing or planned rules, including the availability of the necessary resources.

Crypto-assets require a uniform, global regulatory framework because the market is also global, reaching beyond independent and isolated systems in separate jurisdictions. This can be supported by the proposal of the FSB (Financial Stability Board) on the international regulation of crypto-assets and stablecoins published in October 2022, which states that due to the ever closer links between DeFi and TradFi, a regulation along the principle of “same activity, same risk, same regulation” needs to be established, thereby ensuring a competitive and secure ecosystem.

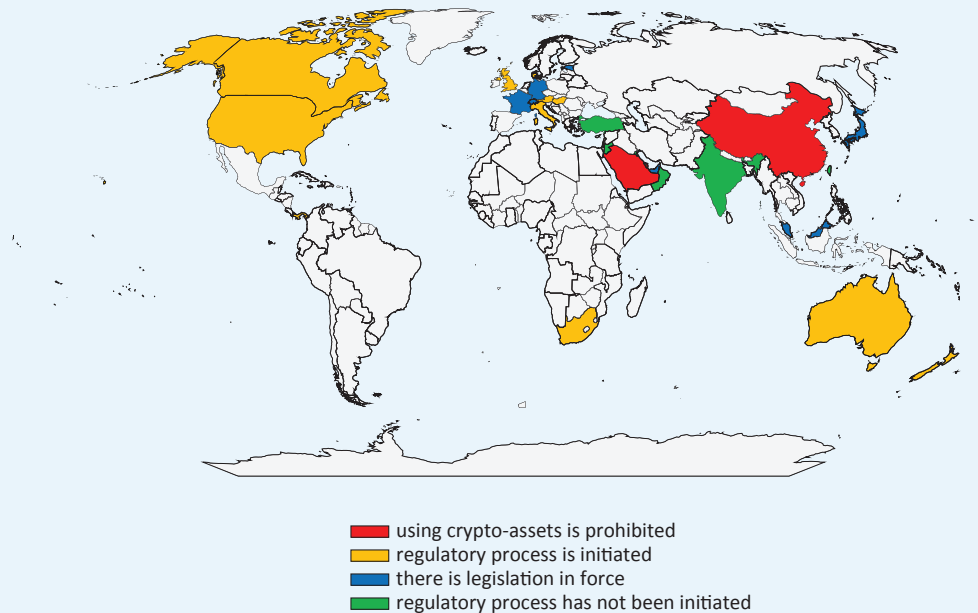
The crucial nature of regulatory action is shown by the fact that national and international approaches (outside the EU) vary widely, and the work on determining legal framework for crypto-assets is now under way, albeit the pace of this work varies, too (Table 6). In 2022, many national authorities treated the establishment of the legal framework for crypto-assets a regulatory priority, and in certain cases they have expressed an intention to become global hubs of innovation, technology and crypto-assets (Chart 30). In 2021, China declared that it would deem mining of virtual assets illegal, in effect prohibiting financial activities linked to crypto-assets and the related services. Saudi Arabia and Pakistan also decided to prohibit these in 2017 and 2018, respectively, but they recently set up committees to develop the regulation of crypto-assets. However, several authorities and international organisations have isolated crypto-assets from TradFi and the real economy. For instance Argentina, Indonesia, Indonesia and Mexico limit how financial institutions can provide services related to crypto-assets. Finally, numerous authorities stated their intention in the past year to regulate crypto-assets. In February 2023, the UK announced that it would extend the provisions of the prevailing Financial Services and Markets Act to crypto-assets, and the United States also made it clear that it would take steps in this area.

Table 6
Rules in connection with crypto-assets in different countries

Country	Anti-Money Laundering (AML) /Counter-Terrorist Financing (CFT)	Travel rule	Stablecoins
United Kingdom	Yes	Yes	Pending final legislation
Switzerland	Yes	Yes	Yes
United States of America	Yes	Yes	Pending final legislation
Saudi Arabia	The country prohibits the use of crypto-assets		
United Arab Emirates	Yes	Yes	Yes
Australia	Yes	Process initiated or plans communicated	Process initiated or plans communicated
China	The country prohibits the use of crypto-assets		
Hong Kong	Yes	No	Process initiated or plans communicated
India	Process initiated or plans communicated	No	No
Japan	Yes	Yes	Yes
Singapore	Yes	Yes	Process initiated or plans communicated

Source: PwC Global Crypto Regulation Report 2023

Chart 30
Regulations of crypto assets at national level in certain parts of the world



Source: PwC Global Crypto Regulation Report 2023

Type	Description
DLT multilateral trading facility (DLT-MTF)	a multilateral trading facility that only admits to trading DLT financial instruments
DLT settlement system (DLT-SS)	a settlement system that settles transactions in DLT financial instruments against payment or against delivery, and that allows the initial recording of DLT financial instruments or allows the provision of safekeeping services in relation to DLT financial instruments
DLT trading and settlement system (DLT-TSS)	a DLT MTF or DLT SS that combines services performed by a DLT MTF and a DLT SS

Source: MNB based on DLTR.

Financial instrument	Limitations
shares	the issuer has a market capitalisation, or a tentative market capitalisation of less than EUR 500 million
bonds, other forms of securitised debt (including depositary receipts in respect of such securities), or money market instruments	issue size is less than EUR 1 billion excluding those that embed a derivative or incorporate a structure which makes it difficult for the client to understand the risk involved
units in collective investment undertakings covered by Article 25(4), point (a)(iv), of MiFID II	the market value of the assets under management is less than EUR 500 million

Note: For the purposes of the above limits, the moment of admission to trading or the moment of recording on a distributed ledger is relevant.

Source: MNB based on the DLTR.

Being part of the digital financial regulation package, the DLT Regulation created the legal opportunity for financial market participants to tokenise financial instruments and to gain experience with the distributed ledger technology. The regulation on a pilot regime for market infrastructures based on distributed ledger technology¹⁸ is directly applicable in its entirety in all Member States from 23 March 2023, and it has created the so-called DLT pilot regime.

While MiCA, presented above, will regulate crypto-assets not classified as financial instruments, the DLT pilot regime aims to improve the efficiency of trading and post-trading processes by creating the category of tokenised assets qualifying as financial instruments (DLT financial instruments). The tokenisation of financial instruments and the use of the distributed ledger (typically blockchain) technology during their issuance, recording, transfer and storage could bring new, innovative solutions to the market and it can create enhanced transparency, wider access for investors, and greater competition in trading and settlement services, thereby improving their efficiency by creating a secondary market for digital assets.

The pilot regime acts as a regulatory sandbox, and offers a limited, six-year exemption and derogation option from the provisions of certain EU laws for the new types of market infrastructures developed for DLT (Table 7). Pursuant to the provisions of Directive 2014/65/EU (MiFID II), Regulation (EU) No 600/2014 (MiFIR) and Regulation (EU) No 909/2014 (CSDR), already licensed or new entrant market participants can receive a six-year exemption from certain requirements in the relevant EU legislation that would otherwise hamper the spread of innovative technology. The legislation includes a detailed and limited list of the applicable exemptions and their conditions, and by setting uniform requirements, it ensures the rule of law and flexibility for market participants that wish to operate DLT-based market infrastructures, even as a cross-border service. Only DLT-based financial instruments are allowed to be admitted to trading or recorded on the distributed ledger by the operators of these infrastructures, and the Regulation also defines limits for the eligible instruments by type and value (Table 8). Besides these unique limits, the aggregated market value of all DLT-based financial instruments admitted to trading on a DLT market infrastructure or recorded on a DLT market infrastructure shall not exceed EUR 6 billion.

¹⁸ Regulation (EU) 2022/858 of the European Parliament and of the Council of 30 May 2022 on a pilot regime for market infrastructures based on distributed ledger technology, and amending Regulations (EU) No 600/2014 and (EU) No 909/2014 and Directive 2014/65/EU

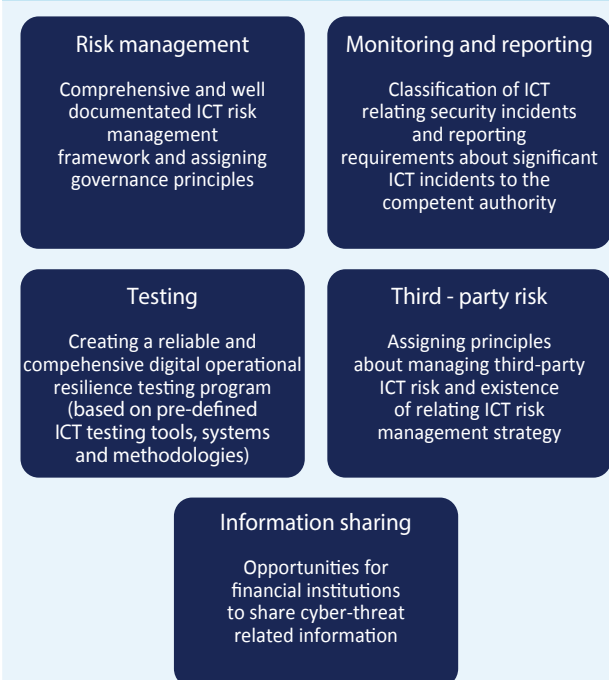
EU legislators have recognised that the financial sector increasingly relies on information and communication technologies, which could make financial organisations more vulnerable to cyberattacks, therefore strengthening the digital operational resilience of the financial sector is vital. An attack targeting financial services or a disruption in the densely connected financial sector, which is key from the perspective of the real economy, could have far-reaching consequences on other companies, sectors, or even the economy as a whole.

To manage the above challenges in the financial sector, the Digital Operational Resilience Act,¹⁹ or DORA, entered into force on 16 January 2023, also as part of the Digital Financial Package. Previous regulatory and supervisory expectations in the EU regarding operational resilience in digital space had serious shortcomings. The inconsistent law enforcement led to unique approaches in different Member States, which considerably hindered the establishment of effective safeguard mechanisms. The uniform regulation addressing these problems, DORA, offers a sector-level response from EU legislators to the growing need for operational resilience, and requires that financial organisations have adequate resilience to disruptions and threats related to information and communication technologies (ICT). The Regulation will be mandatory and directly applicable in all Member States from 17 January 2025, and much preparatory work awaits all players in the financial sector until this deadline.

DORA introduces uniform rules for the detection of cyberattacks and for managing potential operational disruptions, thereby promoting trust in the digital financial system. The Regulation aims to ensure that the participants in the EU's financial systems have safeguards necessary for mitigating cyberattacks during their operation that increasingly relies on digital technologies, and that they are able to manage digital security incidents and threats during potential ICT disruptions without any interruption of service. By virtue of a consolidated version, DORA is expected to create more coherent and consistent mechanisms in detecting and reporting incidents across the EU, which could reduce financial institutions' administrative burden, and strengthen supervisory efficiency. This could ultimately promote trust in the financial system and safeguard its stability.

¹⁹ Regulation (EU) 2022/2554 of the European Parliament and of the Council of 14 December 2022 on digital operational resilience for the financial sector and amending Regulations (EC) No 1060/2009, (EU) No 648/2012, (EU) No 600/2014, (EU) No 909/2014 and (EU) 2016/1011

Chart 31
The five pillars of DORA - the main requirements



Source: MNB based on DORA.

The new rules apply to a broad range of organisations involved in providing financial services, including incumbents and innovative service providers, taking into account the principles of proportionality. DORA covers traditional financial organisations (e.g. credit institutions and insurers) and innovative service providers (e.g. crypto-asset service providers and issuers). It also takes into account third-party risks, which are increasingly relevant in servicing customers and operating systems, and it formulates provisions regarding ICT risk management, the contractual agreements between ICT providers and financial organisations, as well as the rules of engagement between the supervisory framework of critical third-party providers and competent authorities (Chart 31). Due to the principle of proportionality, the requirements are aligned with the risks and needs consistent with size, and the features of the business profile. The new legal framework is also innovative in that it provides for the modernisation of international security and ICT risk management standards.

Table 9
Obligations to providers, users and other parties of high risk AI systems

Legal obligations required by the proposal	Obligations of providers	Obligations of importers	Obligations of distributors	Obligations of users
Establishing of a risk management system	x			
Requirements for regarding training, validation and testing data	x			
Technical documentation	x	x	x	
Record keeping	x			
Transparency and provision of information to users	x			
Human oversight	x			
Accuracy, robustness, cybersecurity	x			
Quality management system	x			
Compliance assessment process	x	x		
Registration obligation	x			
Notifying of national competent authority	x			
CE marking of conformity	x	x	x	
Compliance with the instructions for use				x
Consider relevance of input data				x
Monitoring the system according to the instructions for use				x
Retention of logs automatically generated by the system				x
Execution of data protection impact assessment				x

Source: PwC (2022): *The Artificial Intelligence Act demystified*

The European Union continuously examines how the emerging and developing innovative solutions and their uniform regulation in the EU can improve the competitiveness of the EU, therefore EU regulators' agenda includes a review of the European Digital Identity, and the uniform regulation of artificial intelligence systems as well. (For the review of the regulation of Digital Identity, see Box 3.)

Nowadays, the financial sector increasingly uses technological solutions based on Artificial Intelligence (AI), within the systems of incumbents and FinTech firms alike. In this context, the main areas of application of AI include fraud prevention, combating money laundering, customer identification, and identity verification. Having recognised the potential competitive advantage offered by artificial intelligence, the European Union has committed itself to using reliable artificial intelligence and prepared regulatory proposal on AI solutions used in this area.

The reliability embodied in artificial intelligence operating under human supervision in a lawful, ethical, technically stable, transparent, and accountable manner is the cornerstone of the regulatory proposal. The framework sought to be established contains three pillars that need to be implemented while developing, promoting and using AI systems. The technology has to be legally sound, in other words, it has to comply with the prevailing laws; it has to be ethical, so it has to ensure compliance with ethical norms based on basic laws; and it has to be stable from a technical and social perspective, too, so it cannot cause undue damage. Legislators would also like to ensure the rule of law to facilitate investments and innovation in artificial intelligence, and thus, promote the competitiveness of the European Union. After its adoption, the Regulation will be mandatory and directly applicable in all Member States.

The proposal has an extraterritorial scope, and uses a horizontal, non-sector-specific regulatory approach. It covers providers installing AI systems in the EU, users within the EU, and even providers and users in third countries if the response generated by their AI system is used in the EU. However, the regulation does not apply to the AI systems developed or used solely for military purposes, or to law enforcement AI systems used by third countries and international organisations.

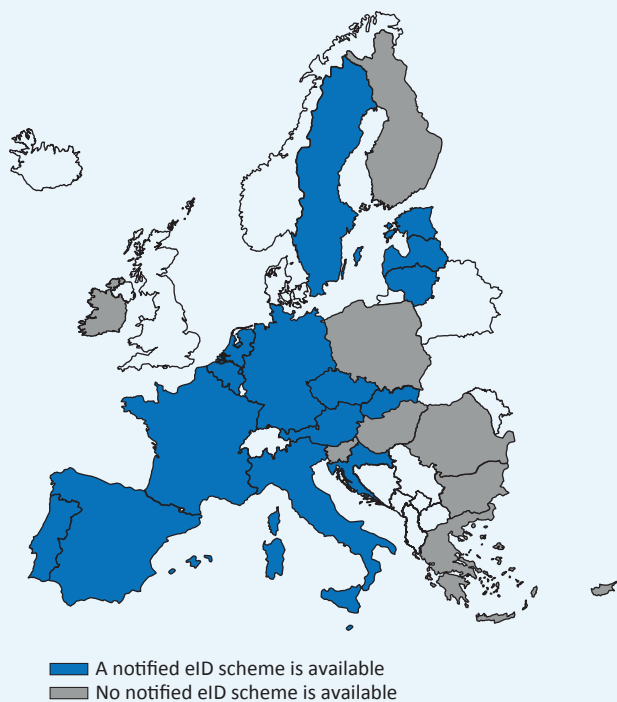
The proposal regulates AI systems based on the scope of autonomous decision-making and the extent of independent activities, using a risk-based approach at four levels, and it stipulates many obligations about their development, entrance to market, and use. (Table 9) The top of the regulatory pyramid includes prohibited artificial intelligence practices, while the bottom level of the pyramid contains low-risk AI systems that do not require any intervention. Between these two, there are limited-risk, and high-risk AI systems, which the proposals aims to make reliable by prescribing requirements aligned with the risk level.

Box 3

Change of paradigm on the European Digital Identity

In the European Union, a new market environment is emerging that the current, fragmented digital EU identity system can no longer manage efficiently. Innovative use cases would require not only simple identification, but

Chart 32
Notified eID solutions in the European Union



Source: European Commission.

also the sharing of characteristics and features connected to the digital identity. Nonetheless, the current regulation is not flexible enough to support these new needs, market participants have limited options to join the system, and not all Member States have an electronic identification (eID) solution that is recognised across borders (Chart 32). Therefore, the co-legislators' agenda includes the review of the eIDAS Regulation²⁰, and the establishment of a single European digital identity framework.

The new digital identity framework seeks to create an interoperable, secure and harmonised European Digital Identity Wallet (EUDI Wallet), that is universally accepted in the public and private sector across borders in the EU, and ensures a high level of user control over data. The wallet is an electronic identification functionality stored on mobile phones, that operates based on common EU technical standards, and is issued by Member States, or by service providers recognised by a Member State after a compulsory certification, offering all European Union citizens and companies a secure and convenient way to identify themselves in the European Union with the click of a button when they use digital or "offline" services. Besides identification, the wallet will also be capable of creating certified electronic signatures and

stamps, and to accept, store, manage, share and transmit identity information and attributes and IDs, from various Member States and reliable private sources (e.g. driving licence, medical information, medical certificates, certificates

²⁰ Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC

of education or training, professional licences), while offering users extensive control and oversight regarding the transmitted data, for example, with an option of tracking the information shared with third parties in a sort of transaction history. To ensure broad availability, the wallet will be issued free of charge, however, according to the current draft, the providers may charge a fee for certain identification and authentication services.

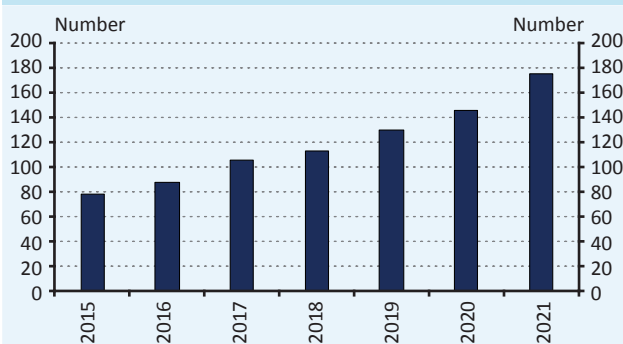
The European Digital Identity Wallet is expected to make using certain financial services simpler, faster, and more efficient for users. For example, when it comes to a loan application at a bank, instead of the current multi-stage administration process, the wallet could facilitate conducting the identification, the transfer of the documents necessary for the loan application (already available in the wallet), and the signing of the contract fully online.

In parallel with the legislative action, the work on the practical implementation of the identity wallet has also started. In February 2023, the Commission issued the technical specifications to lay the foundation for the common software standards necessary for the development, and it also encourages the implementation of the most important use cases related to the EUDI Wallet under a pilot programme, that is planned to start in the first half of 2023, and is co-financed with EUR 50 million.

2 Domestic FinTech sector

The Hungarian FinTech ecosystem has continued to strengthen. In 2021, 175 active businesses operated in Hungary, mainly offering B2B services. In terms of the distribution by company size, micro and small enterprises continue to dominate the FinTech landscape. Most FinTech services experienced growth, financial software development and system integration and payment services continue to be most active areas. The number of people employed in the Hungarian FinTech sector increased at an exceptional rate across all segments, so no major changes were observed in the distribution of services compared to previous years. Despite the uncertainty in the market during the pandemic, sales revenue increased considerably in 2021, and for the first time in years, the number of businesses with rising sales revenue was also expanding, and at the same time, the efficiency of the companies in the market also improved from previous years. A look at the life cycle of Hungarian-owned companies shows that one third of FinTech businesses have received venture capital investment. At the beginning of their life cycle, such firms have a longer preparatory period with lower profits, followed by a dynamic growth in profitability and the headcount.

Chart 33
Number of domestic, operating companies involved in FinTech activities



Note: Companies that submitted accounts to the National Tax and Custom Authority (NTCA) at least for 2021 are shown.

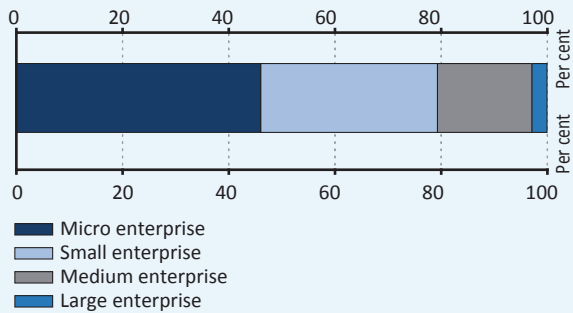
Source: NTCA, MNB.

2.1 ANALYSIS OF THE DOMESTIC FINTECH SECTOR BY COMPANY SIZE AND NUMBER OF EMPLOYEES

The growth in the Hungarian FinTech market continues: in 2021, 175 active businesses operated in Hungary. In the second year of the pandemic, digitalisation improved further, which offered a growing business potential for FinTech firms, so, besides mergers and liquidations, the Hungarian FinTech landscape steadily expanded. The companies engaged in FinTech activities were identified after automatically visiting and analysing in detail the websites of all the potential companies, based on the group of companies filtered on the basis of the relevant definition, submitting annual accounts for 2021, and actively operating in 2022²¹ as well (Chart 33). Some new businesses are FinTech start-ups, while others are subsidiaries of long existing firms with an international presence. Most Hungarian FinTechs, 85 per cent of such companies, have a B2B (business-to-business) focus, however, their share shows a decreasing trend as the market matures.

²¹ In our analysis, the Hungarian FinTech sector comprises only of companies with a Hungarian tax number, operating in a corporate form and active in 2022 (in their case, the latest available annual reports – and thus our assessment – refer to 2021). For details on the identification methodology, see the MNB FinTech and Digitalisation Report 2020, Box 3.

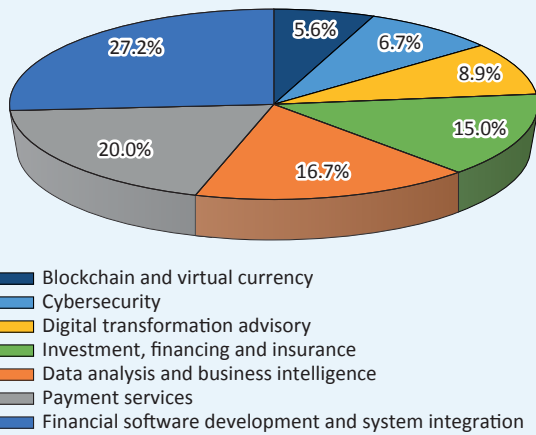
Chart 34
Distribution of FinTech companies by company size (2021)



Note: Company size was determined on the basis of the 2021 reports and year-end or annual average staff number data.

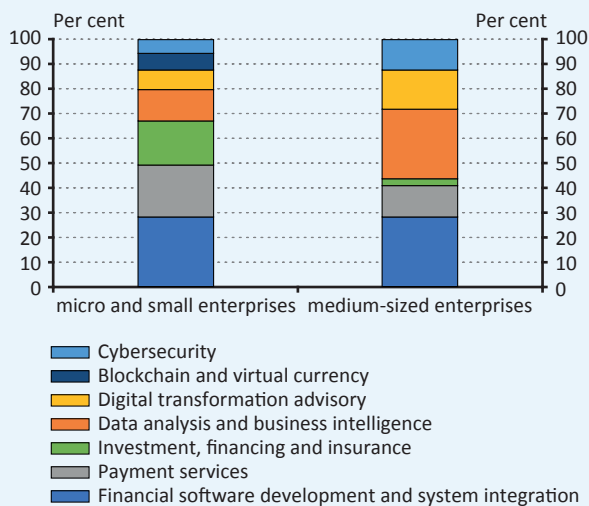
Source: NTCA, MNB.

Chart 35
Distribution of FinTech companies by service scope (2021)



Source: NTCA, MNB.

Chart 36
Distribution of the number of FinTech companies by company size and services provided (2021)

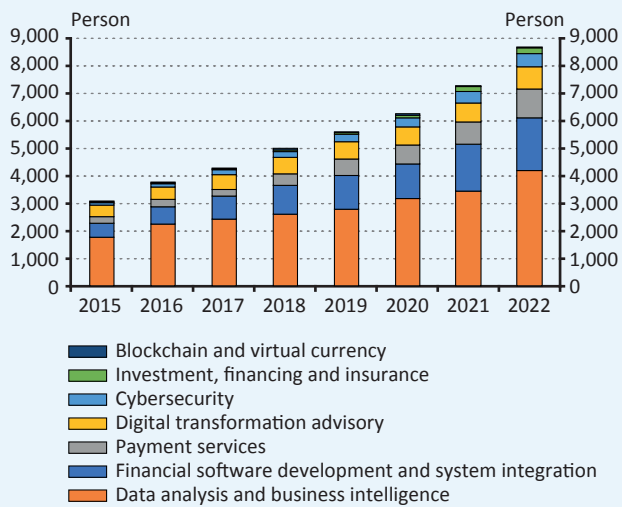


Source: NTCA, MNB.

More than three quarters of the Hungarian FinTech sector comprises micro and small enterprises. In line with the trend from previous years, micro and small enterprises continued to dominate in 2021, with a combined share of around 80 per cent (Chart 34). Continuous growth was influenced by the fact that the proportion of micro enterprises increased by 5 per cent between 2020 and 2021. The high share of micro and small enterprises can be observed at both Hungarian- and foreign-owned FinTechs. It is worth mentioning that there are fewer large Hungarian-owned FinTech companies: while micro enterprises account for 55% of the domestically owned FinTech sector, medium-sized enterprises represent only 13%. However, this is not true of foreign-owned businesses: there are more small and medium-sized enterprises in Hungary than micro enterprises. Larger corporations typically venture into FinTech as a supplementary or new activity, and they are also older, while smaller companies are usually established with a FinTech focus, and are also younger.

Almost all FinTech services experienced growth considering the number of companies, with financial software development and payment services being the most active areas. In 2021, most businesses operated in financial software development and system integration (Chart 35), which represents the persistent cooperation with incumbents. There were 11 newcomers to this sector, bringing the total of the major companies offering FinTech services to more than a quarter of the sector. In relative terms, FinTechs providing investment, financing, and insurance services showed the greatest growth, with predominantly micro and small enterprises (Chart 36). In contrast to earlier trends, there was no change in the number of cybersecurity firms, which reduced the share of this subsegment, mostly comprising medium-sized enterprises, to 6.7% (from 8.2% earlier). Over the course of the past three years, the data analysis and business intelligence segment experienced a small but steady decline: their share diminished from 20% to 16.7% between 2019 and 2021, mostly comprising medium-sized enterprises. The Hungarian FinTech sector shows moderate but steady activity in blockchain and virtual currencies, and the firms that operate actively in this segment are still rather small and medium-sized ones.

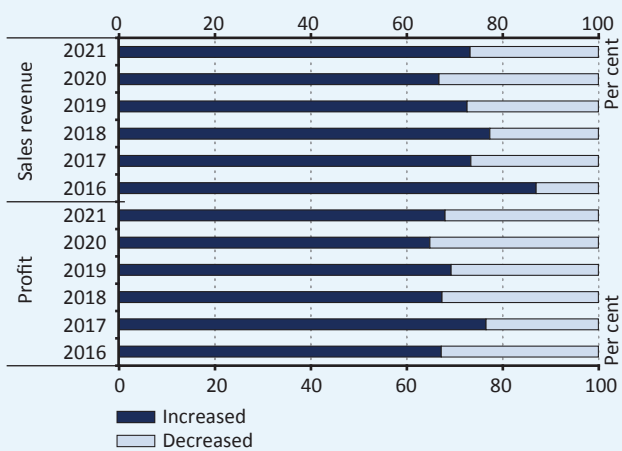
Chart 37
Distribution of the number of employees by service scope at domestic FinTech companies



Note: The data from 2021 has been adjusted from the figures shown last year. The data depicted shows the annual average for each year.
Source: NTCA, MNB.

In 2022,²² the headcount in the FinTech sector grew at unprecedented rates in several service scopes. Continuing the trend from previous years, dynamic expansion was seen in FinTech firms’ employment data in 2022 (Chart 37): The number of people employed in the sector almost tripled between 2015 and 2022, with the combined headcount of the FinTech sector growing by 20% between 2021 and 2022 alone. The growth of the ecosystem is consistent with international trends. The ranking of services remains unchanged: data analysis and business intelligence firms employ the most workers, in contrast to their proportion in terms of the number of businesses, accounting for more than half of the sector’s growth. When looking at the change across years, only blockchain experienced a contraction in headcount in 2022, with 20% fewer employees registered as an annual average. In line with the change in the number of businesses, the rise in the headcount in the investment, financing, and insurance market is also outstanding, with the number of employees up by 23% from 2021.

Chart 38
Breakdown by number of players in the domestic FinTech sector by year-on-year change in revenue and profit after tax



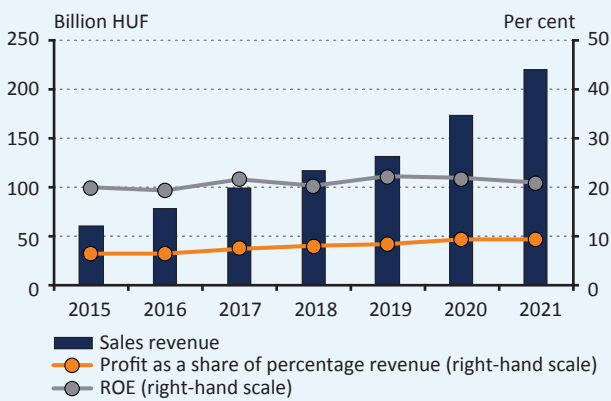
Note: The set of companies examined is the set of companies that have filed reports for two consecutive years. For this reason, companies reporting for the first time in 2021 are not included in the graph.
Source: NTCA, MNB.

2.2 SALES REVENUE AND PROFITABILITY OF THE DOMESTIC FINTECH SECTOR

For the first time since 2018, the share of companies with growing sales revenue is expanding again, with more than 73% of such firms in the second year of the Coronavirus. Despite the uncertain market sentiment in 2021, the FinTech sector was characterised by a massive rise in sales revenue (Chart 38): the overall sector-wide sales revenue was over HUF 220 billion, up by HUF 50 billion. The companies with a growing sales revenue were able to increase their earnings by HUF 421 million on average and a median value of HUF 150 million, which are almost double than the figures from 2020. The average growth in the profits after tax for such firms is over HUF 150 million, while the median value was HUF 41 million in the same period, meaning that companies were able to operate more efficiently on the market than in the previous year.

²² Unlike the other information under review, the headcount is already available for 2022.

Chart 39
Development of sales revenue and profitability of the FinTech sector



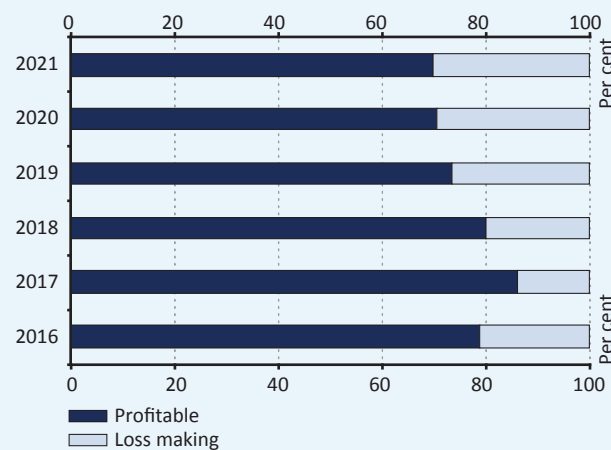
Source: NTCA, MNB.

The sector-wide return on equity (ROE) was similarly high in 2021 as in 2020. After record ROE figures in 2019, this indicator of the sector remained over 21% in 2021 (Chart 39). FinTechs’ cumulative equity rose by more than five times as much (HUF 26.5 billion) as their aggregate profits (HUF 5.1 billion), which clearly shows the extent of the capital raised in the market. The steep rise in sales revenue and high ROE are heavily influenced by foreign-owned corporations, but smaller Hungarian businesses also boast high profitability. Return on sales, which quantifies efficiency, did not change much from 9.3% in 2020, which suggests that companies continued to focus on steady and stable growth.

Two-thirds of Hungarian FinTechs were profitable in 2021.

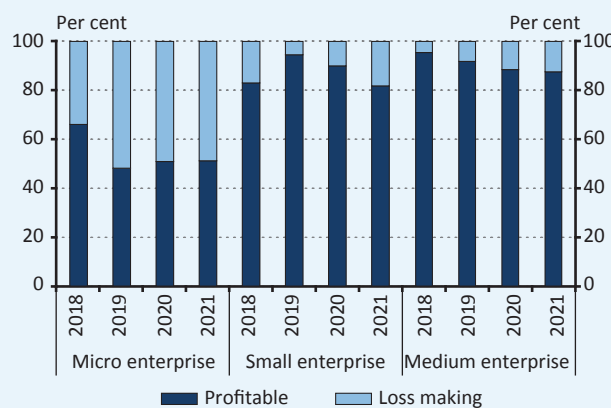
Although the share of profitable firms in the sector was down marginally from 2020 (Chart 40), most companies ended the year in the black. The small contraction was attributable to the fact that half of the new businesses were unable to generate profit in the initial period. Although the number of micro enterprises in the FinTech market soared in 2021, this did not impact the share of profitable firms: in 2021 half of the micro enterprises generated profits (Chart 41). The greatest change was observed in small enterprises, where the share of profitable players diminished by 8 percentage points, but this segment remains consistently over 80%. Similar to earlier years, medium-sized enterprises were predominantly able to generate a profit in 2021. By international standards, the Hungarian FinTech sector stands out with its profitability, probably because Hungarian companies mostly have a B2B focus, and they are not characterised by exceptional growth dynamics, as businesses often have a more stable and moderate growth path.

Chart 40
Annual change in the performance of FinTech firms between 2016 and 2021



Source: NTCA, MNB.

Chart 41
Distribution of profitable and loss-making companies in the domestic FinTech sector by size



Source: NTCA, MNB.

Box 4**The MNB at the Singapore FinTech Festival**

The Singapore FinTech Festival (SFF) was held for the seventh time in 2022, and the MNB and its subsidiaries participated as co-exhibitors. Similar to earlier years, the MNB once again played an active role at the world's premiere FinTech event with 500 exhibitors and 60,000 visitors from 110 countries. In 2022, the central topic was "Building Resilient Business Models amid Volatility and Change", and the presentations of the three days focused on this.

The SFF provided an excellent opportunity for networking and knowledge transfer. The MNB and its subsidiaries, the Budapest Stock Exchange (BSE), Giro Zrt., MNB-EduLab and the Budapest Institute of Banking (BIB), shared a booth at the event, welcoming hundreds of visitors from all over the world, and representatives engaged in professional discussions and even business negotiations with them. The official opening of the booth was attended by Sopnendu Mohanty, the chief FinTech officer at the Monetary Authority of Singapore (MAS) and Deputy Governor Dr Mihály Patai. The possibility to appear at the forum was also an advantage to the Hungarian FinTechs in attendance. MNB Chief Digital Officer Anikó Szombati headed the panel discussion "Smart just like the Rubik's Cube: High-growth FinTechs from Hungary" at the festival's World Fintech Festival stage, where FinTech firms that started operating in Hungary and successfully entered Asia shared their experiences that led to their international achievements. At the panel discussion "Regulators Coffee Chat – The Need for New Credit Models for lending to SMEs", Deputy Governor Patai shared his thoughts about the relationship between the state and the SME sector. Péter Fáykiss, the head of the Digitalisation Directorate of the MNB, talked with international experts about the necessity of new skills related to strengthening financial digitalisation in a chat called "Addressing the New Skills Gap in Financial Services".

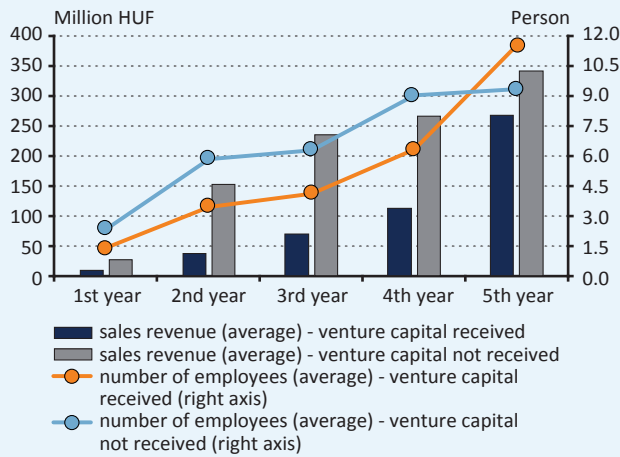
There were several special events related to the SFF with the participation of the MNB, where the bank's high-level delegation was headed by Deputy Governor Dr Mihály Patai. At the second Hungary–Singapore FinTech Business Forum, Hungarian FinTechs present in Asia and major players from the Singaporean FinTech sector discussed the main technological and policy challenges. At Capital Meets Policy Dialogue, internationally acclaimed regulatory executives met business leaders successful in the digital industry and the financial sector to talk about the role of central banks in digitalisation, the importance of the cooperation between the public and the private sector, and the current challenges in the FinTech market.

2.3 VENTURE CAPITAL INVESTMENT IN THE DOMESTIC FINTECH SECTOR

One-third of FinTechs established in the past ten years have received venture capital investment. The development paths of the approximately 70, mostly Hungarian-owned FinTech micro, small and medium-sized enterprises established between 2014 and 2021 were reviewed with an approach of whether they received venture capital at any time, and their management was traced in the first five years of their operation.²³ In this aspect, a comprehensive picture can be given of the early stages of the life cycle of domestically owned companies operating in Hungary, and the similarities and differences of the operating conditions of venture capital funded and non-venture capital funded FinTech companies can be identified. Around one-third of

²³ The sixth year could not be examined because the Hungarian FinTech ecosystem is still young, so the base that could be observed diminished considerably from the sixth year, and did not offer an opportunity to draw meaningful conclusions.

Chart 42
Average revenue and number of employees of FinTech companies by age and venture capital investment

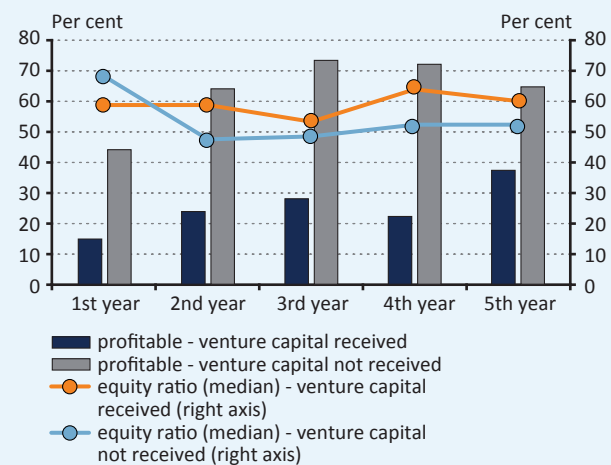


Source: NTCA, MNB.

the businesses under review have received venture capital investment at least once, typically at the end of their second year. Among the FinTechs established since 2019, there are more and more that have received venture capital, and micro enterprises in particular dominate this segment.

The firms that have received venture capital are characterised by slower, but later accelerating growth rather than by dynamically expanding, high revenues from the beginning. The businesses operating with venture capital initially grow at a slow pace, looking for the most profitable segment and niche market, taking greater risks, probably due to solid capital support. This strategy seems to pay off in the long run, as in the fifth year of operation, they start to catch up in terms of sales revenue to those that do not receive venture capital. The latter choose a relatively safer path, targeting profitable operation even at the start of their life cycle (Chart 42). In later stages, the companies that received venture capital grew at an outstanding rate, which is reflected in the growth of the average headcount: at five years, they reached a turning point, and surpassed their peers operating without venture capital.

Chart 43
Profitability and equity ratio of FinTech companies by age and venture capital investment



Note: Equity ratio is defined as the ratio of median equity to total assets.

Source: NTCA, MNB.

At the beginning of the life cycle of the companies that received venture capital, the main goal is dynamic growth optimized for a longer period, instead of profitability. They have a unique perspective, as continuously high liquidity allows them to develop somewhat slower but at a steady pace. The disruptive corporate model usually focuses on gaining market share and outstanding growth, which is made possible by repeated capital raising. The share of profitable venture capital-driven companies jumps in the fifth year (Chart 43), which is when returns start to come in, and it is expected to last for years. The businesses that forego venture capital exhibit more stable operations with lower liquidity but a higher profit rate. Overall, regarding venture capital endowed companies, the raised capital's impact on their growth can be felt in the long run, while those without venture capital become profitable earlier, but their growth in headcount and revenue is less dynamic later on.

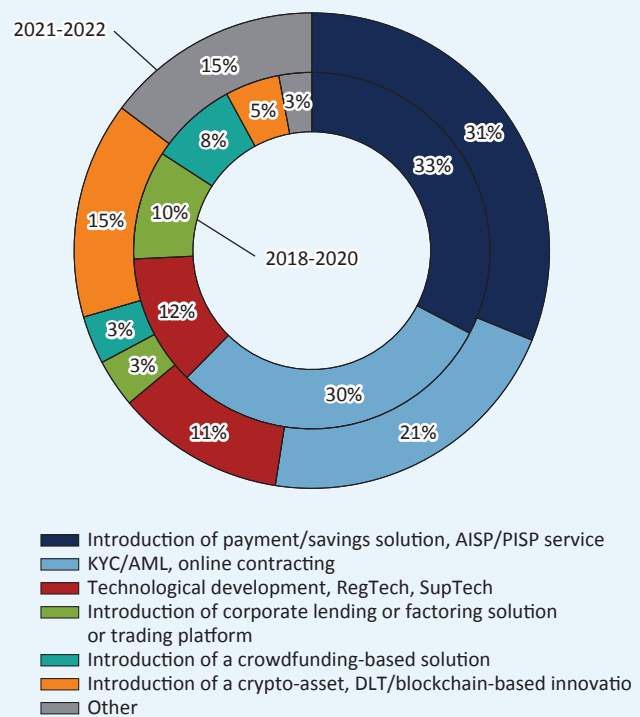
Box 5

The Innovation Hub, the MNB's regulatory support platform has been in operation for five years

In order to strengthen the Hungarian FinTech ecosystem, the MNB encourages and actively supports the initiation and adoption of innovative but safe novelties that strengthen digitalisation and international competitiveness in the Hungarian market. In March 2018, the central bank launched its financial innovation platform that serves as the forum for direct and flexible communication with innovators. The MNB Innovation Hub has been promoting the development of the Hungarian market with quick and professional responses given to regulatory questions related to innovative solutions for five years now. The one-stop shop Innovation Hub provides proactive guidance to both Hungarian and foreign innovative market participants, being an active player of the international innovation ecosystem and a member of the Global Financial Innovation Network (GFIN).

The direct connection to the regulator provided by the platform and the openness to market needs is appreciated by innovators; during its operation, the Innovation Hub was able to provide help in the dilemmas related to market participants' innovative solutions in more than 160 enquiries. As regards the topics of the enquiries, several complex questions have been received covering multiple topics in the recent years, but interest in payment services has remained high. And as the focus of innovation shifts, the related trends evolve, and the situation and development of the regulatory environment in certain areas changes, the distribution of the topics reflects this (Chart 44). For example, as robust and clear regulation regarding customer identification and combating money laundering as well as crowdfunding has been established, the share of enquiries has gradually shifted towards less regulated but increasingly popular topics such as innovative solutions related to distributed ledger technology, for example crypto-assets and tokenisation.

Chart 44
Enquiries distribution by topic directed to the Innovation Hub



Source: MNB.

3 Digitalisation level of the Hungarian banking sector

According to the results of the MNB’s digitalisation survey covering more than 90 per cent of the domestic banking system in terms of balance sheet total, the digital maturity of Hungarian banks continues to show an improvement, though on a smaller scale, compared to previous years, but despite the continuous institutional development of digital maturity, the banking sector as a whole has not yet moved away from the medium level of maturity. Of the 7 pillars of the survey, the so-called management pillar, which indicates the continued and outstanding commitment of institutions’ executives to digitalisation, remains the strongest. Compared to the previous year, a substantial progress was seen in the workflow and client pillars, with the domestic banks paying particular attention to the digitalisation of customer-side and internal processes during 2022. However, the gradual improvements in banking products mean that by the end of 2022, not only current account opening but also personal loan applications became available digitally in all credit institutions offering these products, while there is still room for improvement in the digitalisation of corporate products. On the whole, the areas most in need of improvement in digital maturity are mainly products and internal systems – the latter being a necessary direction of development according to the domestic institutions too – while these pillars can be key areas for ensuring long-term digital competitiveness.

Chart 45
Digitalisation development index of the domestic banking system by subcomponents



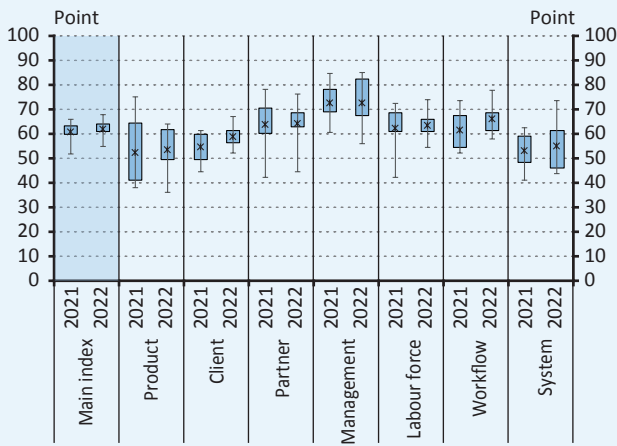
Note: Due to the change in the number of banks participating in the survey, from 2022 onwards we will report average values instead of median values.

Source: MNB.

3.1 DIGITALISATION OF THE DOMESTIC BANKING SYSTEM

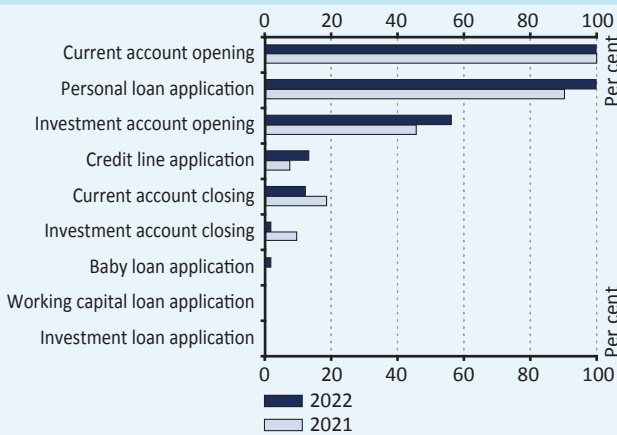
According to the MNB survey, the digital maturity of the domestic banking system has improved further, although to a lesser extent than in previous years. The MNB assessed the digital maturity of the domestic banking system for 2022 again, along 7 main pillars (Chart 45). The fourth edition of the survey covered more than 90 per cent of the domestic banking sector in terms of balance sheet total. The annual survey contains about 200 questions, the majority of which remain unchanged from year to year, providing a picture of the current state of play in the 7 main pillars, with a number of questions updated regularly to keep up with technological developments in the banking sector and to track the general trends of digitalisation. In 2022, the questionnaire has accordingly undergone a major transformation, driven by the accelerating pace of technological development in financial digitalisation and the customers’ ever-higher expectations. In addition, a transformation seen among the actors of the banking sector, affecting the number of banks participating in the survey, also gave a reason for a change in the methodology.

Chart 46
Evolution of the scores by pillars and the total points of the digitalisation development index of the domestic banking system



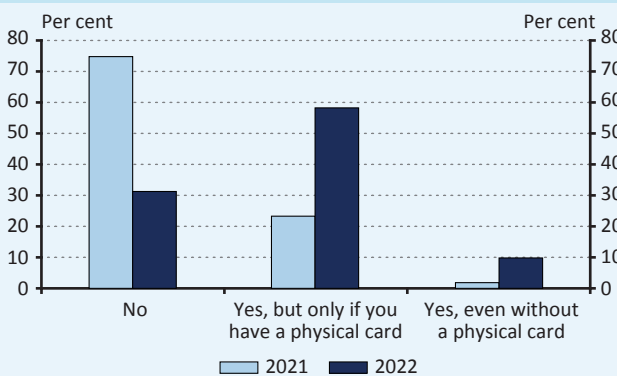
Note: The chart represents the minimum, the maximum, the lower and the upper quartiles, and the average values.
Source: MNB.

Chart 47
Availability of digitally accessible products



Note: The weighting was done in proportion to the total assets of the institutions surveyed. In 2021 the survey did not cover the application of baby loan therefore data for 2021 is not available.
Source: MNB.

Chart 48
Virtual card availability for payment accounts held at domestic banks



Note: The weighting was done in proportion to the total assets of the institutions surveyed.
Source: MNB.

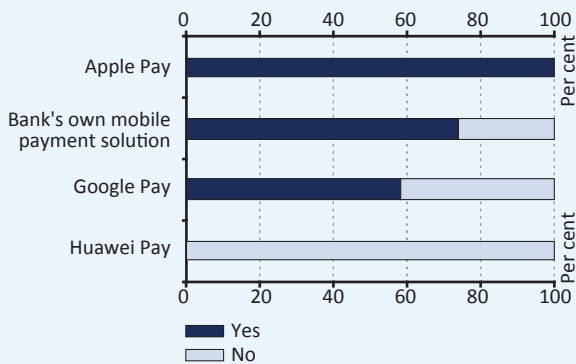
The digital maturity of banks is improving year by year, but the banking sector as a whole has still not moved away from the medium level of maturity. The average composite index for 2022 reached a score of 62, a slight improvement from 60 a year ago, even with the higher expectations built into the methodological changes (Chart 46). Looking at the main index covering the level of digitalisation of the entire operation, it is encouraging that both the minimum and maximum scores have increased, showing that the banking system as a whole has made progress in terms of digitalisation. Looking at the individual pillars, we can see that the average level of development has increased in all cases, but there are also step-backs in the minimum and maximum values, mainly due to the increasing digitalisation expectations, and the changes in the MNB survey that follow this process.

In 2022, varying levels of progress were observed along each pillar, but in none of the cases was it significant. Compared to last year, the biggest improvement is seen in the workflow and client pillars, which shows that the banks have prioritised digitalisation improvements that mainly affected the customer side and internal processes in 2022. Management remains the most advanced pillar, demonstrating a continued high-level commitment of managers to the digital transformation. According to the MNB survey, the digital maturity of the domestic banking sector is the lowest for internal systems and products. The former is a key area for long-term digital transformation, while the latter is the most dynamically changing area where banks need to continuously improve to remain competitive.

3.2 DIGITALISATION OF INTERACTIONS WITH EXTERNAL STAKEHOLDERS

In 2022, the digital accessibility of banking products showed a slight increase in the areas of account opening and loan application (Chart 47). While 2021 saw progress in a number of categories, in 2022 the banks focused mainly on developing certain retail loan products. By the end of 2022, this made it possible to open a current account and apply for a personal loan digitally at all credit institutions offering the products. There has been progress in the opening of investment accounts, while the apparent deterioration in the digital accessibility of investment and current account closing can be explained by the short-term impact of the merger processes in the sector. The availability of digital application for prenatal baby support loans, available since 2019, is at a low level, below 2 per cent in terms of balance sheet total, which leaves room for further improvements by banks, especially as the scheme has been extended until the end of 2024. On the whole,

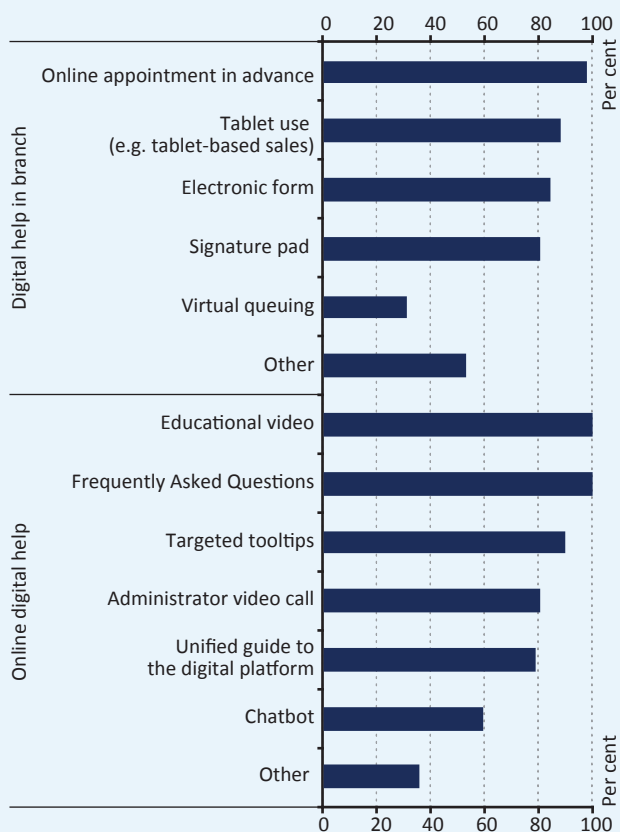
Chart 49
Availability of mobile payment solutions for payment accounts held at domestic banks



Note: The weighting was done in proportion to the total assets of the institutions surveyed.
 Source: MNB.

in terms of product availability, the banks are focusing on attracting and engaging customers with their digital solutions, and the range of products available for active digital customers is becoming wider. In addition, the closing of accounts is a less resolved and more complex process, and there is less incentive to digitalise it. It is also noticeable that the institutions are focusing on retail products by developing digitalisation processes. Given the prevalence of individual product offerings at corporate level, and that there are more complex and sophisticated scoring and risk management protocols, the banks are making less effort to digitalise these processes for the time being.

Chart 50
Availability of digital assistance solutions for customers



Note: The weighting was done in proportion to the total assets of the institutions surveyed.
 Source: MNB.

The availability of virtual cards when opening a retail digital account is increasing (Chart 48).

In 2021, the vast majority of institutions allowed their customers to use only cards issued in physical forms, and only a quarter of the sector in terms of balance sheet total allowed dedicated virtual cards, but only if the customer already had a physical card. However, by 2022, presumably linked to the rise of online shopping, virtual cards became dominantly available in the sector, while almost 10 per cent of the sector already made them available without having a physical card. As this spreads further, and the range of instantly available functionalities expands, online account opening itself could become even more popular.

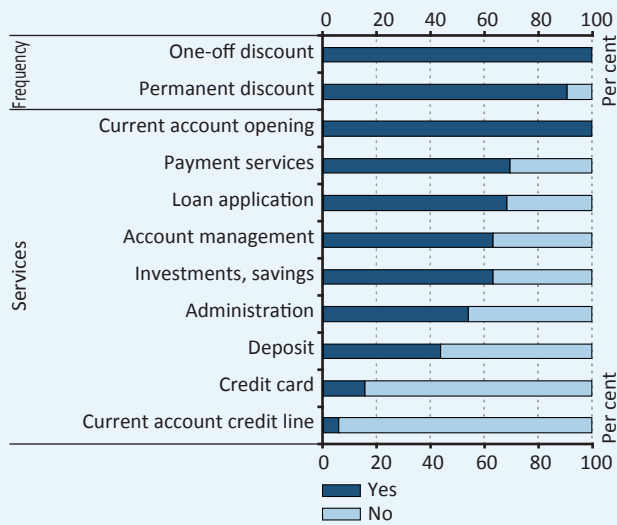
Within digital payment solutions, the integration of bank cards into mobile wallets became widespread.

Apple Pay is available in all banks included in the analysis, and either a proprietary mobile payment solution or the service of Google Pay is available to the customers of all banks (see Box 6 for more details) (Chart 49).

The banks are striving to support their customers with digital tools for both online, and in-branch banking, in order to digitalise banking administration and improve customer satisfaction (Chart 50).

Online appointment scheduling is available with nearly 100 per cent of the institutions in the sector, but virtual queuing is less popular, with even a slight deterioration compared to the previous year. The digitalisation of in-branch documentation (in the form of signature pads or electronic forms) helps the administration become faster and more efficient in more than 80 per cent of the banking sector in terms of balance sheet total. Online tutorial videos and FAQs are available at all banks, but two-way communication channels – such as video calls with the administrator and with chatbot solutions – are also available and popular in most cases.

Chart 51
Applying pricing incentives in case of using certain service types through digital channels

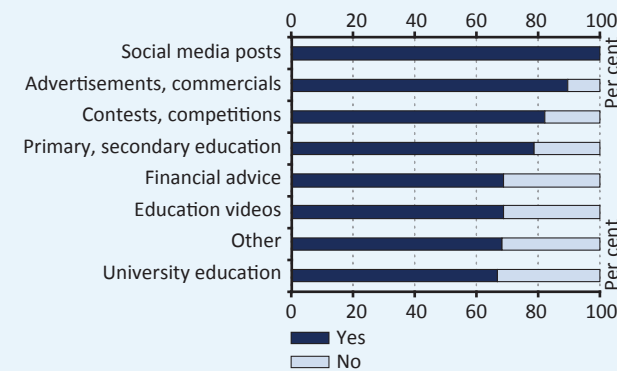


Note: The weighting was done in proportion to the total assets of the institutions surveyed.

Source: MNB.

Domestic players are not only supporting navigation in the digital space, but also providing pricing incentives to push customers in this direction. The digital channel is now the fundamental solution for many services, and banks are increasingly using negative pricing incentives (i.e. higher fees) for in-person administration in traditional services. However, pricing incentives do not appear in the same manner in the case of different products and services. The focus is on opening current accounts and acquiring new customers in general, while the institutions at sector level are less advanced in the digitalisation of additional services, administration, and customised solutions. In terms of positive incentives and regularity of discounts, both one-off and permanent discounts are widespread (Chart 51).

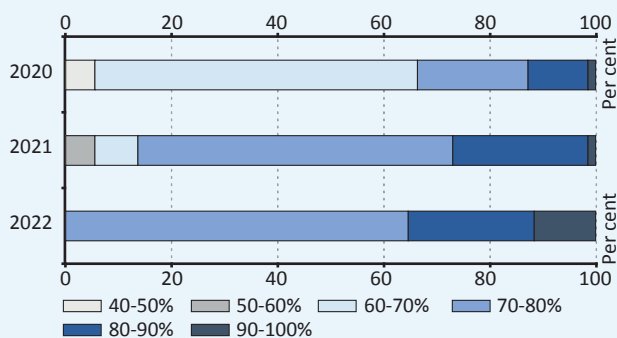
Chart 52
Banking tools to develop financial literacy and awareness



Source: MNB.

By developing financial awareness, the banks are helping their customers to plan their finances more carefully, while also promoting the widespread adoption of digital solutions. All the banks surveyed use their social media platforms for some kind of financial-related information aimed at improving financial literacy, and more than 80 per cent of them also draw their customers' attention to the importance of this topic in the form of advertisements and commercials. A strong emphasis is placed on developing financial literacy already at primary and secondary school level, to help students understand the importance of sound financial management, and to promote both theoretical and practical skills to develop responsible decision-making through competitions and contests (Chart 52).

Chart 53
What proportion of retail customers at banks received regular monthly bank account statements electronically in each year

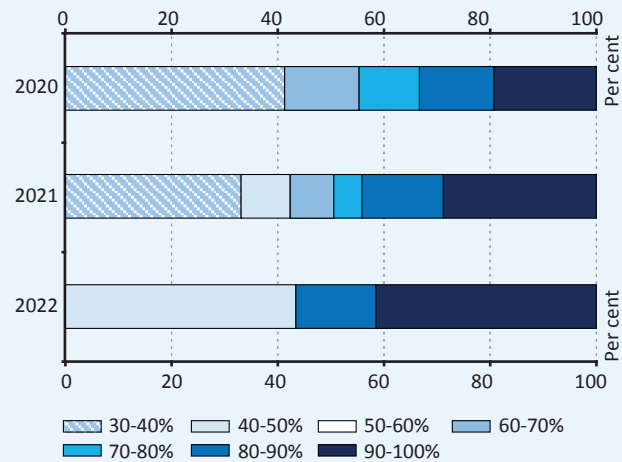


Note: The weighting was done in proportion to the total assets of the institutions surveyed.

Source: MNB.

The development of financial literacy is also reflected in the spread of digital bank statements, with a significant proportion of the retail customer base receiving their monthly statements electronically by 2022. In this area, the momentum of recent years has been maintained, and this continuous progress means that by 2022, at least 80 per cent of retail customers receive their regular monthly bank statements electronically for an institutional population covering more than 30 per cent of the banking sector in terms of balance sheet total. The spread of digital bank statements is also shown by the fact that in 2022 the highest category, with at least 90 per cent at the institutional level, showed a 10 percentage point increase since the stagnation in previous years (Chart 53).

Chart 54
What proportion of corporate customers at banks received regular monthly bank account statements electronically in each year



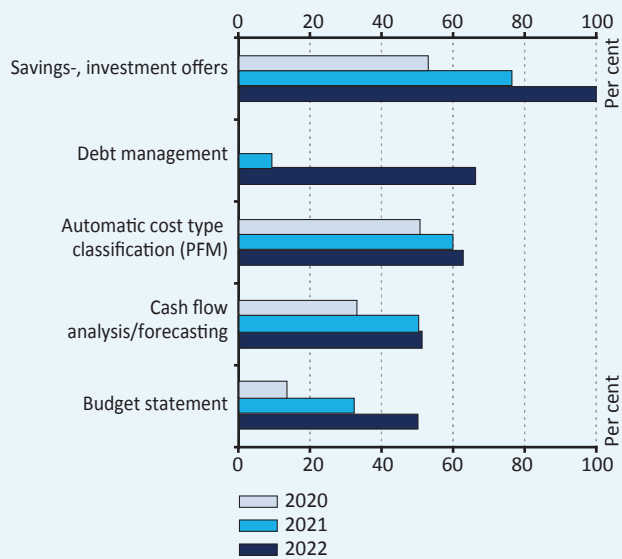
Note: The weighting was done in proportion to the total assets of the institutions surveyed.

Source: MNB.

At the corporate level, similarly significant progress has been made in displacing paper bank statements, but the extremes have been further intensified compared to 2021. In more than half of the banking sector, at least 80 per cent of corporate customers have switched to electronic solutions, but there is also a significant proportion of institutions where only half of the customers take advantage of this opportunity (Chart 54).

With the proliferation of digital bank statements and reports, financial management services have also emerged and are becoming more prominent year by year. The automatic cost type classification available on digital platforms, as well as the various statements and forecasts calculated on the basis of transactions, (all of which have become more accessible in recent years) can help the customers make informed financial decisions. While, on the one hand, these steps improve the financial awareness of customers, they also create an opportunity for the banks to place advertisements and product offers (Chart 55).

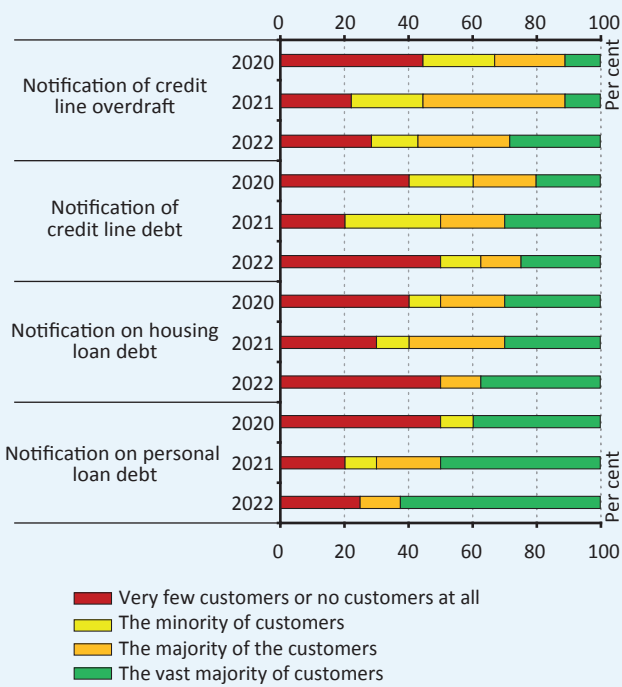
Chart 55
Types of financial management services provided to clients



Note: The weighting was done in proportion to the total assets of the institutions surveyed.

Source: MNB.

Chart 56
How typical it is at particular banks that retail clients receive digital notifications about their loan product



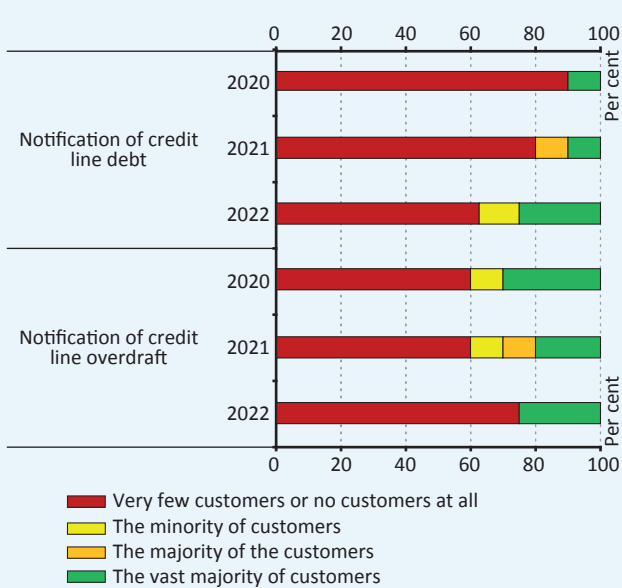
Note: In the proportion of respondents. During the calculation those institutions which are not selling that particular product were not considered.

Source: MNB.

The availability of digital notifications in the area of debts continued to increase in most categories in 2022, in line with previous annual trends.

Typical improvements in the retail segment have been in the areas of credit line debts and overdrafts, where consumers can be more up-to-date on their credit status with the spread of digital delivery, which can lead to more informed financial decisions. Although the overall trend is improving, the merger processes in the sector may complicate the digitalisation picture for the sector as a whole in the short term (Chart 56). At the corporate level, despite some improvement, digital notifications are currently not widespread, for which one of the main reasons being that the domestic banks have been less able to extend the standard solutions already introduced for retail notifications to the needs of this heterogeneous customer base (Chart 57). For the sector as a whole, the main channel for digital notifications is netbank, but there is a general decline in digital notifications across all channels, due to the aforementioned bank merger processes, but as banks have emphasised the importance of digital communication in their digitalisation strategy, we should see an improvement from next year. Also, there has been no improvement in the real-time traceability of personal credit assessment, and, regarding home loan products, the changes within the banking system may also be behind the temporary deterioration in digital availability.

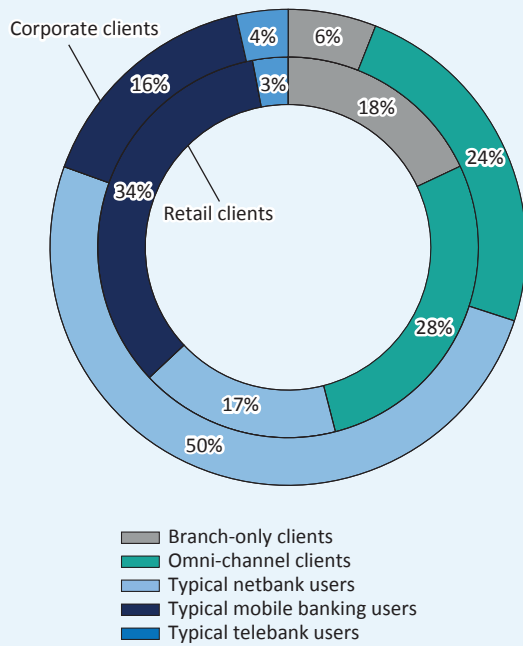
Chart 57
How typical it is at particular banks that corporate clients receive digital notifications about their loan product



Note: In the proportion of respondents. During the calculation those institutions which are not selling that particular product were not considered.

Source: MNB.

Chart 58
Distribution of retail and corporate customers by channel usage



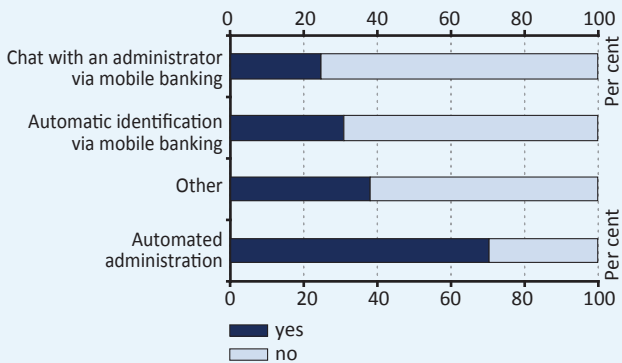
Note: Based on the banks' self-declaration, in proportion to the total number of customers.

Source: MNB.

In terms of channel usage by bank customers, the demand for mobile banking services increased significantly. At retail level, mobile banking was the primary channel for a quarter of the customers in 2021, and a third of the customers in 2022. This increase brought about mainly a decrease in the share of netbanking and omni-channel customers, while the share of branch visitors remained stable. At the corporate level, the proportions have also changed significantly, with half of the customers preferring omni-channel solutions in 2021, but only a quarter of them in 2022. Here, too, mobile banking solutions are forging strikingly ahead, but this segment was still dominated by netbanking in 2022, which served more than half of the customers, a significant advance from the one-third share in the previous year. At both retail and corporate level, the changes described above have been accompanied by a decrease in omni-channel rates, and no change in the number of people visiting the branches (Chart 58).

The focus on mobile and online banking also puts customer service procedures on a new footing. On the one hand, it makes administration more secure, as identification can already be done via the bank's mobile application, so that the various administration topics can already be displayed via a reliable interface, and on the other hand, automated administration saves time for the customers. (Chart 59).

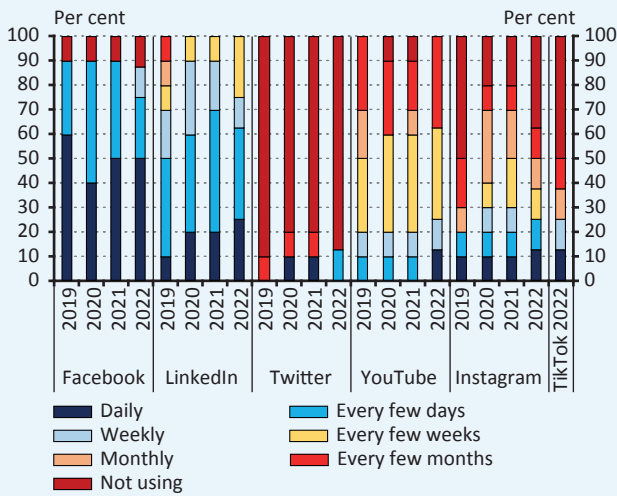
Chart 59
Availability of digital solutions for call centres



Note: The weighting was done in proportion to the total assets of the institutions surveyed.

Source: MNB.

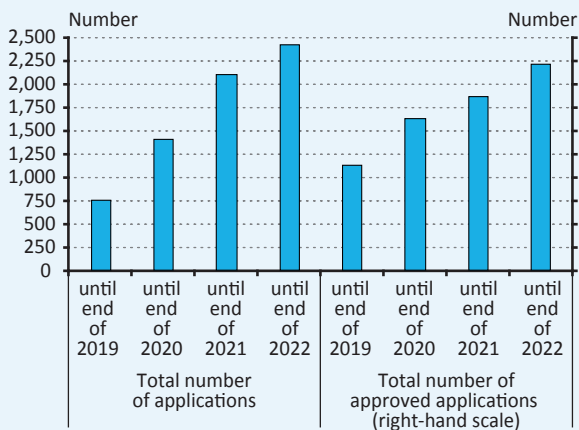
Chart 60
Frequency of use of some social media interfaces among domestic banks



Note: In the proportion of respondents.
Source: MNB.

The banks' continued active and extensive social media presence has also extended to TikTok since last year (Chart 60). In 2022, the banks spent on average more on online marketing than in previous years, mainly due to new brand building, and promotion of new products. The number of staff responsible for managing social media platforms has not changed, but content production has become more active for certain media (LinkedIn and YouTube). In addition, half of the banks already have a TikTok account, but their activity on this new platform shows a mixed picture. The motivations behind the social media presence of institutions are varied, generally dominated by marketing and information sharing, which in the case of Facebook and LinkedIn, is complemented by recruitment.

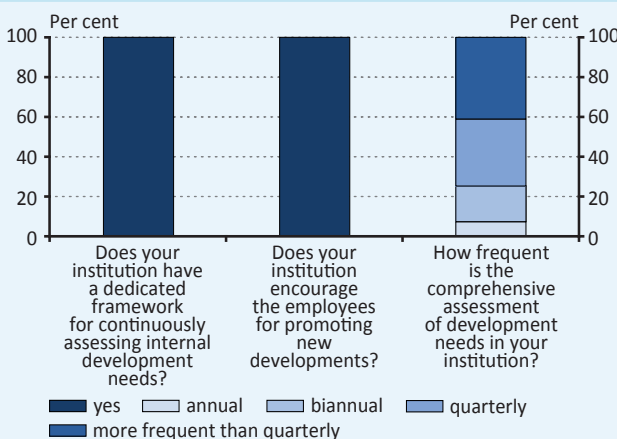
Chart 61
Development of applicants to domestic banking incubation programmes



Source: MNB.

In response to the growing demand for innovation, the number of FinTech partnerships established under incubation programmes is also increasing. In this area, the upward trend of the previous period is continuing, despite the fact that in the last two years, market players had to face different but significant external pressures each year. Domestic banking incubation programmes thus provide a stable background for the growth of the FinTech sector and for bank–FinTech collaborations. At the same time, only three banks have incubation programmes, so there is still room for new entrants, but according to self-reporting by the banks, there are currently no plans to launch such initiatives in the case of the remaining players (Chart 61). The share of innovative collaborations with additional external partners has also increased in 2022, and collaborations with a FinTech partner – outside the incubation programme – now account for more than 85 per cent of the sector. Open banking partnerships have grown both in number and in the percentage of participating banks, with all banks using BigTech platform services in 2022.

Chart 62
Assessing internal improvements and encouraging initiatives in domestic banks



Note: The weighting was done in proportion to the total assets of the institutions surveyed.
Source: MNB.

In the context of digital transformation, the institutions are not only building partnerships with external actors, but are also actively seeking employee support and encouraging openness within the bank. All banks have a dedicated framework for assessing internal development needs, and the institutions also encourage employees to implement new developments. For around two thirds of the banking system, the assessment of development needs is carried out at quarterly or more frequent intervals. The banks seem to place great emphasis on identifying and implementing internal development needs, which is a way forward for automation and digitalisation (Chart 62).

Box 6

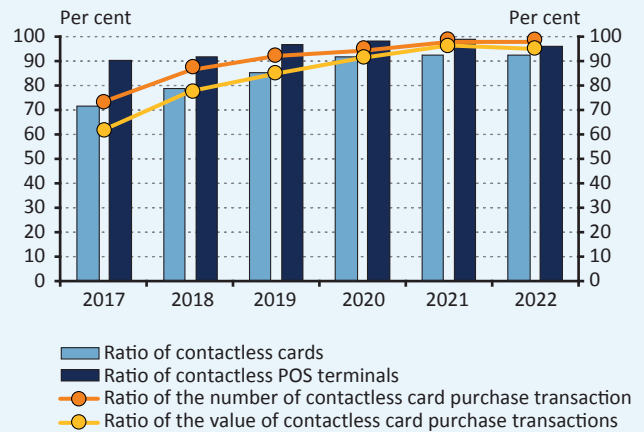
The rise of contactless and mobile wallet payment technologies

In 2022, the uptake of the contactless payment card technology was almost complete, with 93 per cent of payment cards issued by domestic payment service providers being contactless. Meanwhile, on the acquiring side, 96 per cent of POS terminals were capable of contactless payments. This means that 98 per cent of the number and 95 per cent of the value of in shop card transactions were made by contactless payment. The spread of contactless technology has made card payments simpler and faster, helping to increase the proportion of electronic transactions. It could play a particularly important role for low-value payments, where no PIN is required to make a purchase. This technology has successfully paved the way for mobile wallet payments that further simplify electronic payments, where even a physical debit card is not required for payment.

According to data available from the MNB²⁴, by the end of 2022, 1.7 million cards were registered in mobile wallets, an annual increase of almost 500,000 cards. By the end of the year, 17 per cent of payment cards in circulation were available in this form. More than 200 million mobile wallet payments were made during the year, more than double the corresponding 2021 statistics, so that in 2022, 14 per cent of all payment card purchases in terms of the number of card payment transactions were mobile wallet payments.

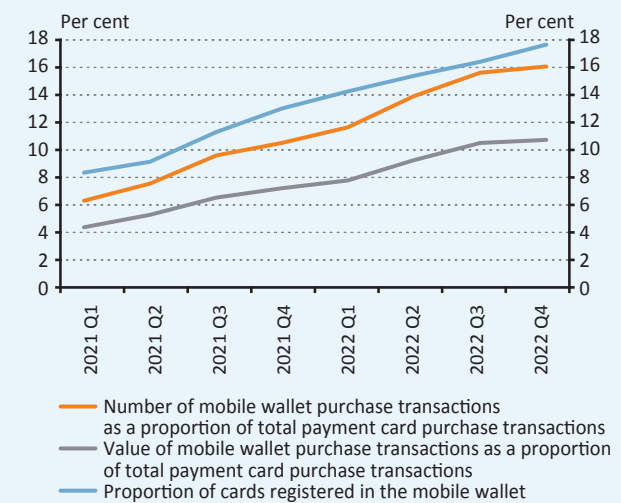
In addition to mobile wallet solutions based on payment card systems, mobile app-based transfers are also expected to grow. These are expected to be payments initiated by QR codes, deeplink or contactless technology similar to card-based mobile payments (NFC), and payment requests based on the instant payment system, which will be available to all customers free of charge next year, thanks to legislative changes, and will be used in an increasing number of shopping situations.

Chart 63
The spread of contactless payment technology (2017-2022)



Source: MNB.

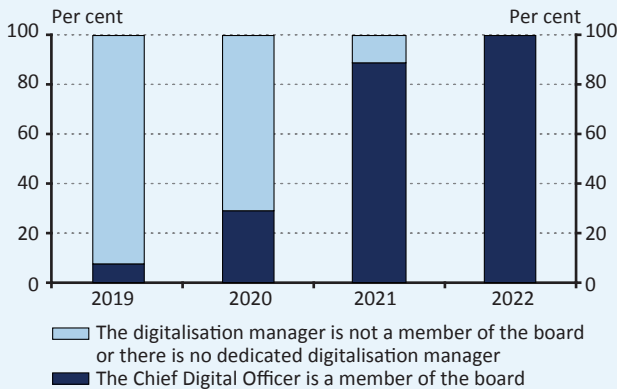
Chart 64
The spread of mobile wallet technology (2021-2022)



Source: MNB.

²⁴ Data on proprietary banking applications as well as on bank-independent mobile wallets with the service-provider of which domestic banks have partnered.

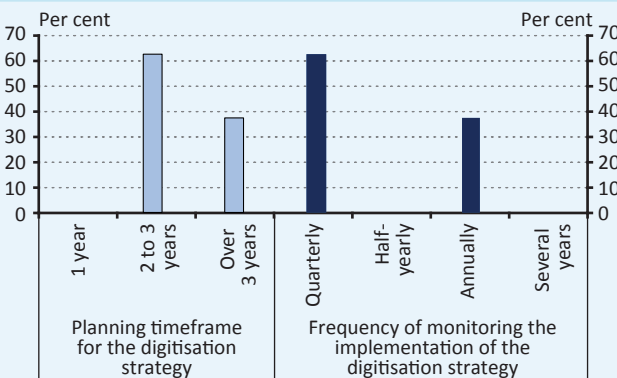
Chart 65
Membership of the Board of the areas responsible for digitalisation in banking (2019-2022)



Note: The weighting was done in proportion to the total assets of the institutions surveyed.

Source: MNB.

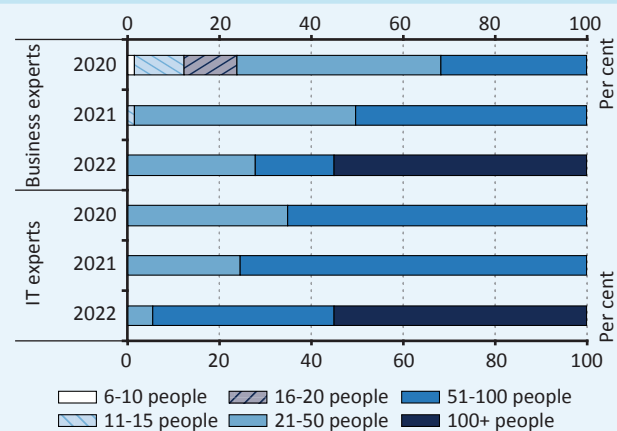
Chart 66
Design and feedback characteristics of digitisation strategies in the banking sector



Note: In proportion to the number of institutions surveyed.

Source: MNB.

Chart 67
Distribution of employment of IT and business experts in banking digitalisation areas (2020-2022)



Note: The weighting was done in proportion to the total assets of the institutions surveyed.

Source: MNB.

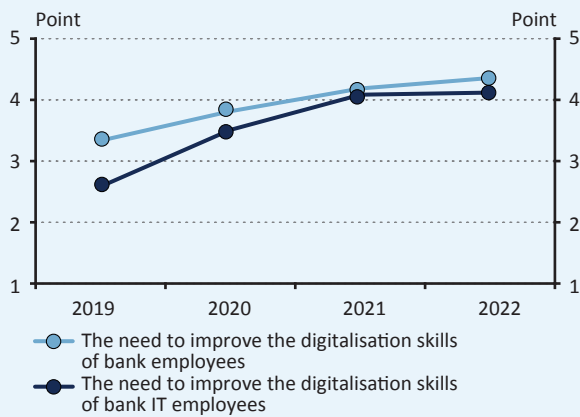
3.3 PREPAREDNESS OF MANAGEMENT AND EMPLOYEES

In line with the MNB’s recommendation on the digital transformation of credit institutions²⁵, by 2022, all the institutions surveyed had a manager responsible for banking digitalisation on their board of directors. Leadership commitment to digitalisation is crucial for the success of digital transformation in banking, and this can be institutionalised by giving it independent representation at the highest decision-making level of the bank, i.e. at the level of the board of directors. Accordingly, there is a growing number of digitalisation-related senior executives in the banking sector, with the Chief Digital Officer (CDO) now joined by senior IT and IT security executives in all banks, and technology and data-related responsibilities are increasingly being taken on by senior bank management. The inclusion of digitalisation responsibilities at board level, as required by the MNB, is particularly beneficial for the development of the digital maturity of the banking system (Chart 65). In this context, digital transformation efforts in banks reflect a holistic approach within the institution, as opposed to a product- or process-specific focus. Nevertheless, there are still no domestic banks that admit to being fully prepared for the challenges of digitalisation, and there is room for improvement in the digital transformation culture of the majority of institutions. In order to overcome these challenges, among others, the MNB expected banks to prepare a digitalisation strategy.

Domestic commercial banks typically plan for a strategic digitalisation timeframe of 2 to 3 years, with frequent interim internal evaluations. From 2021 onwards, commercial banks have been sending annual updates on their digitalisation strategy to the central bank in line with the MNB’s recommendation on digital transformation. The MNB monitors the implementation of these strategies and provides feedback on progress through annual bilateral meetings. The domestic commercial banks typically plan their digitalisation goals for 2 to 3 years, and measure the achievement of these goals at least annually. At the same time, the importance of digitalisation is reflected in the fact that the majority of institutions monitor the current status of the implementation of the action plans formulated in their strategies more frequently than the MNB expects (Chart 66). According to the MNB’s 2022 assessment, the strategic orientations of the banking sector are appropriate, while the qualitative differences between the individual institutional strategies were mainly in the level of elaboration and detail of the objectives, periodic milestones and deadlines.

²⁵ Recommendation No 4/2021 (III. 30.) of the Magyar Nemzeti Bank on the digital transformation of credit institutions Download link: <https://www.mnb.hu/letoltes/4-2021-dig-transzformacio.pdf>

Chart 68
Need for digitalisation knowledge development based on self-reporting by domestic banks (2019-2022)



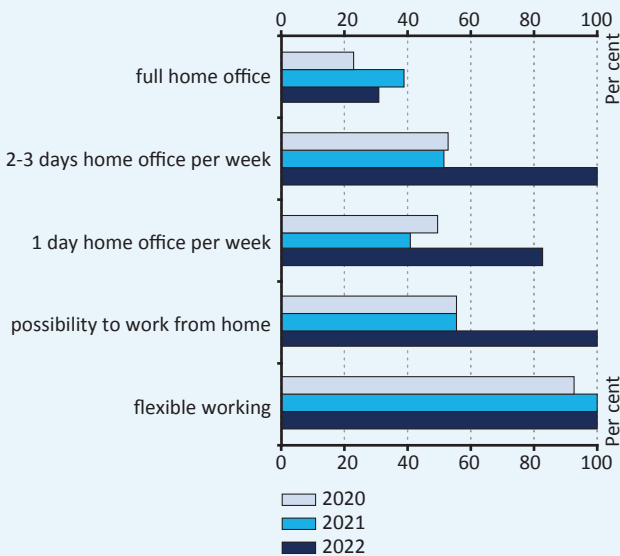
Note: The weighting was done in proportion to the total assets of the institutions surveyed. A score of 1 reflects if there is no need at all for digitalisation knowledge development, while a score of 5 indicates if an institution considers it absolutely necessary.

Source: MNB.

The increasing emphasis on digitalisation in the objectives of domestic financial institutions is also reflected in the growth of the areas responsible for digitalisation. In the majority of banking institutions, the number of business and IT experts working in the area of digitalisation exceeds 100, a significant shift compared to previous years (Chart 67). The challenges of digital transformation are also pushing commercial banks to employ more and more people in these areas.

The fast-changing and evolving nature of digital solutions has also made the development of digital skills for employees a priority area for banking sector players. According to the self-assessment of the domestic banks, the digitalisation skills of their employees need to be improved, and moreover, the need for this is growing, according to the self-report of the institutions (Chart 68). This is linked to the fact that the banks are increasingly confronted with the importance of the digital skills of their employees as they digitalise internally. An important area for this is internal knowledge transfer, which plays a key role in all banks, both when new colleagues arrive, and when existing colleagues' knowledge is developed, typically by more experienced, senior colleagues.

Chart 69
Remote work opportunities in the domestic banking sector (2020-2022)



Note: The weighting was done in proportion to the total assets of the institutions surveyed.

Source: MNB.

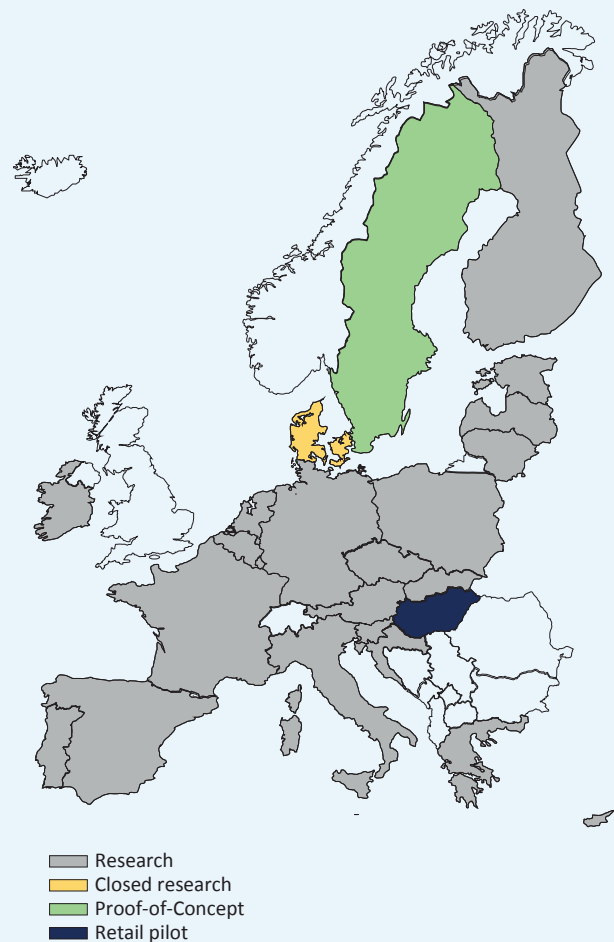
The effects of the COVID-19 pandemic on work have become longstanding in everyday functioning, seemingly staying with us, although a certain setback can also be observed. The full home office, introduced due to the pandemic, is becoming less present in the banking sector, while working from home 2 or 3 days a week has become general (Chart 69). It is typical that practice varies from one institution to another, depending on certain fields of expertise as well, but some form of flexible working is present in all institutions. When allocating home office days during the week, most banks give employees flexibility in how to use them.

Box 7**The first retail central bank digital currency pilot project in the EU: The MNB Student Safe Initiative**

The issue of central bank digital currency and the possibilities for its implementation are being increasingly explored by central banks around the world. Of the central banks participating in the BIS's large-scale survey,²⁶ 90 per cent are already looking into central bank digital currency, 62 per cent are testing it, and 26 per cent are already at some stage of development. The central bank digital currency is a digital form of money issued by the central bank in its own currency, different from traditional reserve and settlement accounts. Sweden was one of the first in Europe to address this issue, strongly motivated by the declining use of cash in payment transactions in Sweden. The Swedish central bank's project is now in its second pilot phase with simulated actors. This further explores and tests the technical solution already developed, and analyses the possible legal framework around the e-krona, but a publicly available pilot project involving real users has not yet been carried out. The European Central Bank (ECB) formally announced on 14th July 2021 that it would start the 2-year research phase, that would lead to a formal decision on the issuance of the digital euro. Following the decision, the development, and introduction of the digital euro would take another three years. In addition, the central bank of the Eurozone has also conducted a technical experiment, but no real users have yet participated. According to a joint assessment by the UK's central bank and the Treasury, current trends suggest that a retail central bank digital currency is likely to be needed in the country, but no formal decision has yet been taken. The project is now entering the design phase, which will take about two to three years, after which a decision will be made on whether to move to the next phase, and introduce the digital pound in the UK. This would allow a testing phase with real users to start in 2025 at the earliest, followed by a formal roll-out.

As in the leading central banks, the MNB is actively involved in the research of central bank digital currency, and, with the renewed Student Safe mobile application, it has launched the first central bank digital currency pilot project for retail customers in the EU. Launched in 2020, Student Safe is an innovative financial and educational mobile application developed in a joint initiative of the Magyar Nemzeti Bank, and the Money Compass Foundation. Over the past almost three years, thousands of students have used the Student Safe mobile application and answered more than a million quiz questions. The Student Safe mobile application, operated by the MNB, and involving commercial banking and FinTech partners, has been renewed in 2023, and is now able to handle real money as well. In the Student Safe, the electronic money accounts of students and their parents are managed directly by the MNB, making the initiative the first central bank digital currency pilot project in the European Union in which the MNB involves real retail users to gain the necessary experience for research.

Chart 70
Status of initiatives of retail central bank digital currency in the European Union



Source: Websites of central banks, CBDC tracker, MNB.

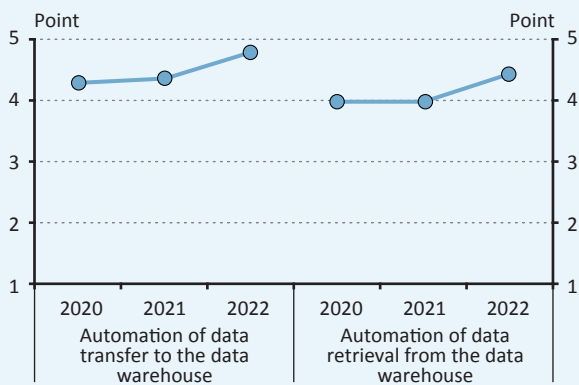
²⁶ Kosse, A., Mattei, I. (2022): Gaining momentum – Results of the 2021 BIS survey on central bank digital currencies, BIS Papers No 125. Download link: <https://www.bis.org/publ/bppdf/bispap125.pdf>

The MNB Student Safe is a savings and financial education mobile application that takes advantage of modern technologies, targeting the young, 8- to 14-year-olds, and their parents. The mobile application is a gamified way for students to learn by answering quizzes on finance, digitalisation and sustainability. By successfully completing the quizzes, students can collect the so called “student thalers” redeemable for purchase vouchers. In addition, in the Student Safe mobile application, which was relaunched in 2023, the users can try out how to use the digital money, transfer money to a bank account, save money by selecting goals that are important to them, and make purchases using QR code payments. In the mobile application, which can be used under parental supervision, the parents can support their children by sending regular, or one-off pocket money, either in HUF, or in student thalers. The renewed Student Safe supports two important objectives at the same time: (i) it can strengthen the students’ theoretical and practical financial literacy; (ii) it also provides an opportunity to test the digital money in practice, with ongoing fine-tuning of the mobile application.

The Student Safe mobile application is a useful pilot project for testing central bank digital currencies in practice from several points of view. The main users of the application are younger age groups, as they are already familiar with the digital space as “digital natives”, and are expected to be the primary users of central bank digital currency in the future. In addition, this age group is open to give feedback in the digital space, so the central bank can get useful suggestions from them on the way forward. Within the framework of the Student Safe, the central bank can gather important experience in the development and operation of a central bank digital currency system (e.g: IT processes, customer management, fraud prevention, KYC processes, UI/UX design), as well as on working with commercial banks and FinTechs.

The MNB considers it important to be at the forefront of international research on central bank digital currency, for which the Student Safe initiative can be considered a milestone. The central bank digital currency pilot project will support the central bank in the successful implementation of central bank digital currency in the event of a need for a general, widespread domestic introduction in possession of sufficient conceptual, organisational, operational, and technological preparedness.

Chart 71
Average level of automation of certain data management processes as self-reported by banks



Note: The weighting was based on the ratio of the balance sheet total of the institutions surveyed, on a scale of 1 to 5, where a score of 1 indicated that the process was not automated at all, and a score of 5 indicated a fully automated system.

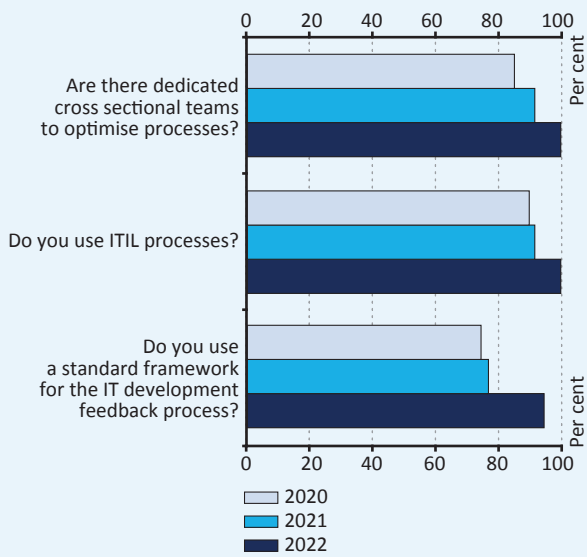
Source: MNB.

3.4 DIGITALISATION OF INTERNAL OPERATIONS

The automation of data management processes has improved more than in previous years. Over the past year, there has been a great improvement in both the automation of data transfer to the data warehouse, and the automation of data retrieval, which facilitates operations along internal processes (Chart 71).

The uptake of solutions having an innovative process management approach has made significant progress after the stagnation of the previous years. The creation of dedicated cross-sectional teams to optimise processes has become general. These teams are usually sufficiently heterogeneous, as product and business development, sales, marketing, and IT development are typically represented. Although user experience (UX) and user interface (UI) development already play a significant role in these teams, it is important to further strengthen the

Chart 72
Prevalence of solutions that reflect an innovative process approach



Note: The weighting is based on the ratio of the total balance sheet of the institutions examined. ITIL is a set of best practice processes for delivering IT services to customers, making systems more efficient to operate and improve.

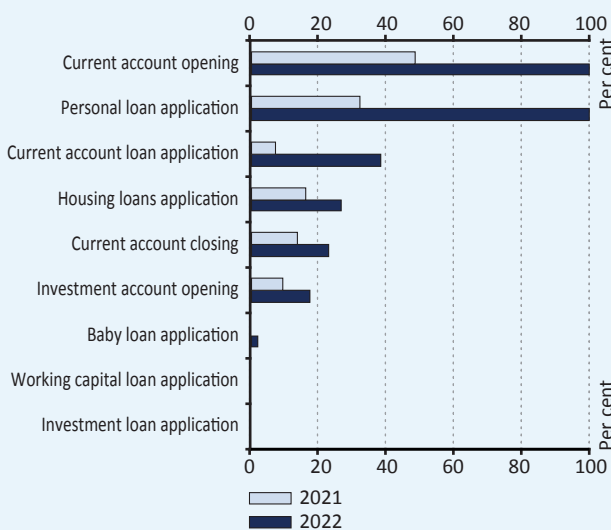
Source: MNB.

user-centric approach also in the internal operations of the banking sector. In the context of internal improvements, the Hungarian banking sector almost entirely uses standard frameworks to measure back IT improvements, and the sector as a whole uses ITIL (Information Technology Infrastructure Library) processes, which facilitate IT governance by focusing on customer needs, without losing sight of the quality of the services provided. The ITIL system creates a common language that facilitates communication between the different disciplines within the bank involved in the development, and also ensures transparency in the delivery of services (Chart 72).

At the product level, the opening of current accounts and the internal process of personal loan application are fully digitalised in all the banks surveyed.

The full digitalisation of current account opening and personal loan application will have a major impact on the banks' operations and customer relationships. The decline of paper-based processes, and the parallel rise of digital solutions enable fast, and convenient process management. In addition, with the exception of corporate-related products (such as working capital and investment loan applications), progress can be observed in all areas. But in all cases, there is considerable room for further improvement at the level of internal processes in the product coverage examined, with the exception of current account opening and personal loan application (Chart 73). Other internal processes related to customer service are also becoming more digitalised and efficient in the banking sector year by year, as can be seen in the development of digital archiving systems, and the existence of a single customer database across institutions. Regarding the latter, 62 per cent of the banking sector in terms of balance sheet total used a single, up-to-date customer database in 2022.

Chart 73
Completeness of the digitalisation of the process within the value chain for each product



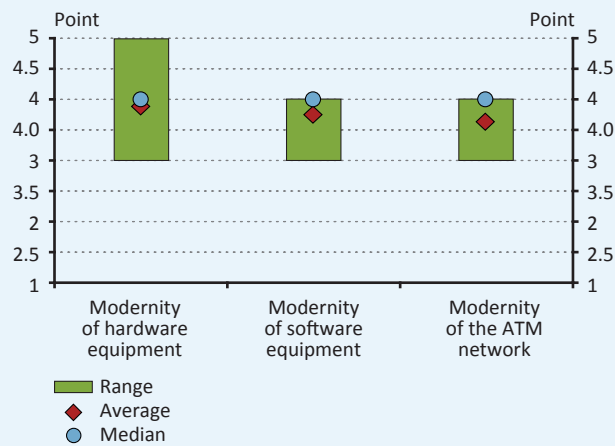
Note: The weighting is based on the ratio of the total balance sheet of the institutions examined. The 2021 survey did not ask about the use of the baby loan, so 2021 data are not available.

Source: MNB.

Banking equipment need to be improved in favour of the digital transformation according to domestic institutions as well.

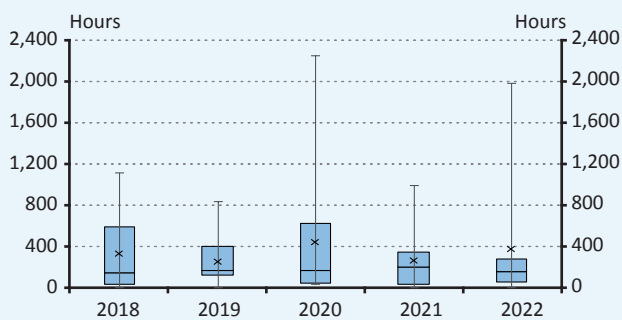
The hardware and software equipment of domestic players need to be upgraded, particularly the ATMs, which are the least developed according to domestic players. The roll-out of so-called smart ATMs would not only be timely, but could also help banks to become more digitalised by increasing process automation and reducing waiting times, thus benefiting the customers (Chart 74). Over the past year, there has been no change in the uptake of cloud services, with almost 90 per cent coverage, making their use

Chart 74
Assessment of the modernity of banking equipment based on self-declaration by institutions (2022)



Note: On a scale 1 to 5, 1 - most obsolete, 5- most modern.
 Source: MNB.

Chart 75
Evolution of aggregate service disruptions due to incidents reported by large domestic banks



Note: The chart represents the minimum, the maximum, the lower and upper quartiles, the median and the mean values. In case of the mean, the weighting was proportional to the number of respondents.
 Source: MNB.

almost universal. It is also apparent that the use of these solutions within certain institutions is increasing, as cloud-based solutions are being used in sales, customer service, and fraud prevention, in addition to supporting operations, and typically offering more flexible and efficient operations.

Despite an increasing trend in the number of cyber-attacks on banks globally, service outages in the domestic banking sector have typically been less severe. By becoming increasingly digitalised, the internal processes of the banking sector can have a positive long-term impact on the efficiency and competitiveness of the sector as a whole. Automated systems and a data-driven approach enable banks to optimise their operations, reduce the potential for errors, and improve the quality of customer service. At the same time, secure and resilient operation is an important aspect of the continuous, 24/7 digital service available in an increasing number of areas, which is a priority in the light of the increasing trend of cyber-attacks targeting banks or banking customers. The domestic banking sector needs to improve reliability through these developments. In this respect, it was a step forward in Hungary to reduce the cumulative service outage for the median bank on the various digital customer interfaces from 199 hours in 2021, to 157 hours in 2022. Although we have seen examples of institutions with less reliable systems catching up in previous years, despite the improvement in median values, the sector-wide improvement is set back by the fact, that the aggregate value of downtime remains a risk factor to watch, due to some poorer performers. Due to the outlying bad values, the average system downtime has worsened, and reached 372 hours in 2022 (Chart 75).

Box 8**CyberShield – protection in finance**

The Magyar Nemzeti Bank (MNB), the Hungarian Banking Association, the National Media and Infocommunications Authority (NMHH), the Special Service for National Security, the National Cyber Security Center, and the National Police Headquarters have launched a joint initiative called CyberShield, to improve the digital financial awareness of customers. The aim of the project is to raise awareness among customers about the basics of safe digital finance, through ongoing communication campaign with uniform image, and to help them to identify, prevent, and effectively manage fraud in time. The five organisations signed a cooperation agreement on 7th November 2022, and the kiberpajzs.hu website was also launched at the same time. In the first quarter of 2023, the Ministry of Justice, and the Supervisory Authority for Regulated Activities (SZTFH) joined the initiative.



KiberPajzs

Védelem a pénzügyekben

In addition to the communication campaign, another very important outcome of the initiative is the sharing of knowledge between experts, the analysis of fraud scenarios, patterns, characteristics and trends, and the improvement of prevention and protection processes. In addition to expert consultations and discussions, the project also organises wider knowledge-sharing events, where speakers present case studies and analyses on abuses, official tools, and communication opportunities. Based on the feedback from participants, it is very useful to see the different approaches – the experiences of supervisors (MNB, NMHH, SZTFH), law enforcement agencies, banks, and the Financial Arbitration Board – together, and to learn about the different approaches they use in their work.

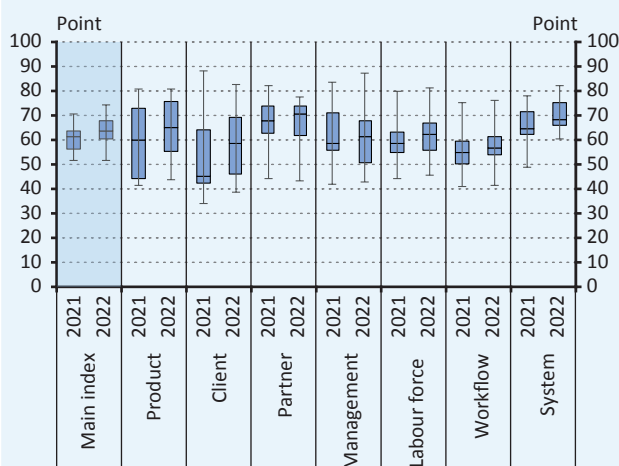
Although domestic electronic payments are extremely secure on the whole, and the rate of fraud is negligible, cyber fraud is clearly on the rise, and almost everyone has now encountered a case. This is why, in addition to regulation/administrative protection, and the use of technical means, it is important to raise the consumers' awareness of security, and draw their attention to it. In addition to the CyberShield initiative, the MNB has also done and is doing a lot to raise awareness of the problem: it has published several professional articles on the topic, and renewed the digital security section of its Financial Navigator website to inform consumers.

In addition to the central bank, financial institutions, public authorities, and various organisations are also conducting awareness-raising campaigns: it is clear that we can only act effectively if we work together, using the tools of all the players involved. The first campaign, launched in November 2022, featured three “everyday role models” on posters who share a similar life situation to most financial consumers. The project plans to introduce more characters, and in the future it will also use campaign films, social media platforms, and other channels to raise awareness of the main forms of fraud.

4 Digitalisation level of the Hungarian insurance companies

According to the results of the digitalisation survey conducted by the MNB in the domestic insurance sector, covering 90 per cent of the sector in terms of gross premium income, the level of digitalisation of domestic insurers showed a gradual improvement over the last period. The sector's commitment to digitalisation is demonstrated by the fact, that a significant proportion of players have a digital transformation strategy in place, but a long-term, high-level digital transformation approach is not yet present in all insurers, and the senior digitalisation-related management positions are still significantly under-represented in the sector. Of the insurance products, retail property insurance remains the most digitally accessible one, but progress in digital accessibility is also visible in the liability and business property insurance areas. Last year, the focus of insurers was on operation, based on user experience and process optimisation, where innovative process management solutions and further automation efforts can significantly improve organisational efficiency and increase competitiveness. Making better use of the data assets available to institutions, and automating the management of customer data can contribute to improving the customer experience.

Chart 76
Evolution of the scores by pillars and the total points of the digitalisation development index of the domestic insurance sector



Note: The chart represents the minimum, the maximum, the lower and the upper quartiles, and the median values.

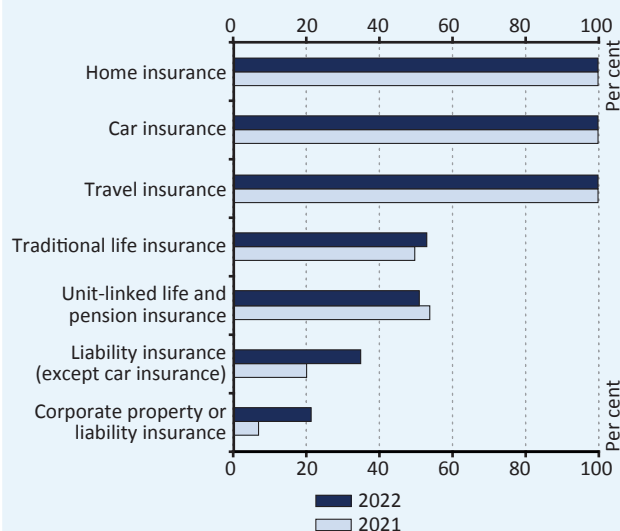
Source: MNB.

4.1 DIGITALISATION OF DOMESTIC INSURANCE COMPANIES

The MNB assessed the level of digitalisation of domestic insurers also for 2022. The digitalisation-focused questionnaire, consisting of 7 pillars with nearly 200 questions, provides a comprehensive and up-to-date picture of the sector's readiness, digital engagement, and level of digitalisation of insurance products and back-office processes. As in the previous years, the survey covered more than 90 per cent of the domestic insurance market, based on gross premium income.

Digitalisation level of the Hungarian insurance companies continued to improve in 2022. The median digital maturity score of the insurance sector has increased from 62 last year to 64, which, although with a declining growth, continues to show steady development. Looking across the 7 pillars of operation, it can be established that progress has been made in all areas in terms of median value (Chart 76). Regarding this year's figures, it is important to note that due to the rapidly changing digitalisation environment, the questionnaire is updated every year to provide a holistic picture of the sector's digital maturity, in line with current digitalisation trends. However, the increase in the minimum expected level of digitalisation has led to a decrease in the minimum or maximum values for some pillars in 2022. In many cases, domestic insurers have a different approach to the main products and services, and the interaction with customers (e.g. differences between life and non-life products), and these differences are also noticeable in

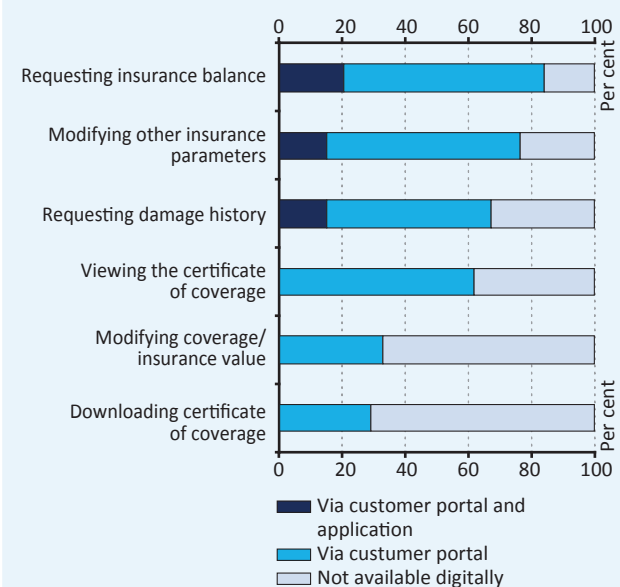
Chart 77
Availability of digitally accessible insurance products



Note: The weighting was done in proportion to the gross premium income of the institutions surveyed. During the mean calculation those institutions which are not selling that particular product were not considered.

Source: MNB.

Chart 78
Digital availability of administrative functions for existing customers on the digital platforms of the insurance companies



Note: The weighting was done in proportion to the gross premium income of the institutions surveyed.

Source: MNB.

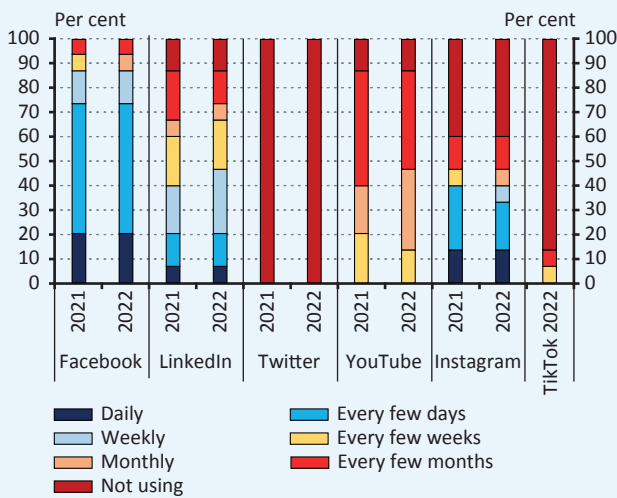
the greater variation among institutions in the context of digital transformation. There has been significant progress in the digitalisation of internal operations in the sector, but the digitalisation of internal processes still needs to be improved. A long-term, strategic approach to the digital transformation is not yet in place at all insurers, but the digital maturity of employees has evolved in a forward-looking way in 2022.

4.2 DIGITALISATION OF INTERACTIONS WITH EXTERNAL STAKEHOLDERS

Retail property insurance continues to be available digitally at all insurers, while progress is also being made in the digital offerings of liability and corporate property insurances. As in recent years, digital access to non-life retail insurance remains the highest, and the number of institutions offering these products has continued to grow in 2022. There has been no significant change in life products, where, in terms of premium income, half of the insurers offer digitally accessible products. Although unit-linked insurance was offered by more institutions in 2022, full digitalisation is not yet achieved for solutions sold by new entrants, which has slightly lowered the ratio in terms of digitalisation (Chart 77). It can be established in general, that for those products, where the process requires personal presence or a more complex procedure, the most common reason given by the institutions surveyed was customer identification, which means, that the sector could achieve significant improvement in promoting digitalisation by advancing in this element.

Digital access to administrative functions has increased in most categories, but there has been no significant progress in the sector. As in the previous year, digital accessibility at the functional level was mainly limited to balance enquiries, the modification of certain parameters, and access to documents. Insurers are not active in the development of mobile applications; mainly the customer portals are operated in the online space (Chart 78). At the same time, the promotion of digital channels seems to be a priority for insurers; it is emphasised by almost the entire sector in online advertising, and this direction is reinforced by the printed information materials available in their branches. Pricing incentives to support this were already used by three quarters of the sector, taking into account a weighting based on gross premium incomes, nearly 60 per cent of these took the form of permanent discounts. In addition, operators supported the use of digital channels with a range of tools, mainly in the form of frequently asked questions, tooltips and guides. The availability of personalised, one-to-one

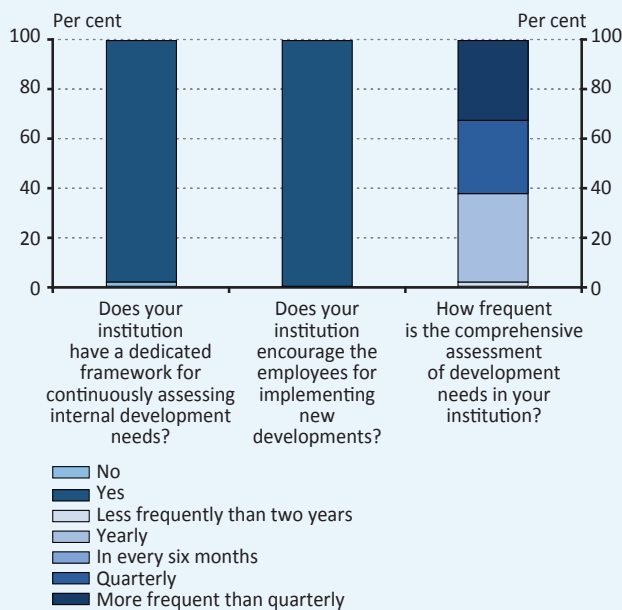
Chart 79
Usage frequency of some social media interfaces by insurers



Note: In the proportion to respondents.

Source: MNB.

Chart 80
Assessments of internal developments and encouraging initiatives within Hungarian insurance companies (2022)



Note: The weighting was done in proportion to the gross premium income of the institutions surveyed.

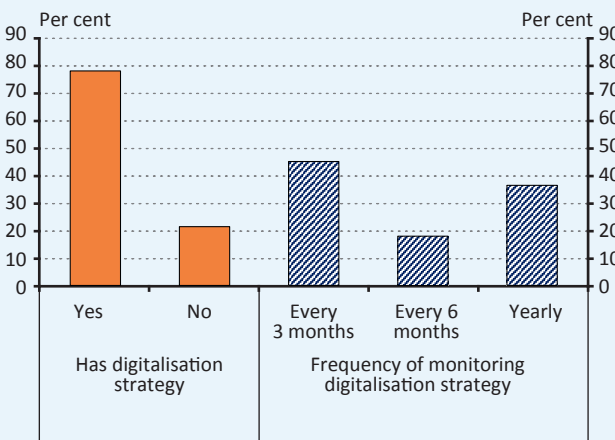
Source: MNB.

assistance (chat, chatbots, video calls) is relatively low, with no improvement compared to 2021, despite the fact, that these features are common ways of guiding customers in the digital space in other sectors. An important milestone of digitalisation is moving the notifications to the online space, but this is only observed in the case of high value retail property insurance, which is already at a more advanced level in terms of digitalisation. As for life insurances, in three quarters of the sector, still only less than 20 per cent of customers request and receive electronic notifications. Regarding corporate customers, the process, which was still improving in 2021, has stalled.

The active use of social media is also widespread among insurers, but there has been no progress since 2021. On at least a weekly basis, more than 80 per cent of insurers are active on their social media platforms, which are managed by a dedicated team almost in the entire sector (Chart 79). The purpose of using social media platforms is mainly marketing and information sharing, but three quarters of the insurers also use these platforms for recruitment. On average, insurers spend 31 per cent of their marketing budget on online marketing, a decrease of 3 percentage points compared to 2021. This suggests that, while insurers recognise the importance of a social media presence, they do not have specific sales or outreach objectives.

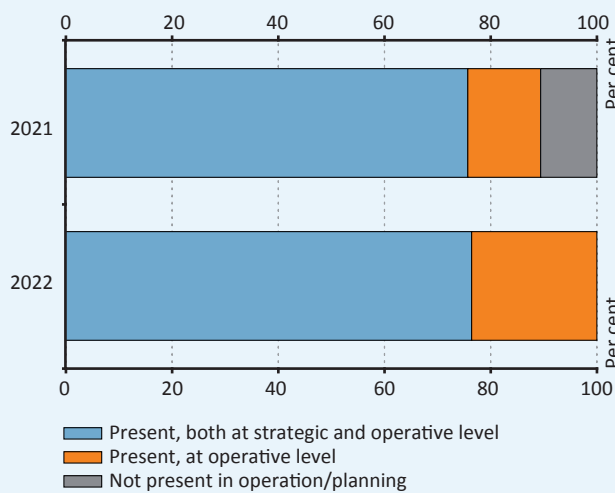
Few in the sector pay attention to a comprehensive, in-house assessment of development needs, which may lead to a loss of competitiveness in the medium term. Progress is being made by insurers in encouraging employees to implement new developments, and almost all have a dedicated framework for assessing internal development needs. However, for more than a third of the insurance sector, a comprehensive assessment of digital skills' development needs is only carried out annually, which could put this part of the sector at a competitive disadvantage in an increasingly digitalised environment (Chart 80). In contrast, roughly 60 per cent of the sector assesses development needs on a quarterly or more regular basis, which is highly progressive regarding the digital transformation of these insurers. If the assessment of development needs is accompanied by implementation, those players in the insurance sector that monitor emerging development needs more frequently may gain a competitive advantage, while the rest of the sector may lag behind in digitalisation.

Chart 81
Availability of digitalisation strategy and frequency of monitoring within the insurance sector



Note: In proportion to surveyed institutions.
Source: MNB.

Chart 82
Prevalence of user experience (UX) focused design and related methodologies in the Hungarian insurance sector



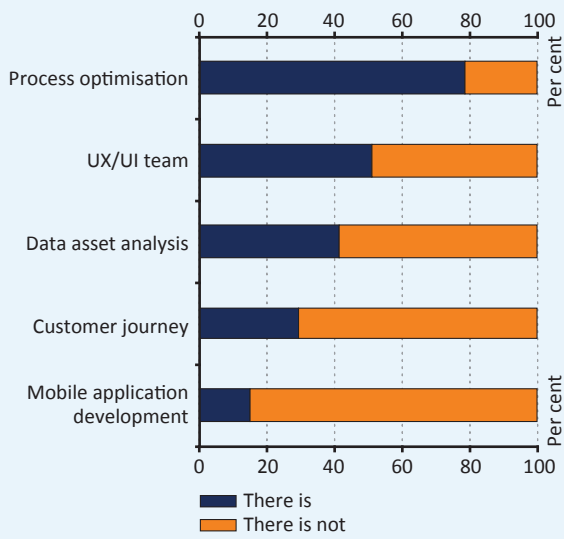
Note: The weighting was done in proportion to the gross premium income of the institutions surveyed.
Source: MNB.

4.3 PREPAREDNESS OF MANAGEMENT AND EMPLOYEES

Digitalisation remains an important strategic goal for the insurance sector, but its dedicated representation in senior management is not common yet. Digital transformation is a priority for all insurers, and it is addressed at an institutional level with a holistic approach. Nearly 80 per cent of the insurers have a dedicated digitalisation strategy (Chart 81), which demonstrates the sector’s commitment to digital acceleration. Leading insurers typically review the planned implementation of strategies on a quarterly basis. Typically, small insurers with low premium income do not yet have a strategy for digital transformation, and many of them do not have a digital transformation department. In terms of senior management representation, digitalisation-related positions (CTO, CDO) are already present in the insurance sector, but are still significantly under-represented on the board compared to the banking sector: 13 per cent of the insurers have a Chief Digitalisation Officer – or equivalent – and one third have a Chief Technology Officer. In contrast, the presence of senior executives related to data protection and information management has improved and in 2022, these positions represent a higher proportion of the sector than in previous years, with 87 per cent of the sector having a Chief Information Security (Privacy) Officer and 53 per cent a Chief Data Officer. However, the drive for modernisation is demonstrated by the fact that, unlike in 2021, there is no longer any insurer, where user-experience-focused design and related methodologies are not reflected in the design and operation (Chart 82).

The composition of teams supporting the digital delivery of services to customers suggests, that there is not yet enough focus on the customer needs. The insurers’ focus on digitalisation in front-end development is on process optimisation and user experience (Chart 83). Due to the longer life cycle of insurance products and less frequent interactions, customer journey planning and in-house mobile app development are not yet a major focus, with only a few institutions having a dedicated team with such

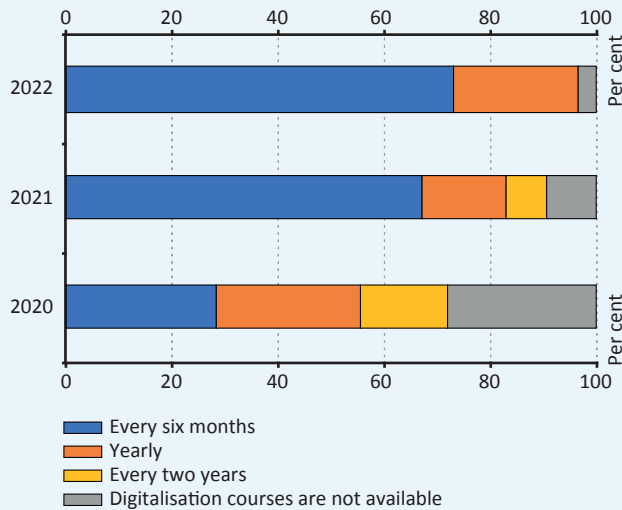
Chart 83
Dedicated teams within insurance companies



Note: The weighting was done in proportion to the gross premium income of the institutions surveyed.

Source: MNB.

Chart 84
Frequency of digitalisation courses and trainings for employees



Note: The weighting was done in proportion to the gross premium income of the institutions surveyed.

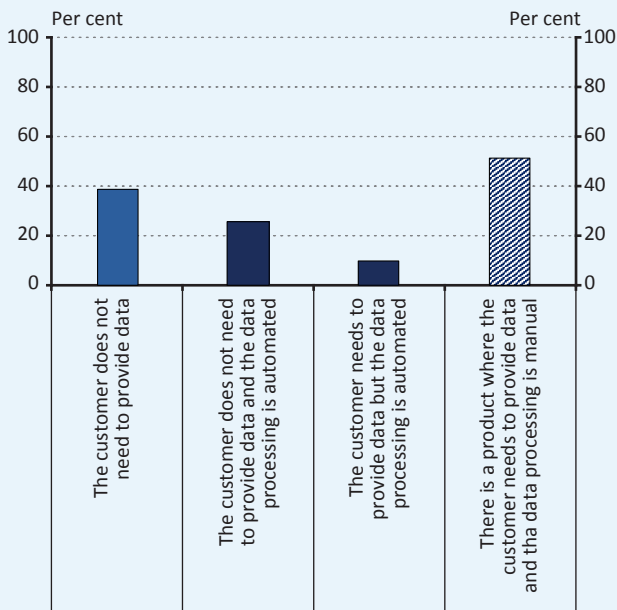
Source: MNB.

responsibilities. To exploit data assets that institutions have accumulated, it may be worth developing and expanding data-driven analytics teams to enhance the customer experience. The composition of the IT staff in institutions varies across the sector: for most insurers, the proportion of workers with no qualifications but with programming skills has decreased compared to 2021, while the number of IT workers with tertiary qualifications has increased in most places. In addition, there have been organisational changes, with IT tasks being outsourced – in some institutions partially. Looking specifically at the area responsible for digitalisation, we can see that these teams are constantly expanding with IT and non-IT colleagues. The number of people with an IT background working in such teams remains high: although there is a 10 percentage point drop in the category with 21 to 50 persons in terms of gross premium income, the number of IT experts in 15 per cent of the sector is higher, between 51–100²⁷. For non-IT employees (e.g. business), two extremes can be observed in 2022: the share of teams of less than 10 people in the area responsible for digitalisation has increased significantly (from 48 per cent to 72 per cent), but there is also a significant share of teams between 51–100 people (15 per cent).

Improving the digital skills of employees remains a priority for the insurance sector. In 2022, two thirds of the institutions report, that they regularly assess the digital skills of their staff, which is a significant increase compared to the previous year. In addition, the proportion of those responding to the survey has increased significantly (58 per cent). When new colleagues arrive, almost all insurers hold a knowledge transfer, which is typically repeated several times a year. In 2022, only the two smallest players did not offer digital literacy courses for their employees (Chart 84). In proportion to gross premium income, the institutions are increasingly providing such training at least once a year, and in most places this development opportunity is provided every six months.

²⁷ The 51–100 category was first available for marking in 2022 for both IT professionals and non-IT workers.

Chart 85
Receipt of data (e.g. claims history, payments) from other insurance company(s) when a new customer is contracted (2022)



Note: The weighting was done in proportion to the gross premium income of the institutions surveyed.

Source: MNB.

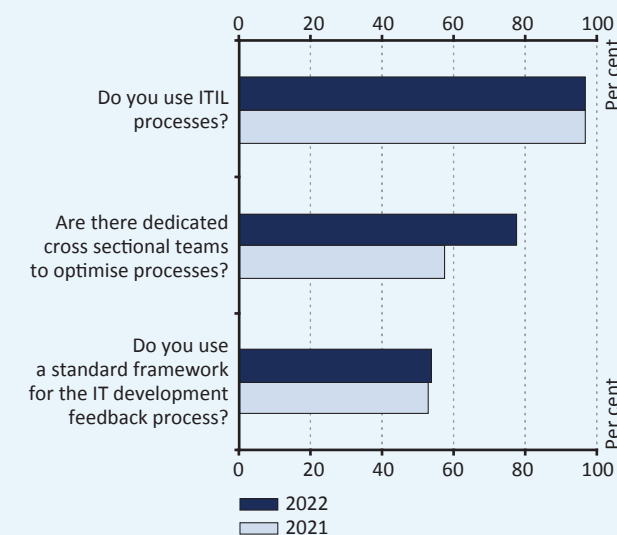
4.4 DIGITALISATION OF INTERNAL OPERATIONS

There is room for improvement in the insurance sector in terms of automation of data processing within the institution. The automation of the collection and management of customer data is an important feature of internal digital maturity. In 2022, on a gross premium income basis, only 38 per cent of the insurance sector did not require customers to provide data, when their data had already been available at another insurer, because they were transferred between institutions. In this respect, it is important to note, however, that data transfers between institutions are not possible for all insurance products, and that some customer data cannot be transferred between institutions under the current data protection provisions. At the same time, there is considerable room for improvement in terms of the automation of the handling of newly received customer data in the area of operation within the institution. More than 50 per cent of the insurance sector has products, where the data provided by the customer is processed manually, which can reduce the efficiency of processes (Chart 85).

There is little consistency in the implementation of solutions reflecting innovative approaches in the sector.

Solutions that reflect a variety of innovative process approaches can also prove to be progressive for more efficient internal processes. These can not only improve the cooperation between different organisational units through the emergence of new principles and methodologies, but also renew the harmonised operation of business and IT areas at the level of the entire organisation, through a digitalisation approach and a common framework. Although such solutions are gradually spreading in the insurance sector, the picture is somewhat mixed in terms of the uptake of the aspects examined by the MNB (ITIL processes, process of measuring back IT developments based on standard frameworks, existence of cross-sectional process optimisation teams), as only 45 per cent of the sector in terms of gross premium income basis is seen to be using all three solutions. By 2022, progress has been made only in the uptake of cross-sectional teams, but for further progress, standardisation in process management, specifically in the process of measuring back the developments, should be strengthened (Chart 86).

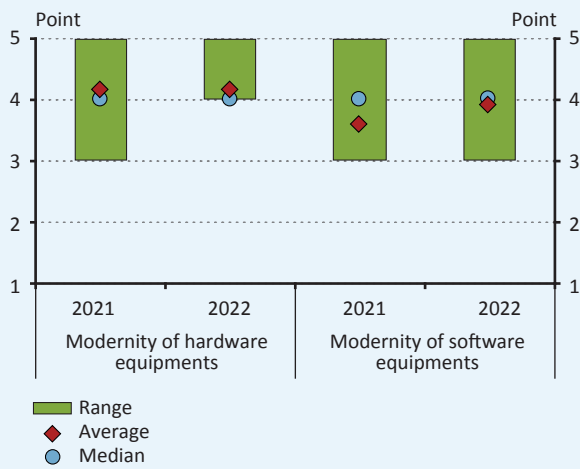
Chart 86
Prevalence of solutions that reflect an innovative process approach



Note: The weighting was done in proportion to the gross premium income of the institutions surveyed. ITIL is a set of practical processes for delivering best practice IT services to customers, making systems more efficient to operate and improve.

Source: MNB.

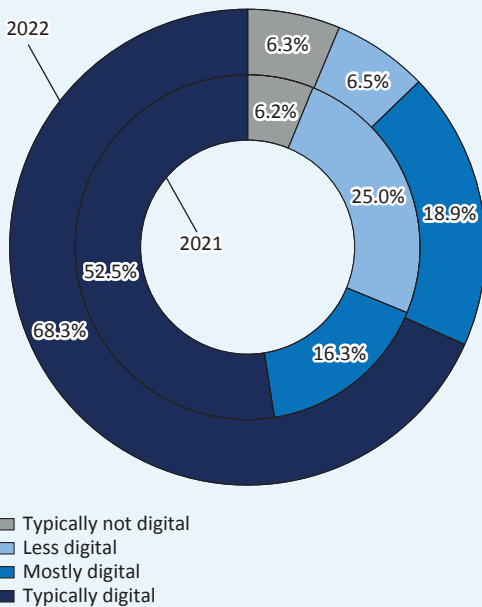
Chart 87
Assessment of the modernity of insurance equipment based on self-declaration by institutions (2022)



Note: On a scale 1 to 5, 1 - most obsolete, 5- most modern
 Source: MNB.

Domestic insurers consider their internal systems to be well developed and incremental system improvements are ongoing. There have been no recent changes in the harmonisation of the various internal system architectures, and the logic of the interconnections between the systems, and the existing frameworks continue to support the operations of insurers. At the same time, the institutions are constantly upgrading certain system components, and thus perceive their technological readiness to be more advanced. According to the self-declaration of the insurers, the state of the hardware equipment is considered to be at least good by all institutions. While the level of development assessed by the sector in terms of software remains mixed, several institutions reported an improvement from 2021 to 2022, with the average score representing modernity (on a scale of 1 to 5) approaching a 4 (Chart 87).

Chart 88
Digitalisation of archives in the insurance sector (2021-2022)



Note: The weighting was done in proportion to the gross premium income of the institutions surveyed.
 Source: MNB.

Despite continuous improvements to increase efficiency, further modernisation is needed, and it is essential to maintain reliable operations. The institutions are constantly improving their internal systems to support their workflows, which gradually reduces the production of paper documents, and the physical movement of already existing paper documents, while at the same time, increasing the digitalisation of document storage. In the latter aspect, the sector has made progress in the last year, and on a gross premium income basis, nearly 70 per cent of insurers typically or even exclusively use digital document archives (Chart 88). However, in some areas, there is still no sign of significant modernisation steps: the 67 per cent rate for institutions using cloud services in 2021 – and 2020 – has not changed for 2022. While there was no change in the proportions, last year also saw a step back in the number of institutions using cloud services, as some institutions discontinued their previously implemented cloud solution, mainly due to operational problems. It is important to keep in mind, that when moving towards innovative solutions, it should be ensured that the IT architecture is stable and reliable within the institution.

John von Neumann

(28 December 1903 – 8 February 1957)

Mathematician, mathematician physicist, founding figure of computing, the brilliant researcher of set theory, game theory, operational research, quantum mechanics, atomic energy, and digital computer design. Former professor at the Institute for Advanced Study in Princeton, member of countless universities and academies of sciences, former president of the United States Atomic Energy Commission. Streets, schools, a university and even a crater at the Moon are named after him.

Neumann showed signs of genius in many areas even as a child, then he gained several awards as a student of the Budapest-Fasori Lutheran Secondary School. After graduation he was already considered a well-qualified mathematician, he enrolled in the mathematics major of the Budapest Science University, while also pursuing his studies at universities in Berlin and Zurich. After earning his doctorate, he gave lectures both in Europe and America, then he eventually settled down in the United States. He was involved in the research and the military use of atomic energy, then also in managing the development of peaceful energy production.

Between 1945 and 1957 he was the leader of the Electronic Computer Project in Princeton. He was working on the development of machines based on the functioning of the human brain and nervous system. In 1944, he took a key role in building the first fully electronic, digital computer, the ENIAC (Electronic Numerical Integrator and Computer) at the University of Pennsylvania.

In 1945, the first electronic, stored-program computer, the EDSAC (Electronic Delay Storage Automatic Calculator), was built at the University of Cambridge using the "von Neumann architecture". Neumann based the operation of the computer on biology: he developed the algorithm similarly to the pattern of problem-solving mechanism of the human brain and used it to perform calculations in the computer. In recognition of his merits, the President of the United States of America appointed him to the Commissioner of the American Atomic Energy Commission.

Neumann is one of the greatest scientists of the 20th century, who applied mathematics not in a self-serving way, but by reacting to the needs of the era, for the purpose of usability, while achieving incredible scientific results. We can be grateful for him for the most important principles of electronic computers, like the use of binary number system, the memory, the program storage, the use of algorithm, or the development of an instruction system.

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