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## DIGITAL BANKING TRANSFORMATION: A BIBLIOMETRIC ANALYSIS OF GLOBAL RESEARCH TRENDS

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**Abstract.** The conservative banking sector is undergoing transformation and reinvention in the era of digitalization. According to this, the purpose of the study is to analyze the dynamics of publications on digital banking, identify the main scientific directions, and develop recommendations for the further development of digital banking in Kazakhstan. The methodological approach is based on the use of bibliometric analysis using VOSviewer software and the Scopus database. The analyzed period covers from 2016 to 2025. The results of the bibliometric analysis allowed us to identify four key areas of research: technological, organizational, behavioral, and regulatory. It is around these areas that the central core of the scientific discourse on digital banking is being formed. Additionally, based on the results, several recommendations were proposed that would be effective in the digital transformation of Kazakhstan's banking sector. The practical significance of the research lies in the fact that its results can be used to determine the priorities for the development of banking and financial markets in various countries, as well as to assess the risks and consequences of integrating traditional banking models with digital technologies.

**Keywords:** digital transformation, banking sector, economic development, bibliometric analysis, artificial intelligence, digitalization, banking innovation.

**Main provisions.** This article is of a scientific nature, as its novelty lies in the identification and systematization of scientific trends in the digital transformation of the banking sector. The results of the bibliometric analysis allowed us to identify four key areas of research: technological, organizational, behavioral, and regulatory. It is around these areas that the central core of the scientific discourse on digital banking is being formed. The practical significance of the research lies in the fact that its results can be used to determine the priorities for the development of banking and financial markets in various countries, as well as to assess the risks and consequences of integrating traditional banking models with digital technologies. Thus, the work contributes to an understanding of global trends in the digitalization of the financial sector and provides direction for its further development. Have the greatest potential to enhance economic development.

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**Introduction.** The era of digitalization dictates its own rules for both the global economy and its individual sectors. The banking sector has not been spared by digitalization. The conservative banking sector is undergoing transformation and reinvention in the age of digitalization. There were several reasons for this: firstly, the development of Internet-based mobile banking, and secondly, the introduction of artificial intelligence into various sectors of the economy, which served as a starting point for transforming the banking sector. The modern digital environment is forcing the banking system to transform its ecosystem and create its own development paradigm to serve businesses and the public, as the banking ecosystem integrates payments into trading platforms and other fintech partnerships. Research on the development of digitalization and its spread to economic sectors is expanding, which is reflected in the growing number of scientific papers in scientific databases. Moreover, interest in digitalization in the banking sector is also growing, as digital changes worldwide necessitate corresponding adjustments in the banking sector. Scientific research on digitalization in the banking sector mainly covers topics such as the introduction of fintech in the banking sector, changes in regulatory documents, and behavioral characteristics of subjects of the banking system; however, there are no studies devoted to a comprehensive systematization of scientific trends in the field of digitalization of the banking sector. In this regard, the research gap in this study will allow us to identify the main directions, thematic clusters, and evolutionary trends in the field of digital banking.

The novelty of this study lies in identifying current scientific trends in the digitalization of the banking sector, which enables us to pinpoint key drivers of its development, formulate recommendations for banks in the context of digital transformation, and identify promising areas for future research. The purpose of the study is to analyze the dynamics of publications on digital banking, identify the main scientific directions, and develop recommendations for the further development of digital banking in Kazakhstan.

**Literature review.** The development of digitalization in the banking sector is one of the popular scientific directions, as the banking sector serves as an intermediary for the exchange of payments between the population and other economic institutions. This was due to the rapid digitization of all economic institutions. In this regard, the banking sector has also become a technological integrator, combining financial transactions as a platform, has partially taken over the services of brokers, and has evolved into a marketplace, providing background personal data of citizens. The beginning of the digitization of the banking sector is the active use of Internet banking services by banks and their clients, which provides an advantage for its users in an online process that also does not require a personal presence [1]. The next stage involves the development of financial technologies, such as PayPal, Revolut, and Kaspi.KZ, Alipay, and WeChat Pay, which focus on improving the efficiency of using banking services and creating an ecosystem [2]. Next, non-banks were created; this is a type of bank that was founded and formed in a digital environment, for example, Freedom. At the same time, during this period, elements of artificial intelligence have been actively integrated into banking applications to enhance the effectiveness of promoting banking services [3, 4].

Additionally, the latest innovations in the bank's digitalization include the introduction of APIs, blockchain 3.0, CBDC, and green finance technology [5, 6], where Banks become part of broad digital ecosystems that integrate finance, trade, logistics, and social services. The focus is on sustainable development, green finance, ESG initiatives, and central bank digital currencies (CBDCs). Thus, digitalization in the banking sector is developing rapidly, and it is imperative for developing countries to keep pace with the introduction of advanced technologies to ensure the competitiveness of their banking systems in the global arena.

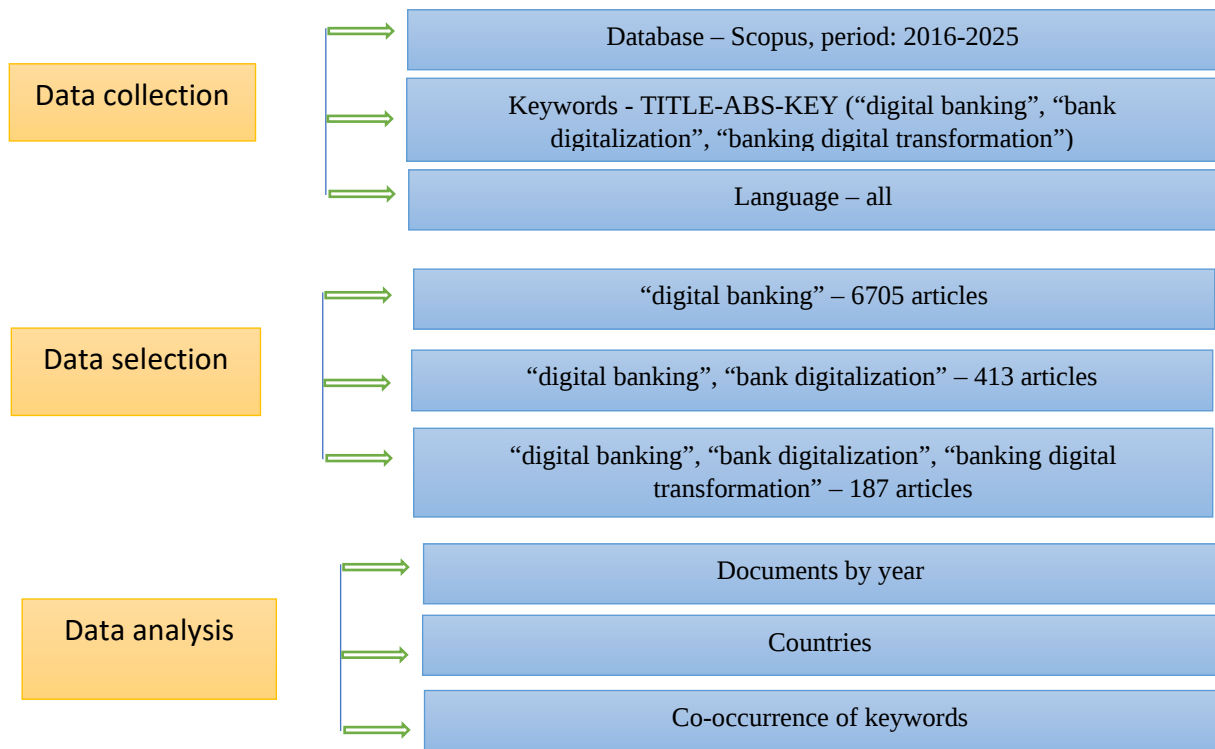


Along with these aspects, there is a growing interest in the issues of interaction between traditional banks and fintech companies, the formation of ecosystem business models, and open banking based on data exchange through APIs [7, 8]. This interest affects both the importance and development of technology and the integration of digitalization into the banking sector, as well as an increasing interest in risks such as technological, operational, and reputational. It is also important to note that the digitalization of the financial sector in Kazakhstan is being actively implemented; one of the unique business models is the development model of the Kazakh Caspian Bank [9]. This bank demonstrates that digitalization can be skillfully integrated into any business process, which will lead to significant success in both the development of the banking sector and the advancement of digitalization. Thus, considerable research has been devoted to the digitalization of the banking sector; however, it is worth noting that a fragmented approach prevails, which highlights the lack of systematization in the study of digital banking, thereby creating a research gap. In this regard, this study fills the research gap by identifying trending areas and systematizing scientific research on the digitalization of the banking sector.

**Materials and methods.** Bibliometric analysis serves as the methodological basis. Bibliometric analysis is one of the most effective methods for identifying scientific trends in the issue under study; in addition, this approach is universal and informative [10, 11]. This method is used to identify trends in scientific research within the framework of the topic under study. Identifying such trends provides important vectors for future development, strategic decision-making, and deepening theoretical understanding. Based on bibliometric research, researchers can expand the boundaries of the field under study and identify promising areas for further research. At the same time, government agencies can use the results to support the development of national or sectoral development programs, while business structures can apply them to innovate and improve management and technological practices within the industry.

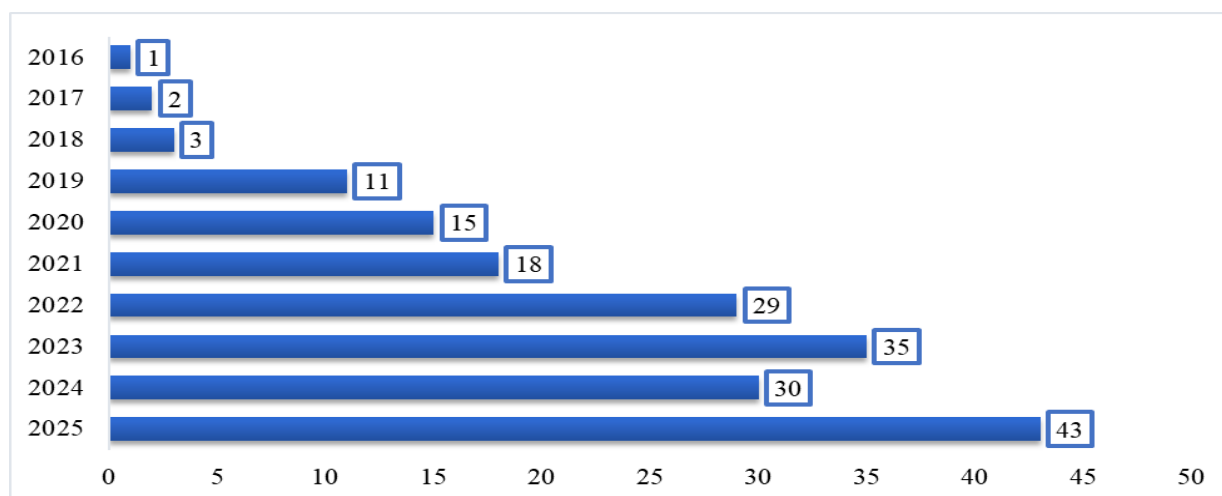
Data analysis and visualization were performed using VOSviewer software, version 1.6.19. This study used several constraints to organize the data and achieve better results. In particular, data from the Scopus database was collected for 2016-2025. This period was chosen because digital banking began to be actively promoted through digital platforms. In 2015-2016, banks began actively developing applications and selling their services through the digital environment. Before this period, of course, there were elements of digital banking, such as installing ATMs and electronic transfers. However, the more active development of digital banking occurred in the middle of 2015-2016. Thus, the analyzed period provides better trends in the development of the science of digital banking. During this period, 6,705 articles were identified using the keywords “digital banking”, “digital banking”, “digitalization of banks” – 413 articles, “digital banking”, “digitalization of banks”, “digital transformation of banking” – 187 articles. These three terms were chosen as keywords because they are the most common and frequently used in the scientific literature. In addition, these three keywords reflect different aspects of digital banking. Using these keywords allows you to cover a wider range of scientific publications and provides a more complete picture of the field of research. There were also no additional restrictions on the selection of publications.

Data analysis and visualization were performed using VOSviewer (version 1.6.19) and the Scopus analysis tool. At the final stage of the study, based on the results of the bibliometric analysis, practical recommendations for the development and improvement of digital banking in Kazakhstan were developed.



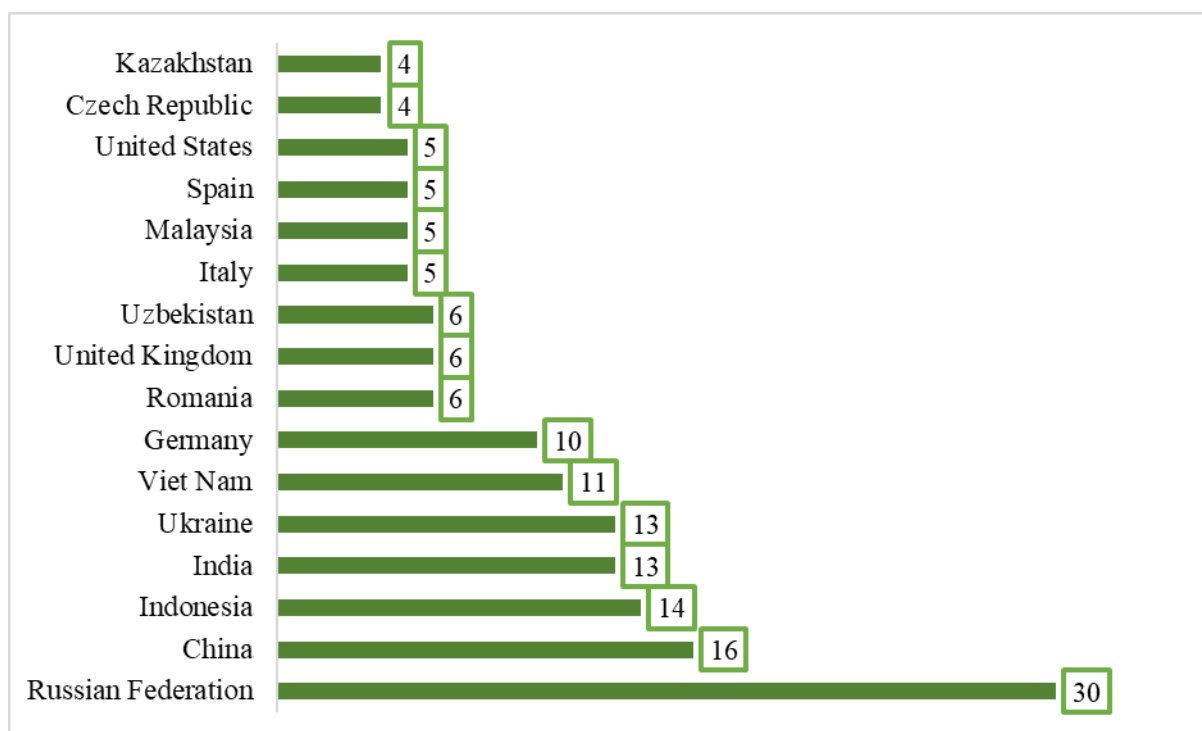
**Figure 1** – Data screening strategy

**Results and discussion.** The popularity of digitalization in the banking sector is growing year by year, as confirmed by Figure 2. The data show that in 2016, there was one publication, and then in 2019, there were 11 publications. Moreover, by 2025, there will be 43 publications. In this regard, the digital transformation of the banking system holds enormous scientific potential and has sparked significant interest from the academic community. In this context, there has been a sharp increase in 2019, driven by the rapid digitalization of the entire economy. As a result, the innovation has also affected the banking sector. Mobile banking was introduced in this area, fintech startups emerged to compete with banks, and online banks without physical branches began to develop. Consequently, the development of digitalization has not spared the banking sector; the entire economy has begun to use digital tools to remain competitive. The next increase in publication is observed in 2022, during the period associated with the COVID-19 pandemic. The pandemic began in 2019, and the main restrictions included quarantine; the population could not contact each other, so the banking sector launched remote services using applications and other fintech tools. Thus, the pandemic accelerated the transition of customers to remote services and contributed to the banking sector's transformation. Further, in 2025, there is another increase in publications. This growth has occurred due to the active introduction of artificial intelligence; the banking sector is also using this tool. Now, consultations, information, and services for Internet banking portals are always available, giving the bank a competitive advantage. Thus, based on the dynamics of publication numbers, it may seem that digital banking is developing with the times, and external economic shocks can only accelerate its growth.



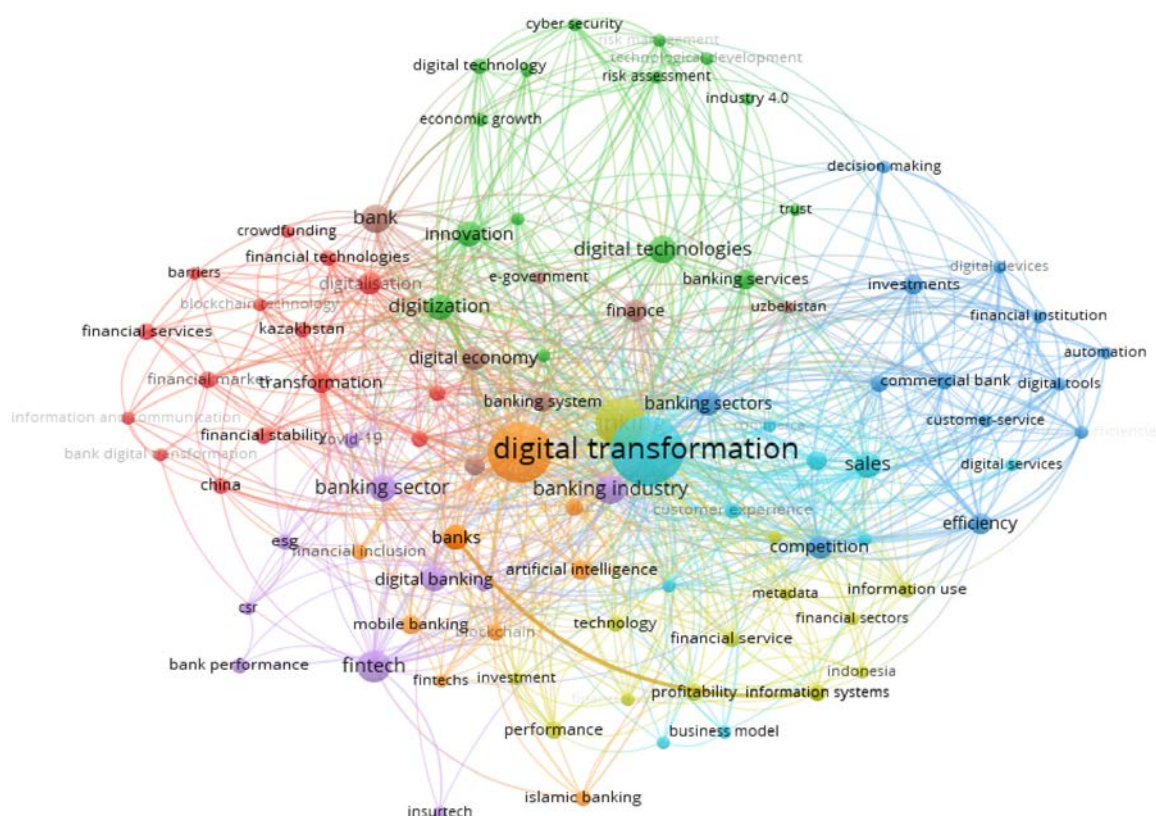
**Figure 2** – Dynamics of the number of publications on the digital banking transformation

The interest in digital transformation by country indicates that the Russian Federation has the most significant number of publications, with 30 publications. Russian scientists are studying the identification of guidelines and needs for legal regulation, as well as the potential opportunities for digital transformation of the banking sector [12, 13, 14, 15]. Russian scientists also pay closer attention to the legal regulation of digitalization and its integration into traditional banking systems, noting that international cooperation processes in the field of regulatory harmonization stimulate institutional consideration of digital transformation. However, the main reason for such a large number of publications is that Russia is implementing a state program for the digitalization of the economy, designed for the period 2019-2024. This national project aimed to reform the financial sector and also contributed to the development of fintech, prompting scientists to take a closer look at the digitalization of banks. Furthermore, by country, China shows the most interest – 16 publications, followed by Indonesia (14 publications), India (13 publications), and Ukraine (13 publications) (Fig. 3). The 16 interested in digital transformation include scientists from Kazakhstan, who also demonstrate that the digitalization of the banking system can provide several advantages in the country's economic development [16, 17]. In this case, China is one of the most powerful countries in terms of digital resources. A large number of publications in this country can be explained by China's large-scale fintech development and the testing of the digital yuan, which is leading to the complete withdrawal of banknotes from the economy. In India, Indonesia, and Ukraine, there is also an increase in publications, largely due to the rapid development of digital payment systems and initiatives to expand financial inclusion. Thus, in terms of the number of publications, Russia is the leader, driven by active research on legal regulation, followed by China, where the growth of publications is attributed to a developed fintech ecosystem; in other countries, publications relate to digital payments and financial inclusion.



**Figure 3** – Dynamics of the number of publications by country

Due to the rapidly growing interest from the academic community in the digitalization of the banking sector, clusters were generated in this study using an application program (Fig. 4). The first cluster includes keywords such as information system, technology, and financial services. This cluster reflects the technological development of the banking system. In particular, the cluster unites research on the introduction of advanced technologies that will subsequently increase the efficiency of the banking sector in the digital age. The second cluster is characterized by keywords such as the bank's business model, digitalization strategy, and bank stability. This cluster brings together scientific research on the organizational aspects of digital transformation in the banking sector, focusing on the proper organization of business processes and an effective digital business strategy to drive competitiveness. The third cluster includes keywords such as financial services, trust, digital banking, cybersecurity, etc. This cluster covers scientific research on consumers' perceptions of digital services, including trust and digital literacy, which together explain consumers' behavioral perceptions of digital banking services.



**Figure 4 – The main scientific trends in the digital transformation of the banking sector**

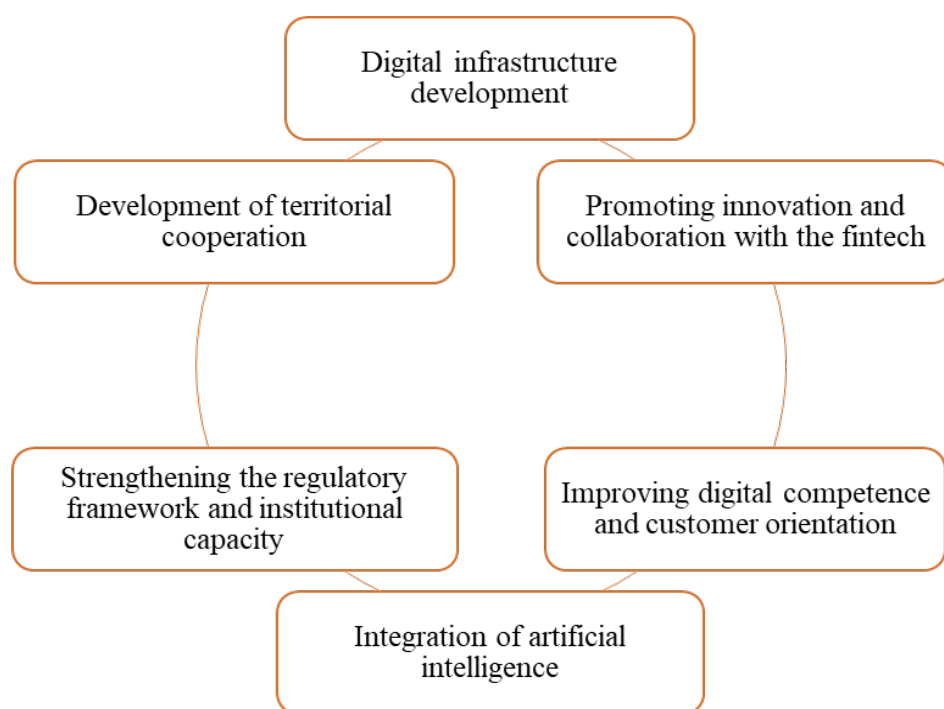
The fourth cluster includes keywords such as e-government, digital economy, globalization, and economic stability. This scientific cluster combines research on regulatory mechanisms that stimulate international cooperation and legislation, as well as the introduction of new approaches to the development and implementation of regulations in the financial market in the context of digitalization. Thus, the results of the cluster analysis of bibliometric data enabled the identification and systematization of four key trending areas of scientific research in the field of digital banking: regulatory, technological, organizational, and behavioral. This classification allows for a clearer structure of the modern scientific discussion on the digital transformation of the banking sector.

A comparison of these scientific trends with the current level of development of the Republic of Kazakhstan's banking sector shows that several areas require further strengthening. Firstly, the pace of technological development is significantly ahead of the ability of banks and regulators to integrate it. To implement digital transformation, the Kazakh banking sector needs significant investments to introduce innovative technologies and update its digital infrastructure. However, the level of financial and technological resources of individual banks may limit the speed of implementation of large-scale digital solutions. To implement such innovations, the bank will need resources, which will increase the cost of banking services and eventually lead to higher prices, reducing consumption. Therefore, it is important to introduce more accessible and efficient digital financial services. Secondly, banks face a dual task: not only to find and adapt innovative solutions, but also to implement them in a way that ensures sustainable productivity and profitability growth. Thus, Kazakhstani banks face the task not only of implementing but also of developing a well-formed strategy and business model in the banking sector. Thirdly, successful digitalization is impossible without a consumer orientation. Kazakh banks should



implement big data processing to track consumer behavior and perceptions. This will allow Kazakhstani banks to increase customer satisfaction and create new financial products and services tailored to users' real needs. Fourth, there are no regulations in Kazakhstan regulating the use of digital instruments in the banking sector. This necessitates that government agencies in Kazakhstan develop and implement regulatory documents that balance innovative development, consumer protection, cybersecurity, and financial stability.

The results of the bibliometric analysis were compared with the development of digital banking in Kazakhstan. The comparison revealed several problems with digital banking in Kazakhstan that require attention, which was the case earlier. Based on the identified problems, in order to improve digital banking in Kazakhstan, it is necessary to create a unified digital infrastructure and standardize data; promote innovation and cooperation with the fintech sector; increase digital competence and customer orientation; develop artificial intelligence and data analytics in the banking sector; strengthen the regulatory framework and institutional capacity; develop regional and international cooperation (Figure 5).



**Figure 5** – Directions of development of digital transformation of the banking sector of Kazakhstan

Thus, the results of the bibliometric analysis showed a gap between the development of digital banking in Kazakhstan and global scientific trends. Within the technology cluster, it is proposed to develop a unified digital infrastructure, standardize data, and expand the use of artificial intelligence and data analytics in the banking sector. Within the organizational cluster, it is proposed to stimulate innovation and strengthen cooperation between banks and the fintech sector. As part of the behavioral cluster, it is proposed to increase digital competence and customer orientation in the provision of digital financial services. Within the regulatory cluster, it is proposed to strengthen the regulatory framework and institutional capacity. The implementation of these measures will ensure a sustainable digital transformation of Kazakhstan's banking sector and create a modern financial ecosystem capable of meeting the needs of the digital economy.



**Conclusion.** The purpose of this article was to analyze the dynamics of publications on the topic of digital banking, identify the main research areas and schools, and develop recommendations for the further development of digital banking in Kazakhstan, which was successfully achieved. The main results of the study indicate that the scientific trends in the digital transformation of the banking sector encompass areas such as technological, organizational, behavioral, and regulatory aspects. Numerous studies have explored these areas, indicating that they are significant to the development of the digital banking sector and the financial market. Thus, global trends suggest that Kazakhstan should focus on enhancing the competitiveness of its banking and financial markets. In this regard, to enhance the global transformation of the banking sector in Kazakhstan, it is recommended that fintech incubators and accelerators be established within large banks and that partnerships be fostered between banks and fintech startups in areas such as artificial intelligence, scoring, blockchain, ESG finance, and digital insurance. In addition, the state should implement the national program "Digital Literacy for Banking Customers", aimed at improving the digital literacy of the population, to increase confidence in banks and the financial market. To improve the adoption of new technological banking innovations, banks should implement customer feedback practices (UX research, interface testing, behavioral pattern analysis) before introducing new technologies.

Additionally, improvements in legislation regarding digital currencies, Big Data, biometric identification, and personal data protection would enhance the digital transformation of Kazakhstan's financial sector. Thus, considerable work remains to be done in the banking and financial sector to integrate digitalization with traditional banking systems. However, digital innovations should not be ignored, as they may hurt the country's economy.

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### ЦИФРЛЫҚ БАНКИНГТІ ТРАНСФОРМАЦИЯЛАУ: ҒАЛАМДЫҚ ЗЕРТТЕУЛЕР ТРЕНДТЕРІНІҢ БИБЛИОМЕТРИЯЛЫҚ ТАЛДАУ

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**Түйін.** Консервативті банк секторы цифрландыру дәуірінде түбегейлі трансформация мен қайта пайымдаудан өтуде. Осыған сәйкес зерттеудің мақсаты – цифрлық банкінг тақырыбы бойынша жарияланымдар динамикасын талдау, негізгі ғылыми бағыттарды айқындау және Қазақстандағы цифрлық банкінгті одан әрі дамыту бойынша ұсынымдар әзірлеу болып табылады. Әдістемелік тәсіл Scopus деректер базасы мен VOSviewer бағдарламалық қамтамасыз етулерін пайдалану арқылы библиометриялық талдауға негізделген. Талдау кезеңі 2016 жылдан 2025 жылға дейінгі аралықты қамтиды. Библиометриялық талдау нәтижесінде төрт негізгі зерттеу бағыты айқындалды: технологиялық, ұйымдастырушылық, мінез-құлықтық және нормативтік. Дәл осы бағыттар цифрлық банкінг бойынша қазіргі ғылыми дискурстың өзегін қалыптастырады. Сонымен қатар алынған нәтижелер негізінде Қазақстан банк секторын цифрлық түрлендіру үдерісінде тиімді болатын бірқатар ұсынымдар ұсынылды. Зерттеудің практикалық маңыздылығы оның нәтижелерін түрлі елдердің банк және қаржы нарықтарын дамыту басымдықтарын айқындау, сондай-ақ дәстүрлі банк үлгілерін цифрлық технологиялармен интеграциялауға байланысты тәуекелдер мен салдарларды бағалау үшін пайдалану мүмкіндігінде жатыр.

**Түйінді сөздер:** цифрлық трансформация, банк секторы, экономикалық даму, библиометриялық талдау, жасанды интеллект.

### ТРАНСФОРМАЦИЯ ЦИФРОВОГО БАНКИНГА: БИБЛИОМЕТРИЧЕСКИЙ АНАЛИЗ ТЕНДЕНЦИЙ МИРОВЫХ ИССЛЕДОВАНИЙ

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**Резюме.** Консервативный банковский сектор претерпевает трансформацию и переосмысление в эпоху цифровизации. В соответствии с этим целью исследования является анализ динамики публикаций о цифровом банкінге, определение основных научных направлений и разработка рекомендаций по дальнейшему развитию цифрового банкінга в Казахстане. Методологический подход основан на использовании библиометрического анализа с использованием программного обеспечения VOSviewer и базы данных Scopus. Анализируемый период охватывает период с 2016 по 2025 год. Результаты библиометрического анализа позволили нам выделить четыре ключевые области исследований: технологическую, организационную, поведенческую и нормативную. Именно вокруг этих областей



формируется центральное ядро научного дискурса о цифровом банкинге. Кроме того, на основе полученных результатов было предложено несколько рекомендаций, которые были бы эффективны при цифровой трансформации банковского сектора Казахстана. Практическая значимость исследования заключается в том, что его результаты могут быть использованы для определения приоритетов развития банковского дела и финансовых рынков в различных странах, а также для оценки рисков и последствий интеграции традиционных банковских моделей с цифровыми технологиями.

**Ключевые слова:** цифровая трансформация, банковский сектор, экономическое развитие, библиометрический анализ, искусственный интеллект.

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