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Modernisation of the national system of administrative services in Ukraine, caused by the Russian-Ukrainian war

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Abstract. The relevance of the study is conditioned by the fact that in the context of a full-scale invasion, the level of efficiency of citizens' exercise of their constitutional rights decreases, specifically, this concerns the functioning of the mechanism for providing administrative services. The purpose of this study was to identify the current issues in the sector and to find ways to overcome them. For this purpose, such methods as logical analysis, formal legal analysis, legal hermeneutics, dogmatic analysis, functional analysis, and others were employed in this study. It was found that the migration processes caused by the war in Ukraine require a complete revision of regulation and the development of a legislative framework and mechanism for the provision of services by public authorities in this area. This necessity is conditioned by the current state of regulation of migration services in electronic format, which needs to be improved and indicates gaps and shortcomings that need to be addressed. It was noted that one of the problems is insufficient legal regulation and funding of state bodies, which also reflects the existence of problems in the provision of electronic services. The findings indicated the current lack of development concept and action plan to improve the provision of migration services in an electronic format. The essence of the process of administrative service provision, which affects decentralisation and the work of relevant bodies, was covered. In this context, the factors that influence the speed of provision of such services were identified by analysing the scientific positions of scientists. The terms "administrative legal instrument" and "administrative service" were considered. The practical value of the recommendations provided lies in their possible use by public authorities and the legislator to eliminate the existing problematic aspects in the regulatory framework and by administrative service providers to improve the efficiency of this mechanism under martial law

Keywords: full-scale invasion; citizens' rights; public authorities; migration; Diia app

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INTRODUCTION

Reforming public administration in Ukraine in line with European standards involves a transition from a functional state to a service state that provides various types of services to citizens and legal entities, including administrative services. Among the important tasks within this reform is to increase the efficiency of administrative services and create accessible conditions for individuals to receive such services. The migration processes caused by the war in Ukraine require a thorough review of administrative legal regulation. In this regard, it is necessary to develop an effective legislative framework for the provision of services by public administrations in this area. The war conditions hinder the access to these services, and therefore it is important to improve the provision of electronic migration services and create an effective mechanism to ensure that Ukrainian citizens can receive quality migration services regardless of their location.

As noted by S.M. Gusarov & N.I. Marchuk (2023), since 2012, Ukraine has been actively developing a network of administrative service centres and introducing a system

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of electronic services. However, the availability of these services and the level of service varies from community to community. According to T.P. Minka (2022), there are obstacles to the integration of popular services into administrative service centres due to excessive centralisation of powers in this process. The conditions of the armed conflict contributed to a deterioration in the quality of administrative services in 2022-2023. The scope of administrative services became clear after the adoption of the Law of Ukraine No. 5203-VI "On Administrative Services" (2012). According to O. Kozhushko (2023), one of the most pressing issues in the context of a full-scale invasion is the provision of administrative services. Ensuring the quality of this mechanism requires constant monitoring and control over the work of the Administrative Service Centre (ASC), as O. Kalynovska (2023) writes.

The Centre of Policy and Legal Reform implemented the project Facilitating access to public services and improving their quality during the war in Ukraine (2022). Within the framework of this project, the work of Administrative Service Centres was monitored in several regions of Ukraine. K. Kandagura & R. Koshel (2022) note that the analysis was conducted for 8 ASCs, including Kyiv, Lviv, and regions close to the frontline, such as Dnipro and Kharkiv. This study found that most ASCs in the context of armed conflict have successfully resumed their work and access to state registers, which, as noted by M. Tymchenko (2022), were blocked in the first months of the full-scale war. V. Yatsenko *et al.* (2022) write that during the war, some of these ASCs suffered property losses and had to rebuild their material base. They were forced to reduce their working hours, and in some cases, some of their staff resigned; according to the monitoring results, not all ASCs provide a full range of basic services.

Despite the relevance of this topic, the number of scientific papers addressing the provision of administrative services during active hostilities is insufficient, as well as recommendations for practical improvement of public administration in this area, which led to the conduct of this study. The purpose was to analyse the problems of the current state of administrative service delivery to citizens and provide appropriate recommendations for overcoming them. This required the completion of certain tasks, namely reviewing the current legislation, describing the practical application of the established norms, and identifying problems and prospects in this area.

MATERIALS AND METHODS

This study was conducted using several types of analysis methods. The method of functional analysis was used to characterise the term "administrative service", to identify its inherent features, functions, and role in ensuring the rights of citizens during martial law. The method of logical analysis made it possible to assess the effectiveness of the current mechanism for providing administrative services, as well as to identify ways to modernise and improve its efficiency. The method of statistical analysis was used to determine the indicator of registered internally displaced persons (IDPs) in 2022-2023.

The formal legal method was used to analyse the provisions governed by the current regulations. The study examined the rules set out in the regulatory documents. This method consisted of a systematic study of their text, determining the content, terminology, sequence of presentation, internal connections, and other formal aspects. This method helped to identify how particular rules govern a particular area of activity, including the provision of administrative services. The formal legal method helped to define the rules for organising and providing administrative services following the legislation, to identify the procedures for providing administrative services under martial law, including requirements for applicants, terms of service provision, the procedure for submitting applications, and other aspects. The dogmatic method was used to understand and interpret legislation based on the text of the law, study its content to determine what rules and principles of law it contains, and to identify its structure and logic. The application of the dogmatic method to the analysis of administrative services helped to define these services in the context of the provisions, rights, and obligations of the parties, and procedures.

The method of legal hermeneutics helped to analyse the understanding of legal texts and norms, the logical structure of the text and the links between its various parts, determine the context and relationship with other norms and rules, and determine the legislator's goal based on the consolidated norms. The method of comparative legal analysis was employed to compare legislation and regulations to identify similar or different approaches to the regulation of administrative services. It provided an opportunity to identify similarities and differences in legal regulation, compare the rules of service provision in martial law and peacetime, which helped identify best practices in the provision of administrative services and their further implementation, and identify innovative approaches to administrative service provision that can be used to improve the service provision system in the country. The method of abstraction was used to focus on such an aspect of the study as the migration process and to identify its characteristic features in the context of administrative service provision in the context of a full-scale invasion. The method of deduction made it possible to characterise the mechanism of administrative services based on their inherent features, principles, and specifics of implementation during martial law. The induction method was used to determine the characteristics of administrative services based on the analysis of the current legislation of Ukraine. The synthesis method helped to combine the results to develop concrete recommendations.

RESULTS

The occupation of a large part of Ukraine and intense hostilities have led to a considerable flow of internal and external migration processes, which have increased the need to provide Ukrainian citizens with various administrative services to restore their social status. There was a need to provide various types of social support and documentary guarantees for compensation for material damage caused by the war. An administrative service is the result of the exercise of power by an entity that provides it at the request of a person, aimed at obtaining, changing, or terminating the rights and/or obligations of such a person following the established rules. The ASC is a permanent working body where the relevant services are provided through an administrator who interacts with the providers.

The administrative services sector has become particularly relevant due to the growing security challenges, especially in the context of a full-scale invasion. During the period of full-scale invasion, the status of people changes rapidly due to significant internal and external migration, which requires documentation or confirmation in the systems of the Civil Registry Office (CRO), ASC, and the Pension Fund of Ukraine. The need to provide social support to citizens who have suffered significant losses caused by the war, such as health damage and loss of property, has increased. At the beginning of the full-scale invasion, there were problems such as identification in case of loss of documents, as well as the suspension of the demographic register and the State Customs Service; blocking of all state registers and the suspension of administrative services to citizens, such as business, real estate, and vehicle registration; interruptions in the operation of the Diia app and other services.

The Diia app eventually helped solve these problems by enabling the rapid resumption of state aid payments (including ePidtrymka) and the restoration of useful services for digital documents (Law of Ukraine No. 1932-IX, 2021). In parallel with this, the Cabinet of Ministers of Ukraine implemented prompt and creative solutions, such as the extension of overdue documents, automatic renewal of social benefits, introduction of extraterritoriality for IDPs in the payment of pensions and social support, telephone confirmation of unemployment status, use of backup state registers and their transfer to the cloud, etc. The Russian-Ukrainian war has led to changes in the system of administrative service delivery at the national level, which are determined by two factors: new characteristics of administrative services and new mechanisms and methods of providing these new services. The Pension Fund of Ukraine, CRO, and ASC are included in the scope of such administrative services.

The ASC was added to the list of administrative services: the creation of an extraterritorial register, which required substantial changes to the Unified State Register of Legal Entities, IEs (individuals-entrepreneurs) and public formations (Resolution of the Cabinet of Ministers of Ukraine No. 381, 2022). This initiative was driven by the relocation of businesses from the occupied territories or areas close to the war zone or regular hostile attacks. It is also worth noting the formation of a register of damaged property of citizens, IEs, and legal entities, which is provided for by changes in the current legislation, and the provision of compensation for the restoration of real estate damaged by the aggression of the Russian Federation, which is carried out through the eVidnovlennia programme using the Diia mobile application, and the payment of compensation for the provision of housing and communal services to temporarily displaced persons (Resolution of the Cabinet of Ministers of Ukraine No. 381, 2023). The provision of primary social protection to servicepeople for their rehabilitation, as well as services for persons with military disabilities, should be highlighted (Law of Ukraine No. 3531-XII, 1993). The CRO system is distinguished by its extraterritoriality in the provision of administrative services, due to the emergence of internally displaced persons in different regions of Ukraine. Thus, CRO provide administrative services that are specific to these individuals but are available to all citizens of Ukraine.

The Pension Fund of Ukraine has created units specialising in pensions for military personnel, military invalids, and social security for their families. However, in Ukraine, the situation caused by the aftermath of hostilities has led to complications in the management of social protection, including the impossibility of calculating social benefits. The decentralised mechanism for calculating and financing social payments by the structures of the Social Insurance Fund of Ukraine has led to these problems. The Pension Fund of Ukraine is ready to perform this function, as it has a developed network of territorial management bodies operating on an extraterritorial basis, which allows it to assign and accrue pensions, subsidies, and insurance payments. This extraterritorial mechanism can ensure the right of Ukrainian citizens to receive social benefits.

The digital transformation of the Pension Fund of Ukraine's functions also contributes to achieving this goal. This administrative complexity prompted the submission of Draft Law of Ukraine No. 9318 "On Amendments to Certain Legislative Acts of Ukraine on Improving the Management and Administration of Social Support for Families and Demographic Policy" (2023) to the Verkhovna Rada of Ukraine. The plan envisages delegating the following functions to the Pension Fund of Ukraine to provide administrative social services,: providing maternity benefits for unemployed women, at the birth or adoption of a child, for children under guardianship or custody, for single mothers, providing financial support to foster parents and adoptive parents for the provision of social services in family-type children's homes and foster families, payment of a single social security contribution for foster carers, foster parents, and adoptive parents, etc. (Volos, 2023). Specialised units have been set up at the district offices of the Pension Fund in Kyiv to provide pensions to the military. All ASCs, structures of the Pension Fund of Ukraine and CROs, as well as the State Enterprise "Document" (SE "Document") (which issues state-issued documents, mainly internal and foreign passports and driving licences) in Kyiv operate on an extraterritorial basis, which is important in the current context of the war with Russia.

When Russia's large-scale aggression began, the issue of external migration of Ukrainian citizens who, to ensure their safety, went abroad with their children became a pressing issue. The need to help these Ukrainians was focused on the procedure for obtaining a passport of a citizen of Ukraine for travelling abroad, as this document helps in resolving issues related to asylum and social support provided to Ukrainians following the national legislation of each country. This problem is significant, as many Ukrainian citizens crossed the border with internal passports of Ukrainian citizens issued in 1994, and their children had birth certificates or expired passports. Due to the large flow of people, consular offices began to experience overloads in meeting the needs of Ukrainians for passport documents for travelling abroad. At the initiative of the State Customs Service of Ukraine, a proposal was put forward to the Cabinet of Ministers of Ukraine to launch a pilot project, which was regulated by Resolution of the Cabinet of Ministers of Ukraine No. 678 "On the Implementation of an Experimental Project on the Issuance of a Passport of a Citizen of Ukraine and a Passport of a Citizen of Ukraine for Travel Abroad to Citizens of Ukraine Who Are Outside

Ukraine, Issuance and Exchange of Permanent Residence Permits for Foreigners and Stateless Persons Permanently Residing in Ukraine Residence During Their Stay Outside Ukraine" (2022), to establish separate SE "Document" units in EU countries. In implementing this governmental resolution, an analysis of the movement of Ukrainians was carried out, which led to the identification of Poland as a priority country for the project. SE "Document" has started to cooperate with the Ukrainian authorities, various foundations and NGOs (non-governmental organisations) to provide funding for the issuance of passports for Ukrainian citizens to travel abroad, as most of them have left the country without financial resources.

SE "Document" work on processing documents for travelling abroad began in Warsaw, where automated mobile complexes for processing documents were sent. This helped to solve the problem of a large flow of Ukrainian citizens wishing to obtain passports for travelling abroad. For this reason, a stationary centre was set up to increase the number of documents that can be processed. These centres were installed in shopping malls in convenient locations to provide logistics. To implement their work, employees from SE "Document" were sent to them and began receiving citizens who needed to draft documents. SE "Document" receives support from the International Centre for Migration Policy Development (ICMPD), which provides funding, specifically from the governments of Germany and the Czech Republic, to develop its activities (Ukrainians in Gdańsk, Prague…, 2023). SE "Document" work in Europe was made possible by a project to digitise and put into electronic format the entire state paper archive, which included millions of applications for Ukrainian passports of 1994 and 1974 in the Unified State Demographic Register. This allows employees of the State Migration Service of Ukraine to make decisions on the identification of persons and the issuance of passport documents to Ukrainian citizens remotely and efficiently. The digitisation of archives is in line with modern innovative technological trends in the development of the administrative service delivery system and the digital transformation policy of Ukraine, which contributes to the improvement of the level of service in Ukraine.

The war conditions have led to an increased burden on the respective government agencies providing administrative services. Specifically, due to military events and forced displacement, many citizens were forced to leave their places of residence and move from regions where active hostilities had been ongoing to safer areas and obtain IDP status. It is worth considering the statistics of registered IDPs (Fig. 1).

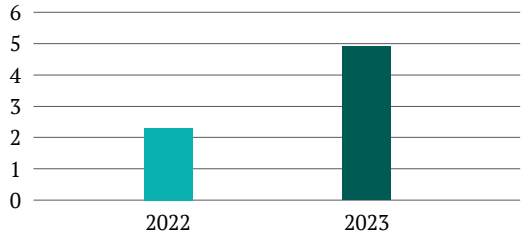

Figure 1. Number of registered IDPs, million people
Source: compiled by the author of this study based on Internally displaced persons (2023)

Proceeding from the above data, the number of registered IDPs has increased considerably, which is caused by the aggression of the Russian Federation. This situation has substantially affected the provision of quality and efficient basic administrative services. To improve this aspect, state and local authorities have taken several important measures. For example, the Law of Ukraine No. 2073-IX "On Administrative Procedure" (2023) was adopted to ensure the equality of the interests of the population and the obligations of the state. The law will come into force in December 2023, and a range of actions have been envisaged prior to its implementation, including amendments to the regulatory framework and training of employees of the relevant authorities in special rules and procedures. The adoption of this law opens a new stage in the interaction of the state with citizens and business. It aims to facilitate decision-making and improve communication between citizens and public administration. This will create an effective mechanism of interaction aimed at meeting the needs of citizens and businesses and will bring Ukraine in line with European standards in the field of the right to a due administration. Summarising the analysis of administrative service delivery in the context of decentralisation during the war, the identified human rights have the potential to be exercised if external and internal circumstances are conducive to this and do not prevent Ukraine from freely developing towards a democratic society and the rule of law.

Thus, to improve the quality and speed of administrative services under martial law, it is important to transfer the authority to provide this type of service to the level of local self-government bodies, which requires the following recommendations. This can be achieved through the instruments of delegation, transfer of powers, and financial resources from state authorities to local governments. It is worth noting the general prospects for the development of this system, namely: it is necessary to streamline the payment for administrative services, deregulate and simplify administrative procedures, including reducing the number of services and simplifying their provision. It is important to ensure that information can be exchanged between electronic registers, that e-services are used more widely at the national level, and that powers are optimally distributed among distinct levels of public administration, including state and local governments. A performance evaluation system should be in place for all local managers and autonomous entities that provide administrative services to citizens.

To ensure full implementation of feedback from service recipients, a mechanism should be introduced to allow the authorities to efficiently process the many citizens' feedback on the quality of public services provided in electronic format. Citizens can evaluate the quality of administrative services through a special system for tracking the quality of public services based on a telephone hotline or the creation of a separate Internet portal for receiving user feedback. The main objective is to ensure that public authorities and local institutions post open public information on the Internet to demonstrate the transparency of their activities. Access should be provided to the main state information resources and systems, except for information that constitutes a security secret, except when such information is provided upon request by regulatory authorities.

It is important to continue to take measures to control the information to be published on the websites of public authorities. The main purpose is to ensure that the necessary information can be obtained from executive authorities and non-governmental bodies (e.g., credit institutions, insurance companies, notaries, etc.) in the form of electronic services. By increasing the number of participants in interagency cooperation, state and local services should strictly adhere to the rules and requirements regarding the protection of personal data, compliance with the regulations governing the exchange of information between agencies, and clearly define procedures for accessing the necessary information. This sector should also include a register of interagency cooperation, which will contain information on participants in interagency cooperation, available documents, and rules for access to information. To create a legal system of information interaction between executive authorities, local self-government bodies and other organisations, including legal entities subject to public law, a concrete form of interaction must be established. The introduction of the administrative services model will contribute to the development of the system of services to the public and business. The introduction of an electronic administrative service delivery system offers considerable benefits that can improve the quality of ASC services.

Therefore, it is worth using the ASC monitoring methodology. This will allow for an expert assessment of the implementation and real use of single-window and e-government technologies, as well as an assessment of the conditions for providing this service from the perspective of customers and the development of appropriate recommendations for its improvement. It is important to consider that one of the main issues is the funding required to create the proper conditions for quality service in ASCs. The main tasks for improving the system are to enhance the quality of information services to visitors on available services, to establish an electronic queue to create comfortable conditions for citizens applying for services, to place information kiosks and booklets to further inform visitors, which will improve the results of service delivery, and to introduce an electronic queue through terminals or an online platform to ensure transparency and openness, which will greatly facilitate the comfortable provision of services and is a key element in improving the system.

DISCUSSION

Ukraine's integration into European processes contributes to the introduction of the concept of a service state as an alternative to the traditional administrative system of state governance. The reform requires the introduction of innovative approaches aimed at meeting the needs of citizens and businesses, as well as serving the entire society. R.E. Wismanu (2019) highlights that the theoretical aspects of administrative services have developed significantly in recent years. It is worth agreeing with this statement, which is due to attempts to define this concept and ending with the approval of the Concept of Development of this system. The constant adoption of governmental decisions and laws on this topic demonstrates the relevance of this issue.

According to J. Chen *et al*. (2020), the very idea of administrative services was taken from international practices, specifically from the concept of "new public management" and the state's focus on the needs and interests of citizens as clients, as well as serving society as a whole. Person-centredness on the part of public authorities is a vital component of the system of public services and administrative services, which are considered as one of the types of public services. Proceeding from this statement, the main purpose is to restructure the bureaucracy into a more flexible organisation that uses other methods. R. Calo & D.K. Citron (2020) believe that the reorientation of the state towards services is the main principle of transforming the system of providing these services. The author of the study agrees with this position and note that the strategic priorities for the development of this system include ensuring that administrative services are provided efficiently, quickly, and effectively, following the established standards that meet the expectations of citizens.

As described by S. Ziyadin *et al.* (2020), the system of administrative service delivery bodies gives a special place to administrative service centres. In this aspect, the issue of the impact of decentralisation on the provision of these services in Ukraine under martial law is also becoming important. Legal regulation of interaction between state authorities and local self-government bodies and individuals and legal entities has become a problem for Ukrainian society in the current context of democratic changes in society and the state. This has led to a review of the legal instruments and methods used by state and local authorities to regulate social relations. This need to adjust legal practice relates to the introduction of new institutions and categories in administrative law.

For example, scholars have varying interpretations of the term "administrative legal instrument". C. Houy *et al.* (2019) emphasise the problem of defining this term and the lack of regulatory support for public administration instruments, which complicates the interpretation of their essence and generates scientific debate. A. Androniceanu *et al.* (2022) propose to replace the term "form of governance" with "instruments of public administration". It should be added to the authors' position that the instruments of public administration are considered to be the means used by entities to regulate public relations in the field of public administration. This approach facilitates the adaptation of national administrative law to European standards and helps to avoid inconsistencies and inaccuracies in legislation.

The main ways of exercising public power, which play a significant role in maintaining the effectiveness of the governance system, include issuing official documents and orders according to the powers of persons, conducting control and supervision activities, reviewing complaints, etc. O. Lincoln (2023) pays particular attention to the provision of administrative services to individuals and legal entities. It is advisable to add to the author's position that public administration bodies combine various forms and methods to achieve positive results in their activities to protect the rights and freedoms of citizens. An indicator of the effectiveness of their work is the level of citizens' satisfaction with the public services they receive. However, the term "public services" does not have a clear legal definition, and

the legislation does not regulate them in detail, except for the issues of payment for such services.

The main areas of development of public services in foreign countries include creating convenient and accessible conditions for citizens to receive services, determining the optimal provider of such services, using special technologies to provide services, including the digitalization of certain services, and the creation of web portals for simplified access to them (Ibrahim & Benabdelhabi, 2022). Notably, the Ukrainian doctrine of administrative services, which forms an integral part of public services, is an internal development in Ukraine. In other countries, such as the United States, the United Kingdom, and Germany, the term "public services" is used very flexibly and in a broader context. They use categories such as "public services", "administrative services", "services for citizens", "services for business", etc. (Mammadli, 2023). According to E. Trammell *et al*. (2020), in these countries, attention is focused on the fact that any actions, decisions, or services provided by public authorities to people and companies can be services, and this is not always accompanied by legal terms.

Notably, the full-scale invasion of Ukraine by Russia and the introduction of martial law did not substantially affect the demand for administrative services. Registration of civil status acts, obtaining passport documents, IDP registration and protection, and other services stayed in demand, although the number of IDPs increased considerably. This period also saw an increase in the need for social support and other services for people in demanding situations due to the war. The analysis of administrative service provision during the war reveals those decisions of the Government that substantially affected the efficiency of their provision. Among these solutions are the following: extending the validity of expired passports and driving licences; automatic extension of social plan payments; telephone confirmation of unemployment status; introduction of the eDocument; the possibility of getting married within a day without added costs using video communication and witnesses, etc. Such actions by the state, according to M.W. Bauer & S. Becker (2020), confirm the level of citizens' satisfaction with public services received, which indicates the effectiveness of public administrative bodies. However, the quality of certain types of administrative services needs to be further improved, considering both security aspects and the needs of different social groups.

When analysing the speed of administrative service delivery during a full-scale invasion in a decentralised context, it is important to note that legitimate authorities, including local governments, should be able to provide basic level services of a critical nature even when they are verified and registered later. For instance, this may apply to paper records and the possibility of issuing temporary documents, especially in the context of a military conflict. As S. Bondarenko *et al.* (2021) write, it is also necessary to ensure that it is possible to establish identity through accessible means, issue identity documents (including temporary ones), register the place of residence in electronic format, considering security requirements and cooperation with other registers. The author agrees with the statement, but it is necessary to retain the possibility of documenting the place of residence in the passport document for security reasons, especially in the context of checkpoints and other restrictions. These aspects are important both for local governments and for ensuring the livelihoods of citizens and cooperation with other structures, such as the Pension Fund of Ukraine and others.

It is necessary to improve the current state of administrative legal regulation of migration services in the form of electronic provision, as it reflects shortcomings and gaps that need attention and resolution. The main problems are insufficient legal regulation and funding of public administration bodies, which affects the provision of electronic migration services. Migration services in electronic form are provided by various public administration bodies, which form a multi-level structure with decentralised links between them. This feature complicates the process of providing electronic services and increases the time required to obtain documents, such as passports. Furthermore, the financial support of ASCs is problematic, as the funds for their maintenance come from local budgets. This often leads to a lack of funding, which hampers the implementation of e-services in ASCs, including poor web infrastructure and insufficient staff training. Consular offices also face an increased workload due to intensive migration of citizens abroad. However, insufficient technical equipment, inefficient service resources and the lack of opportunities to provide migration services in the form of electronic delivery complicate the situation. However, it is necessary to address these problems by devising a concept for the development of electronic migration services that would ensure the quality of such services and be consistent with the strategic development of Ukraine.

CONCLUSIONS

The study found that the Russian-Ukrainian war has led to changes in the system of administrative service delivery at the national level, which are determined by two key aspects, namely new characteristics of services and new mechanisms for their provision. The organisations that provide such characteristic administrative services include the Pension Fund of Ukraine, CRO, and ASC. It was highlighted that in the context of Russia's large-scale aggression, the issue of external migration of Ukrainian citizens has become relevant. The procedure for obtaining a passport of a citizen of Ukraine for travelling abroad was important in helping these Ukrainians. This is explained by the fact that the document addressed issues related to asylum and support under the laws of each country for Ukrainian citizens. In this case, it was noted that SE "Document" was able to work in European countries thanks to a project that involved the conversion of the entire state paper archive into an electronic format, which made it possible to identify persons and issue passports to Ukrainian citizens from anywhere remotely and efficiently. The implementation of this process is in line with current technological trends in the provision of administrative services and Ukraine's digital transformation strategy. As a result, the level of service in Ukraine is improving.

It was found that to improve the quality and efficiency of administrative service provision during martial law, the issue of delegating powers to provide administrative

services to local self-government bodies becomes particularly relevant. The findings of this study suggest that this process can be carried out through the transfer of powers and financial resources from central government agencies to local governments. It is also important to ensure that information can be exchanged between electronic registers, that e-services are used more widely at the national level, and that powers are optimally distributed among various levels of public administration, including central government and local government. Regulation of these aspects at the legislative level will ensure the constitutional rights of citizens under martial law and regulate the activities of public authorities. Further research will focus on human rights violations in the context of armed aggression.

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CONFLICT OF INTEREST

None.

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Модернізація національної системи надання адміністративних послуг в Україні, зумовлена російсько-українською війною

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Анотація. Актуальність дослідження обумовлена тим, що в умовах повномасштабного вторгнення знижується рівень ефективності реалізації громадянами їх конституційних прав, зокрема це стосується функціонування механізму надання адміністративних послуг. Метою роботи було визначення сучасних проблем у вказаному секторі та виокремлення шляхів щодо їх подолання. Для цього було використано такі методи, як логічний аналіз, формально-юридичний, юридичної герменевтики, догматичний, функціональний аналіз та інші. Визначено, що міграційні процеси, які виникли через війну в Україні, потребують повного перегляду регулювання та розробки законодавчої бази та механізму надання державними органами послуг у цій області. Ця необхідність обумовлена сучасним станом регулювання надання міграційних послуг в електронному форматі, який потребує вдосконалення та свідчить про прогалини та недоліки, які потребують вирішення. Зазначено, що однією з проблем є недостатнє нормативно-правове регулювання та фінансування державних органів, що також відображає наявність проблем у наданні електронних послуг. Зроблено висновок, що наразі відсутня концепція розвитку та план дій для поліпшення надання міграційних послуг в електронному форматі. Розкрито сутність процесу надання адміністративних послуг, який впливає на децентралізацію та роботу відповідних органів. У даному контексті було виокремлено фактори, які впливають на швидкість надання таких послуг, шляхом аналізу наукових позицій вчених. Розглянуто терміни «адміністративно-правовий інструмент» і «адміністративна послуга». Практична цінність наданих рекомендацій полягає у їх можливому використанні органами державної влади та законодавцем щодо усунення існуючих проблемних аспектів у нормативно-правовому полі та суб'єктами надання адміністративних послуг із метою підвищення ефективності функціонування даного механізму в умовах воєнного стану

Ключові слова: повномасштабне вторгнення; права громадян; органи державної влади; міграція населення; застосунок «Дія»

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Global financial cycle: Impact on Ukraine

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Abstract. Global financial fluctuations that arise in the financial centres – the US and the EU through international channels of monetary transmission affect the financial markets of peripheral countries, including Ukraine, where the assessment and consideration of such an impact is an important element of monetary policy. Therefore, the purpose of the article was to assess the impact of cyclical fluctuations of the global financial situation on the financial sector of Ukraine's economy. As a result of correlation analysis, a direct relationship between leverage indicators in Ukraine and the Chicago Board Options Exchange Volatility Index and Euro Stoxx Volatility Index has been revealed. At the same time, the direct relationship between these indices and the growth of domestic credit in Ukraine contradicts the concept of the global financial cycle and may indicate the presence of more important factors of domestic credit. Correlation analysis of the volatility index of the Chicago Board Options Exchange and capital flows in Ukraine showed that in the years of increased global uncertainty and volatility, the volume of capital flows decreased, especially for portfolio debt instruments. Analysis of the cyclical components of the global and domestic credit cycle in Ukraine obtained with the Godric-Prescott filter indicates a higher level of volatility in domestic lending. The obtained value of the concordance coefficient did not make it possible to draw an unequivocal conclusion about the counter- or procyclical nature of domestic credit fluctuations relative to the global volume of loans in the non-banking sector. It has been found that the global financial cycle was not a significant factor in domestic credit in Ukraine in the studied period. The practical significance of the results lies in the fact that the National Bank of Ukraine will be able to implement a monetary policy independent of the global financial fluctuations and limit the outflow of capital during the period of growing uncertainty in the international financial markets

Keywords: credit cycles; domestic credit; volatility indices; capital flows; leverage

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INTRODUCTION

Financial globalization, which manifests itself through the deepening of financial integration of countries, the increase in the level of financialization of national economies, the strengthening of influence of multinational banks and other financial intermediaries on the dynamics of global financial flows and asset prices, is a significant factor in the macroeconomic environment of both developed economies and developing countries. Fluctuations in international financial markets caused by a change in the monetary policy of the USA or the EU, significant fluctuations in the prices of financial assets and commodities affect interest rates, exchange rates, asset prices, lending and investments far beyond the country of origin, which makes the study of this problem important.

The global financial cycle is expressed through a high level of consistency in fluctuations in the prices of risky assets, capital flows, the level of lending and aggregated financial indicators in the global economy. S. Miranda-Agrippino & H. Rey (2022) presented a number of empirical studies that substantiate the concept of the global financial cycle, in particular, a single global factor that correlates with the global level of risk acceptance and explains 25% of the variation in the prices of risky financial assets. Since 2010, this factor has covered major global events such as the Eurozone debt crisis, the global asset sell-off in 2016, and the recession at the end of 2018. Two global factors explain 35% of the variation in global financial flows, while a single global factor explains about 30% variation

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of fluctuations in global private liquidity. According to S. Miranda-Agrippino & H. Rey (2022), the monetary policy of the Federal Reserve System (the Fed) is also a significant factor in the global financial cycle; the role of the European Central Bank is less important.

J.S. Davis *et al.* (2021) examined the variance of gross and net capital flows based on panel data for 58 countries. The researchers concluded that two global factors explain about 40% of the variation in net capital flows. One of these factors is related to international risk appetite and represents the global financial cycle. The difference in the sensitivity of the country's capital flows to fluctuations in the global financial situation depends on the gross and net position of external debt assets. The imbalance of debt assets and liabilities increases a country's vulnerability to the global financial cycle through lending mechanisms. O. Bondarenko (2020) substantiates the use of quarterly data in factor models of the global financial cycle and emphasizes the need to study cyclical characteristics, namely reversal points, growth-decline phases, as well as taking into account the consistency between indicators of capital flows. Researcher A. Shlapak (2022) examines the role of transnational banks in the movement of global capital flows and the formation of the global financial cycle. Aggregated indicators of financial cycles in the context of developed economies and developing countries were studied by such Ukrainian scientists as O. Laktionova & O. Benzar (2020).

The length of the global financial cycle plays an important role in decision-making for both central banks and institutional investors in the periphery. Y. Akdi *et al.* (2020) tried to estimate it using VIX (Chicago Board Options Exchange Volatility Index), TED Spread (Treasury-EuroDollar Rate Spread) and LIBOR-OIS Spread (Libor-Overnight Index Swap Rate Spread). Examining the dynamics of these indices for the period from January 1990 to October 2018, they found that the duration of the global financial cycle is 43 months. In addition to panel data studies for large samples of countries, some publications deal with the analysis of the impact of the global financial cycle on individual countries. For example, scientists A.M. Cunha *et al.* (2019) within the study of the impact of Brazil's financial integration on macroeconomic efficiency found that the deepening of financial integration contributed to the strengthening of the negative consequences of the recession phase of the global financial cycle.

Studies of the global financial cycle are developing in a wide spectrum: from the methodology of factor models to the assessment of its impact on a certain country. Ukraine is a country with a small open economy whose level of integration into the global and, in particular, the European financial system is increasing. The limited nature of studies of the impact of the global financial cycle on the financial sector of Ukraine's economy determines the purpose of this study, which is to identify the impact of fluctuations in international stock market volatility indices on lending indicators and the dynamics of capital flows in Ukraine's economy.

MATERIALS AND METHODS

General scientific and special research methods were used in the article, in particular, the method of scientific abstraction was used in the analysis of mechanisms of international monetary transmission. Induction was used to explain the influence of VIX index fluctuations on the dynamics of domestic lending. Methods of analysis and synthesis were used to justify the role of the US dollar as the leading currency in global financial markets. Correlation analysis was used to assess the relationship between the dynamics of global volatility indices and lending and leverage indicators in Ukraine, as well as the dynamics of capital flows. In order to assess the impact of the global credit cycle on the dynamics of lending in Ukraine, the cyclical components of global lending to the non-banking sector and domestic credit in Ukraine were obtained using the Hodrick-Prescott filter (Hodrick & Prescott, 1997). To assess the degree of synchronization of the global and Ukrainian credit cycles, the concordance coefficient was calculated, which shows the average number of periods during which two indicators are in the same phase (growth or decline). The concordance coefficient was determined by the formula of K.P. Prabheesh *et al.* (2021):

$$C_{X,Y} = \frac{1}{T}\sum_{t=1}^{T}\left(S_{X,t}S_{Y,t} + (1 - S_{X,t})(1 - S_{Y,t})\right), \quad (1)$$

where $S_{X,t}$ ($S_{Y,t}$) is equal to 1 if the variable *X(Y)* increases at time *t,* or is equal to 0. The concordance coefficient between two variables $S_{X,t}$ and $S_{Y,t}$ can take on values from 0 to 1: if $S_{X,t} = S_{Y,t}$, then the concordance coefficient is equal to 1, the two variables are absolutely synchronized, that is, they are in the same phase of the cycle; if the concordance coefficient is equal to 0, that is, $S_{X,t} = 1 - S_{Y,t}$, the two variables are completely out of sync, they are in opposite phases of the cycle. The value of the concordance coefficient from 0 to 0.5 indicates the countercyclical nature of fluctuations of the *X* variable relative to the *Y* variable, and from 0.5 to 1 – the procyclical nature of the changes (Harding & Pagan, 2006). To assess the synchronization of fluctuations, the correlation coefficient between the cyclical components of global and Ukrainian lending has been calculated, adjusted for the value of the standard deviation, and its significance has been assessed.

As a proxy for the global financial cycle, the study uses quarterly data (at the end of the period) on the dynamics of the stock market volatility indices VIX (Q4 2002-Q4 2022) and VSTOXX (Euro Stoxx Volatility Index) (Q4 2008-Q4 2022). The choice of time series was determined by the availability of data. In assessing the impact on the financial sector of Ukraine, the leverage indicator of the banking sector has been used, calculated as the ratio of claims to the private sector to transfer and other deposits of depository corporations except the NBU (National Bank of Ukraine). Internal credit was calculated as the sum of net claims of deposit corporations to central government and claims to other sectors of the economy. Quarterly data for leverage of the banking sector and domestic credit have been obtained from the monetary and credit statistics of the NBU (Surveys of financial corporations, 2023). Gross capital flows have been analysed in terms of 4 groups: FDI (foreign direct investment), portfolio equity, portfolio debt and credit according to the NBU balance of payments (Balance of payments, 2023). The global credit cycle was estimated through the global liquidity indicator – the sum of bank loans to the non-banking sector and the issuance of debt securities by the non-banking sector, data obtained from

the Bank for International Settlements (Global liquidity indicators, 2023). To identify the impact of the global financial cycle on the financial sector of Ukraine's economy, the correlation coefficients between the VIX, VSTOXX indices and the growth of domestic credit, the leverage of the banking sector and the growth of leverage have been calculated.

RESULTS AND DISCUSSION

The abandonment of the Bretton Woods monetary system and the intensification of global capital flows have led to new challenges for the monetary policy of central banks. In recent decades, the trilemma of international finance or the trilemma of monetary policy has been empirically confirmed, according to which a country's central bank cannot simultaneously implement an independent monetary policy, ensure free movement of capital and a fixed exchange rate (Fleming, 1962; Mundell, 1963). The trilemma is based on compliance with the conditions of uncovered interest parity, when, with perfect capital mobility, the return on bonds in different countries is equalized as a result of arbitrage operations. With a fixed exchange rate and free movement of capital, the central bank cannot pursue an independent monetary policy. Changes in the interest rate in the country cause an inflow (outflow) of capital, which will have to be absorbed in the foreign exchange market to maintain a fixed exchange rate, thus offsetting the impact of monetary policy.

The transition to a floating exchange rate, which will absorb fluctuations in the foreign exchange market due to capital movements, gives the central bank freedom to choose monetary policy to stabilize output and employment. Empirical testing of the monetary policy trilemma has been carried out through the study of the correlation of short-term interest rates in peripheral countries relative to the central country under different regimes of exchange rates and capital mobility (Herwartz & Roestel, 2017). In countries with floating exchange rates, short-term interest rates showed a lower correlation with the rate in the central country compared to countries with fixed exchange rates. However, the transition to a floating exchange rate alone cannot provide a country with full monetary autonomy, since the central country will influence its monetary sector through other transmission channels. H. Rey (2014) argues that global factors that affect the country's monetary sector even with a floating exchange rate have to some extent turned the trilemma of international finance into a dilemma where the central bank can achieve monetary autonomy only by introducing restrictions on the movement of capital.

The transmission of monetary fluctuations from the central country to the periphery occurs through the exchange rate channel, the credit channel and the risk-taking channel. The exchange rate channel mechanism operates through changes in aggregate demand and consumption patterns in the central country. The easing of monetary policy in the central country causes an expansion of aggregate demand in the central country and stimulates imports from the periphery. A decrease in the interest rate leads to a depreciation of the central country's currency. In the central country, there is a demand shift in favour of domestic goods due to their cheaper prices (Rey, 2014). Consequently, in the periphery, there are two opposing effects affecting output: one due to the expansion of the aggregate demand of the centre, and the other to changes in the composition of its expenditures. The central bank of a periphery country can mitigate fluctuations in output by raising interest rates, provided that the exchange rate is floating. The objective of monetary policy is a trade-off between stabilizing output and worsening the terms of trade.

Transaction costs in the financial market caused by the need to reduce the information asymmetry between the lender and the borrower have an additional impact on monetary transmission and financial stability. If the agency costs between the lender and the borrower are significant, there is a difference between the opportunity cost of internal financing and external financing – the external financing premium. It reflects efficiency losses due to the principal-agent problem and increases the cost of credit for the borrower (Bernanke & Gertler, 1989). The external financing premium may depend on monetary policy. For example, a stimulative monetary policy causes an increase in domestic asset prices and improves the borrower's balance sheet. This alleviates the problems of moral hazard and adverse choices, lowers the external financing premium, promotes credit growth and expansion of aggregate demand (Rey, 2014). Such a transmission mechanism is called a balance sheet channel, or an equity or credit channel. In the risk-taking channel, the leading role belongs to financial intermediaries, who are usually risk-neutral and make decisions under conditions of value-at-risk constraints. A positive shock increases demand for assets and lowers the risk premium, which leads to a weakening of the value-at-risk constraint and stimulates the increase in leverage. Under such conditions, the easing of monetary policy leads to lower financing costs and excessive lending by financial intermediaries.

Thus, the credit channel and risk-taking channel are important channels of monetary transmission that affect financial stability in the country due to the level of indebtedness of financial intermediaries, the volume of lending and asset pricing. These channels also operate in an open economy. Given the existence of external debt, often denominated in US dollars, the central bank must choose between stabilizing production and having implications for the balance sheet of economic agents. For example, if the Fed raises the interest rate, the national currency of the peripheral country depreciates, which stimulates the growth of its exports. However, this worsens the balance sheet of economic agents due to the increase in the cost of external debt. This opposite effect makes the interest rate an insufficient tool for achieving monetary autonomy even with a floating exchange rate. In fact, there is a transmission of monetary policy in the central country to peripheral countries, where external influence extends to financial stability and the state of the balance sheet.

The role of the US dollar in international financial markets determines the degree of influence of the Fed's monetary policy on the rest of the world. During the 20th century the world monetary system evolved from a gold standard to a system of floating exchange rates, while the transition from the Bretton Woods to the Jamaican monetary system was marked by the strengthening of the role of the US dollar in the global financial system, despite the refusal of the United States to convert gold in 1971 (Gourinchas *et al*., 2019). For the private sector, the

dollar and some other currencies perform the function of a medium of exchange as an intermediary in currency exchange operations with third currencies and liquid and safe asset markets, as a store of value – the currency of the issue of securities and banking and cash transactions; as unit of account – the currency of an account in foreign trade and nominal currency of securities. The same functions for the public sector are performed by currencies through the implementation of foreign exchange interventions, formation of official reserves and the currency of the exchange rate peg (Gourinchas *et al.*, 2019). The US dollar remains the leading currency in transactions on the international foreign exchange market despite the introduction of the euro and renminbi; its share in 2001-2022 fluctuated between 85-90%, the share of the euro – 31-39% (Fig. 1).

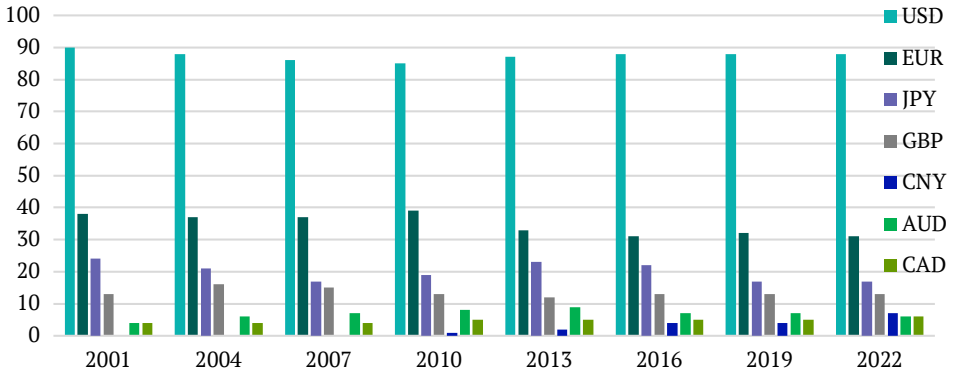

Figure 1. Currency composition of global operations with OTC currency instruments in 2001-2022, %
Source: made by the author based on Turnover of OTC foreign exchange instruments, by currency (2022)

The US dollar dominates international transactions with debt instruments and bank loans and deposits. As of the end of 2020, the share of international debt instruments denominated in US dollars was 63.4%, in euros – 23%. In the composition of international loans, the share of the US dollar was 52.7%, the euro – 26%, international deposits – 55.4% and 25.4% (European Central Bank, 2021). In foreign trade transactions, the main currencies of the account are the US dollar (40.8%) and the euro (33.2%) (Gourinchas *et al.*, 2019). The composition of reserve assets shows a similar dominance of the US dollar with a share of 59.79% and the euro – 19.66% as of the end of the third quarter of 2022, as can be seen in Figure 2.

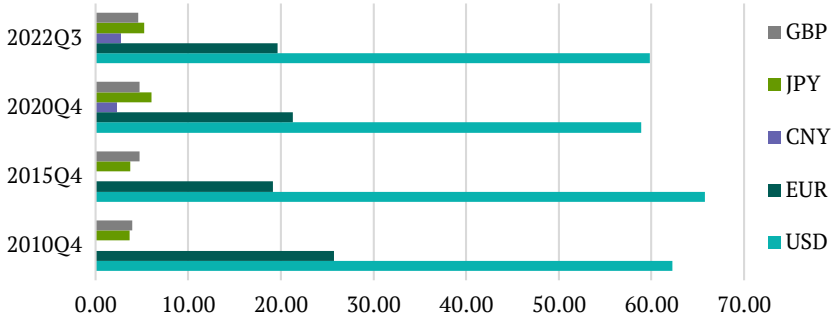

Figure 2. Currency composition of world allocated reserve assets in 2010-2022, in %
Source: made by the author based on Currency composition of official foreign exchange reserves (COFER) (2023)

The composition of reserve assets is related to the choice of currency for fixing the exchange rate. In 2021, according to the International Monetary Fund (IMF), 80 countries pursued monetary policy using hard or soft exchange rate peg, of which 37 countries (or 46.25%) used the US dollar as an anchor for the exchange rate, and 26 countries used the euro (32.5% of countries that pegged the exchange rate) (International Monetary Fund, 2022).

The global financial cycle, which manifests itself through fluctuations in global liquidity, risk appetite, volatility and uncertainty, affects the financial stability of peripheral countries. The VIX and VSTOXX indices are often used as an indicator reflecting global sentiment and expectations in the financial market. The VIX index is an estimate of the expected volatility of index options on the S&P500 (Standard & Poor's 500 Index) over the next 30 days (Akdi *et al.*, 2020). It is often interpreted as a measure of risk and a variation of the risk premium, which reflects the risk appetite of investors, and, given the global nature of the American stock market, as a risk premium at the global level, global risk appetite of international investors, global market uncertainty (Akdi *et al.*, 2020). Fluctuations in the VIX index are associated with short-term capital flows that accompany the boom and bust phases of the global financial cycle. In the growth phase, risk-taking at the global level increases, the risk appetite of

international investors increases, and global liquidity expands. In the recession phase, accompanied by a rise in the VIX index, international investors increase their risk premium requirements, divest themselves of high-risk assets, and as a result, there is an outflow of capital from developing countries. The VSTOXX index estimates the expected volatility in the European equity market for the EURO STOXX 50 stock index.

Using the VIX as a proxy for global risk aversion and uncertainty in financial markets, H. Rey (2015) investigated the relationship between this index and global capital flows, leverage and lending. According to the results of her research, for all regional groups of countries there is an inverse correlation between the VIX and the growth of domestic credit, with the highest density of connection for North America and Western Europe. The level of leverage of the banking sector (the ratio of claims on the private sector to other and transferable deposits) and its growth are also inversely correlated with the VIX in the leading financial centres (North America, Western Europe, Asia). In contrast, a direct correlation is observed for the countries of Latin America, Central and Eastern Europe, and Africa. Thus, during periods of low global uncertainty, when the VIX is relatively low, there is an increase in domestic credit, as well as an increase in bank leverage in financial centres. The correlation dependence between the VIX and VSTOXX indices in this study was investigated for Ukraine (Table 1).

Table 1. Correlation of lending indicators in Ukraine from VIX and VSTOXX indices

Index	Increase in domestic credit	Leverage level	Leverage gain
VIX	0.04	0.21	0.07
VSTOXX	0.17	0.29	0.21

Note: calculated based on quarterly data VIX Q1 2003-Q4 2022 and VSTOXX Q4 2008-Q4 2022
Source: calculated by the author based on the EURO STOXX 50 Volatility (VSTOXX) Index EUR (V2TX), historical prices (2023), Historical price data for VIX index (2023), Surveys of financial corporations (2023)

The results obtained in this article for leverage indicators are consistent with the data of H. Rey (2015) for the countries of Central and Eastern Europe, for which the correlation coefficients between VIX and the level of leverage, VIX and the increase in the level of leverage were 0.3 and 0.07, respectively. At the same time, the obtained correlation coefficients between the VSTOXX index and the corresponding leverage indicators are higher and, according to the author of this study, indicate a closer correlation between lending in Ukraine and the expected volatility of the European stock market. This indicates a higher level of sensitivity of the financial sector of Ukraine to the fluctuations of the European stock market. The positive values of the correlation coefficients between the VIX and VSTOXX indices and the growth of domestic credit turned out to be unexpected and contrary to the theory of the global financial cycle. The direct correlation between them means that in periods of high global and regional uncertainty, there was an increase in domestic lending in Ukraine. H. Rey (2015) obtained a similar relationship, but with a very low correlation coefficient (0.01) for African countries. According to the author of the study, the direct correlation between global volatility indices and the dynamics of domestic credit in Ukraine does not contradict the theory of the global financial cycle, but indicates the presence of other important internal credit factors that determine its dynamics.

Correlational dependencies between global capital flows indirectly confirm the hypothesis of the existence of an international financial cycle. H. Rey (2015) investigated pairwise correlations between gross capital flows of FDI, portfolio equity, portfolio debt and credit for geographical groups of countries. The obtained results indicate a mostly direct correlation between flows reflecting capital inflows in regional groups. A similar positive correlation can be traced for flows that characterize capital outflow. In asset groups, the exception is foreign direct investment, for which pairwise correlation coefficients are negative. The correlation dependence between global capital flows and the VIX index has also been traced. For all groups of assets, except for direct foreign investments, there is an inverse relationship between the amount of inflow (outflow) of capital and the VIX index. To assess the sensitivity of capital inflows and outflows to the economy of Ukraine in relation to global cyclical fluctuations, this study has also calculated correlation coefficients between gross capital flows for various asset groups and VIX (Table 2).

Table 2. Correlation coefficients of capital flows in Ukraine and the VIX index

Index	Assets				Liabilities			
	FDI	Portfolio equity	Portfolio debt	Credit	FDI	Portfolio equity	Portfolio debt	Credit
VIX	-0.07	0.07	-0.05	0.29	-0.03	-0.02	-0.29	0.22

Note: calculated based on quarterly data Q1 2003-Q3 2022
Source: author's calculations based on Balance of payments (2023), Historical price data for VIX index (2023)

The value of correlation coefficients is relatively low for FDI and portfolio equity. The inverse relationship between capital outflows through FDI, portfolio debt, and VIX, as well as between capital inflows through FDI, portfolio debt, and VIX confirms the impact of fluctuations in global risk aversion on the dynamics of capital flows. The obtained results of the inverse correlation of capital outflow through portfolio debt and portfolio equity are consistent with the values for the countries of Central and Eastern Europe in the study of H. Rey (2015). The direct

correlation between capital outflows for credit and VIX can be caused by the substitution of public sector financing in periods of increased global uncertainty. During the years of growing global uncertainty and volatility (the Great Recession, the debt crisis in the countries of the European Union, the COVID-19 pandemic), the value of capital flows decreased, especially for portfolio debt, as can be seen in Figure 3.

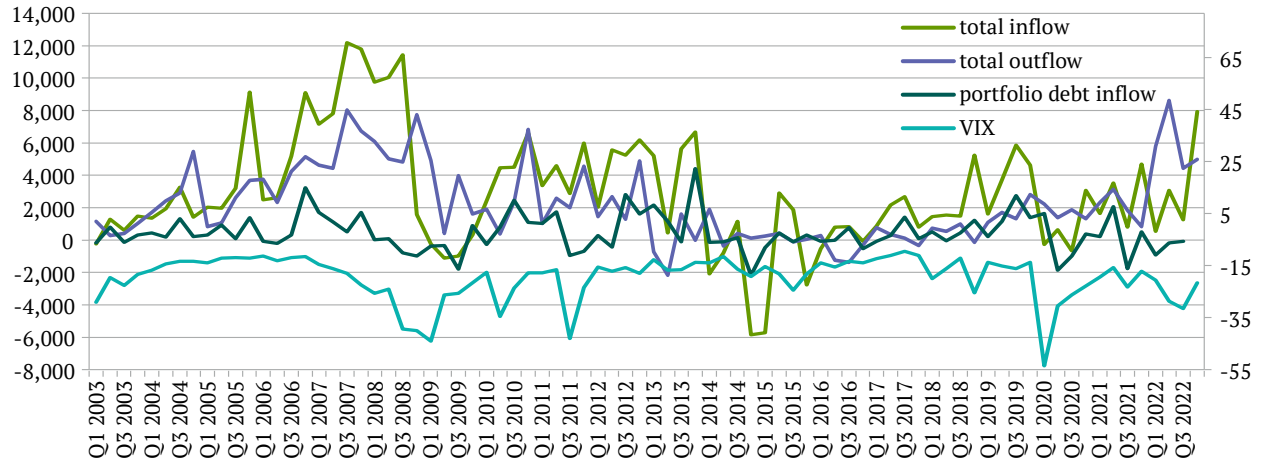

Figure 3. Dynamics of capital flows from/to Ukraine (million USD) and the VIX index

Note: dynamics of capital flows from/to Ukraine – left scale, VIX index – right scale

Source: made by the author based on Balance of payments (2023), Historical price data for VIX index (2023)

O. Bondarenko (2020) also emphasizes the importance of studying the level of capital flows consistency with the global financial cycle. According to her results, for Ukraine the level of consistency of all four capital flows is statistically insignificant, which refutes the impact of the global financial cycle on capital flows to Ukraine. In order to assess the sensitivity of the monetary sector of Ukraine's economy to the global financial cycle, quarterly data on the dynamics of global lending to the non-banking sector and domestic credit in Ukraine in the period of Q4 2002-Q4 2022 have been examined. The cyclical component of the relevant time series is obtained using the Godric-Prescott filter after logarithmizing the initial data, which is shown in Figure 4. The credit cycle in Ukraine is more volatile compared to the global credit cycle, which may indicate greater sensitivity of Ukraine's economy to global financial shocks. Figure 4 shows that the increase in the volatility of the credit cycle in Ukraine can be traced during the Great Recession (Q4 2007-Q4 2009) and after it, as well as in 2014.

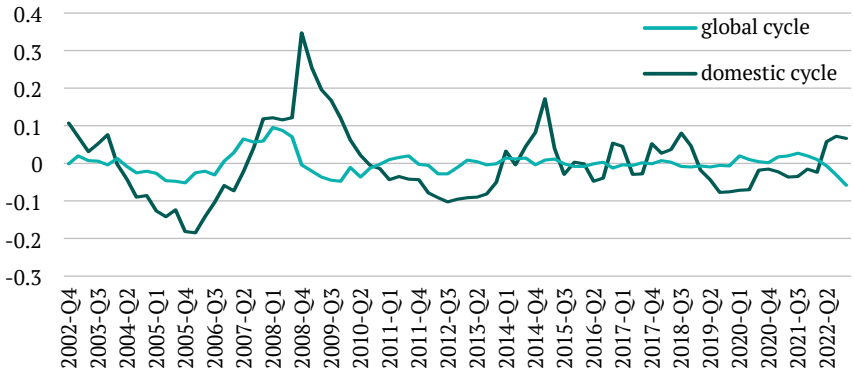

Figure 4. Global credit cycle and credit cycle in Ukraine

Source: calculated by the author based on the Global liquidity indicators (2023), Surveys of financial corporations (2023)

Using the formula for calculating the concordance coefficient (1), based on quarterly data for the period Q4 2002-Q4 2022, the obtained concordance coefficient between cyclical fluctuations in the global volume of loans to the non-banking sector and domestic credit in Ukraine is 0.49. The obtained value of the concordance coefficient does not make it possible to draw an unequivocal conclusion about the counter- or procyclical nature of domestic credit fluctuations in Ukraine relative to the global financial cycle. The research tested the null hypothesis about the synchronization of the change of two variables. The obtained correlation coefficient between the time series adjusted for the standard deviation is -0.03, i.e., it indicates the asynchrony of fluctuations, and is also statistically insignificant. Thus, the global financial cycle, estimated by the indicator of world lending, cannot be considered a significant factor in the dynamics of domestic credit in Ukraine.

The concept of the global financial cycle assumes that the monetary policy of the central country affects the level of credit on a global scale, global risk appetite, global prices of financial and commodity assets, and global capital flows. Under conditions of free movement of capital, peripheral countries lose part of their monetary autonomy, as their financial sector is affected by fluctuations in the global financial markets, and the monetary policy trilemma is transformed into a dilemma (Miranda-Agrippino & Rey, 2022). O. Bondarenko (2020) denies turning the trilemma into a dilemma, arguing that there is a relatively low number of confirmations of the significant sustainable impact of the global financial cycle on capital flows. According to the author of the article, the central bank's choice between an autonomous monetary policy, an exchange rate regime, and capital movement restrictions depends on the specifics of an individual country, its integration into global trade and international financial markets. Given the lack of influence of the global financial cycle on the financial sector of Ukraine's economy (within the scope of this study), the NBU pursuits monetary policy in accordance with the trilemma of international finance.

In a significant number of publications, the authors focus on the impact of the global financial cycle on the macroeconomic environment of developing countries. M. Kolasa & G. Wesołowski (2023) investigated the impact of the global financial cycle caused by US quantitative easing policies on emerging market economies and concluded that the negative manifestations of the cyclical nature of global finance significantly affect countries in which the banking sector owns a large volume of domestic sovereign bonds. Quantitative easing causes the loss of international competitiveness of the periphery country, rising prices and lending in the real estate market. It is worth agreeing with the authors' conclusions that for financial and macroeconomic stabilization, it is necessary to use currency interventions, limiting the level of risk on mortgage loans, taxation of long-term income of non-residents from owning sovereign bonds. Together, these measures will help curb currency appreciation and reduce capital inflows, mitigating the effects of quantitative easing.

J. Aizenman (2019) investigated the vulnerability of emerging economies to adverse global financial shocks, in which countries choose the intermediate goals of the monetary policy trilemma – managed exchange rate floating, controlled financial integration, and limited monetary autonomy. The scientist came to the conclusion that for countries with emerging markets, the accumulation of significant gold and foreign exchange reserves is no longer a sufficient tool to mitigate the negative manifestations of the global financial cycle. The author of this study shares his position on the need to introduce macroprudential regulation and restrictions on capital movements as important safeguards against global monetary shocks.

J. Carrera *et al*. (2023) examined the impact of the global financial cycle on the terms of trade and financial spreads in developing countries, dividing them into net exporters and net commodity importers. For net commodity exporters, favourable global liquidity shocks lead to improved trade balances and lower financial spreads. For net importers, the deterioration of the trade balance ultimately has a negative impact on the cost of financing. The author shares the conclusion of J. Carrera *et al*. (2023) on the importance of diversifying exports and increasing the share of exports of goods with a high level of added value in order to reduce sensitivity to fluctuations in the global financial situation. In their study, K.P. Prabheesh *et al.* (2021) analysed the impact of the global financial cycle on credit and business cycle dynamics in India and Indonesia. The authors distinguished the cyclical components of the global and domestic credit cycles and, based on the analysis of the concordance index, concluded that the domestic credit cycle in India showed a high level of synchronization with the fluctuations of the global financial situation, but for Indonesia, the synchronization was weak. In Indonesia, shocks to the global financial cycle first affected the business cycle and then the credit cycle through the exchange rate channel. The monetary policy of the central bank of Indonesia, aimed at mitigating the shocks of the global financial cycle, involves influencing the exchange rate, macroprudential supervision of the banking system, and limiting the risk of banks on liabilities in foreign currency. Given the asynchrony of the Ukrainian credit cycle, the NBU uses similar tools.

Fluctuations in the global financial situation affect lending dynamics, asset prices, macroeconomic and financial stability in developed economies and developing countries. This study did not reveal a significant impact of the global financial cycle on lending indicators of Ukraine's economy, but capital flows showed a certain relationship with fluctuations in the global uncertainty index.

CONCLUSIONS

Global fluctuations in asset prices, credit volumes, and capital flows are beyond the influence of the country's central bank and can exert additional pressure on its macroeconomic and financial environment. For some countries, global cyclical fluctuations in financial indicators can cause excessive credit growth in the phase of economic growth or deepen the recession during periods of increased instability in global financial markets. The study attempts to assess the impact of the global financial cycle on the financial sector of Ukraine.

Analysis of the impact of the dynamics of the global uncertainty indices VIX and VSTOXX on lending indicators in Ukraine showed that periods of increased global volatility were accompanied by an increase in the level of leverage and domestic lending in Ukraine. The direct relationship between the VIX and VSTOXX indices and the dynamics of domestic credit disproves the theory that it is influenced by the global financial cycle. The assessment of the impact of global uncertainty on the dynamics of capital flows in Ukraine demonstrates that during periods of VIX growth, the volume of capital flows decreased the most for portfolio debt, the increase in capital outflows for credit could be caused by the increase in public sector borrowing.

The cyclical component of domestic lending in Ukraine shows a higher level of volatility compared to the global credit cycle. Based on the assessment of the concordance coefficient, it has been concluded that there is no synchronization between the domestic and global credit cycles. Thus, fluctuations in the global financial situation did not affect the dynamics of domestic lending in Ukraine, but they had a noticeable impact on the dynamics of capital flows. This confirms the need for the central bank to use traditional

monetary policy tools, namely currency interventions and capital restrictions, to mitigate the effects of financial shocks. Further studies of the impact of the global financial cycle on the economy of Ukraine may concern the study of the transmission channels of global shocks, taking into account the exchange rate regime, the composition of foreign trade and the level of integration of the financial sector.

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CONFLICT OF INTEREST

None.

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Глобальний фінансовий цикл: вплив на Україну

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Анотація. Глобальні коливання фінансової кон'юнктури, що виникають у фінансових центрах – США та ЄС, через міжнародні канали монетарної трансмісії чинять вплив на фінансові ринки країн периферії, до яких належить й Україна, де оцінка та врахування такого впливу є важливим елементом монетарної політики. Тому мета статті – оцінити вплив циклічних коливань глобальної фінансової кон'юнктури на фінансовий сектор економіки України. В результаті кореляційного аналізу виявлено пряму залежність між показниками левериджу в Україні та індексами Chicago Board Options Exchange Volatility Index і Euro Stoxx Volatility Index. Водночас пряма залежність між цими індексами та приростом внутрішнього кредиту в Україні суперечить концепції глобального фінансового циклу та може свідчити про наявність більш вагомих чинників внутрішнього кредитування. Кореляційний аналіз індексу волатильності Chicago Board Options Exchange та потоків капіталу в Україні показав, що в роки посилення глобальної невизначеності та волатильності обсяг потоків капіталу знижувався, особливо для портфельних боргових інструментів. Аналіз отриманих за допомогою фільтра Годрика-Прескота циклічних компонентів глобального та внутрішнього кредитного циклу в Україні свідчить про вищий рівень волатильності внутрішнього кредитування. Отримане значення коефіцієнта конкордації не дало змоги зробити однозначний висновок про контр- або проциклічний характер коливань внутрішнього кредиту відносно глобального обсягу кредитів небанківського сектора. Виявлено, що глобальний фінансовий цикл не був вагомим чинником внутрішнього кредитування в Україні в досліджуваний період. Практичне значення результатів полягає у тому, що Національний Банк України зможе здійснювати автономну від коливань глобальної фінансової кон'юнктури монетарну політику та обмежувати відплив капіталу в період зростання невизначеності на міжнародних фінансових ринках

Ключові слова: кредитні цикли; внутрішній кредит; індекси волатильності; потоки капіталу; левередж

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Digital transformation as a factor of changes in the organizational behaviour of international companies

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Abstract. Digitalization is an essential process for enterprises in the post-industrial economy, which contributes to increasing their competitiveness and opens up new opportunities for involvement in global digital value chains. Digitalization practice provides for developing recommendations and algorithms for overcoming and preventing errors within the scientific discourse, thus the aim of the article was to determine the impact of digital technologies on the organizational behaviour of international companies and generalize causes of digital transformation failure. Changes in organizational behaviour under the influence of digitalization have been systematized using the generalization method. The causes of unsuccessful digital transformations in organizations have been structured using the five-stage digital transformation model. The main factors of failures at each stage have been discovered. At the stage of automation errors result from the failure to understand the mission and value of the business and to implement digital technologies. At the isolated stage the negative factor is the insufficient support of priority changes and the wrong choice of what exactly needs to be transformed. It has been discovered that at the stage of partial synchronization systemic digital transformation is hindered by an ineffective change management strategy or an insufficient number of transformation projects for adequate change of the overall operation. Problems with the organizational structure or digital literacy can lead to the disruption of digital transformation at the stage of full synchronization. The risks of continuous transformation stage result from losing the priority, ensuring the transformation, due to inflexible culture, lack of discipline regarding the constant identification of new business disruption risks and responding to them. The practical significance of the present research is stipulated by the proposed recommendations for changes in the organizational behaviour of companies that will reduce the risks of failures in particular and failures of digital transformation as a whole

Keywords: digitalization; organizational flexibility; stages of digital development; agile methodologies; digital transformation mistakes; levels of impact of digital technologies

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INTRODUCTION

The introduction of digital technologies provides both great opportunities and significant challenges for organizations. Despite the benefits of digitization, demonstrated by companies, difficulties in introducing these technologies, their impact on organizational behaviour and causes of failure have not yet been fully researched by scientists. Therefore, there are certain gaps in the formation of recommendations understandable to managers and company

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leaders on overcoming possible obstacles on the way to effective digital transformation. Rapid technological development and increased competition stipulate the need for digital transformation for most companies, which opens up many opportunities, such as increasing productivity, reducing costs, improving customer service and creating new products and services.

New opportunities for optimizing business processes and increasing work efficiency provide for prudence, strategic planning and readiness for changes in organizational behaviour. These issues are discussed and considered by leading scientists and management practitioners. A. Zimmermann *et al*. (2021) presented a digital transformation architecture for intelligent digital products and services. The scientists studied the processes of digital transformation using artificial intelligence and available intelligent technologies, the issue of decision-making and management of these processes. K. Lardi (2022) addresses the practical aspects of digital transformation implementation, paying attention to the key element – the human factor in transformation. She determines the specifics of managing internal interested parties, such as leadership teams and employees, as well as external interested parties, such as customers, partners and suppliers. This made it possible to suggest a system of business digital transformation, which contributes to the successful implementation of new digital solutions.

A. Hinterhuber *et al*. (2021) combine academic theory with practical experience and contributions from companies that are at the forefront of global best practices in the field of digital transformation. The researchers systematized information on planning and implementing digital transformation by leading companies. Interviews with CEOs (chief executive officers) and directors of digital technologies of such companies as: Bulgari, Deutsche Bahn, Henkel, Lanxess, L'Oréal, Unilever, Thales and others were conducted for this purpose. This made it possible to suggest road maps for the successful implementation of digitalization, to systematize organizational capabilities and consequences of digital transformation for business productivity. Authors, studying difficulties and failures faced by companies in the process of digital transformation, deserve special attention. M. Beijen (2021) reflects on the knowledge and experience accumulated in daily practice, focusing on the approach to contemporary digital business challenges. He proves that top management should be the driving force of the company's digitalization process. Digital transformation cannot be imposed through a top-down management approach, however without commitment at the top level, efforts to reform outdated processes or systems will be ineffective. A successful digital transformation also provides for a comprehensive understanding of both the theory and the practical side of the process by everyone involved in the process or those who may be affected by the change.

Modern Ukrainian scientific discourse mainly focuses on the features of digital transformation both at micro level for Ukrainian enterprises and at macro level for using these processes in the post-war recovery. The monograph edited by N. Mazur (2022) examines the issue of digitalization of Ukrainian enterprises taking into account current conditions and limitations. For this purpose, social and economic aspects of digital transformation were analysed, information and innovation changes of business entities in the conditions of the digital economy were identified and the changes in their management systems were substantiated. A. Spitsina *et al*. (2022) summarized the main trends of Ukrainian economy digitization and analysed its state with the help of digitization indices. The scientists studied Ukraine's accession to the digital market of the European Union through the participation in Digital Europe program. It was proven that it enhances and supports IT (information technology) industry in Ukraine and creates synergy between sectors of national economy, restructures labour market.

As can be seen from the analysed literature, a lot of attention is paid to the study of digital transformation processes at micro and macro levels, practical experience of companies and digitalization are summarized, its impact on the company's competitiveness is studied and the importance of human factor is systematized. However, the issue of generalizing recommendations for changing organizational behaviour in order to overcome the problems of digital transformations is not fully resolved. The goal of the present article is to study the impact of digital technologies on organizational behaviour in international companies, to summarize the causes of digital transformation failure, connected with imperfect management of changes in organizational behaviour, and to provide recommendations for their prevention.

MATERIALS AND METHODS

To achieve the stated goal, a combination of general scientific and special methods of scientific research was employed, in particular deduction and induction, analysis and synthesis to determine the impact of modern digital technologies, which significantly change organizational models of behaviour and ways of doing business. The practical experience of companies that have already introduced the process of digital transformation has been summarized by the method of theoretical generalization, which made it possible to identify components of companies' organizational flexibility and determine its impact on organizational behaviour. In this study, with the help of an abstraction method, organizational flexibility is seen as a sign of continuous improvement, continuous delivery, communication, team and people maturity. The use of statistical and economic analysis methods during the study of prerequisites, volumes and characteristics of the environment and digitalization factors, allowed to draw a conclusion about the rapid change in the organizational behaviour of companies and difficulties that arise in the process of digital transformation. The application of systematization methods made it possible to determine the influence of flexible methodologies on the results of companies' activities and to provide recommendations for their further implementation for the integration of digital solutions into the organizational structure of companies, radically changing the principles of their work by creating new business processes, interaction with customers and organizational culture.

Comparison and analysis methods made it possible to identify the main errors in organizational behaviour at

various stages of digital transformation. System-structural and functional approaches were used in building a step-by-step model of digital transformation. The applied graphic method was aimed at visual display of change trends in the organizational behaviour of companies at various stages of digital transformation and formation of strategic directions of action, as well as visual display of certain research results. The generalization method was also used in formulating the research results. With the help of inductive and deductive methods, the conclusions have been substantiated and suggestions for further scientific research have been provided. The abstract-logical method was also used when writing the conclusions and recommendations of the research. The study used a five-stage model of digital transformation, originally proposed by T. Saldanha (2019). The original of this model has been supplemented and improved using the focal object method, which adds new characteristics to existing objects, improving the original. The analysis of the supplemented five-stage model of digital transformation made it possible to determine relevant limitations and failure risks as well as digital transformation failures, which suggests organizational flexibility being the main measure of modern transformations.

The works of leading foreign and Ukrainian scientists, public information and specialized scientific research on the problems of modern trends in the development of digital society and changing organizational behaviour during the introduction of digital technologies into the activities of companies, served as the foundation for the present research. The study used data from the websites of international companies Walmart, Delta Air Lines, Zappos and Toyota, whose digital experience was analysed in the article. When conducting research using the method of generalization, the content of digital transformation and its impact on changing organizational behaviour was studied, the experience of international companies in implementing digital technologies was analysed and summarized.

RESULTS

The digital economy has gained a global scale and powerful companies that have already entered the digital era generate up to 90% of revenue and profit. According to World Trade Organization (2021) forecasts 40-50% of the GDP of the most developed countries will be generated within the framework of the digital economy by 2025. In 2017 companies Google, Apple, Microsoft, Facebook, Amazon, China's digital giants (Baidu, Alibaba, JD.com and Tencent) had leading positions in the field of digital technologies (Gada, 2020). The pace of digital transformation is spreading with the world's largest capitalization companies transitioning to digital mode, giving them significant competitive advantages. X. Teng *et al*. (2022) point out that after the completion of digital transformation, the efficiency of each branch is predicted to increase by 30-50% and companies will be able to increase their overall efficiency by 8-10 times. Representatives of international business are rapidly implementing digital transformations, modernizing technologies in order to become digital leaders. An idea of digital transformation importance for companies around the world is evidenced by data suggesting that international business spending on technology and services will amount to $2.3 trillion (Spending on digital…, 2023) by the end of 2023. In 2018, the McKinsey Global Institute estimated that an additional $13 trillion could be added to global GDP by 2030 through digitization, automation and artificial intelligence as these technologies create new business opportunities, increase productivity, and profits are reinvested in the economy (ITUTrends, 2018).

According to SAP's digital transformation study, 96% of senior executives believe that digital transformation is a primary business objective and 92% report that they have mature digital transformation strategies and processes to improve customer engagement. 93% of leaders believe that digital technology is critical to maintaining a competitive advantage, they invest more in big data and analytics (94%), the Internet of Things (76%) and 50% already work with artificial intelligence and machine learning (Elliot, 2017).

Digital transformation provides for using technologies to radically improve productivity, provide value for customers, change business models of enterprises and is the most relevant trend for many companies around the world. As G. Westerman *et al*. (2014) point out the use of digital advances such as analytics, mobility, big data analysis, Internet of Things, cloud technologies, social media and smart embedded devices enhance the use of traditional technologies (ERP (enterprise resource planning), etc.) to achieve radical changes with customers, transform internal processes and deliver value propositions.

However, digital transformations are accompanied by a number of difficulties. Firstly, they require significant investments, which may not always be justified. Companies must find a balance between technological improvements and financial efficiency. Secondly, digital transformation provides for the reconsideration of business processes and the change of corporate culture. Employee resistance can be a significant obstacle to digital transformation. Thirdly, there is a threat to cyber security. As the amount of digital data grows the likelihood of cyberattacks increases. Companies must invest time and resources in protecting this data.

Digital transformation has significantly affected organizational behaviour in companies. A study by the Centre for Information Systems Research at the Massachusetts Institute of Technology revealed that managers expect digital transformation efforts to significantly impact 67% of employees (Dery & van der Meulen, 2020). It is the employees who must adapt new systems, data, processes and habits to make the transformation happen.

The best companies combine digital activities with strong leadership to turn technologies into transformation. This is known as digital maturity. Companies vary in their digital maturity, and those that are more mature outperform those that are not. Organizational changes that occur under the influence of external environment directly depend on the organizational behaviour of employees. With the advent of new technologies and the increasing use of digital platforms, companies are introducing new ways of operation, communication and collaboration. The significant changes in organizational behaviour brought about by digital transformation are illustrated in Figure 1.

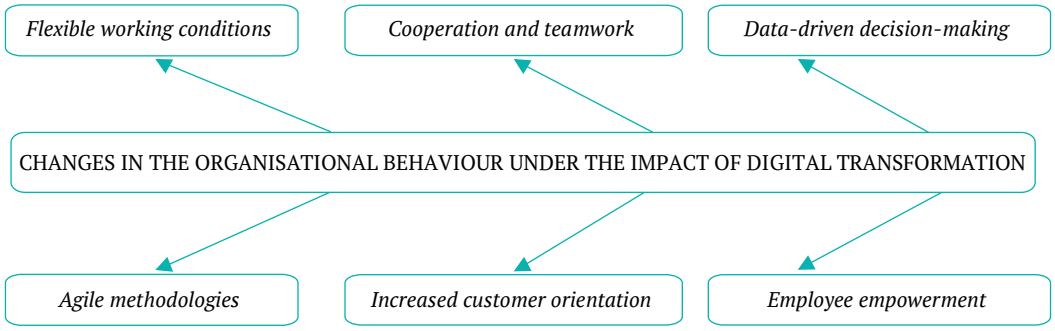

Figure 1. The impact of digital transformation on organizational behaviour
Source: developed by the authors

Digital transformation has enabled companies to offer more flexible working conditions, such as telecommuting, remote work and flexible schedules. It contributed to employees' better work-life balance and increased productivity. Companies that have been able to offer more flexible working conditions due to digital transformation include Google and Dell, which provide their employees with the possibility to work using video communication and collaboration tools, offer flexible work schedules, allowing them to work throughout the day from any places (Remote workers, n.d.; Pichai, 2021). IBM (International Business Machines Corporation) uses video communication and collaboration technologies, allowing its employees to work at a time convenient for them (Poole, 2020). Upwork is an online platform for freelancers and clients that allows to work remotely.

Collaboration and teamwork: digital tools such as instant messaging platforms (Slack, Microsoft Teams, and Google Chat) allow teams to work together effectively, regardless of their physical location. Cloud storage tools like Google Drive, Microsoft OneDrive, and Dropbox allow teams to share files and work on them in real time. With messaging tools like file sharing, screen sharing and video conferencing (Zoom, Microsoft Teams, and Google Meet) one can streamline collaboration by making it easier to share ideas, create documents and work jointly on tasks. Companies that use digital tools to change organizational behaviour include, for instance, a multinational company Google, which has created an entire ecosystem of online services and tools to ensure the efficient work of its companies and users. Google Docs and Google Drive make it possible to create documents and store them in the cloud; the Internet company Amazon has changed the approach to e-commerce, using cloud technologies, artificial intelligence and machine learning to improve user experience and delivery speed of orders (Khudik, 2021); Uber uses mobile communication and geolocation technologies to change the taxi world and provide easy access to its services; online store Zappos uses social networks and e-mail to interact with customers and provide quality service.

Data-driven decision-making: with the help of big data and analytics global companies change their organizational behaviour by making more informed decisions about their operation and strategy. The use of Big Data allows Walmart, Amazon, Ford, Delta Airlines to reduce costs, improve personalised marketing, increase sales and attract new customers. Using big data analytics, Walmart has improved its operational efficiency and achieved significant online sales growth of 10-15% with an additional revenue of $1 billion (Walmart leveraging..., 2023). S. Galea-Pace (2020) point out that Big Data has helped propel Amazon to the top of e-commerce. Using Big Data allows the company to choose the warehouse closest to the customer and significantly reduce delivery costs from 10 to 40%. Ford Motor Company has formed a new strategic partnership with Google to modernize the automaker's IT systems and use data more effectively to increase profits, improve customer experience and introduce innovations. Ford will also implement Google's AI (artificial intelligence) technology to improve efficiency in vehicle development, supply chain and manufacturing, employee training, assembly line inspection and many others (Ford and Google..., 2020; Mixson, 2021). Delta Air Lines is focusing on using artificial intelligence, mobile applications, big data and the cloud to digitally transform its operations. This company's annual ICT (information and communication technology) spending was estimated at $1.42 billion in 2022 (Delta Air Lines..., 2022).

Agile methodologies: managing agility is vital for firms to survive in a turbulent market environment. Companies implement agile methodologies to become more adaptive and responsive to changes. The company's potential primarily depends on the internal flexibility of its resources and its ability to coordinate the use of these resources to achieve strategic goals. Companies can generate sustainable competitive advantages by effectively controlling and utilising their unique resources. Agile methodologies provide for collaboration, iterative development and continuous improvement, which aligns with the digital transformation of organizations. Organizational attributes such as human resources, organizational learning, organizational structure and management style, technological capabilities and supply chain capabilities can influence the company's organizational flexibility. Under conditions of digital transformation, the most important measure is the organizational flexibility of companies, which indicators include: structural flexibility, resource flexibility, leadership, cultural, technological and innovation flexibility (Fig. 2).

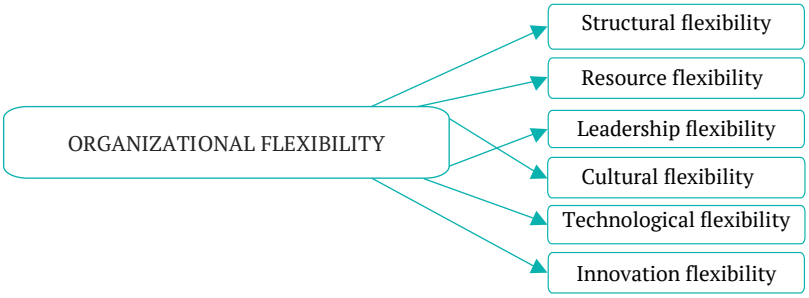

Figure 2. Components of organizational flexibility of companies under conditions of digital transformation
Source: developed by the authors based on G. Ni *et al*. (2021)

Structural flexibility is the organization's ability to restructure. Resource flexibility is the ability to transform resources into other beneficial uses, giving organizations a buffer to adapt to changes in an uncertain environment. Leadership flexibility is leaders' ability to play several different, sometimes opposite, roles to meet the demands of fast-changing environment and diverse activities in different directions, as well as the ability to adapt by adjusting goals using knowledge and skills. Cultural flexibility is the ability to adapt the corporate culture to form a mental model, a sense of dignity and a learning atmosphere in order to effectively adapt to environmental changes and uncertainty. Technological flexibility is the ability to change technical potential in accordance with competitive requirements. Innovative flexibility is the ability to develop new products or services to quickly adapt to market requirements at low costs. The implementation of agile methodologies can positively affect the efficiency of companies, in particular, under the circumstances presented in Table 1.

Table 1. The impact of agile methodologies on organizational behaviour

Results of agile technologies implementation	Content of the results of agile technologies implementation
Reduction of time for solving problems and making decisions	Allow to quickly react to changes in the market and internal processes in the company.
Improving communication and cooperation	Provide for active cooperation between different teams and divisions of the company, which positively affects communication and cooperation between employees.
Increasing employee motivation	Give employees opportunities to be more independent and participate in decision-making, which can increase their motivation and involvement in the company's activities.
Product quality improvement	Focused on the needs and requirements of customers, which allows the company to be more adaptable to changes in their requirements and wishes. This can have a positive impact on product quality and customer satisfaction.
Cost reduction	Allow the company to use resources more efficiently and reduce costs of production, marketing and product development.

Source: developed by the authors

Examples of companies implementing agile methodologies to change organizational behaviour and reaping positive results include companies such as Spotify, Netflix, Amazon, Zappos, and others. Digital service Spotify uses Agile Scrum methodology to rapidly develop and release new features of its music platform (How Amazon and Spotify…, n.d.). Teams work in small groups and regularly interact with each other, which allows them to quickly respond to the changing needs of users and the market. The introduction of the Holacracy methodology by the American online store Zappos insights (n.d.) allows employees to make decisions independently, participate in the company management process and create a more transparent and democratic culture. D.J. Fogarty (2015) reports that the multinational corporation General Electric uses "Lean Six Sigma" methodology to improve the efficiency of its business processes and reduce costs. The company actively implements this methodology in all its departments and processes. Toyota Motor Corporation uses Toyota Production System (TPS) methodology, which is based on "Just in time" and "Kaizen" principles (Toyota production system…, n.d.). It ensures high product quality and improves production processes efficiency and customer communication. Internationale Nederlanden Groep uses the Agile methodology to develop its banking products and services, which ensures the bank's competitiveness and allows it to respond quickly to changes in customer and market needs (Truong, 2023).

Employee empowerment: digital transformation has led to more decentralized decision-making and changes in organizational behaviour through the introduction of new technologies, tools, giving employees more autonomy, decision-making powers and greater employee engagement and job satisfaction. Tools such as Google Docs, Slack, Trello provide opportunities for more decentralized decision-making and coordination between employees from different parts of the world. Companies become more

flexible, responsive to changes in the market and maintain constant communication with their customers and partners. Increased customer orientation: digital transformation enables companies to collect data about customers and their behaviour, which in turn allows them to fine-tune marketing campaigns and sales strategies. Such companies can use a variety of analytical tools and methods to analyse large amounts of data and find useful information that can be used to improve the performance of companies. The impact of organizational changes on the organizational behaviour of employees under conditions of digital transformation is presented in Table 2.

Table 2. The impact of organizational changes on the organizational behaviour

Organizational changes	Content of organizational behaviour
Changes in company culture	Development and formation of the digital culture of companies under conditions of digital economy: digital leadership, adaptation of organizational culture to the digital environment and global challenges, organizational flexibility; customer focus; digital strategy; digital thinking; formation of digital platforms using a network approach; continuous learning.
Introduction of new digital technologies	Introduction of a new project management system, new programs, software products or other digital tools requires additional training, skills and effort on the part of employees and provides for new methods operation and communication. It can affect organizational behaviour, work attitudes, motivation and productivity.
Changes in company structure	Reorganizing company divisions or changing management chains can lead to changes in employees communication and cooperation.
Changes in work conditions	A change in working conditions affects the organizational behaviour of employees. If a company switches to remote work, employees may begin to use e-mail and other means of remote communication more, as well as change their work schedule and the way they organize their working hours. The expansion of remote work and the use of video conferencing can affect communication, the degree of mutual understanding, cooperation between employees and enthusiasm.
Development of communication skills	As digital technologies enable working with remote teams and employees, communication skills and the ability to cooperate become essential. The importance of cloud technologies is growing for information storage, collaboration and interaction; internationalization of online digital communication; individualization of production processes; use of a combined model (online-offline) of human resources management; development of digital literacy.
Understanding and using analytical tools	Digital transformation provides the opportunity to collect large volumes of data, which allows for increased efficiency and better decision-making. Data analysis includes: machine learning algorithms, artificial intelligence, electronic assistants, architectural engineering. However, appropriate skills and knowledge are necessary for using this data.
Development and improvement of digital competences of employees	Employees of international companies must develop digital competencies and skills, namely: the ability to find, understand, evaluate, systematize and disseminate data using digital tools. Cognitive, social skills, ICT skills, the ability to interact and communicate with others using the existing set of digitalization technologies, allows employees to be effective in working with new technologies and processes.
Development of talent attraction and retention strategies	Digital transformation necessitates attraction and retention of qualified employees with new skills and competencies.
Increased openness and flexibility	Digital transformation may require changes in work organization and management, demanding greater openness and flexibility from employees and company management.
Introduction of electronic assessment programs	Can be useful for organizations that want to improve their management and employee evaluation system. This may include using software to collect data on employee performance, task completion and their achievements. Moreover, the use of e-appraisal programs can improve employee motivation. This is possible due to e-appraisal programs ensuring transparency and availability of information about the evaluation criteria, as well as achievements and shortcomings of employees. This gives employees the opportunity to see their success and areas for improvement.

Source: developed by the authors

M. Pratt & J. Sparapani (2022) point out that 91% of organizations are involved in some form of digital transformation. They also found out that although 87% of senior executives consider digitization as a priority only 40% of organizations have implemented large-scale digital initiatives. The five-stage model of digital transformation describes this process and identifies corresponding failure risks and constraints of digital transformation. The model extended by the authors is shown in Figure 3.

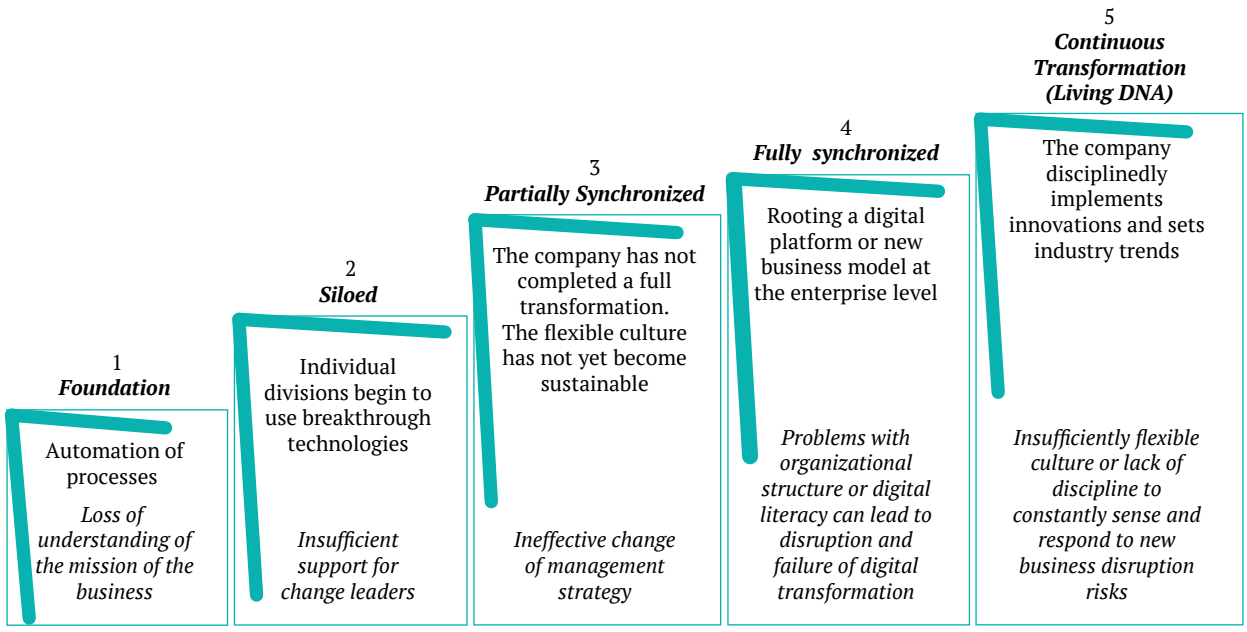

Figure 3. Problems in the organizational behaviour of companies at different stages of digital transformation
Source: developed by the authors based on T. Saldanha (2019)

Automation (or digitalization) of processes is the first stage of digital transformation, its foundation, on which individual internal processes (sales, production or finance) are automated. It is more likely automation (or digitization) rather than transformation that provides digital foundation needed for future transformation. The use of digital platforms ensures the transformation of manual operations into automated ones. This stage delivers enterprise value through the use of technologies for more efficient performance and lays the foundation for further transformation. The risks arising at this stage are connected with the loss of understanding of business mission and value and poor implementation of digital technologies. Improving the strategic thinking of the company's top management can contribute to overcoming these risks.

According to the model of T. Saldanha (2019), the second stage of digital development is isolated, when separate divisions of the company begin to use breakthrough technologies to create new business models. For example, the production department may make progress in the use of the Internet of Things, which will lead to significant changes in production or logistics management, or the finance department will start using blockchain technologies and transform the way of accounting between the company's branches in different countries. These efforts are fragmented, with no overall company strategy to guide the transformation. Insufficient support of change leaders and the wrong choice of what exactly needs to be transformed are among the most common mistakes. Therefore, the successful completion of this stage provides for a change in the organizational behaviour of the company in the direction of expanding authority of change leaders and directing efforts to the most accurate definition of digital influence levers.

The next stage is characterized by a partially synchronized transformation. A business leader, owner or CEO has recognized the disruptive power of digital technologies and determined the state of digital future. The organization, as a system, begins to move in the same direction. However, the enterprise has not completed the transformation to a digital foundation or new business models and the flexible innovation culture has not become sustainable. Systemic digital transformation can be hindered by an ineffective change management strategy or an insufficient number of transformation projects to adequately transform the core organization. To overcome these factors, it is necessary to implement a change management model and ensure the adequacy of the strategy in terms of the portfolio of initiatives necessary for a complete transformation.

The fourth stage or full synchronization provides for the implementation of a digital platform or a new business model at the level of the entire enterprise. This is quite a long and difficult process, since problems with the organizational structure or digital literacy can lead to disruption and failure of digital transformation. The only way to survive the constant threats of disruption is to make digital capabilities and an agile innovation culture an integral part of the enterprise. This requires a reboot of the technical capabilities of both the IT department and the rest of the enterprise.

The fifth stage (stage of continuous transformation) is when the transformation becomes permanent. The company maintains a constant leadership in the industry as it innovates with discipline and sets industry trends. Constant innovation and a highly flexible culture become second nature to the organization. The company becomes the market leader. The risks of this period are related to the loss of the advantage that previously ensured the transformation at the previous stage, or due to an insufficiently flexible culture, a lack of discipline to constantly sense and respond to new risks, undermining the business.

The organizational behaviour of the company should be aimed at forming a flexible culture to support the constant evolution of business and organization, regular identification of risks and disciplined response to them.

Warning signals are often ignored when leaders already sense the threat of digital disruption to their organizations but fail to respond properly. T. Saldanha (2019) attributes this to sociological reasons: fear, inertia and underestimation. Fear of destroying existing products and the cost of change. Inertia results from self-confidence in the current strategy based on its previous success. And finally, an underestimation of the potential impact of the digital revolution and an optimistic view of the organization's ability to face new competition. A summary of the most common causes of digital transformation failures and ways to overcome them is presented in Table 3.

Table 3. The most common causes of digital transformation failures and ways to overcome them

The most common causes of digital transformation failures	Changes in organizational behaviour to overcome digital transformation mistakes
Insufficient employee involvement	• clear understanding of the business strategy and goals of digital transformation by employees; • use of know-how and experience of other companies; • use of emotional intelligence to understand employees' fears; • promoting the spread of startup culture in the organization.
Insufficient support from management	• making senior management aware of business strategy and digital transformation goals before investing in change; • contributing to top management's understanding of the need for digitization and its benefits.
Poor or absent cross-functional collaboration	• understanding of the mechanism and stages of digital transformation by all divisions of the company; • adaptation of know-how and experience of companies that have effectively implemented certain stages of digital transformation; • using emotional intelligence to overcome conflicts and resistance to change.
Lack of accountability	• understanding the need to form an information system to ensure digital transformation.
Immaturity of digital culture	• a clear understanding of the business strategy and goals of investing in digital transformation; • management of resistance to changes and conflicts; • promoting the spread of startup culture in the organization.

Source: developed by the authors based on S. Teker *et al*. (2022)

Summarizing various studies on the causes of failures and ineffectiveness of digital transformation, it is possible to offer a number of practical recommendations for changing organizational behaviour in international companies under the influence of digital transformation. To develop a culture of innovation and openness it is necessary to create an environment where employees can freely share ideas and develop new solutions. It is important to maintain transparency and openness in the organization so that employees feel part of the organization and are involved in ensuring the company's competitive advantage. To encourage collaboration and knowledge sharing it is necessary to motivate employees to share their knowledge and experience, enabling cross-functional teams to work together on digital initiatives, which is an important component of successful digital transformation. Creating a flexible work environment: digital transformation has enabled companies to adopt flexible working arrangements such as remote working. Creating a flexible work environment will allow employees to work anywhere, anytime, and on any device, while maintaining productivity and collaboration.

Emphasizing the importance of digital literacy: companies should prioritize the development of digital literacy among employees at all levels. Training and resources must be provided to help employees master new digital tools and technologies, leading to more efficient and productive collaboration. Development of a culture of continuous learning: to meet the demands of the digital environment companies must create a culture of continuous learning, encourage employees to explore new digital tools and technologies, attend webinars, seminars and gain new knowledge and skills.

Developing a digital strategy: a digital strategy can help companies align their digital initiatives with overall business goals. The strategy should focus on creating a seamless digital experience for customers and employees, improving operational efficiency and driving innovation. Ensuring cyber security and data privacy: as the use of digital technologies increases, companies must prioritize cyber security and data privacy. Implementing measures to protect against cyber threats and training employees in cybersecurity best practices provide companies with the appropriate level of secure operation. Use of data analytics: data analytics can help companies gain insights into customer behaviour, market trends and operational efficiency, make informed decisions and continuously improve digital initiatives.

Therefore, organizational flexibility is the main measure of modern transformations. The results of the study emphasize the relevance of perceiving the importance of digitalization and learning as triggers of digital transformation. In addition to theoretical contributions to the existing literature on digital transformation and organizational capabilities, this study provides some managerial implications for digital transformation in companies. The present study offers a number of recommendations that can help companies overcome the negative consequences that may arise during the digitalization process, advance research on behavioural and organizational culture in the context of digital transformation.

DISCUSSION

The issues discussed in this article are not entirely new. There is quite a broad scientific discourse on the necessity, mechanisms and problems of digital transformation of

companies. The latest scientific research helps to understand the process of digital transformation of companies and to explain the change in organizational behaviour caused by digitalization. I.V. Tokmakov *et al*. (2018) claim that the digital transformation of a company is the introduction of the latest technologies into its business processes. This approach provides for the introduction of modern equipment and software, as well as fundamental changes in approaches to management, organization, corporate culture and external communications. The result of the transformation is an increase in employees' productivity, an increase in the level of customer satisfaction and a progressive and modern reputation for the company.

G. Vial (2019) has pointed out in his work that digital transformation is a process of pushing organizations to strategic responses with the help of digital technologies, such as information, computing and communication, changing their structure, boundaries and ways of creating value, realizing the evolution process of the enterprise. K. Dery & N. van der Meulen (2020) believe that digital transformation is a high-level transformation based on digitization and aimed at creating new dynamic digital business models.

Based on previous research, a group of Chinese researchers X. Teng *et al*. (2022) point out that digital transformation is based on digital technologies, including artificial intelligence, Big Data, cloud computing and blockchain. This will open up new perspectives for companies, develop new products, models and new formats, and provide an opportunity to obtain a model of sustainable development with diversified effectiveness. The main focus of the concept is on investments in digital technologies, digital skills of employees and digital transformation strategies that facilitate digital transformation, thus helping to improve productivity and support their sustainable development.

Since 2021 a large number of research has been conducted on the factors, influencing the success of digital transformation. Scientists P.C. Verhoef *et al*. (2021) point out that at different stages of digital transformation, companies have different requirements for organizational structure, culture, growth strategy, digital and other resources and capabilities, and it is their coordination and adaptation that will help facilitate the digital transformation of the enterprise. In addition to technology adoption, scientists mention such critical factors for successful digital transformation as the organization's ability to change and its operational excellence with the integration of external digital services with internal IT support providing significant benefits in today's business space.

The analysis of the above-mentioned scientific works allows to conclude that the issue of changing the organizational behaviour of employees and companies under the influence of digital transformations and the formation of directions for organizational flexibility is not sufficiently covered and requires a more detailed analysis. It is the study of the activities of international companies, implementing agile methodologies to change organizational behaviour under conditions of digitalization, described in this article, that leads to the conclusion of their chosen effective strategy.

The research of M. Ghobakhloo & M. Iranmanesh (2021), conducted within the framework of Industry 4.0, suggests that the phenomenon of digital transformation success in the context of Industry 4.0 is significantly different from the concept of digitalization success in traditional literature. Digital transformation within Industry 4.0 is extremely resource-intensive and complex. To achieve a certain level of informational, digital, operational and cyber maturity, small enterprises need special competencies in the field of change management and strategic digitalization planning. Achieving a successful competitive position by companies is possible due to the determination of aspects of the enterprise strategic vision, investments in digital transformation, creation of an innovative culture, possession of sufficient intellectual property assets and know-how, and powerful digital capabilities.

J. Dąbrowska *et al*. (2022) analyse four levels of impact of digital technologies: individual, organizational, ecosystem and geopolitical, each of which stipulates and influences the others. One can agree with the author's conclusion that this influence is not exclusively positive and does not always lead to positive results. According to scientists, digitalization can also cause "conflicting interpretations, contradictions and tensions, for which there is no single best solution, but rather different solutions that may be good for some but worse for others". At the individual level, the processes of digital transformation often cause resistance, fears and anxiety on the part of company employees, due to their fears about the reduction of jobs and the need for continuous professional development. At the organizational level, digital transformation involves changes in company strategy, management, resources, processes, competencies, culture and leadership. It is stated that existing organizational structures are often poorly adapted to uncertain outcomes inherent in them, which requires management to provide organizational support for the development of new ideas and organizational structures. At the ecosystem level, the issue of balancing the use of the advantages of digital transformations by its individual members to achieve their own interests, or to promote joint ideas and joint actions to compete with other ecosystems that may be less capable of digital technologies, is problematic. At the geopolitical level, digital transformations are perceived as a tool for market and even socio-political dominance, giving transnational corporations and governments access to user data and the ability to manage their interactions at a level excluding other countries from the market.

The article by N. Uchihira & T. Eimura (2022) examines six factors, preventing the cooperation of all stakeholders in the process of implementing digital projects in an organization. These factors include: lack of information, experience and mutual trust, incompatible evaluation criteria, conflict of interests and a different visions of the future. The authors discovered these factors through interviews with respondents in large Japanese companies. The researchers attribute the lack of information to insufficient knowledge of modern technologies among employees of individual units of the company, implementing certain digital transformations. The lack of experience results from the insufficient transfer of empirical knowledge and previous experience of digital transformations from one company employee to another. The incompatibility of the existing evaluation criteria of the organization with the promotion of digital technologies will lead to the impossibility of

making rational decisions on their implementation. If there are conflicts of interest between stakeholders, cooperation between them will be impossible. It is important to have a mechanism or contract that aligns interests and makes the advancement of digital technologies beneficial for all the parties concerned. It is critical to develop and disseminate a digital vision of the future, as it is an effective dialogue tool to overcome barriers of recognizing the need to introduce digital transformations among stakeholders. The lack of mutual trust, resulting from one of the main problems in promoting digital technologies, is caused by uncertainties as their consequences are unknown until they are actually implemented. For such an uncertain task, it is important to have trusting relationship between the company's business units and the key innovation personnel. In general, agreeing with the conclusions made by the researchers, it is worth paying attention to the lack of prioritization of the listed factors for the stages of digital projects implementation.

In their study M. Poláková-Kersten *et al*. (2023) study the features of digital technologies implementation in high-reliability organizations, providing vital services for society, such as energy, food, defense, communication, etc. The authors draw the following conclusions: they question the assumption of digital transformation being primarily a top-down process and provide insights into the challenges faced by top managers, particularly subordinates' resistance to digital transformation. The importance of involving the IT service in the transformation to ensure a balance between transformation and reliable work is emphasized. The researchers investigate protective mechanisms used by IT staff to respond to the threats connected with the introduction of digital technologies and ways to influence the strategic decisions made by the company's top management. The study offers a detailed micro-processual approach to the challenges connected with the implementation of strategic changes in such organizations and identifies those that must be resolved in the process of transforming their complex systems without compromising reliability. The authors of the article emphasize the preservation of stable functioning of high-reliability organizations during digital transformations, although do not take into account changes in organizational behaviour at different stages of transformations, as it is done in the present research.

In the modern scientific discourse there is a firm understanding of the need to implement digital technologies to increase the competitiveness and stability of the organization. In order to adapt to organizational changes, companies must develop their organizational capabilities to effectively coordinate resources and require effective leadership to manage organizational behaviour. The analysis of existing practices of digital transformations suggests that this process is accompanied by significant changes in the behaviour of subjects at all levels – from individual to geopolitical. Also, the accumulated experience calls for answers to questions about the management of companies overcoming a large number of obstacles on the way to the implementation of digital technologies. It is worth mentioning that expertise necessitates both the identification of such obstacles and specific recommendations and clear algorithms for preventing failures for enterprises from various industries, of various sizes, at various stages of digital transformation.

CONCLUSIONS

Global geopolitical trends, modern technological transformations and digital transformation lead to significant changes in the organizational behaviour of international companies, radically affecting the conditions of doing business, opens up new opportunities and creates significant challenges. Changes in organizational behaviour are driven by technology but they ultimately aim to improve company performance, increase employee engagement and create greater value for customers. It has been discovered that the organizational flexibility of companies is the most important criterion of digital transformation and it is necessary to clearly define and take into account the indicators of measuring organizational flexibility. The components of organizational flexibility under conditions of digital transformation have been studied, the impact of agile methodologies and organizational changes on organizational behaviour has been analysed. The analysed five-stage model of digital transformation, describing this process, is used to identify the relevant risks of failure and constraints of digital transformation.

Summarizing the causes of digital transformation failures made it possible to offer practical recommendations for changing organizational behaviour in international companies under the influence of digital transformation, among which are the following: the need to maintain openness and transparency in companies so that employees feel their significance and involvement in the organization, which will make employees interested in high indicators of their professional performance; the priority of developing digital literacy among employees in the company, mastering digital tools and processes will contribute to an effective and productive organizational environment; compliance with the requirements of the digital space encourages the creation of a culture of continuous learning, the provision of digital learning routes for departments or teams in order to improve the skills of employees; the development of a digital strategy that will help companies align their digital initiatives with overall business goals, will be aimed at leveraging the digital experience for customers and employees and improve operational efficiency, as well as the creation of an innovative outpost. The use of digital technologies should force companies to prioritize cyber security and data privacy, which will ensure an adequate level of secure operation. Using flexible working conditions, creating a flexible workplace will enable employees to work at the most productive time, in conditions that meet their needs, contributing to productivity and work quality. The use of analytical data will help companies to anticipate the needs of customers, offering personalized services based on customer preferences and contribute to quick decision-making and using opportunities to gain competitive advantages. The study opens perspectives for future researches and improvement of the given recommendations on changes in organizational behaviour that will help companies remain competitive in today's changing digital environment.

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CONFLICT OF INTEREST

None.

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Цифрова трансформація як чинник змін організаційної поведінки міжнародних компаній

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Анотація. Діджиталізація є необхідним процесом для підприємств у постіндустріальній економіці, який сприяє підвищенню їх конкурентоспроможності та відкриває нові можливості щодо залучення до глобальних цифрових ланцюжків створення вартості. Практика цифровізації вимагає від наукового дискурсу розроблення рекомендацій і алгоритмів подолання та попередження помилок, тому метою статті було визначення впливу цифрових технологій на організаційну поведінку міжнародних компаній та узагальнення причин невдач цифрової трансформації. Зміни в організаційній поведінці під впливом діджиталізації систематизовано за допомогою методу узагальнення. Причини невдалих цифрових трансформацій в організаціях структуровано за допомогою використання моделі п'ятиетапної цифрової трансформації. Виділено основні фактори провалів на кожному з етапів. На етапі автоматизації помилки пов'язані з втратою розуміння місії і цінності бізнесу та неякісним виконанням робіт по впровадженню цифрових технологій. На ізольованому етапі негативним чинником є недостатня підтримка лідерів змін і неправильний вибір того, що саме потрібно трансформувати. Встановлено, що системній цифровій трансформації на етапі часткової синхронізації заважають неефективна стратегія управління змінами або недостатня кількість трансформаційних проектів для адекватної зміни основної організації. Проблеми з організаційною структурою або цифровою грамотністю можуть призвести до зриву цифрової трансформації на етапі повної синхронізації. Ризики етапу безперервних перетворень пов'язані з втратою переваги, яка раніше забезпечувала трансформацію, через недостатньо гнучку культуру, брак дисципліни стосовно постійної ідентифікації нових ризиків підриву бізнесу і реагування на них. Практична цінність полягає в запропонованих рекомендаціях щодо змін в організаційній поведінці компаній, які дозволять зменшити ризики невдач і провалу цифрової трансформації

Ключові слова: діджиталізація; організаційна гнучкість; етапи цифрового розвитку; гнучкі методології; помилки цифрових перетворень; рівні впливу цифрових технологій

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Methods for assessing corporate social responsibility in the retail business

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Abstract. Corporate social responsibility is a complex concept that characterizes the activities of a company in various areas and requires evaluation of activity using specific methods. As retail has unique characteristics that distinguish it from other industries, there are limitations to the methods that can be used, and it is relevant to explore these methods. The purpose of the article was to analyse the methods of assessing corporate social responsibility in the retail sector, identifying their advantages and disadvantages and reviewing the peculiarities of their application in retail. The study uses scientific methods of analysis and comparison. The article categorizes methods of assessing corporate social responsibility by goals, time frames, focus, duration, scale and approach. A comprehensive assessment of various methods for measuring the level of corporate social responsibility development in retail companies was provided. This assessment includes an analysis of the advantages and disadvantages associated with each approach as well as a study of the potential opportunities for their application in the context of retail trade. This assessment identified the most effective and appropriate methods for evaluating corporate social responsibility in retail, taking into account the unique challenges and opportunities that exist in this industry. However, the analysis of methods for assessing the state of corporate social responsibility does not provide a uniform understanding of which one is universal and absolutely suitable for every retail company. The practical significance of the research lies in the possibility of applying these developments by retail companies when choosing a method for evaluating the state of corporate social responsibility

Keywords: sustainability; analysis; categorization; retail trade; development

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INTRODUCTION

When the concept of Corporate Social Responsibility (CSR) is being implemented in business processes, there is a need to update the methodological apparatus for evaluating business processes and the results of such activity. The update of the methodological apparatus for evaluating CSR results involves the availability of a universal assessment method or the formation of a comprehensive assessment method inherent to a specific type of economic activity. This necessitates a comparative analysis of the methods that can be used to evaluate CSR, based on which the advantages and disadvantages of different methods can be identified, as well as the appropriateness of their application for enterprises in a certain field of activity. With the increase in the use of CSR by retail companies, it is advisable to determine methods that are relevant to this field. The concept of "Corporate Social Responsibility" is actively researched by scholars around the world. Within the framework of the study of approaches to the interpretation of the concept of "Corporate Social Responsibility" in Ukrainian and other normative legal acts (Salun &

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Konstantynovskyi, 2021) and scientific and practical literature (Cerediuk, 2019; Hrytsaienko, 2021), it was established that there is no single definition of this term, since CSR is a complex and multifaceted concept that encompasses different areas of enterprise activity: economic, legal, ethical and charitable categories.

Research on methods for evaluating corporate social responsibility is present in the works of several Ukrainian scholars. Works of K. Cerediuk (2019), M. Hrytsaienko (2021) and N. Stanasiuk *et al*. (2021) are devoted to theoretical studies of methods for evaluating CSR, determining the peculiarities of the researched methods and the possibility of their application in different areas of enterprise`s activity (by types of economic activity or by industrial sectors). Scientists from other countries have made a significant contribution to the advancement of research on this topic. In the work of T.S. Thorisdottir & L. Johannsdottir (2020), a model was proposed for assessing the state of corporate social responsibility aimed at enhancing the diagnostic capabilities of CSR and, simultaneously, supporting organizational management in achieving sustainable development goals of the company. Another group of researchers, J. Lu *et al*. (2020) has developed a model for assessing the state of CSR, considering the objectives of sustainable development. This work was aimed at addressing key challenges in CSR assessment, such as the selectivity of implementation and the difficulty of comparing CSR across different industries or countries. The work of T.A. Tsalis *et al*. (2020) was dedicated to developing a flexible methodology for benchmarking and assessing the environmental dimension of CSR. This method is based on a set of well-defined indices and environmental indicators proposed by the Global Reporting Initiative (GRI) for evaluating information published in corporate social responsibility reports (CSR).

The problem of forming and implementing methods of assessing CSR is also being solved by commercial enterprises such as Acumen Group, Atkisson Group, Balanced scorecard solutions (n.d.), and others. These companies have developed their own methods of assessing CSR and providing consulting services to enterprises. It is also worth mentioning the developments of non-profit organizations such as the William Davidson Institute (SCALA metrics lab..., n.d.) at the University of Michigan, and the Center for the Study of Philanthropy at the University of Pennsylvania (Linking cost and impact, n.d.) which, after developing their own methods, provide opportunities for their use for enterprises in various fields of activity. The goal of the research was to provide a comprehensive assessment of various methods of measuring the level of corporate social responsibility of retail companies. Such assessment includes the discussion of the advantages and disadvantages associated with each approach, as well as the study of how these methods can potentially be applied in the context of retail trade. The present study employed theoretical methods, namely, analysis and comparison, with the purpose of reviewing and comprehensively presenting methods for assessing the state of corporate social responsibility. Each of these methods was thoroughly analysed, with the identification of their advantages and disadvantages. Within the framework of this study, a comparative analysis was conducted on methods for assessing the state of corporate social responsibility, and also the possibilities of combining them for a comprehensive assessment of CSR in retail businesses were investigated. The significance of the definitions of methods was revealed, and texts and categories were interpreted using the hermeneutic method. The conclusions of this study were formed using the method of generalisation. The individual results of the research were presented using a tabular method.

CHARACTERISTICS OF CORPORATE SOCIAL RESPONSIBILITY ASSESSMENT METHODS

Most methods of assessing CSR were developed and actively used in the United States. A.B. Carroll (1991) and C. Clark *et al.* (2004) not only described these methods theoretically but also developed and implemented their own methods of evaluation in the activities of commercial and non-commercial enterprises. T. Loew (2003) identified the most acceptable approaches for each type of environmental cost accounting of an enterprise in conducting CSR activities in the direction of environmental protection. The developments of scientists are used and remain relevant to this day. Towards the end of the 20th century, there was an active development of the concept of CSR. Since that period, methods and indicators for evaluating CSR have been and continue to be developed. The majority of these methods are based on the Impact Value Chain model, which was developed by C. Clark *et al.* (2004). According to this model, it is assumed that enterprises have social, environmental, and economic impacts that affect society, local communities and the environment. This impact includes planned and unplanned results as well as negative and positive effects (Fig. 1).

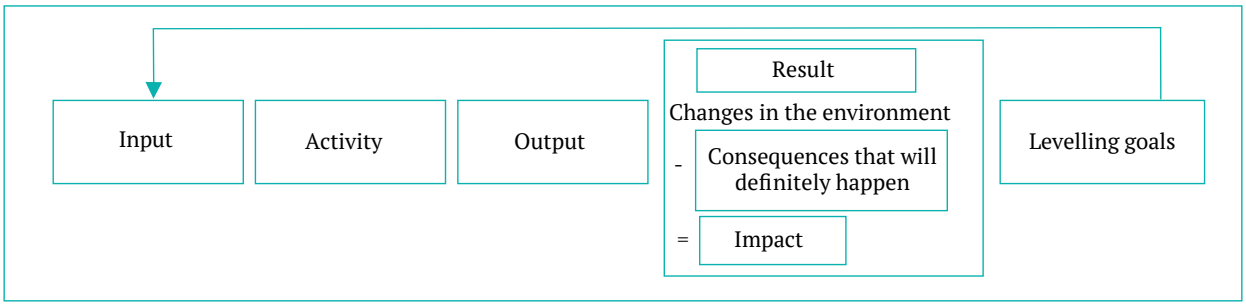

Figure 1. Value impact chain model

Source: compiled by the authors based on C. Clark *et al*. (2004)

According to this model, a goal of company's CSR is formulated as an input to allocate resources (material, technical, financial, informational, etc.) and establish a sequence and technology for their use within the current activities. The output represents the immediate, direct and rapid consequences of the activities carried out. Results indicate the degree to which the company's goal has been achieved and the environment has been affected. The impact of using corporate social responsibility is the result of the positive effects minus the mandatory consequences in case of inactivity (Carroll, 1991). Impacts include predictable as well as unpredictable results and negative and positive effects, both long-term and short-term. If the impact is insufficient, the goal is updated. Based on the presented model (Clark *et al*., 2004) a matrix of characteristics of methods and types of assessing the impact of CSR can be constructed (Table 1).

Table 1. Characteristics of CSR assessment methods

Feature	Type	Characteristics of the method
Set goals	Screening	Methods suitable for screening can facilitate the evaluation of the feasibility and effectiveness of specific social initiatives.
	Monitoring	Methods suitable for monitoring assist management in making current operational decisions and provide data for investor evaluation.
	Reporting	Methods aimed at the formation of reporting are useful for reporting to external stakeholders such as potential investors, the public, or other organizations that make requests about a company's CSR.
	Rating	The methods of evaluation are used for retrospective analysis of the enterprise key performance indicators (KPI) achievements.
Time frames	Perspective	To assess future (planned) impacts, such as expectations from planned projects and programs, forecasting methods are used.
	Actual	Checking the current status of indicators allows to assess the state of affairs before certain control points or deadlines.
	Retrospective	Evaluation of past performance.
Focus	Input data	Input-based methods are useful for assessing differences in input resources (such as costs, savings due to increased employee satisfaction resulting from social initiatives).
	Output data	Output-based methods are useful for assessing differences in outputs (such as brand reputation, number of loyal customers, number of brand ambassadors).
Duration of the analysis	Short-term	In more traditional methods, measurements focus on the short term.
	Long-term	Measuring certain KPIs may require a long-term approach. For example, to assess the impact of implementing a policy to reduce CO2 emissions in production, a long period of time will be needed, and therefore, the KPI evaluation method must be adapted to such duration.
Scale of business	Micro (individuals) Meso (company) Macro (society)	When evaluating the impact of a business (micro), different indicators are used than when evaluating the impact of the macro-environment.
Approach to measuring CSR indicators	Process methods	Monitoring the efficiency and cost-effectiveness of current operational processes.
	Methods of influence	Measure the operational results and their impact by comparing the expected results in the case of successful implementation of CSR activities with the results in the absence of such activities.
	Monetization methods	It is a quantitative assessment of social and environmental KPIs. An example of such method is the 3P (Plan, Prepare, Present) approach, which quantitatively assesses and translates into a monetary form the economic dimension (profit), social dimension (people), and environmental dimension (planet).

Source: compiled by the authors based on R.S. Kaplan & D.P. Norton (1996), C. Clark *et al*. (2004), J.A. Van Ast *et al*. (2005), K. Maas (2009), K. Maas & K. Liket (2011)

The empirical characteristics of sustainability assessment methods presented in Table 1 involve the use of specific indicators or indicator systems that can be applied in the analysis and monitoring of sustainability. Sustainability indicators used in assessments may be specialized and specific to a particular type of economic activity. Therefore, each of the listed sustainability assessment methods will be considered in terms of their applicability to sustainability assessment in retail.

The Impact Metrics System (17 impact..., 2023) was developed by Acumen Fund and the consulting company McKinsey to help commercial and non-profit enterprises focus on actions that provide immediate results and improve the long-term competitive positioning of the enterprise in the changing and dynamic market conditions. The developed system of indicators focuses on building such a management system that balances financial and operational indicators, leading and lagging indicators, as well as indicators based on the vision and mission of the enterprise which reflect the needs of stakeholders and the organization. Typically, there are five areas of "impact metrics": finance, internal business processes, customers, learning and staff growth, vision, management and continuity (17 impact..., 2023). The disadvantages of the Impact Metrics System are: the inability to use it for micro-scales and the inability to quantitatively measure the

impact of CSR on business performance results (for example, in monetary terms). The advantage is the universality of the Impact Metrics System in terms of application and its applicability in retail for large local market players.

The Sustainability Compass (n.d.) by Atkisson Group focuses on key dimensions of sustainability: nature, economy, society and well-being. This popular management tool is used to shape, define, evaluate and measure progress towards sustainable development in retail networks within the United States, demonstrating its potential application in practice and in Ukraine. It also easily integrates with the United Nations Sustainable Development Goals (Sustainability accelerator network). However, the Sustainability Compass cannot be used by large international enterprises and does not provide the possibility to assess the results of implementing CSR projects and their impact on the company's operations.

The Balanced Scorecard (BSC) (Balanced scorecard solutions, n.d.) is based on the idea of considering strategic indicators in addition to traditional financial metrics, in order to form a "balanced" view of a company's performance. The concept of the Balanced Scorecard goes beyond the simple use of perspectives and represents a holistic system for managing strategy. This means that the method reflects the relationship between projects and programs, KPIs, strategic goals as well as the mission and vision. The BSC allows for the integration of indicators for the implementation and application of sustainability strategies with key performance indicators of business operations (BSI). The main advantages and disadvantages are the ability to evaluate the impact of sustainability on a company and to compare the situation in retrospect, but it cannot be used in the long term, making it impossible to use in, for example, building a carbon reduction strategy. Additionally, the Balanced Scorecard cannot be used for micro-businesses. Overall, the method is effective when applied in the retail sector, for medium- and large-scale enterprises and for determining the current balance between different aspects of business activity.

Best available charitable option (BACO) (n.d.) by Acumen Fund is an alternative to the penetration metrics system. The main difference of BACO lies in its approach to the process as well as to the monetization of the results of social impact measurement. The method allows for quantitative evaluation of the social impact of investments and comparison with existing charitable options for addressing a specific social problem, providing systematic information for management decision-making, regarding investment of a charitable fund from a set of options with a quantitative indication of whether a social investment exceeds existing alternatives (Best available..., n.d.). Short-term evaluation and the inability to apply the method to all business scales are its limitations. However, the method is essential for converting social impact measurement results into quantitative indicators, which is particularly important in industries such as food retail, where it is necessary to consider the economic viability of social activities with low profit margins (4% to 15%).

"The bottom part of the impact assessment pyramid" was developed by T. London (2008). The goal is to form a "complete picture" of the impact with a focus on understanding what underlies the enterprise's impact pyramid and assessing the scale of the impact on the external environment of the enterprise's activities: society, local communities, and even global social issues. Any enterprise potentially affects three groups of stakeholders: sellers, buyers and local communities. Therefore, the method helps management assess potential socially oriented projects, and the system of indicators promotes a deeper understanding of the relationships between profit and the solution of certain social problems. The disadvantages of the method include a short-term evaluation perspective and a relatively narrow application – it is used for medium-scale enterprises that are already transitioning to the macro-business class, as well as for the largest market players. The advantages include the ability to quantify global social initiatives and establish a relationship between them and the potential profit the company will receive. This method is used in the retail sector by large international companies as the primary tool for evaluating the results of global corporate social responsibility projects.

Cost per Impact is a development by the Center for High Impact Philanthropy at the University of Pennsylvania (Linking cost and impact, n.d.; Maas & Liket, 2011). The essence of the method lies in evaluating philanthropic projects and determining the most impactful and beneficial alternatives with equal resource investment. Evaluation is conducted based on two factors: social impact, which is measured by specific and concrete indicators (e.g. in youth entrepreneurship projects – the percentage of young people from a particular area engaged in entrepreneurial activity and self-employment); and the cost of investments made in a particular philanthropic project. This method is sensitive to information about what is effective or not, and how much capital is needed to achieve a desired effect. However, the method has certain limitations, such as only evaluating input data, the inability to evaluate results in monetary terms and the inability to analyse project performance at intermediate points. This method can only be used by retailers as an auxiliary tool, due to limitations in evaluating CSR initiatives.

The CHAMP method (Charity Assessment and Management Practice) for evaluating charitable activities was developed by the Dutch charity organization De CBF-DonatieTest in 2006 (Maas, 2009). The essence of the method is to conduct evaluation of five different levels of impact: on the society; on the local community; on outcomes; considering input resources (money, volunteers, etc.); on activities; and on input data. This tool is designed to help businesses report on the current state of corporate social responsibility (CSR) and to help charities and volunteers choose which CSR initiatives to work on together. However, this method cannot be used in the retail sector as a standalone tool: it does not consider the long-term perspective of projects (showing results for today only), is used only for reporting purposes and does not consider the long-term impact after the implementation of CSR measures.

"Bubble chart of an investment fund" is a tool for visualizing the results of CSR and the dynamics of CSR indicators. It allows for easy comparison of the performance of the enterprise with others in the same issue. For example, fund management and executives at different levels can use the bubble chart to evaluate relative productivity and cumulative investments in the fund (or overall charitable

investments) based on productivity indices. The advantages of this method are ease of evaluation, universality and the ability to apply it to enterprises of different scales. Disadvantages include displaying only individual investments in the fund (but it can display current overall investments or overall charitable investments as desired), not reflecting participant costs and displaying performance only at a certain point in time (Tuan, 2008). This method is completely universal and is used in retail for evaluating CSR, but to obtain a complete picture, it is advisable to use it in combination with other methods.

Expected Return is a method developed by the Hewlett family fund (Maas, 2009). The method calculates the expected profitability of CSR investments by investing in the most profitable projects based on the principle of "invested dollar for benefit". The method does not evaluate the current state of affairs but is purely prospective. The Expected Return provides a systematic, consistent and quantitative approach to evaluating the potential benefits of CSR and is based on the analysis of economic efficiency, cost analysis and financial results. Overall, the method is illustrative for managers of different branches and departments when evaluating the state of CSR from an economic perspective, when it is necessary to analyse costs for a specific corporate social responsibility project. This method has certain similarities to Cost per Impact, but there is a significant difference in the research objectives, duration and main focus. Expected Return can be applied in retail, but it should be combined with other CSR evaluation methods to obtain data in dynamics.

LEM (Local Economic Multiplier) is an approach that uses market incentives to promote environmental protection (Maas & Liket, 2011). The LEM approach recognizes that markets are not perfect, and there may be negative externalities that are not reflected in market prices. LEM advocates for the use of market-based tools, such as taxes, subsidies and emissions trading systems, to correct these market failures and align private incentives with social goals. LEM emphasizes that environmental protection should be achieved in the most cost-effective way possible, and market-based tools can achieve this by providing incentives for firms to reduce their pollution and incentivizing the development of cleaner technologies. LEM has been successfully applied in various countries, including the USA, China, and Europe, and is a promising approach for promoting environmental protection in a market economy. In this section, the different corporate social responsibility assessment methods were reviewed and a detailed description of each of them was provided, including both their advantages and disadvantages as well as the history behind some of them and the reasons for which they were created.

THE PECULIARITIES OF APPLYING THE INVESTIGATED METHODS IN ASSESSING THE STATE OF CSR FOR RETAIL SECTOR ENTERPRISES

Empirical categorization of Corporate Social Responsibility (CSR) evaluation methods based on their goals, timeframes, focus, duration, scale and approach, as well as analysis of CSR evaluation methods by identifying their characteristics and using the "Value Chain Impact" model, which states that companies have social, environmental, and economic impacts that affect society, local communities, and the environment, do not provide a unified understanding of which method is universal and suitable for retail companies. Each of the listed methods has its advantages and disadvantages, as well as a specific application (Table 2).

Table 2. Generalized characteristics of the studied methods

Method name	Advantages	Disadvantages	Application in retail
Impact Metrics System	The universality of application and the potential for use in large local enterprises.	Inability to use for micro-scale businesses; inability to quantitatively measure the impact of CSR on business outcomes.	For large local market players.
The Sustainability Compass by Atkisson Group	This allows for the formation, identification, evaluation and measurement of progress towards sustainable development and can be easily integrated with the United Nations Sustainable Development Goals.	It does not allow for evaluating the results of implementing CSR projects and their impact on the company's performance.	This method cannot be used by large international trading companies.
The Balanced Scorecard (BSC)	"Enables to assess the impact of CSR on the enterprise, compare the situation retrospectively".	This method cannot be applied in the long-term perspective and for micro-businesses.	This approach is effective when applied to meso- and macro-scale enterprises.
BACO	Allows to translate the results of CSR into quantitative indicators.	Short-term focus and inability to be applied to all business scales.	This is possible, provided that it is combined with methods for evaluating the CSR process.
"The bottom part of the impact assessment pyramid"	Evaluates global social initiatives in quantitative terms, shows the relationship between costs and potential benefits.	Short-term evaluation perspective and narrow application.	It is applied by large international enterprises as a primary one.

Table 2, Continued

Method name	Advantages	Disadvantages	Application in retail
Cost per Impact	Sensitive to information.	Does not evaluate input data, monetary outcomes, and cannot analyse project activities at intermediate points.	Can only be used as an auxiliary tool.
CHAMP	An effective tool for forming reporting.	Does not take into account the long-term perspective of projects.	Cannot be used as a standalone method.
"Bubble chart of an investment fund"	Ease of assessment, universality, and applicability to enterprises of different scales.	Reflects only individual investments in the fund, does not reflect participant costs, and reflects productivity only at a certain point in time.	Possible, provided that it is combined with methods that allow monetizing the results of CSR.
Expected Return	Provides a systematic, consistent and quantitative approach, allows for planning CSR strategy.	Does not evaluate the current state.	Possible, provided that it is combined with methods for evaluating the current situation.
LEM	Ability to monetize research results, coverage of data over time and ease of use.	Does not cover the process part of CSR.	Often used in combination with process methods.

Source: compiled by the authors based on K. Maas (2009), K. Maas & K. Liket (2011)

The application of a particular method for assessing CSR should be justified by the time frame, scale of business, purpose of assessment, and format of the results obtained. However, a method such as the Local Economic Multiplier (LEM) can be used independently for a basic assessment of corporate social responsibility of retail companies. For a comprehensive evaluation of CSR, a pool of methods should be applied, in which the advantages of some compensate for the disadvantages of others. An effective strategy might involve employing a blend of the LEM alongside the method referred to as "The bottom part of the impact assessment pyramid". By adopting this method, a thorough assessment of a company's corporate social responsibility would be possible to conduct, encompassing an analysis of both its present status and past CSR initiatives.

The obtained results indicate that assessing Corporate Social Responsibility (CSR) in the retail sector requires the application of specific methods. As corporate social responsibility is a complex and intricate concept, the approaches to evaluating its status must be appropriate and well-suited. It is important to note that there is no singular approach to determining the current state of a company's CSR, so it would be prudent to compare the findings of this study with those of other researchers. In the work of A.S. Kantudu & I.A. Gololo (2020), existing methods for evaluating the impact of CSR on Earnings Management were described. Among these methods, the "Reputation Index of Rating Agencies" can be distinguished, which is related to the previously mentioned Balanced Scorecard method. However, there are significant differences between these two approaches. The BSC methodology entails conducting assessments by both the company itself and third parties, whereas the "Reputation Index of Rating Agencies" is solely conducted by consulting firms. Both methods aim to establish clear metrics on which an index will be based. The obtained result is a mathematical representation of the overall state of Corporate Social Responsibility (CSR), accompanied by a specific matrix that provides an interpretation of various aspects of the CSR development on the company. This index can be compared retrospectively, both within the same organization and with other market players. However, similar to the current research, certain limitations in the application of this method have been identified by the authors. These limitations mainly revolve around the focus on larger enterprises and the requirement for significant resources to conduct the evaluation. The "Reputation Index of Rating Agencies" can be applied for evaluating retail sector enterprises; however, it is best suited for larger-sized companies, and its use for local or even regional retail chains might be restricted due to resource constraints.

Another set of researchers who have investigated this issue are B.T.T. Hang & H.T.M Duyen (2020). In their work, the scholars provided categorization of approaches to assessing the state of Corporate Social Responsibility (CSR) in enterprises. One of these approaches is One-dimensional measures. The essence of this approach lies in evaluating CSR in specific areas (e.g., environmental conservation, education, healthcare, etc.). This approach shares similarities with the previously described "The Price of Impact", as both approaches are narrowly focused. Therefore, similar to the findings in this study, the authors concluded that for a comprehensive assessment of CSR, a combination of other methods should be employed by companies. No limitations for application in the retail sector were identified by the authors, so this method can be utilized in trading companies, albeit in conjunction with other methods.

Finally, it is relevant to consider the work of L.F. Gronbach (2023), where the author explores the peculiarities of assessing Corporate Social Responsibility (CSR) in large international enterprises, using one of the world's largest postal services as a case study. The research highlights the necessity of using various methods for a comprehensive and holistic evaluation of CSR status. Furthermore,

the author emphasizes that individual CSR initiatives may require tailored assessment methods, thus supporting the thesis put forward in this current study, regarding the need for a combination of methods to achieve assessment goals. While the focus is solely on the postal company without considering the experience from related sectors such as retail, the authors of this article believe that the findings of the study have practical relevance in the retail industry as well. Overall, it can be concluded that the research, despite the different contexts, shares similarities in results. However, it is important to note that the number of studies on this topic in the retail sector is limited, making comparisons challenging. Although comparable sectors may share common characteristics, they also possess specific nuances inherent to their respective activities. Therefore, when interpreting results, these unique aspects should also be taken into account.

CONCLUSIONS

Corporate social responsibility has become an indispensable component of a company's operations and is deeply integrated into its processes. Given the distinctive traits that distinguish the retail sector from other industries, there are constraints inherent in employing conventional approaches to appraise CSR within retail enterprises and requiring the application of peculiar methods. In this study, existing methods for assessing CSR were analysed, their features (including advantages and disadvantages) were investigated and their potential for application in the retail businesses sector was explored. These methods were categorized according to a number of characteristics and types. An analysis of the possibilities of applying one or another method in combination with other methods, when assessing the state of CSR, has been carried out.

The research findings revealed that each of the analysed methods has its own limitations and advantages when applied to retail companies. It was found that there is no single method for assessing the state of CSR in the retail sector, and a combination of methods is necessary to achieve a comprehensive all-encompassing analysis. One promising approach could be to use a combination of the LEM method and "The bottom part of the impact assessment pyramid". This approach would provide a comprehensive evaluation of a company's CSR by assessing both the current state and previous CSR projects. Given the rapid development of the retail sector and its CSR initiatives, further research is needed to identify the primary challenges in developing methods for assessing the current state of CSR. Another promising direction for research is to identify the characteristics of various methods and how they can be combined to provide a more comprehensive evaluation of a company's CSR efforts.

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None.

CONFLICT OF INTEREST

None.

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Методи оцінювання корпоративної соціальної відповідальності в ритейлі

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Анотація. Корпоративна соціальна відповідальність є комплексним поняттям, що характеризує діяльність підприємства в різних сферах і потребує оцінки діяльності із застосуванням специфічних методів. Оскільки ритейл має унікальні характеристики, які відрізняють його від інших галузей, існують обмеження щодо методів, які можуть використовуватися, і ці методи актуально дослідити. Метою статті було проведення аналізу методів оцінювання корпоративної соціальної відповідальності в сфері ритейлу, виокремлення їх переваг та недоліків, огляд особливостей їх застосування в ритейлі. В дослідженні використано наукові методи аналізу та порівняння. У статті проведено категоризацію методів оцінювання корпоративної соціальної відповідальності за цілями, часовими рамками, фокусом, тривалістю, масштабом та підходом. Надано комплексну оцінку різноманітним методам вимірювання рівня розвитку корпоративної соціальної відповідальності підприємств сфери ритейлу. Така оцінка охоплювала аналіз переваг і недоліків, пов'язаних з кожним підходом, а також дослідження потенційних можливостей їх застосування в контексті роздрібної торгівлі. Завдяки цій оцінці було визначено найбільш ефективні та відповідні методи оцінки корпоративної соціальної відповідальності в ритейлі, враховуючи унікальні виклики та можливості, які існують у цій галузі. Однак, проведений аналіз методів оцінки стану корпоративної соціальної відповідальності не надає єдності розуміння, який з них є універсальним та абсолютно підходить для кожного підприємства сфери ритейлу. Практичне значення дослідження полягає в можливості застосування цих напрацювань підприємствами сфери ритейлу при виборі того чи іншого методу оцінювання стану корпоративної соціальної відповідальності

Ключові слова: сталість; аналіз; категоризація; роздрібна торгівля; розвиток

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Issue of Ukrainian financial sector information security

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Abstract. Protection of financial resources is one of the priority tasks of the state, which determines its independence and subjectivity. This is especially relevant in the case of Ukraine, which is conducting full-scale military operations, therefore the study of the cyber security problem of the financial sphere of Ukraine and the formulation of recommendations for their solution became the purpose of this study. Methods of statistical analysis, systematization and synthesis were used to analyse the dynamics in the field of protection of critical information, whereas the intelligence method, based on open sources, was used to reveal the main trends, methods, and tools of modern cyber fraud. As a result, a list of problems and threats to the financial sector of Ukraine was formed. An assessment of existing trends in the effectiveness of countering such challenges is given, and several recommendations have been developed to prevent the leakage of personal data and the vulnerability of financial structures. Such recommendations included the introduction of clear algorithms for personnel behaviour, separation of subsystems with different levels of access and their restriction of access to external networks, as well as personal digital security rules – use of two-factor authentication, prohibition of transmission of passwords and temporary codes, etc. In the context of the dynamics of the growth of the number of Internet users over the last five years in the world, the international principles of ensuring information security and the legislation of Ukraine, which regulates actions to protect against cyber-attacks, were analysed. The practical significance of the research lies in finding ways to solve problems in the field of information security of the financial sector and forming recommendations that may be useful to the management of financial institutions

Keywords: information security; financial sector; digitalization; threats; cybercrimes; information protection

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INTRODUCTION

Global digitalisation trends affect all spheres of society – economic, political, security, educational, and everyday life. Information shapes the competitive advantages of not only individual companies but also entire countries. Therefore, this proliferation of technologies conceals countless risks of remote influence on financial processes, which is especially critical for modern Ukraine. Wartime risks only increase the country's responsibility in the

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area of financial sector information security, being actively studied by the Ukrainian scientific community.

S. Onyshchenko & A. Hlushko (2020), using a systematic approach to the study of information security, formed the structure of such security in the context of the national economy by applying the method of individual system component interconnection. The structural scheme of relations between security elements and the external environment, proposed by the authors, includes such components of threat response as economic sovereignty, which implies the state's control over its resources; protection against external and internal destabilising factors; development of intellectual potential and equivalence of cyber defence systems for finance.

Further discussion on the issue of society digitalisation in times of crisis, S. Onyshchenko *et al.* (2020) and V. Onyshchenko *et al.* (2020) investigated the impact of the COVID-19 pandemic and subsequent quarantine restrictions on the level of technical awareness of society. In the first months of the lockdown alone, the number of new Internet users worldwide increased by 7%, and the development of such areas as virtual work meetings, distance education, and courier delivery has grown exponentially. The authors note that society is immersed in the virtual world, triggered by COVID-19, which has highlighted the security challenges of the information space and forced the global community to reflect on the vulnerability of the system once again. M.O. Kravtsova (2018), focusing on combating cybercrime in Ukraine, identified certain features inherent in such violations of the law and formulated key indicators of their determination – the dynamic development of technical awareness of the population, the introduction of new, more powerful, high-speed information exchange protocols and the objective inertia of law enforcement agencies, which does not allow them to operate proactively.

Modern trends in financial technologies and their impact on the security of banking institutions were studied by Y. Khudolii & L. Svystun (2021). The researchers examined such relevant digital banking tools as mobile wallets, open banking, microservices, artificial intelligence (AI), and blockchain, and noted a gradual change in the business models of Ukrainian banks and their medium-term FinTech development strategies. Although Ukraine is introducing more secure database organisations with a higher degree of reliability, the authors recommend anticipating the growing demand for online services based on the experience of global banking trends. V. Onyshchenko *et al.* (2020) highlighted such vulnerable aspects of the financial system as electronic payment services, the cryptocurrency market, deliberate dissemination of misinformation, etc. The authors insist that the indicators of the country's digitalisation should also be perceived through the prism of growing threats and the need to ensure proper financial security. V. Bozhenko *et al.* (2021) investigated the rapid cyber fraud spread in the financial sector of Ukraine, identified the main initiators of cyberattacks and the specifics of their criminal activities, stating that the most common forms of such illegal actions are hidden mining, ransomware and deception software that distract the security services of financial institutions from the real epicentre of the attack.

As confirmed by the Ukrainian researchers, the financial sector of Ukraine, albeit belatedly, joined the global fight against cybersecurity challenges. As such, the study aims to analyse the current situation in terms of ensuring its information security.

MATERIALS AND METHODS

The study employed statistical analysis of national economic security indicators, such as the number of registered cyber incidents, types of suspicious files detected by the Vulnerability Detection System of the State Service for Special Communications and Information Protection of Ukraine, and the geography of detections of critical information security events in 2022 and 2023. Statistical analysis and available information security indicators were used to formulate forecasts for further data leakage statistics and the development of the situation in the medium term.

An analysis of the remote access technologies' penetration into people's lives and the dynamics of the number of Internet users in the world from 2019 to 2023 was also conducted to determine the extent of the recent intensive growth of the economy's digitalisation caused by the COVID-19 pandemic and forced quarantine restrictions. Furthermore, the development and transformation of malicious tools for influencing the financial system of Ukraine were studied, and the change in capabilities and effectiveness of cyberattacks over the past few years was examined by a comparative method.

In particular, the study tracked the compliance of existing information system security factors with such principles as legality, comprehensiveness, integration with international rules, balance of interests and cost-effectiveness. The materials used in the study include existing criteria for assessing information security, the concept of a target's hacker attack chain, and the European Union Agency for Network and Information Security experience.

Existing information risks in financial activities were summarised and structured using the systematisation method, including the risk of significant financial data leakage, the risk of destruction of such information in the absence of a recently created backup copy, dissemination of false or negative information in the information space, etc. Such risks were further divided by classification into accidental, intentional, and manipulative.

Since the current martial law requires, for security reasons, additional protection of the financial sector and partially restricted access to the relevant state financial information, an Open-Source Intelligence (OSINT) method was used to form a list of key threats of external interference by intruders in the operating system of financial institutions and to provide examples of fraudulent calls received by bank customers. In particular, examples of calls to consumers on behalf of the security service of banks or other financial institutions were given, which highlight the risks of hacking personal accounts in real-time and using the stressful state of customers to acquire their passwords, temporary access codes, etc.

Through the synergistic effect of the application of existing methods, numerous problems of ensuring information security of the financial sector of the national economy of Ukraine were identified and formulated, and by using existing materials and analysing the research results, several recommendations were made to overcome the threats of their cyber vulnerability.

RESULTS

The current level of technology may be used to significantly increase innovative production, speed up communication processes, and accelerate the development and introduction of new financial products in Ukraine using digital tools. However, this development also has an issue: the digitalisation of financial transactions increases their vulnerability to remote influence, which is an additional factor of instability.

According to the official report of the System for Detecting Vulnerabilities and Responding to Cyber Incidents and Cyber Attacks of the State Service for Special Communications and Information Protection of Ukraine, in 2022, monitoring and analysis tools processed about 58 billion events, detected 181 million suspicious cyber events, processed 179,000 critical events, almost 90,000 suspicious unique files, and documented 415 cyber incidents by System analysts (Statistical report..., 2023). Not only are the absolute figures noteworthy, but also the dynamic development of these indicators – in 2022, the relevant Ukrainian services registered almost three times as many cyber incidents as in 2021. At the same time, most of the new attacks were geolocated in Russia, which means that the protection of Ukraine's information space has become another frontline.

According to the results of the first half of 2023, the State Service for Special Communications notes a certain change in the tactics of cybercriminals representing the interests of the aggressor country – a qualitative transition from an onslaught of simple destructive attacks to more intelligent espionage, implantation and downloading of victim-related data (Russian cyber operations, 2023). The number of incidents more than doubled, from an average of 57 per month in 2022 to 128 per month in 2023. At the same time, Ukraine's special information defence services are also improving their skills: the share of critical incidents fell by 80% – from 144 (first half of 2022) to 27 (first half of 2023) and the number of incidents with negative consequences decreased by 48%. This trend suggests that the protection of important information, including that of the financial sector, has improved. As for the general trend of increasing the number of Internet users, the data for several previous years is shown in Figure 1.

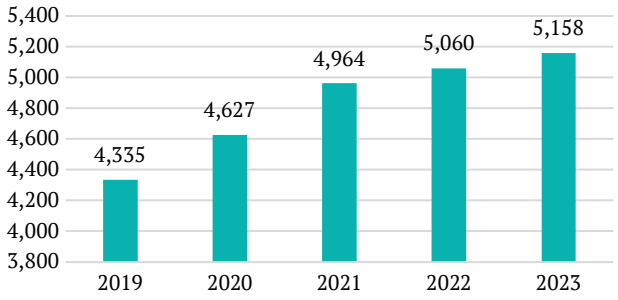

Figure 1. Dynamics of the number of Internet users in the world, billion people

Source: compiled by the authors based on Digital 2023: Global overview report (2023)

Figure 1 shows a rapid increase of almost 14% in the number of Internet users in 2020 and 2021, driven by the need to comply with quarantine requirements and communication limitations. Many banking and financial services customers were forced to discover the benefits of remote account management, making various types of fraud and information manipulation simpler. The principles of ensuring information security include confidentiality, legality, integrity and maintaining a balance between the interests of the state and individuals. There is an international standard of criteria for assessing information security, which is formulated in English as Confidentiality, Integrity, and Availability or, in short, CIA. Another important characteristic of information security is unification, as communication between different national security structures must be identical and mutually integrated, therefore preventing international cybercriminals and fraudsters from exploiting loopholes in the laws of different countries.

An example of such a supranational structure for controlling security in cyberspace is the European Union Agency for Network and Information Security (ENISA), which was established in 2004 and whose functions include the development and implementation of common standards for combating crimes in the virtual environment, the development of an appropriate expert culture, as well as the protection of public and state organisations, enterprises, and individuals within the European Union. In its turn, Ukrainian legislation also attempts to respond to modern security challenges in the information space promptly and ensure the implementation of Article 17 of the Constitution of Ukraine (1996), which provides, in parallel with the protection of Ukraine's sovereignty and state integrity, guarantees of its economic and information security.

In particular, on 14 May 2021, the Decree of the President of Ukraine No. 447 "On Cyber Security Strategy of Ukraine" (2021) was introduced. This Strategy outlines the existing vulnerability of the state's information, economic and financial systems to subversive foreign intelligence services activities in cyberspace and outlines the priorities for appropriate action. These strategic goals include securing cyberspace; sovereignty of the state and the development of society protection; protecting the rights, freedoms, and legitimate interests of Ukrainian citizens in cyberspace; and European and Euro-Atlantic cybersecurity integration. Particular attention should be devoted to The cyber kill chain (2023) concept, which, thanks to Lockheed Martin, moved to the terminology of cyber warfare from "conventional" warfare in 2011 and aims to script a scenario for countering external interference in the information sphere. According to the concept, the chain of countering a hacker attack on a target consists of the following algorithm: detect, shut down, change, corrupt, mislead and deter.

Regarding the problems of ensuring information security in the financial sector, the banking system is the most targeted by criminals, as money is a universal means of payment. In martial law, depriving the enemy of financial resources can significantly reduce the number of available options on the battlefield, and, at last, hacking into financial institutions' databases provides access to the personal data of both individuals and entire organisations. According to the OSINT-acquired data, the key challenges to the information security of financial institutions are gaining access to secret or confidential data; disruption or complete termination of the computer information system;

substitution or deletion of files by intruders; so-called "phishing", when a bank employee clicks on an unfamiliar link and opens access to data on the computer; traffic interception and routing changes.

It is also worth noting that information risks in financial activities can be conditionally divided into accidental, intentional, and manipulative. Accidental risks include the loss of a password (lost media, forgotten password), negligence in creating backups, and physical destruction of servers and databases as a result of a technological failure or natural disaster. Intentional risks include criminal intentions of financial institution employees, hacking of security systems by external intruders, and theft of access media. Manipulative risks are those where fraudsters use deception or blackmail to force bank staff to cooperate, as well as spreading false or negative information in the information space. The total number of cyber incidents in the financial industry, as well as the number of critical financial data leaks worldwide from 2013 to 2022, is visualised in Figure 2.

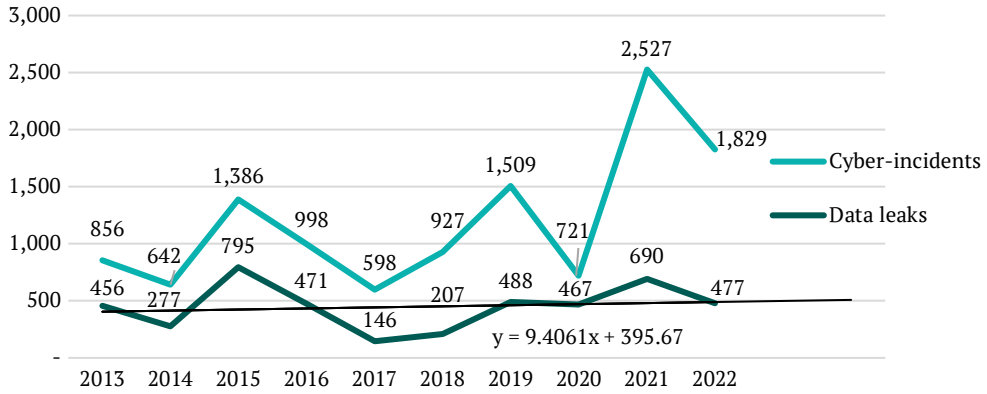

Figure 2. The number of cyber incidents and data breaches in the financial industry worldwide

Source: compiled by the author based on the Number of cyber incidents in the financial industry worldwide from 2013 to 2022 (2023)

According to the data, the number of critical information leaks in the financial sector over the past decade has averaged around 500 events per year. Given the strong technological development that took place between 2013 and 2022 – both in general in various areas of life and the banking sector in particular – this relatively stable figure is rather strange. However, such "passivity" of cybercriminals specialising in data theft might have a rather simple reason. The development of personal data hacking technologies is inseparable from the opposite process – the improvement of the protective mechanisms of financial institutions, and, therefore, the average number of successful attempts does not change critically. As for cyber incidents in general, their number is changing quite dynamically from peaks in 2015, 2019, and 2021 to further declines. As banking institutions change and update their security protocols all the time, this "sine wave" is attributable to various exploits, through which hackers can gain access to financial transactions, as well as the operation of security systems that block identified vulnerabilities – and so on until the next cycle. Therefore, while it is difficult to make detailed forecasts in such an unpredictable industry as cybersecurity, a certain stabilisation of data breach rates in the medium term is notable based on the formation of a trend line.

Numerous information security threats and their diversity require a wide range of countermeasures for financial institution protection. These include, in particular, set algorithms for working with valuable information and the immediate transfer of critical data to an isolated virtual area with minimal and restricted access to the global network. Ideally, a modular data configuration implies a situation in which all subsystems operate separately from each other, and data leakage outside the module is prevented by firewalls. In this case, after preliminary ranking by the degree of importance, the information enters the front office, is transferred for processing to another module, the back office, and then goes for long-term storage in the head office module, which does not have direct access to external Internet networks.

According to several international studies and surveys of banking industry representatives, the human factor is the most vulnerable point of any security system (Villar & Khan, 2021). The lack of digital literacy or negligence among staff causes almost 80% of information security risks (Kurylo *et al.*, 2023). The most illustrative cases include passing passwords to unauthorised or unfamiliar people, disclosing the specifics of the bank's security configuration, following unknown and random links, opening files received from unreliable or unknown addresses, and logging into service subsystems from their unprotected smartphones or laptops.

Therefore, it is worth separating recommendations for overcoming information security problems in financial institutions for employees and individuals, i.e. clients of financial institutions. Staff should undergo frequent and intensive training courses, and understand the existing risks and threats, both old and new. Employees should be obliged to keep proprietary information confidential and non-disclosure, and signed agreements should remain in force even after termination. Each financial institution employee should conduct constant monitoring to detect abnormal situations, unauthorized connections, and unusual activities in the system; regularly back up documents; not use personal computer equipment in a professional environment; regularly change their passwords and in no case keep records at the workplace.

For individuals using bank services, a different list of precautions is used to help protect personal information and funds from fraudsters. There are frequent cases of fraudsters calling from allegedly banking institutions to "prevent illegal debiting of money from the account". Under this fraudulent scenario, financial services consumers, mostly elderly, under the influence of stress and fear of losing their savings, provide confidential information to the criminals, thus opening access to their accounts. A generalised theoretical model of the security system, which is a flowchart showing the interrelationships of various components of the phenomenon, is shown in Figure 3.

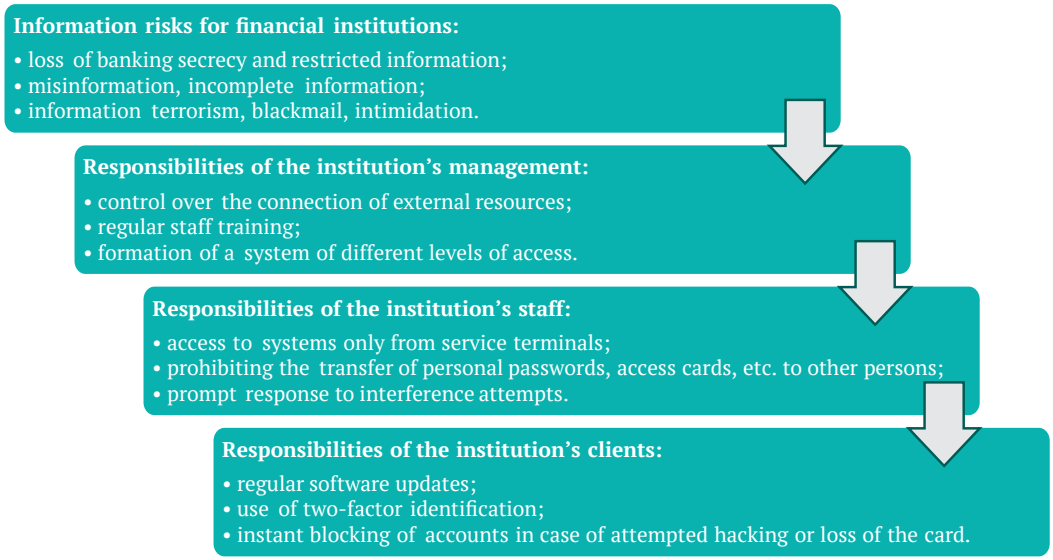

Figure 3. Information security problem-solving model

Source: compiled by the authors

Accordingly, all users of banking services must use two-factor identification, update the bank's software promptly only from official sources, and promptly report fraud attempts. Under no circumstances should passwords, temporary access codes, CVV and PIN codes be disclosed to anyone. Thus, the analysis of the information security challenges faced by financial sector institutions demonstrated, on the one hand, their vulnerability to ever-changing external challenges, and, on the other hand, confirmed that the system's resources are sufficient to respond to and prevent cyber fraud on time.

DISCUSSION

Analysing the study results, it is worth noting the importance of the human factor in security processes and the ability to prevent most cases of cybercrime solely by following existing protocols. It is worth emphasising that the spread and implementation of digital technologies is a global trend. Accordingly, solving information security problems is relevant for the whole world, and many scholars from other countries have also devoted their research to this issue.

S. Calliess & A. Baumgarten (2020), who studied the cybersecurity of the financial sector in the example of the European Union, analysed the existing information protection schemes, their strengths, and weaknesses from a legal point of view, and concluded that the current approach is characterised by the lack of clearly defined areas of responsibility. However, the authors highlight the increasing role of private institutions in shaping the European cybersecurity system and believe that this is a positive practice if such institutions do not have preferences and are governed by a common legal framework. Since in Ukraine, the influence of private entities on the security of the national economy is minimal, this notion may be worth considering (Yesimov & Borovikova, 2023). Methods of detecting credit card fraud in the banking industry were studied by E. Btoush *et al.* (2021). They formulated a thesis, which was confirmed by the author's observations on the growth and diversity of criminal technologies aimed at deceiving consumers of banking services, assessing various techniques, and identifying their advantages and disadvantages. Given the ever-increasing number of bank cards and transactions, the authors compiled a list of recommendations for cardholders to counter this issue more effectively.

The topic of mobile banking, also discussed in this paper, was studied by A. Geebren *et al.* (2021). Considering the issue of mobile applications through the prism of consumer convenience, they noted that trust has a significant positive impact on customer satisfaction. Using partial least squares structural equation modelling, 659 respondents' answers were analysed, determining that trust in the bank and its app is a more important factor in choosing a financial institution than even service quality and profitability. Another perspective on the problem of online banking was presented by A. Sharma *et al.* (2023), who presented their comprehensive empirical research on the security risks of global banking applications. The authors also noted the exponential growth in the number of app users and the risks posed by the massive and dynamic nature of mobile app use and compiled a list of recommendations for users, which, as noted, boils down to the use of two-factor identification and the prohibition of sharing passwords and codes with others.

As cybersecurity risk has emerged as a significant threat to the financial sector, researchers and analysts have sought to understand the issue from different perspectives. M.H. Uddin *et al.* (2020) state that empirical research on this issue based on real data is still limited, but international regulators offer recommendations to combat crime. As noted earlier in this paper, the fight against international crime should be led by supranational bodies, which correlates with the authors' conclusions on the expansion of the powers of such a "cyber-Interpol". S. Varga *et al.* (2021), studying the perception of cyber threats and risk management in the financial sector in the example of Sweden, found that leading participants in the Swedish financial sector already have a well-developed operational concept of regular and crisis management. The survey revealed that much effort is being made to ensure the effective exchange of timely and relevant information between financial institutions, and the importance of communication activities with these institutions was also emphasised in this paper. In general, respondents overwhelmingly agreed that risk management should consider the delay in communications between system units.

To minimise the negative impact of the human factor, which is considered a key threat to the security system, A.S. Villar & N. Khan (2021) conducted a study on the practical use of process robotics in the example of Deutsche Bank. As practice has demonstrated, robotic automation has transformed the financial industry, making popular low-value-added operations much more efficient and allowing banks to improve information security at the same time. H.H. Hettiarachchige & H. Jahankhani (2021) reached similar conclusions, albeit using the UK banking system as an example. They also noted that security and privacy are major concerns for any e-banking system or application and that the transfer of most operations to a remote format creates additional vulnerability, enabling cybercriminals to attack virtual agent endpoints. Nevertheless, the authors' analysis confirmed that the existing two-factor authentication structure meets the requirements for protecting virtual agents in banks.

In terms of the European cybersecurity system in general, S. Fischer-Hübner *et al.* (2021), through 63 interviews with European financial sector professionals, identified key issues in the protection of banking secrecy, as well as challenges and requirements that are to be addressed in the future. As mentioned in this study, an important factor in the cooperation of national economies is the compatibility of protocols for the exchange of confidential information and the joint protection of such communication channels that will prevent fraudsters from manipulating national laws. Hybrid and cyber threats to the European Union's financial system were also the subject of a study by M. Demertzis & G. Wolff (2020). They attempted to achieve a balance between the fragmentation of security systems into separate sub-levels, which were analysed in this paper, and centralisation in financial and other economic matters. The result was a recommendation to EU finance ministers to increase the resilience of the financial and banking systems through regular joint exercises to counter security challenges.

The impact of modern technological capabilities, which have been repeatedly mentioned in this paper, on the transformation of the financial sector was also noted by E. Feyen *et al.* (2021), who noted a significant reduction in transaction costs in the banking sector due to the development of digitalisation. The creation of new business models and the emergence of new financial services market participants inevitably raises several policy issues regarding competition and regulatory spheres of influence that must be agreed upon at the level of national economies. A. Mishra *et al.* (2022), who studied the cybersecurity policies of enterprises in various industries, analysed and compared security protocols governing the implementation of security measures and algorithms for staff behaviour in the event of unusual situations, including cybercrime. Since the importance of strict compliance with such protocols in the banking sector was also emphasised in this paper, it is noteworthy that the results confirmed the same conclusions – cybersecurity requirements in the financial sector are of the highest priority.

The impact of a full-scale war in Ukraine on financial and information security, which was analysed in this paper, was also the subject of research by M. Lehto (2022). The author emphasised that the current security situation on the European continent is the most critical in the previous 80 years and that advanced cyber capabilities are part of a new non-kinetic environment where virtual operations are used in combination with information, financial and electronic warfare. The author analysed the balance between defence and attack in cyberspace and formulates requirements for effective cyber defence. In another paper on the impact of the war on the financial sector, F.M.J. Teichmann *et al.* (2023) note that the operational resilience of financial service providers in Ukraine has deteriorated significantly since the start of full-scale aggression in 2022, but the inherent capacity and assistance of Western financial institutions help the Ukrainian national economy maintain functionality.

In the context of uncertainty and globalisation, it is necessary to consider the impact of financial crises not only on a specific country but also on the global economy. The modern world faces many challenges, but the vulnerability of the financial sector of any country can have the most severe consequences for economic sustainability and development. Comparing the above-mentioned conclusions of the scientific community with the results obtained in this study, it is worth noting a mostly similar assessment of the financial sector's problems and recommendations on how to solve them. Thus, understanding and addressing the problems of the financial sector is an important aspect of global stability and sustainability-based governance.

CONCLUSIONS

Ukraine faces particular risks to the information security of the financial sector, as it is the target of full-scale military operations and the aggressor country's resources for breaching financial security far exceed the capabilities of individual fraudsters or even international criminal organisations. However, the survey results show that both Ukraine and the world have so far managed to successfully counter cyberattacks, demonstrating two tendencies: on the one hand, it is the pursuit of attackers, when certain gaps in information defence are closed in response to their actions, and, on the other hand, proactive actions are taken when potential system exploits are patched beforehand.

The human factor, i.e. staff negligence, remains the weakest and most unpredictable element in the system of financial services, including banking. Risks in this area can be mitigated by constant awareness and responsibility improvement, as employees must understand that approved protocols must be implemented without question and to a word, as even single exceptions can endanger the entire set of protective measures. However, even perfect compliance with the security protocols of financial institution professionals is not enough – each client must, in turn, strengthen collective information security. Customers should protect their personal data and their finances by using only official software and applications, using two-factor authentication, keeping passwords in safe places, and never transferring their cards and qualified electronic signature media to other persons. Since there are no officially recognised state borders for hackers operating remotely, only the same supranational structures with powers that are not burdened by the legislative restrictions of certain states can fight them on an equal footing. The formation of factors for strengthening such international structures to combat cybercrime may be the subject of further research.

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CONFLICT OF INTEREST

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Проблеми забезпечення інформаційної безпеки фінансового сектору України

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Анотація. Захист власних фінансових ресурсів – одна з пріоритетних задач держави, що обумовлює її незалежність та суб'єктність. Особливо це актуально у випадку України, що веде повномасштабні воєнні дії, тому вивчення проблеми кібербезпеки фінансової сфери України та формулювання рекомендацій щодо їх вирішення стало метою даного дослідження. Завдяки методам статистичного аналізу, систематизації та синтезу була досліджена динаміка у сфері захисту критично важливої інформації, а за допомогою методу розвідки на основі відкритих джерел виявлено основні тенденції, методи та інструменти сучасного кібершахрайства. В результаті було сформовано перелік проблем та загроз фінансового сектору України. Дана оцінка наявних трендів ефективності протистояння таким викликам, розроблено ряд рекомендацій щодо запобігання витоку особистих даних та уразливості фінансових структур. До таких рекомендацій було віднесено запровадження чітких алгоритмів поведінки персоналу, відокремлення підсистем із різним рівнем доступу та їх обмеження виходу до зовнішніх мереж, а також правила особистої цифрової безпеки: використання двофакторної автентифікації, заборона передачі паролів та тимчасових кодів тощо. У контексті динаміки зростання кількості користувачів Інтернету за 2019-2023 роки у світі було проаналізовано міжнародні принципи забезпечення безпеки інформації та законодавство України, що регламентують дії з захисту від кібератак. Практична значущість дослідження полягає в знаходженні шляхів вирішення проблем у сфері інформаційної безпеки фінансового сектору та формуванні рекомендацій, що можуть бути корисними керівництву фінансових установ

Ключові слова: інформаційна безпека; фінансовий сектор; цифровізація; загрози; кіберзлочини; захист інформації

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Hybrid approaches to machine learning in software development: Applying artificial intelligence to automate and improve processes

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Abstract. The study on hybrid machine learning approaches is relevant because these approaches have great potential to improve predictive accuracy and software automation, and their use is becoming more widespread. The purpose of this study was to provide recommendations for the use of hybrid machine learning methods and analyse the areas of application of artificial intelligence, which is used to automate and improve processes. Problems related to hybrid approaches to machine learning were identified using the analytical method. The use of the statistical method allowed assessing the development of stability and performance of hybrid machine learning approaches. Features and differences of machine learning in the field of software development are noted. Errors and reasons that are made when improving development processes are analysed. It is established that a comprehensive analysis of the functioning of artificial intelligence is important to assess its effectiveness, development, and complexity of work in automation and improvement of development. The issues of evaluating the work of this type of approach, the expediency of their use, limitations in the process, and the impact of restrictions on the result are considered. It is determined that the use of artificial intelligence in the process of automation and improvement of development processes will improve the quality of resource optimisation. The study offers recommendations that will contribute to the effective regulation of this issue. The practical value of the study lies in the possibility of applying the results obtained to eliminate errors in the development and improvement of hybrid approaches, investigating the reliability of using artificial intelligence, considering various factors that serve as the basis for recommendations on appropriate use

Keywords: predictive accuracy; resource optimisation; information protection; reduced development time; cybersecurity

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INTRODUCTION

Hybrid approaches to machine learning in software development involve combining different machine learning methods and techniques to solve specific software development tasks. Hybrid models can use controlled (such as classification and regression) and uncontrolled learning methods (such as clustering and anomaly analysis) together to analyse and process data in software development. This is useful for detecting errors in code or analysing event logs. Hybrid approaches can use neural networks to analyse structured data and natural language processing to understand text. As V. Kochkodan *et al*. (2023) state, an important aspect of information security and cybersecurity is the development of specialised software that detects potential threats and automatically responds or notifies users. Such software can be used to detect and prevent various cyber threats and security incidents. The improvement of artificial intelligence arises from the need to solve problems related to errors that occur at the stages of software development and operation. These problems arise in connection with the need to define and optimise indicators at the stages of system design, operation, and development. Artificial intelligence has the ability to analyse large amounts of data, including event logs, network traffic, and user activity, and detect unusual and suspicious actions or events that may be threat indicators. According to T. Yarovoy (2023), artificial intelligence is rapidly developing, its application in the public sector has great potential to change how society is managed. It can analyse large

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amounts of data and extract information that is useful for government services.

In this area, it is necessary to introduce effective hybrid approaches and invest in research and development of technologies for more efficient operation of artificial intelligence. According to O. Smyrnov & A. Borysenko (2023), different software can combine and analyse different data sources to identify complex patterns and relationships that indicate potential threats. It can detect anomalies in system parameters, user behaviour, and network traffic, and the detected abnormal changes can indicate potential threats. It is important to implement policies aimed at developing threat detection software. This technology is often integrated with other security systems, such as firewalls and identification systems, to automatically respond to detected threats. According to D.M. Byelov & M.V. Bielova (2023), artificial intelligence can automatically analyse large amounts of data from various sources and help governments make informed decisions in areas as diverse as agriculture, health, education, and transportation. It also suggests that artificial intelligence can use data analysis and machine learning to create personalised programmes and services for citizens that meet their specific needs and requests. K. Nazarova *et al*. (2023) noted that some systems use machine learning and artificial intelligence techniques to improve threat detection and reduce the number of false positives. According to I. Ivanova *et al*. (2023), artificial intelligence can create chatbots and automated response systems that can interact with citizens, provide information, and solve standard questions. As a result of historical data, the software can develop models to predict future threats and risks.

Despite substantial scientific achievements on this issue and its examination in various fields, the issue of applying hybrid approaches to machine learning has not been considered in detail, and some of the studies do not provide enough recommendations. The purpose of this study was to perform an objective analysis and consider recommendations for identifying problems and errors in the process of improving the efficiency of artificial intelligence machine learning using hybrid approaches.

MATERIALS AND METHODS

At the beginning of the study, its main theoretical base was prepared, which included various literature sources on the analysis of which the basis for further drawing conclusions was laid. The use of the analytical research method allowed identifying problems associated with using hybrid approaches to machine learning, which are used in the processes of improving the efficiency of software development. Using the statistical method, an analysis of the investigation of artificial intelligence was conducted, which in turn helps to understand the number and causes of errors in improving artificial intelligence, which is the basis for the sustainable development of automation systems and improving software development processes. The analytical method also examined opportunities for improving the operation of data processing mechanisms, prospects for using these programmes and developing the sustainability and productivity of hybrid machine learning approaches.

Using the method of analysis, the examined issue was divided into smaller components, which helped to conduct a detailed analysis of the role and essence of hybrid approaches at different levels of machine learning development in the field of software; identify the advantages and disadvantages of their application; analyse the impact of the functioning of artificial intelligence systems on the material and technological support of developing countries; consider the areas of using artificial intelligence and its contribution in various fields of life. Through the structural and functional method, trends, factors, and models aimed at improving artificial intelligence were considered, and effective solutions to problems related to errors in development, improving the maintenance of software and its components were identified and analysed; the method allowed further analysing the methods for improving and innovating mechanisms to reduce inaccuracies in their functioning and optimising indicators at the development stages. Using the deduction method, the features of the functioning of complex automation in artificial intelligence in the processing, solution, and neutralisation of cyber threats were considered by highlighting the characteristics of these threats necessary for a complete analysis of the work and solving the problems of this process, in particular, the introduction of error-solving mechanisms.

By applying the synthesis method, various aspects of the subject considered before were formed and examined as one set, which helped to consider the obtained indicators of theoretical analysis and practical experience to identify recommendations aimed at solving problems and achieving progressive growth of the process. The synthesis allowed paying attention to improving the quality of software mechanism development, reducing errors, presenting predictive models, and designing solutions for artificial intelligence. The functional analysis method provided an opportunity to consider in more detail the concept of "using hybrid approaches to machine learning in the field of software development and using artificial intelligence to automate and improve development processes". This method allowed characterising the features and principles of software functioning and the process of improving development, analysing the complexity of mechanisms in the processes of detecting and solving cyber threats and their impact on the satisfaction and requirements of certain users.

RESULTS

Progressive development of automation and hybrid machine learning approaches is necessary to ensure reliable processing and optimisation of information and effective operation of artificial intelligence mechanisms in various areas of the software industry. Special attention should be paid to improving their mechanisms, in particular, precise design and modelling, since these approaches are widely used in software development processes, which will contribute to increasing the production potential of artificial intelligence. The introduction of intrusion detection systems based on artificial intelligence and machine learning allows using resources more efficiently, optimising solutions in many sectors, such as healthcare and education, and has a substantial impact on public safety. Intrusion detection systems based on artificial intelligence can help governments more effectively allocate limited cybersecurity resources: they can prioritise and focus on the most important aspects of protection (Baduge *et al*., 2022). It is

important to solve the problem that occurs when developing, improving, and modelling software mechanisms.

Some errors directly impact improving the potential of artificial intelligence, the reliability of service delivery, and the security of information processing. Attention should be paid to the effectiveness of mechanisms in developing countries and the further development of hybrid software approaches. Anomaly-based systems use machine learning techniques to build models of normal network behaviour, anomalies that deviate from this norm are observed and identified as potential threats. Detecting intrusions into critical infrastructure, such as energy systems, transport networks, and telecommunications systems, can help ensure public safety and protect against cyber-attacks that can have serious consequences for society (Ramachandran *et al.*, 2022). In the field of software and artificial intelligence, it is necessary to analyse and identify the root causes of errors in information processing, and further solving these problems is aimed at improving the quality of information storage services. The use of artificial intelligence and machine learning can help intrusion detection systems more effectively detect new and modern attacks and reduce the number of false positives.

Intrusion detection systems can be used to analyse and optimise healthcare processes. For example, they can help identify possible leaks in medical records and improve the safety of medical equipment. Artificial intelligence can analyse medical data and patient records to predict the spread of diseases and the need for medical care. Hybrid approaches can use information from a variety of sources, such as clinical data, images, and genetic data, to diagnose and even make recommendations for the treatment of diseases. Hybrid recommendation systems can combine collaborative filtering techniques with content-based approaches to provide more accurate recommendations to users. In other industries, such as the financial and manufacturing sectors, intrusion detection systems can help reduce losses from cyber-attacks and data leaks. Intrusion detection systems can ensure the safety and privacy of patients and students and improve the quality of services provided. The use of artificial intelligence and machine learning in Intrusion detection systems can play an important role in ensuring cybersecurity and optimising decision-making in many areas of life and has great potential to improve society's standard of living (Rajagopal *et al.*, 2022). The development of new methods to solve the problems of eliminating errors in developing, designing, and improving software to increase the capacity of mechanisms for intrusion detection systems in many areas has great progress and prospects. Machine learning algorithms can be used to generate code based on specifications or code samples automatically – this can substantially speed up the development process.

However, the use of artificial intelligence in cybersecurity and other areas can also involve risks that need to be carefully evaluated. Hackers can use machine learning algorithms to break into systems, bypass security, or create new types of attacks (Beerbaum, 2022). If modern electronics and computerised data processing of intrusion detection systems are used to improve software and artificial intelligence, which are the basis for the development of many areas, this will help to substantially increase the capabilities of these processes and mechanisms and increase the demand for their use in many areas. Rule-based systems use a set of rules that define acceptable and unacceptable behaviour on the network. The activity can be identified as suspicious or abnormal if it does not meet these standards. The use of artificial intelligence may require access to large amounts of data, including the personal data of users, which requires care to ensure the confidentiality of such data and compliance with the requirements for their protection (Javaid *et al.*, 2022). The challenges of effectively managing technological hybrid approaches to software mechanisms and their problems with the application and development of innovative parts and devices for use are becoming increasingly practical.

Statistical methods use statistical indicators (mean, variance, deviation from the mean) to detect abnormal traffic values. Machine learning techniques use machine learning algorithms such as neural networks, decision trees, classifiers, and clustering to build models of normal traffic. Anomalies are defined as deviations from these patterns. The use of artificial intelligence can sometimes raise ethical issues, especially in certain contexts, such as facial recognition, medical decision-making, and criminal justice, so it is important to consider issues of fairness, bias, and responsibility (Lareyre *et al.*, 2023). In this complex process, reviewing the causes of errors in the improvement, automation, and optimisation of artificial intelligence, which increases the potential for automation and improvement of software development processes, and their solution becomes particularly important since the development of this process and their mechanisms in the world is one of the most pressing problems of our time. Threshold methods detect anomalies, if traffic metrics exceed these thresholds, this can be considered an anomaly. In turn, signature systems are effective at detecting known attacks but are not able to respond to new attacks. Rule-based systems can be configured to detect specific anomalies, but they may not be able to handle complex scenarios.

Machine learning models can make errors, including false positives (false attack alerts) and false negatives (failure to detect real attacks), which can lead to data loss or an overload of security administrators (Celik *et al.*, 2022). Often, the processing and execution of proper processes in a system of software mechanisms has certain errors that degrade the effectiveness of these processes for use in the field of information technology. The behaviour of attackers in computer networks often differs from that of ordinary users, and these differences can be detected by analysing their digital traces and network activity. Intrusion detection systems and anomaly detection systems are used to detect these differences. It is important to ensure transparency in how artificial intelligence systems make decisions and how they affect people's lives, and organisations should be held accountable for the consequences of using artificial intelligence.

The communication capabilities of the internet are taking on new forms due to modern technologies, and communication technologies based on instant messengers and chatbots have become especially relevant. Chatbots are widely used in various business sectors to automate communication with customers and perform analytical tasks: chatbots can learn from user responses or have a pre-programmed set of templates. They can be used both for

personal use and for doing business: to start using a chatbot, you can add it to the general group for all colleagues, start a dialogue in private messages, or take out a subscription (Povolotsky, 2019). Chatbots are a modern solution for simplifying communication between clients and the institution, providing quick answers to user questions.

The problem of eliminating errors in software improvement, automation, and optimisation is not fully solved. Neural networks can be trained to analyse network traffic and detect anomalies that indicate possible attacks or unusual activity. Anomalies that are difficult to detect by conventional methods can also be detected. The volume of data in the public sector is huge, and its processing and analysis require powerful tools and technologies, including systems for storing and processing large amounts of data. The public sector uses data analytics to make decisions in areas such as health, education, and the economy, and data analysis helps identify trends, plan resources, and improve programmes and services.

Software mechanisms and their components are often used because of their efficiency and low cost of operation, and there is currently increased interest in this process in many countries to increase information technology capacity. Neural networks can be trained to recognise attack signatures, including known types of attacks such as Structured Query Language Injection or Distributed Denial of Service attacks – they can even recognise modified or variant signatures. Data analysis using artificial intelligence and machine learning can cover complex relationships and patterns that would go unnoticed in human analysis and can be used to predict events, classify data, and automate routine tasks. Neural networks can analyse the behaviour of users and systems and detect abnormal behaviour, they learn from normal behaviour and warn about deviations from normal patterns. Neural networks filter out noise and reduce the number of false positives, helping to detect only truly substantial anomalies and threats; they can learn from new threats and adapt to changing attack methods. Data processing and analysis involve substantial privacy and security issues. The public sector must comply with relevant standards and regulations regarding personal data protection and information security.

The public sector can promote the availability of data to the public and researchers to encourage innovation and the development of data-based applications, the legal framework and rules for data collection, processing and storage in the public sector are important for ensuring the rights and privacy of citizens. The main advantages of intrusion detection systems that use neural networks and other artificial intelligence methods are their high learning rate and adaptability to new types of attacks. Neural networks can learn large amounts of data in a relatively short period of time and thus detect new attacks and anomalies that were previously unknown, and rapid training allows the system to adapt to changing threats. Artificial intelligence is useful in analysing large amounts of public data, helping to make informed decisions in various sectors: it can process and analyse large amounts of data much faster than humans and identify complex patterns, trends, and connections that go unnoticed by conventional analysis methods.

Neural network training can be automated, allowing the system to update its models based on new data without substantial human intervention. Neural networks are suitable for detecting anomalies because they can detect changes in the data structure, even if they are not typical for attacks. Systems that use reinforcement learning techniques can improve their strategies in real time based on the results of detecting and responding to attacks. Artificial intelligence can help government agencies identify areas where they can use resources more efficiently, optimise processes, and reduce costs. It can track and analyse public opinion based on social media and other sources, which can help governments understand public sentiment and respond quickly to it.

Artificial intelligence can use data from weather stations and satellite observations to predict weather conditions and help take appropriate measures in the event of dangerous weather events. In public administration and finance, artificial intelligence can analyse economic indicators, financial markets, and microeconomic trends to predict economic events and make monetary policy decisions. It can be used to analyse large amounts of data stored in various government agencies, allowing governments to make better-informed decisions in areas such as the economy, health, and education. Hybrid methods can also be used to analyse large amounts of data, where data processing at a preliminary stage (for example, using noise reduction methods) is combined with deep learning to identify complex dependencies. In business, it can analyse data on supply and demand, consumer trends, price dynamics, and other factors to predict demand for goods or services, which helps companies optimise production and inventory. In transport systems, artificial intelligence can be used to predict the intensity and regulation of traffic, optimise routes to improve transport efficiency. Artificial intelligence is used to analyse environmental data to predict natural disasters, pollution, and other environmental problems. Artificial intelligence political systems can analyse social and political trends to predict election results and public reactions to government decisions.

The emphasis on building hybrid systems that combine neural networks with other machine learning methods is of great importance in modern research and development because hybrid systems have the advantages of both approaches and can help in solving complex problems. Hybrid systems can solve multiple tasks simultaneously or sequentially, which is why building hybrid systems is an active area of research in the field of machine learning and artificial intelligence. This is because these systems can achieve excellent results in a variety of complementary areas, such as intrusion detection, pattern recognition, and decision-making. Hybrid systems can combine expert knowledge with data-driven learning. For example, decisions can be made by combining rules and neural networks developed by experts. Many countries have made substantial progress in developing the design and modelling of hybrid approaches to improving software mechanisms. Hybrid systems adapt and can change components according to the task and situation: these systems can be designed to ensure stability and speed of task execution. When improving software mechanisms and automating and optimising them for better passage of complex technological operations, process models should adequately describe the essence of the work, be simple and easy to implement.

In achieving optimal performance of software mechanisms and increasing the potential of the information technology sector, personnel qualifications and timely diagnostics of the neural network are of great importance. Hybrid approaches in computer science and machine translation have made substantial strides and are key to achieving high quality and productivity. In the field of machine translation, hybrid approaches are used that combine statistical methods and deep learning methods, for example, deep learning models such as Neural Machine Translation. Recurrent neural networks or transformers can be combined with statistical machine translation techniques to improve translation accuracy. The introduction of artificial intelligence in public administration is becoming more widespread and has great potential to improve the quality and efficiency of public administration. It can be argued that artificial intelligence can be useful for automating and improving software development processes at various stages. The various areas of its use are summarised in Table 1.

Table 1. Promising areas of artificial intelligence application

Field	Application method
Public sector	Decision-making analytics for all other areas, secure storage of personal data of citizens, efficient use of available resources, cost reduction
Healthcare	Accounting of medical documentation, analysis of the condition of technical equipment, forecasting the course of the disease
Business	Communication with clients and colleagues, maintaining financial documentation, optimising the production of goods, and providing various services
Cybersecurity	Automatic notification about threats, blocking attacks, scanning the network or software to identify weaknesses
Infrastructure and environment	Analysis of air pollution, forecasting of environmental hazards, regulation of traffic

Source: compiled by the author

Therefore, hybrid machine learning methods can be applied in a large number of tasks where different approaches need to be combined to achieve better results. Developing hybrid models can require substantial effort during the data preparation and parameter configuration stages. However, the properly selected and developed hybrid approach can bring substantial advantages in complex machine learning tasks. For optimal use of hybrid approaches, it is recommended to conduct the following actions. Before considering a hybrid approach, it is important to understand the problem in detail, determine why hybridisation is necessary, and which approaches or models can be combined to achieve better results. In addition, it is necessary to consider what components will be included in the hybrid system: it can be a combination of classical machine learning models, deep learning, rule systems, or other methods. It is necessary to build a hybrid model that combines the selected methods, this may include a set of models combined by, for example, multiclass classification, or a sequential approach where the output of one method is used as input for another. It is important to configure the parameters of each method and the hybrid model in general, for which, using cross-validation and optimising the parameters to improve performance is recommended. Data preparation for a hybrid approach should include cleaning, anomaly removal, scaling, and feature selection, but different methods may require different types of data preparation. Different metrics and criteria are often used to evaluate the performance of a hybrid model, so it is important to understand that it solves the problem correctly and is not retrained. After implementing the hybrid model, it is crucial to monitor its performance and results and make adjustments to the hybrid approach if necessary. Hybrid machine learning techniques can be a powerful tool for solving complex problems but also require careful preparation and configuration. Keeping detailed documentation about hybrid models, their parameters, and results is recommended, which will help save settings and make further support more efficient. A balanced approach and a thorough study of the specific task are key success factors.

DISCUSSION

Hybrid approaches to machine learning in software development are important in the modern world. These approaches combine machine learning techniques and methods with other approaches, such as conventional programming, expert systems, natural language processing, computer vision, optimisation, data mining, etc., to achieve improved process improvement and automation results. Many researchers focus their attention both on the examination of this issue and the improvement of artificial intelligence itself and the use of hybrid approaches in working with it. Hybrid machine learning methods allow using the strengths of different approaches and algorithms to achieve more accurate and efficient solutions to complex problems. Hybrid methods that combine expert rules with analysis of large amounts of data can be used to detect threats and cyber-attacks. Hybrid approaches can combine structured data and deep link training to create more complete knowledge graphs. It is important to consider the choice of specific methods, and their combination will depend on the specific task and available data.

Based on the results of the recent study by M.H.A. Banna *et al.* (2023) in Natural Language Processing, hybrid approaches combine rules and statistics. For example, entity recognition systems can use rules to define named entities and statistical methods to determine the context and relationships between them. In computer vision, hybrid approaches can combine deep learning and structural analysis for object recognition in complex contexts. It is necessary to

improve the quality of various methods and approaches to enhance software mechanisms of the information technology sector, for the effective operation of the entire mechanism through the use of new methods. It is necessary to improve the quality of the automation and optimisation of these systems, especially neural networks to begin the process of improving these systems. After analysing the mechanism of artificial intelligence, the researcher established that for the successful implementation of artificial intelligence, it is necessary to have stable fundamental knowledge that allows you to understand the physical principles and determine the optimal number of processes, which is important for effective improvement of software mechanisms, to increase the potential of the information technology sector in many countries under appropriate conditions.

Turning to the definition by M.H. Jarrahi *et al*. (2023), artificial intelligence can help automate citizen registration and service processes using chatbots, virtual assistants, and other technologies to reduce administrative burden and increase the availability of services. Artificial intelligence can use data analytics to predict a city's population and resource requirements. This can help optimise budget allocations and plan infrastructure development. This confirms the fact that this study coincides with modern trends in the field of design and modelling of methods for improving artificial intelligence mechanisms. In the modern world, great attention is paid to considering all factors that affect the quality of these processes to increase the potential of the information and technology sector. However, this study did not consider that an important property of artificial intelligence is its use to automate procurement processes and control costs, reducing corruption in government procurement.

Researchers A. Talukder *et al*. (2023) determined that the development of hardware and software tools for unauthorised access requires constant adaptation of technical data protection tools. As cybercriminals are constantly looking for new methods of attacks and vulnerabilities, it is important to maintain a high level of cybersecurity. It is important to regularly update software and operating systems and install official patches that fix the identified vulnerabilities, preventing attackers from exploiting the vulnerabilities. For more correct operation of cybersecurity applications and software mechanisms, it is necessary to constantly check the entire neural network, so the potential of the information technology sector in countries will reach high values in a short time. There are differences with this study in that the author overlooked the importance of the features of using this type of hybrid approach to machine learning, timely examination of data and possible causes of problems with the mechanisms of this software for further promising development of the use of artificial intelligence mechanisms to increase the prospects of the information technology field.

Researcher J.P. Bharadiya (2023) notes that intrusion detection systems are an important component of cybersecurity, helping to detect anomalies and potential threats in computer networks and systems. Signature-based intrusion detection systems analyse network traffic and system logs for known attack signatures. When they detect a situation that matches the signature, they notify the administrator or perform other predefined actions. This approach is effective for detecting known threats, but not for new attacks. The results of this study of the characteristics of intrusion detection systems were analysed and more accurately considered. It can be supplemented by the fact that increasing the potential of the information technology industry directly depends on the improvement and innovation of software and providing high-quality service to the mechanisms of this artificial intelligence.

I. Arpaci & M. Bahari (2023) showed that the use of machine learning algorithms can affect a number of areas, such as combating fraud and corruption in social security systems, planning transport networks, optimising routes, automating document processing, and interacting with citizens. Machine learning algorithms can analyse large amounts of data to identify anomalies and patterns that signal potential fraud and corruption. For example, they may detect abnormal patterns in social security applications and financial transactions. Machine learning can analyse traffic data, passenger traffic, and road conditions to optimise transport networks and develop efficient routes. It was not specified or considered in the paper by I. Arpaci & M. Bahari (2023) that natural language processing algorithms can automate the processing of documents delivered to organisations by identifying key information and classifying documents. Notably, this is due to the fact that the use of chatbots and virtual assistants based on machine learning has increased substantially in recent years, and this can facilitate the interaction of citizens with government agencies, so there is a difference between this study and that by the authors. As noted by S.S. Ray *et al*. (2023), anomaly detection systems model the normal behaviour of a network or system and look for any abnormal changes or deviations from this norm. They use statistical methods and machine learning to identify potential threats, even if these threats are not known in advance, and are also useful for detecting new attacks and out-of-the-box scenarios.

It should also be attributed to the results of the study that intrusion detection systems are an important element in protecting users' and businesses' information, as they help to respond to potential threats in a timely manner and reduce the risk of loss of confidential information and other cyber events. It is necessary to consider two aspects to improve the design and modelling of methods for improving software mechanisms and to reduce errors in automation and optimisation during complex technological processes: increasing funding and improving the skills of developers, and the introduction of new technologies. The main goal of these measures is to improve the quality and efficiency of the process of improving artificial intelligence mechanisms and reduce the risk of errors.

CONCLUSIONS

The study confirmed that the decision to use hybrid approaches in machine learning should be justified from a scientific and practical standpoint. The results show that the main purpose of intrusion detection systems is to identify and filter potentially malicious requests or attacks in computer networks and systems. Many technological adaptations need to be made for certain areas. In this paper, recommendations for eliminating errors in the processes of designing and implementing mechanisms of hybrid approaches and analysing their functioning were considered,

technological processes during the operation of software and errors and problems made during the functioning of artificial intelligence processes were analysed. Implementing effective tools will solve these problems and prevent mistakes. Hybrid approaches were considered to improve the software. The analysis shows that hybrid models that combine deep learning with classical image processing or natural language processing techniques will help improve object recognition accuracy in images or text comprehension. It was considered that it is possible to improve the efficiency of artificial intelligence and software mechanisms in the information technology field through the introduction of hybrid methods.

The study analysed aspects of improving software mechanisms, ways to improve the processes of artificial intelligence, and identifying methods for eliminating errors in the process of improving software efficiency, which will contribute to improving the potential, competitiveness, and quality in the information technology field. The study provides recommendations for the successful use of hybrid machine learning methods in software development. It is required to configure the parameters of each method and hybrid model using cross-validation and prepare the data by performing cleaning, scaling, and feature selection, considering the requirements of different methods. It is also necessary to carefully examine the metrics and criteria for evaluating the performance of a hybrid model and avoid improper retraining. It is essential to provide detailed documentation on the parameters of hybrid models. These recommendations can help achieve successful results when applying hybrid machine learning methods. Future research will focus on creating and implementing innovative intrusion detection systems to advance the information technology sector.

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CONFLICT OF INTEREST

None.

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Гібридні підходи до машинного навчання в галузі розроблення ПЗ: Застосування штучного інтелекту для автоматизації та поліпшення процесів

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Анотація. Дослідження гібридних підходів машинного навчання є актуальним, адже дані підходи мають великий потенціал у підвищенні прогностичної точності та автоматизації програмного забезпечення, а їх використання стає все більш поширеним. Метою цієї роботи було надання рекомендацій для застосування гібридних методів машинного навчання, а також аналіз сфер застосування штучного інтелекту, який використовується для автоматизації та покращення процесів. За допомогою аналітичного методу було виявлено та визначено проблеми, пов'язані із використанням гібридних підходів до машинного навчання. Застосування статистичного методу дозволило оцінити розвиток стійкості і продуктивності гібридних підходів машинного навчання. Відзначено особливості та відмінності машинного навчання в галузі розроблення програмного забезпечення. Проаналізовано помилки та причини, які допускаються при покращенні процесів розроблення. Встановлено, що важливе значення має всебічний аналіз функціонування штучного інтелекту з метою оцінки його ефективності, розвитку та ускладнення роботи при автоматизації та поліпшенні розроблення. Розглянуто питання оцінки роботи даного типу підходів, доцільність їх використання, обмеження у процесі, вплив обмежень на результат. Визначено, що використання штучного інтелекту у процесі автоматизації та поліпшенні процесів розроблення забезпечить підвищення якості оптимізації ресурсів. В дослідженні запропоновано рекомендації, які сприятимуть ефективному регулювання даного питання. Практична цінність роботи полягає у можливості застосування отриманих результатів для усунення помилок у розробці та вдосконаленні гібридних підходів, вивченні надійності застосування штучного інтелекту з урахуванням різних факторів, які служать основою для рекомендацій щодо доцільного використання

Ключові слова: прогностична точність; оптимізація ресурсів; захист інформації; скорочення часу розробки; кібербезпека

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