The Concept of Using Artificial Intelligence Methods in Debt Financing of Business Entities

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Abstract

The COVID-19 crisis has speeded up the economy's digitalization, including artificial intelligence techniques. Artificial intelligence methods are increasingly being implemented into finance from year to year. The research reveals the essence and concept of using artificial intelligence methods in general and in debt financing in particular. It is proposed to distinguish four criteria (context, data, model and tasks) in the concept of using artificial intelligence methods and to consider such usage through the prism of the life cycle of the artificial intelligence system. The list of tasks of artificial intelligence systems in debt financing is formed, and the main problem situations on debt financing management in which it is expedient to use artificial intelligence methods are identified. Since bonds are the primary tool for attracting debt financing in the stock market, and their scope requires the active implementation of digital technologies, the research clarified the algorithm for pricing bonds using artificial intelligence methods, which improves the interaction between lenders and borrowers. Particular attention is paid to identifying the benefits and risks of using artificial intelligence methods in debt financing and applying artificial intelligence methods in debt financing of business entities at different management levels. It is proved that in the conditions of total digitalization, the necessity of using modern information technologies, particularly methods of artificial intelligence, is necessary.

Keywords

Artificial intelligence, methods, digitalization, debt financing, business entities, economics

1. Introduction

The development of cloud technologies, data analysis systems, artificial intelligence, digital virtual assistants and voice identification, the development of fundamentally new tools and methods of attracting funding for innovative projects without geographical and territorial location is not a complete list of innovative changes in the financial sector.

The COVID-19 crisis has speeded up economic digitalization, including artificial intelligence techniques. Global spending on artificial intelligence in 2020 amounted to 50 billion US dollars, and by 2024 such costs will double to more than 110 billion US dollars [25].

Artificial intelligence technologies have changed the financial services market. From artificial intelligence-driven chatbots to sophisticated robotics consultants, artificial intelligence applications have the apparent potential to empower financial services clients.

The artificial intelligence market is evolving exponentially. Artificial intelligence systems are developed to perform routine tasks, processing Big Data arrays. With the help of artificial intelligence tools, access to financial, production, and other basic operations of the business entity is formed and the possibility of customer feedback.

From year to year, artificial intelligence methods are increasingly being implemented into finance, including asset management, trade, credit underwriting, or block-chain finance. According to Forbes,

70% of financial companies use machine learning to predict cash flows, adjust credit ratings and detect fraud [1].

The main areas of application of artificial intelligence methods in finance are interaction with clients (robotisation for investment management, chatbots, artificial intelligence for collectors, the formation of individual proposals to increase loyalty, personal virtual assistants), decision making (evaluation and automatic adjustment of operational efficiency, Internet of things for financial products, automation and optimisation of structural units), trading (machine learning to analyse foreign exchange markets, stock market), financial analysis, staff training, risk assessment and security system (protection of personal data, protection of information).

2. Literature Review

Applying artificial intelligence methods in the financial sphere is a relatively new area of research. The research is based on the works of foreign scientists, in particular, M. D. Fethi, F. Pasiuouras [10], A. Bahrammirzaee [4]. Thus, M. D. Fethi, F. Pasiuouras [10] presented in 2009 a comprehensive review of 196 studies that use methods of operational research and artificial intelligence to assess the bank's effectiveness. Also, in 2010, A. Bahrammirzaee [4[4]] carried out a comparative analysis of three known artificial intelligence technologies: artificial neural networks, expert systems and hybrid intelligent systems in the financial market. The research was carried out in the following areas: 1) loans evaluation, 2) portfolio management, 3) financial predicting and planning. According to the results, the scientist concluded that the accuracy of artificial intelligence methods is superior to traditional statistical methods in solving financial problems, especially for nonlinear models.

Yin Shi, Xiaoni Li [33], based on an analysis of the scientific literature over the past 50 years, concluded that research on the use of artificial intelligence in finance is interdisciplinary. Artificial intelligence methods are an essential alternative to statistical data analysis methods.

In the study of fin-tech methods based on artificial intelligence Zhongjian Hu [13] notes that the financial sector has become one of the main for the artificial intelligence implementation. The development of finance and artificial intelligence is integrated, so the financial sector needs to digitalize as quickly as possible.

F. Bertoni, S. Bonini, V. Capizzi, MG Colombo, S. Manigart [5], O. Veres, I. Rishnyak, H. Rishniak [40] formed a general view on business digitalization and prospects for the application of innovative digital technologies, including artificial intelligence methods. S. A. Tsyganov and V. V. Apalkova study the evolutionary processes of artificial intelligence development in the international financial market [37]. In particular, they focus on stimulating factors in the implementation of artificial intelligence methods in the financial sector highlight key areas for the use of such intelligence in finance, namely: trading, financial analysis, staff training, customer interaction, security and protection, decision making, risk assessment and ensuring compliance.

Studies of the current state and prospects for the artificial intelligence development in the financial sector of Ukraine are done by O. M. Parubets, D. O. Sugonyako and I. O. Seredyuk [27], focusing on the financial aspects of artificial intelligence its impact on financial and economic processes, as well as the risks of artificial intelligence implementation in the financial sector. The authors studied the application of Big Data Analysis and Data Mining in finance [41, 42, 43], focusing on the specifics of the financial sector and the features of information technology implementation in analysing financial phenomena and processes.

In the work of G. Kou, X. Chao, Y. Peng, F. E. Alsaadi and E. Herrera-Viedma [14], much attention is paid to the study of machine learning methods for managing systemic risks in the financial sphere, which allows analysing Big Data, process various financial information, including news, financial reports, information from social networks. N. R. Moșteanu [24] demonstrates how artificial intelligence combines financial information with technological capabilities and accelerates finance's digital transformation. J. Shao, Z. Lou, C. Wang, J. Mao and A. Ye [32] study the impact of artificial intelligence financing on companies' financial capabilities and use a cash flow sensitivity model. M. Ya. Kushnir, K. A. Tokareva analyse the use of specific artificial intelligence methods in predicting and analysing time series of financial data [17]. M. S. Kurkov proposes an enterprise financial management system model based on artificial intelligence means [16], but his research is purely theoretical. A more

practical study of this author is the work on artificial intelligence in investment activities in financial markets [15], which formed a tree of intelligent system goals, an algorithm for dynamic modelling and predicting of financial data and recommended the use of artificial intelligence as an element of investment decision making for the front office.

T. R. Urumov reveals new opportunities for business entities to access financial resources based on modern information technologies and innovative business models [38]. The author notes that digital loans are of particular interest, facilitating the rapid submission of applications for financial resources. At the same time, S. Savina [30] explores the possibility of applying artificial intelligence methods in analysing the impact of capital structure on the entity's financial stability. The issue of using artificial intelligence methods to formalise decision-making systems in financial analysis is revealed by O. V. Ruzakova and N. P. Yurchuk [29]. They argue that using fuzzy sets, neural networks and genetic algorithms in the decision support systems formation is a promising area of development of support and decision-making systems for the business entities' activities funding.

The EU experience in artificial intelligence application in financial services is analysed by K. V. Efremov [9]; in particular, legal regulation and prudential regulation is investigated.

Also, in scientific research, we find works directly related to the use of artificial intelligence methods in the debt financing of business entities. In their research, R. Verner, M. Tkáč and M. Tkáč [44] propose a long-term bond price predicting system based on a nonlinear autoregressive neural network and demonstrate that artificial intelligence methods are effective for predicting time series with their ability to be nonlinear and hidden patterns in the data. The authors considered the prospects of using artificial intelligence methods in debt financing of business entities in the context of exclusively predicting bond prices. The possibilities for using artificial intelligence methods to model the government bonds price reveal D. Martin, B. Póczos, B. Hollifield [23]. A similar topic has the study of S. Ganguli J. Dunnmon [12], revealing the prospects and possibilities of using machine learning methods to predict bond prices.

However, a general conceptual approach to using artificial intelligence methods in debt financing of business entities has not yet been formed.

3. The Essence and Concept of Using Artificial Intelligence Systems

The artificial intelligence essence is interpreted differently in the scientific literature. The most common are the following approaches to understanding the meaning of artificial intelligence:

- one of the trends in digital technology;
- systems that can think and learn;
- man-made systems that exist in the digital world;
- direction of scientific and technological progress of the third millennium, etc. [27].

The basis of understanding the essence of artificial intelligence is the ability of machines and programs to analyse the information obtained to draw conclusions and make decisions. In many cases, artificial intelligence is considered an innovative approach to solving various economic, political, financial, and social problems [19, 20, 39].

As artificial intelligence is actively developed, the number of systems used increases. Different types of artificial intelligence systems create other opportunities and risks, so they need detailed analysis and classification according to their potential impact (level and direction).

Artificial intelligence systems are machine systems with different levels of autonomy, which can make predictions, recommendations or model solutions for a particular set of human-defined goals [25]. First of all, artificial intelligence systems can be used 1) in different contexts (in different areas; for different business functions; at different levels of interaction between participants, etc.), 2) using different types of data (private or publicly available data; structured, poorly structured or unstructured data) and 3) different models (symbolic; probabilistic and others) for 4) performing different tasks (prediction; recognition; optimisation, decision making). These four criteria (context, data, model and tasks) are the basis of the concept of artificial intelligence usage. The concept of using artificial intelligence systems is shown in Figure 1.
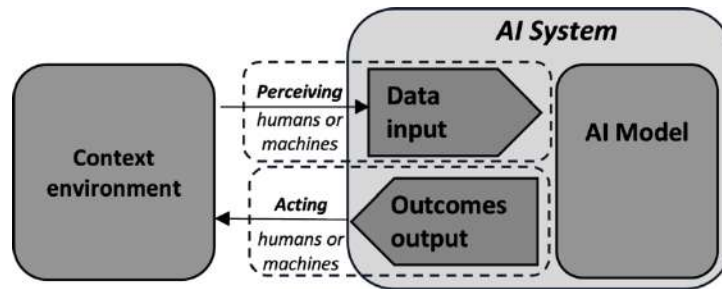
Figure 1: The concept of using an artificial intelligence system
Source: based on [26]

The four criteria for the concept of using artificial intelligence systems can be linked to its life cycle. The life cycle of an artificial intelligence system usually includes six phases:

- planning and design;
- data collection and processing;
- model formation and interpretation;
- verification and validation;
- deployment;
- using and monitoring.

Figure 2 shows the dimensions of the artificial intelligence systems classification.
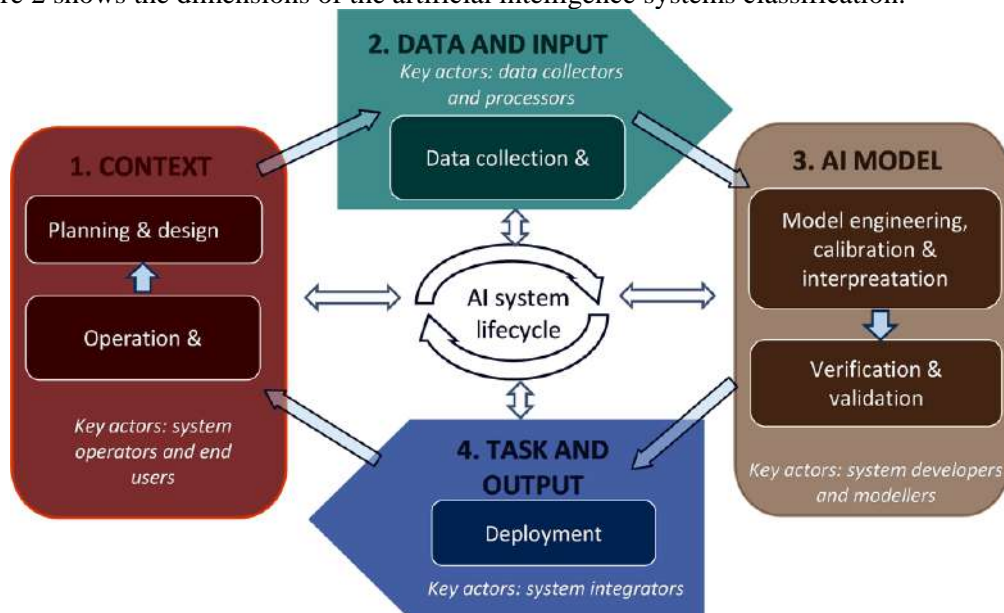

Figure 2: Dimensions of the artificial intelligence systems classification
Source: based on [26]

The life cycle of an artificial intelligence system is unique because artificial intelligence systems can interact with a real or virtual environment and "learn" by improving their dynamics, being nonlinear, and working with varying degrees of autonomy.

4. The Concept of Applying Artificial Intelligence Methods for Debt Financing of Business Entities

Artificial intelligence is a tool, not a solution. Businesses that make the best use of artificial intelligence methods and achieve the most significant improvements in debt financing operations will remain focused on customers rather than their own systems [34]. Artificial intelligence in finance is changing how we interact with money, helping to streamline and optimise processes from credit decision-making to financial risk management [31].

The financial sphere is the widest and most profound application of artificial intelligence. After all, it is used not only by technology companies that provide services to financial institutions but also by traditional financial intermediaries that use technology, new financial formats, and by financial regulators. According to the features and scope of artificial intelligence in finance, we can distinguish intellectual investment advice, intelligent customer service, intelligent risk management, smart marketing, etc. [13].

The application of artificial intelligence methods to debt financing operations has significantly speeded up due to the rapid development of the corporate bond market, which has its characteristics compared to the government bond market. After all, today, bonds are the primary fund tool for attracting debt financing by business entities [42]. Artificial intelligence methods are necessary to improve risk management and decision-making on debt financing and promote the further active development of the financial market.

In 2020, business entities began to borrow heavily, and many companies issued bonds to overcome income cuts due to the COVID-19 pandemic and quarantine restrictions. According to a SIFMA study, daily corporate bond trade in the United States grew by 16.2% year on year to $ 41 billion in 2020. In the first quarter of 2021, this growth was 15%. Note that the debt financing market has real prospects for further rapid growth [3].

According to a JPMorgan survey, asset management managers predict that in 2022 40% of all their corporate bonds will be electronic (by the end of 2020, the share of electronic bonds was about 25%), about 50% of government bond transactions are already electronic, and, according to predictions, in 2022 this amount will increase to 65% [3].

The survey results of 624 representatives of financial organisations in the areas of financial activities digitalization initiatives are presented in Figure 3 [2].
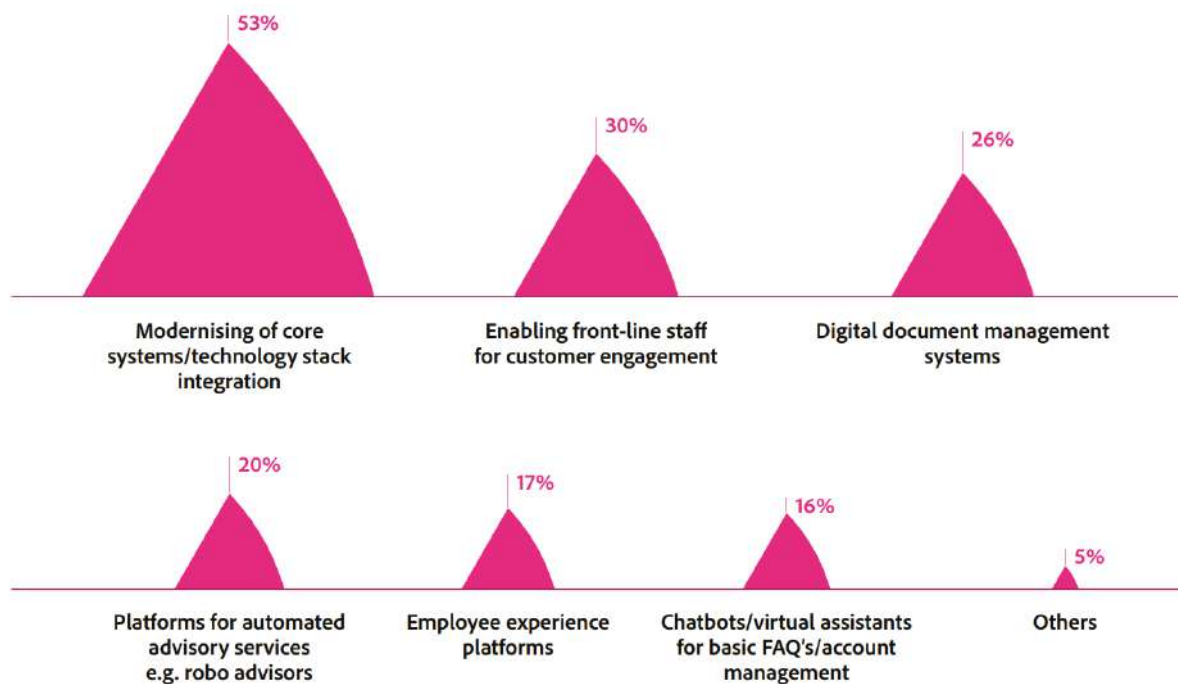

Figure 3: The top areas of focus for business entities' digital initiatives
Source: [2]

New technology platforms based on artificial intelligence systems monitor and report the level of corporate bonds liquidity in real-time. Using artificial intelligence methods to process input from both the buyer and the seller, they can inform the portfolio manager about the feasibility of bond transactions (purchase, sale, resale). This allows market participants to quickly and efficiently assess the liquidity of debt financing and decide on its further service. Analysing the historical models of dealers in similar debt financing agreements and evaluating the activities of market participants, the artificial intelligence systems predict the level of interest in a particular trade operation and identify customer interest in potential trade [28].

The main tasks of artificial intelligence systems in the field of debt financing are:

- formation of corporate bond offers for the client to place financial resources;
- formation of a debt financing portfolio for a business entity to diversify risks;
- search and link the buyer with the seller;
- assessing the possibility of selling bonds and alternative debt management scenarios.

With the information generated by artificial intelligence systems, market participants can more efficiently conduct transactions with debt instruments. These platforms are already beginning to help market participants find liquidity and complete operations in a complex market environment. In the long run, artificial intelligence trading systems can turn corporate bond trading into a market with almost unbelievable levels of transparency and liquidity [28]. Therefore, Ukraine, which has declared an innovative strategy for the financial services market development, needs to pay maximum attention to the potential of using artificial intelligence systems to form high-quality, innovative tools for organising the financial services market's work.

In addition, artificial intelligence techniques can be used to solve debt problems: you can evaluate customers based on the stage of the debt collection process they are in, and then, based on generated scenarios, decide whether to send a letter to the customer, call, visit in person, etc. Artificial intelligence optimises and automates this process, allowing more informed decisions. Artificial intelligence methods are already used in the front offices of financial institutions, identifying early risks at the credit scoring stage of loan applications. Credit scoring - a task involving collecting data and comparing them with specific criteria - is ideal for implementing artificial intelligence systems [34].

Computer vision can scan a face to assess mood, looking for minor changes in facial expressions and comparing them to a list of their effects. It is a powerful customer service tool used in the financial sector when providing financial services. Chinese insurance company Ping An uses this technology to test customers for reliability by evaluating messages that reveal that their disclosure is incomplete. In the UK, Metro Bank has already used computer vision to improve the performance of its chat-bots, making them more sensitive to the facial expressions and moods of human customers, changing scenarios when customers become impatient, nervous or frustrated.

Other aspects of customer service can also be automated or improved through data processing using artificial intelligence methods. Artificial intelligence can simplify decision-making by highlighting successful trends in such cases and recommending acting ways. Artificial intelligence techniques can also help to improve existing practices by analysing data and highlighting issues. Analysis of recorded calls and the data they provide - the specific use of language by successful fundraisers, common debtor objections, and how best to overcome them - creates best practices for using artificial intelligence techniques in the financial sphere. Compliance breaches can also be highlighted and predicted using machine learning methods [34].

There are five ways to use artificial intelligence methods to collect debts:

- improve communication and form contact with the client – chat-bots and virtual assistants work on different platforms (including e-mail, text messages, Facebook Messenger, WhatsApp, Telegram and other programs), and by investing in artificial intelligence, you can expand coverage without losing human connection and optimising costs;
- streamline processes to improve cooperation with the client - using artificial intelligence methods, there is a reconciliation of own interests with expectations of clients, in particular, you can transfer the process online, rather than forcing customers to contact a financial intermediary, automate e-mailing directly to the borrower;
- form a credit profile of a client who uses debt financing of different entities simultaneously - the use of artificial intelligence methods will help to analyse data from different sources, forming the credit history of the client;
- optimise debt collection strategy - artificial intelligence tools can improve debt collection decisions, as they are based on the use of historical data and big data, which are poorly structured and unstructured;
- modernise analytics - you can significantly improve the quality of business intelligence by integrating artificial intelligence solutions and machine learning in the debt collection process because algorithms process data sets in a way that people can't [21].

Table 1 shows examples of the use of artificial intelligence methods in debt financing.

Table 1

Examples of the use of artificial intelligence methods in debt financing

Examples	Characteristics
RadiCall	Polish start-up that helps parents collect alimony from former partners (collect debts) and provides automated phone calls to debtors
Erika	Bank of America uses a chat-bot to collect debts from customers, which helps to make advance or subsequent payments
GiniMachine	an automated decision-making platform with artificial intelligence that makes financial scoring to the client
Eno	the first SMS-based text assistant offered by Capital One in the United States
JPMorgan Chase	fraud detection programs, including the implementation of an algorithm for detecting fraud patterns
Kensho Technologies	offers analytical solutions using a combination of cloud computing and natural language processing; can provide answers to complex financial questions in plain English
Alphasense	artificial intelligence search engine for financial intermediaries to serve customers; the platform uses natural language processing to analyse keyword searches and identify trends and changes in the markets
Enova	advanced analytics and technology to both non-prime consumers, businesses, and banks to facilitate responsible lending.
Ocrolus	makes it easier and more equitable to verify individual loan status with less invasiveness required.
DataRobot	using DataRobot's software to make more accurate underwriting decisions by predicting which customers are more likely to default.
Scienaptic AI	provides an underwriting platform that gives banks and credit institutions more transparency while cutting losses
ZestFinance	helps companies assess borrowers with little to no credit information or history
underwrite.ai	analyses thousands of data points from credit bureau sources to assess credit risk for consumer and minor business loan applicants; applies machine learning to find patterns and determine good and bad applications
Symphony AyasdiAI	creates cloud-based and on-premise machine intelligence solutions for enterprises and organisations to solve complex challenges; is deployed to understand and manage risk, anticipate the needs of customers and even aid in anti-money laundering processes
Canoe	modernises data workflows and is infinitely scalable to serve customers of all sizes
Kavout Corporation	process huge sets of unstructured data and identify real-time patterns in financial markets
Alpaca	provide short and long-term forecasting applications; identifies patterns in market price-changes and translates its findings into multi-market dashboards
Kasisto	helps banks reduce call centre volume by providing customers with self-service options and solutions; give users calculated recommendations, and help with other daily financial decisions
Abe.ai	provide customers with more convenient banking; provides services ranging from simple knowledge and support requests to personal financial management and conversational banking
Trim	a money-saving assistant that connects to user accounts and analyses spending; can cancel money-wasting subscriptions, find better options for services like insurance, and even negotiate bills

Examples	Characteristics
Vectra AI	automates threat detection, reveals hidden attackers specifically targeting financial institutions, accelerates investigations after incidents, and even identifies compromised information
Shape Security	curbs credit application fraud, credential stuffing, scraping and gift card cracking by pinpointing fake users
Darktrace	creates cybersecurity solutions for a variety of industries and financial institutions are no exception
TQ Tezos	create new tools on Tezos block-chain, working with global partners to launch organisations and software designed for public use.
ShapeShift	a decentralised digital crypto wallet and marketplace that supports more than 750 cryptocurrencies across eleven block-chains

Source: based on [1, 21, 31]

In most cases, debt repayment strategies remain complex, ineffective, and outdated. Customers demand flexibility, affordability, and choice in today's fast-paced digital world. Debt repayment should be easy and painless, not a process that consists of nasty letters and a few phone calls at an uncomfortable time of day. Nowadays, artificial intelligence systems are already able to improve debt collection within companies. Their ability to use data, machine learning and behavioural science is a powerful tool for understanding customers deeper and more personal. The use of artificial intelligence methods eliminates assumptions and human prejudices. Each step can be used to logically automate the process and develop a customer-centric approach [11].

Today, the use of artificial intelligence methods in debt collection - the repayment of debt financing - is actively developing. This is because the leading cause of credit losses is the use of outdated approaches to debt collection, which do not reflect the variability of the economic environment and are based on the use of limited data. However, artificial intelligence and machine learning are beginning to modernise debt collection. These technologies make it possible to analyse a huge amount of data from various sources, opening up new insights into the risks of offences and how to manage risk accounts. In addition, machine learning can be regularly retrained, increasing its accuracy in dynamic situations when new information appears [35].

The first users of artificial intelligence technologies already see significant payments in their loan portfolios, i.e. confirm the feasibility and effectiveness of using artificial intelligence in debt collection. They also identified the possibility of early offences warning and optimised debt financing strategies to reduce defaults. Historically, debt collection has been primarily reactive, trying to recoup losses after the borrower became a debtor. The use of machine learning and artificial intelligence methods changes this paradigm, creating opportunities for proactive detection of risky accounts even before defaults [35].

5. The Use of Artificial Intelligence Methods in Transactions with Debt Securities

The financial services market uses digital technologies and artificial intelligence techniques to simplify doing business and ensure higher business efficiency. The emergence of bonds and trade-in bonds are among the few areas that are in great need to embrace this trend. Today's way of organising operations with bonds is inefficient, and in addition, in Ukraine, it is poorly developed. The main problem is the low accuracy of determining credit risk in the long run. The bond market remains dependent on manual transactions with poorly structured and unstructured data sets. This leads to information asymmetry and significant inaccuracies in calculations and predictions [7].

There is a great need to centralise Big Data and use Big Data Analysis to improve pricing, risk management (including liquidity risk and credit risk), and information gathering. Artificial intelligence methods that use profound historical records of essential data elements (verified reports, initial quotations of prices for bonds provided by the dealer, etc.) and points of bonds sale on the secondary market can solve this problem [7].

To predict the best price of new bonds, as well as bond prices on the secondary market, it can be used machine learning algorithms because such algorithms analyse millions of data points: recent quotations of new issues, the dynamics of key financial indicators of business entities, investor sentiment, etc. It is assumed that the data for analysis will be used from different sources:

- reports of business entities, which will disclose relevant information;
- open bank data;
- confidential data obtained as a result of feedback from counterparties;
- data on bond trading, structured according to different criteria.

The key difference between statistical methods and artificial intelligence models is the purpose of these methods. Statistical methods involve forming a set of assumptions that prescribe the model and characterise the studied indicator's behaviour. Artificial intelligence methods aim to find the method that best predicts the outcome of the research [7].

The algorithm of pricing on bonds using artificial intelligence methods is shown in Figure 4.
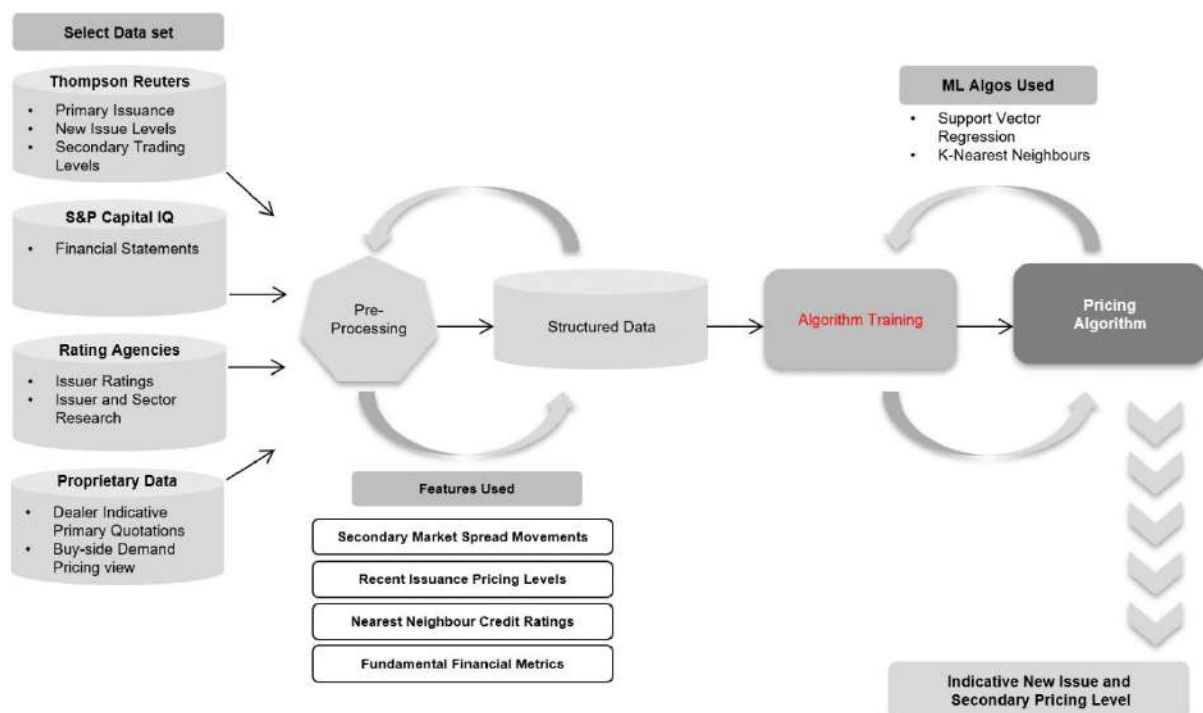

Figure 4: Algorithm of pricing on bonds using artificial intelligence methods
Source: specified by the author on the bases of [7]

This algorithm involves input data from a variety of sources, including Thompson Reuters (bond issue and trade levels), S&P Global Market Intelligence (company-level master data), rating agency data (company ratings and macro-market data), other sources. The algorithm also involves obtaining data (aggregated and anonymised) from Investment groups and investors [7].

The next stage of the algorithm is to learn and apply several models to calculate the bond's price. Each of these models is studied using a subset of historical data. The accuracy of the algorithm result critically depends on the accuracy, timeliness and relevance of input data processing.

Training in the pricing model involves the use of artificial intelligence methods, the main task of which is to measure the best correlations in different liquidity scenarios based on input data that have been previously structured. Accordingly, the output data of the algorithm will be bond prices.

Artificial intelligence algorithms require a large amount of data to analyse the activities of business entities and obtain accurate results. However, some data may be incomplete. It is advisable to fill the gaps in the data because an incomplete data set distorts the simulation results. Businesses with minimal historical information should be supplemented with indicative bond price curves and key indicators to create yield curves successfully. It is necessary to use the method of analogues to fill in the gaps in the data [7].

Artificial intelligence and machine learning promise to change the way lenders understand their borrowers. An accurate understanding of borrowers is becoming increasingly important in economic uncertainty. Accordingly, with the help of artificial intelligence and machine learning, lenders can create a detailed customer profile to determine which borrowers are likely to solve debt arrears on their own and which need active intervention, such as loan restructuring or changes in repayment.

6. Advantages and Risks of Using Artificial Intelligence Methods in Debt Financing of Business Entities

Big data analytics based on the use of artificial intelligence methods provides financial intermediaries with the ability to respond to consumer and economic trends in real-time. Compliance automation systems based on artificial intelligence reduce the cost of legal and risk departments and reduce the percentage of human error. The use of artificial intelligence techniques in the banking and FinTech sectors is expanding, from customer-centric services (such as chat-bots personalised marketing) to internal risk management processes (e.g., automation of operations, contract analysis, risk management) [9].

The main advantages of implementing artificial intelligence methods in the financial sector are the reduction of corruption and the prevention of money laundering; prediction, personalisation and automation of financial services; development of online marketing with a precise definition of customer needs and opportunities to meet them; the processing of payment documents.

Another strength of using artificial intelligence methods is the continuity of data collection: the more comprehensive the database, the more influential the artificial intelligence system. The artificial intelligence system integrates the collected disparate information, allowing us to offer the customer a personalised product that best meets his needs.

The impact of the use of artificial intelligence methods on the business entities' activity in the financial sector is generalised in Figure 5.
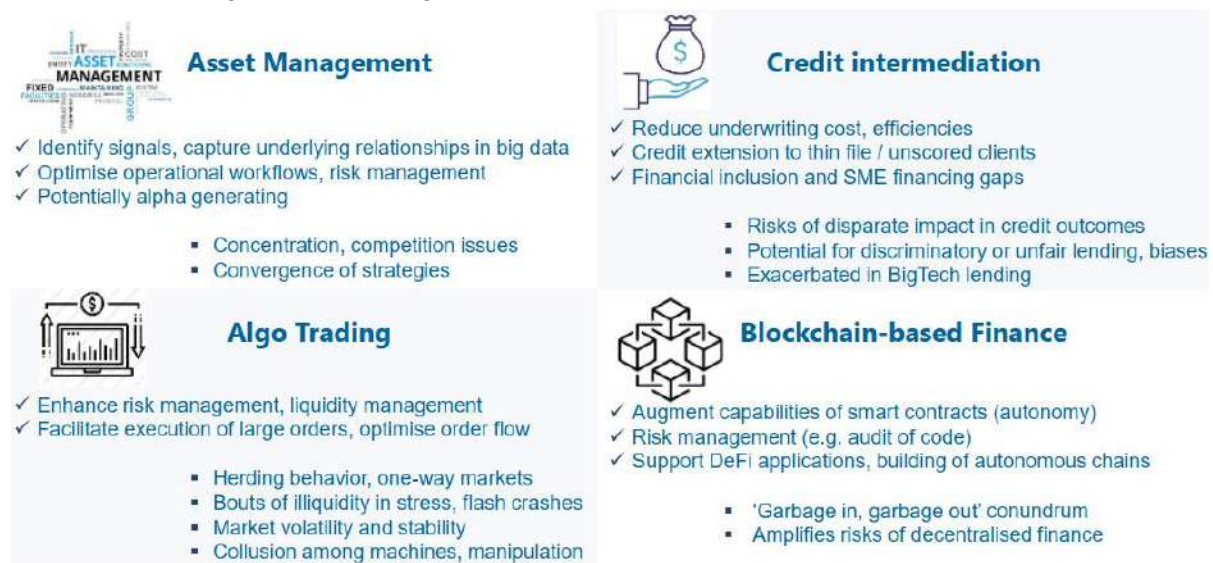
Figure 5: Impact of the use of artificial intelligence methods on the business entities' activities in the financial sector
Source: [25, p. 9]

The use of artificial intelligence methods in debt financing of business entities will reduce the cost of credit underwriting, promote continued cooperation with customers, increase the efficiency of data processing to assess the creditworthiness of borrowers, improve loan portfolio management. However, we should not forget about the risks of incorrect decision-making regarding the inexpediency of financing to the client, which is difficult to explain, arguing solely by machine decision-making on financing.

In recent years, bond market counterparties have increasingly used quantitative investment and liquidity risk monitoring methods, including artificial intelligence analytics [7]. The benefits of using artificial intelligence in attracting debt financing through bonds are systematised in Table 2.

Table 2

The benefits of using artificial intelligence in attracting debt financing through bonds

Application	Business Objectives	Key Benefits
Intelligent automation	Automate liquidity risk monitoring and reporting Enhance independent pricing verification	**Intake fundamental and alternative data** **Scale coverage and increase analysis speed using** machine learning to test correlations on large issuer coverage universe, reducing the required resources and time (cost) and improving precision (revenue)
Enhanced decision-making	Use auto-pricing models to improve reporting and risk systems Realise better investment disclosure with pricing accuracy and coverage	**Using machine learning to monitor pricing and liquidity changes** can improve portfolio reporting and pricing shifts monitoring. Proprietary data from in-house trade flow can be infused into AI models to understand client preferences and buying patterns. **Algorithmic supply-demand matching** can validate at scale pricing levels that would not otherwise be considered with high confidence and would enter expensive external validation cross-check process
Advanced risk management	Advance real-time pre-and post-trade risk management solutions	**Pre-trade risk analysis** can monitor the impact of different trade strategies and systematically incorporate the cost of risk capital in profitability calculations **Continuous risk monitoring** enables institutions to automate risk models on-demand, understand underlying market exposure in near real-time and recalibrate capital levels **Intaking alternative datasets** with machine-learning algorithms can improve the coverage and robustness of risk models, as well as improve the quality of data intake

Source: formed based on [6,7]

The main directions of using the artificial intelligence methods in debt financing of a business entity at different management levels are shown in Figure 6.

Figure 6: The main directions of using the artificial intelligence methods in debt financing of a business entity at different management levels

Source: adapted by the authors on the bases [25]

Financial intermediaries increasingly use artificial intelligence methods and models to assess the creditworthiness of potential borrowers, make underwriting decisions, predict defaults, detect fraud, and analyze the degree of interconnectedness between borrowers, which has a positive impact on their quality of loan portfolio management.

The use of artificial intelligence methods, in addition to the benefits, provokes problems and risks (Figure 7).
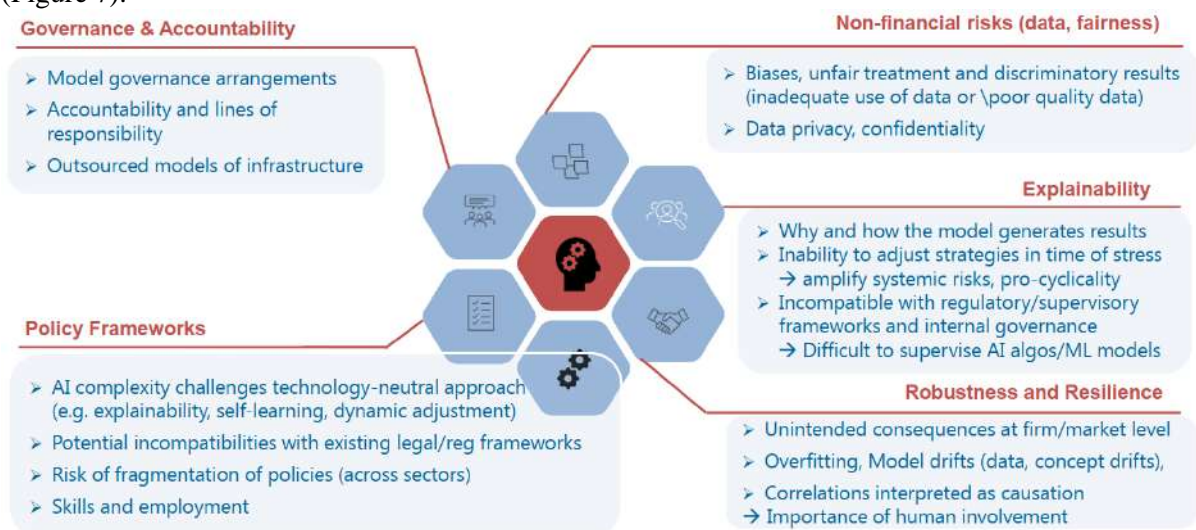

Governance & Accountability
➢ Model governance arrangements
➢ Accountability and lines of responsibility
➢ Outsourced models of infrastructure

Non-financial risks (data, fairness)
➢ Biases, unfair treatment and discriminatory results (inadequate use of data or \poor quality data)
➢ Data privacy, confidentiality

Explainability
➢ Why and how the model generates results
➢ Inability to adjust strategies in time of stress → amplify systemic risks, pro-cyclicality
➢ Incompatible with regulatory/supervisory frameworks and internal governance → Difficult to supervise AI algos/ML models

Policy Frameworks
➢ AI complexity challenges technology-neutral approach (e.g. explainability, self-learning, dynamic adjustment)
➢ Potential incompatibilities with existing legal/reg frameworks
➢ Risk of fragmentation of policies (across sectors)
➢ Skills and employment

Robustness and Resilience
➢ Unintended consequences at firm/market level
➢ Overfitting, Model drifts (data, concept drifts),
➢ Correlations interpreted as causation
→ Importance of human involvement

Figure 7: Relevant issues and risks stemming from the deployment of artificial intelligence in debt financing
Source: [25, p. 8]

There are such main threats to the impact of artificial intelligence on the financial sector: an erroneous algorithm for selecting financial indicators; threat to national and financial security in the event of cyber-attacks; loss of control over the activities of financial market entities, reduction of the number of employees of financial institutions [27]. Excessive dependence on financial services guided by artificial intelligence will undoubtedly lead to problems when algorithms choose which consumers to serve because it is very difficult to overcome the bias of choice based on algorithmic models [22].

In addition, the increasing use of artificial intelligence methods in the financial sphere creates problems with informed consent. Effective informed consent in a hyper-digital financial system requires that consumers understand and consent to use their transactional and personally identifiable information in a financially intrusive manner [22].

7. Conclusions

As artificial intelligence and machine learning methods increasingly modernise debt repayment, both lenders and borrowers can reap significant benefits from using these innovative technologies. First of all, understanding, identifying borrowers, and interacting with them helps reduce the risk of loss and more effective management of overdue payments. Second, more active and productive customer reach helps to improve the efficiency of debt management [35].

The use of artificial intelligence analytics should meet the goals of the business entity because before using this innovative tool, it is necessary to assess the current state of artificial intelligence capabilities and determine a roadmap for the use of artificial intelligence methods by a particular business entity for specific purposes (including debt financing). The implementation of artificial intelligence methods allows us to innovatively organise change management and maintain the expected effectiveness of operations.

It should be noted that the use of artificial intelligence methods is individual and quite personalised, because it involves making their own decisions based on generated by artificial intelligence proposals (scenarios), so to get tangible results from the use of artificial intelligence, businesses need to be paid to forming decision-making models, implementing best practices in engineering and Data Science, which, while increasing cost, reduce the risk of failure to implement such an innovation as artificial intelligence.

Artificial intelligence methods help businesses develop and control debt financing mechanisms, including through the use of bonds, and monitor their ability to attract debt financing and place funds in debt securities using artificial intelligence.

Artificial intelligence methods in the financial sphere have both advantages and disadvantages. However, in the conditions of total digitalization, the necessity of using modern information technologies is absolutely due. After all, the use of artificial intelligence methods can significantly reduce standardised and repetitive work, which is growing, because the amount of information is multiplied every year, and its processing requires the use of modern information technologies such as Big Data Analysis and Data Mining.

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