INTELLECTUAL TECHNOLOGIES AND BIG DATA ANALYSIS AS ANTI-CRISIS CONSULTING TOOLS FOR DECISION-MAKING IN DIGITAL BUSINESS

ІНТЕЛЕКТУАЛЬНІ ТЕХНОЛОГІЇ ТА АНАЛІЗ ВЕЛИКИХ ДАНИХ ЯК ІНСТРУМЕНТИ АНТИКРИЗОВОГО КОНСАЛТИНГУ ДЛЯ ПРИЙНЯТТЯ РІШЕНЬ В ЦИФРОВОМУ БІЗНЕСІ

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The article explores intelligent technologies and Big Data Analytics as key tools of anti-crisis consulting for digital business and e-commerce. The growing complexity of the digital environment and the frequency of crises require a transition from reactive management to data-driven decision-making models. Big data analytics enables identification of hidden patterns, risk assessment, early detection of threats and adaptation of digital business strategies. The study is based on methods of analysis, synthesis, systematization and applied use of machine learning, neural networks and cluster analysis. Practical applications include anomaly detection, forecasting marketing effectiveness and assessment of operational risks. Scientific novelty lies in the development of an approach to integrating intelligent technologies into predictive anti-crisis consulting.
Keywords: artificial intelligence, digital economy, digital business, information systems and technologies in entrepreneurship and trade, business model, startup, e-commerce, risk assessment, decision support, business competitiveness.

Стаття присвячена дослідженню інтелектуальних технологій та аналітики великих даних як ключових інструментів антикризового консалтингу в цифровому бізнесі та електронній комерції. Обґрунтовано, що зростання рівня цифровізації економіки, ускладнення конкурентного середовища, динамічність ринкових процесів та підвищення частоти кризових явищ зумовлюють необхідність переходу від традиційних реактивних підходів до управління кризами до моделей підтримки прийняття управлінських рішень на основі даних. У роботі систематизовано сучасні підходи до аналізу великих даних, визначено їх роль у виявленні прихованих закономірностей, прогнозуванні кризових сценаріїв, оцінюванні ризиків, виявленні аномалій у бізнес-процесах та адаптації цифрових бізнес-моделей до умов нестабільного зовнішнього середовища. Методологічною основою дослідження є методи аналізу і синтезу, індукції та дедукції, систематизації та логічного узагальнення, а також інструменти машинного навчання, нейронних мереж, кластерного та прогнозного аналізу. Запропоновано практичні приклади застосування інтелектуального аналізу великих даних для детекції аномалій, прогно-

зування ефективності маркетингових кампаній, сегментації клієнтів, оцінювання операційних і технологічних ризиків та підтримки розроблення адаптивних антикризових стратегій у цифровому середовищі. Особливу увагу приділено можливостям використання аналітичних платформ і систем підтримки прийняття рішень у реальному часі. Наукова новизна дослідження полягає у розвитку методології інтеграції Big Data Analytics та інтелектуальних технологій у практику антикризового консалтингу цифрового бізнесу з акцентом на використання прогностичних і прескриптивних моделей прийняття рішень та їх адаптацію до специфіки електронної комерції. Практична цінність отриманих результатів визначається можливістю їх застосування консалтинговими компаніями, менеджментом цифрових підприємств і стартапів для підвищення стійкості, конкурентоспроможності, гнучкості та адаптивності бізнесу.

Ключові слова: штучний інтелект, цифрова економіка, цифровий бізнес, інформаційні системи і технології у підприємництві й торгівлі, бізнес-модель, стартап, електронна комерція, оцінювання ризиків, прийняття рішень, конкурентноспроможність бізнесу.

Statement of the problem. The current stage of development of the world economy, including the domestic one, is characterised by a fairly high level of digitalisation, acceleration of most business processes, a constant increase in the amount of information, as well as a gradual complication of the competitive environment and in the context of regional clusters of all levels. E-business, which includes e-commerce, digital platforms, marketplaces, fintech services [1-2], SaaS solutions and various ecosystem models, is currently becoming one of the key drivers of economic growth. At the same time, e-business is one of the most vulnerable areas in the context of crisis phenomena, as it largely depends on consumer demand and technological sustainability.

Global and local crises, including financial, economic, geopolitical, pandemic, energy and technological crises [3], significantly increase the uncertainty of the external environment and require companies to be able to respond quickly enough, adapt and, in some cases, revise their business models [4]. In such conditions, traditional methods of crisis management, which are mostly based on retrospective financial statements and expert assessments, often prove to be insufficient or limited. As a result, there is an objective need to use more accurate, flexible and prognostically oriented tools to support management decisions, especially in the digital environment [5].

In recent years, one of such tools has become Big Data Analytics. Big data is an array of structured, semi-structured and unstructured information characterised by significant volumes, high speed of receipt, variety of formats, as well as certain variability and heterogeneity of quality. In e-business, big data sources include [6]: transaction systems, web logs, user behaviour data, social networks, mobile applications, IoT devices, CRM and ERP systems, payment services, and external open data sets.

Big data analytics allows not only to record the current state of the business, but also to identify hidden patterns/templates [7], detect anomalies in data, predict the development of crisis situations, assess possible risks, model alternative scenarios and formulate management decisions in near real-time.

Analysis of recent research and publications. The current features of intellectual analysis and big data analytics in digital business and/or e-commerce have been thoroughly and systematically analysed by the authors in the following publications, which outline the general concepts of big data analysis & analytics in e-commerce and digital business in general [Shanti M., Annabelle E.[9]; [10]]; empirical research on the application of big data analytics for forecasting, segmentation, building BI systems and marketing optimisation [Shynkarenko R. [11]; Mallik Reddy V., Nalla L.N. [12]; Kui X. [13]; Caroline Y., Yuswardi, Umar Rofi'i Y. [14]] and analysed technical and methodological studies that expand the understanding of infrastructure, ML, DataOps and IoT integration in the context of Big Data Analysis & Analytics [Niyato D., Han Z. [15]; Wu C., Buyya R. [16]; [17].

Modern research shows that crisis consulting in digital business is increasingly based on digital transformation as a key mechanism for increasing organisational resilience and adapting business models in crisis conditions [Cardoso A., Figueiredo J. [18]]. Empirical studies show that the introduction of digital tools, such as e-commerce platforms, data analytics, and digital financial solutions, significantly strengthens anti-crisis strategies and reduces the negative effects of economic shocks [Dafri W., Al-Qaruty R. [19]]. A separate group of studies emphasises the transformation of crisis management itself, where digital technologies are shaping new approaches to risk forecasting, management decision-making and business consulting support [Tubalec A., Korobkin A., [20]].

At the same time, scholars emphasise that the effectiveness of crisis consulting in the digital environment depends not only on technology, but also on management's readiness for digital change and overcoming "digital indecision" in an environment of instability.

Identification of previously unresolved parts of the overall problem. However, the complex scientific and practical task of synergising the features/specifics of the methodology and intelligent technologies of Big Data analysis and analytics within the framework of anti-crisis consulting of digital business (including e-commerce) has not been actually studied - to support optimal decision-making, in particular, regarding objective risk assessment, adaptation of business models of both established digital businesses and start-ups.

Formulation of the article's objectives (statement of the task). Given the above, the main purpose of this study is to improve methodological approaches, further develop technological tools and formulate targeted practical recommendations for the use of intelligent technologies for analysis and big data analytics within the framework of anti-crisis consulting of digital business and e-commerce. Achieving this goal is aimed at increasing the efficiency of supporting optimal management decision-making, in particular in terms of objective risk assessment and adaptation of business models of both established digital companies and start-up projects in conditions of increased uncertainty.

Summary of the main research material. In today's digital economy, companies face rapid changes, high competition, and ever-increasing data volumes. For business entities operating in the digital business and e-commerce sector, the ability to quickly adapt the business model to changes in the external environment and make informed management decisions based on relevant information and analytical tools is crucial [9; 10].

Given the growing uncertainty and dynamism of the market environment, crisis management consulting is increasingly using intelligence tools and in-depth analysis of large data sets integrated with artificial intelligence (AI) technologies [15; 16]. The use of these approaches ensures timely identification of potential threats, comprehensive risk assessment, and increased efficiency of management decision support processes.

The detailed role of big data and data-driven artificial intelligence approaches in crisis consulting for digital business, in particular in the field of e-commerce, is as follows

– Identification of hidden patterns: in-depth analysis of structured data (CRM, ERP systems) and unstructured information arrays (social media data, IoT devices, customer feedback) provides identification of latent trends, potential threats and strategic opportunities that remain inaccessible within traditional analytical approaches;

– forecasting crisis scenarios: the use of machine learning models and artificial intelligence tools allows for the modelling of possible crisis situations, including reduced demand, supply chain disruptions and the transformation of consumer behaviour, which increases the level of readiness of enterprises to respond to negative changes in the environment;

– real-time decision-making support: BI platforms and analytical systems provide management with up-to-date information to assess risks, plan anti-crisis measures and adjust strategies;

– Increasing competitiveness: the use of big data analysis tools and artificial intelligence technologies helps to optimise business processes, improve the accuracy of market forecasting and create innovative value propositions that provide sustainable competitive advantages in the digital environment.

Big data intelligence in digital business is a process of systematic collection, processing and analysis of information for strategic decisions:

– collecting and aggregating big data from various sources: web logs, social media data, CRM/ERP systems, IoT, etc;

– data processing in ETL or ELT modes: cleaning, transformation (including normalisation) of large amounts of information;

– analysis and analytics: application of data mining to identify risks, forecast trends and potential opportunities for digital business;

– formulation of recommendations: development of company development scenarios and anti-crisis strategies to improve competitiveness.

An effective tool for analysing behavioural patterns in digital business is Social Network Analysis (SNA), which enables the study of interactions between users, customers and other stakeholders. The use of graph analytics and specialised software solutions allows the identification of influential nodes, communities and communication structures, which can be applied for marketing optimisation, customer segmentation and risk detection [13; 14].

It should be noted that the methodology of effective anti-crisis in-depth analysis and big data analytics in digital business has been further developed through the introduction and systematic use of the following tools

– big data platforms and warehouses (Hadoop, Spark, Snowflake) that provide scalable storage, integration and high-performance processing of large volumes of heterogeneous information

– analytical and BI systems (Tableau, Power BI, Qlik) designed to interpret analysis results, multidimensional data visualisation and support management decision-making processes [15-17];

– machine learning models and data-driven artificial intelligence technologies, including intelligence visualisation tools, hierarchical and non-hierarchical clustering methods, and shallow neural networks used to solve classification and anomaly detection problems;

– Streaming Analytics, which provides a rapid response to changes in consumer behaviour and transformations in market conditions in near real time.

In this study, we have proposed and implemented an in-depth analytical approach through regression modelling to build a predictive model for assessing the risk of delaying access to e-commerce services for users, customers and buyers in the face of a potential DDoS attack. In particular, a wide range of architectural solutions was investigated and the optimal type, approximate structure, and parameters of the artificial neural network were determined, using the NormalBatches.sta dataset and Statistica 7.0 software [15,;16].

As a scientific and practical result of the implementation of the anti-crisis functionality for detecting anomalies and threats in big data of digital business, we propose to use a specialised architecture of artificial neural networks such as SOM Kohonen. Fig. 1 shows the results of using the unsupervised machine learning algorithm of the SOM Kohonen ANN to detect both clusters and anomalies in a big data set containing 14,999 records with 10 attributes [18-20]. In the course of the experimental work, the optimal network tuning parameters were determined: a network of 125×125 rectangular neurons;
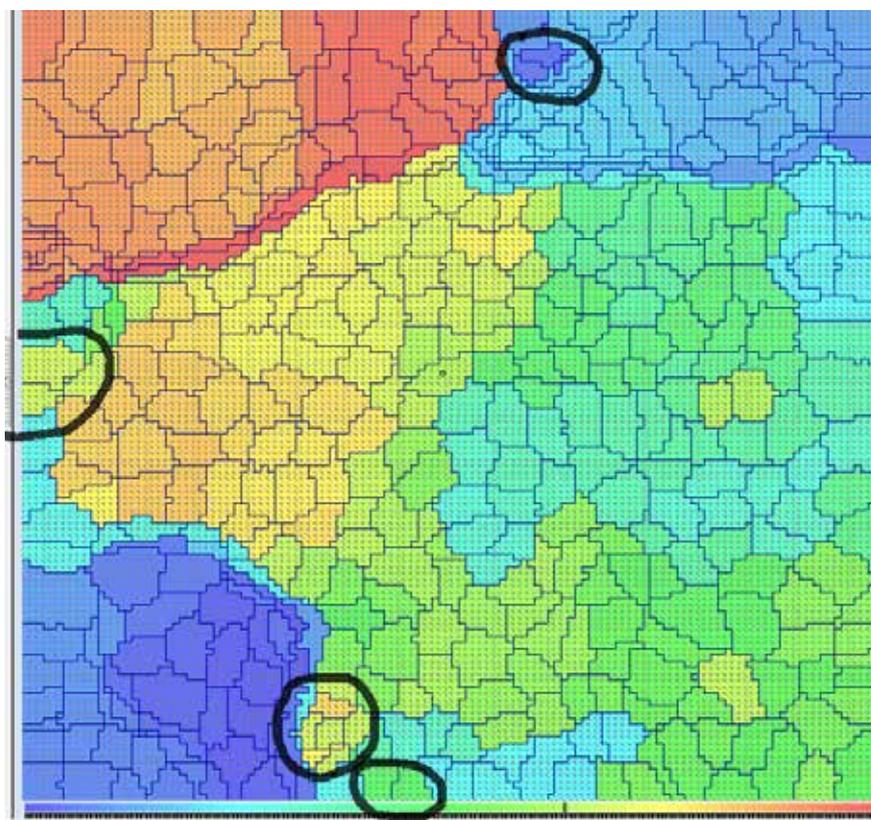

**Figure 1. Visualisation of unsupervised machine learning results
for cluster detection and anomaly visualisation**

Source: author's experimental and modelling results

random initialisation of weights; mixing of input tuples every 5 epochs; stepwise neighbourhood function; learning rate and radius – standard, dynamic and descending; stopping criterion – 100 learning epochs. For training the ANN, 70% of tuples were used, and for testing – 30% of the dataset. In Fig. 1, a black marker indicates employees with abnormal activity indicators.

Thus, intelligence and in-depth analysis of big data, combined with artificial intelligence technologies, are key tools for crisis consulting in the digital economy. Their application ensures timely and objective risk assessment, improves the efficiency of supporting management decision-making processes, helps to optimise business processes, increase competitiveness, and create new start-ups and innovative business models. The introduction of these technologies is a prerequisite for ensuring the sustainable development of companies in the field of digital business and e-commerce.

Conclusions.

1. Big data analysis and analytics are now an important and, in some cases, a backbone element of anti-crisis consulting in e-business. In the context of high uncertainty and dynamism of digital markets, the use of Big Data Analytics ensures a gradual transition from intuitive and predominantly reactive management decisions to a more proactive and predictive approach to management, which allows timely detection of crisis signals and reduction of potential negative consequences.

2. Big Data Analytics helps to improve the accuracy of crisis scenario forecasting and comprehensive risk assessment. The use of machine learning, data mining and predictive modelling techniques allows predicting a decline in demand, an increase in customer churn, deterioration in payment discipline, logistics failures and other crisis manifestations. This gives e-businesses the opportunity to adapt their strategy in advance and take preventive measures to minimise potential negative consequences.

3. Implementation of big data analytics requires an appropriate level of organisational and technological maturity. Effective use of Big Data is possible only if there is a developed IT infrastructure, high-quality data, qualified specialists (data scientists, analysts, consultants) and a culture of data-driven management decision-making.

4. Big Data Analytics facilitates the transition from short-term crisis response to sustainable e-business development. Analytical approaches allow not only to quickly overcome crisis situations, but also to create the basis for further digital transformation, implementation of innovative solutions and improvement of operational efficiency in the long term.

5. Prospects for further research are related to improving methodological approaches and expanding practical application cases. Scientific and practical interest is focused on the integration of artificial intelligence technologies into anti-crisis consulting, assessment of the economic effect of using Big Data Analytics, as well as the development of standards and ethical principles for the use of analytical methods in e-business.

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