Lecture Notes on Data Engineering and Communications Technologies 194

Andriy Semenov
Iryna Yepifanova
Jana Kajanová *Editors*

Data-Centric Business and Applications

Modern Trends in Financial and Innovation Data Processes 2023. Volume 2

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Andriy Semenov · Iryna Yepifanova ·
Jana Kajanová
Editors

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Editors
Andriy Semenov
Faculty of Information Electronic Systems
Vinnytsia National Technical University
Vinnytsia, Ukraine

Iryna Yepifanova
Faculty of Management and Information Security
Vinnytsia National Technical University
Vinnytsia, Ukraine

Jana Kajanová
Department of Economics and Finance
Faculty of Management
Comenius University Bratislava
Bratislava, Slovakia

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Preface

Information technologies are widely used in the decision-making process in business. Databases of important socio-economic characteristics exist mainly in developed countries. In developing countries, the relevant databases needed to optimize economic, financial, production, and innovation activities are often incomplete. This volume includes several chapters in which some statistical data characterizing the economy of Ukraine are given. Also, some chapters are devoted to the description of analysis methods used by people who make decisions at different levels of the hierarchy in business, finance, and innovation management in Ukraine. This allows international scientists to obtain information both about the state of Ukraine's economy, including the impact of the Russian attack, and about the direction of financing future economic aid. Materials of this volume are also important because they can serve as a powerful source of information to improve the effectiveness of communication between international financial donors and the Government of Ukraine when discussing the application of international aid by Ukraine.

Consequently, in the preface, we provide short sketches of every study included in the volume. Starting with the first chapter titled "Formation of Strategies for the Development of Startup Ecosystems as a Prerequisite for Sustainable Entrepreneurship", this study examines startup ecosystems in the world countries based on clustering as a prerequisite for sustainable entrepreneurship. The analysis of startup ecosystems was based on a database presented in the Global Startup Ecosystem Index 2022 from Startup Blink, and 100 countries were included. Two criteria were chosen for cluster formation: Total Score, which demonstrates an overall position in the ranking, and Rank Change (from 2021), which demonstrates the direction of movement of the ecosystem (growth or decline). The authors find four homogeneous clusters of startup ecosystems in considered countries. The first cluster includes only the United States (Total Score 195). The second cluster includes 14 countries (from the United Kingdom with 52 to Ireland with 15), the third cluster includes 46 countries, and the fourth cluster includes 35 countries. The paper proposes 4 types of strategies: absolute leader, leadership retention, considering mistakes, and gradual growth for the obtained classes, respectively. The obtained results allow the government to use the Global Startup Ecosystem Index and Startup Blink databases

to form profitable strategies for the country's development. It will be especially useful for developing countries.

The next chapter presents a study on "The Strategy of Sustainable Development of Digital Business in the Conditions of the Variability of the Business Environment and European Integration". Based on a forecast of the sustainable development index for the EU countries until 2030, the authors identified the conditions that the economy of Ukraine, as a future member of the EU, should satisfy. Digital technologies are proposed as a powerful driver for the development of Ukraine's economy. Such technologies should be used in all spheres of the economy. The authors note that since the majority of Ukrainian enterprises are significantly behind the EU countries or the world, the effect of growth will be large at the beginning. The section presents the results of a survey of 50 experts from all sectors of the economy of Ukraine aged 30–55. According to their estimates: the growth of the economy of Ukraine will be at least 10–15% per year, the high-tech industry sector will grow by 15–20% per year, and there will be growth and attraction of development investments in the country both in production and in R&D centers, incubators, and technological companies. The results obtained by the authors will be of interest to a wide range of specialists in computer modeling of sustainable development in the EU countries. Also, these results will be important for modeling the economic state of the EU taking into account the acceptance of new members.

The next chapter titled "Business Development towards the Application of Innovative Customer Relationship Management (CRM) Technologies in the Context of Global Transformational Changes" ascertains that the world market of CRM systems is developing very quickly. In contrast, the Ukrainian market of CRM systems has not yet gained mass development, which is caused by several factors: insufficient business budgets for implementation, lack of understanding among a significant number of business owners and top management regarding the availability and necessity of CRM implementation, lack of qualified personnel, etc. The IT methods are very needed in the Ukrainian CRM systems market, where the number of clients exceeds hundreds or even thousands. In particular, CRM stores the entire history of communication with customers; CRM improves customer satisfaction by reducing response time and improving the quality of customer support; CRM increases customer retention. The paper has found that for the successful implementation of CRM, a necessary condition is the definition and specification of the company's goals in the short- and long-term perspectives and the definition and development of a strategy that determines relations with customers.

The subsequent chapter "Methodological Principles of Smoothing the Effect of Seasonal Fluctuations on the Components of Labor Intensity in Construction" develops statistical methods for the analysis of the influence of natural factors (season fluctuations) on components of labor intensity in construction in the conditions of Ukraine, and the effectiveness of their application is investigated. It has been proven that in the conditions of Ukraine, climatic conditions and seasonality have a moderate influence on the progress of construction, which can be expressed in the form of seasonal fluctuations in indicators of deviations during the execution of construction works and such parameters as construction terms, labor intensity, and estimated

cost during the year. The deviation of construction terms from a plan for the objects being built in the cities of Kyiv and Chernivtsi in the years 2012–2019 was investigated to identify the impact on the terms of operation, labor intensity, and cost of the seasonality factor and justify correction coefficients to the construction parameters depending on a season. It was found that the level of deviation was 8.3% for labor intensity, and 14.1–16.0% for terms and cost of work for Ukrainian climate conditions.

In the next study titled "Data-Driven Public Budgeting: Business Management Approach and Analytics Methods Algorithmization", the authors investigated the formation of a data-driven government and public budgeting system based on quality conditions of digitized data collected and the support of interaction of all budgeting participants, including citizens. Predictive models, business management approaches to public budgeting efficiency, and data mining techniques were included in this budgeting system. The authors draw attention to the fact that multi-criteria decision-making (MCDM) methods should be used at all stages, especially for the tasks of state and public budgeting. It is in this way that the interests of various active budgeting actors can be reconciled. Both favorable and unfavorable prerequisites for the use of information in the process of forming state and public budgets based on collected data are removed in the section. The authors also discuss specific features of managerial decision-making in the formation of the Ukrainian state and public budgets in conditions of war, high population migration, and relocation of enterprises and businesses.

In the next chapter on "Research of Information Platforms and Digital Transformation Algorithms for Post-war Recovery of Ukrainian Business", the authors propose to introduce a set of scenarios for designing a financial architecture and a large-scale information platform that will allow Ukrainian businesses not only to adapt to the digital dimension in the existing conditions of martial law but also to involve modern tools of digital integration (engineering, technology transfer, cloud technologies, etc.) for post-war recovery. The authors present theoretical developments in the field of substantiating the importance, necessity, and possibilities of implementing modern information systems, developing theoretical models, substantiating stages and procedures of business digitalization, and outlining models and mechanisms separately for the management and accounting systems of companies. Modeling recovery strategies for business with the help of an information software product will allow us to take into account the full toolkit of the latest market tools, which were previously not used to their full extent due to the usual complexity of combining theory and practice. The results described in the section represent Ukraine's current approaches to the development of directions for post-war reconstruction with the involvement of information technologies.

In the following study, entitled "Diagnostics as a Tool for Managing Behavior and Economic Activity of Retailers in the Conditions of Digital Business Transformation", a toolkit for diagnosing the digital behavior and economic activity of retailers in the context of digital business transformation was developed based on modern scientific investigations. The authors offer a set of quantitative parameters characterizing states and processes in the retail trade business. The section offers

methods for assessing the level of the enterprise's mastery of digital technologies and the level of the enterprise's digital readiness for digital transformation. They claim that it is the diagnosis and monitoring of the proposed parameters that is the key factor for fueling the efficiency of retailers. The study provides an opportunity to assess the level of awareness of the scientific community of Ukraine regarding requirements for the activities of retailers in terms of modern business functioning. Also, retail management methods in the conditions of Ukraine may be important for the international scientific community.

The subsequent chapter "Methodical Tools for Identification and Quality Control of Design Products" develops the methods for increasing rationality and quality control of design products, the influence of a material consumption factor on a coefficient of rationality of design products, and other factors are considered. The author's purpose is the development of a methodological toolkit for checking the quality of project documentation to match the designer's remuneration with the results of his work. A possible variant of instrumentation, which is based on dimensionless relative values, is proposed in the paper. The initial value of this type of model is a weighted average linear combination of input variables or certain constants. The fuzzy inference algorithms are chosen for application. The general structure of a microcontroller using fuzzy logic is shown. The main results are equations, which showed that the influence of material consumption and other factors on the quality and price of design products is multidirectional. The membership function of the material consumption of project products is presented, too. The obtained results may be interesting for the optimization of the elaboration of product design.

The next chapter presents a study on "Methodical Approach to Assessment of Real Losses Due to Damage and Destruction of Warehouse Real Estate". Based on information about the estimated value of 192 objects of warehouse real estate in the period 01.21.22–02.04.22 in Ukraine, the chapter has made the systematization of the main price-forming characteristics and their categories and clustering of objects' prices. To determine the market value of a real estate at the time preceding a damage, the paper proposes to use a comparative approach and to substantiate the impact of the main price-forming characteristics on the value of real estate, it makes sense to use statistical methods, as well as technologies of intelligent data analysis. For classification of the price-forming characteristics on the value of real estate, the model in the form of a two-layer perceptron with three neurons in the hidden layer was used. The output of the neural network is the growth force of the area unit value for the evaluated object of warehouse real estate against the average market indicator. This model takes into account the dynamic nature of the warehouse real estate price and is characterized by a high level of approximation reliability. The quantitative results of neural network classification were discussed in the chapter. The first example of the result of estimating the real losses from damage and destruction of warehouse real estate as a result of the war in Ukraine is presented in the chapter.

In the next study on "Development of Information Processes as a Prerequisite for the Sustainable Development of Agricultural Enterprises", the authors propose to introduce the priority factors that determine the specificity of the digital transformation of agriculture and determine the directions of informatization of agricultural

production. The authors established that the informatization of the agricultural sector is characterized by fragmentation. This leads to the differentiation of the level of use of information technologies by both individual agricultural enterprises and branches of agriculture. The authors developed information technologies that can be successfully applied in agriculture to ensure digitization. The authors propose to increase the level of economic development due to the synergistic effect of informatization of agricultural enterprises of the agrarian sector. This will save labor resources in the village, ensure overcoming the digital divide, and contribute to the socio-economic revival of the village. The approaches presented in the section describe a road map for the development of agriculture in Ukraine in the post-war period so its results can be used to forecast the effectiveness of the post-war development of Ukraine's economy.

In the chapter titled "Development and Increasing the Value Added Scenarios for the Woodworking Industry of Ukraine in the Context of the Circular Economy", the contribution of individual types of products to the formation of the gross value added of the industry in 35 countries was examined. The series of linear models of the dependence of a gross value added on the natural indicators of the output of products in 2000–2018 was built in the paper. Based on the analysis, the authors identified and analyzed three possible scenarios for the period up to 2030 for the development of the woodworking industry in Ukraine regarding import substitution, development for domestic consumption, and expansion of exports for various types of products. Based on the results of the analysis of these scenarios, the authors conclude that Ukraine needs to implement a combination of scenarios. The results of this paper can be used to form a database for optimizing international aid for the development of Ukraine after the end of the war.

In the next study, titled "Methodological and Technological Solutions to Improve the Security of Ukraine's Accounting System During the Hostilities", the authors carried out a comprehensive analysis of threats in the information space of accounting associated with the start of full-scale hostilities on the territory of Ukraine. The most important threats in Ukrainian accounting were identified both at the enterprise level and the country level. Blockchain technology was chosen as a perspective for protection. The authors propose the use of blockchains at both enterprise level and macro level. The scheme for the interaction of two-level blockchains was proposed, and the choice of several characteristics of these blockchains was developed. At the enterprise level, the hierarchical structure of internal blockchain users was elaborated. In contrast, at the macro level, the external blockchain was chosen. The description of the steps that Ukrainian scientists are proposing as necessary for the successful integration, including considerations for data migration, system integration, and development of blockchain-based solutions, will be useful for international scientists.

The next chapter is titled "Modeling of the Strategy of Light Industry Enterprise Behavior under Crisis Conditions of Martial Law". The formulation of business behavior and strategies, especially in the light industry sector, faces unique challenges during times of crisis, particularly in the context of martial law. This chapter

explores the complex dynamics and strategic maneuvers of industrial entities encircled by crises. The authors reveal the complexities of corporate cooperation as a strategic approach in a crisis. They carefully develop models that not only identify the challenges faced by light industry enterprises but also provide a structured methodology for formulating optimal strategies for these entities, both individually and in a collaborative coalition. The chapter emphasizes the complex interaction between various factors influencing company performance and emphasizes the need for consistency in the evaluation of utility matrices and the importance of coherent expert grades in decision-making processes. It also examines the complexity of assessing the optimal strategies of coalitions, both broad and incomplete, and outlines the criteria for companies to join or deviate from coalitions based on projected benefits. Overall, this chapter serves as an insight guide for enterprise management and provides a systematic framework for determining behavior strategies in crisis situations. It provides a roadmap for decision-makers to assess the formation of coalitions, maximizing collective profitability while traversing the complex landscape of crisis-related industries.

The next chapter is titled "Innovative Technologies to Make Effective Business Decisions at Every Stage of a Mining Company's Development". In the current era of rapid technological progress and digitalization, industries around the world are witnessing fundamental changes in their operational landscape. The profound integration of digital technology and seamless automation of business processes are crucial factors for informed decision-making and the stability and growth of enterprises. In the midst of this wave of digital evolution, however, the metals and mining industry has not been at the forefront as a "digital leader". Comparative studies indicate that the mining sector lags behind, exhibiting digital maturity levels between 30 and 40% lower than similar industries such as pharmaceuticals, chemicals, and logistics. Based on real examples and using contemporary technology platforms such as Micromine, this study presents a detailed roadmap for the application of innovative technologies and describes their role in improving the efficiency, accuracy, and efficacy of mining operations. As the mining industry is on the verge of digital transformation, this chapter serves as a beacon for industry professionals, stakeholders, and decision-makers to take full advantage of the potential of digital technologies. The author's in-depth research lays the foundations for a paradigm shift, advocating the adoption of advanced technologies to strengthen the mining industry's journey toward informed decision-making and sustainable development.

In the forthcoming chapter "Innovative Method of Forecasting the Manifestation of Dangerous Properties of Coal Seams", the authors examine the multifaceted nature of factors that contribute to the emergence of hazardous properties within coal cables. Their analysis highlights the tripartite blocks that comprise natural conditions during geological processes, mining and geological conditions of coal deposits, and metamorphic transformations that are crucial to understanding the hazardous manifestations. By exploring these blocks, they emphasize the interaction between these blocks and highlight the complexity of the prediction and prevention of emergencies in mining operations. This chapter combines rigorous research, critical analysis, and

pioneering technological advances to pave the way for a more comprehensive understanding of forecasts and the prevention of hazardous phenomena in coal seams. The conclusions contained in this report not only promise to strengthen the safety protocols within the mining industry, but also to significantly mitigate the economic and human costs of accidents. This scientific contribution is a valuable asset for researchers, policy makers, and stakeholders in the industry who have invested in the safety and sustainability of coal mining around the world.

The next study is titled "Assessment of the Efficiency of Decentralization Transformations in the Rural Areas of Ukrainian Western Polissia: Current Trends and Challenges Under the Conditions of Martial Law". The dynamic landscape of rural development in Ukraine has been strongly influenced by decentralization efforts, particularly in the western region of Ukraine named Western Polissia. In the midst of these changes, it is essential to assess the effectiveness of these transformations in order to identify the current trends and tackle the challenges arising, especially in the complex field of martial law. The chapter emphasizes the urgent need to establish effective cooperation between the State and the local authorities and to ensure the principle of subsidiarity, even when there is a tendency to centralize under martial law. It supports coordinated efforts to address urgent needs while promoting sustainable development at the local level. In conclusion, the organizational and economic mechanisms for sustainable development in rural areas depend on sound budgetary and fiscal policies. These policies are linked to the wider goals of social, ecological, and economic progress and form the foundations of effective governance and comprehensive community development. This chapter, therefore, offers a nuanced exploration of the multifaceted landscape of rural decentralization in the midst of the complex background of martial law. It serves as a testimony to the resilience of rural communities and the necessity of adaptation management strategies in times of turbulence.

The subsequent study, "The Technological and Environmental Effect on Marketing of Children's Food", explores the complex interaction between technology, environmental impacts, and their effects on the marketing dynamics of children's food. The influence of these factors on the production and marketing of vegetable products for children is a central point of contemporary discourse. The essence of marketing in children's food has transcended traditional paradigms because of the convergence of technology, environmental concerns, and the decisive role they play in shaping consumers' preferences. Research in this chapter is not only an academic exercise, but an innovative effort to provide meaningful insights for stakeholders in the food industry, policymakers, and marketers. By carefully studying the complex chains of technological advances, environmental impacts, and consumer behavior, the authors seek to chart a way forward for a more informed, sustainable, and consumer-centered approach to the marketing of children's food. This chapter serves as a fundamental contribution to scientific discussions, offering a comprehensive understanding of the evolving dynamics in the area of children's food marketing. The insights obtained from this research promise to guide future strategies, foster innovation, and promote a holistic approach to ensuring healthier and more sustainable consumption patterns among the younger generation.

In the final chapter, titled "Model for Universal Classification of Social Agents' Activity/Behavior in Hierarchical Systems", the authors present the results of elaborating the developed apparatus that allows modeling the activity/behavior of social systems consisting of people and artificial agents. The activity/behavior of a person or artificial agents is described within the universal framework of those environmental changes that a person/object makes. It is shown that there is a finite number of classes of operators that can be used to describe human activity/behavior. The study argues that artificial systems of various origins, such as technical systems, robots, drones, expert and learning systems, and computer bots, can be described in the same terms as human activity/behavior. The obtained results can form a basis of methods for increasing the efficiency of the use of specially structured databases and developed information technologies to accompany and support communication in the process of international negotiations. These results can also form a basis for building new methods of restoring Ukraine's infrastructure in conditions of shortage of highly qualified workers when some people are replaced by robots or robotic complexes.

Vinnytsia, Ukraine Andriy Semenov
semenov.a.o@vntu.edu.ua

Vinnytsia, Ukraine Iryna Yepifanova
yepifanova@vntu.edu.ua

Bratislava, Slovakia Jana Kajanová
jana.kajanova@fm.uniba.sk

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