Lecture Notes on Data Engineering and Communications Technologies

Volume 195

Series Editor

Fatos Xhafa, Technical University of Catalonia, Barcelona, Spain

The aim of the book series is to present cutting edge engineering approaches to data technologies and communications. It will publish latest advances on the engineering task of building and deploying distributed, scalable and reliable data infrastructures and communication systems.

The series will have a prominent applied focus on data technologies and communications with aim to promote the bridging from fundamental research on data science and networking to data engineering and communications that lead to industry products, business knowledge and standardisation.

Indexed by SCOPUS, INSPEC, EI Compendex.

All books published in the series are submitted for consideration in Web of Science.

Andriy Semenov · Iryna Yepifanova ·
Jana Kajanová

Editors

Data-Centric Business and Applications

Modern Trends in Financial and Innovation
Data Processes 2023. Volume 1

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

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

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

Paper in this product is recyclable.

Preface

Several universal problems are emerging in countries that have embarked on the path of developed economy forming. The source of these problems is the system of creating and using effective information communication technologies between innovative companies and funding sources. A large number of innovative companies are emerging in these countries, competing for funding sources. Although these innovative companies work in different areas of the economy, they all have to present their proposals in a form required by funding sources. As a result, there is a need to develop universal methods and communication technologies for passing from databases that characterize an innovative company to databases that provide/create an opportunity for financial structures to compare different companies with each other. This volume summarizes the range of possible development directions for communication technologies between innovative enterprises and financial organizations using the experience of Ukrainian economy as an example.

Consequently, in the preface we provide short outlines of every study included in the volume. Starting with the first chapter titled "Organizational, Financial, and Informational Restructuring in the System of Demonopolization of the Transport Complex of Ukraine in the Conditions of the Knowledge Economy", this study examines and analyzes 25 subjects of natural monopolies of Ukraine, in particular 9 railway transport enterprises, 9 aviation transport enterprises, 5 road transport enterprises. The knowledge economy is considered as an environment for processes of restructuring and demonopolization of the transport complex. Forms, methods, and components of the restructuring of the transport complex are described. Demonopolization of the transport complex is aimed at reducing the negative impact of government monopolies and natural monopolies on the national economy. The priority areas of restructuring in railway transport during the martial law and post-war reconstruction are substantiated. The obtained results can be applied to increase the efficiency of financing utilization in the process of managing innovative processes in Ukraine.

In the next study titled "Modeling of the Key Threats and Identification of the Prospects for Social Security Support in the Sphere of Employment and Labor Payment in Ukraine," the authors extend their prior investigation on employment and labor payment. Using factor models, the study analyzes key threats and prospects for

neutralization within Ukraine's labor market. Such factors as informal employment, youth unemployment, average wages, real wage indices, arrears in salary payments, and wage funds were examined. The deliberate exclusion of data from 2019 onward allows a focused analysis of pre-existing threats, acknowledging the challenges posed by the pandemic and the ongoing conflict in Ukraine. The authors emphasize the need for legislative, socio-economic, and managerial measures to address the complexities of the labor market and ensure the protection of social interests in employment and labor payment matters. Continuous analysis is highlighted as essential for timely adjustments in state policies to adapt to evolving social security landscapes.

In the next study titled "Formation of Marketing Competencies in Case of Startups Integration into the Intellectualized Market Space", attention is drawn to the importance of considering the marketing characteristics at all stages of a startup life cycle. The requirements for the formation of databases, which are necessary for effective communication between the startup team and its environment, have been identified. There are four key stages where these databases will be critical to success. The first stage is the generation of an idea, where it is necessary to lay down as many opportunities as possible for the further development of communication technologies. The second stage is the transition from the idea to a team creation and to a real business. This is where limitations of communication databases come into play. The third stage is a startup creation and the start of its activities, in which marketing constraints begin to come to the fore. The fourth stage is business scaling, in which marketing constraints become decisive for communication databases. The article describes in detail the key barriers to communication during integration of startups into the market space of Ukraine and possible marketing measures to eliminate them.

The subsequent chapter "Information Systems for Vehicles Technical Condition Monitoring" explores directions for modification of the existing system of monitoring the technical condition of road transport in Ukraine, which no longer meets the modern requirements for maintaining the vehicle operability. An information system and corresponding databases for monitoring operating conditions of vehicles were formed, a general information support of the system was proposed, and the following issues were described: investigation processes and evaluation of the operating conditions of vehicles; information model of a vehicle position; speed model of vehicle traffic modes. In addition, evaluation tools are presented: the type and condition of the road surface; state of transport infrastructure facilities; condition of an adjacent area of the road; fuel economy of vehicles in operating conditions, as well as an algorithm for adjusting the speed of vehicles. A mathematical model of the information system for evaluating parameters of the vehicle's technical condition was developed. Results of testing the mathematical model demonstrated its high predictive ability.

In the next study "Model for New Innovation Knowledge Spreading in Society" the authors propose to introduce a method for forming a tuple of knowledge as a set of databases from the objective characteristics of the manifestations of human activity (both in its activity and communication with social group). A method is proposed for introducing a metric in this tuple, which allows setting the task of knowledge dissemination as a change in the number of people who own a certain knowledge

tuple. The diffusion mechanism of knowledge dissemination and the problem of spreading knowledge from one source (a university) in society is described in detail. A method of identifying the tuple of knowledge possessed by an individual, social group, or society was developed. Application of this method to important processes that accompany the development of society is discussed. It is shown that the obtained results can increase the efficiency of migration process management. A method of determining a set of tuples, which is necessary for the functioning of a developed country, is described. The possibility of applying the obtained results to increase the efficiency of regional development management is demonstrated.

In the next chapter titled "Informational and Digital Business Security in Tourism as a Component of the Coastal Region Competitiveness", the authors proposed to consider the peculiarities of tourist activities in the coastal region in the Smart City concept. The organization of travel agency activities in conditions of the global pandemic is described in detail, which is manifested in changes in the travel company operation (transition to remote service, greater flexibility in changing booking conditions, tours, constant control of conditions for entry and exit from countries, new forms of documents for tourists). The study was conducted using the analysis of digital marketing of travel companies in Zaporizhzhia, Ukraine. Databases for 2020-2021 were used. The authors described directions for considering the specific circumstances of recent years in Ukraine, when the number of electronic documents for entering other countries had increased.

Further chapter "Economic Assessment of Outsourcing of Intellectual and Information Technologies" demonstrates how to form databases that will increase the efficiency of outsourcing in IT companies. Methodological approaches used in Ukraine to analyze the effectiveness of outsourcing in IT companies are analyzed. To modernize such approaches, a new graphic-analytical method was developed, which is to provide a graphical comparative analysis and analytical justification of the effectiveness of decisions on IT outsourcing and implementation of IT functions by the company's forces. This method utilizes a comparison of the economic efficiency of internal and external outsourcing for IT companies. Application of the developed method at many enterprises in an industrial district of the city of Kharkiv, Ukraine, demonstrated its high efficiency. The results of the chapter open up new opportunities for application of databases and information communication technologies for outsourcing development in the field of information technologies in developing countries.

In the next chapter "Digitalization of Consumers' Behavior Model in the Dairy Market," the authors delve into the impact of rapidly changing digital economy on consumer behavior in the dairy market. Recognizing challenges such as elastic demand and diverse pricing approaches, the study aims to devise a consumer behavior model using digital tools. Based on a survey of 450 consumers in Ukraine, findings reveal that taste quality and product naturalness are primary considerations. The study evaluates brand strength using Fichbein's model, highlighting key factors influencing consumer choices. Noteworthy findings include popular places for purchasing dairy products, with supermarkets being predominant. The conclusion stresses the need for leading brands to defend their positions by enhancing competitive advantages and

fostering consumer loyalty in the evolving digital landscape of the dairy market. This investigation provides valuable insights for producers navigating the complexities of digital consumer behavior in the dairy industry.

In the next study in "Modelling and Information Support for Assessing the Potential for Increasing the Financial Stability of Enterprises" the authors analyze the potential for increasing the financial stability of an enterprise. The potential for increasing the financial stability of an enterprise characterizes its ability to change the internal environment due to the implementation of relevant organizational, economic, and technological actions, as a result of which an increase in the level of financial stability of the enterprise will be ensured. To carry out an analysis of increasing the financial stability of the enterprise, it is necessary to evaluate the following factors: 1) a potential for increasing the amount of available income that the enterprise can use to repay loans and pay interest, 2) a potential for reducing the amount of loan capital, and 3) a potential for increasing the degree of flexibility of the enterprise. Databases were identified, based on which the potential for increasing the financial stability of the enterprise is assessed and relationships between them are specified. The model was tested on a sample of one hundred enterprises in the western region of Ukraine. Based on the results of the analysis of these enterprises, it was established that the availability of operational databases is crucial for the effective assessment of conditions for increasing the financial stability of the enterprise. An additional value of this study is that it opens up new opportunities for decision-making in regarding the financing of innovative enterprises in developing countries.

The chapter "Transformation of a Regional IT Cluster into a Cross-Border IT Cluster as a Direction of It Business Development Under the Conditions of Negative Influence of External Factors" analyses of the problem of transforming the regional IT cluster (IT cluster Lviv, Ukraine) into the Ukraine-Poland cross-border IT cluster, taking into account the negative impact of external factors. The possible results of integration of the Lviv IT cluster into the EU environment and creation of a cross-border cluster association with the ICT Polska Centralna Klaster are analyzed. The results indicate prospects of creating the cross-border cluster and confirm the possibility of obtaining a positive synergistic effect. Within the framework of the illustrative model, the stability of functioning of combined structures was investigated to determine the level of the synergy effect in the formation of cross-border clusters. The computer simulation of the model showed that the processes of cross-border cluster functioning are very complex and require constant adjustment to maintain it on a stable development trajectory.

In the study titled "Formation of Organizational Change Management Strategies Based on Fuzzy Set Methods", the authors use a method of fuzzy sets to define and justify change management strategies considering the degree of development and financial status of an organization at any moment in time. The model takes into account the factors that influence the company's strategy, and an equation is proposed for identifying the influence of target indicators of the construction enterprise development on the effectiveness of the changes. The method of adjustment, which takes into account the level of financial and market stability of the enterprise and its ability to change, was also studied. This study offers only one vector that

allows to structure and formalize the change management process in the direction of forming, justifying, and supporting the company's strategy. It was found that the following enterprise factors influence the change management process: "flexibility of the management system", "competitiveness", "operational efficiency", and "adaptability". Modeling was carried out based on data from a sample of construction enterprises in Ukraine during 2007-2020. The proposed approach can be used to analyze change management strategies of companies operating in turbulent economic conditions and instability of the country's legal field.

In the subsequent chapter "Modeling the Level of Implementation of BIM by Enterprises as a Means of Optimizing the Cost" the authors argue that today's construction companies need to get additional competitive advantages, which can become new methods of processing databases and information modeling, such as building information modeling (BIM). In Ukraine, BIM must take into account the high level of uncertainty during project implementation. Therefore, to determine the expediency of BIM implementation by subcontractors, the authors proposed a new method of using simulation modeling technology, which takes into account the main barriers to the implementation of BIM models in practical activities in Ukraine. In addition to the imperfection of national standards or their absence, there is a lack of both demand from customers and own experience in using these technologies. The need for training and its high cost, the high cost of BIM technologies, and the small size of projects are also a barrier. It is proposed to base the calculations on a criteria of profitability of the capital invested in the construction project - ROI (Return On Investment), the assessment of changes which as a result of the implementation of BIM is provided using simulation modeling. It is emphasized that the simulation model should use Markov chains at a certain stage of calculations.

In the forthcoming chapter, "Digital Promotion as Innovative Business Management Technologies of Retail Chains", the authors explore the pivotal role of comprehensive marketing knowledge in the competitive landscape of the Romanian retail market. Focused on grocery and consumer goods, the study aims to develop and evaluate a digital promotion complex using platforms like Facebook, Google, and Instagram. By analyzing statistical information on internet usage, the authors propose tailored strategies to engage a wider audience, enhance customer loyalty, and attract new customers. Discussions and conclusions highlight the effectiveness of digital promotion in increasing brand awareness and fostering a loyal customer base. The study emphasizes the importance of strategic and integrated approaches, considering the specifics of the Romanian market, internet users, and communication channels. Evaluation metrics include conversion rates, ROAS, CPA, CPC, CPM, and CTR. Overall, the study reveals that a well-structured digital promotional strategy is profitable and efficient for retail companies in Romania, providing valuable insights for businesses aiming to navigate and thrive in the dynamic Romanian market.

In the chapter "Support for the Development of Educational Programs with Graph Database Technology", the authors tackle challenges in higher education by advocating for modern approaches to align educational programs with standards. Proposing the use of graph database technology, specifically Neo4j, the authors detail its application in modeling connections between educational components and

competencies. Discussions highlight the significance of well-organized educational programs and the flexibility of the developed database, allowing users to make informed decisions for program improvement. Despite acknowledging limitations like the need for user knowledge in query languages, the authors emphasize the broad applications of graph database technology in educational digitization. The article encourages further research, suggesting potential directions such as knowledge graph modeling and text mining for competency compliance. Additionally, the integration of the developed graph database with text processing systems and program formation support systems is identified as a key area for future exploration.

The study "Information Technology for Identifying Hate Speech in Online Communication Based on Machine Learning" presents a robust approach to combat hate speech using machine learning. It covers data collection, preprocessing, labeling, and the evaluation of various classifiers like KNN, Naive Bayes, Decision Tree, Logistic Regression, and Random Forest based on accuracy and ROC AUC metrics. The conclusions highlight the system's effectiveness, with Logistic Regression and Random Forest as standout classifiers. The article emphasizes practical applications, including enhancing online safety, aiding content moderation, supporting human rights policies, promoting digital well-being, and raising awareness through education. It underscores the novelty and practical value in understanding hate speech dynamics and suggests future research areas such as advanced machine learning models, multilingual hate speech detection, contextual analysis, real-time streaming data processing, user feedback integration, transfer learning, ethical considerations, and multimodal approaches to enhance accuracy and ethical considerations in hate speech detection systems.

In the chapter "Method for Counting Animals in Motion for the Milking Plant Information Systems", the authors provided basic information about radio frequency identification (RFID) systems. Systems of radio frequency identification of animals are widely used on modern dairy farms as part of information systems designed to determine parameters of the technological process of milk production. The basic operation principle for such information systems is described in detail. An important factor for obtaining reliable information about the parameters of the technological process of milk production in the information systems of group milking facilities is the accurate accounting of animals during their movement to stalls. The method proposed by the authors increases the reliability of animal passage identification in comparison with existing methods. This ensures an increase in the accuracy of animal counting. The authors took into account the impact of errors in radio frequency identification of animals on obtaining information about milking parameters when using information systems of group milking units. As a result of the conducted experiments, detection of unidentified animals at group milking facilities increased from 60–70% to 80–90%.

In the last chapter "Cryptocurrency as a Tool for Attracting Investment and Ensuring the Strategic Development of the Bioenergy Potential of Processing Enterprises in Ukraine", a profound investigation unfolds into the prospects and challenges of employing cryptocurrencies within the agricultural sector, particularly in processing enterprises. Cryptocurrency has emerged as a financial instrument and as

a transformative innovation in different sectors around the world. Its potential to revolutionize traditional financing mechanisms and stimulate economic growth is under intense investigation. A comprehensive study of the prospects and challenges of using cryptocurrencies in the agricultural sector, particularly in processing enterprises, is performed. The chapter ends with a detailed analysis using regression models and correlation studies, revealing the complex relationships between investment, green tariffs, cryptocurrency production, electricity generation, and computer power in biomineralization. These statistical analyses support the potential benefits and economic impact of incorporating biomine technology into processing enterprises. Finally, this chapter is an invaluable contribution to the discussion on integration of cryptocurrencies into agriculture. It is a beacon of innovative financial mechanisms that unlock the hidden potential of the bioenergy sector within agricultural processing companies and ultimately pave the way for sustainable and technologically advanced economic growth. This chapter is a testimony to the authors' dedication, rigorous research, and innovative insights, providing a compass for traversing the unknown waters of cryptocurrency integration in Ukraine's agricultural landscape.

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

Contents