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Developing Models and Tools for Exploring the Synergies between Energy Transition and the Digital Economy

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Developing models and tools to explore the synergies between energy transition and the digital economy has been an interesting topic, aiming to provide significant contributions to the domains of technological innovation, economic development, sustainability, and global establishment. All efforts from these models and tools can support the advanced and establishing countries by collaborating among all members, researchers, governments, and others.

Our continuing research presented the revolutionary potential of insights derived from data and demonstrated the connection between the digital economy and the search for sustainable energy solutions. The second phase of this ongoing investigation focuses on how the digital economy might catalyze beneficial changes in the energy sector. These computerized tools are crucial for improving the efficiency of renewable energy production, anticipating energy demand accurately, and optimizing patterns of energy usage. These technologies enable decision-makers in the energy sector to use complex algorithms and data processing to make precise and well-informed decisions. They represent a substantial shift from older, less data-driven techniques.

The following argument highlights how important predictive analytics is for forecasting changes in energy consumption. Data analytics and machine learning models can foresee changes in demand and help energy providers make plans by examining historical data and current patterns. This capacity is essential for guaranteeing the best possible use of

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resources, avoiding waste, and preserving the equilibrium between energy production and consumption. Optimizing energy use is another important area where the digital economy could be helpful. Machine learning algorithms can make recommendations for ways to improve energy efficiency by analyzing usage patterns and user behavior. This contributes to general energy conservation, which is in line with environmental goals, in addition to perhaps saving consumers money.

Numerous studies highlight how ICT-assisted modeling is becoming more and more common in various contexts. These include data modeling (representing and analyzing data structures) and behavior/pattern modeling (understanding and forecasting trends in diverse processes). The phrase refers to the cross-platform accessibility and adaptability of these technologies when referring to web-based and mobile-based applications. The conversation highlights the broad applicability of these technologies and suggests that they are not exclusive to any industry or business. The cross-domain applicability of ICT-assisted modeling is demonstrated by its potential benefits for corporate, government, and public groups.

The concept of a digital twin with rich visualization is introduced as a particularly intriguing application. Creating a virtual representation of a real system or process allows for comprehensive tracking, assessment, and optimization. The paragraph argues that the energy sector's efforts to manage energy more effectively can benefit significantly from the adoption of digital twins. Moreover, the potential advantages of digital twins extend to the healthcare sector, where modeling and digitalization can address challenges in this field.

In addition, the conversation presents the idea of digital platforms that offer rewards for environmentally conscious actions within the energy sector. These platforms can use innovative market mechanisms to encourage actions that contribute to environmental goals. The discussion claims that digital platforms can encourage demand response and energy conservation by offering users incentives to adjust their energy consumption patterns in response to market or environmental signals. The focus on sustainability draws attention to how integrating digital platforms into energy markets might help society and the environment more broadly. Incentives for demand response and energy conservation not only encourage the more economical use of resources but also contribute to global initiatives aimed at lowering carbon footprints and mitigating the effects of climate change.

The 5th International Scientific Conference on Innovations in Digital Economy: SPBPU IDE-2023 has already been held on 12 - 13 October 2023 at Peter the Great St. Petersburg Polytechnic University located at Novorossiyskaya, Saint Petersburg, Russia, with interesting topics such as (i) Economic efficiency and the social consequences of implementing digital innovations, (ii) Regional innovation systems and clusters as drivers of economic growth during the Fourth Industrial Revolution, (iii) Industrial, service and agricultural digitalization, (iv) Responses of the educational system and labor market to digital-driven changes in the economic system, (v) Digital transformation in the government sector, (vi) Digital transformation in the financial sector. This conference is organized by the Graduate School of Industrial Economics (GSIE) of Peter the Great Saint Petersburg Polytechnic University (SPbPU) and the Centre for Sustainable Infrastructure Development (CSID) of Universitas Indonesia (UI). SPBPU IDE-2023 is expected to have a significant impact on the economic, social, and environmental aspects of both regional and national levels.

A thorough examination of this phenomenon was evident in the 21 papers that were presented, which mostly focused on researching important aspects such as support systems, finance structures, and regulatory frameworks that control industry operations. The expected results of these research efforts include increased efficiency in investment

use, enhanced competitiveness of businesses, and a significant shift towards an ecologically conscious approach to industrial activity. Especially in industrial activities, there is a significant impact on the progress in the economic, social, and environmental conditions of regions and the country as a whole in Russia. The discussion is supported by the presentation of 21 papers, which primarily examine the main forms of support, financing, and regulation of industrial activities, identifying problematic aspects of state support for them. Their approaches are expected to result in more efficient investment utilization, enhanced competitiveness of enterprises, and a shift towards an environmentally focused approach in industrial activities.

The 1st paper titled "Risks Analysis of the Implementation of Sustainable Solution for the Oil and Fat Industry Waste Recycling" written by S. Gutman, E. Nochevkina, and V. Brazovskaia. They assess the risk level of the proposed solution implementation, taking into account externalities of the industry in the Rostov Region of the Russian Federation submitted by the stability of centralized power supply, local personnel qualification, climatic peculiarities, and industry state finance support of the region. They proposed a model to assess the external environment risk level via fuzzy logic that also contributes to more qualitative subsequent studies.

The 2nd paper, titled "Model of State Support for Industrial Parks as a Tool for Sustainable Development" was written by N. Mozaleva, M. Ivanova, and G. Kulkaev. The study focuses on government support for industrial parks as tools for sustainable development in Russia and other countries. The study investigates the impact of industrial activities, particularly eco-industrial parks, on the economic, social, and environmental conditions of regions and the entire country. It is proposed to increase the use of indirect state support, creating favorable conditions for private investors. This approach is expected to result in more efficient investment utilization, enhanced competitiveness of enterprises, and a shift towards an environmentally-focused approach in industrial parks.

The 3rd paper, titled "Neural Simulation of Digital Twin of Top Management Motivation Mechanism in Regional Government Agencies" was written by S. Yashin, N. Yashina, E. Koshelev, A. Ivanov, and S. Zakharova. The authors highlighted the issue of neural simulation for the digital twin, considering both non-financial and financial motivations of top management in government agencies, along with the strategic potential of regions. This problem requires a separate in-depth study as an example for the Nizhny Novgorod Region, which has been obtained to show that in 2020 and 2021, the top managers worked better than in the leader region (Moscow). In terms of non-financial motivation, the top managers should be rewarded more in 2021 than in 2020. The strategic potential of the Nizhny Novgorod Region as a whole will be more developed in 2021 than in 2020, which will allow us to assess the region's development prospects positively.

The 4th paper, titled "The Special Aspects of Devising a Methodology for Predicting Economic Indicators in the Context of Situational Response to Digital Transformation," was written by I. Eremina and D. Rodionov. The methods currently used for detecting situational deformations in the time series of economic indicators have a number of major flaws, which encourages further research and development in this field aimed at improving the quality and stability of the regression models in the context of digital transformations. The authors argue that the proposed statistical tools are likely to enhance the quality of the economic forecasts obtained with the use of regression models (from 15%) due to the preliminary processing of source data and determination of the cyclic dominance of the modified series.

The 5th paper, titled "Risk Modeling in The Oil and Gas Industry," written by D. Rodionov, M. Gataullin, I. Smirnova, E. Konnikov, D. Kryzhko, and A. Shmatko, described the

oil and gas industry is a sector that is prone to risks that can have severe consequences for both the environment and the economy. The paper aims to develop an effective mathematical tool for risk modeling in the oil and gas industry. The research proposes a simulation modeling approach that focuses on two key risk parameters: frequency and severity. The authors argue that the proposed algorithm can be practically applied to manage risks effectively in this important sector.

The 6th paper, titled "Integrating Data Mining Techniques for Fraud Detection in Financial Control Processes" written by V.M. Sushkov, P.Y. Leonov, O.S. Nadezhina, and I.Y. Blagova. The study investigated the integration of data mining techniques, specifically the combination of Benford's Law and machine learning algorithms, to create an enhanced framework for fraud detection. The authors argue that a financial audit was conducted on a road construction company, illustrating the application of primary, advanced, and associated Benford's Law tests. This paper underscores the comprehensive understanding that can be achieved through the integration of Benford's Law and other data mining techniques in fraud detection, emphasizing their potential to automate and scale fraud detection efforts in financial control processes.

The 7th paper, titled "Assessment of Impact of Economic Sustainability on Shareholder Return and Economic Profit of BRICS Industrial Companies Following Digital Transformation Strategy" was written by S. Grishunin, E. Burova, and S. Suloeva, investigated the impact of economic sustainability (ES) practices of digitally oriented industrial companies in BRICS (Brazil, Russia, India, China, and South Africa) in various horizons. The novelty is driven by (1) exploring the impact of ESG practices on companies' value at BRICS; (2) considering previously overlooked metrics of TSR and EVA; and (3) applying granular ES metrics instead of aggregated ones. The authors argue that cross-industry analysis showed ESG practices had an additional positive and significant impact on the TSR of firms in the basic materials and technology sectors. However, there was an additional negative and significant impact of ES practices on EVA in consumer cyclical and energy sectors.

The 8th paper, titled "Integral Indicator Assessment of Municipalities Sustainability in the Leningrad Region" by A. Tanina, A. Orel, O. Zaborovskaia, and E. Tanin, presented the application of sustainable development principles that hold particular importance for urbanized territories. Assessing the regional sustainability integral indicator can help alleviate unequal socio-economic development among municipalities. The authors propose the integral indicator as the arithmetic mean of indexes reflecting the sustainable development level of each component (economic, social, environmental). The authors applied this tool to municipalities in the Leningrad Region. The authors suggest that a significant factor in the sustainable development of a territory is the presence of small enterprises, which possess the necessary flexibility for innovation in the social and environmental spheres.

The 9th paper, titled "The Impact of Socio-Economic Factors on the Regional Economic Security Indicator" written by A. Ekaterina, N. Olga, and Z. Olga studied the economic security of the region as one of the most important indicators characterizing the ability of the regional socio-economic system to achieve economic and social interests. The authors developed regression models using statistical data from 85 subjects of the Russian Federation for the period spanning from 2014 to 2021. The most influential factors are the main factors of production (share of the employed population, fixed assets and investments), foreign trade, which characterizes the openness of the region's economy, specializing of the region in the mining industry and the share of the employed population with higher education (human capital). The analysis confirms the possibility of using

analysis and modeling tools in the practical activities of executive authorities to solve problems in the field of monitoring the economic security of the region.

The 10th paper, titled "Prediction of the Road Accidents Severity Level: Case of Saint-Petersburg and Leningrad Oblast" written by A. Skhvediani, M. Rodionova, N. Savchenko, and T. Kudryavtseva, examined the factors influencing the severity of road accidents in St. Petersburg and Leningrad oblast for 2015–2023. In particular, the logit model made for a joint sample on Saint – Petersburg and Leningrad oblast showed that the absence of lighting increases the probability of a serious accident by 19.6%, the presence of a vehicle such as a truck or motorcycle in a traffic accident increases the probability by 10.9%, presence of fog by 17.6%. Usage of the Synthetic Minority Over-sampling Technique (SMOTE) did not lead to a significant increase in the prediction accuracy of the models. This study can be useful for organizing safe traffic in the city and providing recommendations for road users and public officials involved in improving the city's infrastructure.

The 11th paper, titled "Development of State Digital Platforms: A Methodological Toolkit for Analysing the Attainment of Regional Health Care Systems' Target Indicators" written by N. Yashina, O. Kashina, K. Yashin, N. Pronchatova-Rubtsova, and A. Vileyshikova, introduced the digital healthcare platforms has a positive impact on the accessibility of the health care system among the population and increased the efficiency of state control over the health care of the society. The proposed methodology relies on the author's system of indicators. Automated calculation of these indicators enables real-time monitoring of the effectiveness of healthcare systems in selected regions. Additionally, it facilitates the timely implementation of measures to sustain and safeguard public health. The application of the proposed methodological tools makes it possible to rank the territories by the level of values of complex standardized indicators, taking into account financial conditions, resources and markers for achieving target indicators.

The 12th paper, titled "Unicorn Companies —How Does the Country's Environment Drive Its Emergence?" written by A. Ilaltdinova and E. Koroleva, presented that Unicorn companies have developed widely driven by innovative solutions and business models, but the existing research is fragmented and limited mainly by descriptive approaches to examine the rise of these companies. The association between country-specific factors and the emergence of Unicorn companies in specific countries needs to be examined. Cross-sectional linear and logistic regression models are used on the dataset of 100 countries, 51 of which have a minimum of 1 Unicorn, and the rest have not anyone. The authors argue that the entrepreneurial spirit, education, and a favourable legal environment can lead to the appearance of Unicorn in the country. The key characteristics are the development of venture financing and the openness of firms to new technologies in the country. The further development and appearance of more Unicorn companies are ensured by the availability of financing and the development of IT infrastructure.

The 13th paper, titled "Multiparametric Optimization of Complex System Management Scenarios Based on Simulation Models", written by K.N. Pospelov, Z.V. Burlutskaya, A.M. Gintciak, and K.D. Troshchenko, presented the development of a multiparametric optimization module for a digital management decision support tool based on simulation models. It is noted that the optimization of simulation models of complex socio-economic and socio-technical systems involves the generation of multiple scenarios of system development, their calculation and further comparison, which imposes additional requirements on the optimization algorithms used. Based on the analysis of existing approaches to the formation of an optimal set of scenarios, ways to improve the algorithm type using approaches to scenario reduction or the introduction of genetic algorithms for the formation of an optimal set of scenarios are proposed.

The 14th paper, titled “Innovation Management Models in the Energy Sector” written by Y.R. Nurulin, I.V. Skvortsova, and O.A. Konovalova, described Economic development, technological innovation, and policy change as especially prominent factors shaping energy transitions. The proposed approach, in which the energy complex is considered a socio-technical system, can be taken into account when describing the sectoral innovation system in the energy industry. Considering the ongoing trends of digitalization and the advancement of cyber-physical systems, the authors' proposed general principles of homogeneous production systems can be applied in managing projects for the development of subsystems within the energy complex.

The 15th paper, titled “Managing Circularity in Industrial Ecosystems: Introducing the Concept of Circular Maturity and its Application in NLMK Group” written by A. Babkin, E. Shkarupeta, E. Malevskaia-Malevich, E. Pogrebinskaya, and L. Batukova, presented the primary objective of this research endeavor is the conceptualization and operationalization of the 'Circular Maturity' construct within the context of industrial ecosystems. A comprehensive evaluative framework is developed, designed to assess circularity in alignment with thresholds that are environmentally, socially, and economically acceptable, commonly encapsulated as ESG results. Key driver projections, namely circular potential, circular activity, and circular efficiency are formulated for the governance of circularity and the enhancement of circular maturity at the corporate level. The applicability and efficacy of the proposed framework are validated through a case study involving the industrial ecosystem of NLMK Group in Russia.

The 16th paper, titled “Digital Platform for Modeling the Development of Regional Innovation Systems of Russian Federation” written by M.V. Bolsunovskaya, T.Y. Kudryavtseva, I.A. Rudskaya, A.M. Gintciak, D.O. Zhidkov, D.E. Fedyaevskaya, and Z.V. Burlutskaya presented the design of a digital tool for analyzing the impact of scientific and technological progress on socio-economic problems and sustainable development of the region. The result of the work is a prototype for a digital platform of the Russian regional innovation system. This prototype includes implemented functionalities such as a personal account, a module for simulation experiments, and various approaches to data analysis and visualization. The research is carried out as part of a project to develop a digital model of the regional innovation system of the Russian Federation as a driver of sustainable development.

The 17st Paper titled “Heuristic Approach to Planning Complex Multi-Stage Production Systems”, written by K.N. Pospelov, I.V. Vatamaniuk, K.A. Lundaeva, and A.M. Gintciak describes an algorithm for finding a quasi-optimal production plan for complex production systems that involve moving products through a chain of linked processes with varying resource sets. The authors argue that the algorithm can be classified as a greedy algorithm. It is partly based on local optimization and performs well for production with a long cycle and a small number of products. For this reason, the approach is recommended for heavy industry, shipbuilding, aircraft manufacturing and other productions with a long cycle.

The 18th paper titled “Forecast of Stability of the Economy of the Russian Federation with the AI-System “Decision Tree” in a Cognitive Model” written by N. Lomakin, A. Kulachinskaya, V. Tsygankova, E. Kosobokova, O. Minaeva, and V. Trunina, showed the increased use of modern mathematical algorithms based on artificial intelligence determined the relevance of this study, which is important for the purpose of predicting sustainable development the country's economy in general and its banking sector in particular. The authors explain that the scientific novelty of the study is due to the fact that the author's approach is proposed for indicating the crisis state of the economy through the calculation and neural network forecasting by the machine learning model "Random

Forest" of the "Stability Coefficient" of the economy, which is calculated as the quotient of dividing the profit index of the banking system to the GDP growth index.

The 19th paper, titled "Assessment of The Impact of Services and Digitalization Level on The Infrastructure Development in Oil and Gas Regions" written by V. Glukhov, V. Schepinin, Y. Luebeck, I. Babkin, and D. Karimov, described the typology of infrastructure services for oil and gas enterprises through the activation of the service component and digitalization programs in the regions of mineral resourcespecialization of Russia. The authors argue that the establishment of innovative infrastructure facilities is justified through economic modeling. Specifically, they examine the impact of oilfield services and the degree of territorial digitalization on the development of infrastructure facilities in oil and gas regions.

The 20th paper titled "Using Digital Tools in Government Procurement Analysis: Detecting Suspicious Purchases with Control Indicators" written by T. Mokeeva and K. Yurko, presented the results of a study focused on the use of digital technologies in the analysis of government procurement in order to identify suspicious transactions. The authors performed an analysis of procurement data utilizing 140 control indicators. Subsequently, they compiled a classification of risk groups and presented comprehensive characteristics. These characteristics encompass details on the specific control indicators, types of economic activities, customer levels, and types of trades that are characteristic for each risk group. This study confirms that the use of digital technologies and tools in the analysis of government procurement is an effective means of detecting suspicious transactions and improving transparency and efficiency in the procurement process.

The 21th paper, titled "Methodology for Creating a Geographic Information System for Transport Infrastructure Facilities" was written L. Talipova, E. Morozova, D. Pestova, and A. Skhvediani. This study examines the methodology for creating a geographic information system of transport infrastructure objects, encompassing the process from obtaining initial data to storing the data itself. The article defines the classification of objects in the transportation system, the procedure for collecting and processing initial data, as well as the sequence of data processing for transmission to the GIS environment. A study was conducted on the dependence of response time on the current number of elements in a database table with indexed and un-indexed data.

In summary, this compilation of scholarly articles encompasses a wide range of research pursuits, with each one providing significant contributions to the domains of technological innovation, economic development, and sustainability. These papers demonstrate the dynamic intersection of economics, technology, and sustainability, which is exemplified through the examination of subjects such as the application of artificial intelligence for economic stability forecasts, the utilization of digital tools in government procurement analysis, and risk modeling in the oil and gas industry. We anticipate that this edition will provide novel perspectives on our research practices, and we encourage you to participate by submitting your work for evaluation.

We hope that this edition of IJTech conveys some new insights into the way we conduct our research, and We warmly invite you to be a part of this endeavor by submitting your work for consideration.

With warmest regards from the editorial desk,

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