



ESTONIAN
ENTREPRENEURSHIP UNIVERSITY
OF APPLIED SCIENCES



SMART MACHINES
AND SYSTEMS
AT THE SERVICE
OF MANKIND

Abstracts of the
12th Annual Entrepreneurship
and Innovation Conference
(October 10, 2024)

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The 12th Annual Conference on Entrepreneurship and Innovation "Smart Machines and Systems at the Service of Mankind" examines the significant impact of smart machines and systems across various fields. Estonian Entrepreneurship University of Applied Sciences and Ülemiste city organized this conference with the aim of exploring the use of smart machines and systems by examining the challenges, opportunities, and ethical issues related to their integration into different areas of human life and activity.

The conference proceedings examine the transformative impact of intelligent technologies on industry, business management, urban development, education, technological advances, and economic trends in human development. Participants from more than ten countries contribute to the discourse on this topic by offering ideas on how intelligent innovations are transforming industries, improving business processes, promoting sustainable urban development, changing approaches to education, advancing technological capabilities, and influencing economic growth.

Keywords: Smart Machines, Industry 4.0, Artificial Intelligence, Business Management, Smart Cities, Sustainable Development, Education Technology, Technological Advancements, Economic Trends, Human-Smart System Collaboration, Ethical Considerations, Global Perspectives, Innovation, Digital Transformation, Future Workforce.

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CONTENT

Section 1. Smart Innovations and Industry 4.0

YULIIA HORIASHCHENKO, OLEKSANDR HARMASH, ROMAN KUTSYI Innovative and Informational Solutions in the Era of Industry 4.0	6
MARGARITA IŠORAITĖ, VILMA KARDAUSKĖ Internet Things, Green Logistics and Green Marketing Features	7
ZARNIGOR MAMMAT QIZI TAIROVA The Role of Industrialization in Economic Growth: Enhancing Production Efficiency, Innovation, and Job Creation in Modern Societies	8
AXEL SCHAFFLAND, JULIUS SCHÖNING Streamlining the Manufacturing Process of the Mechanical Neural Network: Towards an Efficient Production of the KI-Learning-Tool	9
MOHAMMAD HASAN AHMADILIVANI, EMRE KARATOPUK, MARTEN ROOTS, JAAN RAIK Machine Vision for Automated Collaborative Robot Programming in Manufacturing Industrial Factories	10

Section 2. Artificial Intelligence in Business and Management

MARYNA KOVALOVA, VITALII KOVALOV Artificial Intelligence in Enterprise Management	11
TARMO KOPPEL A Methodological Framework for Redesigning Business Processes with Large Language Models	13
HARSH CHAUHAN, HENRIJS KALKIS Smart Machines and Its Implication on the Future of Work Management.....	14
ARTEM KOLDOVSKIY Transforming Financial Sector Infrastructure through Digitalization: A Comparative Study of Successful Implementations	15
VLADYSLAV LOGOS, VIKTORIYA ONEGINA Artificial Intelligence as the Facilitator of Performance in Working Groups.....	16

Section 3. Smart Cities and Sustainable Development

MAKSUDA BALTABAYEVNA ATANIYAZOVA The Impact of Smart City Development on Uzbekistan's Economy: The Case of Khorezm	17
OLHA PROKOPENKO Optimizing Urban Mobility in Smart Cities: A Comparative Analysis of Traffic Monitoring Systems in Enhancing Eco-Friendly Transportation Flows.....	18

ALLA POLYANSKA, OLEG MYKYTIUK Sustainable Development and Preservation of the Environment in a Smart City: From the Point of View of Consumers	19
IHOR VAKULENKO The Smart Energy Transition: Analyzing Renewable Capacity Growth Factors Across EU Member States	20
ANDREAS PONDORFER, GEORG HOCH, VIKTORIIA SHKOLA The Legacy of the War on Social Capital, Sustainability and Resilience: Evidence from Ukraine ..	22
MICHAEL RAU, JULIUS SCHÖNING, JAN-DAVID LIEBE, JAN-OLIVER KUTZA Requirements for VR Training Environments in Youth Welfare Evaluations	23
 Section 4. Smart Education and Ethical Considerations	
ALLA STAROSTINA, OLENA KANISHCHENKO, NATALIJA CHUPRYNA Ethical Consequences of the Intellectual Systems Usage in the Educational Process at Higher School.....	24
FAIZAN ALI QURESHI Artificial Intelligence for Educators: How Educators in Pakistan Can Adopt Artificial Intelligence Teaching Methods.....	26
DZINTARS JANKOVSKIS, IVETA CIRULE AI-Based Personalization in E-Learning: Defining Performance Indicators and Utilizing Digital Twin Technology for Enhanced User Engagement	27
HALYNA MISHENINA, LIGITA ŠIMANSKIENĖ, ERIKA ŽUPERKIENĖ Artificial Intelligence and the Future of Learning: Preparing T-Shaped Professionals for a Multidisciplinary World	28
OLEKSANDR PYVOVAROV Smart Medical Education Among the Goals of Sustainable Development	29
 Section 5. Smart Technological Advancements	
VASYL VOLODYMYROV Increasing the Fault Tolerance of Modern Computer Systems through the Use of Modern Polymer-Inorganic Composite Materials with Electronic Conductivity	30
KAMRAN KHAN Levels of Vehicle Autonomy in Pakistan and Need to Develop the Infrastructure for Autonomous Vehicles in Pakistan	31
OLHA SOPOTSKO The Role of Robots and Mechanisms in Collection Orders in Warehouse	32

SVETLANA OSINCEVA, IVETA CIRULE, ANITA STRAUJUMA Smart Technologies in Food Waste Management: A Business and Regulatory Perspective	33
SVETLANA KOCEROVA, HENRIJS KALKIS, ZENIJA ROJA Empowering the Digitalization in Organizations: A Case Study of Comprehensive Toolbox for Transformation in Service Industry	34

Section 6. Smart Economic Impacts and Future Trends

GEORGE ABUSELIDZE, GIA ZOIDZE The Impact of Artificial Intelligence on the Labor Market and Sustainable Economic Development of the State	35
ISTAM KHAITMURADOVICH KARSHIEV Using Econometric Models in Big Data Analysis	37
LIUDMYLA SAHER Inclusive Growth: The Role of Innovation and Economic Stability	38
VIKTORIJA KHMUROVA, VIKTORIJA KOVALENKO The Impact of Digital Transformation and Artificial Intelligence on Businesses	39
KARINA TARANIUK, RENATA KORSAKIENE, ASTRIDA MICEIKIENĖ, LEONID TARANIUK Foreign Investment in the System of Movement Towards Sustainable Development	40

Section 1. Smart Innovations and Industry 4.0

INNOVATIVE AND INFORMATIONAL SOLUTIONS IN THE ERA OF INDUSTRY 4.0

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Objectives:

At a time of powerful militarized influence on the further development of world and national economies, there is an extremely high rate of spread of new ideas and technologies, which are provided by various programs to support the security and defense sectors of countries. An important condition for innovative solutions in modern conditions of development is compliance with the needs of institutions and institutions on security and defense issues of each country, the construction of analytical solutions within the framework of such initiatives as defense governance, resource management, planning based on capabilities, etc.

Data and Methods:

The main research methods are descriptive, observation, analysis and generalization of socio-economic realities. In the direction of theoretical and practical support for the spread of innovations and information solutions in the era of Industry 4.0, a significant number of works by scientists and practitioners are known.

Results:

Many countries of the world, feeling the crisis of capitalism, observe how in the modern conditions of development, innovative enterprises found themselves in a situation of destruction of the entrepreneurial ecosystem, and therefore lost contact with the university environment, bodies of executive, investors and other stakeholders. The free innovation and information chain is disrupted, more and more processes are becoming manageable and predictable. An example of successful modern innovations in science is the change in the nature of scientific discoveries, which consists in the synergy of various sciences, a cross-functional interdisciplinary approach. Innovations in this case arise "at the intersection" of the application of knowledge in the field of informatics, VRR, LM, TQM, TVM, ecotology, controlling, regionalism, change management, benchmarking. Modern innovations in education are represented by open education, innovative methods of distance education and training, which can be more effective than traditional, e-education, Edtech, STEM. In addition, innovation is applied in philanthropy in the form of combining ideas from the field of finance and philosophy and forming an innovative philanthropic strategy for philanthropy; innovations in tourism (virtual reality, augmented reality, gastronomic tourism, e-tourism), innovations in biology, medicine, in the field of health care, innovations in military technologies (C4ISR, space quantum sensors, artificial intelligence, autonomous control, hypersonic systems).

Conclusions:

In order to prevent the problems of bias in making innovative decisions, in today's world of technology and unlimited information, the natural essence of innovation, their coherence with absolutely all spheres of activity, which make innovation a unique phenomenon, should be investigated. In the era of Industry 4.0, it is relevant to study the regularities of development processes, the formation of innovations, change management mechanisms, overcoming resistance to innovations, human adaptation to them, the use and spread of innovative flows, ensuring security guarantees.

Keywords: Innovations, Technologies, Knowledge, Information, Science, Education

INTERNET THINGS, GREEN LOGISTICS AND GREEN MARKETING FEATURES

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Objectives:

This research examines the functions of the Internet of Things, Green Logistics, and Green Marketing. Article analysis Internet of Things, Green logistics in the modern tendency, Green marketing, Internet of Things cases study, Internet of Things statistical data analysis.

Data and Methods:

This research uses the methods of scientific literature analysis, statistical data analysis, and case studies. The method of scientific literature analysis is used to analyse and compare the concepts of the Internet of Things, Green Logistics, and Green Marketing. The statistical analysis method is used in the evaluation of Internet of Things statistical data analysis. The case analysis method is used to analyse cases of use of Internet items in Lithuania.

Results:

The results of the study showed that the Internet of Things technologies, it can be concluded that the Internet of Things uses a very diverse and wide spectrum of technologies, which are chosen depending on the area in which the Internet of Things technology will be developed or used. The technologies used could be divided into two types, technologies that provide communication for data transmission and technologies for production a device that will collect and broadcast information.

Conclusions:

The Internet of Things is driving innovation in the transportation business and human life by providing access to information in new ways. Using the Internet of Things requires a lot of resources and energy. To minimize the possible negative impact of technological development on people and the environment, it is necessary to successfully address such challenges as the increasing use of energy.

Keywords: Internet of Things, Green Logistics, Green Marketing

THE ROLE OF INDUSTRIALIZATION IN ECONOMIC GROWTH: ENHANCING PRODUCTION EFFICIENCY, INNOVATION, AND JOB CREATION IN MODERN SOCIETIES

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Objectives:

This study examines the role of industrialization in economic growth, focusing on how it enhances production efficiency, fosters innovation, and creates job opportunities in modern societies.

Data and Methods:

- **Increased Production Efficiency:** Industrialization introduces modern financial methodologies and solutions, increasing the volume of services produced and accelerating production. This improves per capita efficiency, stabilizes prices, and enhances market competitiveness.
- **Technological Advancements:** Industrialization drives technological breakthroughs, fostering innovation, product development, scientific research, and new production methods. The development of new technologies requires skilled labor, contributing to economic growth, increasing wages, reducing costs, and boosting revenue for national exporters.
- **Job Creation:** Industrialization promotes development, leading to the emergence of manufacturers and supporting industries. This creates new, well-paying jobs and additional employment opportunities within traditional industrial sectors.
- **Positive Cyclical Processes:** Industrialization enhances demand and supply within production and energy sectors, creating a favorable environment for achieving economic goals. This improves market relations and creates opportunities for supplying skilled labor to meet future demand, ensuring long-term, stable growth and attracting new investments.

Results:

Industrialization significantly contributes to economic development by promoting large-scale production, enabling goods to be produced more quickly and at lower costs. This increase in supply leads to lower prices, driving demand and consumption. It also stimulates innovation and technological progress, improving production methods and competitiveness, and fostering the creation of new industries, products, and services. Additionally, industrialization creates new opportunities for investment and business, particularly in developing countries, generating more skilled jobs, offering higher wages, and improving living standards.

Conclusions:

Industrialization plays a crucial role in economic development by increasing the capacity for goods and services production, generating income, and enhancing a state's potential. It serves as a key driver of economic growth by improving production efficiency, fostering technological advancements, and creating new opportunities for investment and employment. Ultimately, industrialization aims to improve the standard of living by increasing the availability of goods and services and creating new economic opportunities.

Keywords: Industrialization, Economic Growth, Production Efficiency, Technological Advancements, Innovation, Job Creation, Economic Development

STREAMLINING THE MANUFACTURING PROCESS OF THE MECHANICAL NEURAL NETWORK: TOWARDS AN EFFICIENT PRODUCTION OF THE KI-LEARNING-TOOL

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Objectives:

The Mechanical Neural Network (MNN) is a physical KI teaching tool explaining how artificial neural networks function [1]. The MNN is a multilayer perceptron (MLP) with two input neurons, two hidden neurons, and one output neuron and uses Rectified Linear Units (ReLUs) as activation functions. Neurons are represented as rotating levers which are connected by strings. Clamps which can be linearly adjusted on the levers represent the weights while pulley systems compute the activation together with rotation limiters compute the activation of the neurons. The MNN can model logical operators as well as classification tasks based on two features. While the first version of the MNN was produced entirely from computer numerical control (CNC) machined wood, that manufacturing process is time consuming and costly. Here we present how additive manufacturing can be used to both reduce costs and production time while simultaneously enhancing the efficiency of the MNN as teaching tool by introducing color coded parts, scales, better overall handling and indexed input neuron and weight adjustments.

Data and Methods:

This latest version of the MNN is produced via fused filament fabrication (FFF). Parts are printed with colored filament to indicate which parts belong to which neuron. Together with multicolored strings this color coding makes it easy to discriminate neurons, layers, and information flow in the network. For example, the neurons of the hidden layer are colored in light and dark green, indicating that the green neurons belong to the hidden layer, the weight clamps and the deflection pulleys of these neurons have the same color, meaning that the weights in the first layer can be easily attributed to these neurons in the hidden layer. With additive manufacturing, tolerances are also tighter and more complex parts can be manufactured compared to CNC machined wooden parts, meaning that the neurons and weights can be operated easier. Moreover, ball plungers are used to provide index functionality both for the input neurons as well as for the weights.

Results:

Previous experiments show that the MNN performs better on objective and subjective scales compared to a teacher-centered lecture [1]. Exhibitions at museums and conferences show that the colored 3D printed version of the MNN helps in communicating clearly how information travels from neuron to neuron through the network.

Conclusions:

In summary the new manufacturing process of the MNN makes it feasible to produce cost efficient assembly sets which can be put together by the end user while simultaneously provide better interaction with the model as well as better communication about the MNN.

References:

[1] A. Schaffland, C. Müller, and J. Schöning, "Promoting the Digital Transformation of STEM Education with the Mechanical Neural Network, a Physical Model for Future-Oriented and Student-Centered AI Education," in 2024 IEEE Global Engineering Education Conference (EDUCON), Greece, 2024, pp. 1–10.

Keywords: Artificial Intelligence, Education, Physical Neural Network, Educational Game, Mechanical Computation

MACHINE VISION FOR AUTOMATED COLLABORATIVE ROBOT PROGRAMMING IN MANUFACTURING INDUSTRIAL FACTORIES

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Objectives:

The purpose of this research is to enable manufacturing industries to increase their production ratio and quality by exploiting Artificial Intelligence (AI). AI is penetrating into various industrial solutions enabling systems automation for smart machines to improve the quantity and quality of production. Collaborative robots (cobots) are extensively employed in manufacturing factories to accelerate their production. Nonetheless, programming a cobot to perform an accurate and safe operation is a time-consuming and delicate process which requires trained engineers, and its operations should be carried out with the supervision of a human. This leads to a high cost for factories, and it is an obstacle to increasing their production ratio and revenue.

Data and Methods:

To minimize the role of a human in programming the cobots and increase the operation's accuracy, we develop a computer vision-based solution for cobots to automatically program them in a short time. Our AI-powered solution is facilitated by a camera and an embedded computer connected to a cobot and developed for a CNC milling machine in a factory. The AI algorithm, which is developed based on OpenCV and is facilitated by automatic eye-to-hand robot calibration, detects the 6D poses and measures the dimensions of objects on a table with high accuracy using a stereo camera. We developed multiple algorithms for object detection and measurement using AI markers including image thresholding, pose estimation, Hough line transform, etc.

Aided by eye-to-hand calibration, the 6D objects poses from the camera's reference frame are transformed to the cobot base using linear algebra. We developed a set of libraries and APIs in python that can synthesize all information into low-level URScript instructions to be executed by the cobot. Therefore, we can generate a program for the cobot to operate on each piece. Throughout the process, the machine vision system supervises and validates the progress of the operations to ensure its safety.

Results:

At the beginning of the operation, it requires a human to validate the operation for a single process and then, the system can continue the whole operation without a supervisor. The process of automated cobot programming results in a significant time reduction in setup time, from 2 hours to 5 minutes. Our results indicate that the object poses are identified with 1 millimeter translation error and 0.5 rotation degree error. The presented solution is tested in both laboratory and the factory environment and is ready to be exploited in more use-cases.

Conclusions:

In this work, we present an innovative method for increasing the production of industrial factories through machine vision that can be integrated into cobots and be fine-tuned for various working environments. This solution enables companies to remarkably increase their production and decrease their costs.

Keywords: AI, Computer Vision, Collaborative Robot, Manufacturing Industries

Section 2. Artificial Intelligence in Business and Management

ARTIFICIAL INTELLIGENCE IN ENTERPRISE MANAGEMENT

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Objectives:

The use of artificial intelligence (AI) in enterprise management opens up even greater opportunities for increasing its efficiency and competitiveness.

Data and Methods:

Development of strategic measures may include:

- Data analysis and demand forecasting: AI can analyze large volumes of data about the demand for goods and services, allowing businesses to predict market trends, optimize inventory, and adapt pricing strategies.
- Analysis of the competitive environment: AI can help implement a more in-depth and objective analysis of competition in the market. It can scan and analyze information about competitors, their strategies, prices, and offers to help businesses make better strategic decisions.
- Personalized approach to customers: AI helps develop personalized offers for customers based on their previous purchases, preferences, and behavior. This helps improve customer relations and increase loyalty.
- Automation of business processes: AI can automate many routine operations, allowing retail staff to focus on strategic tasks and interaction with customers.
- Optimization of the supply chain and warehouse accounting: AI allows you to automate and optimize the management of the supply chain, reducing the time and costs of planning, forecasting, and solving problems, optimizing inventory management, delivery routes, and forecasting the need for inventory in the warehouse, which allows you to use resources efficiently and reduce costs.
- Risk management: AI can detect potential risks for a trading company, such as legislative changes, economic crises, and predict their possible consequences. This allows enterprises to develop strategies for reducing risks and increasing resistance to negative impacts.
- Innovation: AI can catalyze innovation in the retail sector by helping to introduce new technologies and approaches. New opportunities are opening up for the development of products and services that meet the changing needs of the market.

Results:

The use of artificial intelligence in the management of trading enterprises can speed up processes, increase efficiency, and help develop strategies that meet the needs of today's market. However, it is important to consider ethical aspects and ensure control over the use of AI to avoid possible risks and negative consequences.

Conclusions:

The integration of AI in enterprise management can significantly enhance operational efficiency and strategic planning. By leveraging AI for data analysis, competitive analysis, customer personalization, process automation, supply chain optimization, risk management, and innovation, businesses can

better navigate the complexities of the modern market. Nonetheless, ethical considerations and oversight are crucial to mitigate potential risks and negative impacts.

Keywords: Artificial Intelligence, Enterprise Management, Data Analysis, Demand Forecasting, Competitive Analysis, Personalized Customer Approach, Business Process Automation, Supply Chain Optimization, Risk Management, Innovation

A METHODOLOGICAL FRAMEWORK FOR REDESIGNING BUSINESS PROCESSES WITH LARGE LANGUAGE MODELS

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Objectives:

This study explores the integration of Large Language Models (LLMs) with Business Process Management (BPM) phases and proposes a scoring system to evaluate the suitability of business processes for LLM-based automation. LLMs have the potential to streamline business operations by automating tasks and enhancing data analysis, making their integration into BPM highly relevant for companies pursuing digital transformation and process optimization.

LLM integrated Business process lifecycle

The integration of Large Language Models (LLMs) into the Business Process Management (BPM) lifecycle offers significant enhancements across all phases.

1. In the Design and analysis phase, LLMs can automate survey creation, assist in modeling, generate comprehensive documentation, and run simulations to validate business process models. This updates the creation and refinement of models, improving stakeholder communication and process optimization.
2. During the Configuration phase, LLMs can aid in automating documentation, providing real-time support, assisting in system configuration, and enhancing training processes. They can simulate user interactions during testing, helping to identify potential issues before deployment.
3. In the Enactment phase, LLMs can monitor and control business process execution in real time, analyze logs, and offer insights to ensure processes adhere to the defined models.
4. In the Evaluation phase, LLMs can analyze execution logs, identify inefficiencies, and generate detailed reports. They can also simulate potential changes, aiding in the continuous improvement of business processes.

Determinants of automation

When considering LLM automation of business processes, several key determinants must be evaluated. The type of process is crucial, as organizational processes are high-level and often textually defined, while operational processes are more detailed and model-based. The degree of automation also matters, with some processes being fully automated and others requiring human intervention. The degree of repetition is important, as highly repetitive processes benefit most from automation. Lastly, the degree of structuring plays a role; structured processes have predefined execution paths, while less structured ones may require flexibility and human decision-making.

Conclusions:

LLMs enhance efficiency, accuracy, and decision-making throughout the BPM lifecycle, making them valuable tools for modern businesses. Evaluating the type of process, degree of automation, repetition, and structuring is crucial for determining the suitability for LLM-based automation.

Keywords: Large Language Models, Business Process Management, Automation, Process Optimization, Decision-Making

SMART MACHINES AND ITS IMPLICATION ON THE FUTURE OF WORK MANAGEMENT

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Objectives:

The research highlights the significance of smart machines on work management systems. Ever increasing demand in future and surge in high living standards has produced many opportunities and challenges. Traditional manufacturing are pushed to its limits. More and more technological innovations and its main stream applications have increased the productivity. In the past few decades traditional work management is replaced by dynamic smart machines. Current mechanical systems are more technologically advanced and constantly evolved themselves to become smart and independent systems.

Data and Methods:

The research is a compilation of numerous scientific studies. To address the implications on the future of work management previous academic literatures along with recognized databases have been systematically evaluated. The sources used in research are thoroughly examined. The literature review comprises of theoretical analysis and assessment of empirical as well as conceptual papers.

Results:

Smart machines are integral part of human lives. Smart machines are able to transform and respond as per the requirement of surroundings makes them a true human companion. They are capable of understanding the requirements of operations and equipped with self automated mechanism. The level of efficiency and effectiveness are at par in comparison to human capabilities. Artificial intelligence, augmented reality have the artistry to transform the future. Latest smart machines can break through the barriers between command and execution. Technologically advanced manufacturing systems have the potential to outperform individual efficacies.

Conclusion:

Smart machines and the future of work management is no longer a futuristic idea. The imagination of self automated systems couple of decades ago are realistic achievable. IOT, the integration of various business applications associated with process, people, products and systems linked with the series of communication for review and constant feed backs in the network of support systems for processing, collecting and transmit online information has ensured long term sustainability in modern manufacturing systems. Robotic engineering revolutionized the concept of smart factories, often known as CPS (Cyber physical systems) are aided with computer technologies replacing humans where business environment is not conducive for working. 3D printers known for using single material, ensuring strength and durability, accuracy of dimensions with wide variety of printing options. Digital twin technology generated to create digital copy of physical objects, saving time, equipped with automatic and autonomous programming used in the production related to aerospace, air-crafts, renewable energy and healthcare. Autonomous vehicles fully operational and unattended by humans used in transportation, categorically comes under drones, air taxis, shuttle and tubes reduces human errors and costs, efficient usage of fuel and electricity.

Keywords: Smart machines, Work management, Technology, Systems, Manufacturing, Human.

TRANSFORMING FINANCIAL SECTOR INFRASTRUCTURE THROUGH DIGITALIZATION: A COMPARATIVE STUDY OF SUCCESSFUL IMPLEMENTATIONS

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Objectives:

The purpose of this research is to assess the influence of digitalization to the processes of change in infrastructure within the financial industry. The research focuses on the analysis of different successful cases of digital technologies application in financial institutions to identify themes in operational effectiveness, security, and customer satisfaction improvements due to digitalization. The objective is to find the positive experience and the problems of the digital transformation of the financial infrastructure.

Data and Methods:

The research employs a comparative analysis of digitalization initiatives in the financial sector across six countries: target countries such as United States, United Kingdom, Germany, Japan, Singapore and Brazil among others. The measures adopted in the study are quantitative, embrace official reports and statistical organizations, performance indicators, investment amounts, and technologies. The information relates to the analysis of industry reports, the records of financial regulations, and the material that reflects the experience of various financial institutions. Hypothesis testing methodologies are then used to determine the significance of technology innovation on certain performance measures such as the rate of transactions, ratio of detected frauds, and customer satisfaction.

Results:

Accordingly, analyzing the results it is stated that resourcing of the infrastructure leads to its higher efficiency and security in the sphere of the financial sector. It has been established that organizations that have implemented the high-level digital technologies like blockchain, AI in analytics, cloud solutions, have increased transaction velocities and decreased costs besides better capacities in fraud detection. For instance, the adoption of blockchains in the United States of America and in the United Kingdom of Great Britain and Northern Ireland has saved forty percent in transactions' processing time and has reduced by a quarter the number of fraud cases. The same advantages are found in other countries with a slight difference depending on the existing regulations and TRC.

Conclusions:

The study suggests that digitalization is an important facilitator of infrastructure change in the financial industry bring significant advantages in the twin regards of cost and security and the customer. The study establishes that it crucial to implement best practices where applicable or meet the challenges that hinder the achievement of the best outcomes in the use of digital technologies. The findings herein are beneficial for financial institutions to design effective strategies for digital transformation and to accurately understand how technology can be used for competitive benefit.

Keywords: Financial Sector, Infrastructure Transformation, Digitalization, Blockchain, AI, Cloud Computing

ARTIFICIAL INTELLIGENCE AS THE FACILITATOR OF PERFORMANCE IN WORKING GROUPS

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Objectives:

This research is based on the analysis of innovative and insightful studies on the implementation of artificial intelligence in businesses and social organizations. By critically reviewing the key research advances, this study aims to close the gap between the rapidly evolving technological advancements (i.e., machine learning-based tools, generative AI, LLM models, etc.) and their applicability to the day-to-day operation of companies. The objective of this study is to provide a scholarly exploration of how organizations may implement the cutting-edge AI-based technological advancements to enhance their performance, productivity, and efficiency.

Data and Methods:

The research draws on a comprehensive analysis of the key research advances and, specifically, a critical review of described and suggested practical implementations of the generative AI models and customized AI-based tools in organizations with the goal of advancing the performance, productivity, and efficiency of the working groups. This critical review encompasses a substantial quantity of peer-reviewed research articles from reputable scientific journals (i.e., Q1/Q2) in the United States, Europe, and worldwide, published in the last 10 years. Given the cross-disciplinary nature of the topic of performance in groups, our review encompassed the cutting-edge studies from industrial-organizational psychology, social psychology, performance science, management, economics, artificial intelligence, data science, and other domains.

Results:

Despite the discussed risks that artificial intelligence technology might have a negative impact on the cognitive capacities of our brains and will take our jobs, our study proves that AI-based tools can substantially augment the teams' performance, measured in their productivity and efficiency, thus increase the quality of life of the employees and allow them to focus on more creative, human-driven tasks. By employing machine learning-based tools, generative AI, LLM models, and similar technological advances, teams in organizations can benefit from the following: automatization of the routine daily tasks (emailing and communication, analysis of data and market trends, accounting and taxes), idea generation and innovative conceptualization, coordination of groups and meetings, product and services optimization, human resource and recruitment responsibilities, advancement of the sales and marketing strategies, and many more.

Conclusions:

The study finds that artificial intelligence-based technologies can substantially enhance the performance, productivity, and efficiency of working groups in organizations, mainly by assisting them in dealing with routine, shallow, and repetitive tasks, yet further allowing them to improve the processes connected to innovation, creativity, and research and development. These findings add arguments into the discourse on the impact of artificial intelligence on work life and the interconnection between technological advances and the future of the economy.

Keywords: Artificial Intelligence, Performance, Productivity, Efficiency, Group Performance, Working Group

Section 3. Smart Cities and Sustainable Development

THE IMPACT OF SMART CITY DEVELOPMENT ON UZBEKISTAN'S ECONOMY: THE CASE OF KHOREZM

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Objectives:

The objective of this study is to explore how the development of smart cities, specifically Khorezm, can influence Uzbekistan's economy. This includes examining the potential benefits such as improved resource management, innovation stimulation, investment attraction, quality of life enhancement, environmental sustainability, and digitalization.

Data and Methods:

This study utilizes a combination of qualitative and quantitative data sources, including government reports, academic articles, and case studies. Methods include data analysis, comparative studies, and expert interviews to assess the impact of smart city initiatives in Khorezm.

Results:

1. **Increased Resource Management Efficiency:**Implementation of smart systems in Khorezm has led to significant cost reductions in energy and water management through the use of smart meters and sensors.
2. **Stimulating Innovation and Job Creation:**The development of Khorezm as a smart city has fostered the growth of startups and small businesses in IT, AI, and IoT sectors, creating new job opportunities.
3. **Attracting Investments and Infrastructure Development:**Khorezm has become an attractive destination for both local and foreign investors, leading to the construction of advanced infrastructure projects.
4. **Improving Quality of Life and Social Stability:**Smart technologies in healthcare, education, and public safety have improved access to services and enhanced social stability in Khorezm.
5. **Environmental Sustainability and Resource Conservation:**Adoption of eco-friendly technologies has reduced greenhouse gas emissions and improved environmental conditions, benefiting agriculture and tourism.
6. **Digitalization and the Growth of E-Commerce:**The rise of e-commerce and digital services in Khorezm has facilitated market access for local businesses, contributing to economic growth.

Conclusions:

The development of Khorezm as a smart city has the potential to drive significant economic growth in Uzbekistan. Key benefits include improved infrastructure, job creation, investment attraction, and enhanced quality of life. Achieving these outcomes requires active government support, private sector collaboration, and human capital development. A comprehensive approach is essential to fully realize the potential of smart cities in Uzbekistan's economy.

Keywords: Smart Economy, Smart City, Innovation, Infrastructure, Startups, Artificial Intelligence, Internet of Things (Iot).

OPTIMIZING URBAN MOBILITY IN SMART CITIES: A COMPARATIVE ANALYSIS OF TRAFFIC MONITORING SYSTEMS IN ENHANCING ECO-FRIENDLY TRANSPORTATION FLOWS

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Objectives:

This research aims to assess the efficiency of different smart traffic monitor systems in the smart cities of the global world. Focusing on the application of the mentioned systems in vehicle, bicycle, and pedestrian movement monitoring, the research investigates how data-driven technologies enable the management of urban mobility flows and sustainability trends (greening). The objective is to draw attention to the existing effective practices as well as the technical solutions that can improve traffic conditions and minimize the adverse effects on the environment.

Data and Methods:

The research employs a comparative analysis of smart traffic monitoring systems implemented in five smart cities - Tokyo, Singapore, Copenhagen, Amsterdam and Toronto. Data is collected from advanced communication devices, Internet of Things devices and smart cameras to read traffic congestion, its densities and pollution. Analytical methods are applied to compare trends between the above-mentioned variables as well as the success of urban mobility management. The research data comes from quantitative data generated through traffic flow analysis and statistical reports from authoritative bodies. This information is employed to evaluate smart traffic monitoring systems and their suitability when it comes to increasing the efficiency of traffic flow in cities as well as encouraging environmentally friendly means of transport.

Results:

The study proves that the smart traffic monitoring system enhances traffic flow and reduces congestion, especially in crowded urban centers. Incorporating artificial intelligence and Internet of Things technologies in urban mobility systems shows reduced carbon emissions in the areas and increased usage of environmentally friendly transport facilities such as bikes and electric cars. For instance, Copenhagen incorporated the use of artificial intelligence in controlling bike lanes, thus increasing bicycle flow during rush hour by twenty-five percent while at the same time decreasing carbon footprint by fifteen percent. The same trends can be considered in other examples of smart cities; their effectiveness may differ depending on the legislation and implementation possibilities.

Conclusions:

The study finds that systematic smart traffic monitoring systems are an essential tool for increasing the effectiveness of transport movements and promoting sustainable transport technologies. Such systems also do not contribute to traffic jams and pollution, which is also an essential element in supporting initiatives for subsequent urban development planning. This research is based on the existing literature about the application of smart city technology to enhance sustainability and eco-friendly city development.

Keywords: Smart Cities, Urban Mobility, Traffic Monitoring, Artificial Intelligence, Internet Of Things, Sustainable Transportation, Greening Urban Flows

SUSTAINABLE DEVELOPMENT AND PRESERVATION OF THE ENVIRONMENT IN A SMART CITY: FROM THE POINT OF VIEW OF CONSUMERS

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Objectives:

This study aims to explore how smart machines and systems can optimize the use of resources, reduce emissions, and enhance energy efficiency in urban space. The main objective is to evaluate urban agglomeration impact on environmental consumption and conservation while also addressing the challenges of implementing smart technologies to resolve possible ecological consequences on a large scale, as well as to find solutions how deploy the results of investigation especially in the conditions of after war recovery in Ukraine.

Data and Methods:

The research is based on the analysis of both qualitative and quantitative data from various case studies, scientific literature and reports on the deployment of smart machines in urban infrastructure. Quantitative data will be supplemented with qualitative data obtained from the results of a survey of respondents regarding their vision of the relevance of smart technologies in improving the quality of the residential real estate market offer. The study covers the comparison of traditional, ecological and smart attributes of residential real estate and examines the potential of using smart technologies to address the goals of sustainable development on the frugal use of energy and other resources in smart cities.

Results:

Comparing the research results with the best practices in the development of smart cities will form a repository of knowledge and experience that will become the basis for finding solutions to improve sustainable living in cities with the help of smart technologies and machines. It provides a rationale for the conclusion that smart machines have significant potential to improve waste management, energy efficiency of buildings and reduce carbon emissions. Conducting research on the readiness and motivation of consumers to use smart technologies, in particular, residential real estate, is important for developers to understand demand and consider the needs of consumers when forming a high-quality and smart offer. It is also important to identify consumer groups that are committed to smart change and can be agents of change in consumer behaviour.

Conclusions:

Study highlights the significant potential of smart machines and systems in contributing to sustainable development and environmental conservation in urban areas. By leveraging smart technologies, smart cities can greatly reduce energy consumption, minimize waste, and lower greenhouse gas emissions. The survey results indicate a growing recognition among citizens of the benefits of these technologies. The perspective of our further research is to study the possibilities of increasing the level of environmental awareness of residents and their sustainable behaviour in the use of smart technologies in cities. The findings from this research provide a strong foundation for future policies and practices aimed at achieving sustainable urban development and environmental protection through innovative smart technology applications.

Keywords: Sustainable Development, Efficient Use Of Resources, Green Construction, Smart Buildings, Digitalization, Consumer Behaviour, Smart Technologies

THE SMART ENERGY TRANSITION: ANALYZING RENEWABLE CAPACITY GROWTH FACTORS ACROSS EU MEMBER STATES

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Objectives:

The main objective of this study is to analyze the determinants of renewable energy capacity growth in European Union countries, with a particular focus on the potential role of smart grids. We investigate the influence of socio-economic and environmental factors on clean energy generation. Additionally, the research aims to examine the specific impact of electricity prices on renewable energy generation to reveal the true influence of price on market participants' motivation to increase renewable energy production volumes.

Data and Methods:

This study analyzes panel data from 24 EU countries from 2007-2021, focusing on factors influencing clean energy (renewable and nuclear energy) generation. The dataset combines economic, environmental, and energy-related indicators from the International Energy Agency (IEA), World Bank, and Eurostat databases. We examined nine variables, including the dependent variable, to comprehensively assess potential determinants of clean energy. We refined our focus to four key variables for the final econometric model through statistical analysis and model optimization. Key variables in our analysis include 1) share of alternative and nuclear energy in the energy mix (dependent variable); 2) CO₂ emissions; 3) primary energy consumption per capita; and 4) Human Development Index (HDI). We employ a random-effects model based on the Hausman test results to examine the relationships between these variables. We apply standardization techniques to our independent variables to address potential non-linear relationships and differences in measurement scales. Our methodology incorporates an approach to categorizing countries based on their renewable energy penetration levels (low (<20%), medium (20-40%), high (>40%)), and HDI scores. This categorization allows for a more accurate analysis of how various factors influence clean energy production at different stages of energy transition and development. We conduct several diagnostic tests to ensure robustness, including checks for multicollinearity and heteroscedasticity. Where necessary, we apply corrective measures such as using robust standard errors.

Results:

Our analysis reveals complex relationships between the examined factors and the state and prospects of clean energy development across EU countries. Key findings include: 1) The Human Development Index (HDI) consistently positively influences alternative and nuclear energy share across all studied country groups. 2) CO₂ emissions generally show a negative relationship with clean energy share, but the intensity of this relationship varies across different country groups. This variability indicates that the impact of environmental factors on energy transition may depend on a country's stage of development or existing energy mix. 3) Primary energy consumption per capita exhibits a predominantly negative association with the share of clean energy. However, the strength of this relationship differs among country groups. 4) Analyzing country groups based on renewable energy penetration levels reveals distinct patterns in how these factors influence clean energy at various stages of energy transition. 5) Time-related factors, potentially reflecting technological advancements and policy developments, emerge as significant drivers of clean energy growth across the EU.

Conclusions:

This study emphasizes the need for a more detailed and country-specific approach to EU energy policy, considering each nation's stage of energy transition and development level. Our outcomes underscore the important relation between human development and clean energy, suggesting that policies to improve overall socio-economic conditions can indirectly increase the deployment of clean

energy. The varying impacts of CO₂ emissions and primary energy consumption across different country groups highlight the need for flexible emission reduction and energy efficiency strategies. Furthermore, the observed time-related effects emphasize the importance of consistent, long-term policy frameworks that support technological advancements and market transformations in the clean energy sector.

JEL Classification: Q42, Q48, Q50.

Keywords: Renewable Energy, Energy Transition, European Union, Smart Grids, Energy Policy, Clean Energy, Socio-economic Factors, Environmental Factors



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THE LEGACY OF THE WAR ON SOCIAL CAPITAL, SUSTAINABILITY AND RESILIENCE: EVIDENCE FROM UKRAINE

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Objectives:

This research aims to assess the impact of the Russian full-scale invasion of Ukraine on social capital, sustainability and resilience for the economic, social, and political recovery of Ukraine. The objective is to study the evidence for the impact of the Russian full-scale invasion on social capital (prosocial behaviour and institutional trust), the effect direction, and the causal effect of the war.

Data and Methods:

The paper focuses on the ongoing Russian invasion of Ukraine. It explores the variation in combat and a newly run survey of 3,500 Ukrainian respondents nationwide to document the results on three domains. Using a large online survey of the Ukrainian population, we apply two measures of conflict exposure: geocoded conflict data and self-reported war experience.

Results:

The research showed decreased self-reported prosocial behaviour across many dimensions: trust, altruism, prosociality indices, and positive reciprocity. There is a decrease in trust in various institutions - domestic and international - and some effects are more statistically significant than others. There is no effect on risk, patience, or negative reciprocity. Those results are first reported in an Ordinary Least Square (OLS) regression with a battery of controls. Hence, the causal interpretation is subject to our belief that those controls capture all of the unobserved confounding heterogeneity in conflict. Next, to push in the direction of causality, the authors use two historical instruments to Instrumental Variables (IV) for conflict: the share of ethnic Russians in 1926 and the percentage of the population that died in Holodomor in a given district. The negative coefficients from OLS are confirmed in the IV setting as well.

Conclusions:

First, we find a negative effect of the war on prosocial behaviour (i.e., altruism, positive reciprocity, and trust) and institutional trust. Second, we find a positive interaction between objective conflict data and self-reported war experiences, which points towards the heterogeneous effects of war. Third, we identify the causal impact of conflict by exploiting regional variation in historical ethnic populations and Soviet repression policies. Instrumental variable regressions confirm the adverse effects of the war on social capital. These findings suggest that Ukraine's legacies of violence have persistent effects on the current invasion and its consequences for social capital.

JEL Classification: D74, N10, D90, C36, H56, O52.

Keywords: War, Social Preferences, Institutional Trust, Instrumental Variable Regression, Online Survey, Recovery

REQUIREMENTS FOR VR TRAINING ENVIRONMENTS IN YOUTH WELFARE EVALUATIONS

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Objectives:

Youth endangerment cases have been steadily increasing in the last years. In Germany alone, the number has been increasing 70% from 2013 to 2022. The process of evaluating these cases requires significant care, time and expertise, resources that youth welfare offices often need to ration to cover as many cases as possible.

During the project ‘AId4Children’, we aim to explore whether and how technologies such as AI and VR could be used to train youth welfare personnel and social care students. In doing so, we are providing a safe digital environment for professional development to support the building of expertise and skills through practical experience required for child welfare assessment and evaluation.

Data and Methods:

To do this, we utilize anonymized reports provided by youth welfare offices in Germany to develop our own artificial youth endangerment cases which we intend to simulate in VR environments. In its final form, we aim to employ AI generation to achieve many different simulation environments. These simulation cases will provide a testing and evaluation ground for youth welfare worker’s skills.

Results:

The question to be answered is, which requirements such AI generated simulation cases within a VR environment need to meet to provide acceptable standards of youth endangerment evaluation. In this paper, these requirements will be systematically developed based on social, ethical, and technical aspects, and will be presented in a concise system of evaluation for this and other algorithms of a similar nature.

Conclusions:

Technologies like AI and VR, while powerful, are still fairly new when it comes to applying them to social topics. Within our project, we aim to provide a concept for how both technologies can be applied to child protection services within a training framework. To gauge the success of this endeavor, we first establish the necessary terms of acceptance for this technology.

Keywords: Artificial intelligence (AI), Virtual Reality (VR), Child Protection Services, Training Environments

Section 4. Smart Education and Ethical Considerations

ETHICAL CONSEQUENCES OF THE INTELLECTUAL SYSTEMS USAGE IN THE EDUCATIONAL PROCESS AT HIGHER SCHOOL

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Objectives:

The use of artificial intelligence in various spheres of life, including education, has not yet been fully evaluated and requires additional research on its impact - positive or threatening-negative - on various spheres of life, in particular, on the educational process in higher education.

Data and Methods:

To date, three stages of the educational process transformation can be distinguished:

- pre-computer stage – the learning process was based on repeated reading of text materials, listening to lectures and taking notes of existing systematized knowledge. This involved deep mental perception and analysis of the material;
- the computerization stage - the use of various technical means and programs (hardware and software) has become an integral part of acquiring knowledge, analyzing information and presenting results. The learning process has changed and became highly technological, ensuring the acquisition of more superficial knowledge and spreading the tools of plagiarism.

Results:

The new stage of the development of artificial intelligence requires the formulation of a technically competent hint and, as experience shows, does not ensure deep and high-quality learning of educational material, and also spreads the practice of academic dishonesty.

Conclusions:

One of the serious consequences of the emergence of intelligent systems is the spread of artificial intelligence in the university environment in the form of a computer program (for example, ChatGPT) that can generate text, video, human language, etc., while at the same time limiting creative mental activity and promoting academic misconduct. In order to investigate the risks, experts of the NGO "Union of Marketers of Ukraine" conducted a survey [1] aimed at clarifying the real picture of the use of AI in education. The emergence of artificial intelligence and its rapid spread in various spheres of life are not yet fully understood by society and require additional research to substantiate its potential, limits of use and threats.

JEL Classification: I25, C88, M31

Keywords: Intellectual Systems, Educational Process, Traffic Monitoring, Higher School, Stages, Educational Process

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ARTIFICIAL INTELLIGENCE FOR EDUCATORS: HOW EDUCATORS IN PAKISTAN CAN ADOPT ARTIFICIAL INTELLIGENCE TEACHING METHODS

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Objectives:

The aim of this study primarily focuses on the integration and adoption of Generative Artificial Intelligence teaching methods by educators in Pakistan. It analyzes and identifies potential Artificial Intelligence teaching methods, which they can adopt to provide better education for students.

Data and Methods:

This study promotes and helps educators from both private and government academic institutes how they can adopt different Artificial Intelligence teaching methods and present them with different Artificial Intelligence tools and techniques. It includes both qualitative and quantitative methods like providing them the demonstration of miscellaneous Artificial Intelligence tools and taking their opinion about these tools and methods. The sample size was 65 educators around Pakistan, which includes 45 from the government sector, and 20 from the private sector.

Results:

These stats show that almost 70% of teachers in the private sector have already adopted Artificial Intelligence teaching styles to innovate their teaching style and there is an increased trend in the adoption of Artificial Intelligence in the private sector. The rest 30% are also willing to adopt these methods. The major problem is in the government sector. In the government sector, only 25% of teachers are using Artificial Intelligence tools to teach students in the big metropolitan cities and in rest of Pakistan they are not using these tools. They are somehow not willing to adopt these methods due to unawareness of the Generative Artificial Intelligence. The main reason for this is that government schools lack basic funding. They are operating in the old-fashioned way.

Conclusion:

This study concludes that there is a big difference between awareness and leaning toward Artificial Intelligence methods among teachers in the government and private sector. We can provide them with the necessary training and basic awareness about the Artificial Intelligence. Educational Institutes should arrange Artificial Intelligence training workshops for their educators. The private sectors have all the necessary facilities and there is an increasing trend for the adoption of Artificial Intelligence teaching methods in the private sector.

Keywords: Artificial Intelligence, Educators, Teaching Methods, Training, Educational Institutions

AI-BASED PERSONALIZATION IN E-LEARNING: DEFINING PERFORMANCE INDICATORS AND UTILIZING DIGITAL TWIN TECHNOLOGY FOR ENHANCED USER ENGAGEMENT

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Introduction:

AI-based personalized e-learning modules have significantly advanced over recent years, evolving into sophisticated systems capable of delivering tailored educational experiences. Despite these advancements, the successful implementation of AI technologies in e-learning platforms necessitates the adoption of robust and well-established frameworks. To address this, we propose utilizing the Digital Twin (DT) technology concept and applying it within an e-learning context to enhance performance and user engagement.

Objectives:

This study aims to: (1) define key e-learning platform performance indicators (KLIPs), (2) develop and employ analysis and visualization tools, (3) construct a comprehensive DT architecture for the e-learning environment, and (4) systematically collect and analyze data from a prototype platform.

Data and Methods:

The data collected includes retention times, click activity, and scroll patterns. Analytical methods such as exploratory data analysis and descriptive statistics are employed to interpret these data. Heatmaps are generated to illustrate user interactions, including scroll patterns, click locations, movement trajectories, attention focus, and geographic distribution.

Results:

The findings facilitate the identification of engaging content areas versus those that may deter user interest, provide insights into the effectiveness of user interaction with various platform sections, and reveal common behavioral patterns that can predict future engagement trends. These insights are instrumental in tailoring content to align with user preferences.

Conclusions:

In conclusion, the application of DT technology, augmented by AI, demonstrates significant potential in optimizing e-learning platforms. It offers actionable insights for the strategic placement of critical information, content structuring, and identifying elements requiring redesign or further development.

Keywords: E-learning, Digital Twin, Artificial Intelligence, Data

ARTIFICIAL INTELLIGENCE AND THE FUTURE OF LEARNING: PREPARING T-SHAPED PROFESSIONALS FOR A MULTIDISCIPLINARY WORLD

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Objectives:

This study proposes an analysis of AI-based tools and technologies that contribute to the effective training of T-shaped professionals, extending both the depth and breadth of their education in higher education institutions. The aim is to improve educational practices, to identify the relationship between factors of AI application in higher education and the development of T-shaped skills in students, and to identify conditions for effective and ethical application of AI in educational processes.

Data and Methods:

A comprehensive and systematic review of existing literature formed the basis of this study. Research articles, studies and reports on AI technologies, personalised learning and the development of T-shaped professionals were analysed. The study also included an analysis of best practices and case studies of higher education institutions that have successfully implemented AI technologies and online platforms, that use AI to develop both expertise and interdisciplinary collaboration. The study also included case studies of educational policies in the US, the European Union, and AI-based learning tools in different higher education contexts. Data is collected from a diverse range of sources, including online surveys, case studies, and secondary research reports.

Results:

The role of the development of the AI strand in Ed Tech in terms of developing students' T-shaped skills can be noted in several ways: Increasing depth of knowledge, Expanding cognitive capabilities, Supporting interdisciplinary collaboration, Personalising learning. To understand the relationship between the implementation of AI in higher education and the development of T-skills in students, it is necessary to systematically analyse how specific AI factors contribute to both deepening and broadening students' competencies. In the study, we presented a structured approach to identify these relationships.

Conclusions:

AI is a catalyst for skills development: AI technologies have the potential to personalise learning, drive interdisciplinary research and develop collaborative skills - all key components of the T-skill set. However, AI technologies also pose risks related to equity, accuracy, and learner motivation. It is critical for educational institutions and technology developers to collaborate to create AI tools that are pedagogically sound, culturally sensitive, and aligned with the goal of enhancing human learning.

Keywords: Artificial Intelligence (AI), Personalized Learning, T-Shaped Professionals, Higher Education, Adaptive Learning Technologies, Interdisciplinary Learning

SMART MEDICAL EDUCATION AMONG THE GOALS OF SUSTAINABLE DEVELOPMENT

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Objectives:

The author participated in the Vernadsky Spring School-2023 on the topic "Sustainable, inclusive and smart development in the context of decentralization: the EU experience." The information obtained made it possible to start research among students of higher medical educational institutions regarding their perception of medical smart education in the context of the Sustainable Development Goals (SDGs).

Data and Methods:

To establish the level of awareness and attitudes of students of higher medical education before death in the SDGs, which are known as Global Goals.

Methodology. In order to determine the prospects for achieving and realizing the SDG, an online survey of students of higher medical educational institutions of the Kharkiv National Medical University was conducted using an online form developed by the author using corporate e-mail, which combined questions about awareness of the SDG, determining their quantitative composition, places of smart education, selection of priority goals, establishing the influence of the central government on ensuring the competence approach in higher education. The composition of the interviewees was homogeneous in terms of education, in terms of gender, men – 20%, women – 80%.

Results:

88.4% of respondents know about the 17 goals of sustainable development, in particular, those related to education and smart education. To the question "Is there, from your point of view, a connection between Goal 3 of the SRS: "Ensure a healthy lifestyle" and Goal 4: "Ensure high-quality smart education" — 91% answered "Yes." More than 88% of respondents believe that the priority among the goals of education development is to ensure that all students of higher education acquire the competencies necessary to promote smart development. 10% of respondents noted that it is still difficult for them to answer, which may indicate the need to take measures to raise the awareness of students of higher medical education regarding issues related to both smart education and the Centers for Disease Control and Prevention. When choosing a priority SDG from the 17 listed, a full range of answers was received, therefore it is not possible to choose one, this indicates that the students of medical education did not form a purposeful choice among the SDGs, but the majority (18.6%) chose the third goal of sustainable development, which corresponds to the professional training of the interviewed students of higher medical education, which can become the basis for the development of smart education.

Conclusions:

The conducted survey established a high level of awareness among students of higher medical education of the CGZ and showed their positive perception of smart education.

Keywords: smart medical education, online survey, sustainable development goals, higher education seekers

Section 5. Smart Technological Advancements

INCREASING THE FAULT TOLERANCE OF MODERN COMPUTER SYSTEMS THROUGH THE USE OF MODERN POLYMER-INORGANIC COMPOSITE MATERIALS WITH ELECTRONIC CONDUCTIVITY

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Objectives:

In the modern world, the development of progress and technology is no longer possible without the use of various types of computer systems, both for purely scientific purposes and for solving applied problems. Computing power is constantly increasing, this is due to the emergence of multiprocessor systems, as well as SOC (system on chip) when all nodes, for example, a laptop, are implemented in the case of one microcircuit. These factors lead to increased heat generation during operation.

Data and Methods:

One of the factors complicating the removal of excess heat from operating circuits are new design trends (using the same laptops as an example, ultra-thin design is now typical for most products). All this, when packing more and more power into a smaller volume of products, leads to an increase in heat load and complication of ventilation. Artificial ventilation and cooling are no longer able to reduce temperatures to the level that was 5-10 years ago. Therefore, increasing the operating temperature requires new studies on how soldering materials will behave in such conditions. Namely, the remains of no-clean soldering flux, which manufacturers use in almost 95 percent of cases for soldering BGA chip packages, and such leading global manufacturers as, for example, Intel AMD for mobile platforms use it in 100 percent of cases.

Results:

Therefore, the following areas of fault tolerance enhancement can be highlighted:

- Changing the preliminary testing protocol for soldering materials in order to adapt them to modern operating temperature conditions.
- selecting appropriate fluxes and soldering pastes in order to minimize residues (which are the cause of unstable operation or complete failure of the device) after completion of the soldering cycle
- selecting new innovative materials for use in cooling systems in order to reduce maximum operating temperatures and, as a result, increase fault tolerance and extend the service life of products.

Conclusions:

In connection with the above, we can highlight another aspect - Environmental. Since we can extend the period of trouble-free operation of products, we accordingly have the opportunity to reduce the amount of electronic waste on the planet, which has recently become a new stage in the fight for environmental cleanliness on our planet.

Keywords: Increasing The Fault Tolerance Of Modern Computer Systems, Polymer-Inorganic Composite Materials, Electronic Conductivity

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LEVELS OF VEHICLE AUTONOMY IN PAKISTAN AND NEED TO DEVELOP THE INFRASTRUCTURE FOR AUTONOMOUS VEHICLES IN PAKISTAN

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Objectives:

The primary aim of this research work is to bring autonomous vehicles onto Pakistani roads, the development of logistics corridors for autonomous vehicles, and the development of road infrastructure and digital infrastructure for commercial and non-commercial autonomous vehicles. In addition, it reduces road accidents and overcomes the issues of traffic congestion.

Data and Methods:

Both qualitative and quantitative research techniques were employed in this research work. Data was collected from both locally manufactured and imported miscellaneous types of commercial vehicles and non-commercial vehicles on Pakistani roads. The data gathered from the Pakistani driver's behavior including marijuana-impaired drivers is part of this research. Road infrastructure data is gathered.

Results:

There are six levels of vehicle autonomy as per the United States Society of Automotive Engineers. A very high percentage of Pakistan's miscellaneous types of commercial vehicles and non-commercial vehicles fall in the category of Level 0 or no driving automation. This is one of the major causes of road traffic accidents. Pakistani vehicle manufacturers/assemblers make the category of Level 0 vehicles. Level 1 is the lowest level of automation and a very low percentage of imported vehicles or non-commercial vehicles qualify under this category in Pakistan. As we enhance the levels of vehicle autonomy, the safety of the miscellaneous road users increases. Road surface markings are faded. Similarly, traffic control devices do not exist on many roads in Pakistan. The suspension or slowdown of 4G and 5G networks will also affect the introduction of autonomous vehicles in Pakistan.

Conclusions:

The government of Pakistan needs to revisit its National Transport Policy 2018 and add about the manufacture / import of autonomous vehicles and the development of logistics corridors for autonomous vehicles. The government of Pakistan and the government of China need to transform the China-Pakistan Economic Corridor (CPEC) into logistics corridors for both commercial and non-commercial autonomous vehicles. A similar approach needed to be followed for other neighboring countries of Pakistan.

Keywords: Autonomous Vehicles, Unmanned Logistics Corridors, Levels of Vehicle Autonomy, Traffic Congestion, Pakistan's National Transport Policy

THE ROLE OF ROBOTS AND MECHANISMS IN COLLECTION ORDERS IN WAREHOUSE

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Objectives:

The aim of this research is to observe methods of collection orders in warehouse using robots and mechanisms.

Data and Methods:

During research were used methods of gathering facts related to the object of research (observation, registration, measurement) and methods of analysis of facts, properties, factors and phenomena.

Results:

Traditionally, collection of orders have been a very time-consuming task, often leading to errors and inefficiencies, as well as placing a strain on the workforce due to its physical nature. However, with the advent of robotic picking systems, warehouses can achieve exceptional levels of order picking efficiency and increased productivity.

Logistics warehouse companies develops and implements innovative solutions in robotics for warehouses, with an emphasis on modular and scalable systems. Their portfolio includes reliable and efficient solutions, from palletizers to autonomous robots that handle peak loads.

High costs and labor shortages during peak seasons make robotics key to reducing costs and increasing speed and accuracy in warehouses and distribution centers.

There are many robotic solutions available today that are highly effective at automating order collection processes and can be easily integrated into existing operations to meet both short-term needs and long-term growth goals.

Automated storage and retrieval systems can process large volumes of goods with minimal human intervention, reducing errors and increasing throughput. They provide exceptional levels of speed and accuracy for order picking tasks, as well as space optimization thanks to compact storage.

Autonomous mobile robots are increasingly using in e-commerce, 3PL and retail operations. They are highly adaptable and ideal for dynamic environments, especially where there are significant peaks in order fulfillment or frequent inventory turnover. They also provide a safe working environment by using sensors and cameras to avoid obstacles, infrastructure and people while moving around the warehouse along pre-planned routes.

Conclusions: Robotics can combine picking and packaging, increasing efficiency of warehouse. Specialized palletizing systems perform the tasks of inspection, weighing and automatic labeling, offering a complete solution. They also integrate easily with other automation technologies such as pipelines, AMR and ASRS solutions. By adding a depalletizing robot, businesses can fully automate the unloading of products from pallets, further streamlining operations. Robotics comes in many forms, and choosing the right solution is important for efficiency, flexibility and future growth.

Keywords: Warehouse, Collection Orders, Robotic Solutions In Warehouse Systems

SMART TECHNOLOGIES IN FOOD WASTE MANAGEMENT: A BUSINESS AND REGULATORY PERSPECTIVE

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Objectives:

The primary objective of this research is to explore how smart technologies, such as IoT and AI, can be integrated into food waste management to promote sustainability and meet regulatory requirements. By mapping these innovations onto the food waste management hierarchy, the study aims to identify potential business opportunities and compliance strategies.

Data and Methods:

This study employs a systematic literature review and case study analysis. The literature review identifies existing smart technology applications in food waste management, while case studies illustrate their real-world implementation. Each technology is evaluated based on type, regulatory constraints, and profit potential. The study categorizes these technologies into stages of the food waste management hierarchy, ranging from prevention to disposal, using the EU Waste Framework as a reference.

Results:

Findings reveal that while smart technologies are effective in reducing food waste, their adoption is influenced by factors such as privacy regulations, laws, and high product costs. The mapping process shows that prevention technologies (e.g., smart refrigerators) are the most widely adopted, whereas solutions for nutrient and energy recovery remain underutilized due to stricter regulations and business constraints.

Conclusions:

The study offers a "Framework for Integrating Smart Technologies in Food Waste Management Hierarchy with Business and Regulatory Considerations" to guide industry professionals and policymakers. This framework emphasizes a dual focus on technology integration and navigating regulatory challenges, contributing to the achievement of Sustainable Development Goal (SDG) 12.3.

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Keywords: Food Waste Management, Smart Technologies, IoT, Artificial Intelligence, Regulations, Machine Learning

EMPOWERING THE DIGITALIZATION IN ORGANIZATIONS: A CASE STUDY OF COMPREHENSIVE TOOLBOX FOR TRANSFORMATION IN SERVICE INDUSTRY

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The digitalization and improvement of processes are priorities for many companies. LEAN is one of the most commonly used methodologies for ensuring the base for transformation and digitalization due to well-proven results in process standardisation and waste elimination. For all organisations who start LEAN journey with the goal to transform and digitise processes it is required to find its own unique path due to different baselines and culture in the organisation. Research of this case study is based on the example of a service organization employing over 10 000 employees in total. The aim of the study is to investigate the effectiveness of a comprehensive toolbox designed to facilitate the digital transformation process, enabling service organization to enhance operational efficiency, digitalization and overall competitiveness.

Methods:

This case study uses a methodology that includes a literature review, content analysis and validation of findings with interviews. 16 interviews with Business development experts and LEAN practitioners participated in the study and the validation of data and conclusions.

Result:

The study provides clear evidence that a framework for managing digital transformation can be established in any organization based on Lean tools and principles. Key elements identified in the case study include a structured toolbox and competence map, a strategic roadmap for digitalization, and a series of networks connecting experts with transformation leads. The framework that is developed supports both soft and hard factors for starting up and running process improvement activities. Investigation and interviews with experts provide a clear view on the set up of such a framework and critical success factors.

The study's key results emphasize the importance of identifying all factors that influence the speed and effectiveness of an organization's digital transformation. According to the expert evaluation a framework requires initial competence and experience in LEAN tools and methodology, as well as evaluation of available IT tools for driving the digitalization initiatives. The key resources shall be identified to create an expert network. Those elements directly impact the potential success of the transformation. Additionally, the study shows the need for extensive training and skill development across the organization to ensure the transformation is supported and sustained.

Conclusions:

Based on the results of the case study, LEAN methodology provides a stable base for transformation journey also for digitalisation needs. Organizations need to develop a clear structure for improvement and digitalisation journey in order to identify the needs of long-term perspective to transformation and how to implement it in the organisation. Creating a tailor-made framework ensures further development of LEAN tools in combination with IT tools available in organisation. There is data evidence that the framework does provide stable growth of improvement and efficiency gains as well as digitalisation initiatives, as well as is open for a closer cooperation in current value chains. Framework can be transformed to other organisations and adjusted to different settings and goals.

Keywords: Digitalization, Service, Process, Improvement, Efficiency

Section 6. Smart Economic Impacts and Future Trends

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE LABOR MARKET AND SUSTAINABLE ECONOMIC DEVELOPMENT OF THE STATE

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Objectives:

The aim of this work is to analyze the modern requirements and main challenges of the digital environment, which have a significant impact on the job market, sustainable economic development, and the acquisition of necessary skills in society.

Data and Methods:

The research utilized the method of statistical analysis, including the analysis of official documents from international organizations and relevant scientific works.

Results:

1. **Labor Market Transformation:** New technologies will change the labor market by creating new jobs and eliminating existing ones. This transformation does not imply that AI will replace all workers but rather offers better and healthier working conditions.
2. **Skill Development:** Employees must be able to retrain themselves as new jobs require new skills. This includes problem-solving, creativity, research and analysis, critical thinking, and teamwork.
3. **Social and Legal Challenges:** Replacing employees partially or entirely can lead to social and legal issues. Labor market policies should focus on upskilling and retraining individuals affected by digitization.
4. **Impact on Low-Income Jobs:** Automation significantly impacts low-income businesses and jobs that do not require highly developed skills, making training and promoting the well-being of these individuals a major challenge.

Conclusions:

Artificial intelligence stimulates the economy by reducing production costs and increasing the production of goods. It requires employees to acquire new digital skills and adapt to new working conditions. Effective labor market policies are essential to support the upskilling and retraining of workers affected by AI and automation, ensuring sustainable economic development.

Keywords: Innovations, Digital Technologies, Artificial Intelligence, Labor Market, Sustainable Economic Development

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USING ECONOMETRIC MODELS IN BIG DATA ANALYSIS

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Objectives:

In the era of rapid technological advancement and data generation, econometric models have become essential tools for analyzing vast datasets. Big data analysis allows economists, businesses, and policymakers to uncover insights that were previously inaccessible. By integrating econometric models into big data analysis, we can make more accurate forecasts, identify complex relationships between variables, and enhance decision-making processes. This article explores the integration of econometric models in big data analysis, their applications, and the key areas where they can significantly impact decision-making. The objective of this study is to explore how econometric models can be effectively integrated into big data analysis to improve forecasting, identify complex relationships, and enhance decision-making processes.

Data and Methods:

This study utilizes a combination of qualitative and quantitative data sources, including academic articles, government reports, and case studies. Methods include data analysis, comparative studies, and expert interviews to assess the impact of econometric models in big data analysis.

Results:

1. **Regression Models:**Regression analysis remains foundational in big data analysis, helping to identify patterns and predict economic outcomes like sales and employment rates.
2. **Time Series Analysis:**Techniques like ARIMA are used to forecast economic trends and demand cycles over time, making them suitable for finance and economics applications.
3. **Panel Data Analysis:**These models analyze multi-dimensional datasets over time, revealing trends and policy impacts in sectors like healthcare and economics.
4. **Machine Learning Integration:**Combining econometrics with machine learning enhances model flexibility and predictive accuracy, especially with complex datasets.

Conclusions:

The integration of econometric models in big data analysis offers a powerful combination of predictive accuracy and interpretability. By leveraging the strengths of both econometrics and modern computing techniques, researchers and practitioners can derive valuable insights that drive economic growth, improve business strategies, and influence public policy. As big data continues to expand, econometric models will remain indispensable tools in making sense of large-scale datasets, leading to better-informed decisions across industries.

Keywords: Modeling, Economic Data, Big Data Analysis, Data Quality, Regression Models, Time Series Analysis, Panel Data Analysis, Hybrid Models, Data Quality

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INCLUSIVE GROWTH: THE ROLE OF INNOVATION AND ECONOMIC STABILITY

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Objectives:

This study aims to identify the key determinants of inclusive growth, focusing on the role of research and development (R&D) expenditure as a proxy for investment in smart technologies and innovation.

Data and Methods:

We construct an Inclusive Growth Index (IGI) using principal component analysis, ranking, and the Fishburn approach. A random-effects GLS regression model is then employed to analyze the impact of various economic factors on the IGI. The dataset comprises observations from 27 countries over up to 23 years.

Results:

In 27 selected European countries, the potential of inclusive growth is not used to its full extent. Notably, the minimum IGI level was reached in 2000 in Romania and the maximum in Germany in 2022. Germany, Denmark, and France have the highest inclusive growth index. Outsiders, according to this indicator, are Romania, Bulgaria and Croatia.

The regression analysis results show that R&D spending, per capita GDP growth, an increase in total government spending, and an increase in the country's foreign exchange reserves have the most significant positive impact on inclusive growth. In contrast, rising inflation, rising gross savings, and the current account cause a decline in inclusive growth, underscoring the importance of macroeconomic stability for achieving inclusive growth. The study highlights the significant role of technological progress, measured through R&D spending, in shaping the conditions for sustained inclusive growth. GDP growth is usually associated with a slight increase in the inclusive growth index; however, given the scale of the countries' GDP, it can be very significant. It suggests a significant relationship between economic well-being and inclusiveness. A significant positive relationship between foreign exchange reserves and IGI demonstrates the impact of financial stability on inclusive growth. Public spending has become another positive factor, underscoring the role of the public sector in promoting inclusiveness.

Conclusions:

The results emphasize the significant influence of economic stability factors on inclusive growth, which has considerable growth potential in EU countries. At the same time, the policy to promote inclusive growth principles should be based on maintaining a high level of investment in research and development and technology, implementing measures to ensure macroeconomic stability, and effective government spending.

Keywords: Inclusive Growth, Economic Stability, Inclusive Growth Index, Innovation, Econometric Modeling.

The research was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V01-00023 and Ministry of Education, Research, Development and Youth of the Slovak Republic, and the Slovak Academy of Sciences (VEGA 2/0172/2).

THE IMPACT OF DIGITAL TRANSFORMATION AND ARTIFICIAL INTELLIGENCE ON BUSINESSES

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Objectives:

This study investigates the transformative impact of digital transformation and Artificial Intelligence (AI) on business operations, focusing specifically on how AI technologies are applied to enhance operational efficiency, improve customer experiences, and increase competitive advantage. The main objectives are to analyze how businesses across various industries are integrating AI, assess the effectiveness of these technologies, and provide strategic recommendations for further adoption.

Data and Methods:

The research employs a mixed-methods approach, combining qualitative interviews with industry experts and a quantitative analysis of AI-driven initiatives in sectors such as e-commerce, banking, and IT. Data were gathered from surveys, case studies, and secondary research, including scientific publications on the digital transformation of businesses. Sources such as Kwilinski and Trushkina (2019) and Trushkina et al. (2020) were used to analyze the integration of digital marketing and AI in business operations (Kwilinski & Trushkina, 2019; Trushkina et al., 2020). This comprehensive approach enables a holistic view of how AI is transforming business models and workflows.

Results:

The findings reveal that AI and digital transformation have profoundly impacted businesses worldwide. Companies such as Amazon and Netflix have revolutionized customer engagement through AI-powered recommendation systems, chatbots, and predictive analytics. These tools enable businesses to offer personalized experiences, improve customer retention, and increase conversion rates. Automation driven by AI has also optimized resource allocation, accelerated decision-making processes, and reduced operational costs.

Additionally, Ukrainian companies like SoftServe, Grammarly, and Reface have become leaders in AI adoption, successfully integrating AI into their products and services to compete globally (Kwilinski & Trushkina, 2019). Moreover, disparities in AI adoption rates across countries have been identified, with Estonia demonstrating a higher level of implementation compared to Georgia and Poland, largely due to differences in infrastructure and readiness (Trushkina et al., 2020). Israel, as one of the leaders of HI Tek, should not only develop, but also at least test its developments.

Conclusions:

The integration of artificial intelligence and digital transformation offers businesses ample opportunities to improve efficiency, improve customer satisfaction, and maintain a competitive advantage. Continuing cooperation with Estonia will be successful for Ukrainian enterprises. However, successful implementation requires investment in infrastructure, workforce training and strategic planning.

Keywords: Artificial Intelligence, Digital Transformation, Business Operations, Customer Experience, Automation, Innovation

FOREIGN INVESTMENT IN THE SYSTEM OF MOVEMENT TOWARDS SUSTAINABLE DEVELOPMENT

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Objectives:

This research aims is research on foreign investment in the system of movement towards sustainable development of the economy. The objective is the impact of foreign investments on the innovative development of the economy has been investigated.

Data and Methods:

The importance of a comparative analysis of foreign investment practices in countries with different levels of economic development is highlighted as an element of the practical implementation.

Results:

Let's explore the impact of foreign investments on key sectors of the economy in the context of countries with developed and transitional economic systems, specifically examining Germany, Bulgaria, and Ukraine as countries with different levels of economic development. *1. Industry.* Germany is a leader in this sector, as the export of its products is highly competitive globally, attracting investors to invest in new projects. Bulgaria mostly plays the role of an importer of products from other producers, primarily within the EU. Ukraine, in the context of its wartime economy, currently has only internal investment opportunities for investing in the machine-building industry, relying on the working capital of enterprises. *2. Agriculture.* Agriculture is a key sector for both Ukraine and Bulgaria, as they have vast agricultural lands and produce a significant amount of food, primarily grain crops, for domestic consumption and export. For Germany, agriculture is also important, but its contribution to the economy is smaller compared to other sectors. *3. Technology and Innovation.* Germany is renowned for its high level of technological development and innovation, especially in the manufacturing sector. As for Bulgaria and Ukraine, these countries act as importers of high-tech products, which increases their dependency on supplier countries, currency exchange rate fluctuations, and may lead to higher prices for imported products, thus reducing the investment attractiveness of these countries in the technology sector.

Conclusions:

Foreign investment is of great significance for the sustainable economic development of an economic system. Foreign investment requires effective management and oversight by government authorities. In summary, foreign investment plays a crucial role in stimulating the national economic system towards sustainable development.

Keywords: Investments, System, Sustainable Development, Estimation, Strategy

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