LITHUANIA BUSINESS COLLEGE

SUSTAINABLE DEVELOPMENT SOLUTIONS: REGIONAL ASPECTS

MONOGRAPH

KLAIPĖDOS UNIVERSITETO LEIDYKLA

Klaipėda, 2025

Bibliografinė informacija pateikiama Lietuvos integralios bibliotekų informacinės sistemos (LIBIS) portale ibiblioteka.lt

Recommended for publication by the Resolution No. 2.12-89 of the Publishing Commission of the Lithuania Business College of September 12, 2025

Reviewers:
Angele Lileikiene, Founder of the Lithuania Business College, Professor, Department of Economics, Lithuania Business College, Lithuania.
Jurgita Martinkiene, Director of Lithuania Business College, Associate Professor, Department of Management, Lithuania Business College, Lithuania.
Asta Valackiene, Professor, Department of Economics, Mykolas Romeris University and Professor, Department of Law, Lithuania Business College, Lithuania.
Kristina Puleikiene, Deputy Director for Studies and Quality, Associate Professor, Department of Economics, Lithuania Business College, Lithuania.
Serzgej Vinogradov, Associate Professor, Budapest Metropolitan University, Hungary.
Sarunas Banevicius, Associate Professor, Department of Tourism and Cominucatons, Lithuania Business College, Lithuania.
Simona Grigaliūniene, Associate Professor, Department of Technology, Lithuania Business College, Lithuania.

Editor
Valentinas Navickas, Professor, Department of Economics, Lithuania Business College, Lithuania.

The monograph defines the methodological, theoretical and practical foundations for sustainable development in the modern era of global challenges.
The monographic study is intended for scientists, teachers of higher and secondary schools, future teachers, as well as anyone who is interested in the problems of modern economics.

ISBN 978-609-481-262-0

CONTENTS

PREFACE

In today's interconnected and rapidly changing world, sustainable development has become one of the most pressing global priorities, encompassing economic growth, environmental preservation, technological progress, and social well-being. The accelerating climate crisis, growing inequality, depletion of natural resources, and demographic shifts highlight the urgent need to identify balanced and effective strategies for achieving sustainability. In this context, the presented monograph aims to explore both the fundamental challenges facing sustainable development and the possible solutions that can ensure a harmonious future for humanity.

The scientific value of this work lies in the interdisciplinary approach to analyzing sustainability issues. The monograph presents studies that conceptualize sustainable development in three main dimensions: environmental, economic, and social. Each article contributes to a deeper understanding of the complexity of these challenges while offering practical mechanisms for their resolution.

A particularly important place in the monograph is occupied by research dedicated to the transition towards renewable energy, circular economy models, and green innovations. These studies outline theoretical and methodological foundations for reshaping production and consumption patterns, emphasizing technological and institutional solutions. Another significant contribution of the book is the analysis of governance models, stakeholder cooperation, and community engagement, which are crucial for ensuring the effective implementation of sustainability policies.

The monograph also highlights the role of education, awareness, and cultural transformation in achieving sustainable development goals. By stressing the interconnection of global and local initiatives, it demonstrates how individual, corporate, and governmental actions can converge to create long-term positive change.

This book is intended for scientists, policymakers, educators, entrepreneurs, students, and all those interested in the multifaceted problems and solutions of sustainable development.

AI-BASED TREND MODELING FOR MANAGING EDUCATIONAL RESOURCES IN TRAINING CIVIL PROTECTION SPECIALISTS

Taras Rak[1], Olga Smotr[2]
[1]IT STEP University, Ukraine, [2]Lviv State University of Life Safety, Ukraine
JEL classification: I23, O33, C61

There is a consistently high number of natural and man-made emergencies in the world and in Ukraine (https://files.emdat.be/reports/2024_EMDAT_report.pdf). Their consequences often extend beyond individual countries, causing significant human and economic losses. Effective response requires civil protection specialists to be able to make decisions under time constraints and with incomplete information, which necessitates the updating of educational programs. Such programs should integrate modern technologies, be adaptable to the dynamics of social and technological change, and prepare specialists to deal with new risks.

One of the defining factors in the transformation of education has been generative artificial intelligence (GAI), which spread rapidly after the emergence of models such as ChatGPT in 2022. By 2023, a significant proportion of students and teachers were already using it Coffey (2023). GAI creates learning materials, automates routine tasks, and changes teaching methods Tracey (2024), Smotr, Karabyn, Loza (2024).

Along with the advantages, there are also challenges: threats to academic integrity, risks of reduced critical thinking, and problems of data bias Batista, Mesquita, & Carnaz (2024). The response of educational institutions varies, but the global trend is not to ban AI, but to develop skills for its responsible use. Most teachers recognize that mastering such tools is an important part of professional training Coffey (2023).

For the field of civil protection, AI opens up new opportunities: personalized learning, modeling rare or dangerous scenarios, VR training, and serious games Smotr, Karabyn, Malets & Golovatyi (2024). This enhances the practical component of education, allowing students to practice actions in safe virtual environments and receive instant feedback. At the same time, it is critically important to teach students to verify data and not rely on algorithms unconditionally, because in the field of rescue operations, the price of error is too high.

Therefore, integrating AI into civil protection training requires updating curricula to include topics such as emergency prediction and response, data analysis, cybersecurity, and expanding interdisciplinary training. In the context of growing natural, man-made, and military threats, especially in Ukraine, AI can significantly improve the quality of rescue worker training, but ethical and security issues need to be addressed.

A decision was made to conduct a systematic review and analysis of scientific articles, industry reports, and the regulatory framework that study and regulate the implementation of AI technologies in the civil protection sector.

Literature review

International experience in integrating AI into rescue training covers both the acquisition of new knowledge and the improvement of skills, expanding the capabilities of emergency response services. Key areas of research include the use of AI in emergency rescue equipment, humanitarian missions, training programmes, water rescue operations and strategic initiatives.

The International Committee of the Red Cross (ICRC) in article Beduschi (2022) demonstrated the role of AI in the humanitarian sphere: from predicting population movements (Project Jetson) to funding programmes based on forecasts. These approaches confirm the potential of AI to improve response efficiency. Similar conclusions are drawn by Switchboard (https://www.switchboardta.org/insights-from-the-field-the-use-of-artificial-intelligence-in-resettlement-work/), Batcher (2025), which highlights the use of AI for automation, decision-making and personalised learning, as well as the IRC's experience in implementing innovative programmes to support displaced persons.

The OECD report Senarath, Pandey, Peterson, & Purohit (2022) on healthcare emphasises the importance of continuous training to acquire AI skills. Although the document focuses on medicine, its conclusions are relevant to emergency services, especially in the areas of predictive analytics and decision-making. Similarly, a project Gözalan et al. (2020) for maritime rescue services showed how user-oriented AI systems can improve operational efficiency and safety. The use of modern information technology in healthcare has been studied by scientists in works Tupá, Kordoš, & Mozolová (2024).

Work Hui et al. (2024) presents the results of the STEAMxD seminar attended by 95 people, which explored the training of specialists to work with robotic technology and respond to natural disasters. The emphasis is on ethical aspects, image recognition and the use of rescue robots. Practical exercises, such as robot navigation in simulated areas, demonstrated the potential of AI in training future rescuers.

A global survey of 2,525 executives Ångström et al. (2023) identified best practices for applying AI in industry and emergency services, while emphasising the importance of ethics and context-specific approaches to its implementation in specialist training.

Studies Kohler (2020), Hauri et al. (2020), Kohler (2021) conducted by the ETH Zurich Centre for Security Studies analysed social, technological and environmental trends that will influence civil protection in Switzerland until 2030. The authors emphasise the need to adapt systems to the growing complexity and interdependence of social processes, flexibility and adequate training of personnel.

A number of authors in their publications consider the possibilities of modern IT technologies, in particular 5G communication, in terms of national security, emphasising the need for comprehensive digitalisation of state departments Anna, Z. (2023), Akpan, Ibidunni, (2021), Simonavičiūtė, Navickas (2022),

The Erasmus+ project 'TeleTraining in Crisis Management' Berntzen et al. (2025) focused on the use of ChatGPT in crisis management training. Simulating an emergency landing of an aircraft on water demonstrated the potential of AI in creating dynamic cross-border learning environments. The work Smotr, Karabyn, Malets & Golovatyi (2024) emphasises the gamification of the educational process using modern IT and AI to increase student motivation.

The focus of the research

Obviously, promising areas for further research include: - developing ethical standards for AI in civil protection (in particular, prioritizing safety over efficiency); - creation of multimodal training systems (VR + real simulators); - research into the interaction of AI with social networks to combat panic during disasters, etc.

In summary, we can say that the analysis confirms the significant potential of AI to transform civil protection training: from integration into educational programs to use in simulations, forecasting, and operational processes. At the same time, there is a need to develop a clear strategy for implementing AI in civil protection training.

The aim of this article is to analyze strategies for integrating artificial intelligence into the civil protection specialist training system and to develop scientifically sound recommendations that will improve the process of developing the necessary competencies, taking into account current challenges and emergency scenarios.

The object of this research is the process of professional training of civil protection specialists in the higher education system of Ukraine.

The subject of the analysis is the methods, mechanisms, and tools for integrating artificial intelligence into the educational process of training civil protection specialists, in particular adaptive learning models, simulation exercises, and personalized educational trajectory technologies.

The study was conducted in 2023–2025 with the involvement of scientific experts in the fields of civil protection, artificial intelligence, and education. The article uses the following methods of analysis: a systematic review of scientific publications and industry reports, analysis of the regulatory framework, SWOT analysis, foresight analysis, and scenario modeling.

Based on the analysis of literary sources and applied research on the implementation of AI in education and civil protection, the need for a systematic approach was identified, which would allow for a deeper understanding of the key trends that will shape civil protection in the future and their impact on the training of civil protection specialists.

It is evident that adapting the process of training civil protection specialists to new challenges in the field, shaped by key global trends, must be strategic and comprehensive, with an emphasis on training, the regulatory framework, inter-agency communication, and digital infrastructure.

As a result, Table 1 has been created, which can serve as a practical tool for structuring the educational process. This table links key trends, such as artificial intelligence, digitalization, and climate change, with the corresponding types (technological, social, environmental) and competencies that need to be developed in civil protection specialists, including basic knowledge of machine learning, scenario planning, and resource coordination. The development is based on an interdisciplinary approach that allows training programs to be adapted to current challenges, in particular the military realities of Ukraine, providing a clear guideline for developing skills in the areas of evacuation, infrastructure protection, and international cooperation.

Table 1. Correspondence between civil protection trends and the competencies of civil protection specialists

Trend	Type	Competencies
Artificial Intelligence	Technological	ML basics, data analysis, ethics, digital indicators
Digitalization	Technological	Digital platforms, cybersecurity, digital resilience, GIS
Convergent Technologies	Technological	Interdisciplinary thinking, biosecurity, digital epidemics
Unmanned Systems	Technological	Drone operation, sensor data, search tactics, legal aspects
Mobility	Technological	Evacuation planning, energy systems, transport data
Changing Demographics and Social Norms	Social	Vulnerable groups, inclusiveness, volunteer motivation
Social Media	Social	Crisis communication, disinformation, public engagement
Urbanization and Metropolization	Social	Urban evacuation, social vulnerability, infrastructure protection
Geopolitical Change	Social	Global risk analysis, strategic thinking, international cooperation
Sharing Economy	Social	Resource coordination, intermunicipal cooperation, logistics
Climate Change	Environmental	Scenario planning, vulnerability assessment, environmental management
Governance of Critical Infrastructure	Environmental	Systems thinking, cross-sector risk analysis, infrastructure protection

For example, the "Artificial Intelligence" trend emphasizes the need for basic knowledge of machine learning (ML), data analysis, and ethical aspects, reflecting the need to integrate AI for risk prediction, while "Climate Change" requires scenario planning and vulnerability assessment skills, which are critical for responding to natural disasters.

In order to justify decisions on the integration of AI into educational programs, a mathematical model was developed that allows for the adaptability of training modules, the effectiveness of their impact on the formation of competencies, and the prediction of training needs depending on changes in the risk profile.

Mathematical Model Description

The developed mathematical model for integrating artificial intelligence into the training of civil protection specialists is based on the concept of multifactor evaluation with elements of adaptive learning and forecasting of needs based on trend changes. The model is presented as a system that optimizes the selection of content modules, methods, and digital tools based on changes in the security environment, as well as alignment with the graduate's competence profile.

The input parameters of the model include: trends (T), risk level (R), available educational resources (E), competence profile (C), and forecast time horizon (τ).

The objective function aims to maximize the correspondence between trends and established competencies (F), taking into account resource and time constraints:

$$maxF = \sum_{i=1}^{n}\sum_{j=1}^{m} w_{i,j} \cdot x_{i,j} \quad (1)$$

where: $w_{i,j}$ is the weight of trend i's influence on competency *j*, $x_{i,j}$ is level of competency development *j* in the context of trend *i*.

The model allows you to vary the composition of educational content depending on:

- changes in geopolitical, social, or technological trends (dynamic trend module $T(\tau)$);
- the level of training of a specific target audience (adaptive complexity scale);
- emergency scenarios (simulation of situational cases).

Based on trend coefficients (α_i) and historical data on threats, the model generates a forecast of the required level of training for each competency

$$D_j(\tau) = \sum_{t=1}^{k} \alpha_t \cdot P_{jt}(\tau) \quad (2)$$

where: D_j is expected need for competence j, P_{jt} is probability of trend *t* occurring, requiring competence *j*.

The model takes into account a number of limitations, namely:

- resource constraints (number of hours, teachers, access to GenAI tools);
- compliance with regulatory requirements (state education standards, ethical limits on the use of AI);
- risks of misuse of GenAI in simulations or analysis of real events.

Thus, the proposed model allows not only to formulate a sound educational strategy, but also to quickly adapt it to new threats, the dynamics of combat operations, or changes in the regulatory environment. It also serves as a basis for the creation of a digital educational dashboard or a decision support platform in educational management.

Results and discussion

As an example, let us give a mathematical description of the application of the above model: the formation of the competence "Skills in working with drones and sensors" in the context of the growing use of unmanned systems (UAV/UGV) in civil protection.

During periods of active combat or natural disasters (e.g., earthquakes, mass fires, etc.), there is a need to use unmanned aerial vehicles (UAVs) and ground robots (UGVs) to monitor dangerous areas, locate victims, and map damage. In response to this trend, educational institutions must adapt the training of civil protection specialists.

Let us formalize the task as the optimization of the level of competence C_UAV in the context of the trend T_UAV.

$$maxF_{UAV} = w_{T_UAV,C_UAV} \cdot x_{T_UAV,C_UAV} \quad (3)$$

where: w_{T_UAV,C_UAV} = 0.95 - weight of correspondence between trend UAV and competence; $x_{T_UAV,C_UAV} \in [0,1]$ - level of competence development after module implementation.

The model takes into account restrictions on:

- resource constraints (number of hours, teachers, access to GAI tools);
- compliance with regulatory requirements (state education standards, ethical limits on the use of AI);
- risks of misuse of GAI in simulations or analysis of real events.

Thus, the proposed model allows not only to formulate a sound educational strategy, but also to quickly adapt it to new threats, the dynamics of combat operations, or changes in the regulatory environment. It also serves as a basis for the creation of a digital educational dashboard or a decision support platform in educational management.

Results and discussion

As an example of the application of the above model, let us consider the case of developing competence in 'Drone and Sensor Skills' in the context of the growing use of unmanned systems (UAV/UGV) in civil defence. This is relevant for Ukraine during periods of active combat operations or natural disasters (e.g., earthquakes, mass fires, etc.), where unmanned aerial vehicles (UAVs) and ground robots (UGVs) monitor dangerous areas, locate victims, and map damage. In response to this trend, educational institutions must adapt the training of civil protection specialists.

Let us formalise the task as optimising the level of C_UAV competence formation in the context of the T_UAV trend. We need to maximise the function:

$$maxF_{UAV} = w_{T_UAV,C_UAV} \cdot x_{T_UAV,C_UAV} \quad (4)$$

where: w_{T_UAV,C_UAV} = 0.95 - the weight of correspondence between the UAV trend and competence; $x_{T_UAV,C_UAV} \in [0,1]$ - level of competence development after module implementation.

The model takes into account restrictions on:

- time: $t \leq t_{max} = 16$ hours per module
- material and technical resources: the number of available simulators or drones $d \geq n/r$, where: *n* – is the number of students in the group, *r* – is the optimal ratio of students to one drone;
- budget:

$$\sum_{i=1}^{k} c_i \cdot m_i \leq B \quad (5)$$

where: c_i - is the cost of element *i* (simulator, drone, software), m_i - is the number of units; *B* - is the allocated budget.

Expected competence requirement $D_{C_UAV}(\tau)$. Over a time horizon of τ = 1 year.

$D_{C_{UAV}}(1) = \alpha_{UAV} \cdot P_{C_{UAV}}(1)$ (6)

where: α_{UAV}= 0,85 - intensity of the UAV trend according to national/international reports; $P_{C_{UAV}}(1)$=0,9 probability that the competency will be in demand over the next year.

Thus:

$D_{C_{UAV}}(1) = 0{,}85 \cdot 0{,}9 = 0{,}765$

Based on the forecast of competency requirements, we present a model for adapting the educational module.

The module will include:

- theoretical block (4 hours): basics of *UAV/UGV*, flight rules, civil defence scenarios;
- practical block (8 hours): working with a flight simulator plus search and rescue missions;
- multi-agent modelling simulation (4 hours): analysis of data from drones and decision-making in situations.

Implementation of this module ensures an increase in $x_{T_{UAV},C_{UAV}}$ to a level >0.8, which at $w = 0{,}95$ ensures $F_{UAV} \approx 0{,}76$, which is in full compliance with the projected demand *D*=0.765.

Thus, the model allows us to quantitatively justify that the implementation of the training module «Skills in working with drones and sensors» (UAV/UGV) is expedient from the point of view of strategic relevance, resource realism and adaptive efficiency.

This approach creates the conditions for the formation of a flexible and resilient educational ecosystem capable of responding to the challenges of war, humanitarian crises and climate risks, drawing on the potential of artificial intelligence.

Conclusions

Artificial intelligence has become one of the primary drivers of educational transformation, and its integration into civil protection training creates opportunities for adaptive programs capable of responding effectively to modern challenges. The proposed conceptual and mathematical model enables the optimization of learning processes, the prediction of competency needs, and the design of personalized training trajectories based on potential emergency scenarios. Its application through training modules that incorporate simulations, VR, and automated data analysis systems demonstrates the capacity of AI to increase both the efficiency and resilience of professional education.

However, successful implementation requires clear regulatory frameworks that address ethical concerns, including data protection, equal access to digital resources, and the establishment of new standards of academic integrity. Equally important is the cultivation of critical thinking and professional responsibility to prevent excessive reliance on algorithmic decisions in life-critical situations.

Future research should focus on the experimental validation of the model in real educational environments, pilot testing across institutions, the development of evaluation standards for AI-enhanced learning, and the creation of interdisciplinary collaboration frameworks. Engaging experts from technical, pedagogical, and social sciences will help align training modules with the actual operational needs of civil protection. Another promising direction is the development of unified metrics for assessing the accuracy of educational demand forecasting and the effectiveness of competency formation. Such steps will provide a scientifically grounded basis for large-scale implementation of AI in civil protection education and will strengthen the capacity of future professionals to respond to complex and unpredictable crises.

References

1. Akerkar, R. (2010). Knowledge-based systems. Jones & Bartlett Learning.
2. Akpan, I. J., & Ibidunni, A. S. (2021). Digitization and technological transformation of small business for sustainable development in the less developed and emerging economies: a research note and call for papers. *Journal of Small Business & Entrepreneurship*, 1–7. https://doi.org/10.1080/08276331.2021.1924505
3. Alabdali, S. A., Pileggi, S. F. and Cetindamar, D. (2023). Influential Factors, Enablers, and Barriers to Adopting Smart Technology in Rural Regions: A Literature Review, Sustainability, 15 (10), 7908. https://doi.org/10.3390/su15107908
4. Anna, Z. (2023). Digital technologies as a factor of national security of ukraine. *Vadyba*, 39(2), 23-29. https://doi.org/10.38104/vadyba.2023.2.03
5. Batista, J., Mesquita, A., & Carnaz, G. (2024). Generative AI and Higher Education: Trends, Challenges, and Future Directions. Information, 15(11), 676.
6. Beduschi, A. (2022). Harnessing the potential of artificial intelligence for humanitarian action: Opportunities and risks. *International Review of the Red Cross*, 104(919), 1149-1169. http://international-review.icrc.org/articles/harnessing-the-potential-of-artificial-intelligence-for-humanitarian-action-919
7. Berntzen, L., Sørensen, J. L., Johannessen, M. R., Nielsen, L. R., Sandberg, L., Carlström, E., & Khorram-Manesh, A. Using Artificial Intelligence to Support Emergency Management Training Creating Efficient and Realistic Scenarios with ChatGPT. // Proceedings of the Conference: The Fourteenth Internation-

al Conference on Smart Cities, Systems, Devices and Technologies, – April 2025, P.34-41. https://www.researchgate.net/publication/390678144_Using_Artificial_Intelligence_to_Support_Emergency_Management_Training_Creating_Efficient_and_Realistic_Scenarios_with_ChatGPT

8. Coffey, L. (2023, October 31). Students Outrunning Faculty in AI Use. *Inside Higher Ed*.
9. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press.
10. Gowda, N. R., Kumar, A., Sanjay K. A. and Vikas, H. (2020). The Information Imperative: To Study the Impact of Informational Discontinuity on Clinical Decision Making among Doctors. BMC Medical Informatics and Decision Making, 20 (1), 175. https://doi.org/10.1186/s12911-020-01190-2
11. Gözalan A, John O, Lübcke T, Maier A, Reimann M, Richter J-G, Zverev I. Assisting Maritime Search and Rescue (SAR) Personnel with AI-Based Speech Recognition and Smart Direction Finding. *Journal of Marine Science and Engineering*. 2020; 8(10):818. https://doi.org/10.3390/jmse8100818
12. Hauri, A., Kohler, K., Roth, F., Käser, M., Prior, T., & Scharte, B. (2020). Trend Analysis Civil Protection 2030: Uncertainties, Challenges and Opportunities. CSS Risk and Resilience Reports. https://doi.org/10.3929/ethz-b-000455250
13. Hui, Jeffrey & Jun, Melvin & Zimou, Zeng & Yeo, Soon & Tan, Mei & Wang, Yixiao & Lee, Chee & Chatterjee, Chandrima & Noller, Yannic & Agus, Natalie & Khan, Sumbul & Thahir, Ibrahim & Elara, Mohan & Ang, Lay & Anariba, Fra. (2024). A TRANSDISCIPLINARY STEAM X D WORKSHOP ON AI RESCUE ROBOTICS FOR PRE-UNIVERSITY STUDENTS. 402-407. 10.35199/EPDE.2024.68. https://www.designsociety.org/download-publication/47268/A+TRANSDISCIPLINARY+STEAM+X+D+WORKSHOP+ON+AI+RESCUE+ROBOTICS+FOR+PRE-UNIVERSITY+STUDENTS
14. International Committee of the Red Cross. (n.d.). Harnessing the potential of artificial intelligence for humanitarian action. Retrieved from http://international-review.icrc.org/articles/harnessing-the-potential-of-artificial-intelligence-for-humanitarian-action-919
15. Kohler, K. (2021). Strategic foresight: Knowledge, tools, and methods for the future. *CSS Risk and Resilience Reports*. https://doi.org/10.3929/ethz-b-000505468
16. KOHLER, Kevin; SCHARTE, Benjamin. Integrating AI into Civil Protection. *CSS Analyses in Security Policy*, 2020, 260. https://doi.org/10.3929/ethz-b-000408269
17. Moroney, L. (2020). AI and machine learning for coders: A programmer's guide to artificial intelligence. *O'Reilly Media*.
18. Panukhnyk, O. (2023). Штучний інтелект в освітньому процесі та наукових дослідженнях здобувачів вищої освіти: відповідальні межі

вмісту ШІ. Галицький економічний вісник. Том 84. № 4. С. 202-211. https://doi.org/10.33108/galicianvisnyk_tntu2023.04.202
19. Russell, S. J., & Norvig, P. (2010). Artificial intelligence: A modern approach (3rd ed.). Prentice Hall.
20. Senarath, Y., Pandey, R., Peterson, S., & Purohit, H. (2022). Citizen-helper system for human-centered AI use in disaster management. In International Handbook of Disaster Research (pp. 1-21). *Singapore: Springer Nature Singapore*.
21. Simonavičiūtė, P., Navickas, V. (2022). The Features of Business Digitization Development Indicators in Selected Economies. *Journal of Management*, 2(38), 87–94. https://doi.org/10.38104/vadyba.2022.2.08
22. Smotr O., Karabyn O., Malets I. and Golovatyi R. (2024). Research on the feasibility of employing gamification technologies in the training process of IT specialization seekers. *Proceedings of the IX International Workshop on Professional Retraining and Life-Long Learning using ICT: Person-oriented Approach (3L-Person 2024)*: vol 3781, pp 60-77. Springer, https://ceur-ws.org/Vol-3781/; URN: urn:nbn:de:0074-3781-0 ; https://sci.ldubgd.edu.ua/jspui/handle/123456789/13991
23. Smotr, O., Karabyn, O., Loza, V. (2024). Трансформація діяльності викладача. Нові підходи та технології підготовки освітніх матеріалів. Штучний інтелект у науці та освіті (AISE 2024). *Artificial intelligence in science and education :* збірник матеріалів міжнародної наукової конференції (Київ, 1-2 березня 2024 р.) [Електронний ресурс]. – Київ : УкрІНТЕІ, 2024. ст.263-266., DOI: 10.35668/978-966-479-141-7
24. Switchboard TA. (n.d.). Insights from the field: The use of artificial intelligence in resettlement work. Retrieved from https://www.switchboardta.org/insights-from-the-field-the-use-of-artificial-intelligence-in-resettlement-work/
25. Tracey, E. A. (2024, September 16). Four Uses of AI to Improve Fire Service Training Programs. *Firehouse Magazine*.
26. Tupá, M., Kordoš, M., & Mozolová, V. (2024). Digitization processes in slovak healthcare sector-the issue of slovak doctors and nurses. *Management/Vadyba* (16487974), 40(1).
27. Ångström, R. C., Björn, M., Dahlander, L., Mähring, M., & Wallin, M. W. (2023). Getting AI Implementation Right: Insights from a Global Survey. *California Management Review*, 66(1), 5-22. https://doi.org/10.1177/0008125623119043

Taras Rak is a Doctor of Technical Sciences (in a field of Information Technologies) with extensive academic and administrative experience. He is Vice-Rector of IT STEP University (Lviv, Ukraine) and Professor at Lviv Polytechnic National University (Lviv, Ukraine). His research interests include information and communication technologies in education, decision support systems, education quality assurance, and IT in civil protection and fire safety. Prof. Rak has authored over 150 scientific and educational publications. He has actively contributed to numerous international and national projects, including Erasmus+ initiatives, Polish-Ukrainian cooperation in civil protection, and British Council programs. He organized and co-organized several international and national conferences in various scientific fields. Taras Rak regularly participates in specialized academic councils and expert groups, and has presented at conferences across Europe. His academic background combines degrees in information technology and system analysis, complemented by international training and internships in the UK, Poland, the Netherlands and Estonia. Address: 17/31, Shafaryka st., Lviv, 79032. Phone: +380676739064. E-mail: raktaras74@gmail.com. ORCID ID: https://orcid.org/0000-0003-0744-2883

Olga Smotr is a Candidate of Technical Sciences (in a field of Information Technologies), an Associate Professor at the Department of Information Technologies and Electronic Communication Systems at Lviv State University of Life Safety (Lviv, Ukraine). She research interests include information and communication technologies in education, decision support systems, education quality assurance, and IT in civil protection and fire safety. Dr. Smotr is the author of over 50 scientific and educational publications, 11 of which are indexed in Scopus and Web of Science databases. She has participated in more than 50 scientific conferences. She is also the author or co-author of 8 educational and methodological publications. She served as the responsible executive for 4 research projects commissioned by central and local government bodies and holds the position of Deputy Editor-in-Chief of the scientific journal "Bulletin of Lviv State University of Life Safety ". Address: 9, Zymova st., Lviv, 79020. Phone: +380676731428. E-mail: olgasmotr@gmail.com. ORCID ID: https://orcid.org/ 0000-0003-2767-5019

Editorial Office Address:
Lithuania Business College
Turgaus street. 21,
Klaipeda. Lithuania
Phone: +370 46 311099

publisher@ltvk.lt
www.ltvk.lt

Klaipėdos universiteto leidykla

SUSTAINABLE DEVELOPMENT SOLUTIONS:
REGIONAL ASPECTS

Monograph

Maketavo Karolis Saukantas

Klaipėda, 2025

SL 1335. 2025 11 06. Apimtis 11,41 sąl. sp. l. Tiražas 150 egz.
Klaipėdos universiteto leidykla, Herkaus Manto g. 84, 92294 Klaipėda
Tel. (8 46) 398 891, el. paštas: leidykla@ku.lt, interneto adresas: http://www.ku.lt/leidykla/
Spausdino BooksFactory.co.uk, PRINT GROUP Sp. z o.o., ul. Cukrowa 22, 71-004 Szczecin, Poland