Smart projects on the development of green intellectual capital in eco-industrial parks

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Abstract. The study examines problems related to excessive environmental pressure on the ecosystem caused by industrial activities. It suggests constructing eco-industrial parks to optimize production and natural resources, monitor the condition of environmental safety in a limited territory with a developed infrastructure, and create green intellectual capital. The approach to the maximum automation of territories and introducing startups for the continuous modernization of the production and landscape park as part of the eco-industrial park is substantiated. It is proven that smart projects on the development of green intellectual capital based on eco-industrial parks will positively affect their implementation, can become a promising project for foreign investors, and can enhance the environmental safety of settlements. According to the model, for a settlement with a population of 1,500 people that works in an eco-industrial park, the utility function per person will increase by 12% when building a joint system of innovative ecological production and increasing the level of the country's green capital.

1 Introduction

Due to the development of Industry 5.0, intelligent projects that support automated systems and can improve the quality of the ecosystem and social life are becoming popular among broader population segments, particularly in government projects on populated area development and at innovative enterprises.

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The limits of eco-, bio-, and digital environments are gradually disappearing, creating a single system of green intellectual capital. The rapid growth, volatility, and expansion of the range of technology adoption now characterize the degree of technology development. At the same time, the increasing number of service users and the increase in information dissemination tools contribute to the creation of smart projects and innovative product markets [1–3]. In recent years, municipal projects have significantly enhanced education development in this area, providing young entrepreneurs with opportunities for implementing their ideas and increasing the population's level of digitalization. One also launched crowdfunding platforms to test projects and find investments. A wide range of smart projects are being implemented in Kyiv, particularly in the Kyiv Digital app that allows using public services remotely on mobile devices [4].

Smart technology, artificial intelligence, increased efficiency of activities, and maximization of human potential, along with an increased level of service and access to knowledge, have created conditions for innovation adoption in almost all areas of human life [5–7]. At the same time, we keep struggling to preserve the state of the ecosystem and reduce the anthropogenic impact that significantly worsens the quality of the environment and has become a global problem for the entire planet. Hence, the solution of green intellectual capital is relevant to all countries and has a single interrelated functioning system. Increased consolidation and migration processes create a shared territory of life for biological organisms, the priority of which is safety, survival, and a focus on the future..

2 Literature review

Various areas of human activities are now facing specific problems of modernization of production, goods and the level of services due to the constant development of intelligent technology and the increasing environmental friendliness of human activities [8]. The ability to think critically and forecast creates conditions for the constant development of human intellectual capital. However, there are many difficulties in the adoption of innovations, in particular, the long process of approving new standards in the construction industry, the structure and organization of the construction industry, and bureaucracy results in the higher cost of intelligent construction methods and materials as well as make the implementation process less transparent, according to Frank Ato Ghansah et al. [9].Scientists and representatives of business structures state that smart project programs have become global but differ significantly in each country [10]. The concept of provincialization and urbanization raises many controversial issues, particularly environmental and life safety issues. However, compromises and the restructuring of the existing worldview are possible due to complementarity [11].

Environmental modernization aims to create a maximum natural environment for this area and rationalize used resources. Thus, it starts with industrial transformations and ends with changes in each individual's life in the analyzed territory [12]. Revell argues that political and economic goals dominate over environmental ones, so when desiring to turn the country’s economy into an environmentally oriented one, most projects have failed, even in such countries as the UK, which is a developed country in relation to Ukraine and has more opportunities to implement environmental startups [13]. Korhonen [14] considers environmental modernization not as a social goal but as an indicator of environmental changes required to improve the living standards of the population, focusing on improving eco-efficiency and the constant development of industrial territories.

In 2006, the United Arab Emirates initiated the Masdar City project, developed a map of the city, stipulated key development trends and the necessary principles of construction based on the creation of green intellectual capital and the concept of sustainable development, and is currently under construction, which should be completed in 2030 [15].

3 Theoretical frameworks

Since 2019, Ukraine has been implementing a program from the Global Eco-Industrial Parks Program - Ukraine: Country Level Intervention with a total budget of 1,900,255 USD under the auspices of the United Nations Industrial Development Organization (UNIDO) [16]. Modernizing industrial parks to turn them into green intellectual capital is a capital-intensive and labor-intensive task due to limited financial resources in Ukraine and the need to create conditions for proper maintenance of ecoparks, which is costly and requires support at the local level. Therefore, the Plan of the Government of Ukraine for 2023 envisages, in particular, the development of a draft law on the introduction of amendments to some laws of Ukraine regarding the introduction of the eco-industrial park model, increasing the economic efficiency of the functioning of industrial parks and minimizing their impact on the surrounding natural environment, industrial and organizational relations within the framework of industrial parks The implementation of such legislative initiatives involves: 1) implementation within the framework of industrial parks: principles of sustainable development, circular economy approaches, resource-efficient and clean production; 2) reduction of the negative impact caused by environmental pollution; 3) increasing the efficiency of the use of resources and waste, in particular, by creating closed cycles of their use and industrial symbiosis; 4)increasing production and use of energy from renewable sources; 5) improving the quality of the social component both within the parks and outside them, in particular on a local and regional scale, improving the quality of management at the park level [17].

Modernization of modern industrial parks to their transformation into green intellectual capital is a capital-intensive and labor-intensive task because of limited financial resources in Ukraine and the need to create conditions for maintaining eco-parks properly, which is also costly and should be supported locally. Based on [18-20], a strategy for the development of changes in domestic industrial parks is proposed through their modernization with the obligatory presence of such elements as:

- Availability of green capital: deciduous, coniferous, bush plantings, flowerbeds, green hedges (Yew, Thuja, etc.).
- Equipping the territory with an automatic watering system for plants.
- Equipping the future eco-park with infrastructure objects: the availability of pathways for pedestrians, bicycle pathways, jogging pathways, stations for generating and accumulating solar energy to create autonomous lighting of territories, the availability of innovative recreational areas (benches) with the possibility to charge electronic devices, free access to the Internet, a large number of public landfills with the possibility to separate waste by at least four fractions and a light indicator at night with a built-in solar panel.
- Permanent access to drinking water in the form of drinking fountains equipped with cutting-edge water treatment systems (filters) with the possibility of their constant replacement and monitoring of water.
- Constant access to shared toilets in compliance with all sanitary norms.
- Separate area for staying with animals (a place for walking animals) and the constant availability of bags for cleaning the territory from animal products.
- Availability of a natural or artificial water body with automatic control of the state of this water body and the possibility of aquaculture.
- Interactive recreation area for children and parents (playground).
- Constant monitoring of air quality and prevention of exposure to undesirable anthropogenic factors within the impact.
- The possibility to implement innovative startups for residents every quarter, the funding of which will be provided by local authorities or regional private entrepreneurs on competitive terms.

It is offered to hold a quarterly competition of startup projects among residents of the local community for the development of green intellectual capital based on eco-industrial parks, the results of which would allow implementation projects and increase the innovative potential of eco-parks. With the construction of innovative eco-parks being a priority for residents who will experience a significant effect on their functioning, a group interested in modernizing industrial parks will be formed based on the labor and financial potential of the local community and businesses in this territory.

Modernizing industrial parks improves the comfort and livability of the populated area, so we can consider these changes in recreational areas as changes in the public utility function of the analyzed populated area. Communities having more financing to build an innovative eco-park will increase the utility function if there is no corruption due to the optimization of costs. Expenses for park maintenance will be considered constant and correlated with the quality of services, i.e., increasing expenses for eco-park maintenance will enhance innovativeness, the quality of staff, the number of implemented startups, and the popularity among visitors. The increase in human flow in the eco-park will increase the income of entrepreneurs engaged in business in the territory around the park through advertising or visual representation of the institution's goods [21]. Building an innovative park is also predicted to create additional jobs for community residents interested in doing high-quality work, as they are consumers of the obtained results.

According to Gali's models, the target function of a small group of people using an eco-industrial park depends on consumption and income, stability of the external environment and wage flexibility in terms of changes and stresses and comfort of the used territory. To optimize the activity of the small group of people or the household, one can use the dependence that maximizes the intrinsic utility function (U_t):

$$U_t = M_t \sum_{s=0}^{\infty} (\beta^s (z_t^c \log(C_{t+s} - H_{t+s}) + in_s) - z_t^l \frac{\emptyset}{1+\varphi} l_{1+s}^{1+\varphi}) \quad (1)$$

Household utility positively depends on the deviation of consumption (C_t) at the time interval t from the variable of external consumption habits (H_t – external habits) and negatively on the number of hours worked – l (t). M_t is a conditional mathematical expectation operator derived from all available information at time t; β is a subjective discount coefficient reflecting intertemporal advantages of the small enterprise; in is the number of cultural park green spaces per one person in the given territory; ϕ is the inverse of the wage flexibility of labor supply; ∅ is a normalization constant. Components of the equation z_t^c and z_t^l represent exogenous changes in the benefits of consumption of goods and services and leisure time by the small enterprise (household) [22].

The utility function for the enterprise can also be shown using the following dependence:

$$U_t = \frac{\sum_{n=1}^{N} \frac{w_t l_t - T_t}{in}}{n} + \frac{Ec_t}{n} + \frac{Kom_t}{n} + \frac{inov_t}{D} \quad (2)$$

W_t – the average nominal wage for the project per 1 person; N – the number of individuals whose activities are analyzed; Lt – the demand for labor for a group of people, household (goods); T_t – taxes paid in period t; in – the consumer price index or inflation rate (their sum if both are present); E_c – the coefficient of the cost of implementing environmental projects for the given period; K_{om} – the coefficient of the cost of implementing projects that increase the level of comfort for this community during the given period; I_{nov} – intellectual capital or the cost of innovative changes (adoption of innovations) for the given period; D – the total profit of the community (enterprise, household) for the given period.

4 Results

According to the State Statistics Committee of Ukraine, as of January 1, 2022, Ukraine has 1469 territorial communities with 461 cities and 881 townships and 28369 settlements with 41167335 inhabitants, 70% of which are urban residents [23]. The strategy for cooperation between enterprises located in the same industrial park has a range of positive effects: the joint use of resources and waste, transport and logistics links, the systematic approach and modernization of educational and professional centers that can work together with enterprises and optimize production, common environmental modernization, exchange of knowledge and technology, etc., creating a unified, innovative system of eco-industrial parks.

According to the model, for a settlement with a population of 1500 people working in the eco-industrial park (using the eco-industrial park), the utility function per person will increase by 12% when building a common system of innovative environmental production. The creation of eco-industrial parks is primarily caused by the desire of individuals to improve their living standards by increasing the comfort of their surroundings, which is not a primary need. However, it is an essential criterion for optimizing life activities in the multi-criteria target function when choosing the most appropriate habitat. In the case of the rational behavioural model of Ukrainian people, their existence will be satisfied first. At the same time, environmental friendliness will become a secondary criterion, but other factors will affect consumer choice. Currently, Ukraine has an industrial park development strategy. However, it does not imply the adoption of innovations and the creation of green capital, which are necessary in places of high environmental risk. Therefore, combining industrial parks with recreational places based on green spaces is crucial for a comfortable human existence in the ecosystem. Besides, constructing innovative eco-industrial parks optimizes the country’s land resources, making space for alternative uses to construct recreational areas in populated areas.

In this study, an experimental study was conducted based on the selection of essential criteria, in particular the presence of a recreation park as an additional option when buying real estate to live in Kyiv in the event of a cessation of hostilities. Respondents were divided into groups based on decision-making time, where time constraints were considered an additional stress factor, making it impossible to think deeply about actions. The following scenario considers the additional impact of another interested person on decision-making. This person encouraged the potential buyer to choose hints and examples of successful living in the area away from the eco-park. The study was conducted using data from the Real Estate Ukraine staff. It involved 300 potential buyers desiring to purchase real estate in Kyiv.

Figure 1 shows that the most significant percentage of respondents prefer built houses put into operation because of Ukraine's experience with many unfinished or unimplemented projects. Thus, the smart project under construction is the object abandoned more often (the decrease by 12% without time constraints and 27% with time constraints) when influenced by a third party. It shows the instability of consumer choice and the impact of external factors on the choice despite the increased comfort in the building under construction. The desire to use the purchased product as soon as possible prevails over the desire for more comfortable housing in the future. This example illustrates the different costs of public goods, even at the same price, depending on the use time. The value of goods that will be available soon is higher than those in the future, even at the same price, and prevails over other selection criteria.

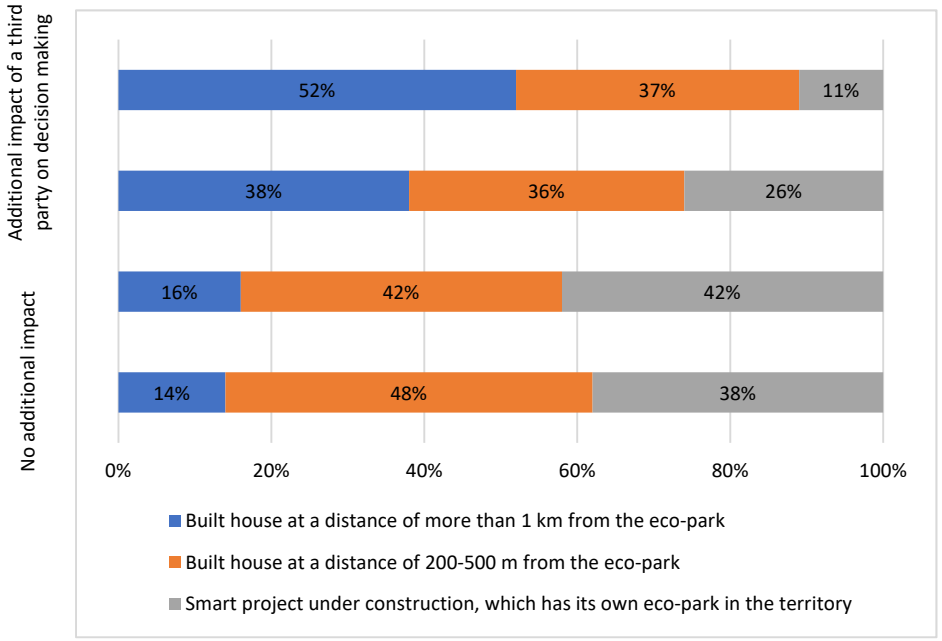

Fig. 1. Tendency to purchase real estate based on the distance to the eco-park, time constraints and the indirect impact of a third party.

When time is limited, as an additional stress factor, individuals make a decision reflexively according to their own desire, having no time to analyze the market, the situation and priorities, so an impulsive choice is more objective for consumers in terms of their own needs at the moment. However, with the third party influencing the choice, individuals tend to accept the other person's point of view to remove their responsibility for the incompletely analyzed choice. Thus, with time constraints and the involvement of the third party in the decision-making process, the number of those desiring to buy a house located at a distance of more than 1 km from the eco-park increased to 52% from 14%. Without additional impacts, most of the population (48%) was inclined to buy a house located 200-500 m from the eco-park and preferred the environmental friendliness of their existence. In this case, 86% of the population considered it essential to have a modern eco-park and comfort of living. The significance level of environmental friendliness and comfortable existence decreased due to additional impacts, with a minimum value of 48%, almost two times less than the control values (without other impacts).

Figure 1 allows us to conclude that the presence of an expert when purchasing goods significantly impacts the result, even if the expert recommends a less eco-friendly product. Thus, values without time constraints for purchasing non-environmental goods changed by 24%, while values with time constraints changed by 36%.

An additional survey was also conducted among individuals who bought real estate far from eco-parks one month after the transaction and offered to exchange the purchased property for real estate with the same indicators (already built) but with an eco-park. 2% of surveyed people agreed to the exchange, which indicates the population's desire for stability and reluctance to change the existing habitat. We can also additionally consider the effect of ownership in this situation: i.e., real estate owned by the individual has a higher value than real estate that can be purchased in the future, as the future has particular uncertainty and additional risks for the buyer, whereas the purchased real estate is already tried and

tested and used for its intended purpose. About 2% of the 150 buyers surveyed turned out to be owners of real estate purchased for rent, i.e., to create a business without using the given product. According to these individuals, the exchange for real estate near eco-parks was profitable because this property could be rented out more expensively, so the decision was made in favor of the exchange to generate additional income. This study suggests that it is easier for individuals to part with objects that they own but do not use (for example, as a business) than with the object of their use. It creates the additional effect of owning goods, which increases their value [24].

According to the research, we can conclude that the successful implementation of smart projects for the development of green intellectual capital requires the example of their functioning in developed countries and the availability of experts offering public and private entities the opportunity to develop this segment of improving the infrastructure of populated areas.

It would be appropriate for further research to investigate the influence of society (rather than a single expert consultant) on decision-making where one considers the choice between environmental and less environmental goods (the individual's habitat). According to our hypothesis, societal influence can significantly impact the choice (even if there are apparent benefits to the environmental project) and create avalanche-like demand flows for goods with less benefit to the individual than an alternative environmental project. It should be especially noticeable in the context of time constraints or another stress factor. In this case, behavioral and social influences will be more critical in decision-making than rational consumer choice [25]. When proving this hypothesis, information can increase the demand for goods, stimulate specific actions of buyers by creating an artificial attraction to the product, and introduce a stress factor simultaneously. Such studies can be conducted using groups of indicators characterizing green human capital, organizational green capital, and relationship capital, with an assessment of their mutual influence according to the methodology [26].

The increase in the level of importance of the ecological condition for citizens of Ukraine will create the need to build eco-industrial parks to produce the green capital of the country, so the need for such actions is already becoming urgent at the end of military operations in the period of Ukraine's reconstruction. The general scheme of eco-industrial park construction is shown in Fig. 2.

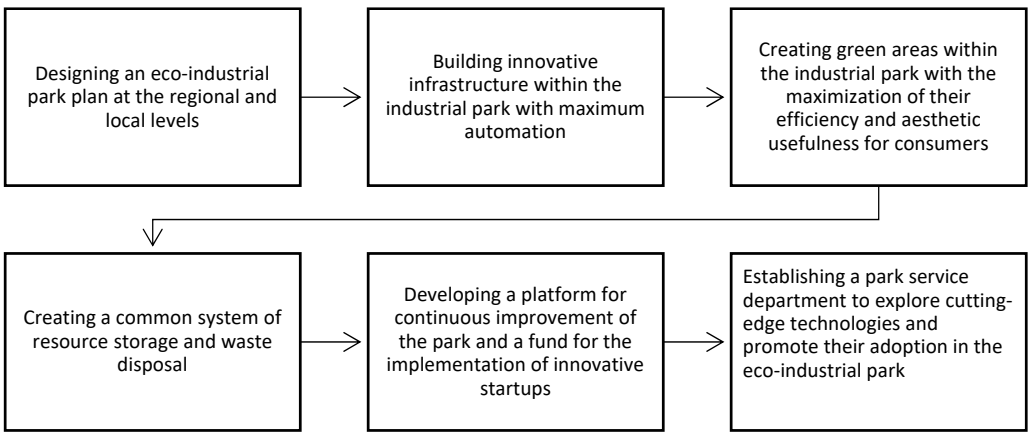

Fig. 2. Scheme of creating the eco-industrial park to increase green capital of the country.

The implementation of each stage from Figure 2 should be based on the principles of smart projects implemented in the eco-industrial park: environmental friendliness, high tech, increased function of public utility, investment attractiveness, creativity and availability of art objects, increased safety, and continuous development.
It is calculated that the land under industrial facilities in different areas has less utility than the public utility of the innovative industrial eco-park:

$$U(\sum S_v) <= U(S_p) + U(k_r + k_e) + U(k_l) \quad (3)$$

where $U(S_v)$ is the utility function depending on the sum of territories under industrial facilities of the populated area (district); $U(S_p)$ is the utility function of the use of land for the innovative industrial eco-park; Kr is the coefficient of rationalization of natural resources (the correlation between total expenses for production resources and disposal of industrial waste after the construction of the project and total expenses for production resources and waste disposal of the innovative industrial eco-park; k_e is the coefficient of environmental friendliness (the correlation between the sum of expenses for neutralizing adverse effects that cause ecosystem degradation and the construction of the project and after the construction of the innovative industrial eco-park summed with the coefficient of increasing the green potential of territories); k_l is the coefficient of logistics operations and infrastructure (the correlation between expenses for the creation of infrastructure and logistics services of the enterprise for the studied period before the construction of the project and after the construction of the innovative industrial eco-park).

According to this model, it was calculated using the example of the enterprise producing construction materials in Switzerland that the public utility from the construction of the innovative industrial eco-park increased by 18% in relation to indicators of the enterprise located in a separate territory and not implying the creation of a recreational area with green capital. The utility function has increased due to the optimization of land resources (5%), joint development of infrastructure (2%), creation of new logistics links (2%), creation of a common system of waste disposal (4%), environmental monitoring systems (1%), increased productivity of employees by improving working conditions (2%), creation of additional green capital (0.3%), the introduction of alternative energy generation systems (1.7%).

5 Conclusions

Implementing smart projects for developing green intellectual capital based on eco-industrial parks in Ukraine increases the productivity of available resources. It has a positive environmental effect on businesses and society. It is suggested that implementation on the territory of Ukraine should be restored or modernized. The concentration of production in a limited territory will positively impact the efficiency of using resources, the monitoring of enterprise activities, logistics, and infrastructure expenses included in the budget of enterprises. The part of the local population living around the influence of the eco-industrial park is the most interested in its development. Therefore, it is desirable to create a unit for developing industrial and surrounding park territories by holding a competition for innovative projects and a constant search for external investments in the implementation of technological development in the eco-park. It is concluded that local communities, as the most interested part of the population, will be able to use financial and labor resources more efficiently, implement their intellectual projects in this area, which can be selected using a quarterly competition, and monitor the state of the ecological environment. The study analyzes the choice of place to purchase real estate depending on the distance to the eco-park.

It is concluded that the impact of third parties is significant in decision-making and can increase due to stress factors. Therefore, the government and society should widely support the establishment of an eco-friendly society and increase the level of importance of the environmental factor when creating the target function of production. It is proposed to create green capital within the industrial park and automated recreational area with the need to adopt green technologies. It is revealed that the tendency of the population of Kyiv toward ecological existence decreases because of stress factors and third-party influences. At the same time, the state of ecology is an essential factor in decision-making for 86% of the population. It is proven that the creation of eco-industrial parks will improve the efficiency of enterprise activities by 18% in relation to the company's independent existence. Due to the instability and risk factors, objects that have already been implemented and put up for sale have a higher value for the population of Ukraine than projects to be implemented, even given the significant advantages of the latter and the same expenses in cash equivalent.

It means that society is not ready to implement the global reconstruction of infrastructure with the possibility of its use in the future and shows the significant impact of uncertainty on the decision-making process. The value of funds today is much higher for Ukrainians than the value of funds after a certain period (similar to goods that are already available and can be produced), which can be an additional barrier to the introduction of eco-friendly technologies that have a long-term effect and require a time range for adoption.

References

1. Kotenko, S., Nitsenko, V., Hanzhurenko, I., & Havrysh, V. (2020). The mathematical modeling stages of combining the carriage of goods for indefinite, fuzzy and stochastic parameters. International Journal of Integrated Engineering, 12(7), 173-180. https://doi.org/10.30880/ijie.2020.12.07.019
2. Megits, N., Aliyev, S.T., Pustovhar, S., Bielialov, T., & Prokopenko, O. (2022). The «five-helix» model is an effective way to develop business in industry 4.0 of selected countries. Journal of Eastern European and Central Asian Research, 9(2), 357–368. http://dx.doi.org/10.15549/jeecar.v9i2.920
3. Tirto, T., Ossik, Y., & Omelyanenko, V. (2020). ICT support for industry 4.0 innovation networks: Education and technology transfer issues. In Lecture Notes in Mechanical Engineering (pp. 359–369). Springer. https://doi.org/10.1007/978-3-030-22365-6_36
4. Kyiv Digital. (2022). https://kyiv.digital/start
5. Demikhov, O.I., Shipko, A.F., Singh, H.H., Saleh, N., Shklyar, S.P., & Dehtyarova, I.O. (2020). Intersectoral component of the healthcare management system: Regional programs and assessment of the effectiveness of prevention of bronchopulmonary dysplasia. Azerbaijan Medical Journal, (2), 88-96.
6. Morgulets, O., Arabuli, S., Nyshenko, O., Arabuli, A. (2020). Analytical assessment of the apparel industry in Ukraine: Problems and opportunities. Vlakna a Textil, 27(3), 111–118.
7. Semenets-Orlova, I., Klochko, A., Shkoda, T., Marusina, O., Tepliuk, M. (2021). Emotional intelligence as the basis for the development of organizational leadership during the covid period (educational institution case). Estudios De Economia Aplicada, 39(5). https://doi.org/10.25115/eea.v39i5.5074

8. Halkiv, L., Karyy, O., Kulyniak, I., Kis, Y., & Adamovsky, A. (2022). Human Potential Innovatization Analysis: the System of Crisis Management Determinants Context. CEUR Workshop Proceedings, 3171, 1606-1616.
9. Ghansah, FA, Owusu-Manu, DG, & Ayarkwa, J. (2021). Project Management Processes in the Adoption of Smart Building Technologies: A Systematic Review of Constraints. Smart and Sustainable Built Environment. 10 (2), 208-226.
10. Hilorme, T., Sokolova, L., Portna, O., Lysiak, L., & Boretskaya, N. (2019). Smart grid concept as a perspective for the development of Ukrainian energy platform. IBIMA Business Review, 2019, 923814.
11. Burns, R., Fast, V., Levenda, A., Miller, B. (2021). Smart cities: Between worlding and provincialising. Urban studies, 58(3), 461-470.
12. Van Koppen, K., & Mol, A. P. (2020). Ecological modernization of industrial ecosystems. In The Ecological Modernisation Reader (pp. 295-317). Routledge.
13. Revell, A. (2005). Ecological modernization in the UK: rhetoric or reality? European Environment, 15(6), 344-361.
14. Korhonen, J. (2008). Reconsidering the economics logic of ecological modernization. Environment and Planning A, 40(6), 1331-1346. https://doi.org/10.1068/a38363
15. Rietmann, H. (2021). Ecological Modernization in the United Arab Emirates?. In Ecological Modernization in the United Arab Emirates? De Gruyter. https://doi.org/10.1515/9783110749298
16. UNIDO. (2022). Open Data. https://open.unido.org/projects/UA/projects/180320
17. Cabinet of Ministers of Ukraine. (2023). On the approval of the plan of priority actions of the Government for 2023. https://zakon.rada.gov.ua/laws/show/221-2023-%D1%80#Text
18. Aristana, I. N., Arsawan, I. W. E., & Rustiarini, N. W. (2022). Employee loyalty during slowdown of Covid-19: Do satisfaction and trust matter?. International Journal of Tourism Cities, 8(1), 223-243.
19. Orozonova, A., Gapurbaeva, S., Kydykov, A., Prokopenko. O., Prause, G., Lytvynenko, S. (2022). Application of smart logistics technologies in the organization of multimodal cargo delivery. Transportation Research Procedia, 63, 1192–1198. https://doi.org/10.1016/j.trpro.2022.06.124
20. Reinhold, K., Järvis, M., Tint, P. (2009). Risk observatory—a tool for improving safety and health at the workplace. International Journal of Occupational Safety and Ergonomics, 15(1), 101–112. https://doi.org/10.1080/10803548.2009.11076792
21. Koval, V., Borodina, O., Lomachynska, I., Olczak, P., Mumladze, A., & Matuszewska, D. (2022). Model Analysis of Eco-Innovation for National Decarbonisation Transition in Integrated European Energy System. Energies, 15(9), 3306. https://doi.org/10.3390/en15093306
22. Galí J., López-Salido J. D., & Vallés J. (2007). Understanding the effects of government spending on consumption. Journal of the European Economic Association, 5(1), 227-270. https://doi.org/10.1162/JEEA.2007.5.1.227
23. State Statistics Service of Ukraine (2023). ukrstat.gov.ua.
24. Koval, V., Olczak, P., Vdovenko, N., Boiko, O., Matuszewska, D., & Mikhno, I. (2021). Ecosystem of Environmentally Sustainable Municipal Infrastructure in Ukraine. Sustainability, 13(18), 10223. http://dx.doi.org/10.3390/su131810223

25. Demianchuk, M., Koval, V., Hordopolov, V., Kozlovtseva, V., & Atstaja, D. (2021). Ensuring sustainable development of enterprises in the conditions of digital transformations. E3S Web of Conferences, 280, 02002. https://doi.org/10.1051/e3sconf/202128002002
26. Khaustova, Y., Durmanov, A., Dubinina, M., Yurchenko, O., & Cherkesova, E. (2020). Quality of strategic business management in the aspect of growing the role of intellectual capital. Academy of Strategic Management Journal, 19(5), 1-7.
27. Stefanov, T., Varbanova, S., & Stefanova, M. (2022). An Overview of some popular devices and technologies designed for blind and visually impaired people. 2022 International Conference Automatics and Informatics (ICAI), Varna, Bulgaria, pp. 173-178. https://doi.org/10.1109/ICAI55857.2022.9959981.
28. Martini, I., Arsawan, I., Sari, D., & Muna, N. (2023). Increasing product competitiveness in weaving SMEs: The role of competency, creativity, and performance. Uncertain Supply Chain Management, 11(3), 855-866.
29. Suhartanto, D., Kartikasari, A., Arsawan, I. W. E., Suhaeni, T., & Anggraeni, T. (2022). Driving youngsters to be green: The case of plant-based food consumption in Indonesia. Journal of Cleaner Production, 380, 135061.