

DIGITALIZATION A NECESSITY FOR SUSTAINABLE BUSINESS

Claudia Ramona CIOCNITU (STOICONI)

Business Administration, Faculty of Economic Sciences, University of Oradea, Romania
stoiconi_claudia@yahoo.com

Abstract: *Digitization, with its profound impact on business, manifests itself in increased efficiency, innovation and competitiveness. This transformation process requires comprehensive readiness assessments and improvement plans. Digitization is essential in driving value creation, operational efficiency and driving innovation, thereby shaping sustainable business practices. The adoption of digital technologies is essential for strengthening economic performance, mitigating the impact on the environment and promoting societal sustainability goals.*

This research proposes to analyse the ramifications of digitization in the field of sustainable business. Its main objective is to analyse how digital technologies have influenced and shaped businesses that adopt economic, social and environmental sustainability. To achieve this objective, a methodological review, based on academic research articles, was undertaken to elucidate how the conceptualization of digitization as a catalyst for changing sustainable business paradigms has evolved. This effort involved delineating digital technologies, discerning prevailing trends, and identifying best practices to drive sustainability goals within business operations. In addition, the review encapsulated the challenges and risks inherent in digitization in relation to sustainable business, encompassing concerns such as cyber security, regulatory compliance and ethical considerations. Finally, the research provided a forecast of the digital trajectory of sustainable business, highlighting emerging trends and potential development trajectories. The research findings underscore the imperative for sustainable businesses to adopt a strategic and meticulously planned approach. This involves investing in robust cyber security measures, upskilling the workforce in digital skills, conscientiously assessing the environmental footprint of technology and formulating robust ethical frameworks. By deftly navigating these challenges, businesses can optimize the dividends of digitization while maintaining their commitment to sustainability.

While certain sustainable solutions may demonstrate effectiveness on a smaller scale, their scalability is essential to making a substantial impact on sustainability goals. Addressing the scalability issue requires concerted efforts by government bodies, businesses, communities and individuals, augmented by investments in education, technology and research. These innovative efforts hold promise for addressing global challenges such as climate change, biodiversity loss and socio-economic disparities, while fostering economic prosperity and societal well-being.

As businesses delve deeper into the realms of digitization, the concomitant risks associated with data security and privacy escalate proportionately. Therefore, adopting strict cyber security protocols becomes of paramount importance. In conclusion, the digital frontier of sustainable business presents fertile ground for innovation and expansion. Combining digital talent with sustainability imperatives can generate business models that not only thrive economically, but also contribute significantly to social well-being and environmental conservation.

Keywords: *digitization; sustainable business; digital technologies; cyber security; scalability; innovation.*

JEL Classification: O33; M15; Q55; L86.

1. Introduction

In the current context marked by an accelerated transition towards digitalization, specialized literature reflects a growing interest in exploring the impact of this phenomenon on business models. Caputo (2021) emphasizes that digitalization has become a predominant research topic, highlighting its essential role in increasing operational efficiency and access to data and analytics, which, in turn, can enhance customer experience, innovation, adaptability, and market competitiveness. This trend underscores an imperative necessity for companies to adapt to the new realities of the business environment.

Machado (2019) highlights the importance of assessing the digital readiness of companies and developing concrete improvement plans. This is a vital preliminary measure for any organization aiming to successfully navigate the challenges of digitalization. In this regard, Martínez-Caro (2020) suggests that access to a vast amount of digitized data represents a new and valuable source of value generation for companies, involving a revaluation of how they conduct their operations and shape their business strategies.

An essential aspect, as evidenced by the works of Kraus (2021) and Bouwman (2019), is digital transformation, which requires constant renewal and innovation of business models to remain competitive. This includes the automation and optimization of processes, which not only increase efficiency and reduce costs but also enable rapid adaptation to market changes. Kamalaldin (2020) adds that digitalization is also a source of future competitiveness, unlocking new opportunities for value creation and revenue generation.

In addition to streamlining administrative processes and reducing human errors, as emphasized by Matarazzo (2021), digitalization also enhances customer experience through digital channels such as websites, mobile applications, and social media platforms. This allows for more efficient and personalized interactions with customers, providing quick responses to their needs. Furthermore, Niaz (2022) emphasizes the importance of integrating digital supply chain data as a foundation for operational excellence and competitive advantage in an ever-changing business environment.

Digitalization also encourages innovation and adaptability, essential for quickly responding to market changes and customer requirements, as mentioned by Lokuge (2019). Adopting emerging technologies such as artificial intelligence, the Internet of Things, or blockchain opens the door to new business opportunities, reinforcing Hasan's argument (2022) that digitalization is vital for the long-term viability of small enterprises.

Moreover, digitalization plays a key role in reducing production costs and service delivery, according to Buck (2018), highlighting its cross-cutting importance in nearly all industrial sectors. This underscores digital transformation not only as a necessity but also as a catalyst for innovation and market success.

An additional important aspect is the contribution of digitalization to sustainability. Demartini (2019) explains how digital technologies can help develop a more resource-efficient industrial base, reducing environmental impact and promoting a sustainable business model. This emphasizes the role of digital technologies not only in economic performance but also in building a more sustainable society.

The current research landscape reflects a widespread recognition of the importance of digitalization for the future of businesses. By improving efficiency, innovating business models, and supporting sustainability, digitalization emerges as a strategic necessity for any company seeking to ensure success and long-term viability in an increasingly digital world.

2. Research methodology

The research objective is to analyse the impact of digitalization within the context of sustainable businesses. It aims to examine how digital technologies influence and shape businesses striving to be sustainable economically, socially, and environmentally.

To achieve the research objective, a methodological review based on research paper articles was conducted, presenting how the understanding of digitalization as a force of change in terms of sustainable business models is deepened. It involves identifying digital technologies, trends, and practical examples that contribute to achieving sustainability objectives in business. The analysis also covers the challenges and risks associated with digitalization in the context of sustainable businesses, such as cybersecurity, regulation, and ethical considerations. Finally, we will present an outlook on the digital future of sustainable businesses, identifying emerging trends and potential directions for development.

3. Results

3.1. Addressing risks of digitization in sustainable business

Digitalization and sustainability represent two major trends shaping contemporary paradigms in the realms of business and technological development. Digital transformation, while paving the way for efficiency and innovation, calls for a precise and honest value foundation, adding value to sustainability (Arnold, 2021). It is widely recognized as a transformative force for sustainable development, with Sustainable Development Goals (SDGs) globally acknowledged as crucial for inclusive and holistic sustainable development in the digital era (Gupta, 2022).

Digitalization alters the way businesses operate in industrial value chains, through the utilization of Internet of Things (IoT) technologies, intensive data sharing, and predictive analytics (Parida, 2019). State-of-the-art technologies such as IoT and artificial intelligence (AI) have significantly fuelled the development of smart manufacturing, with IoT technologies becoming increasingly prevalent across diverse sectors due to their capability to provide connectivity and intelligence to physical objects (Tao, 2019). This interconnectivity and information exchange capability among devices bring significant benefits in multiple domains, including Industry 4.0, where IoT facilitates real-time automation and monitoring of production processes (Hariharasudan, 2018).

Most businesses are undergoing digitalization in the context of the fourth industrial revolution, termed Industry 4.0 (Kayikci, 2018). The concept of "Industry 4.0" brings numerous benefits for industrial value enhancement, yet associated risks complicate its implementation, with a comprehensive overview lacking (Birkel, 2019). The digital revolution is altering the way people live and work, with the public remaining optimistic about the opportunities Industry 4.0 can offer for sustainability (Ghobakhloo, 2020).

Another area of interest is smart agriculture, where IoT devices are employed for monitoring soil conditions, humidity, temperature, and other critical variables, enabling farmers to make informed decisions for irrigation, fertilization, and harvesting, resulting in increased productivity and sustainability (Xu, 2022). Additionally, in energy management, smart energy management systems utilize IoT to monitor and control energy consumption in buildings and homes, identifying energy-saving opportunities and optimizing the use of energy resources (Pawar, 2020).

In healthcare, IoT contributes to the development of digital health through remote patient monitoring, real-time health data collection, and facilitating communication between patients and healthcare providers (Selvaraj, 2020). The energy sector is closely intertwined with the construction sector, and integrated Information and Communication Technologies (ICT) solutions for efficient energy management that support decision-making at the building, neighbourhood, and city levels are fundamental to creating a smart city (Marinakakis, 2018).

The implementation of IoT technologies presents challenges, including issues related to data security, privacy, and the need for interoperability standards among devices (Kumar, 2018). However, advancements in IoT continue to open new possibilities for innovation and efficiency across a wide range of sectors.

Identifying the challenges and risks associated with digitalization in the context of sustainable businesses is crucial for successfully navigating the transition towards greener and more efficient business practices. Digitalization offers many advantages, such as improving operational efficiency and better access to data for decision-making, but it also comes with a host of specific challenges and risks that need to be managed. Thus, cybersecurity and data protection, technology dependency, cost and accessibility, impact on the workforce, ethical and privacy issues, technological sustainability, cybersecurity, and privacy become key elements supporting the integrated development of technological solutions such as the Internet of Things, artificial intelligence, big data, and robotics (Almeida, 2020).

To address these challenges and risks, sustainable businesses must adopt a strategic and well-planned approach, which includes investments in cybersecurity, employee training in digital skills, careful assessment of the technological impact on the environment, and the development of robust ethical policies and practices. By carefully navigating these challenges, businesses can maximize the benefits of digitalization while maintaining their commitment to sustainability.

3.3 Difficulties in implementing sustainable solutions

Integrating sustainability into business development, in a landscape marked by digital advancements, is a central theme in recent research, underscoring the essential role of organizational culture, environmental sustainability, and digitization (Isensee, 2020). However, this journey is not without obstacles, given the variety of difficulties organizations face in implementing sustainable solutions, which can significantly vary depending on the industry, scale, and specific context. Nonetheless, common challenges include high initial costs, limited awareness and education, resistance to change, as well as insufficient legislative and policy frameworks.

Barbosa (2020) emphasizes the need for organizations to exert considerable efforts to navigate this ongoing struggle to maintain or enhance competitiveness, while simultaneously embracing a leadership role in improving the social and environmental impact of human activities. Investing in sustainable solutions, although it may be substantial, especially in the initial phases, represents a fundamental pillar in this direction. Green technologies, such as renewable energies or energy efficiency, although requiring considerable initial capital, promise long-term benefits that surpass initial financial barriers.

A key element in this process is education and increasing awareness. Inadequate stakeholder awareness of the long-term benefits of sustainability constitutes a major barrier, highlighting the need for robust education and awareness campaigns. In this context, resistance to change emerges as another major obstacle, given human predisposition to adhere to traditional ways of operation. Adopting new approaches, which may entail initial efforts or behavioural changes, may thus be met with reluctance.

In the absence of a solid legislative and policy framework that supports and promotes sustainable practices, organizations may find few reasons to deviate from existing approaches. This context is further complicated by technical limitations present in certain areas, requiring innovation and research to overcome existing barriers and make sustainable solutions more accessible and efficient.

Access to resources represents another significant challenge, especially for small and medium-sized enterprises, which may face difficulties in obtaining the funding, technology, and specialized expertise required. Additionally, short-term interests of certain stakeholders may conflict with long-term sustainability objectives, putting pressure on organizations to prioritize short-term profits over investments in sustainable solutions with long-term benefits. A crucial aspect is the scalability of sustainable solutions, which may encounter difficulties in expanding on a larger scale. This highlights the need for an approach that allows for the adaptation and application of sustainable solutions on a wide scale, to have a significant impact on sustainability.

Overcoming these difficulties requires a concerted effort from governments, businesses, communities, and individuals, accompanied by substantial investments in education, technology, and research. By carefully navigating these challenges, organizations can maximize the benefits of integrating sustainability into their business strategies, thereby contributing to a more equitable and sustainable development of society.

3.3. Innovative strategies for mainstreaming sustainability

Sustainable innovation has emerged as an essential catalyst for directing societal changes towards sustainability, as emphasized by Xie (2022). This paradigm shift highlights the crucial role of disruptive technologies and innovations in promoting the evolution of enterprises, as detailed by Fusko (2021). At the core of discussions about innovative strategies for incorporating sustainability into the operational ethos of organizations lies the development and execution of solutions that have the potential to propel societies and organizations towards a state of prosperity. This ambition is aligned with the imperative to protect and manage resources for the benefit of future generations. Among the strategies that exemplify this orientation towards sustainability are circular economy initiatives and renewable energy initiatives. Particularly, strategies related to renewable energy promote the adoption of sustainable energy sources such as solar, wind, and hydro energy as means to reduce dependence on fossil fuels and limit greenhouse gas emissions.

However, achieving these objectives requires companies to focus not only on waste reduction but also on improving their capabilities in waste recovery, recycling, and disposal. An essential component of this effort involves educating end-users, as emphasized by Farooq (2022). Additionally, optimizing resource utilization through the deployment of innovative technologies and processes that enhance efficiency and minimize waste is imperative. This may include adopting advanced technologies for energy efficiency in buildings and industries, along with implementing agricultural practices that are resource-conserving, eco-friendly, and ensure food security, through approaches such as precision agriculture, agroecology, and permaculture.

The successful implementation of these strategies requires collaborative efforts among governments, businesses, non-governmental organizations (NGOs), and citizens to facilitate a smooth and effective transition towards a more sustainable society. These innovative pathways offer promising avenues to confront and mitigate global challenges such as climate change, biodiversity loss, and inequality, while also promoting economic growth and social welfare.

3.4. The digital future of sustainable business

Digitization emerges as a pivotal force driving progress towards the Sustainable Development Goals (SDGs) outlined by the United Nations. Bican (2020) emphasizes its necessity for enterprises to tackle future economic and environmental challenges effectively. However, digitization entails more than technological advancement; it demands a fundamental shift in business operations, as noted by Maffei (2019), who sees it as a catalyst for sustainable production.

Trzaska (2021) expands on this, highlighting the need for strategic approaches to navigate uncertainties in implementing Industry 4.0. Thus, the digital future of sustainable business unfolds as a complex landscape, integrating advanced technologies to promote sustainability.

Moreover, digitization facilitates the integration of sustainable innovations like renewable energy, enhancing their management within business frameworks. Ada (2021) and Velenturf (2020) showcase how digital tools like blockchain support circular energy models, driving the transition towards circular economies.

Digital platforms also play a crucial role, enabling transparent communication on sustainability efforts and fostering stakeholder engagement, as advocated by various

scholars. This accessibility to information, enabled by digitization, contributes to building a more inclusive and sustainable future.

Nevertheless, the risks associated with digitization, notably data security and privacy concerns, must be addressed. Robust cybersecurity measures are essential to mitigate potential vulnerabilities arising from increased digitization.

Overall, the fusion of digitization with sustainability principles presents an arena ripe for innovation and growth in sustainable business. This integration not only promises economic prosperity but also signifies a commitment to social well-being and environmental stewardship.

5. Conclusion

Sustainable businesses must strategically integrate robust cybersecurity measures, digital upskilling, and ethical frameworks to optimize the benefits of digitization while ensuring sustainability. Scalability of sustainable solutions is crucial for substantial impact, requiring collaborative efforts across government, businesses, communities, and individuals, supported by investments in education, technology, and research. These initiatives offer promise in addressing global challenges like climate change and socio-economic disparities while fostering prosperity. However, as businesses embrace digitization, the risks of data security and privacy escalate, necessitating stringent cybersecurity protocols. So, the digital frontier offers opportunities for innovation and growth in sustainable business, aligning economic success with societal well-being and environmental conservation through the synergy of digital expertise and sustainability imperatives.

References

1. Ada, N., Kazancoglu, Y., Sezer, M. D., Ede-Senturk, C., Ozer, I., & Ram, M. (2021). Analyzing barriers of circular food supply chains and proposing industry 4.0 solutions. *Sustainability*, Vol.13, No.12, p. 6812.
2. Ahad, M. A., Paiva, S., Tripathi, G., & Feroz, N. (2020). Enabling technologies and sustainable smart cities. *Sustainable cities and society*, Vol. 61,p. 102301.
3. Almeida, F., Santos, J. D., & Monteiro, J. A. (2020). The challenges and opportunities in the digitalization of companies in a post-COVID-19 World. *IEEE Engineering Management Review*, Vol.48, No.3, pp.97-103.
4. Arnold, M. G., & Fischer, A. (2021). Digitization and sustainability: Threats, opportunities, and trade-offs. In *Research Anthology on Digital Transformation, Organizational Change, and the Impact of Remote Work* pp. 700-721. IGI Global.
5. Barbosa, M., Castañeda-Ayarza, J. A., & Ferreira, D. H. L. (2020). Sustainable strategic management (GES): Sustainability in small business. *Journal of cleaner production*, Vol.258, p.120880.
6. Bican, P. M., & Brem, A. (2020). Digital business model, digital transformation, digital entrepreneurship: Is there a sustainable "digital"? *Sustainability*, Vol.12, No.13, p.5239.
7. Birkel, H. S., Veile, J. W., Müller, J. M., Hartmann, E., & Voigt, K. I. (2019). Development of a risk framework for Industry 4.0 in the context of sustainability for established manufacturers. *Sustainability*, Vol.11, No.2, p.384.
8. Bouwman, H., Nikou, S., & de Reuver, M. (2019). Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs?. *Telecommunications Policy*, Vol.43, No.9, p. 101828.
9. Buck, C., & Eder, D. (2018). The impact of digitization on business models-A systematic literature review, *Twenty-fourth Americas Conference on Information Systems*, p.7.
10. Caputo, A., Pizzi, S., Pellegrini, M. M., & Dabić, M. (2021). Digitalization and business models: Where are we going? A science map of the field. *Journal of business research*, Vol.123, pp. 489-501.
11. Demartini, M., Evans, S., & Tonelli, F. (2019). Digitalization technologies for industrial sustainability. *Procedia manufacturing*, Vol.33, pp.264-271.

12. Ding, Y., Jin, M., Li, S., & Feng, D. (2021). Smart logistics based on the internet of things technology: an overview. *International Journal of Logistics Research and Applications*, Vol.24, No.4, pp.323-345.
13. Duo, W., Zhou, M., & Abusorrah, A. (2022). A survey of cyber attacks on cyber physical systems: Recent advances and challenges. *IEEE/CAA Journal of Automatica Sinica*, Vol.9, No.5, pp.784-800.
14. Farooq, M., Cheng, J., Khan, N. U., Saufi, R. A., Kanwal, N., & Bazkiaei, H. A. (2022). Sustainable Waste Management Companies with Innovative Smart Solutions: A Systematic Review and Conceptual Model. *Sustainability*, Vol. 14, No. 20, p.13146.
15. Fusko, M., Dulina, L., Bubeník, P., Bučková, M., Kasajová, M., & Svitek, R. (2021). The importance of digitization and innovations for small and medium-sized enterprises. *Proceedings of CBU in Economics and Business*, Vol.2, pp.32-40.
16. Ghobakhloo, M. (2020). Industry 4.0, digitization, and opportunities for sustainability. *Journal of cleaner production*, Vol. 252, p.119869.
17. Gupta, S., & Rhyner, J. (2022). Mindful application of digitalization for sustainable development: The Digitainability Assessment Framework. *Sustainability*, Vol.14, No.5,p. 3114.
18. Hameed, A., & Alomary, A. (2019, September). Security issues in IoT: A survey. In *2019 International conference on innovation and intelligence for informatics, computing, and technologies (3ICT)* pp. 1-5.
19. Hariharasudan, A., & Kot, S. (2018). A scoping review on Digital English and Education 4.0 for Industry 4.0. *Social sciences*, Vol.7, Nr.11, p.227.
20. Hasan, N. A., Abd Rahim, M., Ahmad, S. H., & Meliza, M. (2022). Digitization of business for small and medium-sized enterprises (SMEs). *Environment-Behaviour Proceedings Journal*, Vol. 7, No.19, pp.11-16.
21. Humayun, M., Jhanjhi, N. Z., Hamid, B., & Ahmed, G. (2020). Emerging smart logistics and transportation using IoT and blockchain. *IEEE Internet of Things Magazine*, Vol.3, No.2, pp.58-62.
22. Ilcus, A. M. (2018). Impact of digitalization in business world. *Revista de Management Comparat Internațional*, Vol.19, No.4, pp.350-358.
23. Isensee, C., Teuteberg, F., Griesse, K. M., & Topi, C. (2020). The relationship between organizational culture, sustainability, and digitalization in SMEs: A systematic review. *Journal of Cleaner Production*, Vol.275, p.122944.
24. Kayikci, Y. (2018). Sustainability impact of digitization in logistics. *Procedia manufacturing*, Vol.21, pp.782-789.
25. Kamalaldin, A., Linde, L., Sjödin, D., & Parida, V. (2020). Transforming provider-customer relationships in digital servitization: A relational view on digitalization. *Industrial Marketing Management*, Vol.89, pp.306-325.
26. Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Banegas, N., & Roig-Tierno, N. (2021). Digital transformation: An overview of the current state of the art of research. *Sage Open*, Vol.11, No.3, pp.1-13.
27. Kumar, N. M., & Mallick, P. K. (2018). Blockchain technology for security issues and challenges in IoT. *Procedia computer science*, Vol.132, pp.1815-1823.
28. Li, Y., & Liu, Q. (2021). A comprehensive review study of cyber-attacks and cyber security; Emerging trends and recent developments. *Energy Reports*, Vol.7, pp.8176-8186.
29. Lokuge, S., Sedera, D., Grover, V., & Dongming, X. (2019). Organizational readiness for digital innovation: Development and empirical calibration of a construct. *Information & management*, Vol. 56, No.3, pp.445-461.
30. Machado, C. G., Winroth, M., Carlsson, D., Almström, P., Centerholt, V., & Hallin, M. (2019). Industry 4.0 readiness in manufacturing companies: Challenges and enablers towards increased digitalization. *Procedia Cirp*, Vol.81, pp.1113-1118.
31. Maffei, A., Grahm, S., & Nuur, C. (2019). Characterization of the impact of digitalization on the adoption of sustainable business models in manufacturing. *Procedia Cirp*, Vol.81, pp.765-770.
32. Marinakis, V., & Doukas, H. (2018). An advanced IoT-based system for intelligent energy management in buildings. *Sensors*, Vol.18, No.2, p.610.
33. Martínez-Caro, E., Cegarra-Navarro, J. G., & Alfonso-Ruiz, F. J. (2020). Digital technologies and firm performance: The role of digital organisational culture. *Technological Forecasting and Social Change*, Vol.154, p.119962.
34. Matarazzo, M., Penco, L., Profumo, G., & Quaglia, R. (2021). Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective. *Journal of Business Research*, Vol.123, pp.642-656.

35. Niaz, M. (2022). Revolutionizing Inventory Planning: Harnessing Digital Supply Data through Digitization to Optimize Storage Efficiency Pre-and Post-Pandemic. *BULLET: Jurnal Multidisiplin Ilmu*, Vol.1, No.3, pp.522-530.
36. Parida, V., Sjödin, D., & Reim, W. (2019). Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. *Sustainability*, Vol.11, No.2, p.391.
37. Pawar, P., & TarunKumar, M. (2020). An IoT based Intelligent Smart Energy Management System with accurate forecasting and load strategy for renewable generation. *Measurement*, Vol.152, p.107187.
38. Raju, K. L., Chandrani, V., Begum, S. S., & Devi, M. P. (2019, March). Home automation and security system with node MCU using internet of things. In *2019 International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTECoN)*, pp. 1-5, IEEE.
39. Qureshi, K. N., Din, S., Jeon, G., & Piccialli, F. (2020). Internet of vehicles: Key technologies, network model, solutions and challenges with future aspects. *IEEE Transactions on Intelligent Transportation Systems*, Vol. 22, No.3, pp.1777-1786.
40. Saeed, S., Altamimi, S. A., Alkayyal, N. A., Alshehri, E., & Alabbad, D. A. (2023). Digital transformation and cybersecurity challenges for businesses resilience: Issues and recommendations. *Sensors*, Vol. 23, Nr.15, p. 6666.
41. Selvaraj, S., & Sundaravaradhan, S. (2020). Challenges and opportunities in IoT healthcare systems: a systematic review. *SN Applied Sciences*, Vol.2, No.1, p.139.
42. Tao, F., Qi, Q., Wang, L., & Nee, A. Y. C. (2019). Digital twins and cyber-physical systems toward smart manufacturing and industry 4.0: Correlation and comparison. *Engineering*, Vol.5, No.4, pp.653-661.
43. Trzaska, R., Sulich, A., Organa, M., Niemczyk, J., & Jasiński, B. (2021). Digitalization business strategies in energy sector: Solving problems with uncertainty under industry 4.0 conditions. *Energies*, Vol.14, No.23, p.7997.
44. Touqeer, H., Zaman, S., Amin, R., Hussain, M., Al-Turjman, F., & Bilal, M. (2021). Smart home security: challenges, issues and solutions at different IoT layers. *The Journal of Supercomputing*, Vol.77, No.12, pp.14053-14089.
45. Velenturf, A. P., & Purnell, P. (2021). Principles for a sustainable circular economy. *Sustainable Production and Consumption*, Vol.27, pp.1437-1457.
46. Xie, L., Bulkeley, H., & Tozer, L. (2022). Mainstreaming sustainable innovation: Unlocking the potential of nature-based solutions for climate change and biodiversity. *Environmental Science & Policy*, Vol. 132, pp.119-130.
47. Xu, J., Gu, B., & Tian, G. (2022). Review of agricultural IoT technology. *Artificial Intelligence in Agriculture*, Vol.6, pp.10-22.