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ECO-EFFICIENCY AS A PHILOSOPHY OF MODERN BUSINESS IN THE CONDITIONS OF GLOBAL TRANSFORMATIONS

Iulia Caprian[1], Birca Iulita[2], Nataliia Trushkina[3]

Abstract. Eco-efficiency is a concept accepted in the economic sphere that refers to strategies aimed at maximizing the efficiency of production processes while minimizing the negative impact on the environment. It is considered one of the best tools to promote the transformation from unsustainable to sustainable development. Eco-efficiency is a management strategy that links financial and environmental performance to create more value with less environmental impact. *The purpose* of the paper is to clarify the essence and content of the term "eco-efficiency" on the basis of generalization and systematization of existing conceptual approaches to the definition of this concept. *Methodology*. The methodological basis of the study is the scientific works of scientists on the problems of green economy, circular economy, environmental management, waste management. The research was conducted using general scientific methods: analysis and synthesis – to summarize the existing conceptual approaches and provisions, scientific developments on the development of the circular economy, greening of logistics systems, eco-efficiency, green investments, clarification of the terminology; classifications – to systematize theoretical approaches to the definition of "eco-efficiency", which are proposed by various scientific schools; structural and logical generalization – to clarify the essence and content of the term "eco-efficiency as a philosophy of modern business". *Results*. It was established that there is no single scientific approach to the definition of eco-efficiency, but a certain conceptual homogeneity is present. The key goals and specific tasks of implementing eco-efficiency as a modern paradigm of business development are determined. The impact of eco-efficiency on company management was studied and evaluated. The European trends in the development of the circular economy concept have been determined. *Practical implications.* Eco-efficiency approval offers a range of advantages for businesses. The implementation of eco-efficiency is related to the use of a smaller amount of natural resources, energy, and water. It also involves the adoption of recycling, waste management, and disposal in the process of improving production processes, as well as improving the operation of the logistics chain. Implementing eco-efficiency requires significant managerial effort. An important form of applying the concept of eco-efficiency has become the circular economy, which is related to the reconditioning and recycling of existing materials and products in order to increase their life cycle. The key goal of the transition to a circular economy is to change the paradigm of logistics, rethink the value chain and develop new business models that must meet modern requirements and challenges in the global world. The practical significance of the research results lies in the possibility of developing recommendations for the "green" transformation of the national economies of European countries, the implementation of business models and innovative technologies of the circular economy, waste management strategies. *Value/originality.* The author's approach to the formulation of the category "eco-efficiency as a philosophy of modern business" is theoretically substantiated.

Key words: globalization, eco-efficiency, corporate management, circular economy, sustainable development, transformation, strategy, paradigm, business philosophy, economic activity, logistics system, logistics flow of resources, supply chain, waste recycling, green investments, conceptual approaches.

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[1] Moldova State University, Moldova
E-mail: kaprianusm@gmail.com
ORCID: https://orcid.org/0000-0001-7701-5356
[2] University of Suceava "Stefan cel Mare", Romania
E-mail: iulitabirca2021@gmail.com
ORCID: https://orcid.org/0000-0002-3910-8022
[3] Research Center for Industrial Problems of Development
of the National Academy of Sciences of Ukraine, Ukraine *(corresponding author)*
E-mail: nata_tru@ukr.net
ORCID: https://orcid.org/0000-0002-6741-7738

1. Introduction

The global economic, social, demographic and ecological situation has reached an extremely worsening level. In this context, the expert Daniela Vîrjan states the following: "Today, the growth of industrialization is approaching absolute limits through negative consequences (ecological crisis, social crisis, human crisis and economic crisis), as well as through the exhaustion of resources, which will impose a decrease in growth rates and in some cases even a collapse. ... In this respect, it is necessary to rethink the current economic activity, taking into account other economic processes, so that the economic system harmonizes with the natural system and operates on the principle of sailboats, pushed by ecological processes, and not by limited and exhaustible natural resources". (D. Vîrjan, 2011)

Similarly, this author states that eco-efficiency must be the basis for the establishment of a new economy, which "must focus on the use and reuse of values and not on their change, on the qualitative side of products and less on the quantitative side, on regeneration, recycling, reuse and less on the accumulation of money or material goods". (D. Vîrjan, 2011)

According to the definition of the National Research and Development Institute for Industrial Ecology – ECOIND, eco-efficiency has become a management philosophy designed to provide both environmental and economic benefits by streamlining the production process. This principle is to be respected throughout the production chain, i.e. from the purchase of raw materials to delivery to the final consumer.

Lonnie Hernandez, for his part, states: "Environmental efficiency aims to create a harmony between ecology and the economy, in which business activities do not give rise to the environment. The concept assigns responsibility to producers of goods and services, thus taking responsibility for the total human impact on the environment. The main actors of the concept are businesses, government, business association, research organizations, as well as customers and suppliers". (L. Hernandez, 2023)

According to Merilena Koskela, there is a relationship between corporate strategists and cross-effectiveness of: "...eco-efficiency identifies the potential and improvement of the environment and explores business opportunities through sustainable strategies. Eco-efficiency can even contribute to achieving higher values for products and services, reducing the amount of materials, energy and emissions, in other words, producing more for less, strengthening the position of the business in the market, opening up new markets and avoiding criticism from stakeholders, increasing the survival time of business". (M. Koskela, 2015)

Fashion consumers are becoming more and more aware of environmental issues and are demanding products that support the protection of the environment, thus offering a competitive advantage to those companies, which have adopted the concept of eco-efficiency.

The circular economy contributes to the development of new industries and, with it, to the creation of new jobs within economic entities of different sizes and types of activity: from the sorting and processing of material resources to the opening of enterprises, for example, a network of repair shops, which aim to extend the life of the products. (Ellen MacArthur Foundation, 2017)

Various aspects of the development of the circular economy, substantiation of the conceptual foundations of the development and implementation of circular business models in various sectors of the economy are among the scientific interests of many prominent foreign scientists. (G. Reday-Mulvey, 1981; W. Stahel, 1981; D. Pearce, 1989; M. Braungart, 2002; W. McDonough, 2002; M. Andersen, 2007; C. Sherwin, 2013; B. Su et al., 2013; J. Kirchherr et al., 2018; D. Reike, 2018; W. Vermeulen, 2018; S. Witjes, 2018; A. Haney, 2019; O. Krestyaninova, 2019; C. Love, 2019; P. Lacy, 2020; J. Long, 2020; W. Spindler, 2020; H. Dzwigol, 2016, 2021; R. Miśkiewicz, 2019, 2021; A. Kwilinski et al., 2016, 2020; A. Ahadiat, Z. Dacko-Pikiewicz, 2020; W. Drożdż et al., 2021; P. Saługa et al., 2021; K. Szczepańska-Woszczyna, S. Gatnar, 2022) In the scientific literature, there are different views on the interpretation of the category "circular economy". As a rule, scientists identify it with the concepts of "cyclical economy", "restorative economy", "closed-loop economy", "green economy", etc.

For the most part, researchers (Z. Yuan, J. Bi, Y. Moriguich, 2006; Y. Geng et al., 2008; S. Ingebrigtsen, 2008; O. Jakobsen, 2008; H. Hislop, 2011; J. Hill, 2011; M. Geissdoerfer et al., 2017; A. Murray, K. Skene, K. Haynes, 2017;

T. Zink, R. Geyer, 2017; J. Korhonen et al., 2018 and others) under the circular economy consider: the economy of a closed cycle; resource-based economy; management philosophy; the concept of economic development; regenerative production system; sustainable development strategy; tool of "green" economy; activities aimed at preserving the environment; economic activity; direction of industrial modernization; system innovation approach; the basis of sustainable development; model of economic development; sustainable development initiative; economic system; a new way of managing; approach to sustainable development; economy of resource circulation; an integrative approach to economic growth and environmental sustainability; systematic approach to economic development, etc.

Therefore, the existing conceptual approaches to the definition of the term "circular economy", proposed by representatives of various scientific schools, can be conditionally classified according to the following groups: paradigm; model; system; strategy; strategic direction; approach; tool; mechanism; activity.

On the basis of the generalization of the conceptual and categorical apparatus on the chosen topic in accordance with various scientific hypotheses, theories and concepts under the circular economy, it is proposed to understand an innovative approach to the organization of logistics processes, which is based on the closed movement of resources with minimal waste loss and the maximum involvement and use of secondary resources in production in order to achieve sustainable development of logistics systems. (N. Trushkina, 2019; H. Dzwigol, N. Trushkina, A. Kwilinski, 2021)

As a result of research (I. Birca, A. Gribincea, 2020; N. Trushkina, O. Prokopyshyn, 2021; H. Dźwigoł, A. Kwilinski, N. Trushkina, 2021; A. Kuzior, O. Vyshnevskyi, N. Trushkina, 2022; V. Ganea, N. Trushkina, M. Țîrlea, I. Birca, 2022), it has been proven that the concept of "circular economy" should be considered from the standpoint of sustainable development, green transformation, system innovation approach, ecosystem modelling, spatial development of territories, and strategic waste management.

Much attention is paid by researchers (I. Siedschlag, W. Yan, 2021; A. Rokhmawati, 2021; J. Braga et al., 2021; Y. Chen, Zh. Zhao, 2021; X. Wang, Q. Wang, 2021; R. Ronaldo, T. Suryanto, 2022; K.-H. Wang et al., 2022; M. Madaleno et al., 2022; Q. Yang et al., 2022; Ch.-Ch. Lee et al., 2022; G. I. Iacobuță et al., 2022) to the justification and development of green finance mechanisms in the context of the sustainable development of logistics systems.

Therefore, at present it is necessary to look for innovative tools and introduce fundamentally new approaches to the formation and development of ecosystems. (M. Bezpartochnyi et al., 2022) The circular economy is a priority as a new way of managing and a key mechanism for developing and implementing business strategy in the context of global transformations.

In view of this, **the purpose of the paper** is to clarify the essence and content of the term "eco-efficiency as a specific form of organization of economic activity" on the basis of generalization and systematization of existing conceptual approaches to the definition of this concept.

2. Definition of eco-efficiency

Bibliographic sources define eco-efficiency differently, but a certain conceptual homogeneity is present.

For example, the group of experts headed by Peter Glavič sees e-efficiency as a management strategy based on the concept of creating more goods and services, using fewer resources, creating less waste and reducing pollution. Similarly, the aforementioned experts consider co-efficiency as a sustainability measure that achieves environmental and economic performance. (P. Glavič et al., 2012)

The author Paulo Peças is of the opinion that it's eco-effectiveness is "a key concept for companies to reach a more sustainable development, taking into account not only the aspect of the added value of its activities, but also the impact on the environment". (P. Peças et al., 2019)

Some experts present the following definition: "Eco-efficiency generates more value through changes in technology and processes, while reducing resource use and environmental impact throughout the life of the product or service. Eco-efficiency applies to all aspects of business, from purchasing and production to marketing and distribution". (H. Srinivas, 2020)

The group of authors led by Paulo Ricardo Cosme Bezerra states that eco-efficiency

is "a management strategy that combines environmental and economic performance and wants to meet human needs and manage the quality of life by progressively reducing environmental impacts and intensity of resource use throughout its cycle". (P. R. C. Bezerra et al., 2019)

Similarly, eco-efficiency is considered as a management philosophy adopted by many companies in the world, which means a minimum of environmental damage, while maximizing the efficiency of a company's economic (production) activity. Eco-efficient companies use less water, materials and energy while recycling more. (MBN, 2023)

Other experts present the following vision: Eco-efficiency means minimizing environmental damage while maximizing efficiency. Specifically, maximizing the efficiency of a company's production process. This concept is considered one of the best tools to promote transformation from unsustainable development to sustainable development. It's interesting that cross-efficiency applies to all aspects of a business, from purchasing and manufacturing to marketing and distribution.

As the main characteristics of cross-efficiency are considered (H. Srinivas, 2020):
– Minimizing the consumption of energy, water and materials;
– Minimizing waste and pollution levels;
– Increasing the service life of the products offered;
– Increasing the usefulness of recycling products or services;
– Incorporating life cycle principles;
– Taking into account the usefulness and recyclability of products / services at the end of the useful life;
– Increased intensity of service.

An economic activity with a responsible attitude towards the environment accumulates many benefits. When developing an eco-efficiency plan, firms develop profiles that detail processes, products, the market, the source of materials and other information about their operations. (L. Hernandez, 2023)

Accepting eco-efficiency helps companies become more aware of their activities and impact. Optimizing the use of natural resources, water and energy reduces production costs. This competitive advantage is amplified by the improvement of production processes, the development of new products and the recycling of used products.

Modern consumers are becoming increasingly worried about the state of the environment and are looking for sustainable products, thus giving companies that have adopted eco-efficiency a competitive advantage. (L. Hernandez, 2023)

Environmental efficiency promotes technology as a primary solution for environmental degradation. The benefits of eco-efficiency for the environment are becoming increasingly important by reducing emissions of hazardous elements, improving the sustainability and shelf life of products, switching to renewable natural resources, reducing the material and energy intensity of goods and services and adopting recycling. Also, eco-efficiency increases the responsibility of companies for environmental protection. (L. Hernandez, 2023)

Eco-efficiency is based on the principle of using the most efficient technologies and methods, using fewer natural resources and energy for the same volume of production and generating small amounts of waste.

The application of this principle requires a reassessment of the life cycle of products, from the raw material production phase to the final product, as well as the discarded waste after use. For this it is necessary to identify the parties involved in the processes with the highest intensity of use of resources. Then comes the redesign of the product to achieve significant energy savings. In this context, the function of the product matters more than the product itself. Eco-efficiency replaces warning the buyer with the request to share responsibilities for the value and functionality of the product between producers and consumers (customers). At the same time, the value that the product offers to consumers and society is reconsciousized. (M. D. Oancea Negescu et al., 2018)

3. Objectives and specific objectives of the implementation of eco-efficiency

The World Business Council for Sustainable Development has set seven eco-efficiency goals (P. R. C. Bezerra et al., 2019):
– *Reducing resource consumption.* The consumption of materials and energy must be minimized by improving recycling skills;
– *Reducing the impact on nature.* Improvements can be made through the use of sustainably managed renewable resources, as well as minimizing emissions, removing residues and toxic substances.

– *It supplied consumers with high-quality products and services.* The benefits to the consumer can be amplified by making additional services available to the user. For example, it may be additional functionality and increasing service life globally. However, it is important that the growing benefit to the consumer does not run counter to the previous objectives.

– *Reengineering processes* involves reducing resource consumption and pollution, as well as reducing costs;

– *Reassessment of the by-product.* The waste of a particular economic activity can be repeatedly run for a by-product, which can contribute to a more efficient use of resources, creating an additional financial benefit;

– *Elaboration of the concept of a new product.* This is a more simplified design process of using less materials, thus facilitating use and recycling in the future;

– *Rethinking the market* by looking for better ways to meet the needs and expectations of the consumer.

Other experts present dept examples of the implementation of eco-efficiency can serve the following:

– *Optimizing the consumption of materials* for the manufacture of goods, including through investments in the improvement of production systems;

– *Increasing energy efficiency.* It's about producing more using the same (or even less) amount of energy. This task requires initial investment in machinery, which uses less electricity;

– *Implementation of recycling culture.* This can be done by reusing materials, which have been wasted in other productive activities;

– *Using renewable energy resources and reducing energy expenditure in the long term.* Renewable resources cannot be depleted by use due to natural replenishment. These include wind, solar, hydropower, ocean energy, geothermal energy, biomass and biofuels;

– *Production of goods of greater durability (life cycle).* The use of the product in the short term by the consumer often leads to a higher consumption of materials;

– *Exercise control of water, soil and air pollution, as well as noise pollution;*

– *Implementation of solid waste management,* which is related to the collection, monitoring, regulation, transport, sorting, treatment and sustainable disposal of solid waste;

– *The application of the circular economy linked to increasing the sustainability and saving of natural resources and energy sources.* In the context of this economic model, goods are produced, consumed, recycled, produced and consumed again.

4. The impact eco-efficiency on the management of companies

Eco-efficiency is a management philosophy the essence of which is the use of fewer resources in production and investing more in recycling and sustainability. In this context, some experts state that by adopting this style of sustainable management, it is aimed at creating a harmony between ecology and the economy. Basically, eco-efficiency empowers producers of goods and services to achieve a beneficial impact on the environment from humans.

Solving environmental problems requires a change of attitude and a respective behavior of entrepreneurs, permanently involving the environment in their decisions and incorporating technological and managerial concepts as part of the solution. Accepting eco-efficiency makes some businesses reconsider the environmental impact in their activities. (P. R. C. Bezerra et al., 2019)

But in each company this requires an individual approach and adjustment to the strategic preferences of the company's administration. Eco-efficiency can stimulate the technological innovation process in the permanent search of the efficiency of the companies' activity. This management philosophy adjusts the company's activity to the appreciated trend of which consumers expressed in caring for the environment through the ethical choice of materials and their origin, as well as through the services offered by economic experts.

The implementation of eco-efficiency allows companies to carry out the reconsciousization of activities and their impact. The implementation of eco-efficiency requires the development of organizational, financial and environmental profiles. Also, companies that apply the principles of eco-efficiency are more profitable and competitive because they use fewer material resources, water and energy, produce less waste and pollution, improve production methods, develop new products or services, as well as use or recycle existing materials. (H. Srinivas, 2020)

The implementation of eco-efficiency requires the integration and harmonization of management

and environmental plans, policies and strategies. Those indicators shall be used to measure eco-efficiency actions to determine economic, financial and environmental success. It is also necessary to identify and follow trends, prioritize actions and problems, as well as establish areas for improvement. Similarly, reporting is needed both internally and externally, to communicate progress and obstacles, to build the trust of shareholders and consumers (customers), and to report to regulators. Reporting is to be integrated into existing reporting and communication mechanisms.

5. The essence of the circular economy and European trends of circular economy

The circular economy is an essential form of application of eco-efficiency. Wikipedia defines it this way: A circular economy is a model of production and consumption, which involves sharing, renting, reusing, repairing, reconditioning and recycling existing materials and products as much as possible.

Some specialists present the following definition: "Economic circular is an economic system of closed loops in which raw materials, components and products lose as little of their value as possible, renewable energy sources are used and systemic thinking is at the heart". (Ellen MacArthur Foundation, 2017)

The circular economy aims to take part in solving the problems of climate change, biodiversity loss, waste and pollution. The three principles needed to transform to a circular economy are: the elimination of waste and pollution, the circulation of products and materials, and the regeneration of nature.

Some authors are of the opinion that the circular economy is based on the 3-R approach (J. Korhonen et al., 2018):
– *Reduction* (minimum use of raw materials);
– *Reuse* (maximum reuse of products and components);
– *Recycling* (high quality reuse of raw materials).

According to authors J. Korhonen, A. Honkasalo and J. Seppälä (2018) the circular economy focuses on three elements:
– *Closed cycles.* In the circular economy, material cycles are closed forming an ecosystem, in which there is no waste, since each residual stream can be used to make a new product. Toxic substances are eliminated and residual streams are separated into a biological and a technical cycle. Manufacturers take back their products after use and repair them for a new useful life. In this system it is important not only that materials are properly recycled, but also that products, components and raw materials remain of high quality in these cycles.
– *Renewable energy.* In a circular economy, energy lasts as long as possible and renewable energy sources are used. As it is not possible to recycle energy, it is not mentioned energy cycles or energy cycles, but cascade energy flows.
– *Systemic thinking.* The circular economy requires not only closed material cycles and renewable energy, but also systemic thinking. Each participant in the economy (company, person, organization, institution) is connected to other actors. Together they embark on a network where the actions of one actor influence other actors. That is why the short and long-term consequences of the activity of an economic agent in terms of the impact on the entire value chain.

In the circular economy, the paradigm of maximizing the profit of business remains in force. But this concept suggests an alternative way of thinking for competitive advantages while addressing current environmental and socio-economic concerns.

Accepting the circular economy concept leads to the development of new skills throughout the value chain and to superior performance that reduces costs, improves efficiency, promotes brand names, mitigates risks, develops new products and meets advanced government regulations and green consumer expectations. (L. Dezi et al., 2022)

Although at the moment there are many successful examples of companies, which have adopted circular solutions in many economic activities, as well as a lot of opportunities for circular actions adjusted to the unique profile and objectives, decision making in the circular economy remains an extremely complex exercise, without there being a single solution for all of them.

The European Commission has adopted a package of measures on the implementation of the circular economy to help improve global competitiveness, sustainable growth and the creation of new jobs. The main elements of the proposals for the waste review include:
– Setting the European Union-wide target of 65% for recycling municipal waste by 2030;

– Setting the European Union-wide target of 75% for the recycling of packaging waste by 2030;
– Setting a target at European Union level for reducing the landfilling of municipal waste to a maximum of 10% by 2030;
– Prohibition of landfilling of selectively collected waste;
– Promoting economic instruments to discourage landfilling;
– Concrete measures to convert a by-product of one industrial activity into a raw material for another industrial activity;
– Economic incentive for producers to place green products on the market and implement recovery and recycling schemes.

6. Conclusions

Eco-efficiency a is a modern management philosophy meant to combine planetary interests of environmental protection with those of sustainable economic development. This concept consists of producing more goods and services, using fewer resources, creating less waste and reducing pollution. The aim of adopting this country and the concept of sustainable management is to create a harmony between environmental and eco-economic goals. Applying Eco-efficiency requires the integration of plans, the policy or and its management and environmental strategies. The circular economy is an effective form of application of the concept of eco-efficiency based on the elimination of waste and pollution, the circulation of products and materials and the regeneration of nature. Its implementation requires both official legal and economic efforts to encourage economic agents, but also the formation of a specific culture at the level of society, which requires economically efficient products and services with a minimal harmful impact on the environment.

In further studies, it is planned to substantiate the conceptual provisions of green investment in the development of the circular economy in the context of the European Green Deal.

References:

Ahadiat, A., & Dacko-Pikiewicz, Z. (2020). Effects of ethical leadership and employee commitment on employees' work passion. *Polish Journal of Management Studies,* vol. 21, no. 2, pp. 24–35. DOI: http://dx.doi.org/10.17512/pjms.2020.21.2.02

Andersen, M. (2007). An introductory note on the environmental economics of the circular economy. *Sustainability Science*, vol. 2, pp. 133–140.

Bezerra, P.R. C., Vieira, M.M., & Rezende, J.F.D. de (2019). Measurement of the eco-efficiency of small business in the supply chain oil and gas, applying the taxonomy CE7. *Acta Scientiarum. Technology*, vol. 41(1), Article 37730. DOI: https://doi.org/10.4025/actascitechnol.v41i1.37730

Bezpartochnyi, M., Revenko, D., Dolha, H., & Trushkina, N. (2022). Model Tools for Diagnosing the Stability and Survivability of Economic Systems. In: M. Elhoseny, X. Yuan, Sd. Krit (Eds.), *Distributed Sensing and Intelligent Systems. Studies in Distributed Intelligence* (pp. 275–288). Switzerland, Cham: Springer. DOI: https://doi.org/10.1007/978-3-030-64258-7_25

Birca, I., & Gribincea, A. (2020). The role of the evaluator in estimating the Value of the entity in the conditions of the circular economy in the Republic of Moldova and Romania. *Integrated reporting as part of corporate management* (November the 10th, 2020), The International Day of Accounting, from 1PM onwards, and will be dedicated to the 85th Anniversary of accounting studies at the Academy of Economy "D.A. Tsenov" (pp. 36–46). Svishtov, Bulgaria.

Braga, J.P., Semmler, W., & Grass, D. (2021). De-risking of green investments through a green bond market – Empirics and a dynamic model, *Journal of Economic Dynamics and Control,* vol. 131, Article 104201. DOI: https://doi.org/10.1016/j.jedc.2021.104201

Chen, Y., & Zhao, Zh.J. (2021). The rise of green bonds for sustainable finance: global standards and issues with the expanding Chinese market, *Current Opinion in Environmental Sustainability*, vol. 52, pp. 54–57. DOI: https://doi.org/10.1016/j.cosust.2021.06.013

Dezi, L., Hysa, X., Calabrese, M., & Mercuri, F. (2022). Open Total Quality Management in the Circular Economy age: a social enterprise perspective through the case of Patagonia. *Total Quality Management & Business Excellence*, Article 2051698. DOI: https://doi.org/10.1080/14783363.2022.2051698

Drożdż, W., Kinelski, G., Czarnecka, M., Wójcik-Jurkiewicz, M., Maroušková, A., & Zych, G. (2021). Determinants of Decarbonisation – How to Realize Sustainable and Low Carbon Cities? *Energies*, vol. 14, Article 2640. DOI: https://doi.org/10.3390/en14092640

Dzwigol, H. (2016). Modelling of Restructuring Process. *Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie*, nr. 99, s. 89–106.

Dzwigol, H. (2021). Meta-analysis in management and quality sciences. *Marketing and Management of Innovations*, vol. 1, pp. 324–335. DOI: https://doi.org/10.21272/mmi.2021.1-25

Dzwigol, H., Trushkina, N., & Kwilinski, A. (2021). The Organizational and Economic Mechanism of Implementing the Concept of Green Logistics. *Virtual Economics,* vol. 4, no. 2, pp. 74–108. DOI: https://doi.org/10.34021/ve.2021.04.02(3)

Dźwigoł, H., Kwilinski, A., & Trushkina, N. (2021). Green Logistics as a Sustainable Development Concept of Logistics Systems in a Circular Economy. In Khalid S. Soliman (Ed.), *Proceedings of the 37th International Business Information Management Association (IBIMA)*, 1-2 April 2021 (pp. 10862–10874). Cordoba, Spain: IBIMA Publishing.

Ellen MacArthur Foundation (2017). Achieving, Growth Within. A 320-Billion Circular Economy Investment Opportunity available to Europe up to 2025. Brüssel.

Ganea, V., Trushkina, N., Țîrlea, M.R., & Birca, I. (2022). Economia circulară – un model de perspectivă pentru Republica Moldova [Circular Economy – a Perspective Model for the Republic of Moldova]. *UNIVERS STRATEGIC – Revistă de Studii Strategice Interdisciplinare și de Securitate*, Anul XIII, no. 4(52), pp. 52–68.

Glavič, P., Lesjak, M., & Hirsbak, S. (2012). *European Training Course on Eco-Efficiency*. Paper presented at 15th European Roundtable on Sustainable Consumption and Production (Bregenz, Austria, 02.05.-04.05.2012). Available at: https://vbn.aau.dk/en/publications/european-training-course-on-eco-efficiency (accessed 8 December 2022).

Geissdoerfer, M., Savaget, P., Bocken, N.M.P., & Hultink, E.J. (2017). The Circular Economy – a new sustainability paradigm? *Journal of Cleaner Production Clean*, vol. 143, pp. 757–768. DOI: https://doi.org/10.1016/j.jclepro.2016.12.048

Geng, Y., & Doberstein, B. (2008). Developing the circular economy in China: Challenges and opportunities for achieving'leapfrog development. *Int. J. Sustain. Dev. World Ecol.*, vol. 15, pp. 231–239. DOI: https://doi.org/10.3843/SusDev.15.3

Haney, A., Krestyaninova, O., & Love, Ch. (2019). The Circular Economy Boundaries and Bridges. Oxford: Said Business School, University of Oxford.

Hernandez, L. (2023). Conceptul De Eco-Eficiență: De Ce Este Atât De Important Pentru Lumea Modernă? Available at: https://ro.ripleybelieves.com/concept-of-eco-efficiency-why-is-it-so-important-for-modern-world-5971 (accessed 12 December 2022).

Hislop, H., & Hill, J. (2011). Reinventing the Wheel: A Circular Economy for Resource Security. Green Alliance.

Iacobuță, G.I., Brandi, C., Dzebo, A., & Duron, S.D.E. (2022). Aligning climate and sustainable development finance through an SDG lens. The role of development assistance in implementing the Paris Agreement. *Global Environmental Change*, vol. 74, Article 102509. DOI: https://doi.org/10.1016/j.gloenvcha.2022.102509

Ingebrigtsen, S., & Jakobsen, O. (2008). Circulation Economics: Theory and practice. Vol. 3: Frontiers of Business Ethics. Oxford, United Kingdom: Peter Lang Verlag.

Ivanov, S., Lyashenko, V., Tolmachova, H., & Kvilinskyi, O. (2016). Właściwości modernizacji sfery przedsiębiorczej w kontekście państwowej polityki gospodarczej na Ukrainie. *Współpraca Europejska*, vol. 3(10), pp. 9–34.

Kirchherr, J., et al. (2018). Barriers to the circular economy: evidence from the European Union (EU). *Ecological Economics*, vol. 150, pp. 264–272. DOI: https://doi.org/10.1016/j.ecolecon.2018.04.028

Korhonen, J. et al. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, vol. 175, pp. 544–552. DOI: https://doi.org/10.1016/j.jclepro.2017.12.111

Koskela, M. (2015). Measuring eco-efficiency in the Finnish forest industry using public data. *Journal of Cleaner Production*, vol. 98, pp. 316–327. DOI: https://doi.org/10.1016/j.jclepro.2014.04.042

Kuzior, A., Vyshnevskyi, O., & Trushkina, N. (2022). Assessment of the Impact of Digitalization on Greenhouse Gas Emissions on the Example of EU Member States. *Production Engineering Archives*, vol. 28, no. 4, pp. 407–419. DOI: https://doi.org/10.30657/pea.2022.28.50

Lacy, P., Long, J., & Spindler, W. (2020). The Circular Economy Handbook: Realizing the Circular Advantage. 1st ed. Germany, Heidelberg: Springer Nature Customer Service Center GmbH.

Lee, Ch.-Ch., Li, X., Yu, Ch.-H., & Zhao, J. (2022). The contribution of climate finance toward environmental sustainability: New global evidence. *Energy Economics*, vol. 111, Article 106072. DOI: https://doi.org/10.1016/j.eneco.2022.106072

Letunovska, N., Kwilinski, A., & Kaminska, B. (2020). Scientific research in the health tourism market: a systematic literature review. *Health Economics and Management Review*, vol. 1, pp. 8–19. DOI: https://doi.org/10.21272/hem.2020.1-01

Madaleno, M., Dogan, E., & Taskin, D. (2022). A step forward on sustainability: The nexus of environmental responsibility, green technology, clean energy and green finance. *Energy Economics*, vol. 109, Article 105945. DOI: https://doi.org/10.1016/j.eneco.2022.105945

MBN (2023). What is eco-efficiency? Definition and examples. Available at: https://marketbusinessnews.com/financial-glossary/eco-efficiency/ (accessed 5 December 2022).

McDonough, W., & Braungart, M. (2002). Design for the Triple Top Line: New Tools for Sustainable Commerce. *Corporate Environmental Strategy*, vol. 9, pp. 251–258.

Miśkiewicz, R. (2019). Challenges Facing Management Practice in the Light of Industry 4.0: The Example of Poland. *Virtual Economics*, vol. 2, no. 2, pp. 37–47. DOI: https://doi.org/10.34021/ve.2019.02.02(2)

Miśkiewicz, R. (2021). The Impact of Innovation and Information Technology on Greenhouse Gas Emissions: A Case of the Visegrád Countries. *Journal of Risk and Financial Management*, vol. 14, Article 59. DOI: https://doi.org/10.3390/jrfm14020059

Murray, A., Skene, K., & Haynes, K. (2017). The circular economy: an interdisciplinary exploration of the concept and application in a global context. *J. Bus. Ethics,* vol. 140, no. 3, pp. 369–380.

Oancea Negescu, M.D., Burcea, Ş.-G., Georgescu, R., & Constantinescu, C. (2018). Conceptul de calitate totală în managementul ecologic şi eco-eficienţa. In: *Competitivitatea şi inovarea în economia cunoaşterii [online]*: culegere de articole selective: conf. şt. intern., 28-29 sept., 2018. Chişinău: ASEM, vol. 2, pp. 306–311.

Pearce, D., Markandya, A., & Barbier, E. (1989). Blueprint for a Green economy. London: Earthscan Publications Ltd.

Peças, P., Götze U., Bravo, R., Richter, F., & Ribeiro, I. (2019). Methodology for Selection and Application of Eco-Efficiency Indicators Fostering Decision-Making and Communication at Product Level – The Case of Molds for Injection Molding: Chapter I. *Advanced Applications in Manufacturing Enginering*, pp. 1–52. DOI: https://doi.org/10.1016/B978-0-08-102414-0.00001-X

Reike, D., Vermeulen, W.J.V., & Witjes, S. (2018). The circular economy: New or Refurbished as CE 3.0? – Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options. *Resources, Conservation and Recycling*, vol. 135, pp. 246–264. DOI: https://doi.org/10.1016/j.resconrec.2017.08.027

Rokhmawati, A. (2022). The nexus among green investment, foreign ownership, export, greenhouse gas emissions, and competitiveness, *Energy Strategy Reviews,* vol. 37, Article 100679. DOI: https://doi.org/10.1016/j.esr.2021.100679

Ronaldo, R., & Suryanto, T. (2022). Green finance and sustainability development goals in Indonesian Fund Village", *Resources Policy*, vol. 78, Article 102839. DOI: https://doi.org/10.1016/j.resourpol.2022.102839

Saługa, P.W., Zamasz, K., Dacko-Pikiewicz, Z., Szczepańska-Woszczyna, K., & Malec, M. (2021). Risk-adjusted discount rate and its components for onshore wind farms at the feasibility stage. *Energies*, vol. 14, iss. 20, Article 6840. DOI: https://doi.org/10.3390/en14206840

Sherwin, C. (2013). Sustainable design 2.0: new models and methods. Available at: https://www.theguardian.com/sustainable-business/blog/sustainable-design-models-methods-biomimicry-cradle (accessed 18 December 2022).

Siedschlag, I., & Yan, W. (2021). Firms' green investments: What factors matter? *Journal of Cleaner Production*, vol. 310, Article 127554. DOI: https://doi.org/10.1016/j.jclepro.2021.127554

Srinivas, H. (2020). Eco-efficiency. Available at: https://www.gdrc.org/sustdev/concepts/04-e-effi.html#:~:text=The%20main%20aspects%20of%20eco,and%20therefore%20product%2Fservice%20life (accessed 3 December 2022).

Stahel, W.R., & Reday-Mulvey, G. (1981). Jobs for tomorrow: the potential for substituting manpower for energy. New York: Vantage Press.

Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: Moving from rhetoric to implementation. *Journal of Cleaner Production Clean*, vol. 42, pp. 215–227.

Szczepańska-Woszczyna, K., & Gatnar, S. (2022). Key Competences of Research and Development Project Managers in High Technology Sector. *Forum Scientiae Oeconomia*, vol. 10, no. 3, pp. 107–130. DOI: https://doi.org/10.23762/FSO_VOL10_NO3_6

Trushkina, N. (2019). Improvement of the organizational-and-economic mechanism of management logistic activity of enterprise. *Agricultural and Resource Economics: International Scientific E-Journal*, vol. 5, no. 4, pp. 156–172. DOI: https://doi.org/10.51599/are.2019.05.04.09

Trushkina, N., & Prokopyshyn, O. (2021). Circular economy as a new way of managing in the conditions of digital transformations. *Green, Blue & Digital Economy Journal*, vol. 2, no. 3, pp. 64–71. DOI: https://doi.org/10.30525/2661-5169/2021-3-10

Vîrjan, D. (2011). Rethinking economic activity on principles of eco-efficiency, *Theoretical and Applied Economy*, vol. XVIII, no. 7(560), pp. 135–146.

Wang, X., & Wang, Q. (2021). Research on the impact of green finance on the upgrading of China's regional industrial structure from the perspective of sustainable development, *Resources Policy*, vol. 74, Article 102436. DOI: https://doi.org/10.1016/j.resourpol.2021.102436

Wang, K.-H., Zhao, Y.-X., Jiang, C.-F., & Li, Zh.-Zh. (2022). Does green finance inspire sustainable development? Evidence from a global perspective, *Economic Analysis and Policy*, vol. 75, pp. 412–426. DOI: https://doi.org/10.1016/j.eap.2022.06.002

Yang, Q., Du, Q., Razzaq, A., & Shang, Y. (2022). How volatility in green financing, clean energy, and green economic practices derive sustainable performance through ESG indicators? A sectoral study of G7 countries. *Resources Policy*, vol. 75, Article 102526. DOI: https://doi.org/10.1016/j.resourpol.2021.102526

Yuan, Z., Bi, J., & Moriguichi, Y. (2006). The circular economy: A new development strategy in China. *J. Ind. Ecol.*, vol. 10, pp. 4–8.

Zink, T., & Geyer, R. (2017). Circular economy rebound. *Journal of Industrial Ecology*, vol. 21, pp. 593–602.

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