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# Methods of economic evaluation of projects with consideration of ESG risks

## Metody ekonomicznej oceny projektów z uwzględnieniem ryzyka ESG

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ESG, economic evaluation  
of projects, risk management,  
sustainable projects

**Słowa kluczowe:**  
zrównoważony rozwój,  
ESG, ekonomiczna ocena  
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Q56, G32, M14

**Abstract:** Evaluating the effectiveness of sustainable projects is a comprehensive process that requires consideration of both financial, social and environmental aspects. The main objective of the article is to identify the ESG risks necessary to assume in assessing the viability of sustainable projects. In the case of sustainable investments, it is worth using tools that take ESG aspects into account, such as LCA (Life Cycle Assessment) for environmental evaluation or social audits for assessing the impact on the community. This study provides a theoretical and conceptual introduction. It indicates topics within the scope of the economic evaluation of projects methods from an expanded perspective on the profitability of sustainable projects.

**Streszczenie:** Ocena efektywności projektów zrównoważonych stanowi kompleksowy proces, integrujący aspekty finansowe, środowiskowe oraz społeczne. Głównym celem artykułu jest identyfikacja kluczowych rodzajów ryzyka ESG (Environmental, Social, Governance), które należy uwzględnić przy ocenie opłacalności tego typu przedsięwzięć. W procesie tym zasadne jest stosowanie narzędzi zorientowanych na czynniki ESG, takich jak LCA (Life Cycle Assessment) do oceny oddziaływania na środowisko czy audyty społeczne. Opracowanie ma charakter teoretyczno-konceptualny, stanowiąc wstęp do zagadnień metodyki oceny opłacalności projektów zrównoważonych.

## Introduction

With the emergence of a new trend in project management, an important research problem arises regarding the conditions that must be met in order to implement sustainable development principles into project management practice. The topic is explored in terms of the selection of methodologies and focuses particularly on the planning stage. In this regard, an important aspect is the evaluation of the economic viability of the project, on the basis of which the decision to implement the project or reject it is made. Evaluation of investment efficiency is a process in which the costs associated with an investment are compared with its potential benefits. Ultimately, as a result of it, it is possible to determine whether the investment will bring a positive return and whether it is profitable in the long term. The use of a variety of investment methods makes it possible, by means of various indicators, to determine the return obtained from the investment in relation to the capital invested, or to determine the time it takes for the investment to return the initial outlay.

Evaluating the effectiveness of the aforementioned sustainable investments, i.e. those that take into account not only financial returns, but also environmental and social impact (ESG), is a process that requires a comprehensive approach. In addition to the need for an economic determination of profitability, it is important to determine whether the investment project has positive environmental, social and management effects. Evaluating for ESG aspects and sustainable project objectives extends the traditional analysis.

The main objective of the article is to identify the risks necessary to assume in assessing the viability of sustainable projects. Among the specific objectives identified are:

- to clarify the differences between sustainable project management and management of sustainable projects,
- to present methods for evaluating investment projects,
- identify ESG risks necessary for inclusion in the economic evaluation of projects.

Descriptive and comparative analysis, critical analysis of the literature on the subject from Google Scholar and EBSCO were used to achieve the objectives. Publications from the period 2013–2023 were analyzed, searching using the keywords sustainable projects, economic evaluation of projects and ESG risk management. As a result of the deductive approach, the main considerations for the application of ESG-enhanced economic efficiency assessment in project management were formulated.

## Sustainable project management and management of sustainable projects

Sustainable project management and management of sustainable projects are two distinct project management issues. Sustainable project management is concerned with ensuring that all aspects of traditional project management, from initiation and planning to implementation and evaluation, incorporate sustainability principles. This includes considering the social, environmental and economic impacts of a project and taking steps to minimize negative impacts and increase positive ones. Sustainable project management is an approach that integrates sustainability aspects throughout the project management process. The integration of additional dimensions is intended to support the achievement of harmony between the various dimensions of sustainability. Knowledge of sustainable project management is useful for project managers as well as sustainability and CSR personnel (*Corporate Social Responsibility*) [Kołoszycz, Wilczyński, 2023, pp. 66–67].

In addition to the traditional triple constraint, called the iron triangle (time, cost and quality), modern approaches to project management pay attention to the existing other triple constraint, related to ensuring sustainability, known as *triple bottom line* [Ebbesen, Hope, 2023, p. 4]. Classic project management of controlling time, budget and quality suggests a high level of predictability and control. In light of changes considered from a global and long-term perspective, it is important to consider the relationship between the three environmental, social and economic risks in the operation of businesses. These aspects are interrelated. If they are developed or optimized only in terms of one or two of them, it will usually be at the expense of the other aspects [Famielec, Famielec, 2016, p. 55].

In contrast, the term management of sustainable projects, although it refers to project management, is focused on sustainability. It applies project management principles to ensure that a project is completed on time, within budget and to quality standards, while achieving sustainability goals [Kołoszycz, Wilczyński, 2023, p. 59].

Huemann and Silvius' publication introduced into the literature an additional distinction between sustainable management through projects and sustainable management in projects [Huemann, Silvius, 2017]. This distinction relates to whether projects contribute to the creation of services and products that realistically enhance sustainability (by the project), or whether the project management process itself is understood as an activity that has a positive impact on the environment (of the project). Around these areas of scientific reflection are built further, covering other themes [Ćwikła, 2023, p. 92], from understanding success [Khalifeh et al., 2020], to engaging stakeholders [Eskerod, Huemann, 2013] and the responsibility and role of project managers, to how to deal with paradoxes when trying to reconcile different expectations [Sabini et al., 2019].

Elements of sustainable project management are becoming a necessity in methodical project management. In today's world marked by the climate crisis, ever-accelerating social and economic changes, every organization is forced to revise its environmental, social and economic policies. Projects are not exempt from this change. Methodical project management must adapt sustainable elements and update its own ways of operating [Karlikowski, 2024, p. 93]. Integrating the idea of sustainability, due to its timeliness, as well as the growing awareness of the scope, severity and effects of the climate crisis, determines the directions of management research [Gemünden, 2016]. Arguably, this trend will further intensify in the coming years [Ćwikła, 2023, p. 88].

## Methods of evaluating investment projects – the classical approach

Many authors undertake to define a project. Among the basic characteristics that appear in explanatory proposals are the duration of the project, the lack of repetition in a given organization, and the achievement of a set goal. One proposal assumes that a project is “a large, one-time, long-term, expertly managed undertaking of an interdisciplinary nature, with the intention of achieving an unambiguously set goal within a specified period of time and with a specified budget, implemented by an entity (enterprise, institution) that is its response to changes in the environment that take place over time” [Małecki et al., 2019, p. 14]. Its implementation within time, budget and quality frameworks is emphasized [Kerzner, 2005, p. 17]. These three parameters are the constraints on project implementation and are called the project constraint triangle (interchangeably iron or gold triangle). The important thing in the project management process is to maintain balance, and in the situation of having to choose, to focus on the main goal of the project along with obtaining satisfaction of the project stakeholders.

The implementation of projects allows for two types of effects: material (economic) effects, which can be measurable in both natural and monetary units. The second type of projects does not generate material effects, but has a significant impact on society and the economy [Małecki et al., 2019, p. 14]. Examples of economic projects include those involving the construction of an office building, the expansion of a warehouse, the installation of renewable energy sources. Intangible projects include, for example, educational projects related to improving language or specialized skills, cultural and sports projects, raising environmental awareness, marketing campaigns.

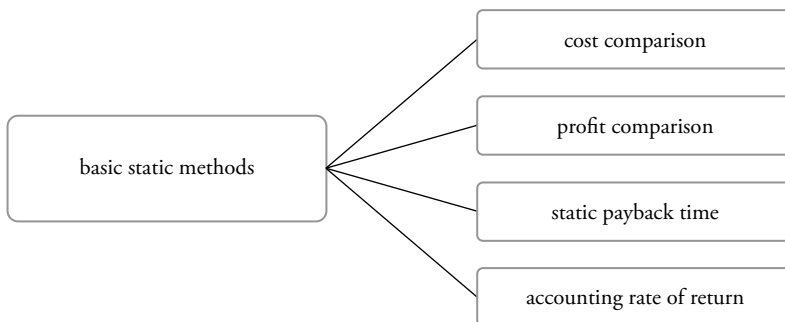
Among the projects carried out in enterprises, the term investment often appears, which can be referred directly to the Accounting Law. According to Article 3.1, investments are assets held by an entity in order to derive economic benefits from them resulting from an increase in the value of these assets, to obtain income in the form

of interest, dividends (shares in profits) or other benefits, including from a commercial transaction, and in particular financial assets and those real estate and intangible assets that are not used by the entity, but are held by it in order to achieve these benefits [Małecki et al., 2019, p. 16]. In management terms, they are classified according to several criteria [Merło, 2021, p. 9]:

- subject – depending on the object whose creation is the subject of financing,
- the time of implementation and duration of operation – short-term, medium-term and long-term investments,
- the size of the involvement of capital – with a subjective division into large, medium, small investments, as the determination of the size of the budget for the project should be confronted with the characteristics of a particular enterprise,
- place of implementation – domestic investments, foreign investments,
- interdependence of projects – mutually exclusive, complementary, substitutive investments,
- choice of the source of financing – own investments, borrowed, mixed,
- method of implementation – commissioned, made in-house.

A variety of methods are used to assess the profitability of an investment project. In terms of time horizon, methods are mainly classified as simple and dynamic. Simple methods, otherwise known as static or simplified methods, do not take into account the effect of the time factor on the value of cash flows (Figure 1). This disadvantage is offset by dynamic methods, otherwise known as discount or developed methods (Figure 2). A more precise evaluation of efficiency becomes possible by bringing receipts and expenditures to a certain date.

**Figure 1. Static methods for evaluating the profitability of investments**



Source: own elaboration based on [Merło, 2021, p. 49].

Static methods, as previously mentioned also called simple methods are mainly used in the preliminary stages of the investment project initiation process. Static methods

are used to study the profitability of small projects with a short life and implementation period. The most adopted calculations include:

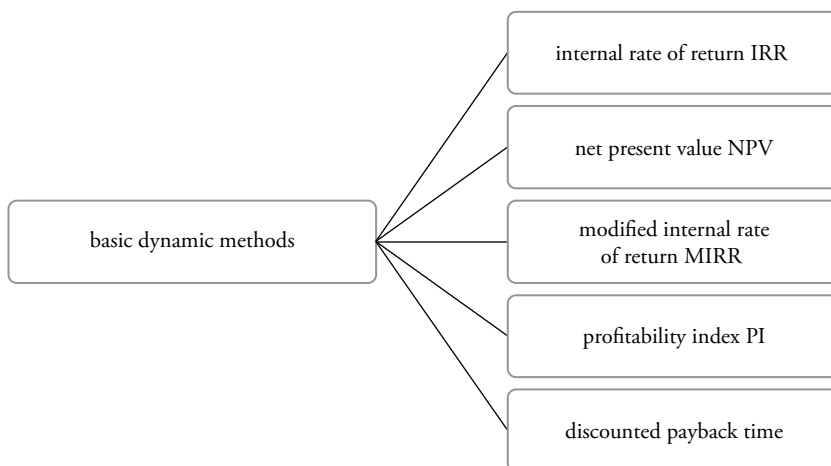
- payback period – the time it takes for an investment to pay for itself,
- simple rate of return – the ratio of the annual profit from the project to the value of the initial investment outlay.

Advantages of static methods include their simplicity in calculation, clarity in communicating the result and its interpretation, and accessibility to a wide range of people and organizations from different industries when it comes to determining the assessment of project profitability. However, there is quite a lot of criticism of the above methods in the literature as well as among practitioners. Mainly they concern the uncertainty of obtaining future revenues and the cost of not taking advantage of the opportunities associated with generating future revenues. They represent only expected figures and do not consider inflation, which reduces real income.

For large projects that last more than a year or investments that require significant cash outlays, dynamic methods are most often used. The following indicators are most often calculated for projects of this type:

- NPV – net present value is the difference, between discounted cash flows and initial expenditures. The investment is acceptable when  $NPV > 0$ , rejected when  $NPV < 0$ ,
- IRR – internal rate of return is based on discounted cash flow analysis. This is the interest rate at which the sum of discounted revenues equals expenditures. With it,  $NPV = 0$  then the investment is neutral, it can be accepted, however, non-financial criteria of project profitability should be considered.

**Figure 2.** Dynamic methods for evaluating the profitability of investments



Source: own elaboration based on [Merlo, 2021, p. 49].

Among the advantages of dynamic methods are the ability to compare the profitability of investments with different inputs and the consideration of the total cash flow associated with the project. Among the disadvantages of this approach are the omission of qualitative factors, the failure to take into account the risks associated with the investment, and, in the case of the IRR method, the fact that it cannot be used to evaluate investments with unconventional cash flow [Guler, 2019]. There is a more frequent tendency to point to dynamic methods as being more effective and providing a more accurate decision to start a project [Grzeszczyk, Waszkiewicz, 2020, p. 2365].

As the design maturity of the enterprise increases, an increasingly broader set of design features influences the determination of its complexity, in accordance with the accepted cost, schedule and functional constraints [Chadam, Kański, 2020, p. 60]. Project management poses a major challenge for managers because of the focus on a wide range of stakeholders in achieving strategic goals. Project investment objectives should be derived from the strategy of a given enterprise. It is understood as a process of creating a long-term plan, a position in the environment, a pattern of action or a process of self-identification [Merlo, 2021, p. 35]. Investment activity cannot be detached from strategy and decision-making based on rational considerations, despite the changing environment. It is crucial to evaluate the profitability of the investment according to several scenarios, so as to obtain information on what is the relationship between the expenditures that will be incurred in connection with the implemented project and the effects obtained during the operating period from the implemented investment. By analyzing the carrying out of the project in several variants, an economically reasonable decision can be made with regard to the available resources and possible risks by selecting the project in the optimal variant.

## **Basic assumptions of economic evaluation of projects with consideration of ESG**

When making investment decisions, it is important to take a broader look at the effectiveness of the investment and its connection to other spheres of the company's activity. It will depend on:

- the level of comprehensive and holistic assessment of project inputs and outputs,
- the multi-stage process of project preparation during which its authors and contractors will use economic calculation to evaluate all general and partial solutions of a given variant,
- selection and application of appropriate methods of efficiency assessment for a specific type of investment of a given enterprise [Małecki et al., 2019, pp. 18–29].

Activities at the level of the economic entity multiplied throughout the economy carried out in a continuous and stable manner are the basis for sustainable economic growth, which is based on the rate of investment [Ciborowski et al., 2001, pp. 15–16]. ESG factors are non-financial criteria, relating to corporate management, aimed at sustainable development of the company. This development is to take place taking into account three aspects, namely the environmental, social and corporate governance.

ESG risks are threats or opportunities to an organization related to environmental (E), social (S) and corporate governance (G) factors. They can lead to negative financial, reputational and operational impacts. In detail, the main ESG risks are shown in Table 1. The financial impacts indicated refer to potential compliance costs, financial penalties, loss of investment or decline in goodwill. In terms of reputation, there may be a loss of trust from customers, business partners and investors. These two areas can also intensify operational impacts in terms of difficulties in obtaining resources, regulatory changes or lack of access to markets with special heightened requirements.

**Table 1.** ESG risks important to consider in evaluating investment projects

Environmental risks (E)	Social risks (S)	Corporate governance risks (G)
Climate change	Social conflicts	Transparency assessment
Greenhouse gas emissions	Social inequalities	Ethical business practices
Natural resource consumption	Labor practices	Regulatory compliance
Waste consumption	Human rights	Internal control
Environmental degradation	Employee health and safety issues	Risk management systems

Source: own elaboration.

Examples of ecological risks within ESG include climate change, which can lead to increased operating costs. Deficiencies in waste management can generate costs for the company and damage to the environment. It is recommended to conduct an environmental audit in a company that wants to operate in accordance with the law, minimize its impact on the environment and improve its efficiency. In turn, after conducting an energy efficiency audit and submitting an application to the Energy Regulatory Office, the company can obtain white certificates, which confirm energy savings [Dołęga, 2022]. These certificates can then be sold on the Polish Power Exchange, which allows for the recovery of some of the costs incurred for energy-saving projects. Inappropriate work practices or personal data protection can in turn result in penalties, sanctions and loss of trust, which can be significant from the perspective of managing the intellectual capital of an organization.

Investment choices in each area, including environmental and social, concern the subject, place, time and size of the investment. They should be preceded by analyses of

the effectiveness of various investment options and their assessment from the point of view of the effectiveness of the investment project [Zalewska, Koziół, 2015, p. 182]. In the basic theoretical approach, investment means the involvement of resources that are to bring expected results in the future. Taking into account ESG risks enables achieving financial and, above all, non-financial benefits such as: preserving natural heritage, limiting the use of resources, reducing waste, improving the quality of life of society, etc. [Zalewska, Koziół, 2015, p. 182]. This means that at the stage of building incremental cash flows, the impact of ESG risks on the investment project which may have a financial dimension, should be analyzed. It is important to precisely determine all costs related to the investment, estimate revenues, but also additional benefits in the form of tax relief, subsidies, financial support from government or international programs, taking into account the risk analysis. ESG can be taken into account, among others, by using sensitivity and scenario analysis, discounting cash flows with an ESG risk premium. Additionally, factors linked to:

- the size and structure of the investment: analysis of costs, benefits and risks related to the investment,
- investment goals: determining what goals the investor wants to achieve (e.g. financial profits, social development, environmental protection),
- work schedule: planning and implementing the investment over time.

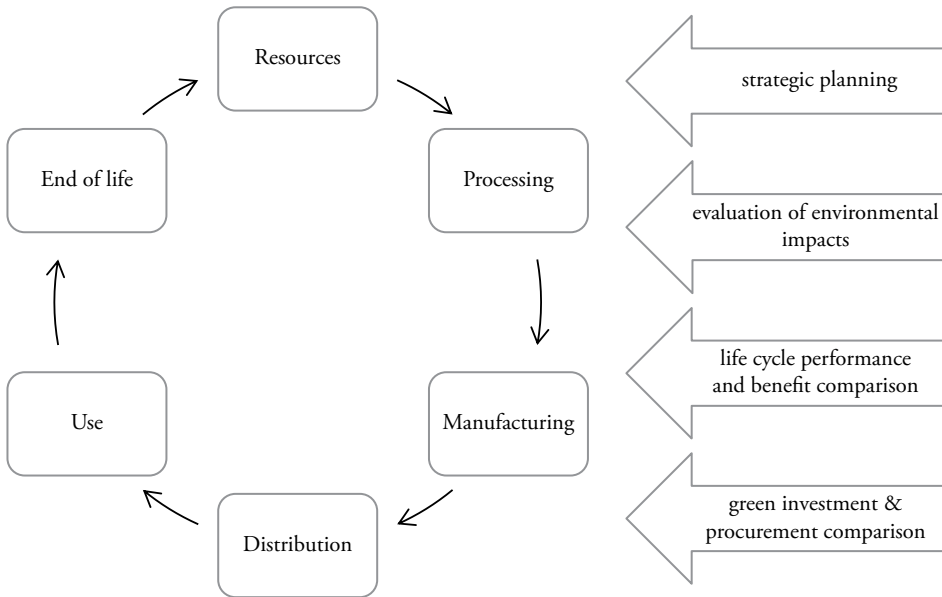
The choice of economic methods that take into account ESG risks depends on the investment objective, type of installation and data. In the case of sustainable investments, it is worth using tools that take into account ESG aspects, e.g. LCA (Life Cycle Assessment) for environmental assessment or social audits [Asante-Appiah, Lambert, 2023] for assessing the impact on the community.

LCA is a method for assessing the impact of a product, process or service on the environment throughout its life cycle [Triguero et al., 2023], from raw material acquisition, through production and use, to disposal or recycling [Rozenkowska, 2021, pp. 108–109]. It is a tool that allows to identify and quantify environmental impacts, such as greenhouse gas emissions, energy and water consumption, or soil pollution [Mahmud et al., 2021]. LCA analysis can be used, for example, to assess the impact of buildings on the environment, to study the carbon footprint of products, to assess the impact of production processes on the natural environment [Sarna, Ferdyn-Grygierek, 2021; Szymańska, 2021; Węglarz et al., 2023]. The LCA is presented on Figure 3.

In turn, social audits are used to assess the impact of business on society. A social audit is used to assess whether an organization operates in a socially responsible manner and whether its activities have a positive impact on society [Desperak, 2012]. Social audit can be conducted in various ways, e.g. through surveys, interviews, observations, document analysis, etc. An approach that takes into account the actual impact of enterprises on society, and thus the social effects of their activities, provides a basis

for more in-depth research into the actual effects of integrating social policy with the overall policy and strategy of the company [Baran, 2021, p. 35]. Additionally, the legal environment is important and can have a positive or negative impact on investment processes [Kłobukowska, 2023].

**Figure 3.** Life Cycle Assessment Applications – inside the company perspective



Source: own elaboration.

## Conclusion

The assessment of the efficiency of sustainable projects is a comprehensive process that requires taking into account both financial, social and environmental aspects. The use of appropriate indicators and methods, as well as the analysis of investment objectives and work schedules, allows for a precise economic evaluation of projects and making more informed investment decisions. In reference to the main objective of the work, ESG risks necessary to be adopted in the assessment of the profitability of sustainable projects were identified. It is worth paying attention to the use of incremental flows related to ESG factors and then applying the characterized simple and dynamic methods. The article also presents a note on the differences between sustainable project management and management of sustainable project. From the perspective of assessing the profitability of projects, establishing the definition of the project, its purpose

and scope is very important. Especially when the possibilities of this assessment are expanded to contain LCA (Life Cycle Assessment) analysis or conducting an internal audit, including a social, environmental and energy audit.

Conducting an economic assessment of the profitability of projects currently requires a broader approach to the analysis of risks in projects, including risks related to achieving ecological, social and corporate governance goals. Assessing the profitability of sustainable projects allows managers to make informed decisions based on an analysis of whether a given project will bring financial and non-financial benefits. It is important to identify which ESG aspects have the greatest impact on a given project and how they can affect its profitability. Finally, it is necessary to assess whether the costs of its implementation do not exceed the potential profits. This assessment is crucial for companies wishing to invest in sustainable development and increase their attractiveness to investors. Such activities will help maintain or increase competitiveness on the market.

This study is a theoretical and conceptual introduction highlighting the most important issues with an extended view of the profitability of sustainable projects. In subsequent studies, it is worth using the approach related to building models to verify the assumptions related to the inclusion of ESG risks in projects for specific types of environmental, social or mixed projects.

## References

- Asante-Appiah B., Lambert T.A. [2023], The role of the external auditor in managing environmental, social, and governance (ESG) reputation risk, *Review of Accounting Studies*, vol. 28(4), pp. 2589–2641.
- Baran G. [2021], *Spółeczna odpowiedzialność w zarządzaniu*, Monografie i Studia Instytutu Spraw Publicznych Uniwersytetu Jagiellońskiego, Kraków.
- Chadam J., Kański Ł. [2020], *Zarządzanie projektami inwestycji kapitałowych*, Uniwersytet Marii Curie-Skłodowskiej w Lublinie, Lublin.
- Ciborowski R.W., Gruszewska E., Meredyk K. [2001], *Podstawy rachunku efektywności inwestycji*, Wydawnictwo Uniwersytetu Ekonomicznego w Białymstoku, Białystok.
- Ćwikła M. [2023], Zrównoważone zarządzanie projektami. Krytyczny przegląd literatury, *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, vol. 67(5), pp. 87–100.
- Desperak I. [2012], Audyt społeczny jako propozycja wzbogacenia repertuaru metod badań społecznych, *Przegląd Socjologii Jakościowej*, vol. 8(1), pp. 60–75, February, DOI: 10.18778/1733-8069.8.1.04.
- Dołęga W. [2022], Efektywność energetyczna gospodarki krajowej – wybrane aspekty, *Przegląd Elektrotechniczny*, vol. 98(8), pp. 118–122.
- Ebbesen J.B., Hope A. [2023], Re-imagining the Iron Triangle: Embedding Sustainability into Project Constraints, *PM World Journal*, no. 2 (III), pp. 1–13.

- Eskerod P., Huemann M. [2013], Sustainable Development and Project Stakeholder Management: What Standards Say, *International Journal of Managing Projects in Business*, vol. 6(1), pp. 36–50, DOI: 10.1108/17538371311291017.
- Famielec J., Famielec S. [2016], Integracja nauk ekonomicznych, technicznych i chemicznych na rzecz rozwoju zrównoważonego, *Ekonomia i Środowisko*, no. 3, pp. 47–61.
- Gemünden H. [2016], Project Governance and Sustainability – Two Major Themes in Project Management Research and Practice, *Project Management Journal*, vol. 47(6), pp. 3–6, DOI: 10.1177/187569728160470060.
- Grzeszczyk T.A., Waszkiewicz M. [2020], Sustainable investment project evaluation, *Entrepreneurship and Sustainability Issues*, vol. 7(3), pp. 2363–2381, DOI: 10.9770/jesi.2020.7.3(60).
- Guler O.V. [2019], Modelling financial sustainability with performance indicators: NPV and IRR, *Emerging Markets Economics and Business. Contributions of Young Researchers*, vol. 304, pp. 22–28.
- Huemann M., Silvius G. [2017], Projects to create the future: Managing projects meets sustainable development, *International Journal of Project Management*, vol. 35(6), pp. 1066–1070, DOI: 10.1016/j.ijproman.2017.04.014.
- Karlikowski M. [2024], Zrównoważone zarządzanie projektami w oparciu o metodykę PRiSM (PProjects integrating Sustainable Methods), *Studia i Prace Kolegium Zarządzania i Finansów*, no. 198, pp. 81–95.
- Kerzner H. [2005], *Advanced Project Management, Edycja polska*, Helion, Gliwice.
- Khalifeh A., Farrell P., Al-edenat M. [2020], The Impact of Project Sustainability Management (PSM) on Project Success: A Systematic Literature Review, *Journal of Management Development*, vol. 39(4), pp. 453–474, DOI: 10.1108/JMD-02-2019-0045.
- Kłobukowska J. [2023], Ocena projektów inwestycyjnych o charakterze społecznym w kontekście zmian podatkowych na przykładzie Polskiego Ładu, *Zeszyty Naukowe Polskiego Towarzystwa Ekonomicznego w Zielonej Górze*, vol. 10(19), pp. 37–54.
- Kołoszycz E., Wilczyński A. [2023], Integracja zasad zrównoważonego rozwoju w zarządzaniu projektami, *Zeszyty Naukowe Polskiego Towarzystwa Ekonomicznego w Zielonej Górze*, no. 18, pp. 66–67, DOI: 10.26366/PTE.ZG.2023.244.
- Mahmud R., Moni S.M., High K., Carbajales-Dale M. [2021], Integration of techno-economic analysis and life cycle assessment for sustainable process design – A review, *Journal of Cleaner Production*, vol. 317, pp. 128247.
- Małecki P.P., Rosiek K., Żaba-Nieroda R. [2019], *Metody oceny projektów gospodarczych*, Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Kraków.
- Merlo P. [2021], *Inwestycje rzeczowe w praktyce gospodarczej*, Instytut Badań Gospodarczych, Olsztyn.
- Rozenkowska K. [2021], Ocena cyklu życia w teorii i praktyce, in: Żemigła M. (ed.), *Współczesne problemy organizacji i zarządzania*, WUW, Warszawa.
- Sabini L., Muzio D., Alderman N. [2019], 25 Years of ‘Sustainable Projects’. What We Know and What the Literature Says, *International Journal of Project Management*, vol. 37(6), pp. 820–838, DOI: 10.1016/j.ijproman.2019.05.002.
- Sarna I., Ferdyn-Grygierek J. [2021], Zastosowanie techniki LCA do środowiskowej oceny cyklu życia domów jednorodzinnych, in: Bogacka M., Pikoń K. (eds.), *Współczesne problemy ochrony środowiska i energetyki 2020*, Silesian University of Technology, Gliwice, p. 123.

- Szymańska I. [2021], Ocena cyklu życia (LCA) opakowań w koncepcji zrównoważonego rozwoju, *Przemysł Spożywczy*, no. 75, pp. 35–42.
- Triguero Á., Moreno-Mondéjar L., Sáez-Martínez F.J. [2023], Circular economy and firm performance: The influence of product life cycle analysis, upcycling, and redesign, *Sustainable Development*, vol. 31(4), pp. 2318–2331, <https://onlinelibrary.wiley.com/doi/full/10.1002/sd.2509>.
- Węglarz A., Pierchalski M., Wojdyła I., Koper M., Zdanowski P. [2023], Obliczanie całkowitego śladu węglowego na przykładzie nowego budynku biurowego, *Izolacje*, no. 28, pp. 34–40.
- Zalewska M.E., Koziół W. [2015], W poszukiwaniu miar efektywności inwestycji na rzecz środowiska, *Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania*, vol. 2(40), pp. 179–188, DOI: 10.18276/sip.2015.40/2-14.

