

ANALYSIS OF THE IMPLEMENTATION OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT USING THE INDICATOR METHOD

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Purpose: The purpose of the study was to perform an analysis of the essence and importance of the idea of sustainable development and an analysis of progress in meeting one of the Sustainable Development Goals in Poland and Slovakia using a system of indicators. The progress in implementing Sustainable Development Goal 9 (industry, innovation and infrastructure) of the document "Transforming Our World: Agenda for Sustainable Development - 2030" was analyzed.

Design/methodology/approach: Achieving the purpose of the study required a structured research methodology, which included a diagnostic survey method, comparative analysis, and content analysis and desk research techniques were used as part of data collection.

Findings: The realization of the analysis of the level of fulfillment of Goal 9 of the 2030 Agenda made it possible to identify the difficulties that arise from the specifics of the adopted research method. With regard to the level of fulfillment of Goal 9, it was found that Poland and Slovakia are gradually meeting the set objectives. A critical area in relation to Slovakia's development is the aspect of inventive activity, i.e. the country's ability to use knowledge and research results to reap potential economic benefits.

Research limitations/implications: Through the implementation of the proposed methodology for analyzing data for Poland and Slovakia in relation to Sustainable Development Goal 9 (industry, innovation and infrastructure), it was found that monitoring progress in meeting the provisions of the 2030 Agenda using the indicator method is fraught with the following difficulties: the need to standardize relevant data for EU countries, lack of access or difficult access to adequate data in individual countries, generalizations and subjectivity due to the specifics of the indicator method.

Practical implications: The indicator analysis of the completed research procedure contributes to the accumulation of factual knowledge and the identification of development trends, which is the foundation for determining milestones and strategic plans for the implementation of the concept of sustainable development.

Originality/value: The analyses presented here complete the research gap regarding the diagnosis and analysis of the level of fulfillment of one of the goals of sustainable development with its assumptions by Poland and Slovakia against the background of the European Union.

Keywords: indicator measurement, sustainable development indicators, Agenda 2030, sustainable development.

Category of the paper: Research paper.

1. Introduction

Human endeavors in the economic sphere not only influence the organization of social life, but also affect the state of the environment. The ubiquitous hegemony of mankind over the natural world, combined with the irresistible need to constantly satisfy needs, results in the endangerment of nature and the emergence of an environmental crisis (Becla, Czaja, 2022). The expansiveness in terms of economic development and the fulfillment of human needs has a significant impact on the development of economic processes and transformations in the area of values (Wolniak, 2022; Lazar et al., 2022). However, the natural environment also has certain limits of endurance, and once these limits are exceeded to its destruction, which negatively affects human well-being and condition (Czerwinska, Pacana, 2022). This outlines the circle of interaction, while emphatically depicting the interdependence between: the economy, society and the natural environment.

For the formation of the idea of sustainable development from an axiological perspective, the transformations in the area of values, formed as a result of economic activity, were crucial. The core around which the transformation of values took place was the processes of industrialization proceeding along with the development of science and technology (Czerwinska et al., 2022).

The changes in values discernible in the context of the clarification of the assumptions of the idea of sustainable development progressed in a way that makes it possible to see an analogy with the successive stages of technological development. The changes in values are part of the division of societies whose characteristics have transformed from the old traditional societies (based on agriculture), through industrial, post-industrial and post-modern societies, also called information societies (Szacka, 2008). In the 1960s, when the encyclical *Mater et magistra* was published, the use of the classical Catholic methodology for social teaching was emphasized: examine - evaluate - act. The indicated method calls for identifying the historical dimension in terms of specific aspects of social life (Prüfer, 2006). Based on the presented treatment of the environmental issue and the idea of sustainable development, two historical phases of the formation of the concept of sustainable development can be distinguished: indirect - related to the effects of the industrial revolution; direct - related to events confirming the progressive degradation of the environment due to technical and scientific progress.

When listing individual phenomena indicating environmental degradation, one should not overlook the interdependence occurring between man and his natural environment. In many scientific studies, this relationship is captured in the category of a bond. This specific bond indicates the relationship between man and other entities, in relation to which man, being a rational being, occupies a superior position. Man cared for natural resources and the environment as a whole, as through its resources he was able to satisfy existential needs (Mikalauskiene, Atkociuniene, 2019). It was only the progressive economic conditions associated with increased exploitation of natural resources that contributed to an increased awareness of the interdependence between humans and nature. This has made it possible to conclude that the neglect of this coexistence will lead to negative consequences affecting the dependence of ecosystems, within which humans also function. The answer to such negative and acute circumstances is the implementation of the premises and goals flowing from the idea of sustainable development in the macro and microeconomic spheres (Pacana et al., 2020).

Based on the considerations presented, the purpose of the study was to perform an analysis of the essence and importance of the idea of sustainable development and an analysis of progress in meeting one of the Sustainable Development Goals in Poland and Slovakia using a system of indicators. The progress in the implementation of Sustainable Development Goal 9 (industry, innovation and infrastructure) of the document "Transforming Our World: Agenda for Sustainable Development - 2030" was analyzed. Progress in meeting the objectives of the selected goal was analyzed for Poland and Slovakia.

2. Sustainable Development as an idea of balance

Sustainability is a concept that owes much of its success to the creation of an opportunity to identify trade-offs between rationales occurring in the social, economic and ecological spheres. The concept is not just about simple compromise, because the environmental life-sustaining systems and the common heritage of humanity cannot be preserved in all its glory by paying attention only to simple compromise. Especially since, in essence, sustainable development means not only the constant search for harmony between its basic aspects, but also the moral, spatial, institutional aspects, in the present and intergenerational perspectives (Biekša et al., 2022).

The guiding principles of sustainable development are not invariably fixed, but are shaped as a result of global dialogue (Ulewicz, Blaskova, 2018). In the initial stage, considerable emphasis was placed on the sphere of economic development and environmental protection (Grebski et al., 2022). After that, the concept of sustainable development was deepened and expanded attaching to its scope an ecocentric vision of nature and social development. Although

activities aimed at maintaining the level of environmental quality at the current level are in order, preventive measures and broadly understood activity in this area have a primary place in the concept presented. Restoring the value of nature that has lost value as a result of human activities is a further activity that is in line with the new paradigm of environmental protection and sustainable development (Astorga, Valdes, 2021).

Despite the openness and creative ambiguity regarding interpretation, the term sustainable development has retained a fundamental set of guiding values of the principles detailed in the Brundtland Commission's standard definition (development that meets present needs without compromising the ability of future generations to meet their needs) (Cerne, Jansson, 2019). Moreover, the terms "sustainable" and "development" themselves evoke positive associations in most people, while their association evokes virtually universal agreement on the seriousness of the values and goals to which it points. The phrase is also an important tool in various conflicting social contexts (Dagbanja, 2022).

The concept of sustainable development is defined in Polish legislation and is interpreted as social and economic development, in which the process of integrating economic, political and social activities is implemented. These activities are carried out while maintaining the balance of the natural environment and ensuring the sustainability of basic natural processes to ensure that the fundamental needs of citizens of the present and future generations are met (Environmental Protection Law, 2001). Thus, it can be said that the definition established in this form deals with the essential aspects of sustainable development. In addition, it emphasizes its basic assumptions - the need to integrate three planes: human development and development in the economic area that includes the goods of the natural environment. As indicated by (Figure 1a).

Sustainable development is a concept that focuses significantly on the quality of human life and health. Achieving the expected level in this aspect is possible through proper management of five categories of capital: natural, economic, human, social and integrating the other capitals (Adamowicz, Dresler, 2006). The disposition of all categories of capital should be done in accordance with the assumptions of ecological, economic, social, institutional and spatial order (Figure 1b).

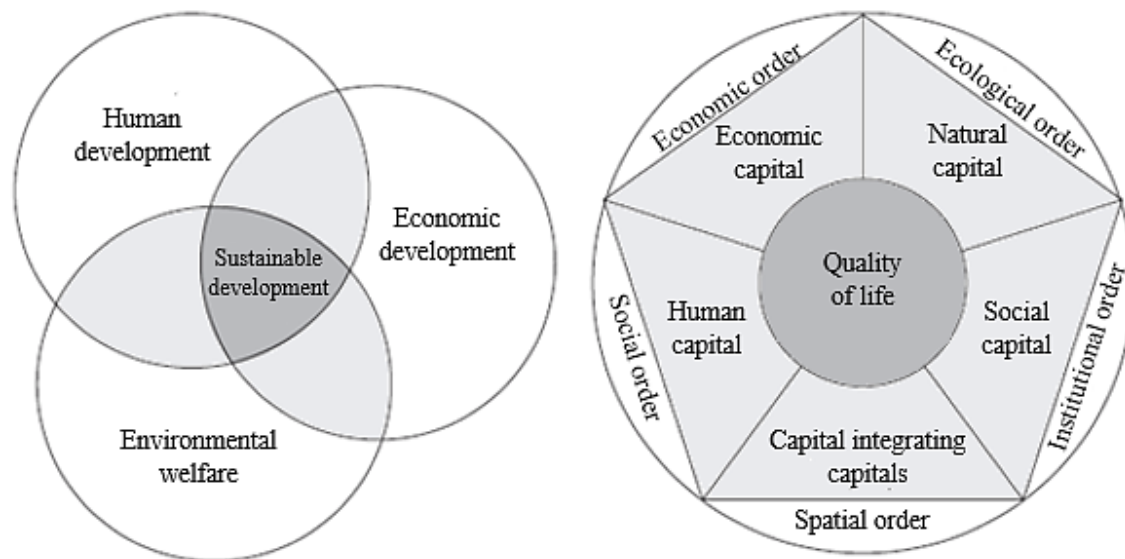


Figure 1. The idea of sustainable development a) the basic concept of sustainable development, b) sustainable development in terms of capitals and orders.

Source: own elaboration based on Adamowicz, Dresler, 2006, pp. 17-24.

A key aspect of quality in sustainable development conceived as a concept shaping the relationship between the economy, people and the environment is to attempt to capture them collectively, rather than treating them as independent issues, as has traditionally been the case (Dobrzanski, 2011). The indicated components are often included in the aspect of sustainable development as three types of capital. While their effective management is supposed to ensure well-being (Pacana et al., 2023), which is most often associated with such qualities as harmony, fulfillment, happiness, community and appreciation (Kronenberg, Bergier, 2010).

The spread of the concept of sustainability, which is now a globally accepted and even desirable solution, was linked to the development of environmental awareness (Hajduk-Stelmachowicz, 2014). Its foundation became the public perception of environmental degradation, followed by the spread of attitudes of individual involvement (perception of the risks resulting from a consumerist model of behavior) and collective involvement (civic initiatives, protest actions, promotional and informational campaigns), up to the ushering in of disapproval of behavior incompatible with the pro-environmental spirit (Olkiewicz, Wolniak, 2020; Hys, 2014).

The concept of sustainability has also become widespread in manufacturing industries. Enterprises wishing to maintain a stable position in the EU market must take care of the appropriate level of competitiveness (Pacana, Czerwinska, 2019; Olkiewicz et al., 2019). One of the fundamental conditions for mature competition has become the formulation and implementation of developmental strategies that take into account pro-environmental measures (Ulewicz et al., 2023; Staniszewska et al., 2020).

3. Research Methodology

The creation of new knowledge involves the recognition of the existing state of knowledge and the identification of findings noted in earlier studies and literature. The cognitive procedure, aimed at identifying the existing state of knowledge, is the basis for the implementation of analyses. The course of the developed research procedure consisted of six structured research steps and allowed to perform an analysis of the level of implementation of the selected objective of sustainable development of Poland and Slovakia against the background of the European Union. The first steps of the research methodology are based on the principle of continuity. The orthodox understanding of this principle allows to study the literature in layers - starting with the most recent. Each layer should include the knowledge gained in previous research. A cross-sectional characterization of the different stages of research implementation is presented in Table 1.

Table 1.

Summary of the various stages of survey implementation

No	Name	Synthetic description
1.	Clarification of the subject and purpose of the research	Establish the categories of objects for which the research will be carried out and for the cognition of reality, which involves descriptions and explanations of the phenomena and processes occurring in the reality under study
2.	Diagnostic survey	Getting to know the phenomenon specified in the purpose of the research, establishing its scope, extent, level and intensity. This activity will create a description of important processes taking place in the communities. The study uses the technique of document analysis
3.	Data evaluation	Assessing the quality of the selected data in terms of achieving the research objective
4.	Comparative analysis and interpretation of data	Analyzing the characteristics of the established subjects of the study in terms of identifying similarities and differences (dissimilarities) and making sense of the collected data
5.	Presentation of results and data visualization	Presenting the results taking into account the principles of effective communication and the standards set for scientific research; this step also involves deciding how to organize the data and identify the relevant ones to be included in the study. Data visualization plays an important role as an element that promotes understanding and remembering of the results of the analyses carried out
6.	Conclusions and future research directions	Determination of conclusions and reflections on the completed analyses and identification of the area of future scientific inquiry

Source: own elaboration.

The application of methodological rigor to the realization of the research objective set in the study leads toward the use of transparent techniques, as well as the possibility of replicating the proposed procedures.

4. Analysis of the level of fulfillment of objective 9 of the concept of sustainable development of Poland and Slovakia

The document "Transforming our world: the 2030 Agenda for Sustainable Development" adopted by the United Nations (UN) is a program of action of unprecedented scope and importance that defines a model for sustainable development in global terms. Given that the 2030 Agenda is a universal development plan for the whole world, it requires adaptation to the specifics of each country. Therefore, the role of countries in the process of implementing the goals of Agenda 2030 (SDGs) crucial (Novovic, 2022). The multidimensionality and permeability of the SDGs compels commitment and appropriate cooperation. In doing so, it is important to transfer the global goals to the national, regional, local level and make them relevant (Manero-Salvador, 2022).

The analysis included selected sustainable development indicators related to SDG 9 - Industry Innovation and Infrastructure, Agenda 2030. This goal refers to building stable infrastructure, promoting sustainable industrialization and fostering innovation.

At the core of efforts to achieve environmental goals is technological progress, including a significant impact of increasing energy and material efficiency. Without technology and innovation there can be no industrialization, and without industrialization there is no development. Hence, the study pays attention to such indicators as gross domestic expenditure on R&D by sector (Figure 2), R&D personnel by sector (Figure 3) and patent applications to the European Patent Office by applicants' / inventors' country of residence (Figure 4).

The indicator Gross Domestic Expenditures on R&D by sector measures gross domestic expenditures on research and development (GERD) as a percentage of gross domestic product (GDP). The indicator is the main measure of R&D statistics, characterizing the competitiveness and level of development of the knowledge-based economy. Figure 2 shows the values of the aforementioned indicator over the years 2000-2021 for Poland and Slovakia against the background of the European Union (EU).

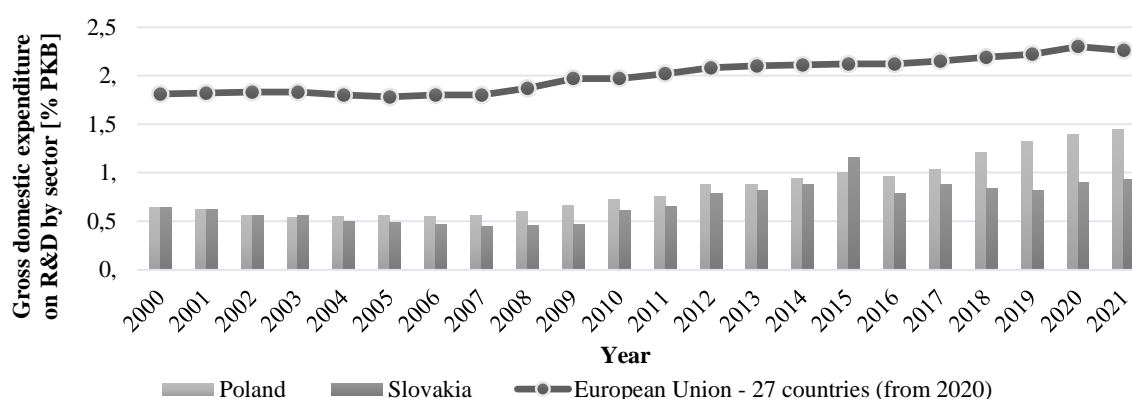


Figure 2. Dynamics of the index of gross domestic expenditure on R&D by sector for Poland and Slovakia against the EU.

Source: own elaboration based on: <https://ec.europa.eu/eurostat>, 18.07.2023.

Over the analyzed period, the values of gross domestic expenditure on R&D by sector show an upward trend. Since 2000, the value of the indicator has increased by 124.99% compared to 2021, while in Slovakia an increase of 45.31% is observed. Despite the fact that in 2000-2003 the values of the indicator for Poland and Slovakia were almost identical, in 2021 the value of the indicator for Poland is 35.41% higher than that of Slovakia. The dynamics of changes in the value of the analyzed indicator shows similar trends to those observed for the EU.

The R&D personnel by sector indicator measures the share of R&D personnel by the following institutional sectors: business enterprises (BES), government (GOV), higher education (HES), private non-profit (PNP). Figure 3 shows the values of the indicator for Poland and Slovakia against the EU from 2000 to 2021.

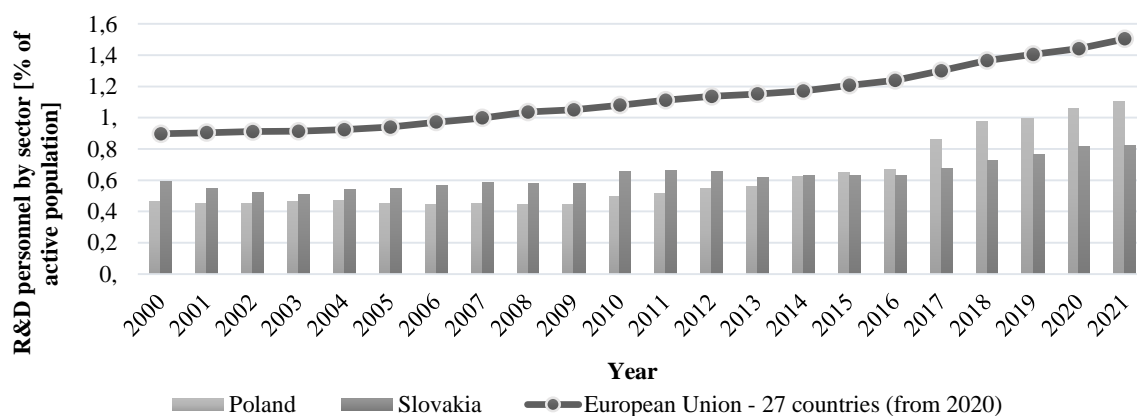


Figure 3. Dynamics of the R&D personnel by sector index for Poland and Slovakia against the EU.

Source: own elaboration based on: <https://ec.europa.eu/eurostat>, 18.07.2023.

In the first year of the analyzed period, the indicator of R&D personnel by sector in Slovakia exceeded the value achieved by Poland (20.98% higher value). This trend continued until 2014. Since 2017, Poland has seen a sizable increase in the value of the R&D personnel by sector indicator (with respect to 2016, an increase of 28.85%). This has been influenced by a significant increase in the number of R&D personnel for every one million people and by increasing public and private funding for development. This measure helped generate a 27.80% increase in the indicator over 5 years (2017-2021) (2017 - 0.8623, 2021 - 1.1021). Slovakia did not see such a marked increase between 2017 and 2021, but the country, like the EU, is on an upward trend.

Another indicator subject to analysis was patent applications to the European Patent Office by applicants' / inventors' country of residence. Figure 4 illustrates the values of the indicator for Poland and Slovakia against the EU in 2000-2022.

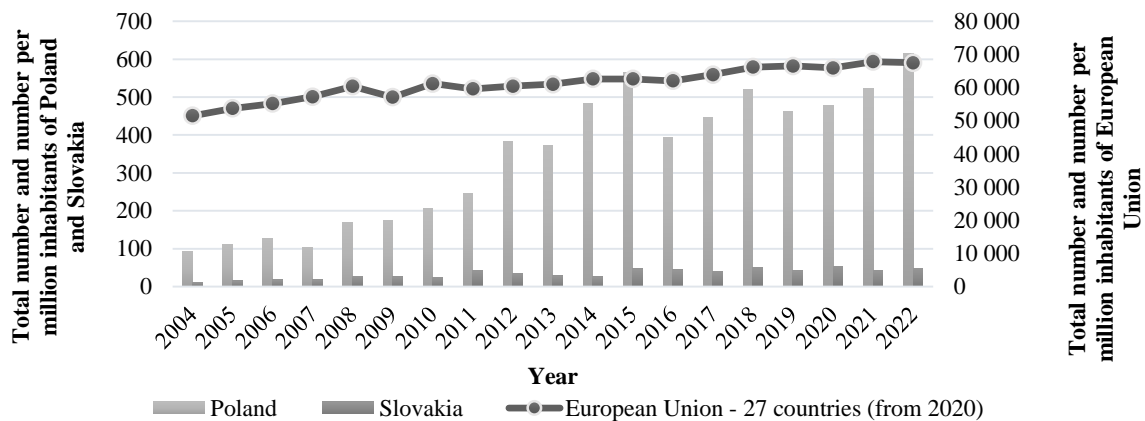


Figure 4. Dynamics of the R&D personnel by sector index for Poland and Slovakia against the EU.

Source: own elaboration based on: <https://ec.europa.eu/eurostat>, 18.07.2023.

Due to significant differences in the number of patent applications between Poland Slovakia and the EU, two vertical axes were used in the graph (left axis for Poland and Slovakia; right axis for the EU). Patent applications in Slovakia during the period under review ranged from 12 (2004) - 54 (2018), while in Poland they ranged from 93 (2000) - 615 (2022). The number of patent applications indicates the level of inventive activity and the ability of the country and its companies to use knowledge and research results and translate them into potential economic benefits. In this context, Slovakia is far from achieving the goal of sustainable development. In relation to the EU, there is an upward trend. Over the period under review, there was a 31.04% increase in patent applications, which is a satisfactory result.

Analysis of data on indicators of gross domestic expenditure on R&D by sector, R&D personnel by sector and patent applications to the European Patent Office by applicants'/ inventors' country of residence makes it possible to check whether one of the specific objectives of Goal 9 of Agenda 2030 is being met. This goal reads as follows: By 2030, research should be strengthened and the technological level of the industrial sector should be raised in all countries, especially in developing countries, including through innovation, a significant increase in the number of R&D workers for every million people, and by increasing public and private financial investment in development. Analysis of the data indicates that the stated goal has been met by Poland. Slovakia, on the other hand, should increase its level of inventive activity.

SDG 9 calls for building resilient and sustainable infrastructure and promotes inclusive and sustainable industrialization. For this reason, attention was paid to the indicator - share of buses and trains in inland passenger transport (Figure 5) and share of rail and inland waterways in inland freight transport (Figure 6).

The indicator share of buses and trains in inland passenger transport measures the share of public transport modes in total inland passenger transport work, expressed in passenger kilometers (pkm). Figure 5 illustrates the values of the indicator for Poland and Slovakia against the EU in 2000-2021.

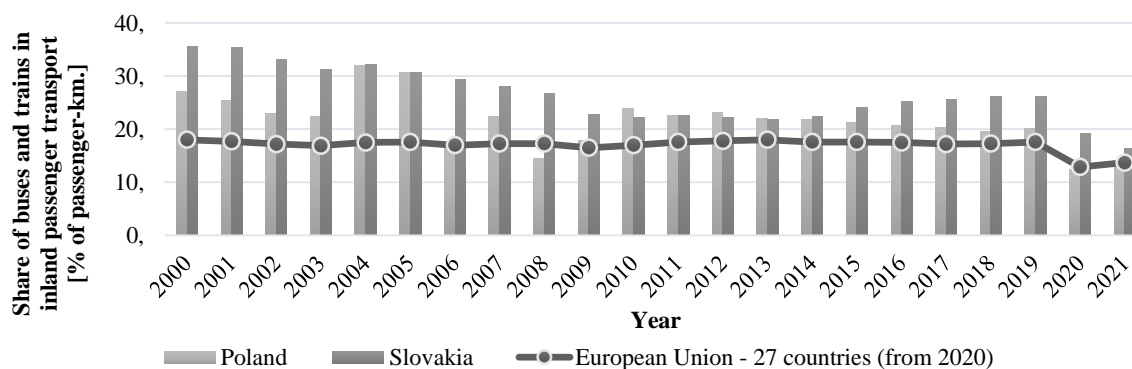


Figure 5. Dynamics of the indicator share of buses and trains in inland passenger transport for Poland and Slovakia in comparison with the EU.

Source: own elaboration based on: <https://ec.europa.eu/eurostat>, 18.07.2023.

During the period under review, the share of public transportation is decreasing in both Poland and Slovakia. A decrease in the rate of 49.63% for Poland and 54.21% for Slovakia, respectively, is observed. A similar trend, albeit milder, is taking place in the EU (a decrease of 23.88%). This may be due to the propensity to use passenger cars that has been observed in recent years in Europe.

It is worth noting that the methodology for collecting data of the indicator share of buses and trains in inland passenger transport is voluntary and not fully harmonized at the EU level. For countries without legislation on rail transport statistics, the totals include only the share of coaches, buses and trolleybuses.

The share of rail and inland waterways in inland freight transport indicator measures the share of rail and inland waterways in total inland freight transport. Data over the years 2005-2021 of the aforementioned indicator for Poland and Slovakia are presented in Figure 6.

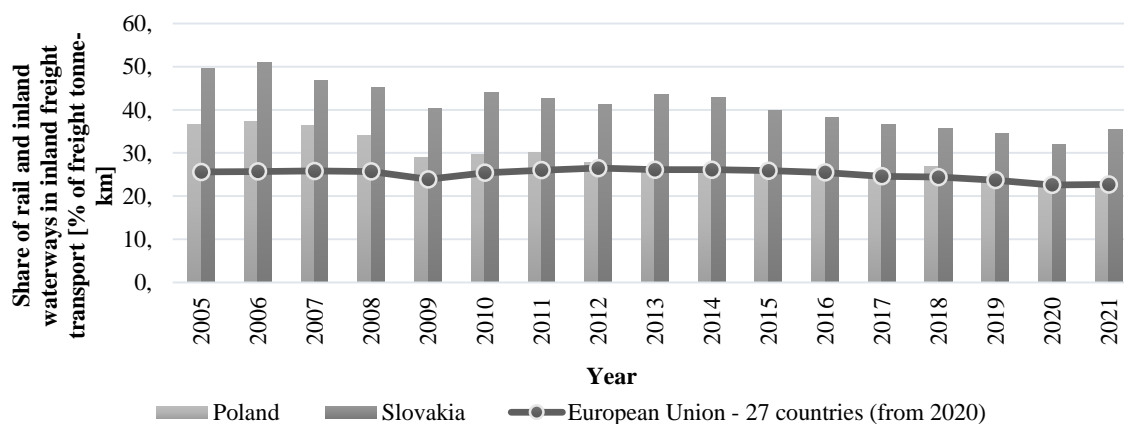


Figure 6. Dynamics of the indicator share of rail and inland waterways in inland freight transport for Poland and Slovakia against the EU.

Source: own elaboration based on: <https://ec.europa.eu/eurostat>, 18.07.2023.

In the analyzed years 2005 - 2021, the share of railroads and inland waterways in inland freight transport in Poland successively approached the indications of the EU parameter, and since 2012 has not shown significant differences. With regard to Slovakia, the level of the

mentioned indicator shows a downward trend. In the first year of the period under consideration, the value of the indicator was 25.85% higher than in Poland, and at the same time 48.28% higher than in the EU. In 2021, the indicator for Slovakia was 35.40% and was 37.85% higher than in Poland and 35.87% higher than in the EU. Which indicates that Slovakia is approaching the European level at a slow pace. However, it should be remembered that for countries that do not apply statistical rules for inland waterways, the totals include only the share of rail transportation.

Both Poland and Slovakia are striving to effectively manage available resources and achieve the goals of Agenda 2030 in line with sustainable development. These countries indicate different trends in all the areas studied, which is due to their specificities. However, it is important to remember that sustainable development and economic growth are highly dependent on investments in innovation and infrastructure. SDG 9 also seeks to increase technological progress and scientific research, which are important instruments for achieving sustainable development. Today, more than half of the world's population lives in cities, which underscores the importance of urgently promoting new and sustainable ways of living, such as public transportation, providing renewable energy and improving means of information and communication.

5. Summary and conclusions

Sustainable development is identified with intergenerational solidarity consisting in finding solutions that guarantee growth, which allow active inclusion in development processes of all social groups, while giving them the opportunity to benefit from economic growth. The purpose of the study was to perform an analysis of the essence and importance of the idea of sustainable development and an analysis of progress in meeting one of the goals of sustainable development in Poland and Slovakia using a system of indicators. The progress in implementing Sustainable Development Goal 9 (industry, innovation and infrastructure) of the document "Transforming Our World: Agenda for Sustainable Development - 2030" was analyzed.

The procedure proposed in the study for analyzing the collected data for Poland and Slovakia in relation to selected Objective 9 - industry, innovation and infrastructure was found to be fraught with the following difficulties in monitoring progress in meeting the provisions of the 2030 Agenda by means of indicator analysis:

- the need to standardize relevant data for EU countries,
- lack of access or difficult access to adequate data in individual countries,
- generalizations and subjectivity arising from the specifics of the indicator method.

With regard to the degree of fulfillment of Goal 9 and related provisions, it was found that Poland and Slovakia are gradually meeting the set objectives. A sensitive area with regard to Slovakia's development is the aspect of inventive activity, i.e. the country's ability to use knowledge and research results to reap potential economic benefits.

In spite of the identified handicaps, the need for control in the form of regular analysis of progress in the implementation of the provisions of sustainable development in the European Union countries is indisputable. Future directions of research will be related to the analysis of the level of implementation of the remaining goals of sustainable development in Poland and Slovakia and the developmental forecasts of both countries.

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