

BIBLIOMETRIC ANALYSIS: INTERCONNECTIONS BETWEEN SUSTAINABILITY AND ENTREPRENEURSHIP

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DOI: 10.17973/MMSJ.2023_12_2023130

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Based on a bibliometric study, this article analyses the interconnections between organization and sustainability. Using VOSviewer, 1046 articles written in English published in journals in the scientific database WOS published from 2015 to 2022 were retrieved. Specifically, we present the number of publications over the years, the areas to which the publications belong, the authors, the journals, and a cluster network of relevant keywords. An important contribution is the identification of authors and citation networks regarding publishing on sustainability in business models. The aim of this article is to contribute to a better understanding and the creation of a theoretical framework for sustainability and the SDGs as drivers of business development in the future. On the basis of the software visualization, valuable knowledge was obtained about the interconnections, the development of the theory, and the relevance of the published research.

KEYWORDS

Sustainability, sustainable development, SDGs, organization, entrepreneurship, bibliometric analysis

1 INTRODUCTION

In the context of current global challenges, such as climate change, environmental pollution, and social inequalities, sustainability has become a primary concern. The key strategic document *Our Common Future*, also known as the Brundtland Report, was published by the World Commission on Environment and Development in 1987. Sustainability is interpreted as the ability to meet current needs without compromising the ability of future generations to meet their own needs [Brundtland, 1987].

An important step for further negotiations was the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. Therefore, it was of the utmost importance that the Rio+20 conference agreed on the next steps, such as the development of global sustainability goals or the establishment of the Global Council for Sustainability, to accelerate progress toward sustainable development. Sustainable development is now an important direction for the future development of all economies in the world. Sustainability is naturally complex, interdisciplinary, and multidimensional considering economic, social, and ecological perspectives [Stead 2012]. The concept of sustainable development emphasizes the critical need to balance economic [Silk 2020], environmental [Ben 2021], and social considerations [Stofkova 2021, Chajduga 2021, Szymanska 2021] in decision-making, creating processes to ensure the well-

being of current and future generations. Researchers are considering factors that influence the effectiveness of implementing the concept of sustainable development in many areas [Prus 2021, Klimecka-Tatar 2021, Ingaldi 2020]. Many new innovative solutions appear to balance economic development with the impact on the environment and our planet [Huk 2021, Todorovic 2018] including digitalization [Meier 2023], manufacturing [Cahn 2016] and production.

Awareness of sustainability terms, their definitions, and interconnection are crucial for understanding and better communication in the process of moving our societies toward sustainable development [Glavic, 2007]. Sustainability is often understood as the ultimate goal of any organisation to survive in the long term [Jurik 2017].

In response to these multifaceted challenges, the United Nations established Agenda 2030 including 17 Sustainable Development Goals (SDGs) with 169 targets to provide a comprehensive framework for addressing the world's most pressing problems considering sustainability.

The 2030 Agenda for Sustainable Development published in 2015 is a development plan for the world, assuming the elimination of poverty, a decent life for all people, and ensuring peace by 2030. Sustainable development, or rather striving for its full achievement, remains, beyond any doubt, one of the most important challenges facing the modern world [Raszkowski 2019]. Achieving the SDGs requires the active participation of various stakeholders, including businesses, enterprises, and organizations that play a key role in shaping the trajectory of sustainable development. The SDGs are strongly interconnected [Nilsson 2018]. The benefit of SDGs is narrowing the divide between developed and developing countries [Death 2015]. SDGs are a critical commitment for future development to drive collaboration and bring about systemic change in the world [Richnak 2022].

On the contrary, several authors have expressed criticism of the SDGs so far, focusing mainly on the large number of goals and objectives that are seen as too complex to communicate with the public or drive policy, and too ambitious, universal, and absolute to be successful [Langford, 2016].

The three-pillar principles of sustainability mean including economic, environmental, and social aspects when setting goals. Economic prosperity and environmental care must be aligned with the win-win strategy [Porter 2015]. One of the basic principles of sustainability is the reconciliation of economic prosperity with the care of the environment and people. Companies realize that long-term economic success depends on environmental sustainability. This includes reducing emissions greenhouse gas emissions, minimizing waste, conserving resources, and adopting environmentally responsible practices. Companies recognize that unsustainable practices can cause reputational damage, regulatory burdens, and financial risks. As such, they are integrating eco-efficiency measures into their operations and supply chains [Starostka-Patyk 2019].

As mentioned above, sustainability and the SDGs go beyond environmental concerns and include social dimensions as well [Eizenberg, 2017, Lorincova 2020, Paulikova 2021, Veselovska 2023]. It is crucial to empower people with solutions to the sustainability challenges [Kopnina 2016].

As enterprises increasingly recognize their key role in addressing these challenges, they are increasingly incorporating sustainability principles into their strategies, operations, and decision-making processes, as well as promoting awareness by publishing sustainability reports. Entrepreneurs now recognize their role in promoting community well-being, solving problems

of inequality, and protecting human rights. Ethical work practices, diversity and inclusion, and philanthropic efforts are becoming an integral part of corporate social responsibility efforts. Companies increasingly understand that they exist in a wider social context and that their actions affect communities as a whole.

As mentioned above in recent years, increased attention has been paid to sustainability topics, specifically after the definition of SDGs and targets in 2015.

Many prominent multinational corporations or companies publicly declare the importance of implementing sustainability, sustainable development, and the SDGs in their decision-making processes. At the same time, they publish reports on humility in the field of sustainable development and are filled with selected SDGs.

Furthermore, in our previous research the awareness of sustainability and sustainable development goals in the context of business opportunities by analysing the results of a survey of organisations in Finland, Slovakia, Italy, Austria, Spain and Türkiye [Fidlerova 2022].

We identified a theoretical gap in the professional literature thus it is no clear connection between the diffusion and internalization of sustainable development and the SDGs in a broader business sense among enterprises, companies, and organizations. As discussed, the fulfilment of the stated objectives can create new business opportunities. Consequently, it is important to focus on increasing the level of awareness and involvement of these areas in theory and practice. Lack of knowledge and attention to the identification of changes and the possibility of future development and protection of the environment in the wider context of human activity.

Therefore, at the moment is the best and most efficient way to understand the overall picture of the mentioned research area using bibliometric analysis using statistical and mathematical approaches for the mapping and orientation necessary for grasping and gathering common contexts and trends in scientific literature including keyword analysis, research areas, and also authors.

We focused our analysis by narrowing our research considering interconnection between sustainability issues and entrepreneurship with the aim of identifying the potential of business opportunities to achieve the SDGs and sustainability. The objective of this study is to perform a bibliometric analysis considering megatrends as an effect of change toward sustainability at the business level, in order to clearly highlight the main directions, interconnections, and characteristics of research in this field.

At the beginning of the analysis, we formulate the following research questions:

RQ1: *Which issues are identified as part of sustainability, sustainable development and SDGs?*

RQ2: *What are the main interconnections between enterprise/organization/organisation and sustainability/sustainable development/SDGs?*

At the same time, we identified how research interest changed in this topic over time. The identification of the top articles and top authors in the field was important and the finding of links and networks of co-citations according to the author.

The aim of this article is to provide researchers with a brief overview of this topic. Part 2 describes the methods used to perform the bibliometric analysis. Part 3 focusses on the presentation of the results, including their visualization, and

discusses the findings. Finally, part 4 focuses on summarizing and predicting future trends.

2 MATERIALS AND METHODS

For the purpose of bibliometric analysis, we used the Web of Science database (WOS) for search. We focus within analysis on papers written in English with Open Access published in 2015-2022. Totally 1046 articles or proceeding papers were the target after using the relevant keyword filter. After a primary search for articles in WOS, we filter relevant publications according to keywords as follows: 1. „Sustainability“ OR "SDGs" OR "sustainable development" OR "SDG" and 2. "enterprise" OR "organization" OR "organisation" OR "company". Therefore, each analysed article should contain a combination of two mentioned keywords within the first and second categories. Furthermore, in order to receive appropriate and comprehensive information the results were refined according to the following parameters: Open Access, English language, Article or Proceeding Paper and publication for specific time interval from 2015 to 2022. The lower limit for the bibliometric analysis, 2015, was determined because the SDGs were defined as a commitment of the UN in that year. After data filtering and redefinition, the output consisted of 1046 publications.

Details related to these publications were studied, such as research area, year of publication in the context of growing interest in the topic. Important for the analysis was the identification of relevance to each of 17 SDGs. For the bibliometric analysis, the authors of the article used the VOSviewer software, which is a software tool designed to create and visualizing bibliometric networks. VOSviewer is a free software designed for the graphical visualization and analysis of scientific data that are included in scientific databases such as Web of Science or Scopus. VOSviewer is often used in the field of scientometrics, bibliometrics and scientific content analysis at various levels, such as the analysis of scientific journals, conferences, authors and various topics [Waltman 2013]. Created networks can include various items that can visualize mutual connections. Examples of visualization of relationships between items are: publications, journals, researchers, which can be visualized based on citations, bibliographic links, co-citations or co-authorship relationships. VOSviewer also offers a text mining function that can be used to construct and visualize co-occurrence networks of important terms / keywords extracted from a wealth of scientific literature and the like [Warner 2017]. The main functions of VOSviewer include Network visualization, Keyword analysis, Document clustering and Data export.

3 RESULTS

In this part, we present results of the conducted analysis.

3.1 Evaluation Research Question 1

The following part of the article is devoted to the evaluation of Research Question 1 (*RQ1: Which issues are identified as part of sustainability, sustainable development, and SDGs?*). In Figure 1, we can see the number of publications according to the most common areas of research. We can see the results in Figure 2 and Figure 3.

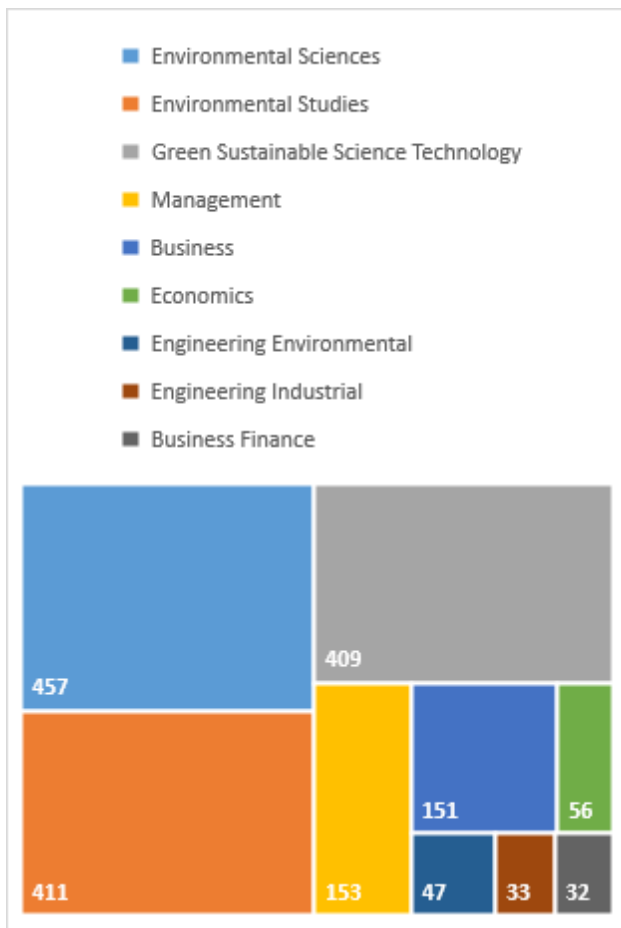


Figure 1. Research areas of filtered and redefined Web of Science outputs (own elaboration, 2023)

Based on Figure 1, we can state that combining sustainability keywords and linking them to companies, enterprises or organisations are the most common areas of research in Environmental Sciences, Environmental Studies, and Green Sustainable Science Technology. Other important areas of research related to the issue include Management and Business. The following Figure 2 shows an overview of publications according to the years of their publication.

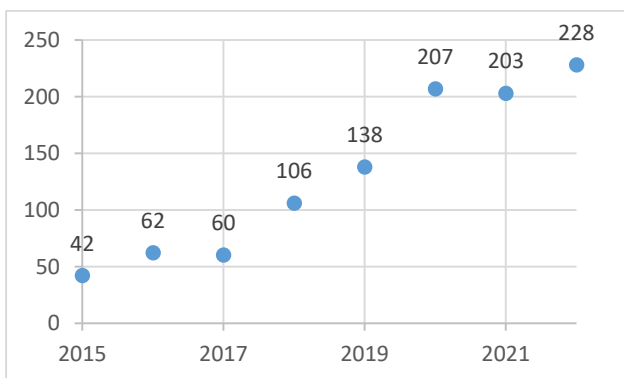


Figure 2. Visualisation of publication years including filtered and redefined Web of Science outputs (own elaboration, 2023)

The above Figure 2 presents that the interest of researchers in the field of sustainability with a connection to companies / enterprises / organisations is gradually increasing. Taking into account the establishment of the SDGs in Agenda 2030 in 2015, 42 outputs were achieved, but 4 years later the number of outputs was more than tripled. In 2022, there were up to 228 publications.

The Web of Science database enables the classification of a publication by a specific SDG. Within our outputs, out of 1046 publications, up to 670 were classified in this way. The following Figure 3 shows the ratio of outputs classified to a specific SDG with respect to the total number of outputs.

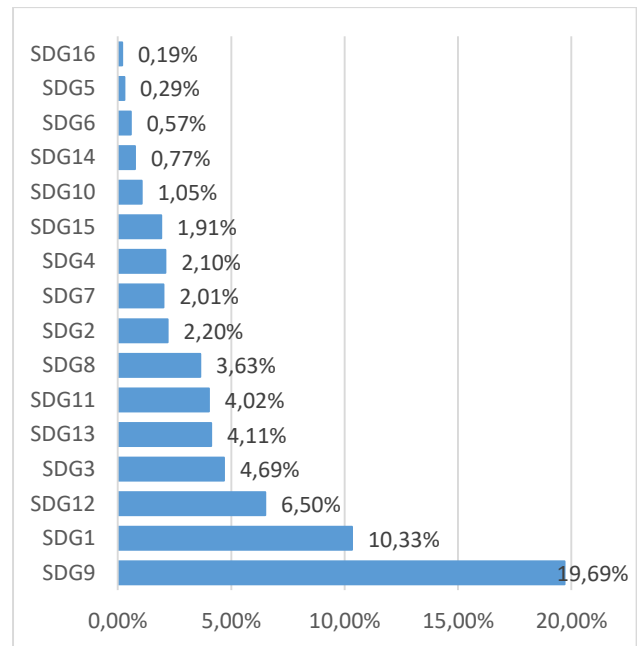


Figure 3. Relevance of filtered and redefined Web of Science outputs to a specific SDG (own elaboration, 2023)

Based on the data in Figure 3, we can see that almost 20% of the publications were related to SDG9 Industry, Innovation, and Infrastructure. Subsequently, more than 10% of the publications dealt with SDG1 No poverty. On the other hand, the least frequent SDGs related to businesses were SDG16, Strong Institutions for Peace and Justice, and SDG05 - Gender Equality.

Among the countries in which researchers have dealt with this area the most (more than 40 publications), we can mention the following: England (129), People's Republic of China (124), United States of America (91), Italy (73), Spain (71), Poland (68), Germany (47), Sweden (47), Romania (44), Netherlands (42) and Russia (40). The Czech Republic achieved 28 publications and the Slovak Republic 26 publications in this area.

The results of the conducted analysis show the main connection and potential of business opportunities to fulfil the sustainable development strategy and the SDGs in many areas. The Environmental Sciences, Environmental Studies, and Green Sustainable Science Technology and Management and Business were identified as key determining research and study issues.

Based on achieved results, as the most important interconnection of the SDGs with enterprises (organizations) was identified following: with almost 20% of the publications were related to the SDG9 Industry, Innovation and Infrastructure. The areas that have not yet been paid attention in connection with businesses were SDG16 - Strong institutions of peace and justice and SDG05 - Gender Equality.

A positive result of the trend analysis considering the growing number of researchers studying the 2030 Agenda and the SDGs was confirmed the increased interest during the monitored period (2015-2022) in conjunction with scientific evidence based on Scopus database analysis [Bierman 2022]. Other positive findings were the greater coverage of research fields and the geographical diversity of authors. Therefore, this also confirms

our previously published research findings based on a statistical survey of corporate practice, where the obtained results pointed to differences in the approach to the issue of sustainability, the extent of knowledge, interest, competences in the field of sustainable development and SDGs, and the content of the implementation of sustainability and SDGs in organizations in different sectors, regions and countries. [Fidlerova 2022].

3.2 Evaluation Research Question 2

The following part of the article is devoted to the evaluation of the Research Question 1 (RQ2: What are the main interconnections between enterprise/organization/organisation and sustainability/sustainable development/SDGs?). We can see the results in Figure 4, Figure 5 and Figure 6.

The authors of the article used the WOS database as described above. On the basis of the created data set, the first analysis was carried out and the result can be seen in Figure 4.

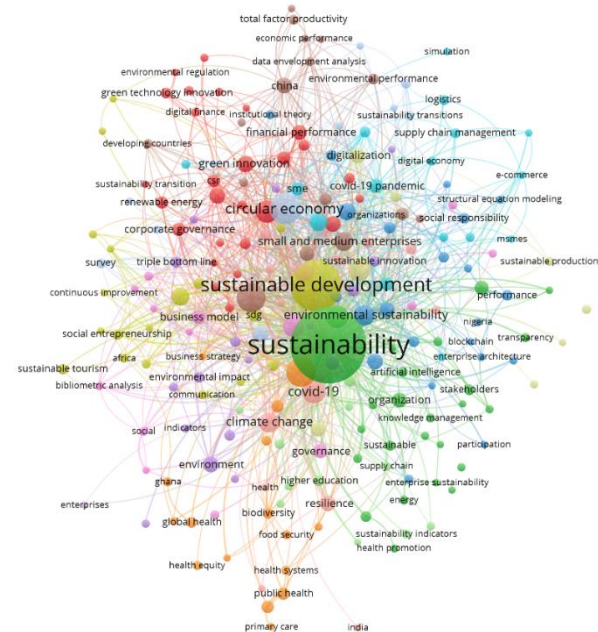


Figure 4. Cluster analysis: co-occurrence of keywords (own elaboration, 2023)

Figure 4 shows the result of type of analysis (Co-occurrence) with Unit of analysis (Authors Keywords) where we can identify that there are 16 basic clusters and 220 items that are related to each other. As shown in the figure above, the wheel size is the level of validity of a specific keyword, and the colour indicates the group of words that belong to it. The clusters in the diagram, which are close to each other, indicate keywords that are closely related.

The central items of the cluster visualization are for instance following: sustainability, sustainability development, SDGs, circular economy, industry 4.0, sustainability development goals and environmental sustainability, business model, artificial intelligence, environment, small and medium enterprises, green innovation, climate change and renewable energy. At the same time, all items are homogeneously related units that differ according to the area of the problem being addressed.

Another analysis, which was carried out as part of the bibliometric analysis, was the analysis focused on countries and the year of their occurrence. The type of analysis used (Bibliographic coupling) and Unit of analysis (Countries). The results are shown in Figure 5.

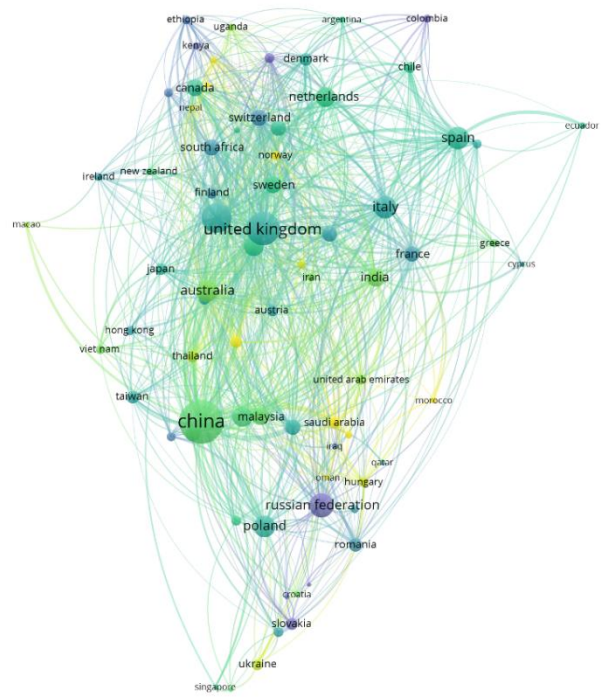


Figure 5. Bibliographic coupling – Countries (own elaborations, 2023)

Figure 5 includes eight basic clusters and 75 items that are related to each other. The colour of occurrence expresses the time series when the publication was created from purple, which shows the oldest publication (2015), to yellow, which shows the newest publication (2022). Among the countries that devoted themselves to scientific publishing in the given issue first: the Russian Federation, Belgium, Colombia, Slovakia and Lithuania. On the contrary, the countries that have devoted themselves to the analysed issue in recent years are: Saudi Arabia, Bangladesh, Ukraine and Tanzania. The second important information resulting from the visualization is the size of the cluster, which tells about the number of publications, where we can say that the countries with the largest number of publications in the given area are: China, the United Kingdom and the United States of America.

The last cluster analysis was focused on Co-citation and author citations in scientific publications using WoSViewer and its result is processed in Figure 6.

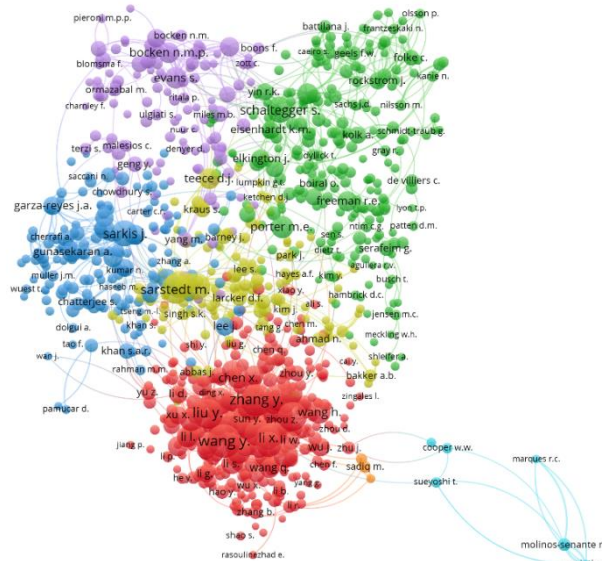


Figure 6. Cluster analysis: co-citation – citation authors (own elaboration, 2023)

Figure 6 above shows the result of the authors who, within the framework of the analysis, are devoted to the given issue the most and at the same time create citation interconnection with other authors who are devoted to the solution of the given issue. The data analysis shows that there are seven basic clusters and 1000 items. The mentioned authors can be considered from this point of view as world-renowned experts in the field of sustainability and related issues.

Bibliometric analysis of scientific sources on the Sustainable Development Goals (SDGs), sustainability and sustainable development is an important tool for evaluating and understanding research trends and results in the analysed area. The analysis carried out provides important information on how research related to the SDGs and sustainability is developing, which topics are popular and which researchers are publishing active in this area. The analyses show that the issues of sustainability are understood and presented an important part of business opportunities in many publications around the world. Due to the fact that the United Nations emphasizes effort of all the countries in world, it is desirable that all countries deal with the sustainable solution in entrepreneurship.

4 CONCLUSIONS

Sustainability, in general, is an important aspect, especially from the point of view that human activity and lifestyle are in line with the needs of the current and future generation. On the other hand, we need to seek the long-term prosperity of economy for people, society, the environment and the planet ensured as a whole. For this reason, the need for sustainable development came to the fore, and as a response to growing global challenges, SDGs were created. Their intention is to manage development in a way that is sustainable in terms of the environment, social justice and economic stability. The defined targets focus on the current complex challenges such as climate change, poverty, limited resources, hunger, inequality, environmental pollution, threats to biodiversity and others. Since these problems do not have borders, they require global solutions.

Enterprises and organizations have a significant impact on sustainability in the use of resources, the production and consumption of products, and an important part is also involvement in the community. Supporting local communities, supporting the local economy and creating jobs is also an opportunity for organizations to contribute towards sustainable development in the region.

Using the WoSViewer data visualization of the top scientific articles in the field, identified links and co-citation networks according to the authors were identified, which significantly pointed to the interdisciplinary nature of the topic of sustainability and its broad scope of research. The general limits of the presented results and discussion are that it was possible due to the scope of the publication to include only publications and data published in English, whereby we omitted findings from various regions where English is not the common working language or included publications without indexing in WOS.

Overall, examining the engagement of enterprises and organizations in the field of sustainability ensures transparency and accountability in their activities. It helps to detect unfavourable behaviour and the need for measures to correct it to achieve sustainable production and competitive advantage. Considering sustainability in research and sustainable business strategies following the SDGs can help businesses achieve long-term success while contributing to a better world.

The connection between enterprises / organizations and sustainability concerns various aspects, including environmental

and socio-economic aspects. Businesses can contribute to sustainability by improving their production processes and implementing sustainable production processes (circular economy, reducing greenhouse gas emissions, minimizing waste, efficient use of natural resources). It is also important to create products and services that are environmentally friendly and meet market needs.

Cooperation with suppliers is also an integral part, where enterprises can collaborate and motivate with suppliers and thus minimize negative consequences in the entire supply chain following targets of SDG9 Industry, Innovation and Infrastructure. Enterprises should invest more in innovation, research and development that contribute to solving sustainability problems (clean energy, less waste, responsible production and production and ecological technologies).

In future research, the authors will focus on the specific area of business opportunities and sustainability models in industrial enterprises. In future research, we plan to compare the results within the Slovak Republic, the Czech Republic and Poland. The field of sustainable development is still relevant and important in the world, to which many research teams are dedicated, and with their systematic research they partially help to achieve the goals of the Agenda 2030.

ACKNOWLEDGMENTS

This work is part of the international research project SDG4BIZ No. 621458-963 EPP-1-2020-1-FI-EPPKA2-KA: SDG4BIZ-“*Knowledge Alliance for Business Opportunity Recognition in SDGs*”.

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