BIBLIOMETRIC ANALYSIS OF INVESTMENT CLASSIFICATION CRITERIA

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Abstract:
In this paper, the scientific articles from the Web of Science base were analyzed, which address the investment classification criteria by means of the bibliometric analysis. Querying the Web of Science database and applying filters revealed a sample of 273 articles. The distribution by years, by countries, by authors, by categories, by fields of research, by sustainable development goals of this sample was followed. Also, within the work, a qualitative analysis was carried out, following the words and phrases with the highest density in the studied articles.
The investigation method was based on the PRISMA Statements methodology. To determine the correlations regarding the countries of origin of the authors, the Co-authorship filter was used with a minimum number of 10 documents/country and a minimum number of 11 citations/country, so out of 73 countries only 14 met the conditions for

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analysis. For the word density analysis, the co-occurrence filter was applied, with a minimum occurrence of 5, resulting in 37 words grouped into 5 clusters. To support the conclusions, the following classifications were analyzed: WOS Categories, Research Areas, Sustainable Development Goals, Citation Topics Micro. The results of the research constitute the starting point for future analyzes in the field of investments.

Keywords: Investment classification criteria, bibliometric research, Vosviewer, Web of Science, Word art.

1. Introduction

Savings and investments in any developed economy have a particularly important role in the development and profitability of economic activity, both at the macroeconomic level and at the level of each natural or legal person - economic agent.

The volume and profitability of investments represent the foundation of the future development of companies, playing a decisive role in the supplementation, diversification and qualitative growth of all production factors, ensuring the improvement of the competitive position in relation to other existing economic agents within the market economy.

At the macroeconomic level, investments represent the material support of economic growth and development, being a decisive factor for ensuring the normal functioning of the economy, for increasing the production apparatus and for ensuring the material support of social-cultural activities, as well as for increasing the standard of living of the population a country

In most companies, from the date of incorporation or from the moment when a significant development of the existing activity is desired, it is necessary to establish a policy and some investment strategies, which ensure a superior and efficient capitalization of the capital attracted to finance the company's activity.

Investments viewed as total expenses show a certain homogeneity, but viewed through the lens of the nature of these expenses, the way in which they are found in works, in one or another sphere of activity, financing resources, etc., investments can and must be classified, this fact responding to practical needs.

When we are forced to choose an alternative to invest, from a given, finite set, it is necessary to take into account the particularities of the field, the environment, the risks existing at the time of making the investment and the particularities of the economic branch where it will be made and implemented the investment. The factors that can influence the decision and the implementation of the investment at the national level are: the political-economic governance regarding the investment and credit policy; establishing the legal framework, the status of economic agents; relations with other units and the state; socio-cultural environment; standard of living, consumer tastes; implementation of technological transfer at national level, environmental policies (Văcărescu Hobeanu, 2018).

Justin Chan notes that in addition to “liquidity differences, investors face many institutional and informational differences. Factors affecting investors include three major categories: first, market-based factors such as investment barriers, short selling restrictions, hedge accounting standards, etc., which are regulatory in

nature; second, information-based factors such as the degree of synchronization of the joint movement between the stock and the domestic market, the existence of information asymmetry between insiders and other shareholders; and third, trading-based factors such as whether cross-listed stocks have a preferred trading location (Chan and Hong et al, 2008, p 953).

In this paper, a bibliometric analysis was carried out to identify current research directions in the field of investments by evaluating, analyzing and synthesizing information from a series of scientific works that address this topic. This analysis aims to identify trends, so-called "hot topics", important authors and research trends in the investment field. The analysis was carried out through the section of a relevant source from which the scientific works were identified - the Web of Science database. The search in the database was carried out using the search term "investment classification criteria". Later, 273 relevant works were selected and the bibliometric data about them were collected (distribution by year, number of citations, authors, states, institutions, affiliation of authors, distribution by categories, areas covered). The data analysis was carried out using the VOSviewer software.

2. Literature Review

The rigorous classification of investments requires the use of rational criteria, well-founded from a methodological and practical point of view. Such investment classification criteria can be: the nature of the investments, the method of implementation, the nature of the investment works, the purpose, the destination, the method of realization, the resources and the method of financing, the degree of immobilization of advanced investment resources, the risk of the investments, other criteria .

Within developed market economies, two problems are noticed:

- resource allocation that was resolved through a combination of political choices
- planning system dysfunctions where the system was unable to generate changing technologies and organizational improvements which are the main sources of growth in the developed market. (Fakin, 1997).

Appropriate choices for the implementation of the investment program can help enterprises to create the appropriate expansion framework, to be able to identify new sustainable destinations for the right investments (Kacani et al. 2022). The factors that lead to such an approach can be:

1) investments form the long-term support for the economic and social growth of any organizational structure, and in some conditions a form of survival in the competitive environment;

2) investments sometimes represent substantial expenses, which represent the use of material, financial and labor resources, and the investor engaged in making the investment must be able to support them;

3) investments are made over a period of time, being influenced by different factors generated by the technical and financial environment in which the investor implements his investment;

4) investments can have a different involvement of economic agents in the process depending on their experience, the branch where they operate and their financial potential.

5) Investments must incorporate up-to-date technical progress to be competitive in the market economy. thus we have to determine the financial losses by losing customers because they are dissatisfied with the restructuring of the business model, and the value of the investment for incorporating technical progress in production (Schmidtke and Siegfried, 2022).

In the uncertain and unpredictable global market, where the speed of technical, technological and economic development is rapidly increasing, selecting the optimal investment project is quite difficult. The rapid development of technique and technology has a direct impact on the production process, the business environment, the competitive environment, the level of the estimated sales volume and the prices of the factors of production, that is, on the cash flow of the investment project. (Karanović et al., 2010).

In current economic theory and practice we can find various approaches regarding the classification of investments, as follows:

- from the point of view of the general investment policy within the company:

1) Domestic investments;
2) Foreign investments.

- from the point of view of the nature of the investments:

1) tangible investments:

a) actual investments;
b) assimilated investments.

2) non-material investments;
3) financial investments.

- from the point of view of the way in which the investment is realized (structure);
- according to the nature of the works;
- from the point of view of the purpose of the investments;
- by destination;
- according to the method and source of financing;
- according to the method of realization;
- depending on the complementarity of the investment processes;
- in relation to the risk related to the investments.

The use of effective criteria during the investment evaluation and classification process could increase the probability of success in the so-called problem of choosing the optimal investment. Thus, the analysis of investment classification criteria has gathered great interest among entrepreneurship researchers. (Ferrati and Muffatto et al, 2021). From the research of the scientific articles in the Web of Science database, other aspects besides the usual ones related to the classifications of investments were revealed with the help of the VOSviewer software tool through cluster analysis.

3. Research objectives

In order to discover the correlations and connections that we proposed to analyze in this article, we will bibliometrically analyze the data from the Web of Science using the World Art and VOSviewer tools. Thus, from the analysis of the theoretical definitions of the previously presented investment classification criteria and the correlations between this and other economic definitions present in the

articles in the sample, we can substantiate new perspectives regarding the classification of investments.

The investigation method for this research is based on the PRISMA Statements methodology (Figure 1). which is structured in four steps (Moher, Shamseer et al, 2015):

(1) data search by applying tags
(2) filtering data by applying filters
(3) the quantitative analysis carried out with the help of the Word art instrument and the VOSviewer software
(4) interpretation of the data within the clusters in the results and conclusions section

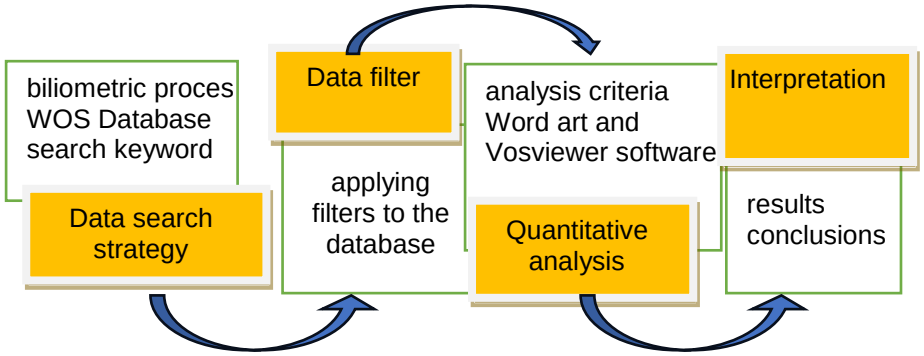

Figure 1. Steps taken in bibliometric analysis of WOS data
Source: Own conceptualization using the PRISMA diagram

3.1 Methodology of research

The bibliometric research was carried out on a set of measurements based on graphical representations and statistical tables used to present the current state and the development potential of future investment classifications (Radu, Radu et al, 2021).

The Web of Science database is an open educational resource that can be accessed by researchers at any time from any corner of the world. The term "open" shows how users have access to this resource, at no cost to them, but researchers must respect the conditions regarding copyright and non-use of the accessed data for commercial purposes (Brătășanu, 2023).

The term "bibliometrics" was first used in the Journal of Documentation by Robert Fairthome in 1969, a term he said was "spontaneously" donated by Alan Pritchard (Fairthorne, 1969) Bibliometrics is based on principles of bibliography and statistical bibliography as defined by Pritchard. He presented it as an application of mathematical and statistical methods to books and other means of communication. (Broadus, 1987).

Bibliometric analysis is a statistical analysis of scientific articles on a certain topic and over a defined period of time, it turns out to be a complex tool, made to collect various relevant information about the research of a certain topic, such as main keywords , authors, citations, affiliations, funders, countries of origin of the authors or data about the journals where it was published (Ellegaard, 2018). A systematic review of a group of papers has the role of substantiating a complete documentation on a specific research topic (Tranfield, Denyer et al, 2003),

bibliometrics provides statistical relevance for a specific research topic, but also the possibility to estimate developments emergent phenomena studied in the research (Obreja, 2022), as it was done in this article through the highlighted clusters but with the help of the WOSviewer software based on data selected from the Web of Science database.

However, the bibliometric analysis has some difficulties because the rapid increase during the digitization period the amount of information makes it difficult to capture the entire knowledge structure of a research area, requiring a longer period of time for processing and labelling so that they are available for research. (Maria, Ballini et al, 2023).

3.2 Research question

Bibliometric studies manage to map relevant information, such as the most popular keywords and authors, as well as related issues discussed (Agbo et al., 2021).

For the bibliometric analysis we chose to use the existing scientific articles in the Web of Science database. After the query with the tag Investment classification criteria, 361 articles resulted. Analyzing the volume of articles published by year, we decided to limit the research period between 2014-2023, and after this filter, 273 articles remained in the selection. The year 2023 was chosen because even though only 8 months have passed it has 456 citations of articles from previous years.

In this work, evaluations were made from a quantitative point of view (number of articles by year, by country, affiliation) and qualitatively (frequencies of phrases and words) because the aim was to identify as many relationships as possible within the articles on the topic investment classification criteria.

The first approach regarding bibliometric analysis and density analysis, being performed according to the year of publication, according to the number of articles per country (also via WOSviewer) and according to affiliation.

A second analysis was carried out starting from the following 4 classifications from the Web of Science database: Categories, Research Areas, Sustainable Development Goals, Citation Topics Micro. The data contained in the 4 analyses will be used in the analysis part of the results and the conclusions regarding the content of the clusters, resulting from processing with the VOSviewer software, regarding the words often used in the selected articles.

Citation Topics is a new classification scheme implemented at the document level on the Web of Science database. It is built on a three-level hierarchy of macro, meso and micro-themes, which allows choosing the right level of classification for the analysis carried out, depending on the purpose of the analysis carried out. Thus, hierarchies with 10 broad macro-themes, 326 meso-themes and 2,444 micro-themes are available at the level of the Web of Science database.

Also in the paper, a qualitative analysis was carried out starting from the word density through the word cloud, in order to identify the association of words often used in association with "Investment classification criteria", according to the name of the articles, the abstract, author keywords and keywords plus.

The analysis was carried out with the help of the WOSviewer software, to identify the density of phrases or words used in the articles in the sample. Co-occurrence filters were used, for all keywords, a minimum of 5 co-occurrences. Co-occurrence networks represent the connection of pairs of articles that used a specific set of co-occurrences and define the criteria set when using the WOSviewer software.

In this part of the research, the 5 resulting clusters were analyzed by associating them with the investment classification criteria. Thus, several notions with the highest link strength were associated to analyze the graphs specific to each cluster with the component notions and the links with the other clusters.

4. Results and discussion

The query of the Web of Science database was performed according to the label investment classification criteria resulting in 361 articles. Depending on the density of articles, the most relevant period was 2014-2023. Being selected 273 articles that were published in that period.

Table 1 shows the evolution of the number of articles that will be subjected to bibliometric analysis according to the search keywords and applied filters.

Table 1. Filters used when querying Web of Science

Keywords **/ Filter applied**	**Item number in the selection**
Keywords ” investment classification criteria ”	361
Publication period 2014-2023	273

Table 2 shows the distribution by year of the 273 scientific works that will be included in the bibliometric analysis. The year 2023 was eliminated because it would not be relevant for the research results (being the current year), it being selected for the 456 citations of articles from previous years. It can be seen that in the period 2018-2022 the number of articles in the section is double compared to previous years, which shows us that there is a growing interest in the investment classification criteria.

Table 2. Distribution of the 273 articles retrieved from the Web of Science query

Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Number articles	19	12	12	17	32	39	43	42	39	18

We will perform a first analysis on the authors' countries of origin and their affiliation. Afterwards we will make a comparison between the countries of origin of the affiliation and those of the authors. We will use the data from the results of applying filters from the Web of Science database and processing this data with the WOSviewer software.

In figure number 2, the origin of authors for the first 12 countries is presented with the help of bibliometric analysis and density analysis.

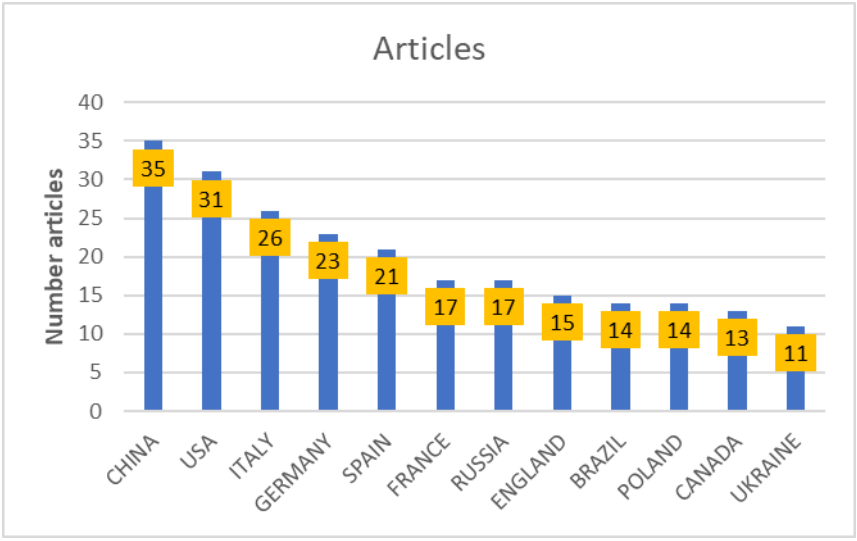

Figure 2. Origin of authors from the top 12 countries resulting from the Web of Science query

Source: Own conceptualization, data from WOS (accessed on 11.08.2023)

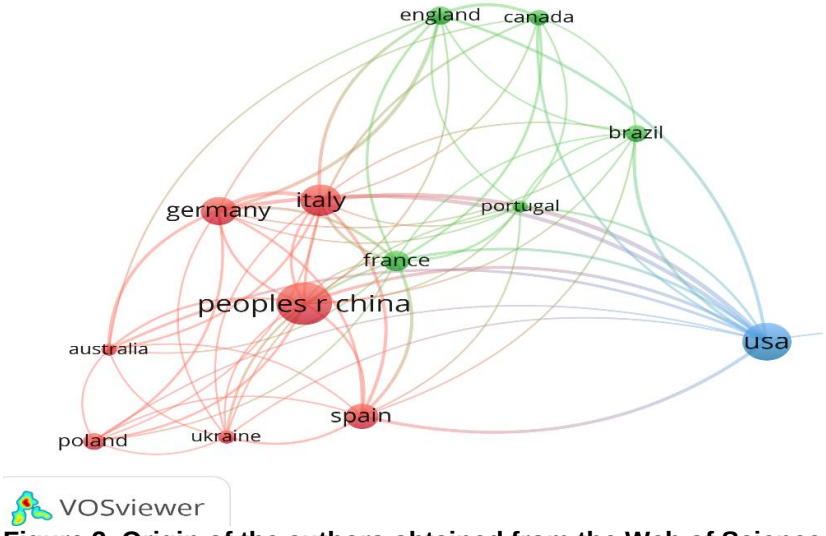

Figure 3. Origin of the authors obtained from the Web of Science query and processed with VOSviewer

Source: Own conceptualization, data processing from WOS (with VOSviewer

For the analysis regarding the countries of origin of the authors with the help of VOSviewer, the Co-authorship filter was used, with a minimum number of 10 documents per country and a minimum number of 11 citations per country, and out of the 73 countries, 14 met the conditions.

In figure number 3, the number of articles per country is graphically represented, the size of the circles being directly proportional to the number of articles per country, but also the correlations between the articles.

VOSviewer helps us identify links between articles in addition to the actual number. Thus, in table number 3, following the analysis carried out with the VOSviewer software, the articles by country, the number of citations and the links between the documents are presented, and the classification was made according to the links between the articles. Making a comparison with the data contained in figure number 1, we see that the USA, Germany and Italy are the first 3 in terms of strength of links between articles and China is in 4th place, even if it has more articles, the average of citations per article is lower than in the case of the first 4 states before it.

Table 3. Links between analyzed articles by country of origin

Country	Documents	Citations	Total link strenghth
USA	31	478	40
Germany	23	499	32
Italy	26	473	31
France	17	147	24
China	35	306	21
Spain	21	197	20
England	15	423	20
Australia	10	180	15
Canada	13	313	14
Ukraine	11	31	11

In table number 4, the affiliation of the authors of the 273 scientific works selected in the sample was analysed

Table 4. Affiliation inferred from Web of Science query

Affiliations	Record Count
Ministry of Education Science of Ukraine	8
Udice French Research Universities	7
Centre National de la Recherche Scientifique cnrs	6
Consiglio Nazionale Delle Ricerche cnr	5
Consejo Superior de Investigaciones Cientificas csic	4
Poznan University of Technology	4
Universidade do Porto	4
University of California System	4
University of Oviedo	4
University of Sydney	4

It is observed that an important weight is given to the articles elaborated by trumps active in the academic environment of universities and research institutes.

A second analysis must be carried out on Web of Science Categories, Research Areas, Sustainable Development Goals, Citation Topics Micro. We chose to see the membership of these 4 classifications to be able to more easily interpret the composition of the clusters in the conclusions section.

Analyzing the articles contained in the Web of Science Categories database, it is observed that 27% of the articles are on economic fields. Table number 5 lists the specific color domains of 273 items from our selection.

Table 5. Distribution of articles in Web of Science Categories

Web of Science Categories	Record Count
Environmental Sciences	35
Economics	24
Green Sustainable Science Technology	23
Environmental Studies	22
Management	19
Business Finance	18
Computer Science Artificial Intelligence	17
Business	14

In table 6, the articles were analyzed from the point of view of Research Areas declared by the authors of the articles, and we note that scientific works from economic fields have a weight of 23% compared to the sample.

Table 6. Distribution of articles Research Areas

Research Areas	Record Count
Business Economics	61
Environmental Sciences Ecology	45
Engineering	41
Computer Science	30
Science Technology Other Topics	27
Energy Fuels	14
Operations Research Management Science	13
Public Environmental Occupational Health	10

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Next, the individual objectives of the "Sustainable Development Goals" were analyzed and compared with the Micro Citation Topics. The United Nations 2030 Agenda for Sustainable Development contains 17 core Sustainable Development Goals, which are calls to action for all countries.

The Sustainable Development Goals scheme allows 16 of these to be explored and analyzed. Goal 17, Partnerships for the Goals, is not included in the scheme.

The selected Micro Citation topics and their associated publications were assigned to one or more of the 1 to 16 Sustainable Development Goals and indicators were calculated for the Sustainable Development Goals entity.

When the Micro Citation topics are revised the Sustainable Development Goals are also updated.

Thus, in table 7 the articles according to the "Sustainable Development Goals" criterion are presented with the corresponding number of each Sustainable Development objective, and in table 8 Citation Topics Micro.

Table 7. Distribution of Sustainable Development Goals articles

Sustainable Development Goals	Record Count
03 Good Health And Well Being	51
11 Sustainable Cities And Communities	30
08 Decent Work And Economic Growth	26
13 Climate Action	25
09 Industry Innovation And Infrastructure	23
15 Life On Land	23
07 Affordable And Clean Energy	13
01 No Poverty	12

Table 8. Distribution of Articles Citation Topics Micro

Citation Topics Micro	Record Count
4.61.56 Fuzzy Sets	16
6.10.80 Option Pricing	11
4.61.1820 Credit Scoring	9
6.3.385 Corporate Social Responsibility	9
6.115.284 Thermal Comfort	6
4.18.296 Unit Commitment	5
4.224.599 Project Scheduling	5
6.3.726 Entrepreneurship	4

The first qualitative analysis of the sample of articles was performed through the word cloud containing the article title, author keywords, plus keywords and abstracts. Plus keywords in a bibliometric analysis are as effective as author keywords in investigating the structure of knowledge in a given scientific field. (Rodríguez-Sabiote et al, 2020)

The words with the highest frequency of use were: Classification, Invest, Criteria, Model, Study, Base, Method, Develop, System, Analysis, Decision, Result, Risk, Approach, and Project. From the analysis of the frequency of the words, we observe that the scientific articles are oriented towards classifications based on models, methods, analyses, on the decisions to invest, results, projects and on risks that manifest themselves in the decision-making process. In figure number 4, using the data exported from Web of Science for the 273 articles, with the help of the Word Art tool we graphically highlighted the words with the highest frequency, according to their size.

Figure 4. Word cloud of the 273 articles

Source: WOS database (accessed on 11.08.2023) made via https://wordart.com/

The second analysis was that of the phrase density made with the help of the VOSviewer software. After applying the co-occurrence filter, for all keywords, with an appearance of at least 5 times, out of the 1937 words we have 37 words that meet this criterion, and the distribution is presented in figure number 5.

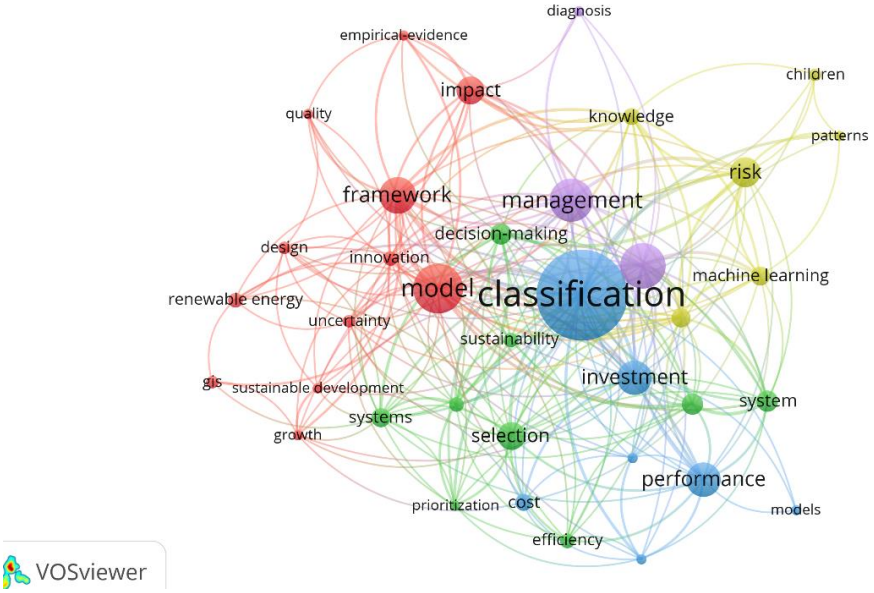

Figure 5. Phrase and word density of the 273 articles in the Web of Science query

Source: WOS database (accessed on 11.08.2023), made with the VOSviewer software

The words and phrases with the highest density resulting from the analysis using the VOSviewer software are: classification, management, model, criteria, framework, risk, prediction, decision–making, performance, and selection. In table number 9 we present the classification of words according to total link strength.

Table 9. Link strength between articles analyzed according to Keyword

Keyword	Occurrences	Total link strenghth
clasification	42	71
management	20	45
model	23	44
criteria	21	36
framework	17	35
risk	14	32
prediction	9	31
decision - making	10	30
performance	16	27

Keywords are grouped into 5 clusters with a total of 37 items. The cluster represents a set of elements contained within a bibliometric map. Each item is in only one cluster, but there may be items that are not included in any cluster. Table number 9 includes the content of the 5 clusters.

Table 10. VOSviewer clusters and related colors

Cluster 1 (12 items)	Cluster 2 (9 items)	
design empirical - evidence framework gis (geographic information system) growth impact innovation model quality renewable energy sustainable develepment uncertainty	decision – making efficiency methodology optimization prioritization selection sustainability system systems	
Cluster 3 (7 items)	**Cluster 4 (6 items)**	**Cluster 5 (3 items)**
big data classification cost information investment models performance	children knowledge machine learning patterns prediction risk	criteria diagnosis management

In order to visualize the clusters graphically, the words with the strongest links were set for representation as follows:

- for cluster 1 - "keyword *model* with link strength 44", (figure no 6),

- for cluster 2- "keyword *decision-making* with link strength 30", (figure no 7),
- for cluster 3 - "keyword *classification* with link strength 71", (figure no 8),
- for cluster 4 - "keyword *risk* with link strength 32", (figure no 9),
- for cluster 5 - "keyword *management* with link strength 45", (figure no 10).

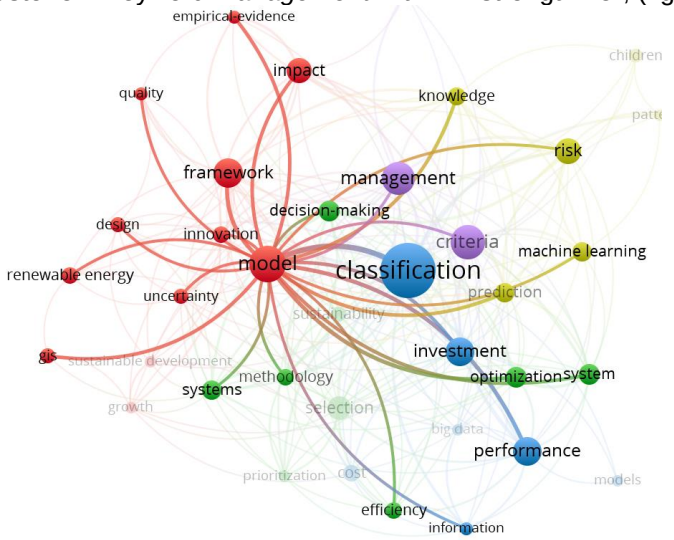

Figure 6. Cluster 1 keyword *model* with link strength 144

Source: WOS database (accessed 11.08.2023), made with the VOSviewer software

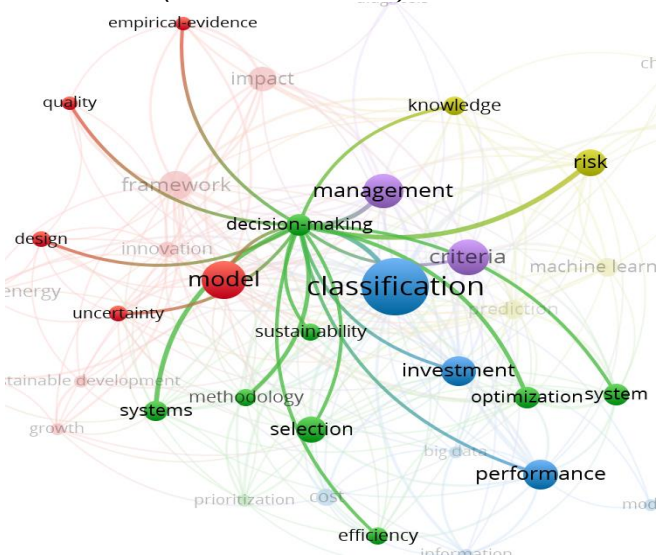

Figure 7. Cluster 2 keyword *decision - making* with link strength 30

Source: WOS database (accessed on 11.08.2023), made with the VOSviewer software

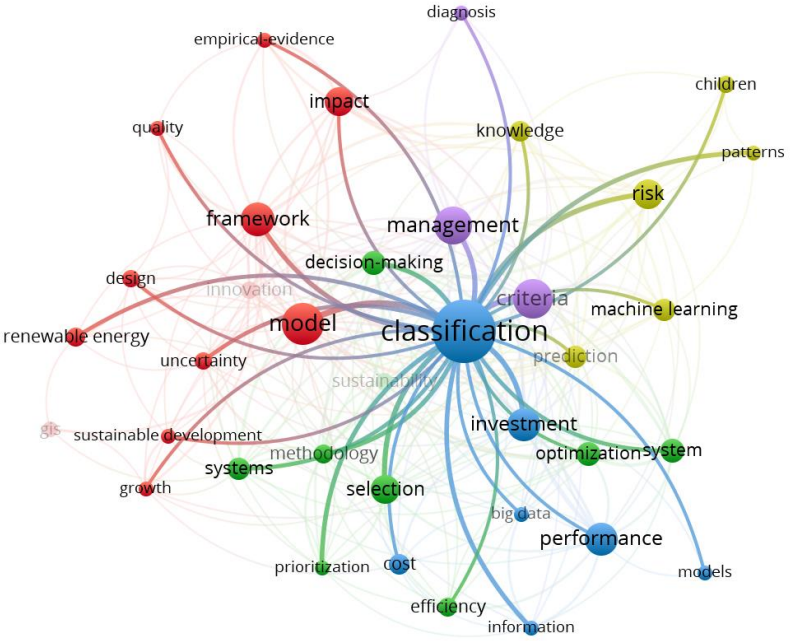

Figure 8. Cluster 3 keyword *classification* with link strength 71

Source: WOS database (accessed on 11.08.2023), made with the VOSviewer software

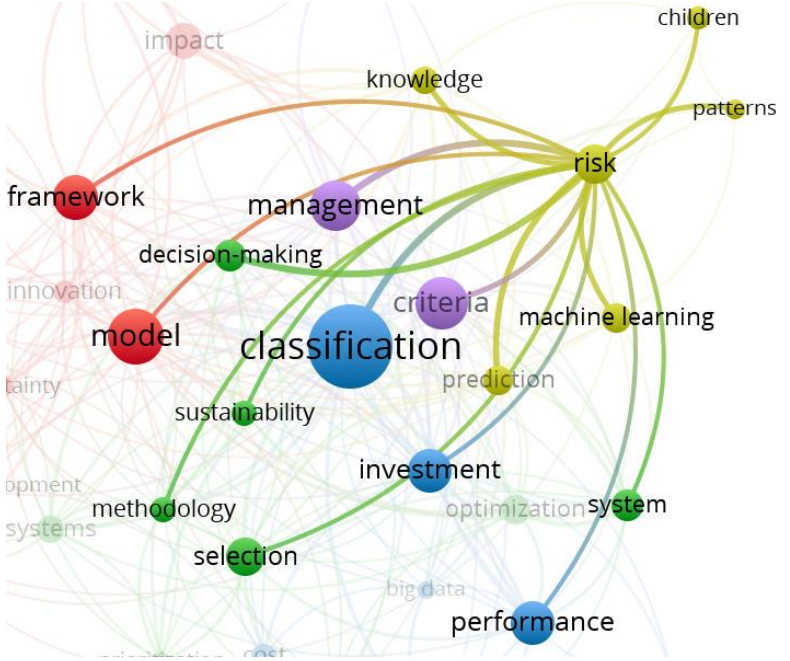

Figure 9. Cluster 4 keyword *risk* with link strength 32

Source: WOS database (accessed on 11.08.2023), made with the VOSviewer software

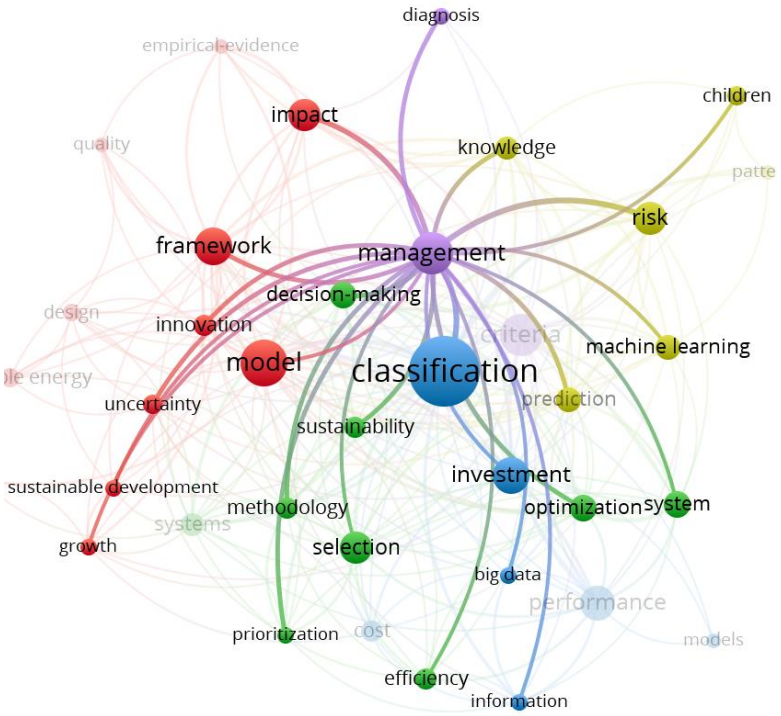

Figure 10. Cluster 5 keyword *management* with link strength 45

Source: WOS database (accessed on 11.08.2023), made with the VOSviewer software

Limitations of the study

In order to have a correct picture of the results of a high-quality bibliometric analysis, its limitations must also be mentioned. First, the analysis was performed using only data from a single platform, Web of Science, therefore further studies should also address other databases such as: Scopus, Dimensions or Lens.

Second, even though this study had quantitative and qualitative assessments, after applying the filters we may miss important aspects because some scientific articles were excluded. Thus bibliometric maps can be extended beyond the current study, to show networks of co-authors, co-words, correlations between membership groups, etc.

Thirdly, the VOSviewer software does not show the component articles in a cluster and thus some aspects regarding the affiliation of the authors, the countries from which they come can be lost and thus correlations cannot be made between this information and the analyzed keywords

5. Conclusions

The bibliometric analysis within this article was the basis of the analysis of the current state of the investment classification criteria within the scientific articles within the Web of Science database.

From the analysis of the 5 clusters we have the following results:

- cluster 1 contains the definition of the criteria for classifying investments from the point of view of development and economic growth regarding new trends

at European level regarding sustainable development and renewable energy within an integrated geographic information system and taking into account the impact and innovation of investments in conditions of uncertainty;

- cluster 2 contains criteria for classifying investments regarding their sustainability, taking into account optimization, prioritization and selection systems;
- cluster 3 contains reference to classifications based on performance models based on information on their costs;
- cluster 4 contains articles that analyze risk and uncertainty prediction models and how investments can be classified according to this environment.
- cluster 5 contains articles that refer to investment classifications based on management criteria

From a theoretical point of view, in researching the criteria for classifying investments in different fields of interest, analyzes can be carried out on groups of countries, with the help of the VOSviewer program. To make a selection specific to a certain field of research you can use keywords found in the 5 clusters for bibliometric selections from various databases and respond to the topic of interest.

From a practical point of view, the criteria for classifying investors should take into account, in addition to theoretical aspects, the evolution of countries, the legislation of the investment process, the taxation of investment activity and the need for investments in the targeted area.

The research subject can be further developed through analyses related to the evaluation of investment performance through the lens of European indicators and the analysis of the risk and uncertainty environment in which the investment process is carried out.

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