

# Bibliometric Study of the Conceptual Approach of Intellectual Capital

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**Abstract** – This study aims to map the conceptual approach of intangibles for the period 1982 – 2022 by using a bibliometric study. For this study, we used the Web of Science Core Collection database as a main reference for data collection. From 1982 to 2022, we filtered 21,564 records for our final sample. Collected data were analysed with descriptive statistics and co-word analysis, where a co-occurrence network was used for visualisation of co-word analysis. From a total of 37 460 keywords, the most frequent are: “Risk”, “Performance”, “Human Capital”, “Impact”, “Growth”, “Return” and “Volatility”. USA is the leader in researching the area of intellectual capital (approximately 30% of the total amount of papers belongs to USA researchers). Separately, we analysed the case of the Slovak Republic. Our results show that Slovakia has a huge time gap with other countries, but the positive is that Slovak researchers are in step with worldwide popular areas of intellectual capital. Also, we found that Slovak Republic published 0,75% of the total 21,564 papers. This study offers a wide range of the current state of researching intellectual capital worldwide and separately for the Slovak Republic.

**Keywords** – Intellectual capital, Web of Science, bibliometric analysis, co-word analysis.

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## 1. Introduction

The phenomenon of intellectual capital has become a core topic as a result of implementing a new knowledge-based economy. This knowledge-based economy moved attention to intangible assets owned by organisations and economics [1].

Researching intellectual capital has its roots in the topics of intangible assets. Galbraith established the pioneering work in the field of intellectual capital [2]. The important role of intellectual capital and intangibles was described in the works about innovation by theoretical researchers such as Schumpeter and Drucker [3],[4],[5]. Much attention to intellectual capital was paid in the 90s of the 20th century when intellectual capital began to be understood as a part of a knowledge-based economy [6],[7]. Taxonomy of intellectual capital defined four research stages, described in Table 1.

Table 1. Stages of intellectual capital research

Stage	Period
Developing a theoretical framework	End of 1980s and 1990s
Developing supported by empirical evidence	2000 – 2003
Developing research as a result of using intellectual capital	2004 – nowadays
Developing regional and national intellectual capital	2004 – nowadays
Developing a theoretical framework	End of 1980s and 1990s

In literature, intellectual capital was defined from different points of view: by the level of analyses (individual or organisational), by time value (present or future value) and by objectivity (input or output) [6]. The difficulty of accepting a common term for intellectual capital is usually explained by its multidimensional nature. On the other hand, this multidimensional nature discovers some scales of perspectives such as economic, managerial, and accounting [8], [9], [10].

Stewart and Loose [11] defined intellectual capital as an accumulation of knowledge and skills of individual and professional knowledge and skills embodied in the human brain. Rastogi defined intellectual capital as a phenomenon that presents the organisation's holistic and meta-levelled ability to coordinate, organise, and deploy its knowledge to create new values and, as a result, complete its vision [12]. Martin characterizes intellectual capital as intellectual material that is formalised and used to create higher values [13]. Manzari et al. determined intellectual capital as ownership of knowledge, applied skills, organisational technologies, relations with customers and professional skills, which provide a competitive advantage for the organisation [6]. Beattie and Thomson defined intellectual capital as a term to describe intangible assets which create value for the organisation [14]. Bukh et al. characterized intellectual capital as a combination of human, structural, and relational capital. In other words, it is a combination of competencies and liabilities [15]. Gavius and Russ defined intellectual capital as a combination of intangible assets that enable an organisation to function [16]. These few definitions of the term “intellectual capital” approve the multidimensional nature of this topic, as we wrote above.

This study will systematically review the conceptual approach of intellectual capital from 1982 to 2022. The given period is chosen to examine approaches to intellectual capital before and after they began to perceive it as part of the knowledge-based economy.

## 2. Research Methodology

With the help of bibliometrics, this study aims to fill a research gap by carrying out a systematic and quantitative analysis of intellectual capital. This study combines descriptive statistics of data samples with co-occurrence analyses. To collect data samples for further analysis, we used the Web of Science database.

Pritchard introduced bibliometric analysis as “the application of mathematical and statistical methods to books and other means of communication” [17]. Quantitative analysis of empirical data in published literature leads bibliometrics analysis to the research area of study and identifies major themes [18].

This study aimed to research the conceptual approach of intellectual capital. Bibliographic research has mainly focused on keywords analysed by co-occurrence network analysis. The next important part of the study describes categories of analysed papers, their trends, and the most published authors.

These analyses were made for the final sample and the Slovak Republic sample as a part of the final sample.

This study aims to respond to the research questions:

*RQ1: What topics are the most studied in the field of intellectual capital*

*RQ2: Which countries are leaders in intellectual capital research?*

*RQ3: What trend in intellectual capital research do we observe in the period 1982 – 2022?*

*RQ4: What is the situation in Slovak Republic in intellectual capital research?*

To answer this research questions we collected data from the Web of Science database. Gathered data were analysed using co-word and co-occurrence analysis (in VOSviewer software) as well as descriptive statistics.

Co-word analysis helps researchers map the bibliographic structure of the research area. This analysis is an effective method for data mining from the texts of publications. Co-word analysis is based on the co-occurrence of two or more keywords in a document and helps identify the correlation between them. Co-occurrence analysis methods became popular during the last two decades, focusing on the analysis of co-occurring entities within a collection unit. For samples with 1000 or more records, researchers used a threshold of occurrences of 30 – 50 keywords (for small samples threshold is a maximum of 5 keywords) [19], [20]. Our final sample has 18 146 records, so we set our threshold to 50 keywords.

VOSviewer is free to download software for constructing and visualising bibliometric networks from journals, researchers or individual publications. They can be constructed on the citation, bibliographic coupling, co-citation or co-authorship relations. The software offers text mining functionality, which can be used to visualise co-occurrence networks of important information from the scientific literature. This software links keywords by using association strength (by default). Association strength is used for normalising the strength of the links between items [21].

## 3. Data Preparation

The main database used for this study is Web of Science (WoS) Core Collection by Clarivate because it is one of the most reliable databases for university researchers. We were using WoS filters to create our sample.

We selected 11 keywords (Intellectual, capital, intangible, assets, human capital, structural capital, relational capital, intangible assets, knowledge assets, intellectual assets, intellectual capital) used with the WoS database on January 27, 2023. This filter found 252,252 papers in all WoS categories. Figure 1 shows 10 the most recorded field.

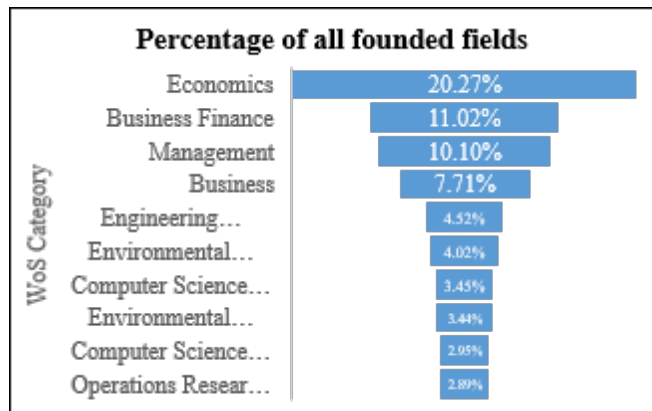


Figure 1. Ten most recorded fields as a percentage of all founded fields

Next, we filtered categories because many results were out of fields under study (e.g. Environmental Studies, Computer science theory, Oceanography, etc.). We added fields like Economics, Business, Management, Business Finance, Operations Research Management Science, and Social Science Interdisciplinary. However, all others have been excluded. That reduced our search scope to 104,771 records. Figure 2 shows the record count of selected categories.

Category “Economics” included 47.49% papers of all 74 205 records, “Business Finance” – 32.69%, “Management” – 24.28%, “Business” – 19.30%, “Social Sciences Interdisciplinary” – 4.07% and “Operations Research Management Science” – 3.78%.

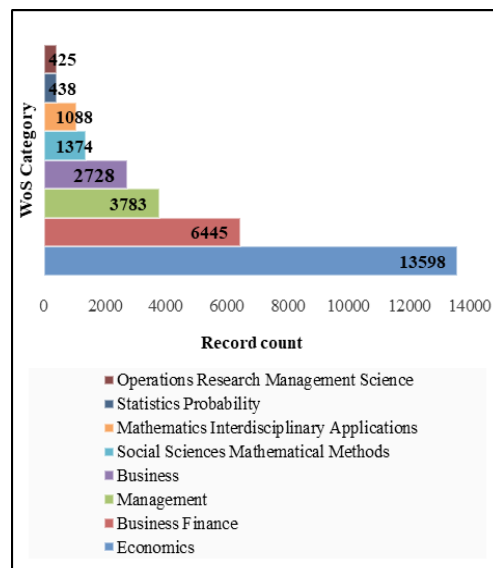


Figure 2. Record count of selected WoS Categories

Next, we defined the period which we want to analyse. In our case, we filtered all papers from 1982 to 2022. This step reduced our search scope to 90,187 records. Figure 3 shows the frequency for a selected period. As we can see, the frequency of publications rises every year. Also, we can see that from the beginning of the 1990s, there are pretty much more papers.

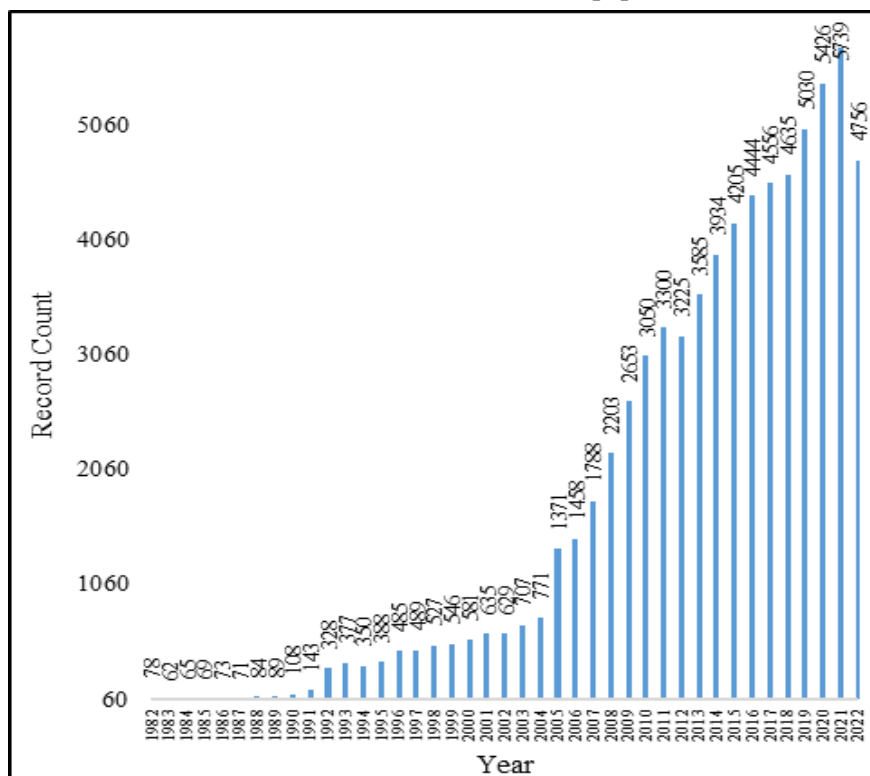


Figure 3. Record count according to the years

Next, we defined “Business Economics” as a main research area, and it reduced our search scope to 81,674 records. Then, we set English as the main language because approximately 95% of all records are written in English (77,933). After this, we set the document type to be an article with open access, which reduced our search scope to 21,658 records.

Therefore, after we filtered keywords in the WoS database, we used above applied five filtering criteria to collect our final data sample. Table 2 shows the data filtering proceeding step-by-step with all inclusion or filtering criteria.

Table 2. Data filtering from the Web of Science database

<b>Selected Keywords</b>	ALL=(Intellectual Capital OR Intangible Assets OR Human capital OR Structural Relational Intangible Knowledge Intellectual Intellectual capital)	AND OR OR OR OR OR OR OR
<b>WoS database</b>	Total documents: <b>252,252</b>	
<b>First filter</b>	Web of Science Categories: “Economics”, “Business”, “Management”, “Business Finance”, “Operations Research Management Science”, “Social Science Interdisciplinary”, “Social Science Mathematical Methods” AND exclude all others Total documents: <b>104,771</b>	
<b>Second filter</b>	Period: 1982 – 2022 Total documents: <b>90,187</b>	
<b>Third filter</b>	Research area: “Business Economics” Total documents: <b>81,674</b>	
<b>Fourth filter</b>	Language: “English” Total documents: <b>77,933</b>	
<b>Fifth filter</b>	Document type: “Article”, Quick Filters: “Open access” Total documents: <b>21,564</b>	
<b>Final sample</b>	<b>21,564</b> records	

#### 4. Bibliographic Research Results

After collecting the data, the analysis was employed using the research methods mentioned above (in the “Research methods” chapter). The key results are about the selected sample, and we also added analysis for the Slovak Republic as an additional part of this study. For this, we filtered out the final sample for the Slovak Republic, achieving a new sample of 136 records.

The final sample includes 7 Web of Science categories, as shown in Figure 2. The core part of publications is in the Economics category, with 13,553 records, 62.85%. Business finance is the second biggest category, with 6,420 records of 29.772%. Next is the Management category, which counts 3,749 records, representing 17.385%. The Business category includes 2,719 records, 12.609% of the total. The social sciences mathematical methods include 1,368 records (6.344%). Operations Research Management Sciences present the smallest with 420 records (1.948%). These results are represented in Figure 4.

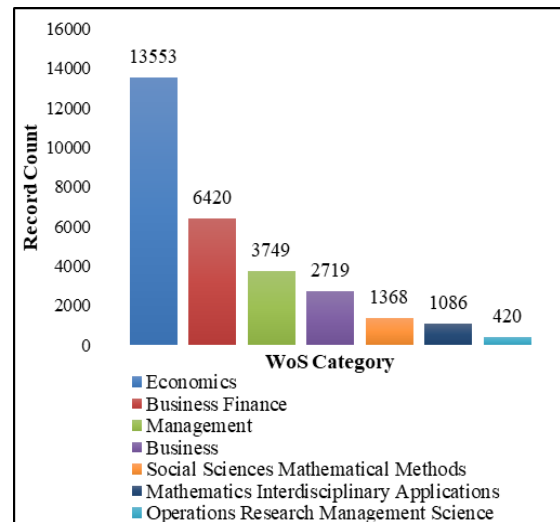


Figure 4. Final sample records by Web of Science Categories

In Figure 5, we illustrated the trend of the final sample. As we can see, the trend is positively rising year by year. In 2006, there were 367 records, and in 2007, 443 records, with the number constantly increasing (thanks to developing theoretical background of intellectual capital). Accordingly, in 2021, we can see the highest number of records, 2,402. In 2022, the record count decreased to 2056.

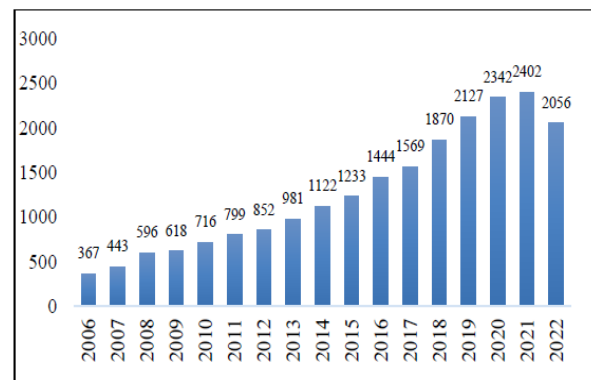


Figure 5. Final data sample structured in time

The most prolific countries are illustrated in Figure 6, where a strong blue colour shows the high published records. In grey areas, there were no selected papers.

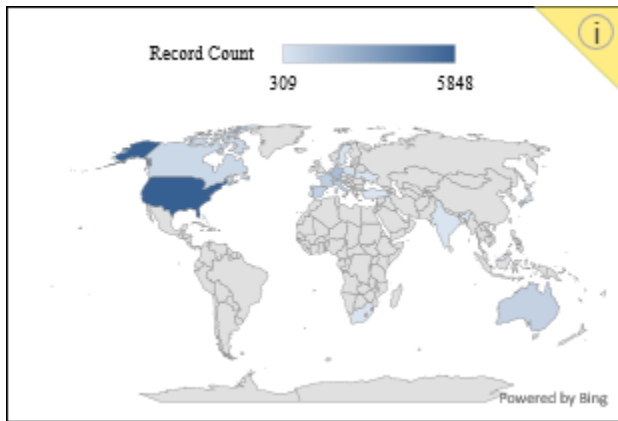


Figure 6. World map of the published records

Most articles are published in the United States of America (27.119%). In second place is England with 19.713% of articles. Approximately in the same lever are Germany (9.145%), China (6.121%), Italy (6.358%), Spain (5.671%), France (5.954%), Australia (5.365%), Netherlands (4.61%), and Canada (4.048%). Slovakia published approximately 0.686% of articles. We must note that between the USA and other countries there exists such a big gap. Our final sample includes 121 countries in total for further analysis.

Figure 7 illustrates the top 10 authors from our final sample. According to the data, Gupta R. scored best with 47 papers. The second is Cuaresma J.C., with 29 papers. The next eight authors are approximately at the same level. We have also analysed Slovak authors. The results will be described in the next part of the chapter.

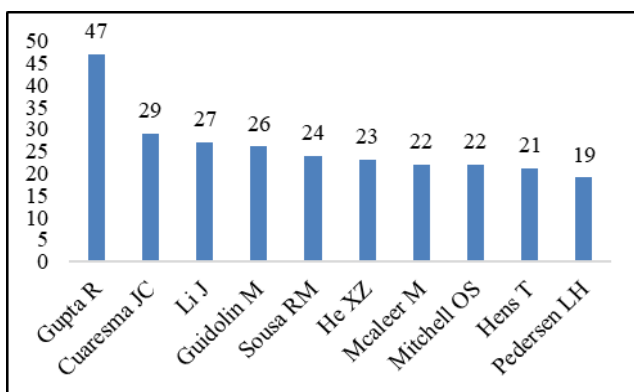


Figure 7. Number of records of the top 10 authors

## 5. Results of the Keyword Analysis

As mentioned before, the final sample has 21,658 records. To analyse their co-occurrence relations, we used VOSviewer. The software found 37 460 keywords, and 429 meet the threshold of 50. Table 3 illustrates the first fifty of the most frequent keywords.

Table 3. Top 50 most frequent keywords (1982 - 2022)

Keyword	Frequency	Keyword	Frequency
Asset prices	478	Innovation	808
Asset pricing	428	Intellectual capital	308
Behaviour	483	Investment	1055
Choice	317	Knowledge	412
Consumption	817	Liquidity	664
Corporate governance	379	Management	685
Cross-section	539	Market	843
Debt	374	Markets	563
Determinants	782	Model	1445
Dynamics	403	Models	628
Earnings	357	Monetary policy	364
Economic growth	355	Ownership	364
Education	486	Performance	1725
Efficiency	437	Policy	395
Entrepreneurs	302	Prices	699
Equilibrium	591	Productivity	437
Firm	409	Returns	1074
Firm performance	418	Risk	1741
Firms	486	Selection	313
Growth	1070	Stock returns	413
Human capital	1063	Technology	338
Impact	1167	Tests	375
Income	334	Uncertainty	402
Inequality	371	Valuation	310
Information	798	Volatility	636

These keywords were divided into 4 clusters: first 148 items, second – 125, third – 94 and fourth – 62. The results of the co-occurrence analysis of keywords are illustrated in Figure 8.

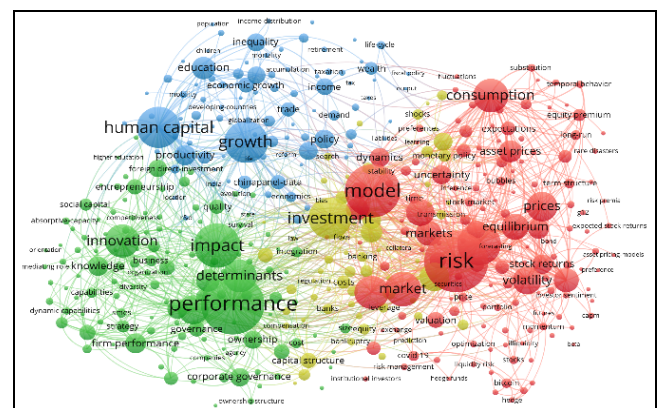


Figure 8. Co-occurrence network of keywords for final sample (1982 - 2022)



The first cluster (red) includes risk-related keywords (e.g., market, volatility, prices, valuation, portfolio, consumption, etc.). The second cluster (green) includes performance-related keywords (e.g., innovation, knowledge, strategy, firm performance, foreign direct investments, etc.). The third (blue) cluster includes keywords related to human capital (e.g., productivity, growth, policy, income, economic growth, higher education, etc.). The last fourth (yellow) cluster includes investment-related keywords (e.g., costs, banking, flows, capital structure, etc.).

### 6. Research Results for the Slovak Republic

As mentioned in the previous chapter, Slovakia published approximately 0.75% (136 records) of articles. Similarly, as in a final sample, the core part of articles are published in the “Economics” category with 86 records, representing 63.24% of this sample. The second category is “Management”, with 43 records (31.62%). The third is the “Business” category, with 26 items (19.12%). The fourth category is “Business Finance”, with 16 records (11.77%), and the last is “Operations Research Management Science” with 2 records (1.47%). The “Social Sciences Interdisciplinary” category is not presented in this sample. These results are illustrated in Figure 9.

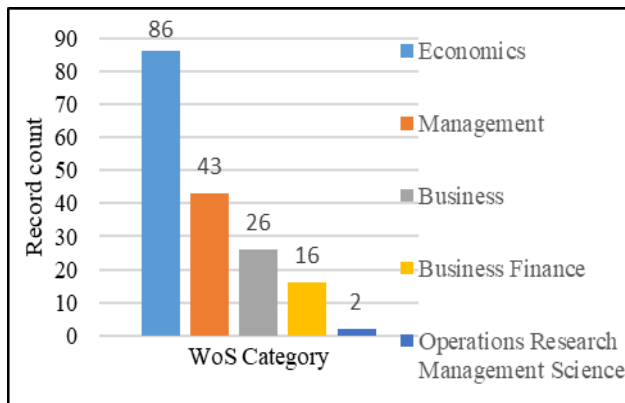


Figure 9. Slovak sample records by Web of Science categories

Researching of intellectual capital timeline for the Slovak Republic started in 2008. There, we can see a big delay with the final sample (e.g., the USA's first publication in 1970). But similarly, as in the final sample, we can see a positive trend. When researchers in Slovakia started to explore the intellectual capital area, there was only one paper in 2008 and 2009. The most productive years were 2020 and 2021 (26 articles were published). These results are illustrated in Figure 10.

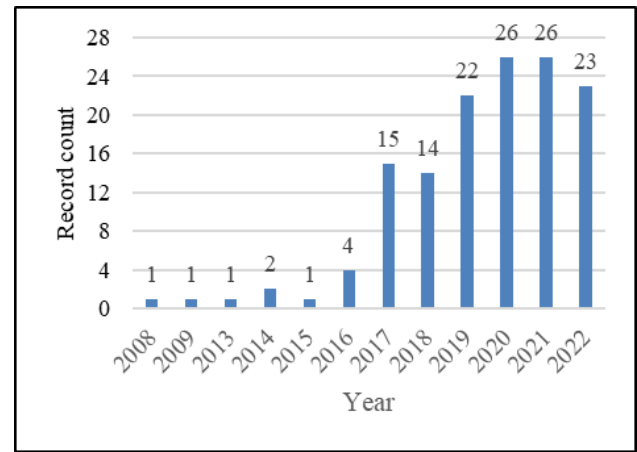


Figure 10. Timeline of publication frequency in the Slovak Republic

In Figure 11 we illustrated the top 10 Slovak authors. According to the data, Glova J. have 6 papers, which present 4.41% of the sample. The same result has Valaskova K. Second place belongs to three authors: Baumohl E., Gavurova B. and Kliestik T. (5 papers for each which creates 3.98% of the total). Third place also belongs to three authors: Andrejovska A., Durana P. and Jencova S (4 studies for each which is 2.94% of the total). The last two authors have 3 papers: Chapcakova A. and Harcarikova M. (2.21%).

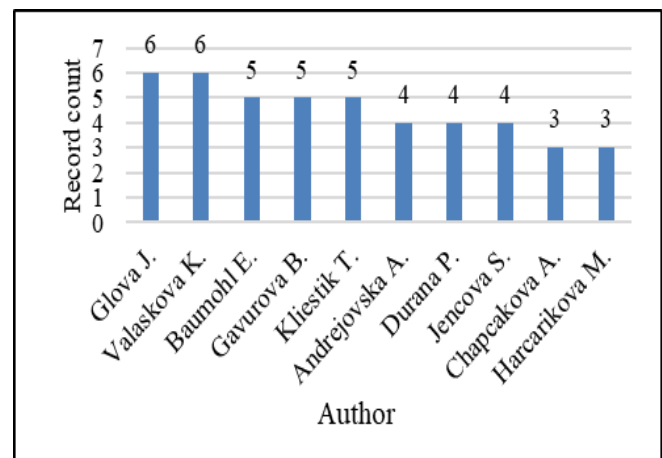


Figure 11. Top 10 Slovak authors

### 7. Keyword Analysis

The Slovak sample has only 136 records, so the threshold for co-occurrence was set to the 3 keywords. Our sample software found 791 keywords, and 52 of them meet the threshold of 3 keywords. Table 4. illustrates these keywords and their frequency.

Table 4. Frequency of keywords from the Slovak sample

Keyword	Frequency	Keyword	Frequency
Bankruptcy	7	Human capital	16
Bankruptcy prediction	3	Human resources	5
Capital structure	5	Impact	16
Companies	5	Indebtedness	3
Competitiveness	8	Industry	5
Consumption	4	Innovation	10
Corporate taxation	3	Intangible assets	4
Countries	3	Intangibles	3
Covid-19	3	Intellectual capital	4
Credit risk	3	Investment	4
Czech Republic	3	Leverage	3
Debt	3	Management	10
Determinants	7	Market	6
Economic growth	5	Model	7
Economic growth	4	Option pricing	4
Economy	4	Performance	16
Education	7	Portfolio	3
Efficiency	3	Profitability	5
Employment	3	Regression analysis	4
Entrepreneurs	3	Risk	11
Entrepreneurs hip	3	Risk management	3
Finance	4	Slovakia	4
Financial performance	5	Small and medium-sized enterprises	3
Financial ratios	3	Spillovers	3
Firms	4	Strategy	3

These keywords were divided into 4 clusters: first 14 items, second – 13, third – 12 and fourth – 12. The results of the co-occurrence analysis of keywords are illustrated in Figure 12.

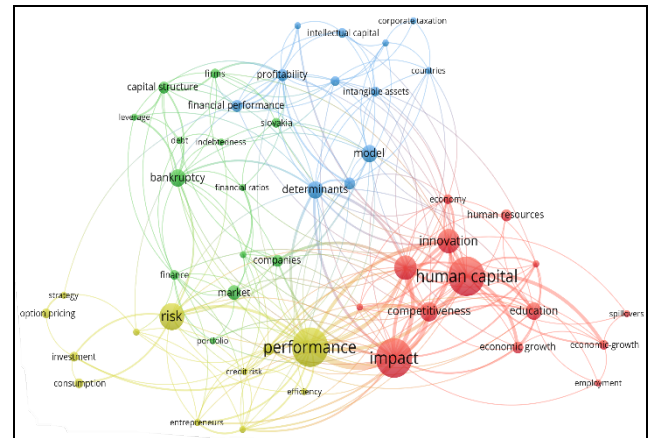


Figure 12. Co-occurrence network of keywords for Slovak sample (1982 – 2022)

The first cluster (red colour) includes keywords related to human capital (e.g. human resources, education, innovation, employment, economic growth, etc.). The second cluster (green colour) includes keywords related to capital structure (e.g. bankruptcy, debt, finance, portfolio, etc.). The third (blue colours) cluster includes keywords related to financial performance (e.g. profitability, intangible assets, intellectual capital, taxation, etc.). The last fourth (yellow colour) cluster includes performance-related keywords (e.g., credit risk, investment, option pricing, etc.).

### 8. Conclusion

This study provides an overview of published papers about intellectual capital from 1982 – 2022. We used simple descriptive statistics and co-word (co-occurrence) analysis to answer the research question. We analysed the final sample of 21,658 publication records. We highlighted that the number of papers is increasing from year to year and that researchers are more interested in the area of intellectual capital.

The first research question deals with the most studied topics in the area of intellectual capital. We performed a co-word analysis for our final sample (1982 – 2022) and separately for the Slovak Republic in the same period. The results show that the most frequent keywords for the final sample are “human capital”, “growth”, “performance”, “innovation”, “risk”, “market”, “competitiveness”, etc. (see Figure 8).

In the case of the Slovak Republic, the most frequent keywords are “human capital”, “competitiveness”, “education”, “risk”, “performance”, “capital structure”, etc. (see Figure 12). These results show that researchers during the last 40 years have focused on areas which are in touch with structure and the main determinants of intellectual capital, which made this topic much more relevant nowadays.

The second research question is concerned with the countries which are the leaders in the area of intellectual capital. Our results from the final sample, during the last four decades, show the USA is the leader in intellectual capital research. England, China, Germany, Spain, and other European countries also had good results in research, but there is a huge gap between them and the USA.

The third research question explored trends for the period 1982 – 2022. The results show that the number of publications is increasing year by year. At the beginning of the 1980s, there were around 10 papers about intellectual capital. Since economists discovered this field as a part of the knowledge-based economy (the 1990s), the number of papers doubled during the one year (1990 – 1991). From 2014 number of papers began to vary around thousands. In accordance, these simple statistics prove the fact that intellectual capital become one of the important areas in a new knowledge-based economy.

The fourth research question is about researching intellectual capital in the Slovak Republic. Results show that the Slovak Republic has a time gap with another sample. This gap also influenced the categories where researchers publish, the numbers of their papers and finally, a co-occurrence network is much purer. The positive thing for the Slovak Republic is that economists are going in step with other leaders. The most productive years for Slovakia started in 2017 (the number of records approximately tripled during 2016 – 2017). As in the final sample, there is a positive trend, and the number of papers is increasing yearly. About the authors, we can mention two leaders: J. Glova and K. Valaskova. They both have the highest number of papers in the intellectual capital area (6 papers).

This study also has its limitations. The Web of Science database is comprehensive but does not cover all existing papers about intellectual capital. Also, we must note that readers should be careful with generalising our results because the bibliometric analysis is focused on titles, keywords, and abstracts of published studies. So, the applied approach does not analyse the full papers. However, we try to focus on the positive side, which offers readers a comprehensive overview of the area they are interested in.

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