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Business Intelligence in Balanced Scorecard: Bibliometric analysis

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Abstract

The aim of the research described in the article was to determine how and to what extent business intelligence solutions were presented in scientific articles concerning Balanced Scorecards published until 2022. The bibliometric analysis method was used in the course of the research. As a result of data analyses, the following have been determined: key phrases describing business intelligence in scientific articles concerning the Balanced Scorecard, the number of their occurrences, the structure of research, and countries in which researchers carry out scientific activity in the field of the Balanced Scorecard, which constitute the article's contribution to science. Areas in which there are research gaps, where the practical significance of this research manifests, and what is particularly important for researchers of the Balanced Scorecard, have also been identified.

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1. Introduction

The reason for my interest in studying the relations between Business Intelligence (BI) and Balanced Scorecard (BSC) solutions consists in an assumption that such a relation is natural and results from the need to ensure rapid

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processing and presenting many different data monitored in the Balanced Scorecard, which I observed in the implementation practice of the Balanced Scorecard. This assumption seems correct since it is based on data defined and processed in a Balanced Scorecard – in the data's large amount, varied (both qualitative and quantitative) nature, in many sources of the data's origin in an enterprise, the required high frequency of their refreshing, the need to ensure high quality of the data itself, as well as the way the data is monitored, processed and analysed, the need to adjust the range of available results to the positions, etc.

When launching a Balanced Scorecard, it is usually assumed to implement certain solutions in the field of business intelligence in order to analyse and illustrate the results of measuring the activities of enterprises. In balance scorecard implementations specifically, I noticed that selecting and launching business intelligence solutions supporting Balanced Scorecard in its operation remains to be launched in the second place, is launched gradually, or stops at the planning stage. In this research, I have decided to verify my doubts concerning the scope of the actual presence of business intelligence solutions in the practical service of a Balanced Scorecard. An additional argument for undertaking this task consists in my interest in learning about the practical functioning of Balanced Scorecard structures, their compliance with theoretical assumptions, their impact on accounting, management accounting, measuring results, enterprise strategies, as well as organizational and IT support solutions. I found only four articles [1] [2] [3] [4] related to bibliometric analysis of Balanced Scorecard and some of its aspects but none of it is related to business intelligence (in response for a query to Web of Science: ALL=("balance* scorecard*") AND ALL=("business* intelligence*") AND ALL=("bibliometric*")) but I found no article which could be comparable to this article. I am additionally motivated by that lack of research with a similar thematic scope and methodology. By this article I begin exploring this research area by recognizing the relation between a Balanced Scorecard and business intelligence.

As for the structure of the article, then in the introduction is presented the general characteristics of the Balanced Scorecard, business intelligence and the research is generally characterized, i.e. the research problem, research questions, the research procedure used, methodology and software used to support the analysis of the results. After that the process of defining data for analysis in the field of business intelligence is characterized, and then described the process of analyzing this data and its results. The next part of the article presents a similar procedure relating to the Balanced Scorecard, the result of which was the establishment of a list of key phrases describing business intelligence co-occurring with the phrase "balanced scorecard" in articles on the Balanced Scorecard. In the above stages of work, phrases relating to business intelligence were defined and the scope and scale of their co-occurrence with the phrase "balanced scorecard" was established. Then, further stages of bibliometric analysis were carried out and the research areas, countries of origin of articles and concentration of phrases in particular years were established. The summary presents the research results and conclusions, especially research gap for further exploration.

1.1. Balanced Scorecard

Balanced Scorecard, as a strategic management concept, has been known since the 1990s. Its authors Robert S. Kaplan and David P. Norton, almost 20 years after publishing the first article in the Harvard Business Review making their Balanced Scorecard concept available to a wide audience [5], have been included on the Thinkers50 list [6] next to other authors of concepts most significant for modern management, such as Michael Porter or C.K. Prahalad. Balanced Scorecard still seems to constitute the answer to the growing complexity of the dependencies that govern the world of enterprises – Kaplan and Norton structured the manner of thinking about an enterprise, its goals and results, and in this sense revolutionized it. Balanced Scorecard is currently one of the most widely known management concepts in the world [6]. Its significance in enterprises results from its structure – it can be used to define a strategy, to transpose it into operational purposes, as a method of focusing resources and employees around goals understood in a common way, but also as a tool for measuring the financial and non-financial results of an enterprise.

Measuring results of enterprises has also been taken to a higher level. Thanks to the Balanced Scorecard, the scope of monitored areas of activity and processes has been expanded – with new ones, no measurement of which was previously carried out, as well. The interest in qualitative and non-financial measures, leading measures, intangible assets, etc., has also increased. The Balanced Scorecard itself has become a tool for monitoring the level of achieving goals, a source of data from various processes launched by implementing a strategy, as well as a tool for supervising the results of activities and signalling deviations from the planned measurement values. Therefore, its implementation

results in broadening of the scope of data from various processes carried out by a company, which should be constantly monitored. This, in turn, is the reason for the increase in the amount of data itself, and differing in type, quality, source, and other features. The Balanced Scorecard is intended to serve enterprise management primarily at the strategic level, but the basic data can also come from tactical and operational levels. Therefore, it is necessary to quickly acquire, verify, and process the data into information about the results and to present them; therefore, it seems natural to take advantage of software to handle a wide set of diverse data. For this purpose, it seems beneficial to use IT tools, and that is where Business Intelligence solutions find their application.

1.2. Business intelligence

The global volume of data generated in 2020 was 64.2 ZB (zettabyte) ($64.2 \cdot 10^{21}$ bytes), and forecasts for 2025 indicate that these values may be at least tripled [7]. A large part of this data concerns enterprises and financial services on the Internet, and providers of trading systems more and more often offer access to such services [8] [9]. The rapidly increasing amount of data requires constantly improved analysis tools, and a stronger development of analytical areas in business structures. An increase in the demand for employees from the areas of analysis can also be observed [10]. Large data sets and the availability of tools for their deep exploration enable detailed, multi-directional and multi-dimensional analyzes of the performance of enterprises. In practice, however, the analysis of historical results is used to describe the results of activities, and only sometimes prediction tools [11].

Business intelligence, in its classic approach, constitutes various types of organizational and technical instruments that support the processing of large amounts of data available in real time into information that can be useful in decision-making processes. Using these tools results from the scale and significance of problems concerning data in modern enterprises [12], especially large databases, and difficulties in browsing them and analysing the results. Business intelligence as a concept has existed for years, but we are still faced with difficulties in activating its full potential [13]. However, there is evidence that the implementation of business intelligence solutions leads to an improvement in financial results, as well as the favorable relationship between business intelligence solutions and Balanced Scorecard [14]. Business intelligence instruments are developing, and one of the best known for storing and combining data from multiple sources is the Data Warehouse [15]. The term "big data" has become quite popular, relatively new and already used in almost every area of human activity, as well as its new analytical capabilities [16] and has become a buzzword between other trending topics as artificial intelligence, machine learning or blockchain [17]. These are, for example, Online Analytical Processing systems (OLAP) allowing to store and use terabytes of data as well as taking advantage of the data by creating analytical queries to databases [18]. Fuzzy logic semantic expert systems constitute another solution that can be found in articles concerning Balanced Scorecard [19]. Implementation of business intelligence instruments positively influences on internal process and learning and growth activities [20]. From the implementation quality point of view, positive influence on success of business intelligence implementation have compatibility, technological readiness, top management support and competition [20].

2. Research characteristics

2.1. Research problem

The main research problem consisted in how articles on the Balanced Scorecard have so far presented business intelligence solutions and whether the issue of business intelligence constituted a significant area of research presented in scientific articles on the Balanced Scorecard published until 2022.

2.2. Research questions

In order to determine the solution to the research problem, the following questions related to articles concerning business intelligence have been defined: 1a. What phrases co-occur with the phrase "business intelligence" in the researched articles? 1b. Which of the identified phrases describe business intelligence solutions or tools? 1c. Which phrases co-occur with the phrase "business intelligence" most often?

And for articles regarding the Balanced Scorecard: 2a. Which of the previously identified phrases describing business intelligence solutions occur in articles concerning the Balanced Scorecard? 2b. Which phrases co-occur with the phrase "balanced scorecard" most often? 2c. Was the topic of using business intelligence solutions in the Balanced Scorecard so far a significant area of research related to Balanced Scorecard?

In order to determine the scope of business intelligence topics appearing in articles concerning Balanced Scorecard, the following questions have been asked: 3. In which areas of scientific research do phrases describing business intelligence solutions most often co-occur with the phrase "balanced scorecard"? 4. In which countries the interest in using business intelligence solutions in Balanced Scorecard was the greatest? 5. How does the co-occurrence of phrases describing business intelligence solutions used in Balanced Scorecard spread over time? Is it possible to distinguish time ranges in which some phrases appear more often?

In addition, an attempt was made to establish a research gap in the field of business intelligence in Balanced Scorecard: 6. Are there areas of business intelligence not yet described in articles concerning Balanced Scorecard, and is it possible to indicate a research gap? The research objective is to solve the research problem by obtaining answers to the above-mentioned general and specific research questions.

2.3. Preparing the research and research procedure

In the initial phase of the research concept of business intelligence and Balanced Scorecard relations, I considered two potentially possible directions of research work: direct research in a group of Balanced Scorecard users and an analysis of results concerning the conducted research. Due to the fact that I was interested in a broad approach to the subject, including identifying research gaps, I chose to analyse the results of research carried out so far. The planned research procedure (Fig. 1) made it possible to efficiently prepare and carry out research and analyses. Selecting the methodology to fit the purpose of the research, the scope of data, and the size of the article database (i.e. a systematic review of literature, meta-analysis, or bibliometric analysis) [21] required an initial review of the available literature. I used Web of Science and Google Scholar as source databases for this review. I started the analysis by determining the scope of data for searching. Seeing how I am interested in a broad approach to balanced scorecard and business intelligence, I decided to search for "balanced scorecard" and "business intelligence" phrases in the above-mentioned search engines. Web of Science offers numerous filtering options, for example, searches in the title, abstract, keywords, authors, source, publication dates, and several additional criteria. Google Scholar includes fewer detailed data filtering options, i.e. by accuracy, date, language, type of publication (with two options: any type, or review articles). Due to these differences, I made an attempt to increase the similarity of the search definitions for both search engines. However, it was impossible to achieve identical search conditions, especially due to the narrower scope of Google Scholar capabilities. The search results indicated significant differences between the searches: the phrase "balanced scorecard" resulted in 4,920 articles in WoS and 4,290 in GS, "business intelligence" in 7,430 in WoS and 6,360 in GS. Despite these differences (14% difference in the case of "balanced scorecard" and 17% in the case of "business intelligence"), both search engines indicated the existence of a large number of sources meeting the selected conditions. The Web of Science database indicates the presence of a larger number of articles including the phrase "balanced scorecard" as well as the phrase "business intelligence" than the Google Scholar database. For this reason, as well as due to the possibility of defining the detailed scope of search data in Web of Science, I decided to use only the Web of Science Core Collection database. Determining the detailed methodology of the research on the basis of the results at this stage required referring to the size of the database to be analysed. An initial analysis of articles concerning business intelligence and Balanced Scorecard contained in the WoS database indicates that the number of articles that should be initially accepted for analysis is too large to apply the methodology of systematic literature review. In combination with the research objective (including a description of relations between Balanced Scorecard and business intelligence in literature, determining the scope of conducted research, trends, and research gaps), this indicates that the method corresponding to the theoretical assumptions and adapted to the goal of this

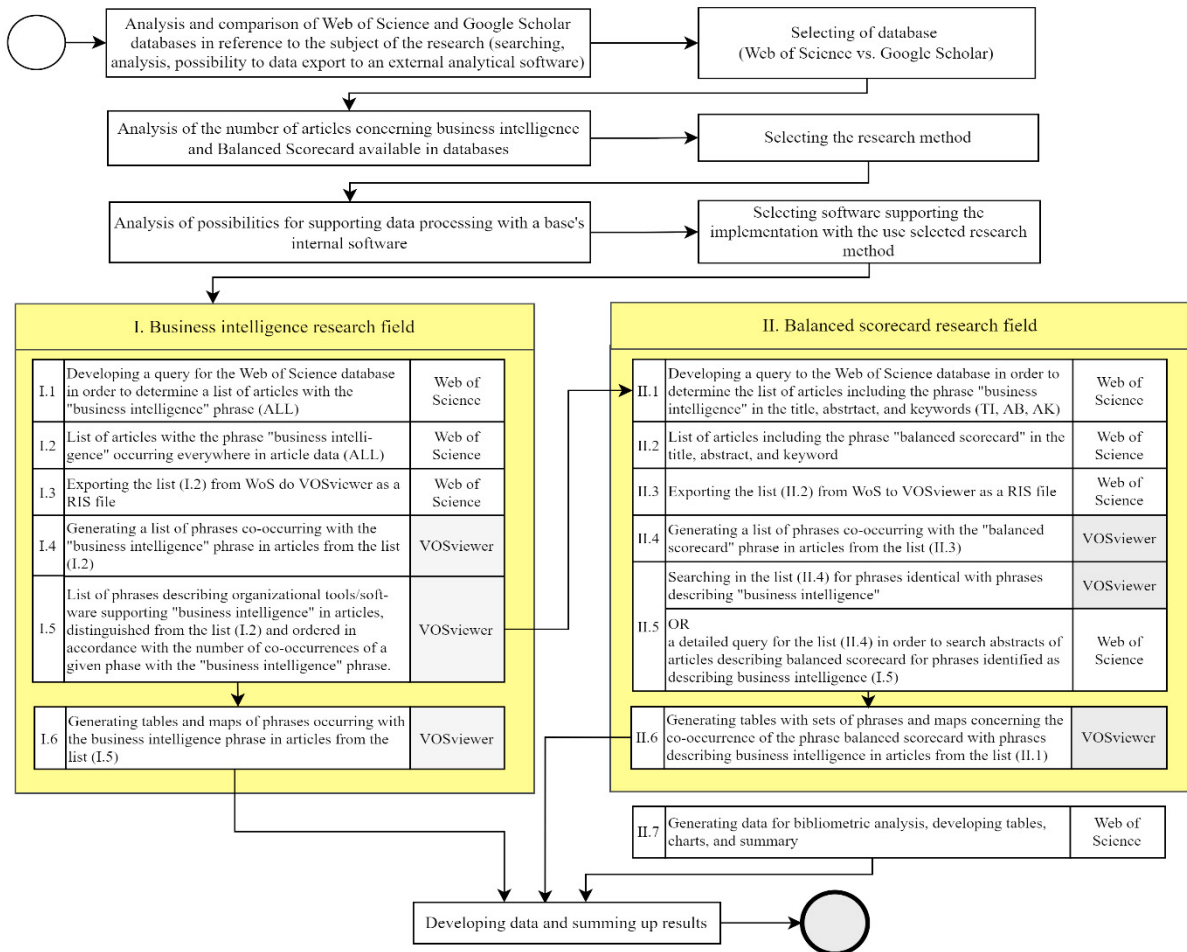


Fig. 1 Procedure of the research

research is the bibliometric analysis method [21]. It takes advantage of quantitative techniques to analyse bibliometric data. This is not a new methodology, but it began to be used on a broader scale at the beginning of the 21st century. Its significant development is evidenced, for example, by an increase in the number of articles including bibliometric analysis of phenomena related to business and economics – in 2005, 170 articles in which bibliometric analysis was used were written, and in 2020-1950 [21]. In the initial period of using bibliometric analysis in scientific research, classic review methods were used. Supporting bibliometric analysis using specialized software began when content started to be shared in scientific databases available on the Internet, using for example VOSviewer [22], Gephi [23], Bibexcel [24], CiteSpace [25], Leximancer [26], or HistCite [27]. After a general overview of the tools, based on detailed analyses and descriptions of the software used in bibliometric analysis [24], I chose to use the VOSviewer software. Its functionality ensures implementing tasks set in the research [28], it is convenient to use and available in the freeware model.

3. Analysis of scientific articles concerning business intelligence

3.1. Database of articles for researching the phrases co-occurring with the "business intelligence" phrase

My intention was to determine the broadest possible background for research in the field of business intelligence – the largest possible number of phrases that in scientific literature are combined with business intelligence solutions,

or which are used to describe business intelligence solutions. Therefore, the only limiting criterion that I used in all the query definitions was the criterion of English as the language of publication.

In accordance with the assumptions, I limited the search to the Web of Science Core Collection (hereinafter: WoS). I described the searched phrases with full words, but due to the observed possibility of plural words constituting phrases, I finally decided to use an entry that searched for both a singular and plural forms. The relevance of this decision was confirmed by verifying the number of articles through a query for the Web of Science database: $[(ALL=("business* intelligence*")) \text{ not } ALL=("business intelligence") \text{ AND } LA=(English)]$, which showed that there are 9 previously not found articles including the key phrase in the form of "businesses intelligence" [29] or "business intelligences" [30]. To search for articles with the phrase "business intelligence", I used one query $[ALL=("business* intelligence*") \text{ AND } LA=(English)]$, and as a result I obtained a list of 9,687 articles. During an initial review of these articles, I also observed that in some titles, the abbreviation "BI" is used independently, without the phrase "business intelligence", to describe business intelligence. To determine their number, I used a query $[AB=("business* intelligence*") \text{ AND } TI=("BI") \text{ NOT } TI=("business* intelligence*") \text{ AND } LA=(English)]$, as a result of which 92 additional articles have been found. Ultimately, the number of articles searched in WoS for researching phrases co-occurring with the phrase "business intelligence" was determined to be 9,779. It was the base for further analyses of business intelligence describing phrases.

3.2. Data analysis and its results

The found articles were analysed in order to answer the research questions in the field of business intelligence:

- 1a. What phrases co-occur with the phrase "business intelligence" in the researched articles?
- 1b. Which of the identified phrases describe business intelligence solutions or tools?
- 1c. Which phrases co-occur with the phrase "business intelligence" most often?

The analysis was carried out using the Web of Science database. Data concerning the articles found in the WoS were exported to RIS files, and then used as a database for an analysis in the VOSviewer software [31]. When defining tasks for VOSviewer, the following task parameters were selected: type of analysis: co-occurrence; unit of analysis: keywords; counting method: full. In the following step of preparing the data for analysis, the minimum number of keyword occurrences was defined in VOSviewer. Based on the data from VOSviewer, it was determined that in the researched set of 9,779 articles there were 20,303 keywords, of which in any database field with the phrase "business intelligence" there were: 1 time – 20,303 key phrases, 2 times – 6,841, 3 times – 2,904, 4 times – 1,911, 5 times – 1,376, 10 times – 585, 20 times – 256, 30 times – 169, 40 times – 119, 50 times – 92, 100 times – 36 key phrases. Based on the above list of the number of occurrences of phrases co-occurring with the business intelligence phrase in 9,779 articles, I assumed that the minimum number of these occurrences is 30. Then, I performed a simulation using VOSviewer and determined that this condition was met in the case of 169 phrases (not listed here), the number of which was reduced due to removing phrases that do not relate to organizational, technical, or conceptual tools, software, as well as phenomena and techniques describing business intelligence. As a result of this reduction, I obtained a list of 54 phrases that were presented on the map (Fig. 2). It was created using the VOSviewer software and depicts both the most important phrases co-occurred with the phrase "business intelligence" as well as the strength of their relation. It generalizes the scope and strength of relations between the phrase "business intelligence" and phrases that describe organizational, technical, conceptual, and software tools, phenomena and techniques by presenting the number of co-occurrence of each of the phrases with the phrase "business intelligence" (illustrated by the diameter of the circle – the larger the number of occurrences the larger the diameter), as well as the co-occurrences of individual phrases with each other and the strength of these relations (illustrated by the thickness of the line connecting the phrases – the thicker the line, the stronger the relation, i.e. the more frequent co-occurrence). Colours indicate the belonging of phrases to specific clusters. During the following stage of verifying the list, I identified phrases that are identical in meaning, but have been written differently (e.g. some with a dash between words, others without), used in different form or number. As a result, I obtained a final set of 33 phrases: artificial intelligence, big data, business analytics, business intelligence, business intelligence system, cloud computing, dashboard, data analytics, data integration, data mining, data science, data visualization, data warehouse, database, decision support,

abstract, and keywords of articles – if an article focuses on a specific subject/concept/phenomenon, it includes its name in the title of the article, its abstract, and in the author's keywords. Therefore, in order to recognize that a given article focuses on Balanced Scorecard, I assumed that the phrase "balanced scorecard" should appear in full in the article's title, abstract, and in the author's keywords, or in Keywords Plus. In addition to the English language of publication conditions, these are the main conditions for searching for the phrase "balanced scorecard" in the WoS database. In the first approach I used the "Topic" (TS) field of the WoS search engine to define a query searching for articles related to Balanced Scorecard, i.e. simultaneously searching the title, abstract, keywords, and Keywords Plus. However, searching using the "Topic" field was inadequate in relation to my needs. In the following step, I prepared a query that referred directly to the following fields: title (TI), abstract (AB), keywords (AK), and Keyword Plus (KP) and defined it as follows: (((((TI=("balance* scorecard*")) AND AB=("balance* scorecard*")) AND AK=("balance* scorecard*")) or KP=("balance* scorecard*")) AND LA=(English)) AND DT=(Article OR Early Access OR Proceedings Paper)). As a result of this query, I obtained a list of 2,306 articles, and a detailed overview of titles, abstracts, and keywords assured me that this time the query ensured the occurrence of the phrase "balanced scorecard" in the title, as well as in the abstract, keywords, and Keyword Plus. I used the above-described article database for further analyses and in the following step I exported RIS files with the data concerning articles from WOS to VOSviewer. Taking advantage of the analytical tools offered by this program, I set the number of keywords in the imported set of articles to 6,380. After establishing at least 5 co-occurrences of the analysed phrases with the phrase "balanced scorecard" in the articles, VOSviewer indicated the presence of 594 keywords. Seeing how keywords are repeated in articles, the number of occurrences of all keywords determined in VOSviewer summed up to 13,903, while the sum of the total strength of relations to 95,690.

Among the phrases representing organizational, technical, conceptual, software tools as well as phenomena and techniques describing business intelligence and presented higher in the list of 594 keywords related to Balanced Scorecard, there were (Fig. 3): framework, information-technology, business intelligence, big data, information-systems, information technology, risk management, erp, fuzzy logic, business analytics, big data analytics,

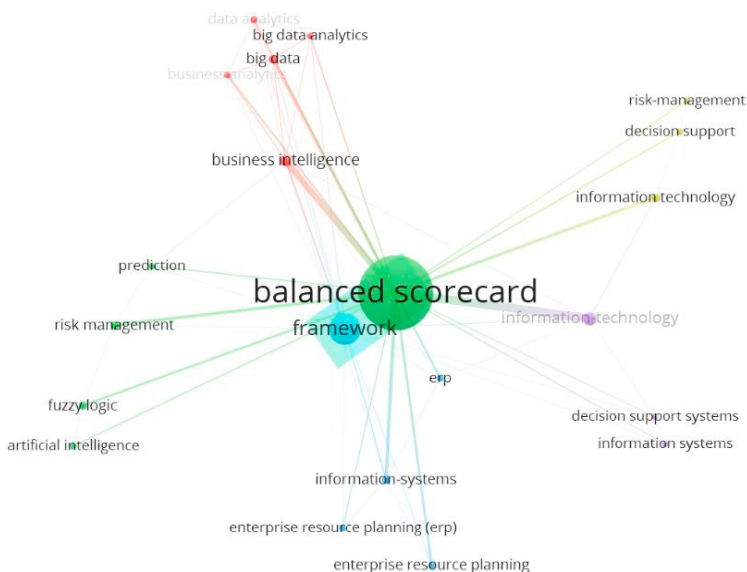


Fig. 3. Phrases describing business intelligence co-occurring with the "balanced scorecard" phrase in articles related to Balanced Scorecard. (with use of VOSviewer)

information systems, enterprise resource planning, decision support systems, risk-management, enterprise resource planning (erp), prediction, decision support, artificial intelligence, data analytics. The order of the phrases followed from number of co-occurrences with the phrase "balanced scorecard". The sum of the number of occurrences of

phrases describing business intelligence in articles concerning Balanced Scorecard is at 456, while the total strength of the relations is 3,395. This means that the share of the number of occurrences of phrases related to business intelligence in articles concerning Balanced Scorecard is 3.28% and the strength of the relation between these phrases and the main Balanced Scorecard phrase constitutes 3.55% of the total value of relations. This proves the low share of research concerning organizational, technical, conceptual tools, software as well as phenomena and techniques describing business intelligence on their use to support Balanced Scorecard as well as the very low significance of this area in research so far. The topic of using business intelligence solutions to support Balanced Scorecard has not been a significant area of research published so far. Among the phrases identified in reference to question 2a, in connection with the "balanced scorecard" phrase, the following phrases occur most often: framework, information technology, business intelligence, big data, information systems.

The total number of their co-occurrences constitutes over 80% of all in the analysed articles, which means that these are the phrases most often co-occurring with the phrase "balanced scorecard" in articles concerning Balanced Scorecard.

4.2. Bibliometric analysis

In articles concerning the Balanced Scorecard phrases describing business intelligence solutions which most often co-occurred with the "balanced scorecard" phrase are related to the following research areas: Business Economics (over 35% of co-occurrences), Computer Science (over 14% of co-occurrences), Engineering (over 13% of co-occurrences), Operations Research Management Science (over 9% of co-occurrences). Therefore, their total share comes down to more than 70% of all co-occurrences.

When it comes to the share of articles including phrases 2a co-occurring with the Balanced Scorecard phrase according to country, all articles came from 81 countries. More than 30% of the phrases concerned articles from only 4 countries (USA, Taiwan, England, and China), more than half came from 9 countries, and 80% from 25.

If we consider 80% of the occurrences, the highest number of occurrences were included in articles originating in the European country (over 32%), Asia (almost 30%), as well as the USA and Canada (12%). The result presents the structure of interest in the issue of business intelligence in applications related to Balanced Scorecard – as a single country, the USA (almost 10%) accounts for the largest share. The USA is the country where the Balanced Scorecard has been created and is constantly developing both in terms of concepts and all kinds of support tools. However, both European and Asian countries, especially China, are trying to adopt and develop the Balanced Scorecard concept and are interested in supporting it with business intelligence tools.

When it comes to the distribution of interest in individual areas of business intelligence solutions in Balanced Scorecard over time, such changes were observed. It can be said that they are in a sense concurrent with the development of Balanced Scorecard and business intelligence tools. At the beginning of the second decade of the 21st century, articles referred to the following phrases: information systems, information technology, erp, fuzzy logic. Later, in the middle period of this decade, the focus was put on risk management, decision support systems and their support, while the end of the 2nd decade of the 21st century stands for discussing data analytics, big data, and big data analytics.

I obtained additional information in VOSviewer, where in overlay visualisation it can be observed whether a given phrase appeared earlier or is it a new topic. In the conducted research, the existence of dozens of phrases describing business intelligence solutions that did not co-occur with the "balanced scorecard" phrase was determined. This area may constitute a research gap and is defined by the following phrases: business intelligence system, cloud computing, dashboard, data visualization, data integration, data mining, data science, data warehouse, deep learning, information management, internet of things, machine learning, neural network, online analytical process, olap, predictive analytics, semantic web, text mining, web mining. In this area, research gaps and fields for further research should be sought.

5. Summary

As a result of the research presented in the article, I obtained answers to the following research questions:

1a) In 9779 articles recognized as related to business intelligence it was identified 20,303 phrases co-occurred with the phrase "business intelligence". After deeper analysis and establishing a bottom level of amount at least on

30 co-occurrences in the analysed articles it was found 169 phrases co-occurred with the phrase “business intelligence”.

1b) 33 phrases from among those co-occurring with the phrase "business intelligence" (approx. 20%) concern or describe organizational, technical, conceptual and software tools, phenomena and techniques related to business intelligence and these are: business intelligence, artificial intelligence, big data, business analytics, business intelligence system, cloud computing, dashboard, data analytics, data integration, data mining, data science, data visualization, data warehouse, database, decision support, deep learning, enterprise resource planning, framework, fuzzy logic, information management, information system, information technologies, internet of things, machine learning, neural network, online analytical process, olap, prediction, predictive analytics, risk management, semantic web, text mining and web mining.

1c) 20 of the 33 phrases identified earlier, co-occur most often with the phrase “business intelligence” and these are: big data, data mining, data warehouse, framework, olap, big data analytics, machine learning, data analytics, information technology, cloud computing, business analytics, business intelligence, data warehousing, information-systems, text mining, decision support systems, data science, prediction, predictive analytics, artificial intelligence.

2a) 9 of the previously identified phrases co-occur with the phrase ”balanced scorecard” in articles concerning Balanced Scorecard and these are: business intelligence, framework, information technology, risk management, big data, fuzzy logic, technologies, erp, artificial intelligence.

2b) 6 of them co-occur with the phrase “balanced scorecard” most often, and these are: business intelligence, framework, information technology, information-systems, big data, and fuzzy logic.

2c) The topic of using business intelligence solutions in Balanced Scorecard so far was not significant area of the research related to Balanced Scorecard: the share of the number of occurrences of phrases related to business intelligence in the keywords of articles concerning Balanced Scorecard was 3.28% and the articles concerning Balanced Scorecard have so far presented business intelligence solutions either in general (using the phrases "business intelligence" "framework", "information technology", "information-systems"), or with specific solutions ("big data" and "fuzzy logic").

3) In 4 areas of scientific research, i.e. Business Economics, Computer Science, Engineering, and Operations Research Management Science, phrases describing business intelligence solutions most often co-occur with the phrase "balanced scorecard".

4) Approximately 30% of the authors of articles concerning business intelligence solutions in Balanced Scorecard came from the USA, Taiwan, England, and China. The largest number of authors – from the USA.

5) The co-occurrence of phrases describing business intelligence solutions used in Balanced Scorecard changed over time in parallel to Balanced Scorecard concept development and in accordance with business solutions development. Interest in business intelligence solutions for supporting Balanced Scorecard still exists, but its subject matter is changing, adapting to the development of both Balanced Scorecard and business intelligence, and concerns especially topics that are new or current at a given moment. The topic co-occurred with the phrase “balanced scorecard” in articles concerning Balanced Scorecard with the latest average year of publication is "big data" (2017).

6) 18 phrases out of 33 (55%) identified as key phrases describing business intelligence do not appear in articles concerning Balanced Scorecard and these are: cloud computing, dashboard, data visualization, data integration, data mining, data science, data warehouse, deep learning, information management, internet of things, machine learning, neural network, online analytical process, olap, predictive analytics, semantic web, text mining, web mining. This is an area constituting a research gap that can be explored.

The conclusions of the research are as follows: articles concerning Balanced Scorecard described business intelligence solutions rarely and usually in general. The largest number of articles was developed by authors from the USA, and the area of the most frequent research was the area of Business Economics. There is a significant research gap concerning the research on using business intelligence solutions to support Balanced Scorecard, which concerns newer solutions (cloud, internet of things, neural network, machine learning, data mining, artificial intelligence, text and web mining) as well as visualization (dashboard, data visualization).

I am aware of obtaining interesting results, as well as a good decision to initially examine business intelligence articles without any restrictions and conditions, thanks to which I obtained a complete image of the description of business intelligence in various research areas, which constituted a complete list of phrases coexisting with the phrase "business intelligence". I am also aware of the limitations, the most important of which resulted from the use of one

source of data in the research – the Web of Science database. A certain limitation may also consist in the use of one analytical tool – VOSviewer. I consciously chose this software to support my research and it met my expectations. However, I do not know whether other programs include other functions that could help me visualize the results to a greater extent.

The analysis carried out as part of the research indicates how much bibliometric analysis tools can be helpful in preparing and planning research as well as in recognizing the scope of existing research. In this paper, I presented an analysis of publications concerning the field of a narrow fragment of business activity – business intelligence supporting Balanced Scorecard. Such a combination seems natural, due to the benefits of using business intelligence tools for strategic management, collecting and storing data, and most importantly using them relatively conveniently. In the article, I presented the share of articles describing business intelligence solutions in the support of Balanced Scorecard. It turns out that the area of business intelligence and the use of its tools in the support of Balanced Scorecard is still a more general concept than specific and practically applied tools, the effects of which are worth studying. Despite the potential benefits of including business intelligence tools in Balanced Scorecard, the share of the number of articles concerning this subject in the number of articles concerning Balanced Scorecard is low. Both areas are constantly developing, but this is not evident in articles. Following research could concern identifying the causes of this situation or a deeper understanding of the determining and not yet explored areas.

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