

Business Intelligence as Decision Support in Organizations: A Systematic Review of the Itinerary

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Summary

The large amount of data handled by organizations has made the task of analyzing that data and generating information more complex, given this problem we opt for the use of Business Intelligence (BI), since through various techniques valuable information can be generated, which will serve as support in the Toma of Ecisiones. The main objective of the research focuses on determining the state of the art about Business Intelligence as a support for Decision Making in Organizations. For the present research, a systematic literature review (RSL) of publications carried out from 2017 to 2021 was carried out. 8 sources of information were used to obtain the articles, including: Scopus, ARDI, Web of Science, Taylor & Francis Online, ScienceDirect, Wiley Online Library, Google Scholar and ACM Digital Library. Finally, after applying various exclusion criteria, 70 articles were selected for the present work. The results obtained in the research show us various aspects related to the development of articles on Business Intelligence, as well as statistical data found in the development of these.

Keywords: Business Intelligence, Decision Making, Organizations, Systematic Review of the Literature

I. INTRODUCTION

Being able to generate valuable information for decision making through the application of BI is a task that has a great impact on organizations, because it allows better and faster decisions, which represents a competitive advantage today.

Good information management should be a priority for organizations because of the advantages it generates, however, studies show that less than 60% of organizations around the world perform a correct analysis and exploitation of their information (Ul-Ain *et al.*, 2019). This is mainly due to the lack of strategies or

technologies that help organizations carry out these activities mentioned above Yin and Fernandez (2020). That is why the importance of using Business Intelligence to take advantage of the large amount of data from organizations transforming them into useful information that will allow them to make a better decision in less time.

Over the years, research on Business Intelligence and its support for decision management have been increasing, this due to the importance it has been having within organizations, mainly in the management of data and generation of information for the various processes they perform. Years ago Salisu *et al.* (2021), carried out a study on the acquisition and implementation of a business intelligence system in a health sector organization. In this study Salisu *et al.* (2021) They made known the reasons that led the organization to opt for this solution, in turn also mentioned the impact and benefits it generated in the processes of the organization. In another study conducted on Business Intelligence by Tavera Romero *et al.* (2021), mentions the evolution that BI has presented in industry 4.0, an interest of organizations can be identified to be able to make decisions more efficiently, being able to make a difference in the competitive market that has been presented over the years. The review of the

articles allowed to identify the implications and factors that could influence both positively and negatively in the application of BI in organizations.

The present work aims to know in depth the impact of Business Intelligence on Decision Making in organizations. The structure is as follows: section II details the Methodology that was used for the review, and in section III shows the results obtained at the end of the process and their discussion. Finally, section IV presents the conclusions, as well as the aspects to be considered in future research.

II. REVIEW METHODOLOGY

The present study has been carried out following the steps recommended by Kitchenham *et al.* (2009) for RSL. The methodology used defines the phases of elaboration of the research questions, identification of the data sources, search of the information, identification of studies, application of the exclusion criteria, selection of the studies, evaluation of the quality of the selected information, extraction of data and finally the synthesis of the data.

Figure 1 shows the stages through which the systematic review must pass in order to carry it out correctly.

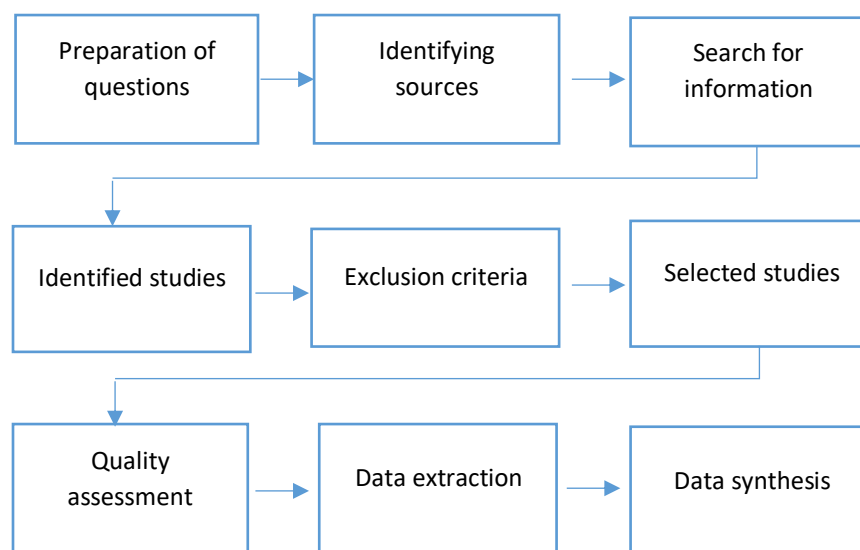


Figure 1. Stages of the Systematic Review of the Literature

A. Questions and Research Objectives

When starting with the systematic review it is very important to define well the research questions (RQ), because they have influence on

the following stages to follow as they are the starting point of the research. Table I then presents the research questions, along with their respective Objective or Method.

Table I. Questions and Research Motivation

Research Question	Motivation
RQ1: What is the chronological distribution of publications on Business Intelligence and its influence on Decision Making?	Identify the chronological distribution of publications on Business Intelligence and its influence on Decision Making.
RQ2: In which business areas is Business Intelligence being applied?	Determine the business areas where Business Intelligence is being applied.
RQ3: What are the Keywords that present co-occurrence in research on Business Intelligence and its influence on Decision Making?	Identify the Keywords that present co-occurrence in research on Business Intelligence and their influence on Decision Making.
RQ4: Who are the authors who present co-occurrence in their research on Business Intelligence and its influence on Decision Making?	Determine the authors who present co-occurrence in their research on Business Intelligence and its influence on Decision Making.
RQ5: Which are the Countries that present Co-occurrence in research on Business Intelligence and its influence on Decision Making?	Show the Countries that present Co-occurrence in Business Intelligence research and its influence on Decision Making

B. Search Sources and Search Strategies

The search sources used for the search and collection of information were the following: ACM Digital Library, ARDI, Google Scholar,

ScienceDirect, Scopus, Taylor & Francis Online, Web of Science and Wiley Online Library.

The key terms used in the search strategy used are shown in Table II.

Table II. Search descriptors and their synonyms

Descriptor		Description
Spanish	English	
Business Intelligence / Business Analytics	business intelligence/ business analytics	Independent variable
Decision making/ value judgment – organization/ company/ industry	decision making/ value judgment – organization/ company/ industry	Dependent variable

The research search has been carried out using Boolean logic, which are shown in Table III. rigorous search equations elaborated using

Table III. Information Sources and SearchEquations

Fountain	Search Equation
Scopus	(ALL (("business intelligence" OR "business analytics")) AND ALL (("decision making" OR "value judgment")) AND ALL (("organization" OR "company" OR "industry")))
Wiley Online Library	"("business intelligence" OR "business analytics") anywhere and ("decision making" OR "value judgment") anywhere and (organization OR company OR industry) anywhere
Web of Science	("business intelligence" OR "business analytics") (All Fields) (All Fields) and ("decision making" OR "value judgment") (All Fields) and (organization OR company OR industry) (All Fields)
ARDI	(\("business intelligence" OR "business analytics"\)) AND (\("decision making" OR "value judgment"\)) AND (\(organization OR company OR industry\))
Google Scholar	("business intelligence" OR "business analytics") AND ("decision making" OR "value judgment") AND (organization OR company OR industry)
ScienceDirect	("business intelligence" OR "business analytics") AND ("decision making" OR "value judgment") (organization OR company OR industry)
ACM Digital Library	[[All: "business intelligence"] OR [All: "business analytics"]] AND [[All: "decision making"] OR [All: "value judgment"]] AND [[All: organization] OR [All: company] OR [All: industry]]
Taylor & Francis Online	[[All: "business intelligence"] OR [All: "business analytics"]] AND [[All: "decision making"] OR [All: "value judgment"]] AND [[All: organization] OR [All: company] OR [All: industry]]

C. Identified Studies

When the search for the articles using the search equations is finished, Figure 2 shows the number of articles obtained in each source.

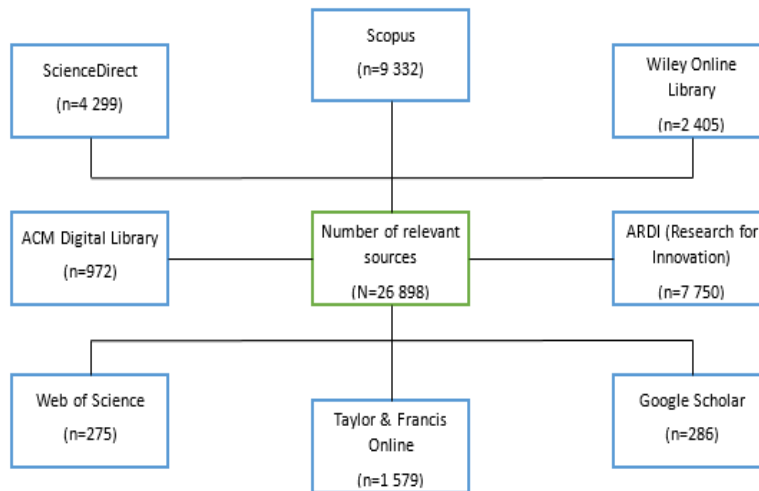


Figure 2. Number of publications per Source

D. Exclusion Criteria

For the selection of articles, 8 exclusion criteria (EC) were established for their evaluation and filtration, in order to ensure the best quality of the articles. The exclusion criteria established were:

CE1: The articles are older than 5 years.

CE2: Articles are not written in English.

CE3: The articles were not published in conferences or journals.

CE4: The titles and keywords of the articles are not very appropriate.

CE5: The proposed solution does not apply to decision-making within an organization or company or industry.

CE6: The articles do not mention a methodology, model or method.

CE7: The abstract of the articles is not very relevant.

CE8: The full text of the article is not available.

E. Selection of studies

For the application of the filters and subsequent selection of articles, the PRISMA graph was elaborated where the amount of articles discarded with each filter applied, and in turn the amount of articles remaining is mended. This process is shown in Figure 3, from which 70 articles were obtained for review and exhaustive analysis.

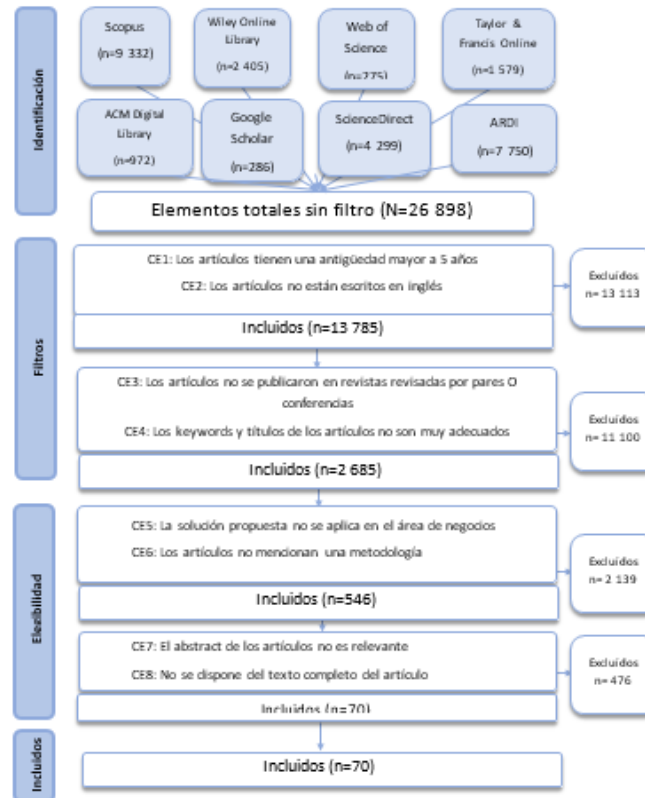


Figure 3. PRISMA Chart

F. Quality Assessment

At this stage, the quality of each of the selected articles was verified. To analyze the rigor, credibility and relevance of the studies, 6 quality criteria (QA) were established for their evaluation:

QA1: Is the article well organized?

QA2: Does the paper explain the context in which the research was conducted?

QA3: Is the specific area of the topic clearly defined?

QA4: Is it possible to consult the researcher?

QA5: Is research done in an organization, company or industry?

QA6: In general, is the document considered useful?

After reading each article and verifying that it

meets each quality criterion mentioned, it was determined that the 70 selected articles met the established criteria, guaranteeing their quality.

G. Data Extraction Strategies

At this stage, the most relevant information was extracted from each article, which allowed us to answer the proposed research questions. The information taken into account for the extraction was as follows:

Article ID, article title, URL, source, year, country, number of pages, language, publication type, publication name, authors, affiliation, number of citations, abstract, keywords and sample size.

Not all selected articles helped answer all research questions. For the management of the articles, the Mendeley Desktop tool was used as shown in Figure 4.

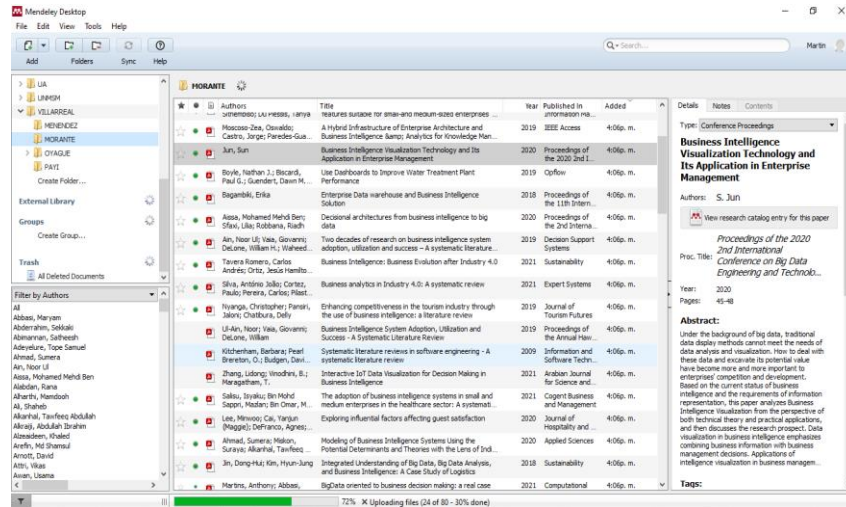


Figure 4. Reports in Mendeley Desktop

H. Synthesis of Findings

Data synthesis refers to the review and analysis of the extracted data to proceed to elaborate the answers to each research question posed. The data synthesis stage has been carried out through the use of descriptive statistics, inference statistics and natural language processing (NLP).

The information obtained to answer the research questions RQ1–RQ5 was sorted, classified and presented as quantitative and qualitative data, which served to make a comparison of the information collected for each research question.

III. RESULTS AND DISCUSSION

A. Study overview

After concluding with the process of selection and evaluation of the articles, 70 articles were obtained, which were analyzed in detail. Table IV shows the number of articles classified according to the number of citations and the type of publication. It can be seen that the most cited articles are those published in Journals, with a total of 58 articles, 15 of which exceed 15 citations per article.

Table IV. Number of articles by type of publication and range of citations

Publication Type	<5	≥5 and <15	≥15	Total
Journal	11	1		12
Conference	29	14	15	58
Total	40	15	15	70

The selected articles that were published in Journals significantly exceed those that come from Conferences, accumulating 80% of the total articles.

As mentioned by Yin and Fernandez (2020), it is confirmed that journal articles are the most used when making citations, due to their structure, and the amount of information provided by them, according to the depth of the analysis performed.

In research conducted by Ain *et al.* (2019) It was identified that the most cited articles were those from journals.

Regarding what was shown in the research of Silva *et al.* (2021) mentions that in the search carried out, the appearance of articles that came

from publications of various journals predominated.

Figure 5 shows the number of articles classified according to the Objectivity of their abstracts by Year of publication, identifying that most of the articles chosen present neutral or objective abstracts.

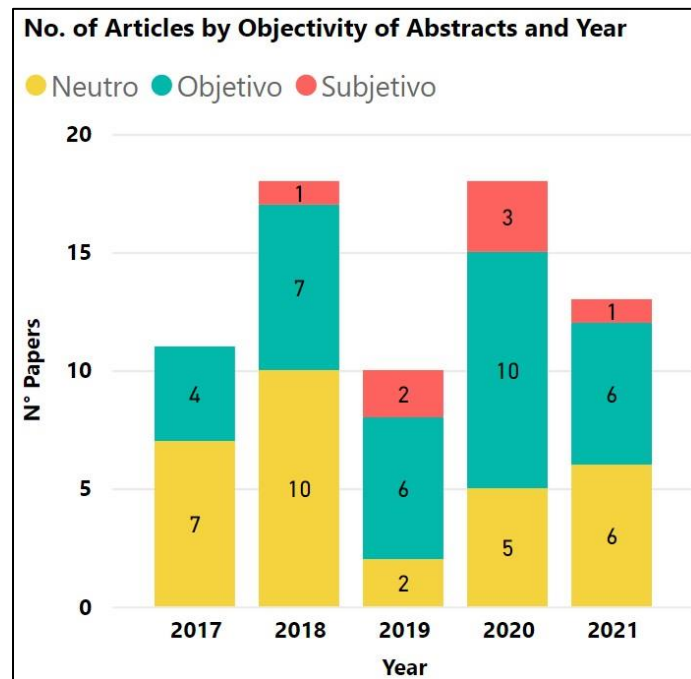


Figure 5. Number of articles by Objectivity of their Abstracts and Year

When observing the graph, it is noted that according to the analysis carried out, 7 articles present subjective abstracts, representing 10% of the total articles.

According to Silva *et al.* (2021), it is confirmed that most of the articles that have Business Intelligence as their central theme, must present a neutral or objective summary in order to guarantee the impartiality and reliability of these.

From what was shown by Yin and Fernandez (2020), it is pointed out that in recent years investigations have been increasing their objectivity, to guarantee the reliability of the publication.

The authoris Ain *et al.* (2019), mentionin this regard that for an investigation to stand out, its objectivity must prevail.

B. Responses to Research Questions

RQ1: What is the chronological distribution of publications on Business Intelligence and its influence on Decision Making?

According to the literature review, it was obtained that the most productive years in the publication of the articles that helped to answer the RQ's were the years 2018 and 2020, accumulating 56.03% of the total of selected

articles. F igura 6 shows the number of articles that helped answer the questions, classified by

year of publication.

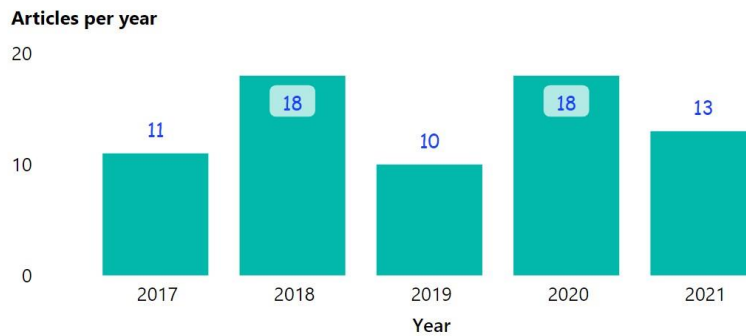


Figure 6. Aarticles by Ayear of publication

According to the graph, the year with the highest number of publications was 2018 and 2020, the other years together do not represent even 50% of the chosen studies.

As shown in the graph, the authors are Ain *et al.* (2019), agree in their analysis that one of the most productive years was 2020, which provided articles with information that is more adjusted to the current reality.

Regarding the results shown in their research, the authors are Silva *et al.* (2021) comment that in recent years research on Business Intelligence has been increasing.

Authors Tavera Romero *et al.* (2021) point out in their research that in the coming years a greater number will continue to be registered in

the preparation and publication of research related to Business Intelligence.

RQ2: In which business areas is Business Intelligence being applied?

The result obtained for this research question was that 4 business areas were identified in which a greater application of Business Intelligence was found. Table V shows the references of the articles where they mention the business area in which the application of the BI-based solution is applied or proposed, classified according to the 4 business areas proposed in the table, as well as the amount in percentage according to the Total articles presenting one of the 4 areas mentioned to answer the question.

Table V. Business areas of Business Intelligence application

Business area	References	Cant. (%)
Economy	(Alkrajji, 2020) ; (Lee <i>et al.</i> , 2020) ; (Adeyelure <i>et al.</i> , 2018) ; (Power <i>et al.</i> , 2018) ; (Ranjan & Foropon, 2021); (Suša Vugec <i>et al.</i> , 2020) ; (Bagambiki, 2018); (Bouaoula <i>et al.</i> , 2019) ; (Mezera & Křupka, 2017); (Min <i>et al.</i> , 2021) ; (Ahmad <i>et al.</i> , 2021) ; (Sousa & Dias, 2020); (Alzeaiden, 2019); (Awan <i>et al.</i> , 2021) ; (Kurnia & Suharjito, 2018); (Chen & Lin, 2021)	16 (27.6)

Health	(Drake & Walz, 2018) ; (Divatia <i>et al.</i> , 2021) ; (Lee <i>et al.</i> , 2020) ; (Sousa <i>et al.</i> , 2019) ; (Visinescu <i>et al.</i> , 2017) ; (Martins <i>et al.</i> , 2021) ; (Ranjan & Foropon, 2021); (Delen & Ram, 2018); (Ulman <i>et al.</i> , 2021) ; (Phillips-Wren <i>et al.</i> , 2021) ; (Kunc & O'Brien, 2019); (El Bousty <i>et al.</i> , 2018) ; (Min <i>et al.</i> , 2021) ; (Ahmad <i>et al.</i> , 2021) ; (Moscoso-Zea <i>et al.</i> , 2018) ; (Yusof <i>et al.</i> , 2019) ; (Kurnia & Suharjito, 2018); (Arefin <i>et al.</i> , 2021) ; (Mathrani, 2021)	19 (32. 8)
Education	(Drake & Walz, 2018) ; (Hoelscher & Mortimer, 2018); (George <i>et al.</i> , 2020) ; (Scholtz <i>et al.</i> , 2018) ; (Visinescu <i>et al.</i> , 2017) ; (Arnott <i>et al.</i> , 2017) ; (Ni <i>et al.</i> , 2019) ; (Ulman <i>et al.</i> , 2021) ; (Combita Niño <i>et al.</i> , 2020) ; (Ahmad <i>et al.</i> , 2021) ; (Moscoso-Zea <i>et al.</i> , 2019) ; (Moscoso-Zea <i>et al.</i> , 2018) ; (Ortiz & Hallo, 2019)	14 (24. 1)
Manufacture	(Bouchra <i>et al.</i> , 2019) ; (Yiu <i>et al.</i> , 2021) ; (Zhang <i>et al.</i> , 2021) ; (Niu <i>et al.</i> , 2021) ; (Suša Vugec <i>et al.</i> , 2020) ; (Min <i>et al.</i> , 2021) ; (Wu & Chen, 2020); (Awan <i>et al.</i> , 2021) ; (Mathrani, 2021)	9 (15.5)

In the table you can see that the application of Business Intelligence has been occurring equally in the first 3 business areas mentioned.

As determined by the author Ain *et al.* (2019) In the literature review, it was found that the application of Business Intelligence in the Economy has increased due to the risks involved in decision-making in this sector.

Authors Nyanga *et al.* (2019) concluded that in the future there was going to be a greater implementation of Business Intelligence in various areas.

The authoris Ul-Ain *et al.* (2019), in the review carried outby Aron,determined that the application of Business Intelligence in the

manufacturing area helped to decide on the choice of a certain product to manufacture.

RQ3: What are the Keywords that present co-occurrence in research on Business Intelligence and its influence on Decision Making?

Figure 7 shows the keywords that are co-occurrence in the selected articles and the number of times they appear together. The keywords that present a greater co-occurrence are 'business intelligence' and 'big data' with a total of 9 repetitions.

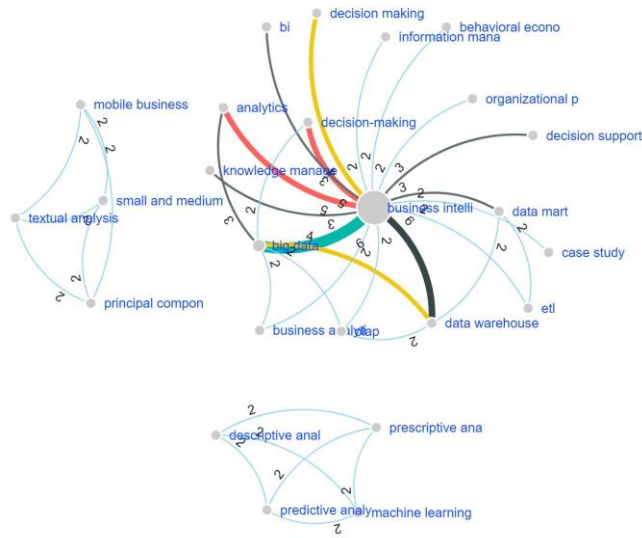


Figure 7. Keywords that present co-occurrence in research

It is observed that the keyword 'business intelligence' is repeated several times in the figure, presenting co-occurrence with other keywords, because it belongs to the main topic of most of the selected articles.

This result is reaffirmed by the study conducted by Salisu *et al.* (2021), who determined in their systematic review of the literature on Business Intelligence, that the keyword that was most presented in the identified co-occurrences was that of 'business intelligence'.

The authoris Boyle *et al.* (2019) determined in his research on Business Intelligence and its influence on decision making, that in the articles he selected the keyword 'business intelligence'

was presented 5 times along with the word 'decision making'.

RQ4: Who are the authors who present co-occurrence in their research on Business Intelligence and its influence on Decision Making?

To answer this research question, the information presented in Figure 8 will be used as support, which shows the authors who present co-occurrence in the preparation of papers on Business Intelligence.

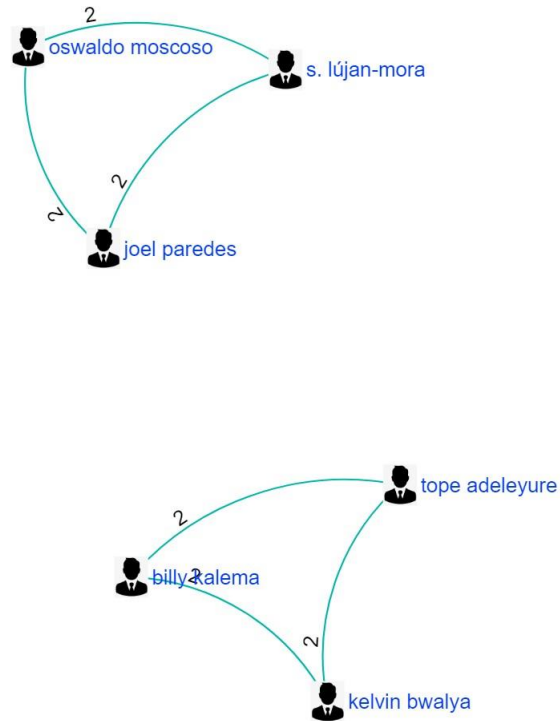


Figure 8. Authors who present co-occurrence in the selected investigations.

The bibliometric network shows 6 groups of co-authors who were identified in the selected studies, and it can be seen that in the case of the authors Billy Kalema and Joel Paredes appear 2 times as co-authors.

According to the analysis carried out in the studies carried out by authors Ain *et al.* (2019), determined that one of the authors who most often appeared as a co-author with other authors was Billy Kalema, coinciding with what was determined in the present study, in addition to other authors, which do not appear in the previous graph.

In other research conducted by the authors is Nyanga *et al.* (2019), Pansiri determined that there were not many cases of co-occurrence of authors due to the variety of research that was emerging on the subject, and the incursion of collaborative groups into new areas.

As also found by Silva *et al.* (2021) in his research, the authors appear Joel Paredes together with Oswaldo Moscoso due to the collaboration presented by the organizations to which they both belong respectively.

RQ5: What are the countries that present co-occurrence in research on Business Intelligence and its influence on Decision Making?

After conducting the literature review, the data to answer this question were obtained, which will be shown in Figure 9, which contains the countries that present co-occurrence in Business Intelligence research and their support in decision making.

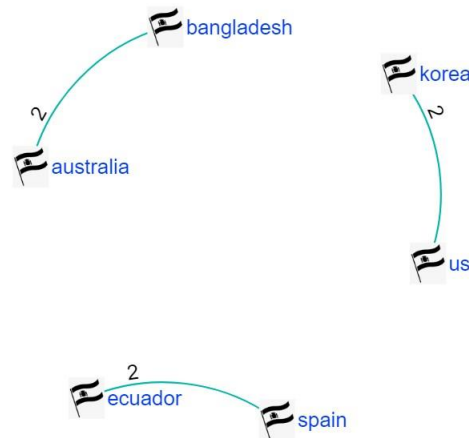


Figure 9. Bibliometric Network by country

The figure shows that 3 pairs of countries that present co-occurrence in research on Business Intelligence or support for Decision Making; of these relations the only country in South America that appears is Ecuador, which participates in the development of some research together with Spain.

According to the results obtained in the literature review by Nyanga *et al.* (2019), the US was identified as one of the countries that most intervenes and presents more participations along with other countries in research related to the subject of Business Intelligence, according to these authors this is attributed to the level of development of this country, and the importance and financing they give to their investigations.

Taking into account the mention by Ain *et al.* (2019) in the systematic review of the literature that he carried out, affirming the low appearance of South American countries in the investigations, we can point out the lack of importance and interest that is given in some countries to the development of research.

In relation to the question posed, authors Ain *et al.* (2019) highlighted the collaboration of the US with Asian countries such as Korea, or also on some occasions identified co-occurrence between the US and China in research on Business Intelligence and its support for the Toma of decisions.

IV. CONCLUSIONS AND FUTURE RESEARCH

In this research, an exhaustive statistical or descriptive and inferential analysis of publications on Business Intelligence as support in the Toma of decisions within organizations was carried out. For this process, data were extracted from 70 articles, which were published from 2017 to 2021. According to the results obtained, it was identified that US was the most productive country in research on the subject raised, about the most used methodologies for the application of Business Intelligence it was determined after the systematic review that the Kimball methodology was the most used within organizations. For future research, consideration should be given to reviewing the most recent research that can consider the advances and evolution of Business Intelligence as a support for decision making within the organization.

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