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Exploring the Challenges and Opportunities of Big Data in SMEs: A Bibliometric Analysis

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BUSINESS
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Department of Strategy, Marketing, Operations, and General Management

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Acknowledgments

To all my professors, for the help and guidance.

To my family, for the support and motivation.

To Manuel, for your patience and encouragement.

To my friends, for always walking beside me.

Thank you.

Resumo

O objetivo desta tese é investigar os desafios e as oportunidades associados à implementação de big data nas pequenas e médias empresas. As principais conclusões deste estudo, baseadas numa análise bibliométrica, que utiliza o Elsevier Scopus como motor de pesquisa e o Vos viewer para analisar os resultados, demonstram que o *big data analytics* permite às PMEs melhorar o desempenho financeiro e a eficiência operacional, tornar-se mais inovadoras e capazes de tomar decisões mais informadas. Capacitando assim as PMEs de alcançar um crescimento estável e ganhar competitividade no mercado. Este estudo resulta da síntese da literatura existente, que fornece informações úteis e recomendações práticas para as PMEs, os decisores políticos e os investigadores. Os resultados ajudam a compreender os fatores decisivos da adoção de big data nas PMEs e prepara o caminho para futuras pesquisas nesta área.

Palavras-chave: Big Data; PMEs; Análise Bibliométrica; Desempenho da Empresa;

Classificação JEL:

L25 - Firm Performance: Size, Diversification, and Scope

O32 - Management of Technological Innovation and R&D

Abstract

The aim of this thesis is to investigate the challenges and opportunities associated with the implementation of big data in small and medium-sized enterprises. The main findings of this study, based on a bibliometric analysis using Elsevier Scopus as a search engine and Vos viewer to analyze the results, demonstrates that big data analytics enables SMEs to improve financial performance and operational efficiency, become more innovative and able to make more informed decisions. Thus, enabling SMEs to achieve stable growth and gain competitiveness in the market. This study results from the synthesis of existing literature, which provides useful information and practical recommendations for SMEs, policy makers and researchers. The results help to understand the decisive factors of big data adoption in SMEs and paves the way for future research in this area.

Keywords: Big Data; SMEs; Bibliometric Analysis; Firm Performance;

Table of Contents

Index of Figures

Index of Tables

x

CHAPTER 1

Introduction

SMEs face unique challenges in leveraging the potential of big data to drive growth and innovation in today's data-driven world. By exploring the challenges and opportunities of big data implementation in SMEs it becomes clear that big data is critical for unlocking their potential, improving competitiveness, and fostering growth in the digital economy. It enables SMEs to make more informed decisions, improve operational efficiency, and compete more effectively. The purpose of this research is to identify the key challenges and opportunities that SMEs face when implementing big data.

SMEs are the largest contributors to gross domestic product, regardless of a state's level of development or standard of living. SMEs generate 60% of GDP in countries such as Japan and China, 65% in the United States, and 52% in the European Union. Furthermore, the degree of employment generated by SMEs in the EU was 67% in 2010, and the global growth of SMEs has had a positive impact by creating new jobs and lowering unemployment. SMEs have a greater impact on employment levels in countries with lower per capita income, approximately 78%, compared to countries with higher income, where the percentage drops to 59%. As a result, SMEs play a critical role in driving economic growth and creating job opportunities. (Robu, 2013)

To effectively use big data, SMEs can pursue a strategic path that includes identifying their current position, meeting their needs, and making a significant directional shift. This entails creating a detailed overview of where they are, how they can meet their needs, and emphasizing a critical directional shift to achieve their goals. By doing so, SMEs can become data-driven organizations that can adapt to changing global market needs over time. This strategic direction will allow SMEs to use big data tools and methods to drive growth, improve performance, and provide better customer service. SMEs can also use big data analytics to investigate risks, opportunities, predictive analysis measures, demand forecasting, optimization, inventory and resource planning, market segmentation, and customer modeling. (Shah , Soriano, & Coutroubis , 2018)

The first chapter of this dissertation introduces the topic and outlines the objectives of the study. It also presents the overall structure of the dissertation and provides a brief overview of the importance of exploring the challenges and opportunities associated with the adoption of big data in small and medium-sized enterprises (SMEs). By exploring this

topic, this dissertation hopes to shed light on the potential benefits and challenges that SMEs face when adopting big data.

The second chapter, focused on methodology, presents the research questions that will guide the investigation. It also describes the methodology used, which consists of a bibliometric analysis. In addition, it explains how relevant articles were selected and establishes the criteria for conducting the research. The research objectives are then presented, followed by the PRISMA methodology.

The third chapter focuses on the bibliometric analysis, specifically the results obtained from Elsevier Scopus and the correlations discovered using the Vos viewer. By examining the available literature, this chapter provides valuable insights into the current state of research on big data adoption in SMEs.

The fourth chapter is devoted to the research discussion and findings. This chapter is organized around the research questions, allowing for a thorough examination of the main points revealed in the reviewed papers. The chapter provides a deeper understanding of the topic and highlights significant findings from this comprehensive review.

Finally, chapter five serves as the dissertation's conclusion, summarizing the key findings of the research. It provides a concise answer to the main research question, while also highlighting the theoretical and practical contributions of the research. In addition, this chapter provides recommendations for future research and identifies potential areas for further investigation. Additionally, it addresses the limitations encountered during the development of the thesis. By acknowledging these limitations, this thesis establishes the boundaries within which the research findings should be interpreted, thereby contributing to a broader understanding of the topic.

CHAPTER 2

Methodology

1.1.   Research Questions:

This study intends to elaborate on the use of big data in Portuguese SMEs, as well as to examine the challenges and benefits associated with doing so. To accomplish this, the research questions will be:

Q1: What does the bibliographic literature reveal about the challenges and opportunities of using big data in SMEs?

Q2: What is big data analytics' impact on firm performance as discussed in the bibliographic literature?

Q3: How can SMEs overcome the challenges and leverage the opportunities of big data to enhance their competitive advantage and achieve sustainable growth?

1.2.   Identification of the research:

This study will follow the bibliometric analysis guidelines as outlined by Professor Doctor Leandro F. Pereira in the Bibliometric State-of-the-Art Research Checklist.

Bibliometric analysis is a popular and rigorous method for exploring and analyzing large volumes of scientific data that has been applied in various fields of business research, allowing it to uncover emerging trends and explore the intellectual structure of a particular area in the existing literature (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021). Ellegaard (2018, p. 187), refers that several methods are used to perform this analysis, including co-author analysis, co-citation analysis, bibliographic coupling schemes, and keyword co-occurrence.

Research by Xiao and Watson (2013) found that there are eight common steps for conducting a systematic literature review,: (i) Formulating the research question (ii) Developing and validating the review protocol (iii) Searching the literature (iv) Screening for inclusion (v) Quality assessment (vi) Data extraction (vii) Data analysis and synthesis (viii) Reporting the results. However, the authors state that this is an iterative process and that changes to the research question or review protocol may be required if unexpected problems arise during the review process.

According to Linnenluecke, Marrone, and Singh (2020), conducting a systematic literature review involves four main steps: (i) identifying relevant literature for inclusion, (ii) cleaning and screening the selected studies for quality and relevance, (iii) analyzing and synthesizing the data from the selected studies, (iv) and presenting the results of the analysis clearly and concisely.

As a result of these two methods, this study will follow the research method shown in Figure 1.

Figure 1. Research Method

Source: Self-elaborated
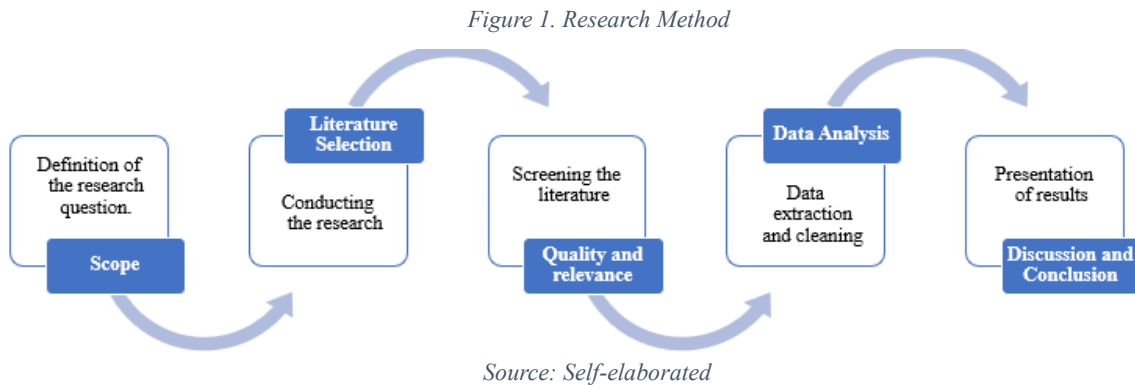
1.3. Articles Selection

The article selection process began with a search in Elsevier Scopus, which allowed a larger sample of documents to be retrieved by applying appropriate filters and keywords. This method helps to identify literature that may be relevant to the research proposal. With the initial screening of articles based on their abstracts, followed by a full-text review, the initial sample begins to decrease.

1.4. Data Criteria

The criteria defined to narrow the search string are as follows:

1) English academic articles, journals, conference papers, conference reviews, and book chapters
2) Published between 2013 and 2023
3) The database used was Elsevier Scopus
4) The research conducted was limited to specific study areas: Business, Management and Accounting, Decision Sciences, and Social Sciences

1.5. Research Objectives

To answer the research questions, research objectives were defined to better outline the research.

Table 1. Research Objectives and Questions

Key Research Question	What is the current state of research on the challenges and opportunities of using big data in SMEs, as reflected in the bibliographic literature?
Research Question	**Research Objective**
Q1: What does the bibliographic literature reveal about the challenges and opportunities of using big data in SMEs?	R.O.1: To identify the main challenges and opportunities associated with using big data in SMEs.
Q2: What is big data analytics' impact on firm performance as discussed in the bibliographic literature?	R.O.2: To assess the impact of big data analytics in financial performance, operational efficiency, innovation, and competitive advantage.
Q3: How can SMEs overcome the challenges and leverage the opportunities of big data to enhance their competitive advantage and achieve sustainable growth?	R.O.3: To identify effective strategies and approaches that SMEs can adopt to overcome the challenges of implementing big data analytics.

Source: Self-elaborated

1.6. Articles Screening

Figure 2. PRISMA Methodology

5
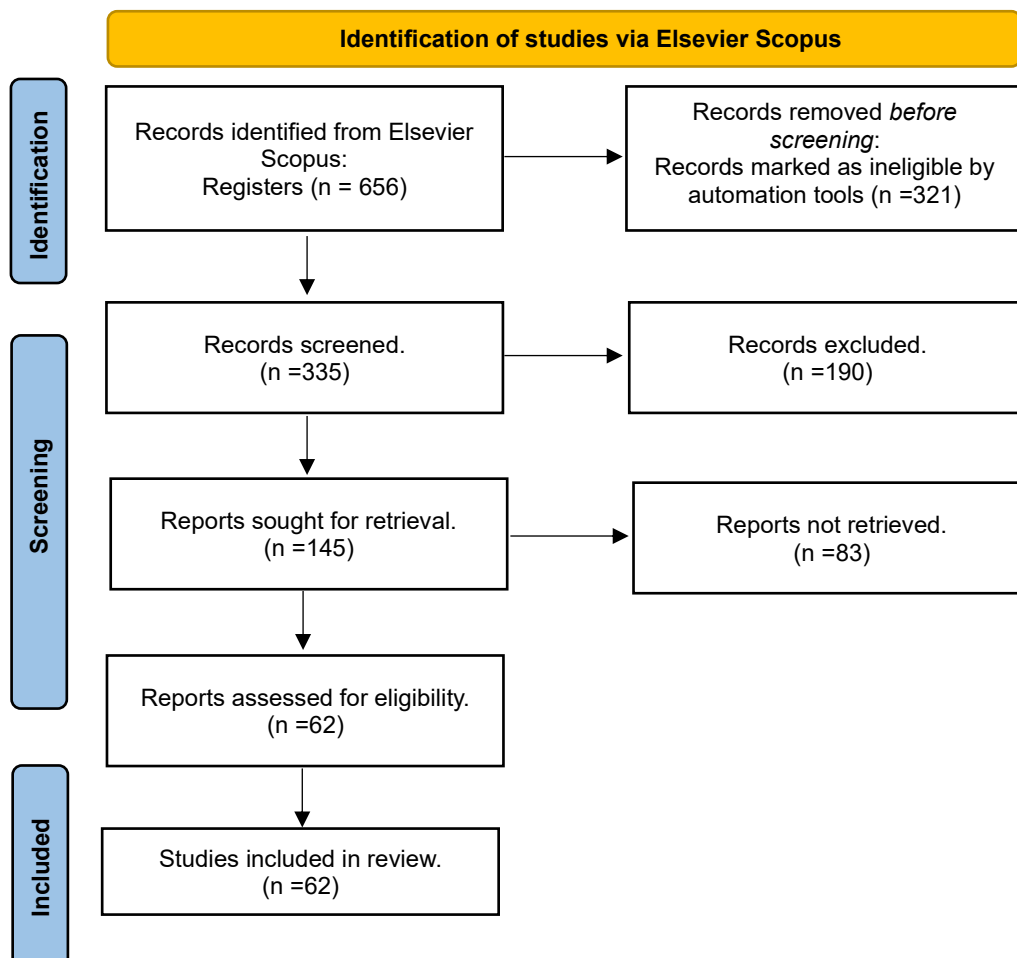
CHAPTER 3

Bibliometric Analysis

This chapter aims to examine the correlation of topics in the literature over the last ten years.

1. Overall Findings

1.1. Elsevier Scopus

Elsevier Scopus[1] was used as the search engine, which is a comprehensive database that provides access to a wide range of scholarly literature. The papers were identified by searching the keywords big data and SMEs.

TITLE-ABS-KEY (big AND data AND in AND smes) AND PUBYEAR > 2012 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA , "DECI") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "cr")) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Portuguese"))

Before applying the filters, a keyword search identified 656 documents. After applying the filters, 335 papers were found.

1.2. Documents by year

Figure 3 represents the total number of publications between 2013 and 2023. The year with the most publications was 2022, while the year with the fewest publications was 2013. The presented results show a clear upward trend over the last ten years, with a decrease in 2023 since the year is not yet over.

1.3. Documents by Subject Area

Figure 4 shows that the search yielded 656 documents, 26.9% of which are in the field of Business, Management, and Accounting, 14.8% in the field of Decision Sciences, and 12.1% in the field of Social Sciences. The Computer Sciences area accounts for 15.3% of the results but was excluded since it contained more technical papers.

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[1] Website can be accessed on www.scopus.com

Figure 3. Documents by Year

Year ↓	Documents ↑
2023	45
2022	57
2021	52
2020	51
2019	37
2018	34
2017	18
2016	24
2015	11
2014	4
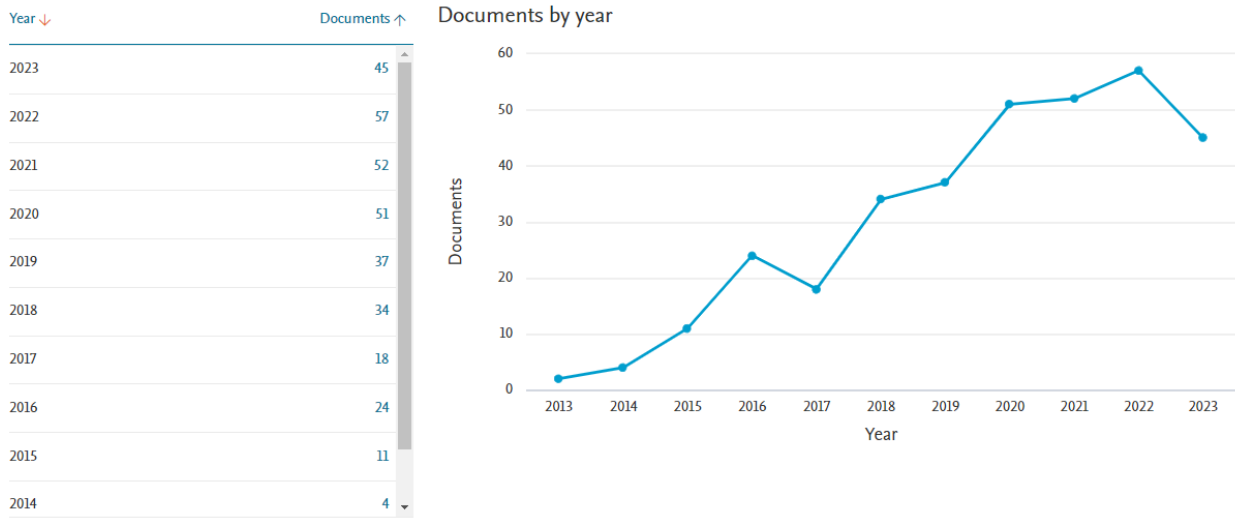
Documents by year

Source: Elsevier Scopus Website

Figure 4. Documents by Subject Area

Subject area ↓	Documents ↓
Business, Management and Accounting	213
Computer Science	121
Decision Sciences	117
Social Sciences	96
Engineering	70
Economics, Econometrics and Finance	64
Environmental Science	31
Energy	26
Mathematics	24
Medicine	9

Documents by subject area
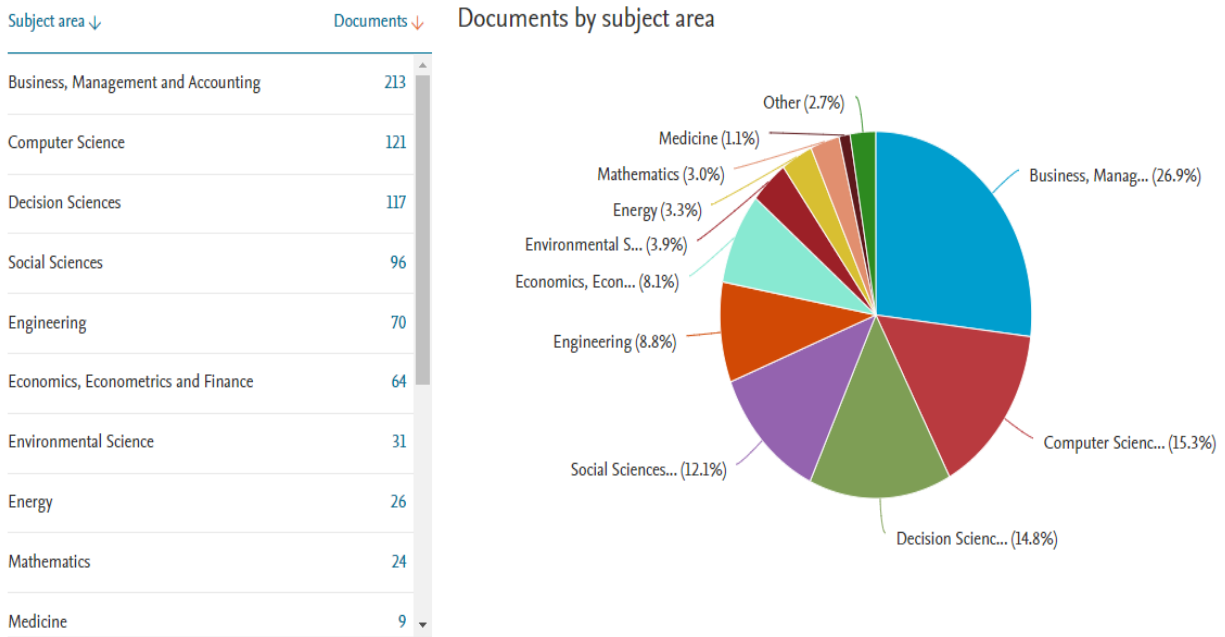
Source: Elsevier Scopus Website

1.4. Documents by Country

The results in Figure 5 shows that the majority of documents returned by the search come from China, the United Kingdom, and Italy. Malaysia comes next with 23 documents, followed by the United States with 20 documents.

Figure 5. Documents by Country

Country/Territory ↑	Documents ↓
■ China	39
■ United Kingdom	35
■ Italy	30
■ Malaysia	23
■ United States	20
■ Spain	19
■ India	18
■ Indonesia	18
■ Germany	15
■ Pakistan	14

Documents by country or territory

Compare the document counts for up to 15 countries/territories.
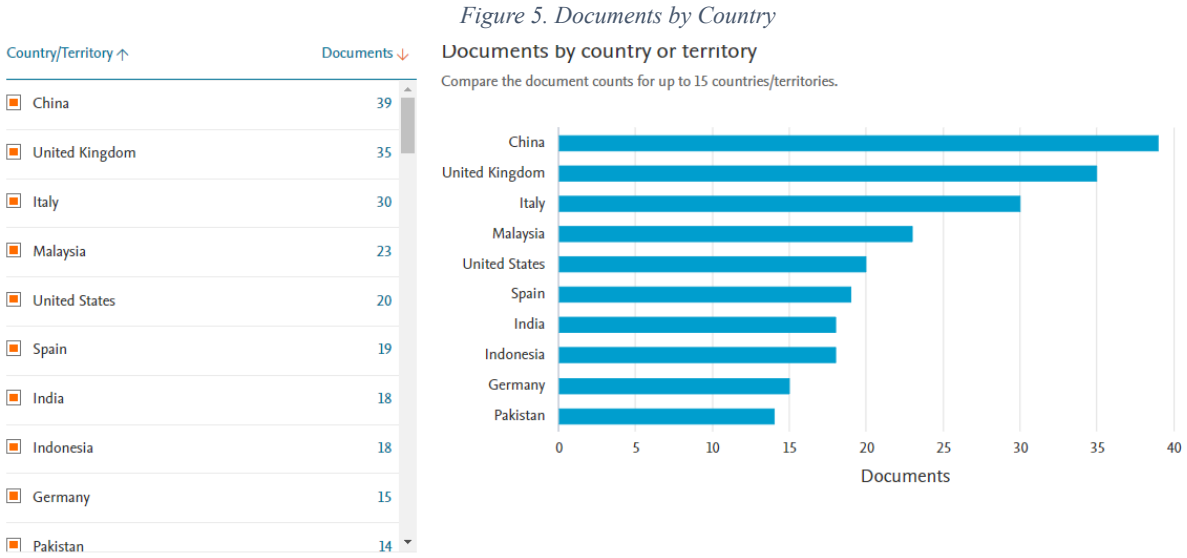
Source: Elsevier Scopus Website

1.5. Documents by Type

As shown in Figure 4, 64.5% of the documents returned by the search are articles, 23.9% are conference papers, 8.7% are book chapters, and 3% are conference reviews.

Figure 6. Documents by Type

Document type ↑	Documents ↓
Article	216
Conference Paper	80
Book Chapter	29
Conference Review	10

Documents by type

- Conference Revi... (3.0%)
- Book Chapter (8.7%)
- Conference Pape... (23.9%)
- Article (64.5%)
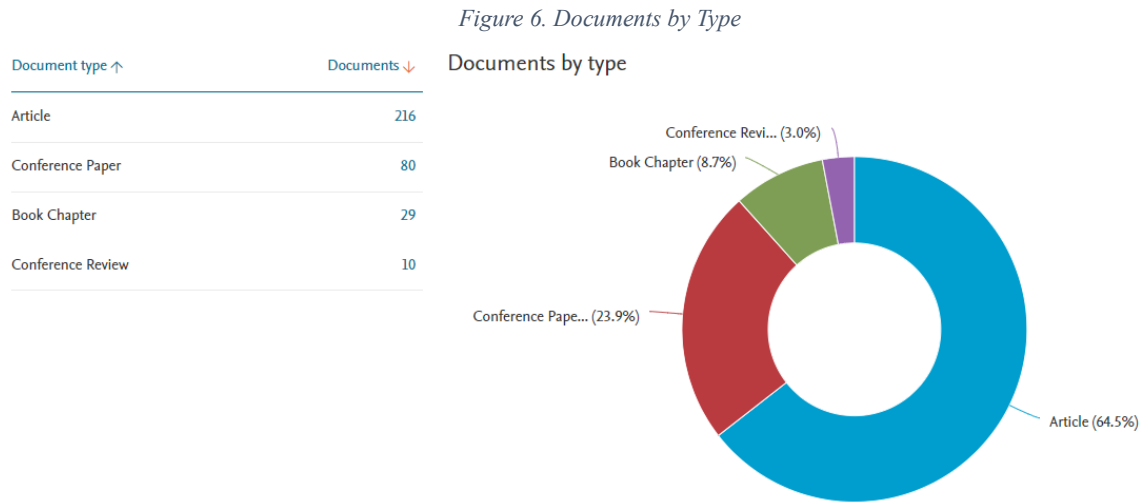
Source: Elsevier Scopus Website

1.6. Keywords Selection

The co-occurrence of keywords was mapped using VOS viewer[2] on the dataset of the 656 documents returned by the Scopus search. This allows for the visualization of the network of the main keywords and provides information about thematic relationships and patterns in a specific research domain by grouping them into clusters. Figure 7 shows that 28 keywords were chosen from a total of 1042.

Figure 7. Keyword Selection
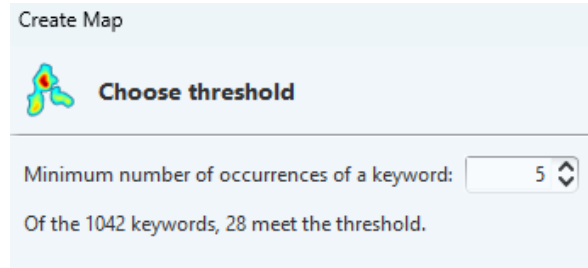
Source: VOS viewer

1.7. Keyword co-occurrence Map

The keyword co-occurrence map in Figure 8 enables the identification of a keyword's frequency of occurrence based on its size. The bigger the word, the more common it is. Furthermore, the distance between two keywords indicates the strength of their co-occurrence relationship (van Eck & Waltman, 2011).

Figure 8. Keyword Co-occurrence Map
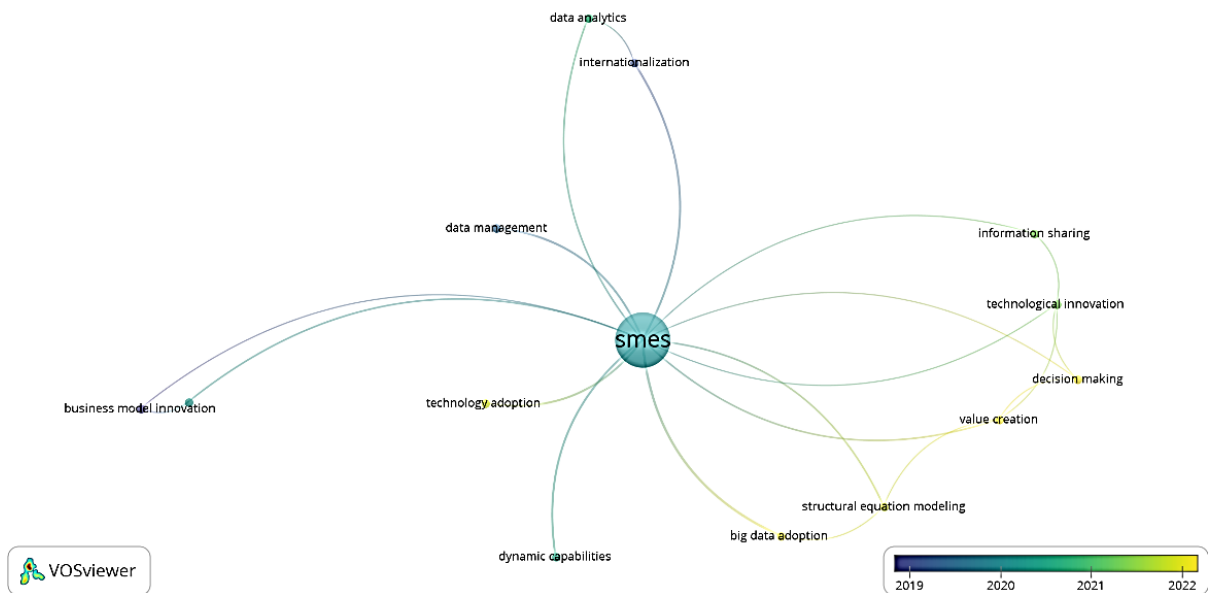
Source: VOS viewer

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[2] VOS viewer can be accessed on https://www.vosviewer.com

As shown in Figure 8, the most frequently used keyword is "SMEs." Furthermore, "data management" and "technology adoption" have the strongest co-occurrence relationship with the main keyword. In other words, the term "SMEs" appears frequently with one of these two terms in the documents under consideration.

As shown in Table 2, VOS viewer returned 5 clusters. The clusters represent a group of keywords that have a strong co-occurrence relationship, meaning they appear frequently in the same documents, whereas keywords from different clusters appear together less frequently.

Table 2. Keywords Clusters

Cluster 1 Knowledge Management	Cluster 2 Data-Driven Innovation	Cluster 3 Analytical Approaches	Cluster 4 Digital Strategy	Cluster 5 Global Market Intelligence
Decision Making; Information Sharing; Technological Innovation; Value Creation;	Data Management; Dynamic Capabilities; SMEs; Technological Adoption;	Big data Adoption; Structural Equation Modeling;	Business Model Innovation; Social Media;	Data Analytics; Internationalization;

Source: Self-elaborated

2. Data Analysis

2.1. Data Cleaning

After reading the titles of the documents and eliminating duplicates, 145 papers remained after a first triage of the 335 documents returned by the search in Elsevier Scopus. Following that, a second screening was performed by reading each abstract to ensure the relevance and quality of the documents and by eliminating the documents that required payment. After the second screening, 62 documents were left, which are listed in Annex A.

2.2. Main Publications Keywords

By analyzing the keywords from the selected articles, as shown in Figure 9, it is now more in line with the research questions and objectives. However, an analysis of a map based on text data was performed to understand the relevance of these keywords (Figure 10). This map illustrates the terms that are more relevant in the papers in Annex A.

The colors in the term map represent the density of terms, with blue representing the lowest density and red representing the highest density. Relevant terms include *big data*

analytics, *SMEs*, and *big data adoption*, with the one with the lowest density being *knowledge*. Furthermore, some terms, such as *'factors'* or *'term'* were excluded since they were included due to their prominent presence in article titles.

Figure 9. Keywords Articles Selected
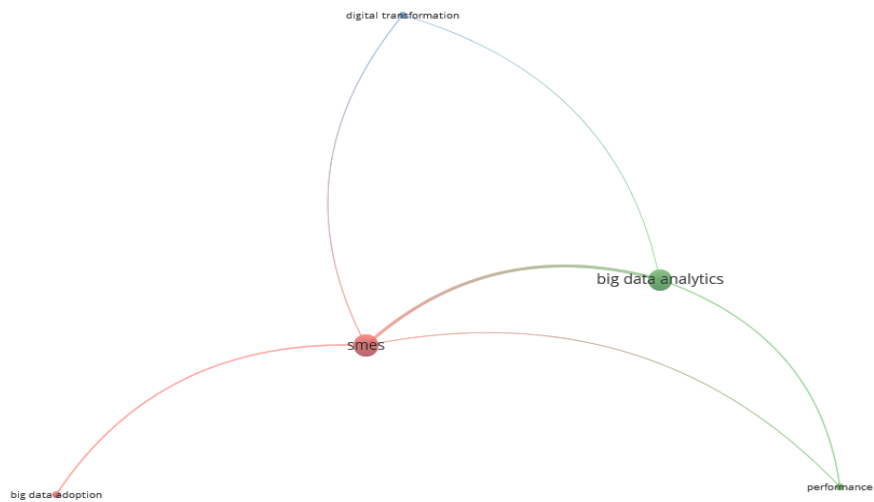
Source: VOS viewer

Figure 10. Term Map
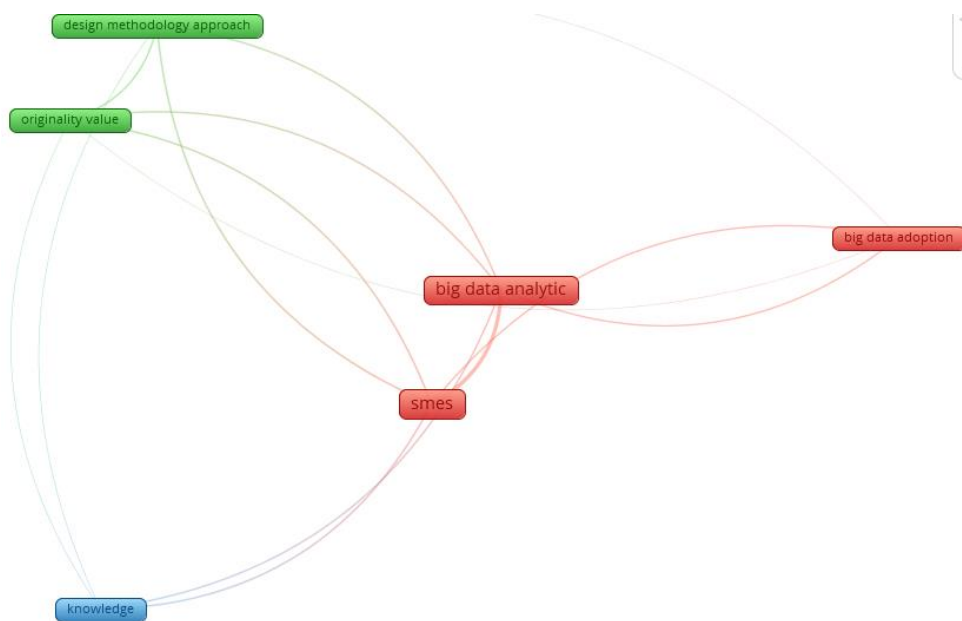
Source: VOS viewer

VOS viewer returned 3 clusters in the term map, which are listed in Table 3 below. These 3 clusters represent the dimensions of the bibliographic network.

Technology	Innovation	Knowledge
Big data adoption; Big data Analytic; SMEs;	Design Methodology Approach; Original Value;	Knowledge

Source: Self-elaborated

To answer the first research question, it is necessary to understand what factors influence "big data adoption" among "SMEs" so that they can leverage their performance with "big data analytics". (Figure 11)

Figure 11. Technology Cluster
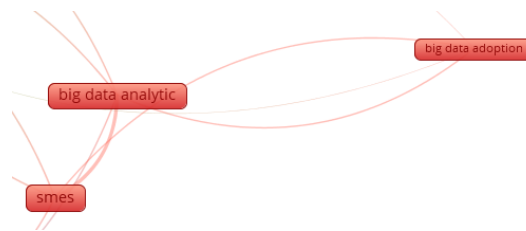
Source: VOS viewer

Subsequently, the "design methodology approach" and "originality value" are essential to answering the second research question by providing information on the impact of big data on firm performance.

Figure 12. Innovation Cluster

Source: VOS viewer

Finally, to overcome the challenges and leverage the opportunities of Big data to enhance their competitive advantage and achieve sustainable growth, it is necessary to gain "knowledge" of what has been done in other SMEs that have successfully adopted big data.

Figure 13. Knowledge Cluster

Source: VOS viewer

CHAPTER 4

Discussion and Findings

The purpose of this chapter is to conduct a literature review to answer the research questions.

1. What does the bibliographic literature reveal about the challenges and opportunities of using Big data in SMEs?

1.1. Main Challenges

According to Ciasullo, Montera, and Douglas (2022), the main challenges for SMEs in adopting big data are the high investments required for the deployment of a data policy, a lack of expertise and skills in data analytics, and the difficulty in integrating big data into existing organizational processes. Furthermore, Chuah and Thurusamry (2022) mention infrastructure as one of the major challenges. As a result, SMEs frequently lack the necessary server equipment, high-performance processors, or middleware to handle big data efficiently, making it difficult for them to interpret data quickly enough to gain a competitive advantage.

Willets, Atkins, and Stanier (2020) identified six types of barriers to SMEs adopting big data (Figure 14), which are as follows: (i) Data barriers, which refer to issues with the data itself, such as data quality, complexity, and so on; (ii) Knowledge and skill barriers, which refer to the fact that, because big data is still relatively new, many SMEs will lack the necessary skill sets. (iii) Regulatory barriers, which include legal, ethical, and data privacy concerns. (iv) Technical barriers related to infrastructure requirements. (v) Organizational barriers, which are associated with organizational structure, culture, management, and a lack of strategy. (vi) Finally, financial constraints are related to resource barriers.

In a study led by Truong (2022), the author identified challenges related to perceived benefits, compatibility, data quality, security and privacy concerns, organizational readiness, lack of financial and human resources, physical infrastructure, and flat leadership styles. Furthermore, the author emphasizes the importance of company leaders encouraging big data adoption by clearly explaining the benefits of big data adoption to employees who are unaware of them.

Karim, Al-Tawara, Gide, and Sandu (2017) identify five types of barriers to big data adoption among SMEs: There are strategy barriers, technology barriers, policy barriers, organizational barriers, and legal barriers. The distinction between policy barriers and legal barriers is that policy barriers concern company policies, whereas legal barriers concern external regulations and policies.

Figure 14. Thematic map of barriers to Big data analytics adoption

Data
- Availability of data
- Complexity of data
- Data lifecycle management
- Data presentation
- Data redundancies
- Data scalability
- Data silos
- Do not have large volumes of data
- Lack of data management processes
- Lack of techniques and procedures
- Limited collection and/or storage of data
- Poor data quality
- The highly context-dependent nature of big data analytics
- The lack of common standards
- The objectivity and accuracy of big data resource

Knowledge and Skills
- Behavioural issues - unintentional misuse
- Bottlenecks in the labour market
- Dominance of domain specialists
- Inability to assess and address digital risks
- Inexpert staff
- Lack of business cases
- Lack of specialists
- Lack of understanding
- Low level of entrepreneurial skills and talent
- Missing know-how
- Shortage of in-house data analytic expertise
- Shortage of useful and affordable consulting and business analytics services

Regulatory
- Complex regulatory environment in the domain of personal data
- Concerns on data protection and data privacy/poor data privacy
- Ethical concerns in data use
- Legal issues
- Regulatory framework

Resources
- Financial barriers
- High costs
- Insufficient resources
- Investment and maintenance costs
- Lack of cost-benefit analysis
- Lack of time for implementation

Technical
- Access to required internet data - cloud based BDA
- Concerns on data security
- Data security and confidentiality
- Energy management
- Hardships in designing analytic systems
- Infrastructure readiness
- Lack of current database software in analytics
- Lack of intuitive software
- Lack of SME-tailored solutions
- Non-transparent software market
- Overwhelming bandwidth connection

Organisational
- Businesses with a defender or reactor orientation
- Creating leadership teams that set clear goals, define what success looks like and ask the right questions
- Cultural barriers and intrinsic conservatism
- Different venture concept
- Effective decision-making through a flexible organisational structure
- Interdisciplinary cooperation
- Issues with change management
- Lack of business concept and organizational structure
- Lack of clear goal
- Lack of digital entrepreneurial culture in Europe
- Lack of management and organisational models
- Lack of managerial awareness and skills
- Lack of top management support
- Limited network engagement
- Management of technology
- No strategy for developing IT systems
- Passive to major clients
- Sustaining a company culture that underpins the data-driven organisation
- Talent management of the big data professionals
- Top-down engagement internally

Barriers to adopting Big Data and Big Data Analytics

Source: Willets, Atkins & Stanier, 2020

Overall, these articles show six major barriers to big data adoption in SMEs, identified in the table below.

Table 4. Main barriers to big data adoption in SMEs

Data	Infrastructure	Financial	Legal	Organizational	Lack of knowledge or Skills
Data quality; Data availability; Data complexity; Data compatibility; Strategy towards big data;	Infrastructure requirements; Integrating big data in the existing processes; Lack of high-performance processors or middleware to handle big data efficiently;	High Costs; Insufficient resources; Financial barriers; Low resources;	Privacy policies; Ethical policies; Regulatory framework;	Company's culture; Flat leadership; Cultural barriers; Perceived benefits; Organizational readiness;	Lack of skills; Lack of in-house knowledge; Behavioural issues; Lack of affordable consulting services;

Source: Self-elaborated

1.2. Main opportunities

SMEs can benefit from big data analytics to improve decision-making because it provides insights into customer behavior, market trends, and operational performance, allowing them to make more informed decisions. Furthermore, it improves efficiency by automating and optimizing workflows. It provides better customer insights, which can inform product development and marketing strategies about the needs and preferences of their customers. SMEs can improve their competitiveness by identifying new opportunities and responding to market changes more quickly by leveraging big data analytics. It also assists SMEs in identifying and mitigating potential risks such as fraud and cyber threats. Finally, big data analytics can help with cost savings by optimizing operations and reducing waste. However, specific advantages may differ depending on the industry (Lutfi, et al., 2022).

Coleman et al. (2016) refer that the main benefits are gaining insights into customer behavior; improving operational efficiency; identifying new business opportunities; enhancing decision-making capabilities; improving product and service quality; increasing competitiveness; enabling personalized marketing and customer experiences; and facilitating predictive maintenance. According to Del Vecchio, Di Minin, Petruzzelli, Panniello, & Pirri (2018), the phenomenon of the Internet of Things has created opportunities for SMEs to collect and use open big data to start new businesses or improve existing ones.

All the benefits can be divided into the categories in the table below. These are benefits that cut across several industries, not specific ones.

Table 5. Main benefits of adopting big data among SMEs

Customer Insights	Market Insights	Operational Efficiency	Product/ Service Innovation	Competitive Advantages
Better customer insights; Personalized marketing; Personalized customer experiences;	Insights on market trends; Identification of new business opportunities; Improve market position	Operational performance; Automation of processes; Optimization of workflows; Faster adaptation to market changes; Risks mitigation; Cost saving	Product improvements; Higher quality service; Predictive maintenance; Develop new products/services; Innovative value propositions	Improved competitiveness; Start new businesses or improve existing ones

Source: Self-elaborated

2. What is Big data analytics' impact on firm performance as discussed in the bibliographic literature?

2.1. Financial Performance

More data-driven companies perform better financially. Firstly, in terms of customer acquisition, it allows organizations to effectively target their marketing efforts by understanding customer preferences, needs, and purchasing patterns. This targeted approach lowers customer acquisition costs, improving financial performance. Second, it helps in revenue generation. Organizations can identify new revenue opportunities and optimize their pricing strategies by analyzing large data sets. Furthermore, customized offerings based on customer preference, result in increased revenue generation for the company. Finally, identifying operational inefficiencies and streamlining processes enables cost optimization. Organizations can identify areas for cost savings by analyzing large amounts of data, which leads to improved financial performance (Ferraris, Mazzoleni, Devalle, & Couturier, 2018).

2.2. Operational Efficiency

According to Lacam (2020), organizations that incorporate big data into their innovation processes are more likely to outperform their competitors in terms of operational efficiency:

Firstly, SMEs can improve operational performance by identifying inefficiencies, optimizing processes, and making data-driven decisions by analyzing large amounts of data. It initially enables process optimization by assisting in the identification of bottlenecks, inefficiencies, and areas for improvement in their operational processes.

Second, big data analytics can assist businesses in implementing predictive maintenance strategies. Organizations can identify patterns and indicators of potential equipment failures or maintenance needs by analyzing data from sensors and monitoring equipment. This enables proactive maintenance interventions, reducing downtime and optimizing resource utilization.

Thirdly, it enhances inventory management by providing real-time visibility into inventory levels, demand patterns, and supply chain dynamics. Organizations can optimize their inventory management processes by analyzing this data, ensuring that they have the right amount of stock at the right time. This reduces inventory holding costs, decreases stockouts, and improves overall supply chain efficiency.

Furthermore, big data analytics can assist organizations in optimizing the allocation of resources such as manpower, equipment, and materials. Organizations can identify areas of over or underutilization and make data-driven decisions to allocate resources more effectively by analyzing data on resource utilization. This results in higher productivity, lower costs, and better overall resource management.

Finally, big data analytics can help businesses improve their quality control processes. Organizations can identify patterns and trends in product quality by analyzing data from various sources, such as production lines, customer feedback, or warranty claims. This allows them to be proactive in addressing quality issues, reducing defects, and increasing customer satisfaction.

2.3. Innovation

According to Chen, Li, and Jingwen (2022), big data plays a significant role in improving firm performance in terms of innovation by enabling the development of data-driven dynamic capabilities. The ability to collect, analyze, and interpret substantial amounts of data to gain insights and make informed decisions is one of these dynamic capabilities. Firms can identify patterns, trends, and customer preferences by leveraging big data analytics, which can lead to the development of innovative products, services, and business models. Big data also makes it easier to identify new market opportunities and improve existing processes and operations. This, in turn, improves a company's ability to innovate and compete in the market. The study also emphasizes the significance of incorporating data-driven specific content into the connotation and dimensions of dynamic capabilities. This means that firms must incorporate big data into their

innovation processes and strategies to fully realize their potential for driving firm performance and innovation.

Additionally, (2018) Del Vecchio, Di Minin, Petruzzelli, Panniello, & Pirri claim that big data analysis can lead to innovation in a variety of areas, including products and business models. Firms can gain valuable insights and identify patterns, trends, and customer preferences that can drive innovation by leveraging big data. This may result in the creation of new and improved products, services, and processes. Furthermore, big data can help companies develop and implement open innovation strategies, making them more competitive and opening new entrepreneurial opportunities. However, while there is evidence of big data analysis's potential role in driving innovation, more research is needed to fully understand the outcomes and benefits it can bring to firms in terms of innovation, efficiency, productivity, quality, and customer satisfaction.

2.4. Competitive Advantage.

According to Wided (2023), big data plays a critical role in creating and sustaining competitive advantage due to its ability to provide market insights, improve resilience, and improve information flow. The author mentions that many scholars agree that big data is a major source of competitive advantage and performance. Big data supports opportunities to fit customer needs and maintain a competitive advantage by managing and collecting determinant and efficient market-related information. Furthermore, the process of adopting big data analytics provides resilience and has become more determinant because it is the best alternative to traditional information systems, which, due to their rigid structure, can limit resilience. This adaptability enables SMEs to respond to changing market conditions. Furthermore, significant investment in IT capabilities contributes to the firm's competitive advantage's sustainability by improving information and knowledge flow within and between organizations.

Big data can have an impact on competitive advantage in a variety of ways. It has the potential to unlock critical data and make information more transparent, allowing businesses to gain insights and make more informed decisions. Big data also enables businesses to create and store transactional data in digital form, which can then be analyzed to improve performance and more precisely tailor products or services. Furthermore, advanced big data analytics can improve decision-making, reduce risks, and reveal valuable knowledge that would otherwise be hidden. Organizations can gain a

competitive advantage by leveraging big data to develop and optimize products and services. (Iqbal, et al., 2018)

Finally, the adoption of big data analytics improves firm performance, especially in terms of competitive advantage. Big data analytics enables SMEs to extract valuable insights from massive amounts of data, which can then be used to make informed decisions, identify market trends, and devise novel strategies. This can lead to increased market share, faster entry into new markets, faster introduction of new products or services, and higher success rates for new offerings. (Maroufkhani, Wan Ismail, & Ghobakhloo, 2020)

3. How can SMEs overcome the challenges and leverage the opportunities of Big data to enhance their competitive advantage and achieve sustainable growth?

In a study conducted by Araque-González, Suárez-Hernández, Gómez-Vásquez, Vélez-Uribe, & Bernal-Avellaneda (2022) in SMEs in the textile industry, the authors discovered that the proper placement and data structure of big data technology in the textile industry can allow SMEs to consolidate data and present comprehensive reports, facilitating interpretation and adaptability to internal and external processes. Furthermore, the authors recommend that SMEs focus on the planning, design, and structuring of an industrial model specifically tailored to big data to make structured and automated decisions. SMEs can improve their competitive advantage and achieve sustainable growth by implementing big data-driven production strategies, defining a production model and operational system, and utilizing data science and industrial analysis.

SMEs must align their business strategies with their big data analytics capabilities. This entails incorporating big data analytics into a variety of aspects of their operations, including marketing, supply chain management, and customer relationship management. SMEs can effectively use data-driven insights to drive innovation, improve operational efficiency, and deliver superior value to customers by aligning their strategies with big data analytics. Furthermore, by forming collaborative networks with other organizations such as industry associations, research institutions, and technology providers, SMEs can overcome resource constraints. These networks can provide access to expertise, resources, and data-sharing opportunities, allowing SMEs to leverage big data analytics and gain a competitive advantage more effectively. Finally, to keep up with the latest

advancements in big data analytics, SMEs should cultivate a culture of continuous learning and adaptation. This includes investing in employee training and development programs, staying up to date on industry trends, and actively seeking opportunities to improve data analytics capabilities. SMEs can stay ahead of the competition and capitalize on the potential of big data for long-term growth by constantly learning and adapting (Asad, Asif, Khan, Allam, & Satar, 2022).

Mattera (2018) led a study on the transformation of SMEs through the use and understanding of big data, with a focus on the Spanish restaurant industry. According to the author, SMEs can overcome the challenges of investing in complex data management systems by expanding their knowledge of free or low-cost tools and improving their skill set. This allows them to benefit from the information that big data can provide to help their business grow. SMEs can use big data to obtain the majority of the data they require, as well as analyze how virtual word of mouth spreads, find new partners in a simpler and faster manner to expand their business-to-business operations, find synergies, reduce costs, create joint-service offerings, and implement other strategies. This has the potential to transform the business models of SMEs in the Spanish restaurant industry and increase their competitive advantage, resulting in long-term growth. Furthermore, the authors argue that SMEs can become more multidisciplinary and contribute to the business's long-term growth by facilitating its adaptation to the digital economy. This can be accomplished by collaborating with national governments or regional/local institutions that can provide an accurate assessment of the local workforce's skill set and training needs, as well as by taking advantage of initiatives such as Google Activate, which offers free courses for individuals who want to expand their knowledge in big data and new technology areas.

According to Nguyen, Liaw, and Duong (2022) several strategies can help SMEs overcome challenges and capitalize on big data opportunities to improve their competitive advantage and achieve long-term growth:

1. Enhancing Governance Readiness: SMEs should improve their decision-making processes based on the results of data analysis. Top management must understand the benefits of big data and be ready to implement it. To motivate SMEs, suppliers can provide information about the benefits of big data analytics as well as evidence of successful applications. The government can improve big

data analytics training programs for SME managers and guide them in preparing the necessary factors for big data adoption.

2. IT Resource Cost Reduction: SMEs can use cloud computing technology in big data analysis to cut IT resource costs. This can be accomplished by employing costly big data analytics software and training staff in big data analysis through collaboration with universities and research institutions.

3. Developing a Clear Strategy: SMEs can use the study's findings to develop a clear strategy and be better prepared to implement big data in their business. This includes addressing areas in which they are not yet prepared and identifying appropriate support options for their businesses. To meet the needs of SMEs, service vendors can offer a variety of support options at varying prices.

4. Government Support: SMEs require more government assistance in securing the regulatory environment and obtaining loans to invest in big data analytics adoption. Policymakers can use the study's findings to create better policies that support the future implementation of big data in SMEs.

SMEs can overcome challenges, harness the power of big data, and gain a competitive advantage in the market while achieving sustainable growth by implementing these strategies.

The strategies most frequently described in the studies presented are listed in the following table.

Table 6. Strategies to successfully adopt Big data in SMEs

Establish a comprehensive data management system	SMEs should prioritize data consolidation from multiple sources and implement strong data management practices. This includes structured data collection, storage, and organization in order to facilitate comprehensive reporting and analysis.
Develop a model tailored to Big data	SMEs must focus on planning, designing, and implementing an industrial model that incorporates big data technology. This model should enable structured and automated decision-making based on data insights, allowing SMEs to effectively adapt to internal and external processes.
Align business strategies with big data analytics	SMEs should align their business strategies with big data analytics capabilities. This entails incorporating big data analytics into different aspects of their operations, such as marketing, supply chain management, and customer relationship management, in order to drive innovation and improve operational efficiency.
Foster collaboration and networking	Collaborations with other organizations, such as industry associations, research institutions, and technology providers, should be actively sought by SMEs. These collaborative networks provide SMEs with access to expertise, resources, and data-sharing opportunities, allowing them to overcome resource constraints and effectively leverage big data analytics.
Cultivate a culture of continuous learning and adaptation	To keep up with the latest advancements in big data analytics, SMEs should foster a culture of continuous learning and adaptation. Investing in employee training and development programs, staying current on industry trends, and actively seeking opportunities to improve data analytics capabilities are all examples of this.

Source: Self-elaborate

CHAPTER 5

Conclusion

This chapter aims to provide key conclusions derived from the study by taking into account the data retrieved from the bibliometric analysis conducted in this study, as well as the corresponding discussions and findings presented. Finally, the limitations of this study will be presented.

The study reveals several significant findings about the challenges and opportunities of using big data in SMEs. To begin, it is clear that SMEs face significant challenges when it comes to adopting and leveraging big data. These challenges include high investment costs for implementing a data policy, a lack of data analytics expertise and skills, difficulties integrating big data into existing organizational processes, and infrastructure limitations. These difficulties highlight the need for targeted assistance and resources to help SMEs overcome these obstacles.

Despite these obstacles, the analysis emphasizes the potential benefits that SMEs can derive from effectively utilizing big data. By leveraging the insights and competitive advantages provided by big data, SMEs can improve their financial performance and operational efficiency. Furthermore, Big data can boost SMEs' innovation potential and provide them with a competitive advantage in the market. These findings highlight the importance of SMEs embracing big data as a strategic asset in today's data-driven business landscape to drive growth, sustainability, and success.

This analysis' theoretical contribution is to provide a comprehensive overview of the challenges and opportunities associated with big data adoption in SMEs. This analysis provides valuable insights into the specific challenges faced by SMEs and the potential benefits they can achieve by synthesizing existing research. Furthermore, this study makes a significant practical contribution. This analysis adds to the existing literature and advises SMEs, policymakers, and researchers on how to navigate the challenges of effectively adopting and utilizing big data. The insights gained from this analysis can be used by SMEs to develop strategies for overcoming the barriers to big data adoption, such as high investment costs and a lack of expertise. Policymakers can use these findings to create targeted support programs and policies that facilitate the integration of big data in SMEs. Researchers can build on these findings to further investigate the potential of

emerging technologies and develop practical solutions tailored to the specific needs of SMEs.

In the future, research should focus on developing practical solutions and tools that are tailored to the unique needs and constraints of SMEs. User-friendly data analytics software, training programs for SME staff, and collaborations with data analytics experts are all possibilities. Furthermore, the potential of emerging technologies such as artificial intelligence and blockchain in enhancing SMEs' use of big data should be investigated further.

Overall, the study emphasizes the importance of SMEs continuing to research and invest in big data. It emphasizes the importance of collaboration between academia, industry, and policymakers to create an enabling environment for SMEs to effectively leverage big data. SMEs can improve their competitiveness, achieve sustainable growth, and contribute to economic development by addressing the challenges and capitalizing on the opportunities presented by big data.

This final section discusses the current study's limitations in relation to the problem statement and research objectives. It identifies the limitations that influenced the research findings.

The sample size is one of the study's limitations. The sample size may not have been large enough to capture the full complexity or diversity of the population under study. Despite the fact that the initial research yielded 656 documents, only 62 were deemed suitable for the sample. A larger sample size would have provided a more comprehensive representation and improved the findings' generalizability. To improve the robustness of the results, future studies should consider increasing the sample size.

Another constraint is the availability of data. The study relied on data collected from only one research engine, and while it is a reliable source among the scientific research community, it may be worthwhile to investigate other sources because this may have been limited in terms of completeness or accuracy.

Another significant limitation is the scarcity of prior research studies on the subject. The existing literature on big data adoption in SMEs in Europe and/or the United States is limited in terms of established knowledge and frameworks.

While the aforementioned constraints are critical, it is important to recognize that additional constraints may have influenced the study's results. These could include factors like language barriers or a lack of resources. Furthermore, because SMEs differ significantly by industry, the challenges and opportunities in big data adoption will differ as well.

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Annexes

Authors	Title	Year	Cited by	Document Type
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Coleman S.; Göb R.; Manco G.; Pievatolo A.; Tort-Martorell X.; Reis M.S.	How Can SMEs Benefit from Big data? Challenges and a Path Forward	2016	116	Article
Del Vecchio P.; Di Minin A.; Petruzzelli A.M.; Panniello U.; Pirri S.	Big data for open innovation in SMEs and large corporations: Trends, opportunities, and challenges	2018	110	Article
Dong J.Q.; Yang C.-H.	Business value of big data analytics: A systems-theoretic approach and empirical test	2020	84	Article
Liu Y.; Soroka A.; Han L.; Jian J.; Tang M.	Cloud-based big data analytics for customer insight-driven design innovation in SMEs	2020	71	Article
Lutfi A.; Alsyouf A.; Almaiah M.A.; Alrawad M.; Abdo A.A.K.; Al-Khasawneh A.L.; Ibrahim N.; Saad M.	Factors Influencing the Adoption of Big data Analytics in the Digital Transformation Era: Case Study of Jordanian SMEs	2022	54	Article
Yadegaridehkordi E.; Nilashi M.; Shuib L.; Hairul Nizam Bin Md Nasir M.; Asadi S.; Samad S.; Fatimah Awang N.	The impact of big data on firm performance in hotel industry	2020	50	Article
Maroufkhani P.; Wan Ismail W.K.; Ghobakhloo M.	Big data analytics adoption model for small and medium enterprises	2020	47	Article
Ricci R.; Battaglia D.; Neirotti P.	External knowledge search, opportunity recognition and industry 4.0 adoption in SMEs	2021	35	Article
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Iqbal M.; Kazmi S.H.A.; Manzoor A.; Soomrani A.R.; Butt S.H.; Shaikh K.A.	A study of big data for business growth in SMEs: Opportunities & challenges	2018	31	Conference paper
Soni G.; Kumar S.; Mahto R.V.; Mangla S.K.; Mittal M.L.; Lim W.M.	A decision-making framework for Industry 4.0 technology implementation: The case of FinTech and sustainable supply chain finance for SMEs	2022	31	Article
Saleem H.; Li Y.; Ali Z.; Mehreen A.; Mansoor M.S.	An empirical investigation on how big data analytics influence China SMEs performance: do product and process innovation matter?	2020	30	Article

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