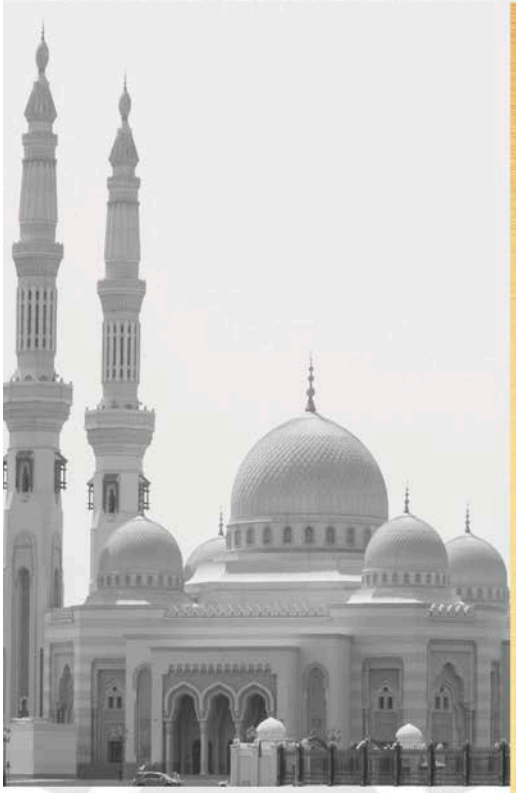
AL QASIMIA UNIVERSITY JOURNAL OF ISLAMIC ECONOMICS



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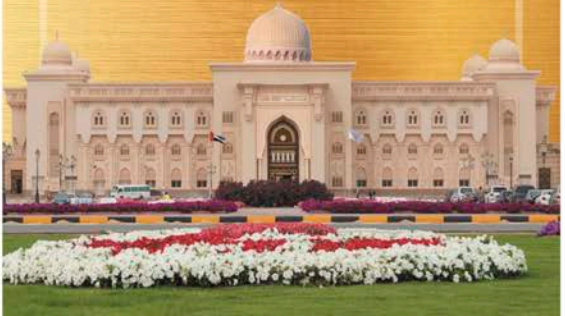

Vol.6, No. 1
Dhu al-Hijjah 1447 A.H. / June 2026 A.D.
ISSN: 2788-5542

AQU Journal of Islamic Economics, Vol. 6 No. 1, pp. 27-56 (Jun. 2026)
DOI:10.52747/aqujie.6.1.526
E-ISSN 2788-5550 / ISSN 2788-5542

رسم خريطة الترابط: مراجعة ببليومترية لأهداف التنمية المستدامة في أبحاث التمويل

MAPPING THE NEXUS: A BIBLIOMETRIC REVIEW OF SUSTAINABLE DEVELOPMENT GOALS IN FINANCE RESEARCH[1]

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[1] Article received: Feb. 2026; article accepted: Apr. 2026

الملخص

أدى تزايد متطلبات المساءلة المؤسسية وتوقعات المساهمين والضغوط التنظيمية المحيطة بعوامل البيئة والاستدامة والحوكمة (ESG) إلى خلق حاجة ملحة لفهم المشهد البحثي المتطور في هذا المجال. تتناول هذه الدراسة المسارات الراهنة والتوجهات المستقبلية لأهداف التنمية المستدامة (SDGs) في دعم التمويل المستدام (SF). يُستخدم في الدراسة نهج ببليومتري لتحديد أنماط البحث الرئيسية، والمحاور الكبرى، والمؤشرات المهمة المتعلقة بأهداف التنمية المستدامة والتمويل المستدام. استناداً إلى 1,693 وثيقة منشورة في مجلات مفهرسة في قاعدة بيانات سكوبس خلال فترة جائحة كوفيد-19 من 2020 إلى 2023، أُجري التحليل باستخدام برنامجي Biblioshiny وRStudio، متضمناً شبكات الاستشهاد المشترك، وخرائط تكرار الكلمات المفتاحية، والخرائط الموضوعية، والإحصاءات الوصفية لتحديد المؤلفين المنتجين، والمصادر المؤثرة، والدول الأكثر استشهاداً. تكشف النتائج عن ركيزتين محوريتين في تقييم فعالية الحوكمة البيئية والاجتماعية والمؤسسية، هما: تحقيق أهداف التنمية المستدامة واستقرار التمويل المستدام، إذ يكشف الرسم الموضوعي عن المحاور البحثية الأساسية والمحركة والمتخصصة والمتراجعة التي ترسم خارطة طريق واضحة للتوجهات البحثية المستقبلية. الجدير بالذكر أن حقبة كوفيد-19 ساهمت في تعزيز الوعي العالمي بالاستعداد واليقظة تجاه التهديدات المستقبلية، مما يعزز إلحاحية تقوية أطر الحوكمة البيئية والاجتماعية والمؤسسية في سبيل تحقيق أهداف التنمية المستدامة المدعومة بآليات تمويل مستدام راسخة. يقدم البحث إطاراً شمولياً قائماً على الأدلة يُسهم في خدمة الجهات التنظيمية والمستثمرين والباحثين الناشئين، وذلك من خلال رسم مسار التقدم بصورة فريدة من تطلعات أهداف التنمية المستدامة نحو تحقيق التمويل المستدام، وذلك بالاعتماد حصرياً على منشورات المجلات العلمية المحكمة عالية التصنيف، ومُقدماً بذلك إسهاماً فاعلاً في الأدبيات الحالية حول التنمية المستدامة وأبحاث الحوكمة البيئية والاجتماعية والمؤسسية.

Abstract

Growing corporate accountability demands, shareholder expectations, and regulatory pressures surrounding Environmental, Sustainability and Governance (ESG) factors have created an urgent need to understand the evolving research landscape in this domain. This study examines the present trends and future directions of Sustainable Development Goals (SDGs) in supporting Sustainable Finance (SF). A bibliometric approach is used to identify key research patterns, major themes, and important indicators related to SDGs and SF. Drawing from 1,693 documents published in SCOPUS-indexed journals during the COVID-19 pandemic period from 2020 to 2023, the analysis was conducted using Biblioshiny and RStudio, incorporating co-citation networks, keyword occurrence maps, thematic maps, and descriptive statistics to identify prolific authors, influential sources, and highly cited countries. The findings reveal two central pillars in evaluating ESG effectiveness, namely SDG achievement and Sustainable Finance stability, with thematic mapping further uncovering basic, motor, niche, and declining research themes that chart a clear roadmap for future research directions. Notably, the COVID-19 era heightened global awareness of preparedness and vigilance toward future threats, reinforcing the urgency of strengthening ESG frameworks in pursuit of SDG objectives supported by stable Sustainable Finance mechanisms. The study offers a holistic evidence-based framework valuable to regulators, investors, and emerging scholars by uniquely mapping the progression from SDG aspirations toward Sustainable Finance realization, drawing exclusively from high-ranking peer-reviewed journal publications and contributing meaningfully to the existing body of literature on sustainable development and ESG research.

الكلمات الدالة: الحوكمة البيئية والاجتماعية والمؤسسية، أهداف التنمية المستدامة، التمويل المستدام، التحليل الببليومتري.

Keywords: ESG, Sustainable Development Goals, Sustainable Finance, Bibliometric analysis.

1.0 Introduction

The insurmountable challenges of the growing pains due to the COVID outbreak back in 2020 have awakened the world to stay vigilant and prepared for the current and future threats which could cause the long-term sustainability to the life. Increased poverty and inequality, environmental degradation, political instability, economic decline, and human suffering are the impacts when the threats and risks to non-sustainability are not being properly addressed. All these risks shall be able to be mitigated when the proposed plans established by the United Nations in 2015 for the 17 Sustainable Development Goals (SDGs) are taken into consideration.

Figure 1: U.S. Sustainable Development Goals

Source: U.N. SDGs (2026)

The United Nations Sustainable Development Goals (UN SDGs) aim to develop healthy societies aligned with collective well-being (Saxena, A et al., 2021) Prior to 2015, There were many SD indicators and indices already developed and new metrics will certainly yet appear (e.g. Eurostat, 2007, Bandura, 2008, Tasaki et al., 2010). On 1 January 2016, the identification of 17 SDGs had come into force towards achieving the sustainability which was introduced at a historic UN Summit including Malaysia. In that event, Malaysia

had pledged together with 192 other world leaders to adopt the 2030 Agenda for Sustainable Development at the United Nations General Assembly. This is a global commitment towards a more sustainable, resilient and inclusive development, with 17 Sustainable Development Goals (SDGs) and 169 targets. Sustainable finance (SF) refers to financial activities that support environmental, social, and governance (ESG) objectives, including investments in renewable energy and environmentally responsible project (Cheng et al., 2021; Le et al., 2021).

This is a global commitment to more sustainable, resilient and inclusive development with 17 Sustainable Development Goals (SDGs) and 169 targets. Sustainable finance (SF) refers to the environmental, social and governance (ESG) initiatives of companies, governments and macroprudential authorities to finance renewable energy projects and environmentally friendly motives (Cheng et al., 2021; Le et al., 2021). Improving sustainable finance practices can strengthen national economies, as these projects support financial stability and long-term development (Sinha et al., 2021). The beauty of leveraging the need to boost the SF is significant to accelerate the sustainable economic growth (Taghizadeh-Hesary and Yoshino, 2019). 17 SDG goals are the framework for directing the maturity of SF for the world. This paper investigates the current and future direction in these areas of interest across the published papers by the researchers in the Scopus journal. Using bibliometric techniques, the study identifies key research areas, including major keywords, contributing countries, institutional affiliations, themes, and citation patterns. Section 2 explains the sampling method and research design. Section 3 presents the bibliometric results and network visualisations. Section 4 discusses the key findings and the practical implications. Finally, Section 5 summarises the study, outlines limitations, and suggests areas for future research.

2.0 Literature Review

"Sustainable Finance" (SF) is a commonly used term denoting the financial investments related to environmental, social and governance (ESG) considerations undertaken by a range of entities such as organisations, institutions and macroprudential authorities with the

aim of be carried out to generate funds for initiatives that promote sustainable development goals and renewable energy (Le, Cheng, et.al, 2021). In his research, Mohammad (2010) explains the concept of sustainable finance. In particular, he suggests that sustainable finance aims to balance environmental protection, economic growth, and social. The aim of this form of financing is to promote sustainable economic growth, contain climate change, protect human rights, and promote social justice. Sustainable finance is relevant to the United Nations Sustainable Development Goals (SDGs) initiative as it provides the necessary funding to support sustainable development activities that contribute to the achievement of the SDGs. The SDGs are a set of 17 goals adopted by the United Nations in 2015 that aim to eradicate poverty, protect the planet, and ensure prosperity for all.

"Sustainable development" (SD) is a multipart concept that has gained prominence in recent years due to worldwide society's concerns about the adverse effects of human manipulation on the environment and society. Consequently, SD has been defined in many ways. The reliable definition, for example, comes from the Brundtland Commission report "Our Common Future" back in 1976 presented by xx and emphasizes the connection between economic development and environmental issues. Accordingly, they define it as development that meets the needs of present generations without compromising the ability of future generations to meet their own needs. (International Institute for sustainable development, Earth Negotiation Bulletin, 2021). The Brundtland Commission report served as an important catalyst for the convening of the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil, in 1992. The so-called Earth Summit laid the foundation for a worldwide institutional implementation of the integration of a sustainable development. Sustainable development is of great importance to the United Nations Sustainable Development Goals (SDGs) initiative. Sustainable development is a central theme that runs through all SDGs and reinforces their goals. The UN SDGs initiative recognizes the importance of sustainable development in achieving its objectives. For example, SDG 1 aims to eradicate poverty, which is a critical component of sustainable development. SDG 7 focuses on ensuring access to affordable, reliable, sustainable, and modern energy, which

is crucial for economic growth and environmental sustainability. SDG 13 aims to combat climate change, a significant threat to sustainable development.

Pritchard (1969) proposed that "Bibliometric Analysis" refers to the systematic and numerical appraisal of various forms of disseminated resources. A bibliometric analysis is a crucial way to identify a research gap and shortcomings in a particular research area. Ellegaard and Waillin (2015) claim that the use of bibliometric methods has great potential for facilitating rigorous and quantitative assessments of textual materials. This can give these materials increased epistemic credibility in relation to a particular topic. According to Zupic and Cater (2015), bibliometric analysis serves as a quantitative method that is considered suitable for examining various published materials such as, but not limited to, books, articles, and journals.

Accordingly, our research uses this systematic and rigorous methodology to counteract a change in the prevailing situation while identifying potential avenues for SDGs related to sustainable finance. At least 7 factors are thoroughly reviewed to provide insights into the United Nations SDG initiative related to sustainable finance. Factors are reviews such as Most Prolific Author, Most Influential Document, Most Influential Sources, Top 10 Affiliations, Most Cited Country, Top 10 Words, and Sub streams of Sustainable Finance.

3.0 Sampling and Methodology

3.1 Database Selection

According to Bashar et al. (2021) and Rabbani et al. (2021), bibliometric analysis has become a popular technique for investigating a specific research area using bibliographic data. In this study, explicit network analysis and scientific mapping approaches are used to assess the overall trend of the domain (Noyons et al., 1999; van Raan, 2003). Because of its logical graphical format, it also facilitates the study of how an area has changed over time, links between institutions and countries, and research collaborations (Guet al., 2019; Donthu et al., 2021a; Kumar et al., 2021; Herrera-Franco et al., 2020). Because of its logical graphical format, and it also facilitates the study of how an area has changed over time, links between institutions and countries, and

the research collaborations (Guet al., 2019; Donthu et al., 2021a; Kumar et al., 2021; Herrera-Franco et al., 2020). That is why academics use this tool to review quotes, co-citations, popular words, and relevant topics in their fields of study. The bibliometric analysis requires a structural description of the articles indexed in the database. This information comes from the broader Scopus database, which contains over 20,000 peer-reviewed journals from publishers such as Elsevier, Emerald, Informs, Taylor & Francis, Springer, and InderScience. In addition, bibliometric software such as Observed R Studio is compatible with the database. Using data from previous studies, the Scopus database provides a complete and comprehensive index of a wide range of scientific papers (Gorraiz and Schloegl, 2008; Herrera-Franco et al., 2020; Kolle et al., 2018; Mishra et al., 2021). Using data from the previous studies, the Scopus database provides a complete and comprehensive index to a wide range of scientific papers (Gorraiz and Schloegl, 2008; Herrera-Franco et al., 2020; Kolle et al., 2018; Mishra et al., 2021). Compared to other sources, the Scopus database has the advantage of covering a wider range of publications and providing more useful bibliometric information (Ansari and Kant, 2017; Jin et al., 2018).

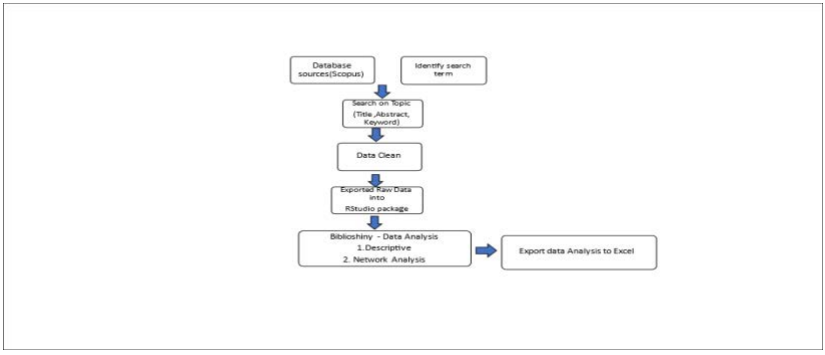
3.2 Bibliometric Process

1. To meet the requirements of the Biblioshiny software, data in CSV format was obtained from the Scopus database. The following is the structure of data retrieval used for this study Keywords for search strategies -The keywords sustainable finance and SDGs were used to identify research contributions, and 1693 documents were extracted using the keywords search criterion.
2. Search Strategy-Keywords (Sustainable Finance and) and (SDGs)
3. Refined by: Scopus Database
4. Categories of Document Types Journal Articles or Conference Articles
5. Language - English
6. Time Range - 2020 to 2023

Figure 2 below shows, the steps of the bibliometric analysis method. The bibliometric study involves a series of processes, including searching for the preferred topic and determining the sources

of the platform (Scopus). Then the Scopus platform is used to search for the selected topics (title, abstract and keyword). The Scopus platform is used to search for the selected topics (title, abstract and keyword). Initially, the set keyword to be used for the study of the document is "Sustainable Finance," "Green Finance" and "Sustainable Development Objectives." A total of around 2000 raw data sets were collected from documents; These raw data sets were then cleaned before being entered into the RStudio packaging software, and a total of approximately 1963 clean data points were exported to the software for actual analysis.

Figure 2: Bibliometric process



Source: Authors Illustration

3.3 Selection of Bibliometric Tools

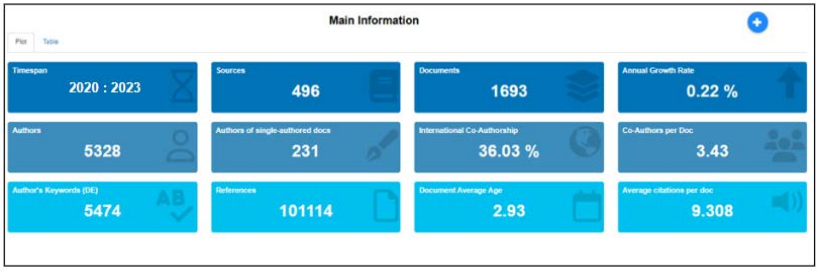
The current analysis utilises the bibliometric R package from Massimo Aria (Aria, 2017). This application does a thorough analysis of science maps and is open-source and free. This programme provides analytical and visualisation capabilities. Also, this study makes use of Biblioshiny, a web-based software from the Bibliometrics R package. Using the programme Biblioshiny, users can receive bibliometric data in graphical formats and export the data as an image or an Excel file for additional organisation, claim Moral-Muoz et al. and Xie et al. (2020). This tool allows users to create visual graphs and export results into formats such as images and Excel files for further analysis, claimed by Moral-Muoz et al. and Xie et al. (2020).

4.0 Results and Interpreation

4.1 Descriptive Analysis

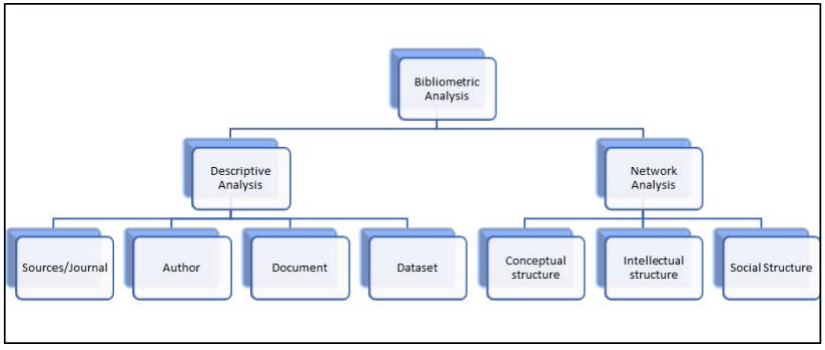
In summary, the bibliometric data set is published in the Scopus database with 1693 articles published from 2020 to 2023, carefully chosen after a systematic search (see Table 1). These documents consist of 496 sources with an average citation value of 9.31. These articles show the value of academic collaboration in the disciplines of sustainable finance, green finance, and SDGs research. They were written by 5328 authors and used with 101,114 citations and 5,474 keywords.

Table 1: Main Information arising from bibliometric analysis for 1,683 documents from 5,328 authors from 2020 to 2020.



Source: Authors Own

Figure 3: Descriptive analysis and network analysis

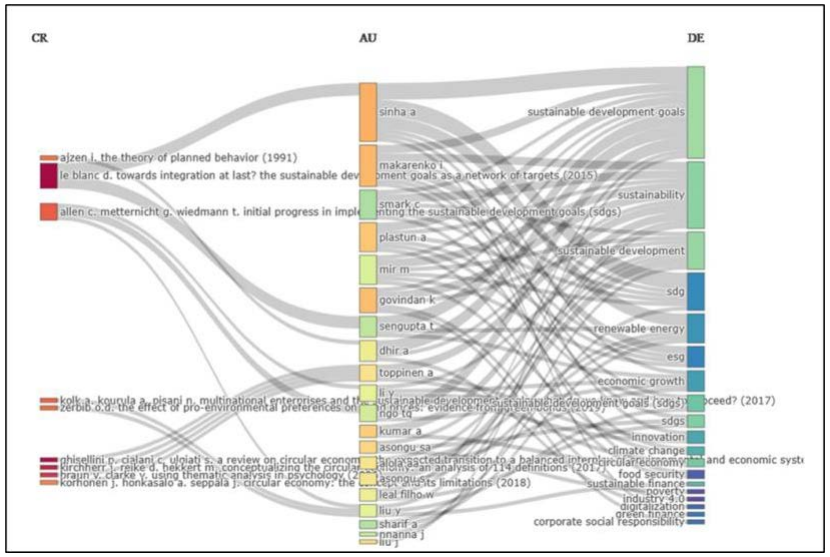


Source: Pendse, Nerlekar, and Darda (2022).

4.2 Three Field Plots (Sankey Pots)

Three-field plots were used to illustrate relationships among selected variables, as shown in Figure 4. A Sankey diagram represents connections between elements using nodes and linking lines. The width of each connection reflects the strength or importance of the relationship (Riehmann et al., 2005). In this diagram, authors appear in the centre column, keywords are displayed on the right, and publication sources are shown on the left. Figure 4 shows the prominent keywords, such as Sustainable Development Goals, Sustainability, Sustainable Development, Sustainability and Renewable Energy, and ESG, with their sources and most prolific authors. These results indicate that sustainability-related topics dominate the research contributions within this field.

Figure 4: Three Fields Plot



Source: Biblioshiny tools - RStudio package

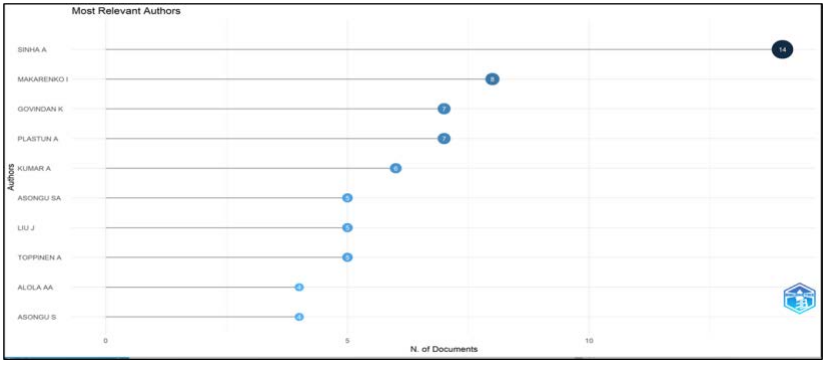
In the three-field plot, the authors are represented on the middle column of the tripartite diagram, the keywords are on the right side, and the sources selected for analysis are represented on the left. Figure 4 shows the prominent keywords, such as Sustainable Development

Goals, Sustainability, Sustainable Development, Sustainability and Renewable Energy, and ESG, with their sources and most prolific authors. The main themes of these eminent authors and publications were also sustainable development goals, sustainability, and sustainable development.

4.3 Most Prolific Authors

Prolific authors play an important role in shaping the development of a research field. This study evaluates author performance based on publication output, collaboration patterns, and citation impact (Kumar et al., 2021; Singh and Bashar, 2021). This analysis is based on the total number of articles a certain author has written. The analysis primarily focuses on the total number of articles produced by each author. According to Figure 5, Sinha A. is the most productive researcher in the area of sustainability and SDGs, publishing 14 articles. Makarenko I. is ranked second with 8 academic publications, while Govindan is ranked third with 7 articles. The authors with the most publications in sustainable finance, and SDGs are shown in Figure 5.

Figure 5: Most prolific authors on SF, GF, and SDG

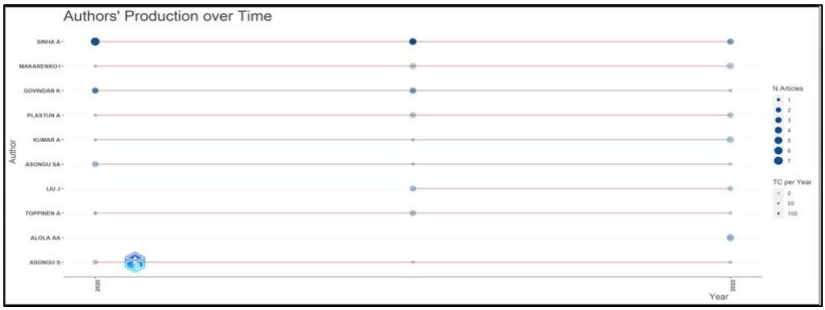


Source: Cited from Biblioshiny tools - RStudio package

Figure 6 shows the authors most active in the fields of sustainable finance, and SDGs by a number of publications. Since the early 2000s, a few early authors have emerged in sustainable finance that have remained constant.

Most of the articles were written by an author who remained active throughout, such as Sinha A., Makarenko and Govindan K., who is similarly constant in his writing and has consistently contributed to the growth of the sustainable finance, and SDGs fields of study. Since 2020, this field has attracted numerous other scholars, such as Plustun A., Kumar A., and others, who often explore the different facets of sustainable finance and SDGs.

Figure 6: Most active authors on SF, GF & SDG



Source: Biblioshiny tools - RStudio package

4.4 Most Influential Document

Documents that have received the most local and international citations are considered the most influential. The influential documents show how a specific subject matter is studied and expanded (Kumar et al., 2021). Table 2 presents the ten publications with the highest citation impact in this study. The most cited documents in the top list of most influential documents are articles from Management Research and the UN Sustainable Development Goals (SDG): A Bibliometric Investigation and Systematic Review, authored by Pizzi et al. (2020). This article provides support and inspiration for researchers who wish to expand the study to learn more about the SDG. Second, the article Achieving Sustainable Development Goals by Identification and Analysis of Barriers to Industrial Sharing Economy: A Framework for Development, authored by K. Govindan and published in 2020 (Govindan, K., 2020), is also widely cited by local and global researchers. Most highly cited publications focus on themes related to Sustainable Development Goals (SDGs). Additional

recurring sub-themes include technological innovation, environmental sustainability, and Industry 4.0 developments.

Table 2: Top 10 most influential document on SG, GF & SDG

Document	Year	Local Citation	Global Citations	LC/GC ratio (%)
Pizzi Journal Clean Production	2020	14	124	11.29
Govinda International Journal Production Economic	2020	13	999	13.13
Fatimah Ya, Journal Clean Production	2020	8	172	4.65
Zafar Mw, Journal Clean Production	2020	8	165	4.85
Montiel 1,	2021	7	43	16.52
Sinha A, journal Clean Production	2020	7	173	4.05
De Silva, Journal Australas Account Business Finance	2020	6	11	54.55
Chien Journal Innovative Knowledge	2022	5	19	26.32
Van Der Waal, Journal Clean Production	2021	5	34	14.71
Pan Sl, International Journal Management	2020	5	104	4.81

Source: Biblioshiny tools - RStudio package

4.5 Most Influential Sources

Academic journals play a key role in shaping the direction and growth of research fields. Table 3 lists the top twenty journals based on the number of publications included in this study. Journal quality is commonly evaluated using citation-based indicators such as the H-index and total citation counts. The sources play an important role in the development of a research stream. Table 3 shows the top 20 sources by total number of publications. The quality of a journal can be assessed by its H-index and citations. The number of citations received often reflects the level of recognition a journal gains within the academic community.

Among the listed journals, Business Strategy and the Environment recorded a strong H-index performance despite publishing a relatively smaller number of articles during the selected period. Despite the lower publication count, the journal achieved significant citation impact, receiving 388 citations. Another influential source is World Development, which published 34 articles and recorded 490 citations, supported by an H-index value of 14.

Table 3: Top 20 most influential sources on GF,SF & SDG

Journal	h-index	g-index	m-index	TC	NP	PY Start
Journal of Clean Production	33	57	8.25	3895	161	2020
Business Strategy and The Environment	14	19	3.5	388	26	2020
World Development	14	21	3.5	490	34	2020
Technological Forecasting and Social Change	13	23	3.235	568	27	2020

Environment Development and Sustainability	10	16	2.5	303	29	2020
International Journal of Production Economics	10	14	2.5	690	14	2020
Journal of Sustain Tourism	10	16	2.5	281	20	2020
Resources Conservation and recycling	10	21	2.5	713	21	2021
Economic Research	9	14	3	217	26	2021
Journal of Business Research	8	17	2	126	24	2020
Marine Policy	8	10	2	126	24	2020
Administrative Sciences	7	10	1.75	122	16	2020
Ecological Economics	7	16	1.75	264	17	2020
Sustainable Finance and Investment	7	11	1.75	203	11	2020
Cities	6	12	1.5	157	20	2020
CSR and Environment Management	6	10	1.5	136	10	2020

Food Policy	6	8	1.5	129	8	2020
Frontier in Energy Research	6	7	1.5	103	8	2020
International Environmental Agreements:	6	7	1.5	61	9	2020
Problems and Perspective in Management	6	8	1.5	71	15	2020
Accounting, Auditing and Accountability	5	6	1.25	110	6	2020
Cogent Business and Management	5	9	1.25	90	17	2020
Economics	5	9	1.25	90	17	2020
Forest. Policy and Economic	5	8	1.25	198	8	2020
Humanities and Social Sciences Communication	5	7	1.25	50	14	2020

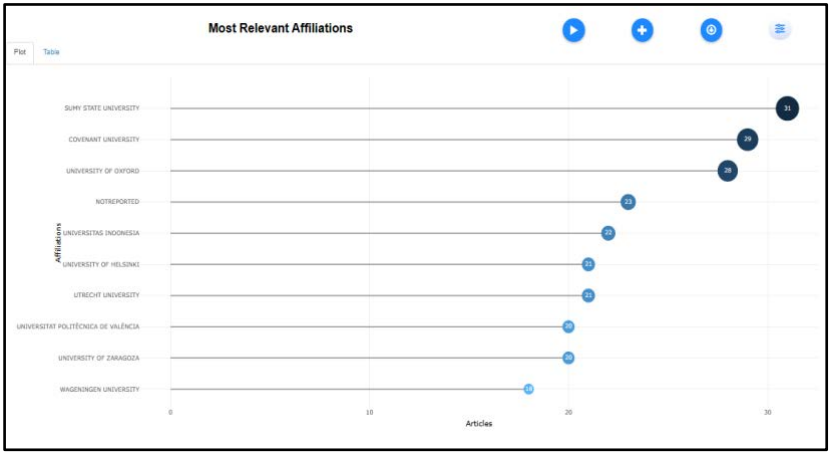
Source: Biblioshiny tools - RStudio package

4.6 Top 10 Most relevant Affiliations

Figure 7 illustrates the leading institutional contributors involved in sustainable finance research. The State University of New York (SUNY) recorded the highest research contribution, with a total of 31 published articles. Covenant University in Nigeria ranked second, contributing 29 research publications. The University of Oxford in the

United Kingdom ranked third, producing 28 publications within the study period.

Figure 7: Top 10 most relevant affiliations on SDG and SF

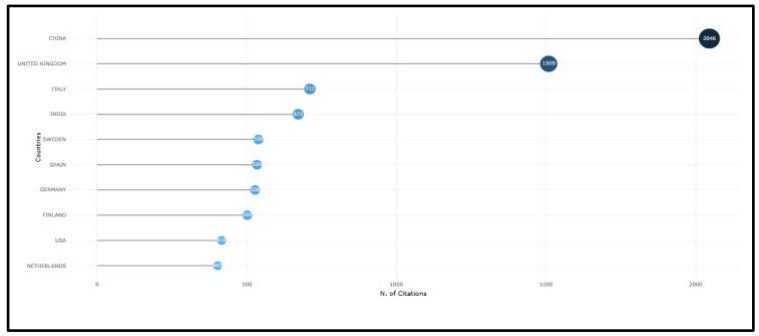


Source: Biblioshiny tools - RStudio package

4.7 Most Cited Countries

The most cited countries shown the countries' contribution to total scientific output. Figure 8 shows the top 10 countries contributing to sustainable funding, with China, the UK, Italy and India being the most influential. Collaboration between countries can also be seen in the chart below, and it is evident that most collaboration comes from the UK, China, the US, Italy and Australia. There are metrics based on the production of a single country and multiple countries. The countries with the highest production in one country also have the most collaborations in multiple countries. To understand how countries cooperate, the map of country cooperation is shown in Figure 9. The criteria for creating this map were a minimum number of 10 documents for a country and a minimum number of 10 citations for a country. Of the 73 countries, only 35 met the criteria. As can be seen from the map, the UK, China, the US, Italy and Australia are strongly collaborating, and the authors are working together to explore the field of sustainable finance and to conquer sustainable finance solutions in different areas.

Figure 8 : Top 10 most relevant affiliations on SDG and SF

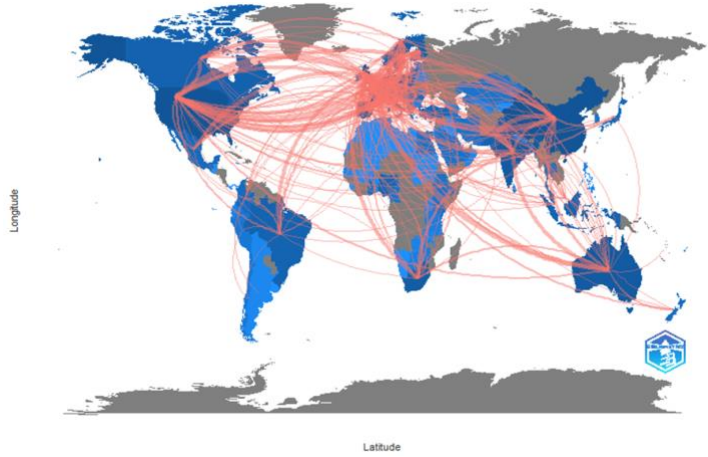


Source: Biblioshiny tools - RStudio package

4.8 Top 10 Most Frequent Words

The frequency of words shows the development and theme of a particular research area (Kumar et al., 2021). This analysis helps gain insight into the most popular research stream and sub-streams and the most common words authors use in their titles, keywords or abstracts (Wu et al., 2021). The Biblioshiny application is used to identify the most frequently repeated words, with a minimum frequency of 10.

Figure 9. Country Collaboration Map on sustainable development goals towards sustainable finance.



Source: Biblioshiny tools - RStudio package

Collaboration between countries can also be seen in Figure 9, and it is obvious that most collaboration comes from the UK, China, the US, Italy and Australia. There are metrics based on single-country and multi-country production. The countries with the highest production in one country also have the most collaborations in multiple countries. Accordingly, to understand how countries cooperate, the map of country collaboration is presented in Figure 9.

The criteria for creating this map were a minimum number of 10 documents for a country and a minimum number of 10 citations for a country. Of the 73 countries, only 35 met the criteria. As can be seen from the map, the UK, China, the US, Italy and Australia are collaborating strongly, and the authors are working together to explore the field of sustainable finance and to conquer sustainable finance solutions in different areas. Sustainable development, sustainable development goal, sustainability and planning are the most common words in this domain as shown in Table 4. The Table shows that scholars are concerned with these topics in the context of sustainable finance and related disciplines.

Table 4 : Top 10 most frequent words on sustainable development goals towards sustainable finance

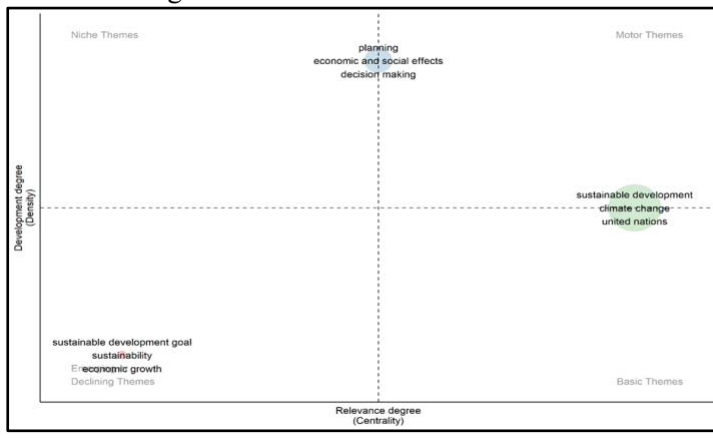
Terms	Frequency
Sustainable development	408
Sustainable development goal	197
Sustainability	121
Planning	97
Climate change	74
Ddecision making	61
United nations	60
Economic and social effects	56
Eeconomics	52
Environmental economics	48

Source: Biblioshiny tools - RStudio package

Figure 10 shows a map of the occurrence of keywords. The criterion for minimum occurrence was set at 5. Of the authors' 5,474 keywords, only 290 met the threshold criterion. The output map forms three clusters of these keywords, with Cluster 1 (Red) consisting of 44 keywords, Cluster 2 (Blue) consisting of 50 keywords and Cluster 3 (Green) consisting of 49 keywords. The criterion for minimum occurrence was set at 5. Of the authors' 5,474 keywords, only 290 met the threshold criterion. The output map forms three clusters of these

keywords, with Cluster 1 (Red) consisting of 44 keywords, Cluster 2 (Blue) consisting of 50 keywords and Cluster 3 (Green) consisting of 49 keywords. These clusters represent the trend in sustainable finance. These clusters show the research streams that revolve around sustainable finance. Cluster 1: Sustainable Development Goal (SDG) - The first cluster (red) consists of 44 keywords integrating the studies corresponding to sustainability research. These clusters show the research streams that revolve around sustainable finance.

Figure 10. Keyword occurrence map on sustainable development goals towards sustainable finance



Source: Biblioshiny tools - RStudio package

- Cluster 1: Sustainable Development Goal (SDG) - The first cluster (red) consists of 44 keywords that integrate the studies corresponding to sustainability research. Sustainability research in finance has attracted scholars from around the world who collaborate to study and analyse the related areas such as sustainability, economic growth and governance approach in countries like China, Europe and the developing world. The SDGs are a global initiative aimed at sustainable development, i.e. meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. The SDGs focus on achieving economic growth while addressing social and environmental concerns through a governance approach that involves stakeholders from all sectors. In Europe, sustainable

development is a top priority, and countries are implementing policies and programmes to promote sustainability. However, developing countries face major challenges in achieving sustainable development, such as poverty, climate change and resource depletion. Therefore, adopting a collaborative approach involving stakeholders from all sectors is important to achieve sustainable development globally.

- Cluster 2: Planning - The second cluster, the blue cluster, collects words that refer to planning various economic instruments used for sustainable financing. Some notable works in this cluster are decision-making, economic and social effects, economics, circular economy, life cycle, supply chains and economic analysis. This cluster is closely related to the first cluster, which is about the goal of sustainable development, while this cluster is about planning various economic instruments used for environmentally sustainable financing. Planning is a crucial process where decisions are made to ensure that economic and social effects are taken into account. Economics is essential in planning, providing a framework for understanding the trade-offs involved in different decisions. The circular economy is an increasingly important concept in planning as it highlights the importance of considering the entire life cycle of products and resources, including their environmental and social impacts. Planning also includes the analysis of supply chains, including their economic and environmental impacts. Economic analysis is an essential tool for planning, as it helps to identify the costs and benefits of different options and ensure that decisions are made with full consideration of their long-term impacts. Overall, effective planning requires a comprehensive approach that takes into account economic, social and environmental factors and involves careful decision-making at every stage.
- Cluster 3: Sustainable development - This cluster (green) is characterised in the literature by terms that refer to the goal of sustainable development. Sustainable development is a concept that has gained much attention in recent years, particularly in the wake of growing concerns about climate change and the impact of

human activities on the environment. The United Nations has been at the forefront of promoting sustainable development through various initiatives, such as the Sustainable Development Goals (SDGs), which seek to balance economic growth, social development and environmental protection. Environmental economics has played a crucial role in the transition to sustainability by emphasising the need to internalise the costs of environmental degradation and pollution. COVID-19 has further emphasised the importance of sustainable development, and many countries have recognised the need to prioritise sustainability in their economic stimulus programmes. Innovation and finance will also play a critical role in achieving sustainable development, with new technologies and financial instruments being developed to support the transition to a more sustainable future.

4.9 Sub-Streams of Sustainable Finance

The comprehensive analysis of sustainable finance and the careful study of the trend help to discover the sub-streams in this field; the sub-streams are the potential research area to understand responsible finance that helps achieve growth and maintain the planet's sustainability. Table 5 (i, ii, iii) illustrates the main and sub-streams of sustainable finance based on the occurrence of keywords and the formation of nodes in different clusters.

Table 5 (i): Mainstream on Sustainable Development Goal

Mainstreem and sub-stream of sustainable finance

Mainstream	Sub streams	Potential exploration	References
Sustainable development goal	Sustainability	Explore the relationship between the SDGs and sustainability and how they can be used together to achieve sustainable development. It could also lead to exploring the implications of this synergy for policy, business and society.	Bhaskar Chatterjee (2016); Cristiana Parisi, et al (2020); Carla C.J.M. Millar, et al (2019); Ioannis Ioannou, et al (2013)
	Economic growth	Analyze the trade-offs and synergies between economic growth and environmental sustainability	Costantini et al. (2020); Gómez-Álvarez et al. (2020); Sachs et al. (2019)
	China	Analyze the challenges and opportunities for developing a sustainable financial system in China	He and Wu (2019) ; Feng et al. (2019); 2. Wang and Shi's (2018)
	Governance approach	Examine the role of government policies, institutions, and stakeholders in promoting sustainable development in China	Kostka (2019): 1. Gallemore et al. (2020); 1. Gallemore et al. (2020)
	Europe	Identify best practices and lessons learned for achieving the SDGs.	Lozano and Huisingh (2019); van der Heijden and Vellema (2017); Jordan et al. (2018)
	Developing world	Identify the challenges of implementing SDGs in developing countrie	Ali, S., Liu, Y., & Li, X. (2020); Dar, M. A., & Hayat, S. (2020); Okereke, C., & Charlesworth, M. (2018).
	Stakeholder	How organizations can identify, prioritize, and engage with stakeholders to achieve sustainable development goals	Freeman et al. (2010) ; Camilleri (2017); Saeed et al. (2019)

Source: Authors Own

The comprehensive analysis of sustainable finance and the careful study of the trend help to discover the sub-areas in this field. The sub-sectors are the potential area of research to understand responsible finance that helps to achieve growth and maintain the sustainability of the planet. Table 5 (i, ii, iii) presents the main and sub-fields of sustainable finance based on the occurrence of keywords and the formation of nodes in different clusters.

Table 5 (ii): Mainstream on Sustainable Development

Mainstreem and sub-stream of sustainable finance

Mainstream	Sub streams	Potential exploration	References
Sustainable development	Climate change	Explore the relationship between sustainable finance and specific adaptation measures, such as coastal protection or water management	Bansal, P., & Ochoa, C. M. (2019); Scholtens, B., & Wagner, N. (2018); Faff, R., & Gow, I. (2020).
	United nations	To understand the different SDGs and their interconnections, the role of the United Nations in promoting sustainable development, and the challenges and opportunities for achieving the SDGs.	Jeffrey D. Sachs, Guido Schmidt-Traub, and Laura E. R. Petersen (2019); Steve Waygood and Alice Evans (2018); Philipp Degens, Kerstin Martens, and Michael Viehs (2019)
	Environmental economics	To understand the different environmental and economic benefits of sustainable development, the potential trade-offs and synergies between environmental and economic objectives, and the challenges and opportunities for achieving sustainable development.	Zhihong Yu and Yiming Chen. Citation (2018); David W. Pearce (2001); J. B. Opschoor (1996)
	Environmental impact	To understand the principles of sustainable development and how they relate to environmental impact assessment	Mark Deakin and William F. Lamb. (2015); Chunlu Liu, Xiaojun Wang, and Shuai Zhang (2019); Thomas Fischer and Frank Vanclay (2015)
	Finance	To understand the potential risks and challenges associated with sustainable finance	Anne-Laure Delatte and Priscilla Fialho (2020); Alesia Ofori-Atta, James Darko, and Olumide Adisa (2021); Daniel Arenas, Daniel Beunza, and Raghu Garud (2018)
	Covid-19	Exploring the potential challenges and opportunities for accelerating progress towards achieving the SDGs in the post-COVID-19 era	Andrea Bassi, Emily Benson, and Juan Pablo Sarmienton (2021); John Thwaites and Cameron Hepburn (2020)
	Innovation	Exploring potential strategies for promoting sustainable innovation	L. Cruz-Mejía and J. A. Parra-López (2020); J. J. Bozeman and J. W. Sadowski (2019); R. A. Vargas et al. (2021):

Source: Authors Own

Table 5 (iii): Mainstream on Planning

Mainstreem and sub-stream of sustainable finance

Mainstream	Sub streams	Potential exploration	References
Planning	Decision making	A study of the effectiveness of different decision-making models in promoting sustainable energy practices	Agliardi, E., & Agliardi, R. (2021); Li, L., & Wang, C. (2021); Chatterji, A., & Toffel, M. W. (2020)
	Economic and social effects	An analysis of the effectiveness of different sustainable finance mechanisms in promoting low-carbon investments	Linnenluecke, M. K., & Griffiths, A. (2021); Stavins, R. N. (2021); Keles, D., & Celikyurt, U. (2021)
	Economics	A study of the potential trade-offs between economic growth and climate mitigation and adaptation efforts in different sectors of the European economy	EIB. (2020); 1. Fankhauser, S., & McDermott, T. K. (2020); Liu, X., & Cao, Y. (2021)
	Circular economy	Examine the challenges and barriers to implementing circular economy principles and identifying potential solutions to overcome these barriers	1. Kirchherr, J., Reike, D., & Hekkert, M. (2017); Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017); 2. International Energy Agency. (2020)
	Life cycle	Further investigation into the environmental impacts of urban wastewater systems in different regions and under different management practices	Ryberg, M. W., Hauschild, M. Z., & Owsianiak, M. (2014); Muthu, S. S. (2014); 2. European Commission. (2019)
	Supply chains	Understand how companies can incorporate sustainability goals into their supply chain planning to create long-term value for all stakeholders, including the environment, society, and the economy.	Seuring et al. (2018); Sarkis et al. (2011); Holweg, M., & Miemczyk, J. (2015).
	Economic analysis	Identify the most promising avenues for sustainable finance to contribute to economic development in a country	Rana and Sharma (2021); Glachant and Lévêque (2021); Sun and Gao (2020)

Source: Authors Own

5.0 Summary of Findings

The current research explores on the typologies and segmented identifiers for the current and future state of sustainable development goals towards achieving sustainable finance on the future direction. Identified the main and sub-themes of the research ecosystem for the reference of prospective researchers to further refine on the ongoing research. Using the available segmented identifier in Biblioshiny, we have identified the top 3 popular themes of SDG, Sustainable Development and Planning with 21 sub-themes (refer Table 5). Pizzi Journal Clean Production is the most influential document while the Journal of Clean Production is identified as the most influential source. The analysis prompted that Sinha, A is the most prolific and active author for this 3 years research period based on the date of the article published during the three years of COVID-19 pandemic and endemic (2020 until 2023). The analysis proposed that the Suny State University of New York is the most influential organisation with 31 research articles. In terms of the most cited counties, indicated that China is championing the publication of SDG and SF with 2,046 articles.

6.0 Conclusion

This study investigated the current popular typologies and areas of research of SDG and SF using the bibliometric analysis for 3 years period of COVID-19 pandemic and endemic based on the final articles published on Scopus (2020 until 2023). We have used RStudio programming for trends visualization, clusters, most recent topics, the evolution of sustainable finance and key prolific and authors with key prominent affiliations and most cited countries. We used RStudio programming to visualise trends, clusters, the latest topics, sustainable finance development and the most prominent authors, and also the most cited countries. Finally, the analysis produced the thematic analysis of the terminology's mainstreams and sub-streams with the potential exploration. The key areas identified are in line with the recent trends and challenges faced by stakeholders who are concerned about the evolution and development of SDG with the utmost concert towards achieving the SF. Given these implications, this study has some limitations due to the absence of theoretical statements to support

the growing concern of main themes and sub-themes. The usage of keywords of both SDG and SF in our quest to identify the current and future popular typologies allowed us to get better understanding on the future exploration that prospective researchers could do and signal the other stakeholders on the current state of available research. The best result of bibliometric analysis could be supplied with quantitative or qualitative research from the academia and industry practitioners' perceptions.

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