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Digital transformation in the halal industry: A bibliometric analysis of global research

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Abstract

Purpose – This study explores the global literature trends concerning the digital transformation of the halal industry through the lens of a bibliometric methodology by finding key countries, institutions, journals, authors, thematic clusters, and co-occurring keywords and emphasizing the point of intersection of digitalization and sustainability as a potential future research direction.

Methodology – Bibliometric analysis and visualization were used to conduct the research using the Scopus database and VOSviewer software. A total of 298 articles published between 2011 and 2025 were analyzed. Signs of publication increase, citation trends, country and institutional cooperation, and keyword co-occurrence networks were analyzed.

Findings – It was discovered that the growth of publications has been rapid since 2018, peaking in 2024. Malaysia and Indonesia were the major contributors, and hence, the central role of Southeast Asia. Keywords were dominated by blockchain and halal, as research no longer focused on certification and food safety but on state-of-the-art technologies such as blockchain, AI, and machine learning. There was also the identification of strong institutional collaborations in the Journal of Islamic Marketing.

Implications – This research offers lessons to policymakers, scholars, and the industry to improve halal practices using digital technologies with a focus on transparency, traceability, and sustainability in global supply chains and certification systems.

Originality – This work provides a detailed bibliometric review of digital transformation in the halal sector and the concept of twin transformation, connecting digitalization with sustainability and resilience in the international halal ecosystem.

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Introduction

The halal industry has emerged as one of the most vibrant and fastest-growing industries in the global economy, encompassing food, pharmaceuticals, cosmetics, tourism, finance, and logistics. Its rapid growth is not only due to the rising demand of Muslim consumers, but also the growing worldwide interest in ethical and sustainable products. Alongside this growth, the digital revolution has become a key innovation, efficiency, and compliance force in the halal sector. The Fourth Industrial Revolution (IR4.0)-related technologies, including blockchain, artificial intelligence (AI), machine learning, fintech, big data, and e-commerce, are increasingly employed to enhance the

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transparency of halal supply chains, speed up certification procedures, and increase consumer confidence. These innovations are transforming the skills that halal executives need and new infrastructure to ensure compliance (Ahmad et al., 2024; Hidayah & Solihah, 2025).

Reflecting on recent bibliometric analyses, it is evident that since 2010, research in the halal industry has increased significantly, and the number of publications is expected to peak by 2024 (Marlina et al., 2025). Malaysia has been the most dominant country in halal-related research studies after Indonesia and some non-Muslim nations, which indicates the extent of globalization of the discourse (Aulia & Azizah, 2024; Hardiana et al., 2023). The search results reveal that the literature is dominated by terms such as halal, halal food, halal certification, and halal tourism, although new themes such as the effects of Covid-19, chemometrics, and real-time PCR are also being discussed (Marlina et al., 2025). It has also been noted in the literature that there are a number of groups of research interest; halal business, halal industry and tourism, halal marketing and certification and supply chain and logistics, with digital transformation cutting across all these areas more and more (Hardiana et al., 2023; Hidayat & Musari, 2022).

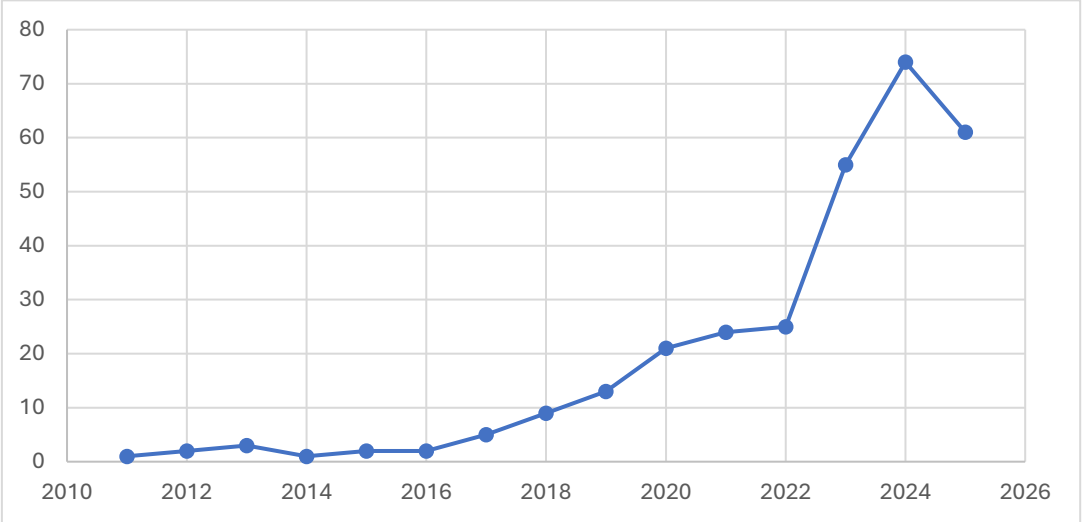

Figure 1. The number of digital transformations in halal industry publications
Source: Scopus data

Looking at the trend depicted in Figure 1, it is evident that there has been an increased focus on the topic of digital transformation in the halal industry over the last ten years. There were rather few publications between 2011 and 2017, indicating that the subject had not yet become an important field of research. Nonetheless, since 2018, there has been a visible upward trend and the volume of research output has been rising consistently and at an accelerated pace since 2021. This boom resulted in a high number of over 70 publications by 2024, not only due to the rapid digitalization of the industry but also because of increased worldwide interest among researchers. This forward-looking low in 2025, although still reflecting a greater amount than previous years, gives an indication of a stabilizing period in the research world. This tendency underlines the significance of digital transformation as a key theme in the study of the halal industry, especially in the context of certification, supply chains, and technological implementation, as well as the prospects of future studies to further enrich and diversify the discussion.

The responses that this study received to the questions provide both theoretical and practical knowledge about the digital revolution of the halal industry. This research uses a broad bibliometric method to map the overall trends of global research in using technology, unlike earlier studies that primarily focused on particular technology adoption or regional studies. The timeliness of this research is that the integration of digital technologies into halal ecosystems is rapidly increasing with the need for global sustainability. It reveals the new paradigm of the twin transformation of digitalization and sustainability that opens new avenues to harmonize the practices of the halal industry with sustainability goals on a global scale (Philp et al., 2025). This study offers an opportune and unprecedented contribution because it can inform future innovation

and ensure the sustained growth and sustainability of the global halal industry by establishing what already exists, new themes, and knowledge gaps that guide innovation.

Literature Review

The breakneck growth of studies on digital transformation in the halal industry, including the topics of blockchain-mediated transparency, adoption of technology in halal certification, green innovations, and digital practices of SMEs, testifies to a fragmented yet fast-changing sphere. A bibliometric methodology is especially acceptable because it allows the mapping of scientific output, collaboration, and thematic changes in a systematic manner over time, which is commonly missed in narrative reviews (Donthu et al., 2021). In this way, researchers can reveal the intellectual framework of the field, determine prevailing clusters, including halal supply chains, certification, and digitalization, and identify new research fronts, that is, twin transformation and sustainability integration (Hardiana et al., 2023; Marlina et al., 2025; Philp et al., 2025). Bibliometric analysis can provide a conceptual basis for the maturity, knowledge gap, and strategic direction of halal industry research in a digital transformation setting by offering a systematic and data-based overview.

Growth of research in the halal industry

With its estimated global market value projected to reach USD 2.4 trillion by 2024, the halal industry has received growing academic interest in the last 20 years (Masood et al., 2022). Bibliometric studies show a fifteen-fold increase in halal-related publications between 2010 and 2021, indicating its growing significance in academic discourse (Nadiha et al., 2023). Malaysia has always been at the forefront of world production, followed by non-Muslim nations, as far as the relevance of halal studies in the world is concerned (Aulia & Azizah, 2024; Hardiana et al., 2023). The application of blockchain technology to enhance transparency and traceability within halal supply chains is increasing, but further research is required (Veldhoven et al., 2021; Yanti et al., 2022). Thematically, digital transformation in the halal industry emphasizes technology implementation strategies, food supply chain optimization, and green technology innovations to support sustainability (Gurcan et al., 2023; Xue et al., 2022). Therefore, along with the substantial potential of digital transformation to provide efficiency and innovation, issues associated with compliance, technological preparedness, and consumer confidence need to be resolved to guarantee the sustainable development of the halal industry.

Technological integration and digital transformation

Digital transformation has now been a vital element of halal industry research, especially after the use of IR4.0 technologies like blockchain, artificial intelligence, and big data. More specifically, blockchain has become well-known with 353 publications between 2011 and 2022, dedicated to improving transparency and traceability in the halal supply chain (Yanti et al., 2022). At the institutional level, certification organizations such as LPPOM MUI have been digitally transformed with a primary focus on operational assessment and risk control mechanisms to promote the integrity of halal certification (Jati, 2021). Previous bibliometric analyses have identified four major clusters in halal industry research: halal business and economics, halal industry and tourism, halal marketing and certification, and halal supply chain and logistics (Hardiana et al., 2023; Hidayat & Musari, 2022). Keywords, such as halal food, halal certification, and halal tourism, are widely used; new themes are the effects of Covid -19, chemometrics and real-time digital authentication technologies (Marlina et al., 2025). These topics underscore both conventional and modern problems that inform halal research spaces.

SMEs, entrepreneurship, and digital adoption

Halal small and medium enterprises (SMEs), particularly in Indonesia, are turning to digital practices to become more competitive and sustainable. According to empirical research, both digital economy knowledge and the combination of these two aspects with halal principles can play significant roles in boosting business performance and promoting sustainable approaches (Alfarizi 2023). Nevertheless, adoption is also heterogeneous, and studies have found that larger businesses

have often been more capable of capitalizing on digital tools than SMEs (Li et al., 2023). Despite the rapidly changing environment, a number of challenges remain with the digital transformation of the halal industry. These include unevenness in regional and business adoption, tailored financial and policy assistance, and the constant challenge of consumer trust and certification adherence. Researchers are increasingly advocating holistic concepts to integrate digital transformation with sustainability, or twin transformation, as a way of making halal industry development consistent with global sustainable development aims (Philp et al., 2025). This perspective highlights the need for interdisciplinary collaboration and long-term strategic approach.

Research Methods

The purpose of this study was to find and visualize articles related to Digital Transformation, particularly in the field of Digital Transformation in the Halal Industry.

1. Research design
   This study used both bibliometric and bibliometric visualization. Bibliometric analysis is a quantitative methodology that describes and assesses the research patterns and characteristics of a group of publications using descriptive and evaluative approaches.
   (Dupi & Prayogo, 2025). To display a structural overview of a certain field of study, a bibliometric visualization approach was employed (Garfield, 2009).
2. Research subject
   Based on the chosen keywords, 298 articles were obtained from the Scopus database to constitute a sample for use in this study. The search string used was TITLE-ABS-KEY (halal AND ("digital transformation" OR blockchain OR "artificial intelligence" OR AI OR "machine learning" OR "big data" OR fintech OR "financial technology" OR ecommerce OR "e-commerce" OR "digital economy" OR "information technology" OR ICT OR "digital innovation" OR "digital business")) AND PUBYEAR > 2010 AND PUBYEAR < 2026. for the period from 2011 to 2025. These keywords were also included to ensure that the wide scope of technology that defines the digital transformation of the halal industry was captured. To be more precise, the terms digital transformation and digital economy were presented to find the studies related to the adaptability and modernization of organizations; the terms artificial intelligence, machine learning, or big data were used to locate the studies devoted to the analytical and automation technologies that could assist with halal assurance and increased efficiency of production; the terms financial technology (fintech) were used to locate those studies devoted to online halal markets and consumer behavior; and the terms information technology and digital innovation were used to introduce more exhaustive digital infrastructures and innovations that would facilitate connectivity and traceability in halal supply Most of the articles that were found were journal articles which is the sign that the focus was highly scholarly and digital halal research was already mature.
3. Research indicators
   The selected articles were from the last seven years (2011–2025) and made use of the VOSviewer application with three views: network visualization, overlay visualization, and density visualization. The indicator may be found by examining the overall connection strength between the items shown, both the number of publications and citations.
4. Research procedure
   Data on digital transformation in the halal industry were obtained from the Scopus database for the last 15 years (2011-2025). The choice of this period is strategically planned to capture the most topical and active period of technological development and adoption of digital technology in the global halal industry. The conversation on Industry 4.0, the digital economy, and the Islamic economy has escalated since 2011 and is compelling to implement digital transformation practices into halal production, certification, and trade (Nik Abdullah et al., 2024; Philp et al., 2025). The 15-year window will offer an adequate longitudinal scope to see how the trend in research has been changing over the years, starting with the initial discussion about halal traceability, the use of ICTs, and the latest developments in blockchain, AI, and sustainability convergence. Moreover, information from the year 2025 will allow the research

to consider the last academic input to the topic, and bibliometric analysis will be able to capture the latest trends and changes in the digital era of the halal industry.

Researchers have collected information on Digital Transformation in the Halal Industry based on the Scopus database. All publication data collected in this field, including author bibliographies, countries, institutions, journals, and events with author keywords, were analyzed, visualized, and evaluated using VOSviewer software (Oyewola & Dada, 2022; Sovacool et al., 2022; van Eck & Waltman, 2010, 2017). The VOSviewer software was used to create network representations of frequently used phrases in a field. VOSviewer (Shah et al., 2020) is a popular and useful bibliometric analysis tool. VOSviewer is not only used to create network visualizations but also to analyze the evolution of a field by analyzing frequently used phrases (Huang et al., 2022). According to Huang (Dewi et al., 2021), there are five stages of research in bibliometric analysis.

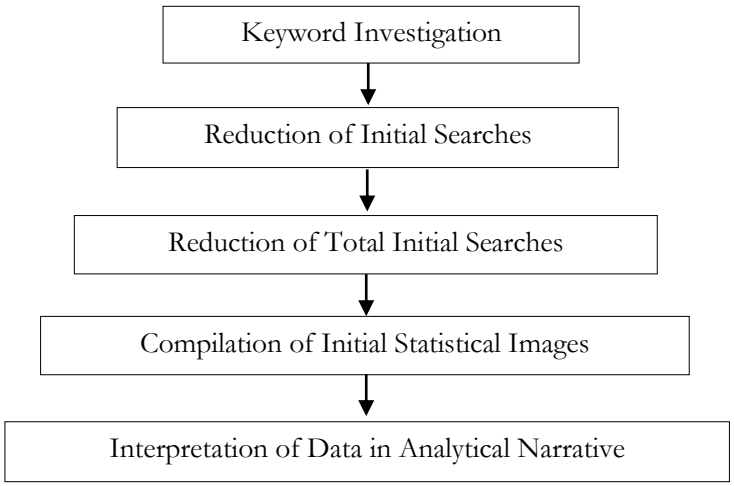

Figure 2. Phases of the method of bibliometric analysis
Source: Dewi et al. (2021)

The bibliometric analysis approach consisted of five steps, as shown in Figure 2. The first stage is Keyword Investigation, where before collecting data, researchers determine keywords that focus on TITLE-ABS-KEY (halal AND ("digital transformation" OR blockchain OR "artificial intelligence" OR AI OR "machine learning" OR "big data" OR fintech OR "financial technology" OR ecommerce OR "e-commerce" OR "digital economy" OR "information technology" OR ICT OR "digital innovation" OR "digital business")) AND PUBYEAR > 2010 AND PUBYEAR < 2026. Additionally, the process of grouping or clustering searches that focus only on predetermined keywords is known as the "Initial Search Reduction" stage. In this step, researchers in the Scopus database look at relevant publications and use these keywords.

The third stage is the Reduction of Total Initial Searches, which entails choosing every search result manually. At this point, the researchers determined the threshold based on the demands of the study using the VOSviewer program. The fourth stage is the Compilation of Initial Statistical Images, which is the process of grouping data as a topic description. During this procedure, visualization results on bibliographic pairings of nations, organizations, journals, publications, and authors were compiled, along with the co-occurrence of author keywords. The last stage is the Interpretation of Data in Analytical Narrative, This provides an explanation of the study's conclusions derived from the selection process. VOSviewer was used to understand the data, and the visualization that was produced showed the data as a variable map associated with the study keywords. The results of this visualization also provide insight into further development opportunities for Digital Transformation in the Halal Industry.

Researchers used the following keywords, and 298 publications on Digital Transformation in the Halal Industry were first found in the Scopus database: TITLE-ABS-KEY (halal AND ("digital transformation" OR blockchain OR "artificial intelligence" OR AI

OR "machine learning" OR "big data" OR fintech OR "financial technology" OR ecommerce OR "e-commerce" OR "digital economy" OR "information technology" OR ICT OR "digital innovation" OR "digital business") AND PUBYEAR > 2010 AND PUBYEAR < 2026. However, the number decreased to 302 articles after the researchers filtered them based on the years 2011–2025 and Publication Type, specifically articles in the Scopus database. The results are presented in Table 1.

Table 1. Number and percentage of digital transformation in the halal industry publications

No	Year	Documents	Percentage (%)
1	2025	61	20,47
2	2024	74	24,83
3	2023	55	18,46
4	2022	25	8,39
5	2021	24	8,05
6	2020	21	7,05
7	2019	13	4,36
8	2018	9	3,02
9	2017	5	1,68
10	2016	2	0,67
11	2015	2	0,67
12	2014	1	0,34
13	2013	3	1,01
14	2012	2	0,67
15	2011	1	0,34
Total		298	100

Source**:** Scopus data

Table 1 indicates a strong positive trend in publications on digital transformation in the halal industry from 2011 to 2025. Of the single publications in 2011 (0.34%), the number of documents grew slowly, but the pace accelerated after 2018. The years 2020 through 2025 indicated the most vigorous growth, with the largest volume of 74 documents (24.83) in 2024, 61 documents (20.47) in 2025, and 55 documents (18.46) in 2023. On the other hand, previous years, such as 2011–2016, reflected very negligible research outputs, averaging less than 2 per annum. This steep rise over the last five years underscores the emerging academic and practical topicality of digital transformation in the halal industry as a result of global tendencies towards digitalization, the development of the halal economy, and the need to implement new technologies in the wake of Covid-19. In general, the distribution highlights a distinct move away from a peripheral scholarly focus in the early 2010s towards a central and fast-growing body of research in the 2020s.

5. Data analysis technique

For readers to follow the information from general to more specific, the data analysis technique used is deductive, starting from general findings to more specific findings. This includes author bibliographic pairs, bibliographic pairs, bibliographic pairs, bibliographic pairs, bibliographic pairs, and keywords (Karakus et al., 2019).

Results and Discussion

The researcher presented the findings of the analysis using a deductive approach. For readers to follow the information from general to more specific information, the results of the bibliometric analysis are presented in a deductive manner, or starting from general findings to more specific findings. Examples include country bibliographic pairs, institute bibliographic pairs, journal bibliographic pairs, publication bibliographic pairs, author bibliographic pairs, and co-occurrence of author keywords (Karakus et al., 2019).

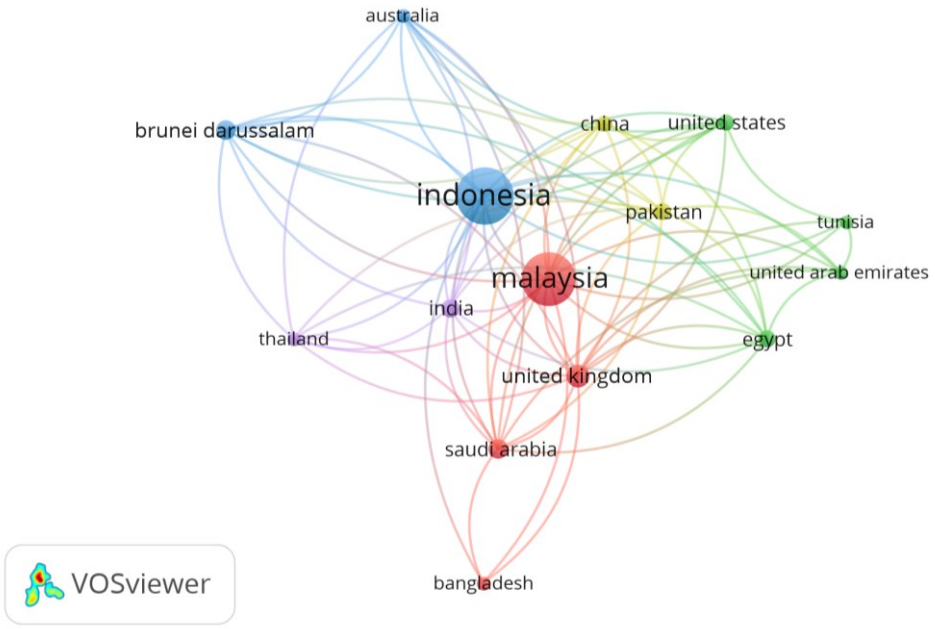

Figure 3. Network visualization of country bibliographic pairs
Source: VOSviewer

Country bibliography pair

Figure 3, which shows a visualization of the network, shows country bibliographic pairs. At this point, we used the criteria that a country must have at least 5 publications and 4 citations. 42 out of 12 countries made the cut. With a total of 1321 link strengths, 1533 citations and 113 publications, Malaysia leads the world in terms of overall link strength. Then, in second place is Indonesia with 1266 total link strength, 930 citations, and 127 publications. Moreover, to show other countries, the researcher will categorize like this, first number will be the total link strength, the second number will be the number of citations, and the third number will be publications. These countries are; United Kingdom (471, 522, 15), India (264, 257, 9), Saudi Arabia (254, 80, 10), China (234, 192, 7), Egypt (190, 93, 8), Pakistan (180, 48, 8), United States (165, 372, 7), Australia (126, 169, 5), Brunei Darussalam (118, 39, 11), Thailand (100, 4, 5), United Arab Emirates (86, 63, 5), Tunisia (60, 258, 5), Bangladesh (33, 72, 5).

Based on the results of the clustering analysis, research collaborations on digital transformation in the halal industry were divided into five main clusters. The first group, Cluster 1, includes Bangladesh, Malaysia, Saudi Arabia, and the United Kingdom, meaning that there is a good relationship between-majority nations and Western nations on this issue. Cluster 2 covers Egypt, Tunisia, the United Arab Emirates, and the United States, a reflection of cooperation throughout the Middle East and the United States. Cluster 3 includes Australia, Brunei Darussalam, and Indonesia, emphasizing Southeast Asia's role in developing halal research with the support of non-Muslim countries such as Australia. Cluster 4 includes China and Pakistan, which emphasize strategic collaboration in the development of halal research capacity. Cluster 5 is a cluster of India and Thailand, so there is increasing research interest in South Asia and Southeast Asia. Overall, this clustering pattern illustrates that research on digital transformation in the halal industry has a collaborative character, involving both Muslim and non-Muslim countries, with increasingly strong cross-regional linkages.

Institution bibliography pair

The pair of bibliographies of the institution is shown in Figure 4, with an overlapping representation. The researchers used a threshold at this stage, where the minimum number of publications of an institution was nine publications that have been cited by at least 38 institutions. Of the 309 institutions, only six met the threshold. Researchers sorted by total link strength, where Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia ranked first with 46 total link strengths,

113 citations, and 13 publications. This was followed by Universiti Teknologi MARA, Shah Alam, Malaysia, with 46 total link strengths, 54 citations, and 16 publications.

The first number is the total link strength, the second number is the number of citations, and the third number is the number of publications from Universiti Utara Malaysia (38, 65, 15), Telkom University (31, 169, 13), Universiti Kebangsaan Malaysia (31, 287, 12), and International Islamic University Malaysia (10, 38, 9).

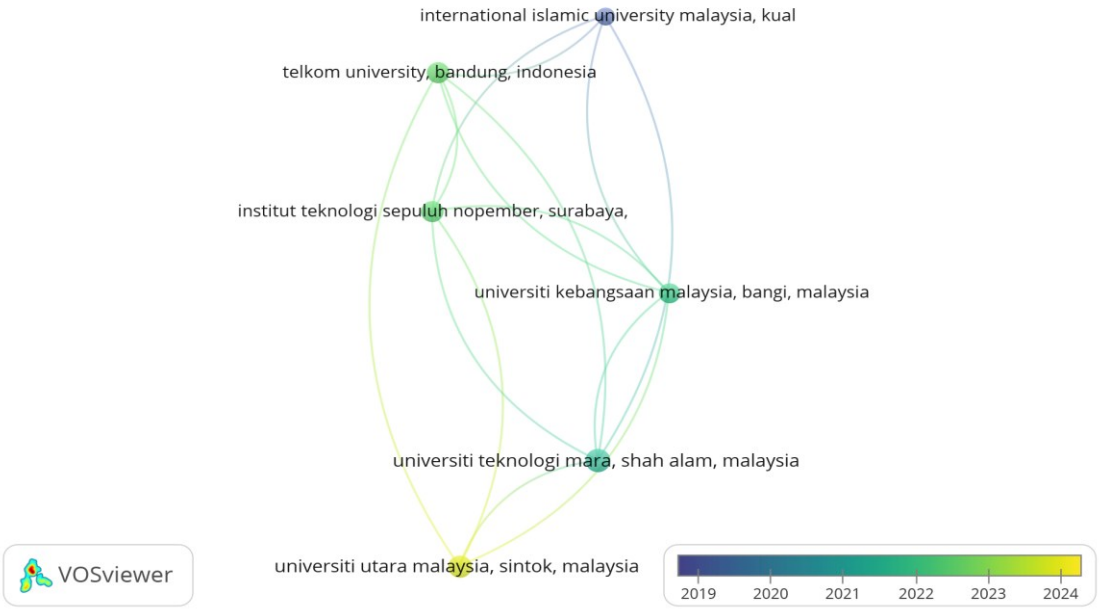

Figure 4. Visualization of overlays on institution bibliographic pairs
Source: VOSviewer

Based on the results of the overlay visualization of institutions, there is a fairly close collaboration network between universities in Indonesia and Malaysia in the field of digital transformation research in the halal industry. Universiti Teknologi MARA, Universiti Utara Malaysia, Universiti Kebangsaan Malaysia, and International Islamic University Malaysia form the center of collaboration from the Malaysian side, whereas Telkom University and Institut Teknologi Sepuluh Nopember are important partners from Indonesia. The color scheme indicates that the majority of the intensive collaborations occurred during the 2020-2024 timeframe, which indicates that interest in this subject has been growing rapidly over the past years. The network shows strong synergies between higher education institutions across countries, focusing on the development of digital-based halal research, while reflecting that the Southeast Asian region is an important center in the global discourse on digital transformation in the halal industry.

Journal bibliography pair

Figure 5 shows journal bibliography pairs with density visualizations. The density of the journal is indicated in yellow. More articles in the journal in question are indicated by the hue that turns solid yellow. At this point, the researchers used a threshold that states that a journal should have at least four papers that have received at least one citation. Of the 138 journals, only five journals met the threshold. The researchers ranked the journals by total link strength, with Journal of Islamic Marketing topping the list with 10 total link strengths, 459 citations and 20 publications, followed by International Journal on Informatics Visualization (5, 21, 4), Springer Proceedings in Business and Economics (4, 1, 4), IOP Conference Series: Earth and Environmental Science (3, 22, 9), Lecture Notes in Networks and Systems (2, 19, 4).

Figure 5 presents a density visualization of journal bibliographic pairs with VOSviewer, where the color density corresponds to the relative extent of the linkage and influence between journals. The Journal of Islamic Marketing seems to be the center with the highest density, showing that it is a dominant part of the citation network and closely connected with other journals,

especially Lecture Notes in Networks and Systems and Springer Proceedings in Business and Economics. Meanwhile, the International Journal on Informatics Visualization and IOP Conference Series: Earth and Environmental Science constitute their own somewhat distinct clusters, implying internal connections, but lacking strong connections to the central cluster. This pattern confirms that the Journal of Islamic Marketing is the core of the study in the bibliographic network under study, whereas other journals play a supporting role with different levels of contribution.

Figure 5. Visualization of density against journal bibliography pairs
Source: VOSviewer

Bibliographic pairs of publications

Figure 6, which displays the network visualization, shows pairs of publication bibliographies. At this point, the researchers used a threshold, which means that an article must have a minimum of 53 citations. Out of 298 publications, only 15 publications met the threshold. Helmi Ali (2021) ranks first with 210 citations, in second place with 211 citations, then successively, Tan (2022), Hew (2020), Ab Talib (2015), Khan (2021), Haleem (2017), Alamsyah (2022),

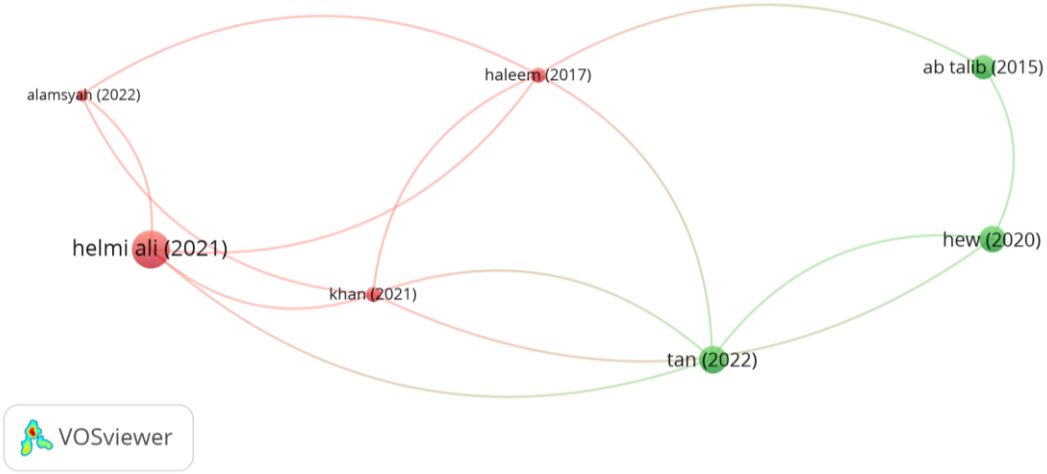

Figure 6. Network visualization of publication bibliographic pairs
Source: Vosviewer

Figure 6 represents the publication network, which is represented through bibliographic pairs, and illustrates the relationships between some major publications. Helmi Ali (2021) is regarded as the central node with the most links, establishing close ties with Haleem (2017), Alamsyah (2022), and Khan (2021); therefore, it is regarded as one of the central documents in this network. Meanwhile, Tan (2022) serves as a cross-cluster connector, while developing a connection not only with the group of Helmi Ali (2021) but also with Ab Talib (2015) and Hew (2020), forming a green cluster with rather solid connections. This pattern suggests two main interlinked clusters, with the first cluster centered on the work of Ali (2021) and the second cluster focused on the work of Tan (2022), with the connections between clusters indicating the integration of topics as well as continuity in broader research.

There were two main clusters of interconnected publications. Cluster 1 is composed of Alamsyah (2022), Haleem (2017), Helmi Ali (2021), and Khan (2021), indicating that these studies focus on similar topics and form a cluster of scholarly works with high bibliographic connections. Cluster 2 includes Ab Talib (2015), Hew (2020), and Tan (2022), which are clusters of closely related studies. This pattern suggests two main foci in the literature, with the first cluster highlighting new and ongoing contributions, whereas the second cluster represents conceptual foundations and the development of more specific themes, both of which remain interlinked in the research network map.

Author's bibliographic pairing

Illustration 7, which is an overlay view, shows the bibliographic pairs for the authors. We used a threshold at this stage, in which the authors considered in the analysis must have at least five published documents and at least 10 citations. Of the 822 authors identified in the database, only nine authors met these criteria: Battour and Mohamed Mohamed ranked first with 181 total link strength, 79 citations, and 6 publications; Mady, Khalid with 181 total link strength, 79 citations, and 6 publications, followed by Salaheldeen, Mohamed (163, 93, 6), Ratnasari, Ririn Tri (135, 20, 5), Vanany, Iwan W. (43, 59, 7), and Salaheldeen, Mohamed (163, 93, 6). (43, 59, 7), Rakhmawati, Nur Aini (39, 49, 7), Fernando, Yudi (6, 72, 6), Rahman, Md Mahfujur (9, 18, 8), and Raimi, Lukman (1, 10, 5).

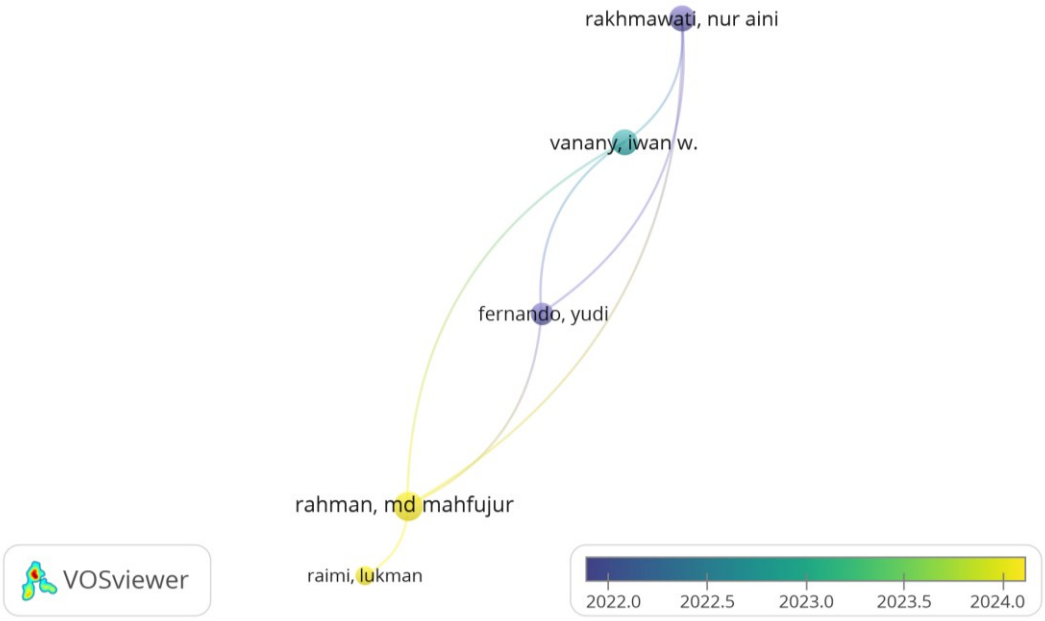

Figure 7. Visualization of overlay on author bibliographic pairs
Source: VOSviewer

Figure 7 shows an overlay visualization of the authors' bibliographic pairs, with color gradations representing the development of publications based on the time span. A strong collaboration network was formed by Rakhmawati, Nur Aini, Vanany, Iwan W., Fernando, and

Yudi around 2022, with a blue to green color. Rahman, Md Mahfujur and Raimi, Lukman, by comparison, are more recent and concurrently more eminent in more recent publications, yellow denoting recent contributions. Such a trend represents a continuity between authors who make an initial contribution, which forms the basis of the study, and another group of authors who reinforce and revise the study later, which results in creating a stratified and related dynamic of research development.

Co-occurrence of keywords from authors

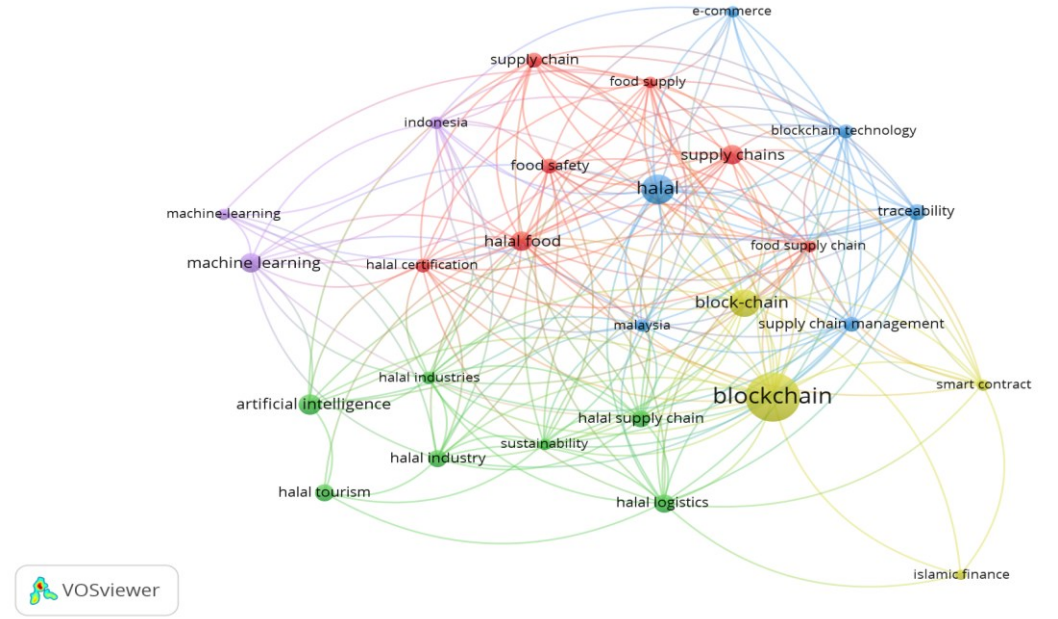

Figure 8. Network visualization of co-occurrence of author keywords
Source: VOSviewer

Figure 8 shows a network visualization of the co-occurrence of author keywords. At this point, researchers used a threshold, which means that there must be at least nine co-occurrences. Out of 1446 keywords, 27 keywords met the threshold. blockchain ranks first with 62 occurrences, and 142 total link strength, in second place is the keyword block-chain, with 30 occurrences, and 108 total link strength, then with the keyword supply chains with 20 occurrences, and 71 total link strength, then successively written dengarn keywords (total link strength, occurrences), namely, supply chains (71, 20), halal food (61, 20), halal (58, 34), traceability (52, 16), food supply (48, 10), supply chain (46, 14), supply chain management (43, 14), food supply chain (38, 10), blockchain technology (37, 13), food safety (37, 14), halal supply chain (35, 17), malaysia (35, 12), halal logistics (33, 18), halal industry (31, 17), smart contracts (30, 11), halal industries (28, 12), sustainability (28, 11), halal certification (25, 13), machine learning (25, 20), indonesia (24, 12), artificial intelligence (23, 21), machine-learning (16, 10), e-commerce (12, 10), halal tourism (8, 17), islamic finance (8, 9).

Based on the clustering results, research keywords were divided into five main clusters. Cluster 1 focuses on supply chain and food safety aspects, which include food safety, supply, supply chain, halal certification, halal food, supply chain, and supply chains. Cluster 2 presents the halal industry and the technologies that support it using the following keywords artificial intelligence, halal industries, halal industry, halal logistics, halal supply chain, halal tourism, and sustainability. Cluster 3 combined technology, management, and geographical context issues, including blockchain technology, e-commerce, halal, malaysia, supply chain management, and traceability. Cluster 4 focuses on digital innovation with blockchain, Islamic finance, and smart contracts. Meanwhile, Cluster 5 yielded regional context and learning technologies, such as Indonesia, machine learning, and machine learning. On the whole, this cluster division demonstrates strong interdependence of halal supply chain problems, digital technologies, in particular blockchain and AI, with the regional aspect in Southeast Asia, particularly Indonesia and Malaysia.

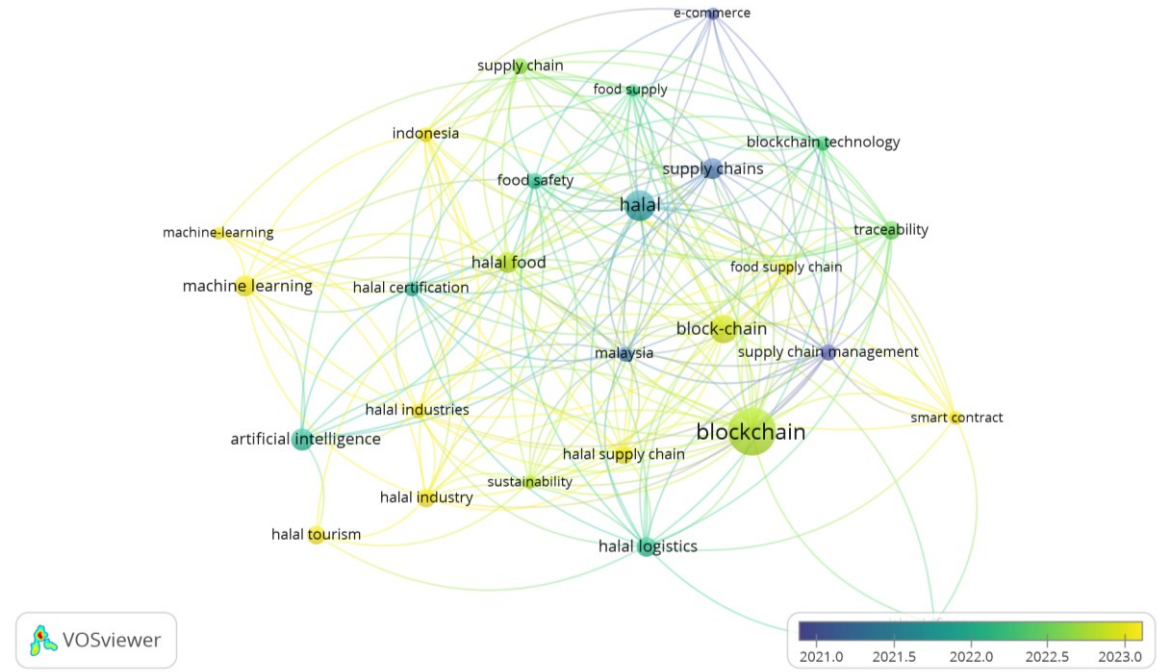

Figure 9. Visualization of overlay against co-occurrence of author keywords
Source: VOSviewer

This co-occurrence visualization overlay provides a rich picture of the dynamics of research development on the topics of blockchain and halal supply chains. Figure 9 shows that the keywords "blockchain" and "halal" occupy a central position with the highest degree of connectedness to other keywords, indicating that these two topics have become the main axis of research in the last decade. The visualization colors indicate the time tendency: bluish terms such as supply chain, food safety, food supply, and halal certification prevail in the first period (about 2020-2021) due to the specifics of the study on the foundations of supply chain and product quality safety.

Furthermore, keywords with green to yellow gradations, such as blockchain, halal logistics, smart contracts, sustainability, and artificial intelligence, began to appear and develop more intensively in the 2022-2023 period. This indicates a shift in research from the traditional focus on halal assurance and food safety towards the integration of cutting-edge digital technologies, such as blockchain and AI, to support the efficiency, transparency, and sustainability of the halal supply chain system.

From the pattern of linkages, it is also evident that regional issues such as Malaysia and Indonesia have a prominent place, confirming that blockchain-based halal supply chain discourse is highly relevant in the Southeast Asian region as the center of the global halal industry. Thus, this visualization not only maps the dominant themes but also shows the evolution of research towards a more innovative and multidisciplinary direction, combining halal studies, digital technology, logistics, and sustainability.

Conclusion

The aim of this study was to map the trends in the study of the digital transformation of the halal industry on a world map with the help of a bibliometric method using Scopus data on the subject to 2011-2025. The results align with the early goals and objectives that show how digital transformation has become a growth force, innovative, and sustainable in the global halal ecosystem. Bibliometric mapping showed that the number of publications has increased dramatically since 2018, and this tendency proves the growing academic interest in technologies such as blockchain, artificial intelligence, machine learning, fintech, big data, and e-commerce as providers of transparency, efficiency, and consumer confidence.

In terms of geography, Malaysia and Indonesia produce the highest volume of research and cooperation, and cement Southeast Asian dominance as the hub of digital halal research. In-store,

good inter-university connections, and the pre-eminence of the Journal of Islamic Marketing also indicate a fully grown and interrelated research environment between conceptual and applied formats. The identified thematic change, that is, between halal certification and supply chain research and digital technology and sustainability, is also consistent with the research objective of determining new frontiers and interdisciplinary fusion of the halal industry.

Our findings have two implications. Hypothetically, this study assists in developing a conceptual analysis of the two-fold transformation in which digitalization and sustainability meet to create more competition in the halal industry. Practically, it provides policymakers and industry stakeholders with an indicator to establish inclusive digital ecosystems that would promote the idea of halal compliance, consumer trust, and competitiveness at the global level.

Nonetheless, this research is constrained by the fact that it uses the Scopus database, which might not be able to identify all pertinent literature, and the bibliometric approach itself, as it is designed to identify trends and not qualitative data. The latter databases, such as Web of Science or Dimensions, must be included in future studies, and bibliometric mapping should be complemented by content analysis or case studies that will help to study the implementation of digital technologies in various halal sectors and regions.

Altogether, this study proves that digital transformation in the halal business is not just a temporary event but a paradigm shift to redefine the way the halal economy is integrated with global sustainability goals. Cross-border and interdisciplinary cooperation will also be vital in the future to ensure that the halal industry is innovative and resilient in the digital era, but with a focus on ethics.

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