

Mapping the nexus between digital transformation and the green brand in the context of achieving SDGs

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Abstract. The aim of this study is to conduct an extensive review and evaluation of the global scientific literature that explores the nexus between digital transformation and green brands in achieving SDGs. This study focuses on 866 relevant scientific articles published in journals indexed in the Scopus database. The analysis encompasses a timeframe spanning from 2000 to 2023, with data collected up to September 1. The research process followed a logical sequence involving the collection and processing of relevant articles, followed by the application of various bibliometric methods to analyze and visually present the gathered data. Biblioshiny, VOSviewer 1.6.16 software toolkits, and Scopus analytical tools were employed for the bibliometric analysis. In the final stage, the obtained results were integrated, and potential directions for future research were explored. The findings suggest that digitalization acts as a catalyst for advancing sustainable development, ultimately facilitating the development and promotion of green brands. This chain of influence underscores the consensus among scholars that digitalization and green brands play instrumental roles in contributing to the achievement of SDGs. However, there is a relative scarcity of studies directly addressing the relationship between digitalization and green branding. This gap underscores the need for further research in this specific area to bridge the knowledge divide and provide valuable insights into how the synergy between digitalization and green branding can be harnessed to promote sustainability and advance the SDGs.

1 Introduction

In the highly competitive global landscape, nations are actively working to establish distinctive national brands to enhance their international presence. A country's image holds sway over its political and economic capabilities, global standing, etc. However, the creation

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of a successful national brand necessitates more than just achieving economic objectives; it also involves addressing pressing social and environmental issues. The growing concerns related to ecological pollution and the depletion of natural resources pose significant risks not only to the business sector but also to the overall well-being of the country. These concerns resonate with people worldwide and underscore the importance of addressing environmental challenges as an integral part of a nation's brand-building efforts.

As economies continue to grow rapidly, environmental challenges such as shortages of natural resources and increased carbon emissions have progressively risen to the forefront. To confront these challenges, there is a growing emphasis on encouraging governments and businesses to embark on a green transition and assume their social responsibilities. It entails adopting more sustainable and environmentally friendly practices to mitigate the negative impacts of economic development on the planet.

The Sustainable Development Goals (SDGs) adopted for 2030 represent a global commitment to reshape the world. They are altering market dynamics by embedding sustainability at the heart of business practices, driving the creation of innovative products and the emergence of new market niches. Consequently, governments and businesses are embracing sustainable development strategies and positioning themselves as green brands in the international marketplace. This shift reflects a growing recognition of the importance of sustainability not only as a global responsibility but also as a strategic driver of economic growth and competitiveness on the global stage.

Currently, in line with environmental concerns, digitalization has taken center stage in public policy discussions on a global scale. The EU and its European Green Deal (EGD) [2] are actively integrating policy initiatives focused on both digital technologies and environmental sustainability. Notably, the EU Commission has outlined its commitment to exploring measures that enable digital technologies such as cloud and edge computing, artificial intelligence (AI), 5G, and the Internet of Things (IoT) to accelerate and enhance the effectiveness of policies aimed at addressing climate change and environmental protection [3-11].

Furthermore, the EGD [2] introduces the adoption of the European Industrial Strategy [12], which will explicitly address the dual challenges of transitioning toward both environmental sustainability and digital transformation. This integrated approach underscores the recognition that digital technologies can play a pivotal role in advancing sustainability goals and protecting the environment while strengthening the green brand.

According to the World Economic Forum [1], technological solutions have the potential to reduce emissions by over a third of the 50% reduction needed by 2030 to address climate change effectively. Digitalization plays a crucial role in helping the EU achieve its sustainability objectives. The application of these digital technologies across various industries and the development of new digital services can significantly accelerate the process of decarbonization in diverse sectors. Moreover, advanced connectivity and high-capacity networks might enhance efficiency and contribute to making economies greener and more sustainable.

2 Literature review

The preliminary literature review [13-66] demonstrates that a country's influence and competitiveness in the international market are contingent upon its performance across the three critical dimensions of sustainable development: economic, social, and environmental. These studies underscore the interconnectedness of these dimensions and how they collectively shape a nation's standing in the global marketplace.

In the context of study [67-79], the concept of green branding was explored as an integral component of sustainable development. The authors observed a positive trend in the level of

scientific interest dedicated to investigating green brands, which led to the emergence of circles of scholars dedicated to exploring the various facets of green branding in the context of sustainable development.

Numerous scientists have underscored the importance of focusing on the development of a country's green brand as a means of enhancing its investment attractiveness. It was proven that [80-81] green investments play a pivotal role in fostering economic growth, particularly when the proportion of renewable energy in the final energy consumption rises. Additionally, engaging in green business activities could lead to improved performance, driven by heightened interest from investors who prioritize sustainability and environmental responsibility [82].

Through the application of structural equation modeling, Tiwari [83] unveiled a noteworthy and significant relationship between green brand, green satisfaction, green loyalty, and green word of mouth. The study's conclusions have revealed that green awareness and a positive green brand image have a tangible impact on encouraging green word-of-mouth. This effect is particularly pronounced among millennials, who are recognized as active advocates in the global fight against climate change. This research underscores the pivotal role of green branding and its influence on environmentally conscious consumer behavior and advocacy.

Panda et al. [84] concluded that sustainability awareness exerts a positive influence on consumer altruism. This, in turn, has a cascading effect, enhancing consumer purchase intention, green brand loyalty, and green brand evangelism. This research highlights the important role of altruism in bridging the value-action gap for green brands. In essence, when consumers are more aware of sustainability issues and act altruistically, it not only drives their own purchase intentions but also fosters loyalty to green brands and motivates them to become advocates for these brands.

On the other hand, there is a stream of scientific literature that supports the conclusion that digitalization can indeed contribute to environmental sustainability [85-111]. This suggests that the adoption and integration of digital technologies and practices can have a positive impact on environmental conservation and sustainability efforts [112-133].

Luo et al. noted that the development of the digital economy has the potential to enhance green innovation in several indirect ways [134]. One of these is fostering greater economic openness, which could lead to increased cross-border collaboration and the exchange of environmentally friendly technologies and practices. Additionally, the optimization of industrial structures, often driven by digitalization, could promote the development and adoption of green technologies and processes. Furthermore, the expansion of market potential, facilitated by the digital economy, could create opportunities for green innovation as companies seek to meet the demands of environmentally conscious consumers.

Balogun et al. [135] indicated that digitalization empowers cities to transform their socioeconomic dynamics in favor of sustainability by optimizing resource use, promoting renewable energy, reducing waste, enhancing mobility, facilitating data-driven decisions, engaging citizens, and improving resilience to climate challenges. These advancements contribute to the creation of urban environments that are more climate-friendly and conducive to sustainable development.

Therefore, the initial scientific literature review unveils a significant research gap related to the interplay between digitalization and green branding within the context of achieving SDGs. While previous studies have focused on the environmental sustainability consequences of digital transformation, there is a lack of empirical evidence to substantiate the influence of digitization on the development of green brands. This gap underscores the need for further investigation to comprehensively understand how digitalization could contribute to the promotion and enhancement of green brands in the context of achieving SDGs.

Therefore, the aim of this paper is to conduct a comprehensive review and assessment of the global scientific literature concerning the nexus between digital transformation and green brands within the context of achieving the SDGs. To achieve this aim, this study ran a bibliometric analysis of the international scope of scientific publications indexed in the Scopus database, widely recognized as the largest multidisciplinary database available. This study offers both quantitative and qualitative insights into the overall landscape of the theoretical framework addressing the relationship between digital transformation and green brands in the context of SDG attainment.

The paper's structure is organized as follows: the introduction section provides the research problem and underscores the need to analyze the extent of scientific literature addressing the interplay between digitalization and green brands concerning SDG achievement. The literature review section presents the initial findings from the scientific literature analysis on this subject. The methodology section outlines the materials and methods employed to achieve the research objectives. The research results section reports the outcomes of the bibliometric analysis, shedding light on the current state of research in this area. Finally, the section with conclusions offers relevant conclusions and suggests future research directions.

3 Methodology

This section of the paper outlines the methodology employed for conducting a bibliometric analysis to investigate the relationship between the research fields on digital transformation and green brands within the context of achieving the SDGs. The study utilized the Scopus scientific research database, recognized as the largest repository of scientific literature globally [136-155]. This extensive database enables a comprehensive examination of global research output, providing an in-depth critical assessment of the subject under investigation.

The bibliometric analysis, complemented by knowledge visualization techniques, was applied to examine the connections among articles, thereby creating a comprehensive overview of emerging trends and potential research avenues within the studied field. The analysis included an assessment of publication trends, key thematic areas, prolific authors and their collaborative networks, and contributions from journals, affiliations, and countries. It is worth mentioning that one of the critical advantages of bibliometric analysis is its ability to ensure a quantitative and objective literature review, thereby minimizing potential subjective biases introduced by the authors [156-163].

The bibliometric analysis was performed using the bibliometric R package, VOSviewer 1.6.19 software, and Scopus toolkit. The research process involved three stages: first, the collection and preprocessing of articles relevant to the research topic; second, the application of various bibliometric techniques to analyze and visualize the findings; and third, the integration of the obtained results and the discussion of potential directions for future research.

The search of relative publications was conducted using combinations of different keywords to include the articles devoted to 1) green brand – ‘green brand’, ‘sustainable brand’, ‘ecological brand’, ‘environmental brand’, ‘environmentally friendly brand’, ‘eco-friendly brand’, ‘eco brand’, ‘responsible brand’; 2) ‘sustainable development’, ‘sustainab*’, ‘sustainable development goal’; and 3) ‘digitalization’, and ‘digital*’.

The Boolean operator ‘AND’ was utilized to combine the keywords and their variations, and the ‘*’ operator captured various word endings. To ensure the inclusion of relevant publications, the search results were narrowed down to article document type and specific subject fields: 1) business, management, and accounting, 2) social sciences, and 3) economics, econometrics, and finance. The research encompassed publications from 2000 to September 1, 2023.

After the filtering process, the analysis was conducted on a comprehensive dataset consisting of 866 articles. Among these, 78 articles were single authored, while 788 articles had multiple coauthors (Table 1). These articles were sourced from 451 distinct sources (journals, books, etc.). The dataset comprises a cumulative total of 2689 authors, with 77 authors exclusively contributing to single-authored articles. International coauthorship is observed in 30.48% of cases. On average, each article is authored by approximately 4 scholars. The average age of the documents in the dataset is calculated to be 1.85 years, with an annual growth rate of 25.31%. Furthermore, the average number of citations per article is 11.39, and the total number of references across all documents amounts to 55633.

Table 1. The main characteristics of the filtered dataset

Description	Value
Timespan	2000-2023 (up to September 1)
Documents (articles)	866
Single-authored documents	78
Multiauthored documents	788
Average citation per document	11.39
Document average age	1.85
Annual growth rate, %	25.31
References	55633
Sources	451
Authors' keywords	2917
Authors	2689
Authors of single-authored documents	77
Coauthors per document	3.53
International coauthorship, %	30.48

Source: developed by the authors.

To assess the primary research trends within the studied field, this research employed both productive (such as the annual growth rate of investigated articles) and impact metrics. The impact metrics encompass contributions from scholars, journals, authors, affiliated countries and institutions. Analysis of productive and impact metrics offers a comprehensive understanding of the evolution and significance of research within the investigated field, allowing for a more robust analysis of research trends.

This study utilized Scopus analytical tools to accomplish several objectives, including tracking the publication trends within a selected sample of documents to understand how the research in the field has evolved over time; identifying and recognizing the authors who have been most actively engaged in research within the field; and assessing and quantifying the contributions of different affiliations (such as universities or research institutions) and countries to the research output in the field.

In this study, a method for visualizing similarities was applied to construct networks that depict collaborations among scholars on a global scale. For coauthorship analysis by countries, a full counting method was employed. Additionally, a minimum of five documents per country was set as the threshold. Consequently, 34 out of 93 countries met these criteria for analysis.

Furthermore, co-occurrence analysis was used to create a network map illustrating the co-occurrence of keywords. The full counting method was applied in this analysis, with a minimum threshold of five occurrences for keywords. The analysis also calculated the total link strengths of co-occurrences with other keywords. As a result, 76 keywords out of a total of 2886 met the specified threshold for inclusion in the analysis.

These analytical techniques and thresholds were employed to gain insights into collaboration patterns among scholars. The study utilized cword network analysis and

clustering methodologies to categorize thematic areas associated with the keywords under investigation. These methodologies allowed for the identification of distinct themes within the research area by examining connections and co-occurrences among keywords.

4 Results

The analysis of scientific studies indexed by the Scopus database identified a total of 688 articles that focus on the intersection of digital transformation, green brand withing pursuing SDGs. These articles were published between 2000 and 2023 (up to September 1, 2023). The substantial number of articles reflects the growing interest in understanding how digitalization could contribute to green branding efforts and the broader agenda of achieving SDGs.

Figure 1 provides an overview of the evolving research landscape at the nexus between digital transformation, green brand, and achieving SDGs, highlighting the increasing scholarly interest in this area over the years. Notably, it excludes data from 2000 to 2007 due to the limited number of publications during that period, totalling three articles (one in 2000 and two in 2001).

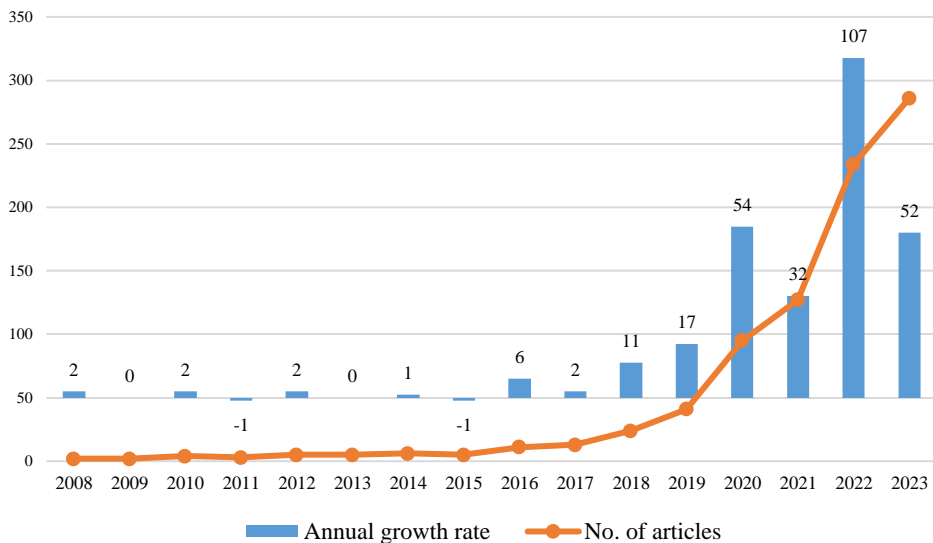


Fig. 1. Annual scientific production according to Scopus, 2008-2023 (up to September 1)

Source: Developed by authors based on Scopus data.

Figure 1 highlights the annual growth in the number of investigated publications since 2008, with two notable spikes in publication activity: one in 2016 and another in 2019. The growth of publication activity may be attributed to various factors, including the increasing awareness of environmental issues, adverse climate change, advancements in digital technologies, and the rising importance of sustainability in business and branding.

The surge in publications in 2016, which could coincide with the adoption of the SDGs, suggests that the global commitment to SDGs may have stimulated the research activity. The second spike in 2019 could be caused by the COVID-19 pandemic. It has significantly impacted various aspects of society. This event may have influenced research trends in 2020 and beyond, with scholars exploring the role of digital transformation in the context of the pandemic's effects on sustainability.

The analysis of the publications in the investigated scope of scientific literature has revealed several countries with significant contributions. Among these countries, China stands out as the leader, accounting for 16.7% of the publications (176 articles or 20.3%). Other contributors include Italy (67 articles or 7.7%), Germany (62 articles or 7.1%), the UK and Ukraine (57 articles or 6.6%), and India (56 articles or 6.5%). Notably, many studies involve collaboration between scientists from different countries, indicating the global nature of research in this field. Notably, the share of international coauthorships is 30.48%.

To visualize the patterns of coauthorship between countries, the VOSviewer tool was employed. The resulting visualization (Figure 2) provides insights into the collaborative networks among countries in the field of investigation. It helps identify clusters of countries that frequently collaborate on research related to the topic under study.

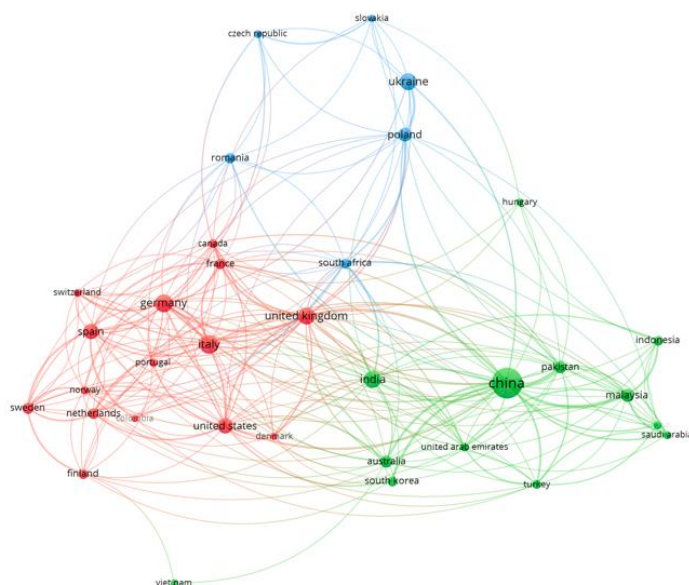


Fig. 2. The network of worldwide scientific collaboration

Source: developed by authors using VOSviewer software tools.

The size of each circle corresponds to the number of documents published by researchers from the particular country. Additionally, the distance between circles indicates the strength of collaboration between two countries. The shorter distances indicate more frequent collaboration. The color of the circles represents specific clusters of coauthorship among countries.

Based on the visualization, there are three main clusters of coauthorship among countries. Thus, the first (red) cluster indicates wide collaborations among EU countries (Denmark, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland), Canada, Colombia, Norway, the UK, and the USA. Notably, in this cluster, the leading countries by the number of published articles are Spain (47 articles), Germany (62 articles), the UK (57 articles), and the USA (46 articles).

The second (green) cluster uncovers the collaboration between scholars from China, Australia, India, Indonesia, Malaysia, Pakistan, Saudi Arabia, South Korea, Taiwan, Turkey, the UAE, Vietnam, and Hungary. In turn, in this cluster, the leaders are China (176 articles) and India (56 articles). Additionally, it is worth noting that China has established the most extensive coauthorship network in this research field. This network comprises a total of 26

collaborative interactions. Notably, Chinese scholars have predominantly collaborated with researchers from Pakistan.

The third (blue) cluster shows the collaboration between the Eastern EU countries (Poland, Slovakia, Czech Republic, and Romania), Ukraine and South Africa. Herewith, in this cluster, the most productive countries are Ukraine (57 articles) and Poland (36 articles).

The results revealed that a total of 1213 affiliated institutions were actively involved in researching the connections between digital transformation and green brands within the context of achieving the SDGs. Table 2 presents a ranking of the top 10 affiliated institutions globally that have published a relatively substantial number of articles based on the refined Scopus dataset.

Table 2. Top 10 affiliations in research according to Scopus, 2000-2023 (up to September 1)

Nº	Affiliation	No. of articles	Authors/Doc.	Country
1	School of Management and Economics	16	437/802	China
2	Sumy State University	16	1819/ 4719	Ukraine
3	The Bucharest University of Economic Studies	15	2469/ 7125	Romania
4	University of Salerno	14	4762/39417	Italy
5	Leibniz Centre for Agricultural Landscape Research (ZALF)	13	600/ 3625	Germany
6	Technische Universität Braunschweig	12	11264/ 42605	Germany
7	National Economics University	11	766/ 1189	Vietnam
8	Shandong University	11	49640/ 127604	China
9	Universidad Politécnica de Madrid	11	49650/ 11391	Spain
10	Xinjiang University	11	10608/ 17291	China

Source: developed by authors based on the Scopus data

This ranking three affiliations are from China (School of Management and Economics, Shandong University, and Xinjiang University), two from Germany (Leibniz Centre for Agricultural Landscape Research (ZALF) and Technische Universität Braunschweig), and per from Ukraine (Sumy State University), Romania (The Bucharest University of Economic Studies), Italy (University of Salerno), Vietnam (National Economics University), and Spain (Universidad Politécnica de Madrid). In turn, the School of Management and Economics in China emerged as the most prolific affiliated institution. This affiliation accounts for 437 authors who contributed 16 articles to the research in the investigated field. On average, each affiliated institution published approximately 0.71 articles.

Table 3 presents the top-10 sources out of a total of 451 (including journals, books, and others) that have made significant contributions to the advancement of research on the connections between digital transformation and green brands within the framework of achieving the SDGs.

The Swiss journal ‘Sustainability’ (MDPI publisher) has secured a place in the top 10 most productive sources (with an h-index of 136). It is worth noting that all these sources have received more citations than what is typically expected within their respective subject fields (indicated by the SNIP 2022 metric). Additionally, the UK journal ‘Journal of Cleaner

Production' boasts the highest average number of citations received per document (CiteScore of 18.5 in 2022).

Table 3. TOP-10 prolific sources according to Scopus, 2000-2023 (up to September 1)

№	Sources	No. of doc.	Publisher	Country	h-index	SNIP 2022	CiteScore 2022	Scopus cov. years
1	Sustainability	105	MDPI	Switzerland	136	1.198	5.8	2009-pr.
2	Journal of Cleaner Production	21	Elsevier Ltd.	UK	268	2.379	18.5	1993-pr.
3	Business Strategy and the Environment	31	Wiley-Blackwell	UK	131	2.754	17.8	1992-pr.
4	Technological Forecasting and Social Change	12	Elsevier Inc.	USA	155	3.008	17.2	1970-pr.
5	Energies	11	MDPI	Switzerland	132	1.025	5.5	2008-pr.
6	Environmental Science and Pollution Research	11	Springer Nature	Germany	154	1.214	7.9	1994-pr.
7	Environment, Development and Sustainability	9	Springer Nature	Netherlands	72	1.291	7.2	1999-pr.
8	Technology in Society	9	Elsevier Ltd.	UK	69	2.058	11.2	1979-pr.
9	International Journal of Environmental Research and Public Health	9	MDPI	Switzerland	167	1.280	5.4	2004-pr.
10	Resources Policy	9	Elsevier Ltd.	UK	95	2.001	11.3	1974-pr.

Sources: developed by the authors.

Table 4 highlights seven authors who have made substantial contributions to the advancement of the analyzed topic between 2000 and 2023 (up to September 1). These authors hail from six different countries (Taiwan, China, India, Vietnam, Ukraine, and Germany).

In terms of the number of articles published up to 2023 (September 1), the Chinese scholar Chen Yushan stands out as the most prolific author on the investigated topic (7 articles). However, the share of articles devoted to investigating the nexus between digital transformation and green brands within the context of achieving the SDGs is approximately 9%.

On the other hand, Table 4 indicates that Sharma Meenakshi specializes in the investigated field (46.1% of scholarly publications are dedicated to investigating the nexus between digital transformation and green brands within the context of achieving the SDGs). It is worth mentioning that all the above authors have a significant interest in sustainability research.

Looking at the global stage, the most productive author is Hao Yu from China (h-index is 62). The scholar has published 179 publications that have been cited 10238 times. However, the investigated topic represents approximately 3% of the scholar's research

output. Furthermore, this scholar has the most expanded research collaboration networks (272 coauthors).

Table 4. Prominent authors in the investigated research field, according to Scopus, 2000-2023 (up to September 1)

No	Authors	No. of doc./Total	TC	h-index	No of coauthors	Country
1	Chen Yushan	7/78	8249	35	68	Taiwan
2	Wu Haitao	7/46	3419	30	72	China
3	Hao Yu	6/179	10238	62	272	China
4	Sharma Meenakshi	6/13	143	5	7	India
5	Ha Lethanh	5/83	412	12	46	Vietnam
6	Pimonenko Tetyana V.	5/79	1461	26	93	Ukraine
7	Santarius Tilman	5/35	780	13	71	Germany

*Note: TC – Total citations; FWCI – Author Field Weighted Citation Impact.

Sources: developed by the authors.

Table 5 presents the top 10 most cited and influential articles on the investigated topic in the Scopus database from 2000 to 2023 (September 1). These articles are considered highly influential in advancing research on the relationship between digital transformation and green brands in the context of achieving the SDGs.

Table 5. Top 10 most cited articles according to the filtered Scopus dataset, 2000 to 2023 (up to September 1)

No	Authors/Year	Title	TC	FWCI	Readers
1	Lange et al. (2020) [70]	Digitalization and energy consumption. Does ICT reduce energy demand?	346	27.37	464
2	Ren et al. (2021) [71]	Digitalization and energy: How does internet development affect China's energy consumption?	304	34.48	195
3	Gandhi et al. (2018) [72]	Ranking of drivers for integrated lean-green manufacturing for Indian manufacturing SMEs	205	7.53	546
4	Burmann et al. (2009) [73]	Toward an identity-based brand equity model	168	2	718
5	Panda et al. (2020) [74]	Social and environmental sustainability model on consumers' altruism, green purchase intention, green brand loyalty and evangelism	154	9.19	783
6	Kam Fung So et al. (2010) [75]	"When experience matters": Building and measuring hotel brand equity: The customers' perspective	138	1.32	281
7	Balogun et al. (2020) [76]	Assessing the Potentials of Digitalization as a Tool for Climate Change Adaptation and Sustainable Development in Urban Centers	133	8.86	555
8	Denicolai et al. (2021) [77]	Internationalization, digitalization, and sustainability: Are SMEs ready? A survey on synergies and substituting effects among growth paths	121	14.72	713
9	Kang and Hur (2012) [78]	Investigating the Antecedents of Green Brand Equity: A Sustainable Development Perspective	118	1.38	325
10	Chauhan et al. (2022) [80]	Linking circular economy and digitalization technologies: A systematic literature review of past achievements and future promises	107	28.33	677

*Note: TC – Total citations; FWCI – Field-Weighted citation impact.

The most cited article is titled ‘Digitalization and energy consumption. Does ICT reduce energy demand?’ published in 2020 [70]. This article had been cited 346 times (with an average of more than 38 citations per year). The FWCI suggests that the actual citations of this article exceed the expected number by 27.37, highlighting its significant impact. Lange S., Pohl J., and Santarius T. devoted their article to examining the impact of digitalization on energy consumption. The authors concluded that digitalization contributes to sustainability when it leads to greater energy efficiency and economic growth through improved labor and energy productivity without causing direct effects related to the production, use, and disposal of information and communication technologies.

To gauge the interaction with the mentioned articles (Table 5), the PlumX matrix 'Readers' was considered. Thus, the most cited article [70] has been added 464 times to the readers' library or briefcase, indicating its substantial influence and readership in the academic community. On the other hand, the largest number of readers (783 individuals) relates to the article by Panda et al. [74] ‘Social and environmental sustainability model on consumers' altruism, green purchase intention, green brand loyalty and evangelism’.

To enhance the analysis of keyword evolution, the study divided the period of publication activity into three subperiods: 1) pre-UN SDGs adoption – 2001-2014 (predates the adoption of UN SDGs and serves as a baseline for understanding pre-SDG research trends); 2) the UN SDGs influence – 2015-2019 (the period from the adoption of the UN SDGs up until the emergence of COVID-19 shading light on how the global sustainable development agenda influenced research on investigated topic); 3) a modern period – 2020-2023 (up to September 1) (captures the latest trends in research on digitalization and green brand in the context of achieving the SDGs).

Figure 3 provides a more detailed examination of how keyword trends have evolved over time in specific intervals, allowing for the capture of nuances and shifts in keyword usage and relevance within different phases. This approach enhances the study's ability to comprehensively understand the development trends in the intersection of research on digitalization and green brands in the context of achieving the SDGs.

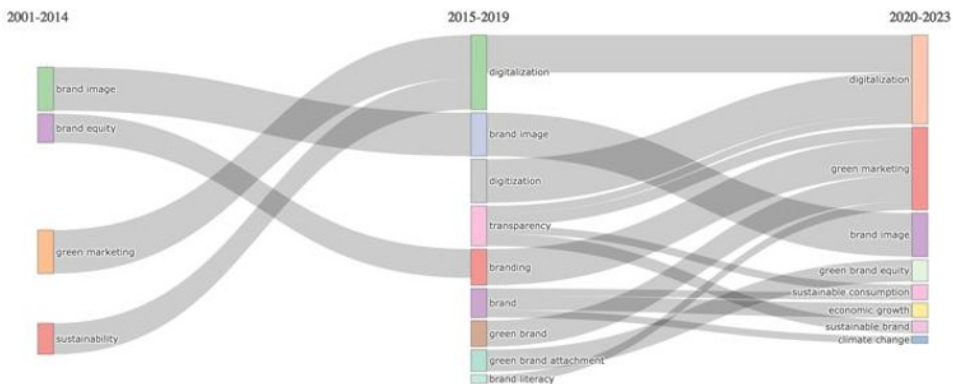


Fig. 3. Thematic evolution of the investigated keywords, 2000-2023 (up to September 1)

Source: Developed by authors based on Scopus data.

The findings reveal that prior to the adoption of UN SDGs, scholars primarily focused on topics such as brand equity, brand image, sustainability, green marketing, and sustainability. In turn, the research on green marketing and sustainability transitioned to digitalization in 2015-2019 (Figure 3).

During 2015-2019, the most popular research topics included digitalization, digitization, transparency, branding, brand, green brand, green brand attachment, and brand literacy. Notably, the topic of brand image maintained its popularity throughout all periods.

Since 2020, scholars have continued to explore digitalization issues. At the same time, the most prominent research concerns digitalization, green marketing, brand image, green brand equity, sustainable consumption, economic growth, sustainable brand, and climate change. Research on transparency has diversified into studies on digitalization, green marketing, sustainable consumption, and sustainable brands. Figure 3 highlights the particular emphasis on green marketing issues within branding research by scholars. Therefore, in 2020-2023 (up to September 1), the most prominent research concerns digitalization, green marketing, brand image, green brand equity, sustainable consumption, economic growth, sustainable brand, and climate change.

Figure 4 provides a visual representation of the keyword co-occurrence map, delineating the primary scientific clusters within the examined scientific articles spanning from 2000 to 2023 (up to September 1). This map was constructed by analyzing the interconnections between authors' keywords, considering keyword links, total link strengths, and occurrence frequencies. To ensure the robustness of the clusters, a minimum threshold of five keyword co-occurrences was applied. Consequently, 76 keywords out of a total of 2886 met this criterion. These keywords formed five distinct clusters.

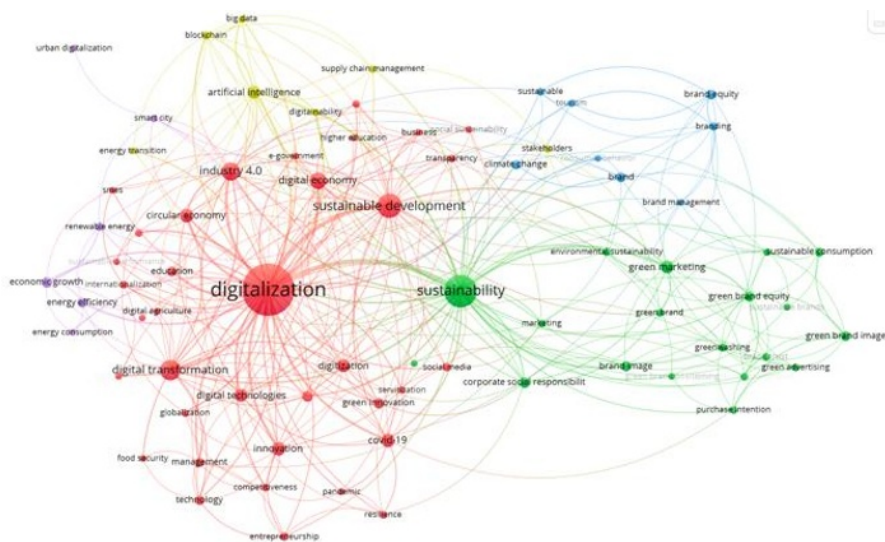


Fig. 4. The network map of keywords' co-occurrences, 2000-2023 (up to September 1)

Source: developed by authors using VOSviewer software tools.

Each cluster is denoted by its core keyword, which signifies the keyword with the highest frequency of occurrences, links, and total link strengths within that cluster. The identified clusters are as follows: 1) red cluster – digitalization; 2) green – sustainability; 3) blue – brand; 4) yellow – blockchain; and 5) purple – economic growth.

Figure 4 underscores the pivotal role of sustainability in bridging the realms of green branding and digitalization within the context of achieving the SDGs. It demonstrates the interconnectedness of these three domains, revealing a chain of influence that progresses from digitalization to sustainable development and, ultimately, to green branding.

Specifically, Figure 4 suggests that digitalization serves as a catalyst for advancing sustainable development, which, in turn, facilitates the development and promotion of green

brands. This chain of influence highlights the perception among scholars that digitalization and green brands are instrumental in contributing to the attainment of the SDGs.

Concerning the literature, Mondejar et al. highlighted that the rise of digitalization creates distinctive avenues to address the UN SDGs strategically. It forges an equitable, eco-friendly, and thriving society, underscoring digitalization's role in shaping the sustainable future [67]. In turn, Pérez-Martínez et al. affirmed robust correlations between composite indices measuring digitalization, sustainability, and economic growth [68]. Moreover, Yang et al. found that digitalization has a positive promotional effect on green economic development, whereas technological innovation's impact on green economic development is not statistically significant [69].

Notably, Figure 4 indicates the relative scarcity of studies directly addressing the relationship between digitalization and green brands. Figure 4 shows that the keyword 'digitalization' links with 54 other items, such as 'energy transition', 'energy consumption', 'renewable energy', 'energy efficiency', 'environmental innovations', 'environmental sustainability', and 'green marketing'. This gap in the literature emphasizes the need for further research in this specific area. Exploring the nexus between digitalization and green branding could offer valuable insights into how these two dimensions can be synergistically leveraged to promote sustainability and advance the SDGs. Consequently, this gap underscores the significance of conducting additional research to bridge this knowledge divide.

5 Conclusions

The study's findings underscore the growing emphasis on research examining the connection between digital transformation and green brands in the pursuit of SDGs. To comprehensively explore this trend, the research employed bibliometric methods. Furthermore, the study integrated visualization techniques to offer a thorough assessment of emerging trends and potential directions for future research in this domain. Through the integration of bibliometric analysis and visualization tools, this study introduces a comprehensive methodology for examining the body of scientific work concerning the intersection of digital transformation and green brands within the framework of SDGs. This approach offers impartial insights and unveils fresh avenues for future exploration in this field.

The findings indicate that scholarly publications focusing on the nexus between digital transformation and green brands within the context of SDGs originated in 2008. Notably, the apex of academic interest in this area coincided with the adoption of SDGs in 2016. Furthermore, another splash of research activity was in 2019, likely spurred by the impact of the COVID-19 pandemic.

The obtained results highlight Chen Yushan, a Chinese scholar, as the most prolific author in this research area. In total, 1213 affiliated institutions worldwide have engaged in research exploring the relationship between digital transformation and green brands within the context of achieving SDGs.

However, when examining the filtered Scopus dataset, it becomes apparent that the School of Management and Economics in China has been the most active. The scholars from this affiliation published 16 articles in the investigated domain. In terms of publication activity by country, China leads the pack with 176 articles or 20.3%, followed by Italy with 67 articles (7.7%), Germany with 62 articles or 7.1%, the UK and Ukraine each contributing 57 articles or 6.6%, and India with 56 articles or 6.5%.

Upon closer examination of the filtered Scopus dataset, it becomes evident that the School of Management and Economics in China has been the most prolific in this research area. Scholars affiliated with this institution have published a total of 16 articles within the investigated domain. In terms of publication activity by country, China leads with 176 articles

(20.3%), followed by Italy with 67 articles (7.7%), Germany with 62 articles (7.1%), and both the UK and Ukraine, each contributing 57 articles (6.6%). India is also a substantial contributor, with 56 articles (6.5%).

This study highlights the work by Lange et al. (2020) entitled "Digitalization and energy consumption (346 citations in the Scopus database). This acclaim underscores its significant impact and influence within the research field under investigation. The research conclusion suggests that digitalization contributes to sustainability when it enhances energy efficiency and economic growth through improved labor and energy productivity without causing direct adverse effects related to the production, use, and disposal of information and communication technologies.

The current findings also reveal an evolution in research focus over time. Before the adoption of UN SDGs, scholars primarily concentrated on topics such as brand equity, brand image, sustainability, green marketing, and sustainability. However, from 2015 to 2019, there was a noticeable shift toward research on green marketing and sustainability transitioning into the realm of digitalization.

Between 2015 and 2019, the most popular research topics encompassed digitalization, digitization, transparency, branding, brand, green brand, green brand attachment, and brand literacy. It is noteworthy that the topic of brand image remained consistently popular throughout all periods.

Since 2020, the most prominent research themes have revolved around digitalization, green marketing, brand image, green brand equity, sustainable consumption, economic growth, sustainable brands, and climate change.

This study identified five clusters of research directions, where the first cluster focuses on studies related to digitalization, the second on sustainability, the third on brand-related topics, the fourth on blockchain, and the fifth on economic growth.

The findings underscore the crucial role of sustainability in bridging the realms of green brands and digitalization within the context of achieving the SDGs. Digitalization is depicted as a catalyst for advancing sustainable development, which, in turn, facilitates the development and promotion of green brands. This interconnected relationship highlights scholars' belief that digitalization and green branding are instrumental in contributing to the realization of the SDGs.

However, there is a relative scarcity of studies directly addressing the relationship between digitalization and green brands. This gap in the literature emphasizes the urgent need for further research in this specific area. Exploring the nexus between digitalization and green branding could offer valuable insights into how these two dimensions could be synergistically leveraged to promote sustainability and advance the SDGs. Consequently, this gap underscores the significance of conducting additional research to bridge this knowledge divide.

This paper exclusively addresses scientific publications related to the nexus between digitalization and green brand withing achieving the SDGs sourced solely from the Scopus database. However, it is recommended that future research endeavours broaden their scope by incorporating relevant documents from other databases, such as Web of Science.

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