Sustainability in Fashion Industry: A New Era of Trends and Opportunities

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Abstract

Given climate change, environmental degradation, and pollution, the world must face together since entering the 21st century. Understanding the studies on fashion and sustainability is vital for the fashion industry. It can guide more apparel enterprises substantially to the transition toward low-carbon and green economies. Duo to the importance of sustainability, the present study predicts trends and opportunities by characterising the existing research and achievements of sustainability in the fashion industry. To this end, the scientific literature on the topic was mapped through bibliometric analysis techniques. The results indicated that Stakeholders use sustainable approaches to resolve challenges in the fashion industry. These findings highlight that sustainability in the fashion industry planning process has gained increasing interest and many practices. This study found the research gap and future direction. Finally, this study is the first bibliometric analysis in the fashion industry employing Scopus and Web of Science (WoS) databases between 2000 to 2021.

Keywords: Bibliometric; Sustainability; Fashion industry; Trends; opportunities.

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1. Introduction

The world must face issues that come from Climate change, environmental degradation, and pollution since entering the 21st century. The root lies in the excessive needs of billions of people on the planet for more than 200 years [1]. Among them, fashion has a massive industry in the world. The industry affects the planet and residents' well-being, from environmental impact to labour standards [2]. Therefore, sustainability in the fashion industry is crucial to harmony between humans and the environment.

Considering the importance of sustainability for the fashion industry, the literature on sustainable fashion recognises that fast fashion may increase the industry's pressure that threatens the environment because massive products from the latest spring and fall fashion collections are published per year. Reversely, slow fashion has become the ideal sustainable product in the fashion industry era because of its great importance in saving the domain from the risk of pollution [3] and its local and responsible production and high-quality products. Understanding the benefits of slow fashion can help consumers cut down textile waste and improve the fashion products' durability to lengthen the life cycle [4]. Therefore, fashion enterprises must understand how sustainable practice the relationship

between fashion and sustainability is. The extracted articles were subjected to bibliometric analysis techniques, which provided insights into the main topics of sustainability in the fashion industry covered by the studies. The findings reveal that sustainability in the fashion industry has gained increasing interest among researchers and scholars. The dominant business model of fast fashion is a linear system [5] that manufactures virgin fibres for textiles and garments, followed by the purchase of consumers and then disposal by users—items via landfill or burning to end. Some scholars have reviewed the fashion industry's impact on environmental pollution and economic issues [6]. The most prominent topic, "circular economy (CE)" and "consumer", is highly rated on sustainability and covers several scientific areas, offering great research opportunities. Sustainability has emerged as a critical way forward in transitioning to a more sustainable and less wasteful fashion industry [7]. Studies mainly focus on "supply chain management", "sustainable design", "recycling", directly related to the supply chain. These are effective attempts for the fashion industry to carry out sustainable development. To understand the fashion industry's sustainability clearly, this study uses bibliometric analysis to map the literature produced in the sustainability and fashion industry field to present a clear image of its state of visualisation. Therefore, it should be helpful in further predicting trends and opportunities while considering design, production, purchasing, and sustainability disposal.

The research aims to reveal emerging trends in articles and keywords about sustainability and investigate the intellectual structure of the fashion and sustainability domain in the extant literature. This article provides an overview of sustainability related to the fashion industry and summarises the bibliometric analysis results in many parameters. Furthermore, this analysis delivered insight into the importance and characteristics of sustainability in the fashion industry. It highlighted slow fashion, sustainable consumption, the supply chain, and sustainable practices. There has been a discussion and prediction of current trends and opportunities.

The rest of the article's organisation is as follows: the research methodology is defined in section 3, introducing datasets extraction, dataset pre-processing, datasets analysis, and visualise to reach our research objective. The bibliometric analysis is presented in Section 4, which gives preliminary results from a bibliometric study the discussion section was arranged in Section 5. The conclusions are outlined in section 6.

2. Research background

The term "sustainability" was initially proposed in the Brundtland report in 1987, and it means meeting present demands without jeopardising future generations' requirements [8]. Sustainable practices are commonly involved with environmental, economic, and social, which is also known as the "Triple Bottom Line (TBL)" of sustainability [9]. The fashion industry has a substantial impact on the environment, primarily through the use of large amounts of water, the emission of excess amounts of carbon dioxide, and the pollution of the environment with harmful chemicals by dyeing [10]. United Nations 2030 Agenda on SDGs (Sustainable Development Goals) presents sustainable consumption, and production goals [11] that can reduce carbon emissions and textile waste in the fashion industry have gained especially importance. The fashion

industry should take a sustainable strategy by manufacturing eco-friendly and durable clothing at accessible pricing. Enterprises must be responsible to the community and the environment to ensure that garment production, including materials, processes, and manufacturing, does not negatively impact the environment. As the fashion industry faces balancing environmental and business needs, numerous fashion brands are committed to adopting sustainability as a fashionable fashion trend. However, the transformation of fashion direction cannot rapidly address the rising fashion industry's severe environmental effects [12]. The production and consumption levels of clothing still keep continually increasing- the total demand for clothing increases by 2 % annually [13]; therefore, understanding the previous research on fashion and sustainability is vital for fashion industry planning as it can guide more apparel companies substantially to the transition towards low-carbon and green economies.

The bibliometric analysis uses statistical and rigorous methods for exploring and analysing books, articles, and other publications [14]. Since modern information technology is widespread, bibliometric methods have also been applied in various fields [15], [16]. It enables us to unpack the evolution nuances of a specific area while shedding light on the emerging trends in that field. Yet, its application in fashion industry research is relatively new and underdeveloped in many instances. Although a significant number of scholars have reviewed the fashion industry's impact on aspects of environmental pollution and issues with economic trends as compared in **Table 1**. These facts derive from the wisely considered sustainability of their products. The primary objectives of their reviews are to improve the sustainability aspects of fashion products significantly products and examine customers' ability to understand the sustainable fashion industry. Although we found one paper that applied bibliometric analysis in sustainable design, it focused on the user's perspective to use sustainable design and only extracted datasets from the Scopus database.

Table 1: Comparison of Related Studies

Ref	Major findings	Comparison	
		Bibliometrics Analysis	Trends, Opportunities
[17]	This research demonstrates a systematic review of the literature on environmental and social responsibility management in fashion operational activities, covering 38 Scopus-indexed research articles from 2006 to 2016.	×	×
[18]	This study aims to highlight the main points of view of sustainable retail research in the FI.	×	×
[3]	This paper presents a systematic review of the literature to create an opportunity for scholars to consider empirical studies on the sustainability strategies of fashion businesses.	×	×
[19]	This paper presents a bibliometric sustainability analysis from the perspective of the SD of users in the Scopus database between 1992 and 2019.	✓	×
[20]	This paper presents an overview and a comprehensive interpretation of the textile and clothing industries' inter-organisational and governance relationships on 301 academic articles published between 1992 and 2018.	×	×
our	This paper presents a bibliometric sustainability analysis from the fashion industry perspective in the Scopus and Web of Science (WoS) database between 2000 and 2021.	✓	✓

The Santos etc. also uses bibliometric analysis from the Scopus database for tourism and hospitality. Still, they related the limitation of the Scopus database: It does not include all of the research output on any given topic. They advised extracting the datasets from another reliable peer-reviewed literature database to subdue this limitation [16]. WoS is another widespread database on different scientific fields, with citation databases and publications covering all science domains for many years [17]. Considering the complementarity of the two databases, this study employs Scopus and WoS databases to ensure our research reliability and validity.

From the literature analysis and to the extent of our knowledge, no previously published work presents a bibliometric analysis about "sustainability" in the fashion industry. Therefore, we conduct bibliometric research of

articles on sustainability in the fashion industry from 2000 to 2021. The study will be the first to implement a bibliometric analysis to predict the trends and opportunities in the fashion industry. It should be a significant resource that can help scholars, Stakeholders, designers and executors of strategies gain insight into the status quo of sustainable development and predict future trends and growth opportunities in the fashion industry. Thereby further guiding more apparel companies substantially to the transition towards low-carbon and green economies.

3. Research Methodology

This study utilised two main bibliometric analysis techniques: performance analysis and science mapping. Performance analysis accounts for research constituent contributions, whereas science mapping focuses on the relationships between research constituents [14]. Bibliometric analysis is based on quantitative techniques, which can help to avoid or mitigate bias [18]. Meanwhile, bibliometric analysis can handle large volumes of scientific data and produce high research impact, it is also reliable in deeply analysing relationships between articles, citations, co-citations, and keywords. Thus, the results can provide comprehensive information. It has the strong visualisation ability of bibliometric analysis, which helps readers quickly identify clusters of research interests in the field.

For the above reasons, this research undertakes a bibliometric analysis of research articles that sustainability in the fashion industry indexed by Scopus and Wos databases, including dataset extraction, dataset pre-processing, and comprehensive analysis and visualisation of datasets in Figure 1.

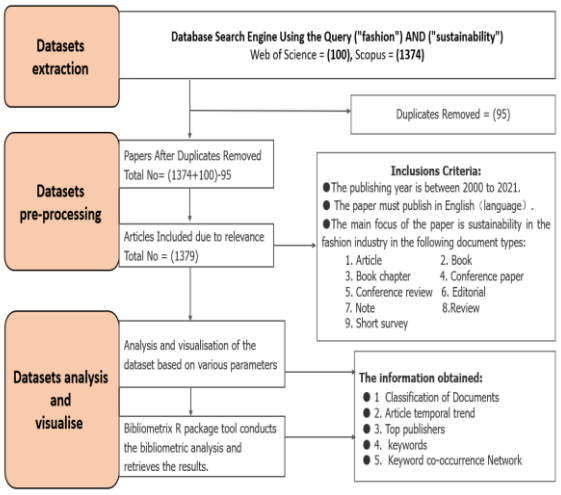

Figure 1. Flow diagram of the research methodology

3.1 Datasets extraction

The data collection process took place on 5 April 2021 and started with a general search for articles including ("fashion") and ("sustainability"). Initially, 1474 WoS (100) and Scopus (1374)) relevant publications were extracted from WoS and Scopus. This study conducts a bibliometric analysis of articles so that publications meeting the following rules were removed: including duplicate contents (1) articles; (2) books, (3) book chapters, (4) conference papers, (5) conference reviews, (6) edition, (7) note, (8) review, and (9) short survey. Finally, 1379 journal articles were obtained and extracted.

3.2 Datasets pre-processing

The study concentrated on sustainability in the fashion industry by including all research articles that fulfil our study's scope. The way irrelevant studies and duplicating research articles exclude through advanced search tick in the database engine (**Figure 2**).

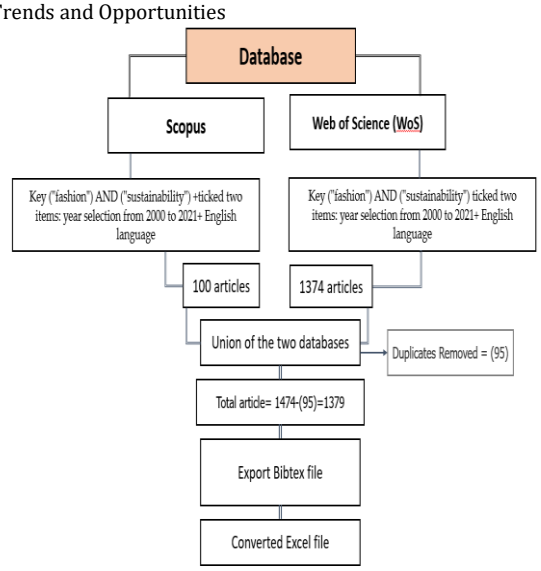

Figure 2. Data collection and systematisation procedures

3.3 Datasets analysis and visualise

R conducted a bibliometric study using the statistical system to obtain the findings. R Studio is an integrated development environment (IDE) for R, a programming language for statistical computing and graphics. Datasets were downloaded in Bibtex format from Scopus and WoS and is installed and used in the Studio Desktop 1.3.1093 system. Later, the database was exported to R Bibliometrix 3.0 and used for network analysis.

4. Bibliometric Analysis

This section presents a bibliometric analysis of the utilise of sustainability in the FASHION INDUSTRY based on the following aspects: (1) dataset distribution, (2) annual production of articles, and (3) keyword analysis. Performance analysis is the hallmark of bibliometric studies, which is descriptive. It is standard practice in reviews to present the performance of various research constituents in the field, similar to the background or profile of participants typically shown in empirical research [14]. **Table 2** and **Figure 2** are the performance analysis involving total publications, authors, number of contributing authors, sole-authored publications, co-authored publications, number of active years of publication, and productivity per year. Dataset distribution is the first crucial step in the bibliometric study that describes the primary information and classification of documents; it is the basis for the subsequent investigation.

Table 2: Description of Main Information about Data

Sources	Description of Main Information about Data	No.
	Timespan	2000-2021
Articles	Total number of articles	1379
Sources (Journals, Books, etc.)	The frequency distribution of sources (journals, books, etc.)	826
Keywords Plus (ID)	Total number of keywords	2945
Author's Keywords (DE)	Total number of keywords	4090
Average citations per document	The Average the environment document	14.64
Author Appearances	The number of author appearances	4128
Authors of single-authored articles	The number of single authors per article	264
Authors of multi-authored articles	The number of authors of multi-authored articles	3347
Authors per Article	The average number of authors in each article	288
Co-Authors per Articles	The average number of co-authors in each article	0.369
Average citations per article	The average number of sources in each article	2.71
Collaboration Index	The average index	3.1

4.1 dataset distribution

This section analysed the information extracted from the Scopus and WoS database, with (1379) articles published between 2000 and 2021. This study is the first to investigate sustainability in the fashion industry utilising a bibliometric analysis. The aim is to understand the achievement of study sustainability for the FI in this century. **Table 2** shows the primary information.

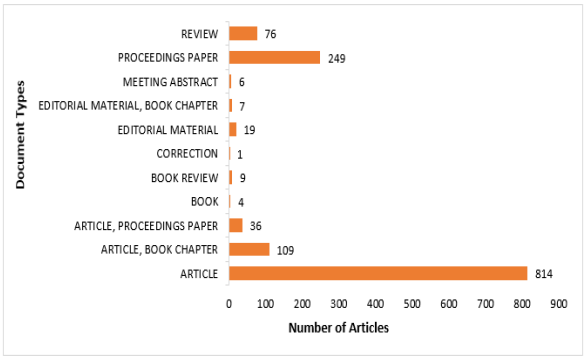

Figure 3: Classification of documents

Figure 3 shows the classification of documents that extracted data and the number of articles

in each source. It sheds light on the results of the placements. This can be seen here that article types of document content (814) documents have the highest ranking. This was followed by conference papers containing (249) records and a book chapter containing (109) documents. The current trend among researchers in the development of sustainability-based fashion mainly aims to publish research work in article form rather than the accumulation of papers published on websites or in conference papers. Other types of classification documents published are considerably lower in production than articles.

4.2 Annual Production of Articles

Figure 4 depicts the annual production of articles. The publication rate shows annual increases with a yearly growth rate of 13.31 %. In the recent two decades, sustainability in the fashion industry has gained increasing interest amongst researchers and scholars. The growth of sustainable developments in the fashion industry rose dramatically in 2020, and further research is expected to be conducted in 2021.

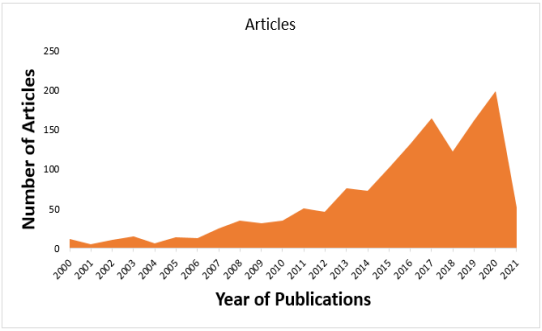

Figure 4: Annual scientific production

4.3 Keywords analysis

This section researches keywords to identify research gaps in sustainability in the fashion industry. The most frequently used keywords in research on sustainability in the fashion industry are presented in descending order. **Table3** shows the top 20 most frequent keywords: sustainability, sustainable fashion, sustainable development, fashion, sustainable consumption and the circular economy appeared 269, 213, 153, 151, and 48 times, respectively. This result reveals that most studies on the fashion industry focus on developing enterprise economic benefits to solve a single problem from the perspective of business and consumers.

The circular economy appeared 45 times in **Table 3**. This term has had a significant impact on the fashion industry. It also indicated that the fashion industry has recently implemented plenty of circular plans and strategies so that the fashion-related economy can become more sustainable.

The fast fashion business model based on mass-producing with low cost caused consumers to overconsumption clothing. Sustainable fashion has contributed to eco-friendly and high-quality products, providing value to consumers and producers. Fast fashion appeared 42 times, as shown in **Table 3**. And slow fashion appeared 37 times.

Table 3: Most frequent keywords

Rank	keywords	frequency
1	sustainability	269
2	sustainable fashion	213
3	sustainable development	153
4	Fashion	151
5	sustainable consumption	48
6	circular economy (CE)	45
7	fast fashion (FF)	42
8	slow fashion (SF)	37
9	sustainable design (SD)	27
10	education	23
11	fashion design (FD)	20
12	supply chain management (SCM)	18
13	consumer behaviour(CB) & perception	17
14	sustainable supply chains	13
15	eco-design	13
16	recycling, re-use	11
17	upcycling	9
18	Second-hand clothing	8
19	rent clothing	5
20	3d printing	4

The sustainability design appeared 23 times, along with other words such as education, fashion design, supply chain, consumer behaviour and perception, and sustainable supply chain, which occurred (23), (20), (18),

(17), (13) and 13 times, respectively. This finding indicates that research is being conducted on sustainable approaches to improve various audiences' perceptions and behaviour of sustainability. Other interesting keywords were identified, such as eco-design (13), recycling, re-use (11), upcycling (9), second-hand clothing (7), rent clothing (5) and 3d printing (4). These fields are just starting to use sustainable technology to address some problems in the conventional fashion industry.

Figure 5 shows the analysis of Word-Cloud keywords to identify the research trends and the opportunities for sustainability in the fashion industry. Word-Cloud's highest keywords were sustainability, slow fashion, sustainable development, fast fashion, sustainable consumption, circular economy, design, and sustainable fashion. Other Specific keywords have also been highlighted, such as textiles, education, fashion industry, luxury, recycling, consumption, ethics, upcycling and environment. The Word-Cloud analysis results indicated that sustainable development in the fashion industry has significant potential in these research fields and would grow in publications in the coming years. To summarise the keywords Word-Cloud provides to define the most important keywords that attract researchers, designers and organisations, three potential areas are highlighted such as (1) supply chain, (2) consumer behaviour, and (3) recycling. The above demonstrates that researchers are interested in applying sustainability to solve challenges, trust sustainability, and utilise its approaches to mitigating environmental impacts.

Figure 5: Word-Cloud of sustainability into sustainable fashion

Figure 6 shows the keyword co-occurrence network analysis parameter of datasets. In this analysis, the node's size implies the node value keywords' significance, representing the number of adjacent nodes directly connected to that node. As shown in **Figure 6**, A group with warmer colour (red) and a higher density value indicates that the group is more frequently used and gains greater attention from researchers in the field than a concept with another colour (pink, purple). The main keyword topic could be easily identified from the heat map in **Figure 6**, which is "sustainability". The co-occurrence network recorded high-frequency words of sustainability literature such as sustainable fashion, sustainable consumption, corporate social responsibility, and supply chain management. Simultaneously, the edges node high frequencies keywords are circular economy, fast fashion, slow fashion, supply chain, consumption, sustainable design, recycling, fashion industry, fashion design, design, luxury, textiles, waste and environment.

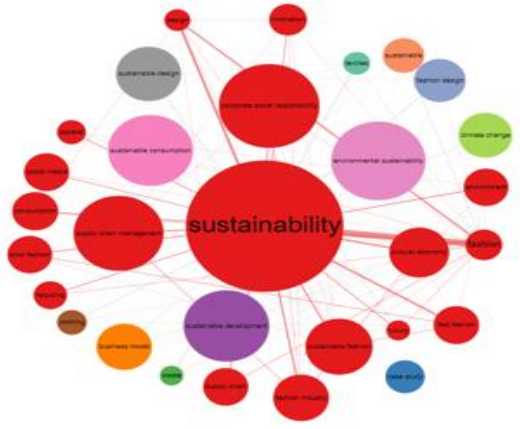

Figure 6: Keyword co-occurrence network

We reviewed ten articles from the previously collected 814 articles (see **Figure 3**) to further understand the fashion industry's implementation and current sustainability achievements. The ten articles' extraction depends on the keywords in Table 3, the keyword co-occurrence network in **Figure 6** and the top 20 publishers. These articles are extracted from ranked leading 20 publishers house such as Sustainability MDPI, Journal of Cleaner Production, Fashion Practice etc. **Figure 7** presents the top 20 publication venues for the research papers related to sustainability in the case of FASHION INDUSTRY publication domains in ascending order. Two crucial indicators for determining articles are the journal's impact factor and the citation rate of the article. **Table 4** can help readers deeply understand the current sustainable achievements in the fashion industry.

Table 4: Comprehensive analysis of the literature on sustainable fashion

Ref	Case Study	Problem Addressed	Proposed Solution	Major Findings
[23]	Sustainable fashion	Advancing an understanding in fashion design of sustainability.	Designers' participation in the management of a sustainable fashion business	At a strategic level, product development teams can implement sustainability.
[24]	Sustainable consumption	Environmental impact of production and consumption in	Reimagine and rebuild the textile and apparel industry	Strategies from consumers' values and needs
[25]	corporate social responsibility (CSR)	Companies have started incorporating CSR into their supply chains.	Using a bibliometric method, analyse the CSR literature in SC.	CSR implementation at all echelons of supplier chains
[26]	Supply chain management (SCM)	Blockchain-enabled SC	The system architecture of blockchain-enabled circular SCM in FF.	The proposed blockchain-based framework can manage the sustainability concerns in fast-fashion supply chains to establish a zero-waste CE.
[27]	Circular economy (CE)	The present state of research concerning sustainable SCM toward a CE in the textile and apparel industry	Identifying some indicators for the evaluation of sustainable performance in a CE-oriented sustainable SC in the textile industry	Technological innovation is a critical enabler in implementing a CE.; the dependence of traditional companies on their supplier networks for innovations.
[28]	Fast fashion	There is a notable lack of empirical data on the global fashion industry's impacts.	Eora is used to assess the effects of the clothes and footwear value chain.	FF has changed consumers' previous purchase habits, which are that based on physical needs.
[29]	Sustainable fashion	The issue of fashion as a contradiction to the term slow must be addressed.	The cases of four retailers who self-identify as part of the sustainable fashion retail segment.	The balance between traditional strategic retail objectives and a conscious consumption model.
[30]	Sustainable Design	Developing new products in an environmentally sustainable fashion.	Creating a conceptual model of how internal resources form sustainable design practices.	Using interior (firm) and external (supplier) resources to build sustainable products.
[31]	Recycling & Re-Use of Textiles	CE has recently been the most prominent strategy to target resource scarcity and environmental problems simultaneously.	Using systems thinking to investigate the impact of CE reuse and recycling strategies.	Recycling and reuse are a limited extent, capable of achieving the goal of reduced material flows.
[32]	Slow fashion	The creation of a proper sustainability roadmap from the standpoint of the SC.	To provide a sustainable roadmap for fashion businesses.	The road to sustainability is not necessarily linear but rather the outcome of a complicated and dynamic implementation.

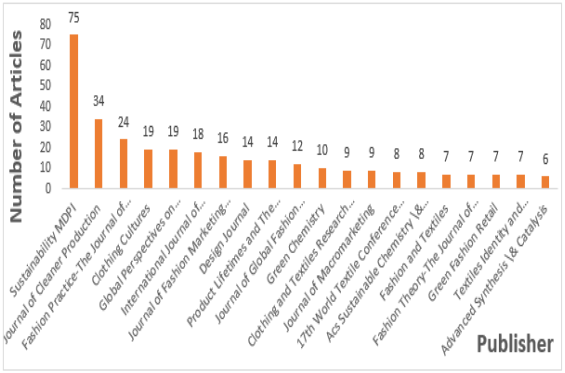

Figure 7: Top publishers' houses involved sustainably

5. Discussion

Regarding the sustainability achievements in the fashion industry (bibliometric analysis results) between 2000 to 2021, 1379 articles have been published in 826 sources (Journals, Books, etc.), and 288 authors have appeared in this field since 2000. The number of author appearances is 4128, and the total number of articles is more than 1379. We calculate the average number of publications per person for about three papers. This indicates that the author's publication volume is relatively low. As a result, nobody is particularly prolific. The relatively high collaboration index is (3.1). It shows that co-authored works are written mainly by scholars from multiple institutions.

Regarding journals in which works are published, one journal concentrates a

significant portion of publications: Sustainability (75) articles and Journal of Cleaner Production (34) articles. Therefore, these two journals can be considered too spec in sustainability subject.

Articles in the journal are the main form to present researchers' contributions to sustainable fashion. In the recent two decades, the publication rate has shown annual increases with an annual growth rate of 13.31%. **Figure 3** shows the classification of documents that extracted data and the number of articles in each source. It sheds light on the results of the placements. This can be seen here that article types of document content (814) articles have the highest ranking. This was followed by conference papers containing (249) records and a book chapter containing (109) documents. The result shows that researchers mainly aim to publish research work in the article's form. Other types of classification documents published are considerably lower in production than articles. These findings indicate that in the past 20 years, the FI has held relatively few conferences with the theme of "sustainability". Organisations or institutions may increase the number of discussions on sustainable theme to promote sustainable development. At the same time, there are only four books, and publishers can add readings on sustainable topics to guide more scholars and educators to contribute to sustainable development.

Also, Word-Cloud (**Figure 5**) reveals that sustainability is essential in the fashion industry. Concerning the analysis results on the prominence of the top 20 keywords (relational bibliometric analysis results), only one prominent topic stands out: sustainability, with 269 articles. Sustainability in the fashion industry has gained increasing interest among researchers and scholars. It is an evolving area and can provide excellent opportunities for scholars and organisations in the industry.

The results of the keywords co-occurrence network reveal two groups of words that are most frequently related to sustainability (**Figure 6**): (1) supply chain, sustainable fashion, circular economy, fashion industry, consumption, supply chain, fast fashion, slow fashion, fashion, recycling, design, et. (2) sustainable consumption, environmental sustainability. The key elements concentrate on trends for sustainability in the fashion industry. Edge nodes related to sustainability are receiving low attention and are still in the development stage of emerging fields.

Besides, (3d printing=4), (rent clothing=5), (second-hand clothing=8), (upcycling=9), and (recycling =11), which use a sustainable approach to the fashion domain, are all emerging stages and have not yet been paid attention to enough. The keyword (CE=45) is a refined vision of sustainability but is much fewer in article publications than sustainability. At the same time, (education= 23) has obtained even less attention than (CE=45) (**Table 3**).

Table 4 describes the problem and significant findings of adopting sustainability as a fashion industry solution from multiple perspectives. This has also shown that sustainability has a significant competitive factor for the fashion industry and enough confidence to turn fast fashion into a sustainable business model to cut down on textile waste and environmental pollution [19].

6. Gaps and future research directions

Given the discussion, we have found gaps in the existing literature to motivate future research. Meanwhile, the current study has generated

extraordinary opportunities and future directions for scholars, organisations, and sectors.

Firstly, sustainability can be an essential competitive factor for developing the transformation of the fashion industry. Fast fashion challenges environmental sustainability in the fashion industry [20]. Fast fashion has always been profitable through the business model of "pile up and sell more". Its styles are updated, and popular cycles are rapid. This has also led to consumers blindly pursuing novel fashion styles and shortening the service life of clothing. Clothing becomes unwanted garments speedily thrown away or piled up in wardrobes, and these thrown away clothes become textile waste. Fast fashion carries overconsumption of raw material, and the amount of waste textile generation has a tremendous negative impact on the environment [21]. Thus, a significant issue facing corporate competitiveness and growth will be researching fast fashion's competitive integration and transformation. This is also one of the gaps found in this research. Meanwhile, the foundation of slow fashion is a pursuit of stability between style and economic, social, and environmental systems[22]. Implementing and sustainability mentioned technological, economic, and social developments, upcycling, and 3Rs (reduce, reuse, and recycle) [23].

Secondly, sustainable consumption. Sustainable fashion companies have invested a lot of research and development in the product stage. Many fashion designers create fantastic and significant efforts in the sustainable fashion and industry[24]. They realised the positive contribution of sustainable fashion products to the environment [25]. On the other hand, consumer participation expands the sustainable mode of consumption. It depends on the particular and exciting experience of the product among users[26]. Collaborative consumption generates user interest by linking co-design with social media apps and strategies to create a consumer experience [27]. Likewise, prolonged service life can ensure sustainability, but it is still the initial stage [28]. Emotional attachment affords a possibility for the long service life of garment products. However, it is a significant challenge to make clothes that last for a long time through emotional attachment [29]. The study found that a few scholars have been carried out to research consumers or users, such as the charity's awareness, collaboration, and social responsibility concept. Therefore, studying the association between consumer or user acceptance, perception, and emotional experience will be one of the primary directions in the sustainable future.

Thirdly, designers are less involved in corporate sustainability in the strategy phase[30]. Optimal brands with more defined sustainability initiatives offer designers more opportunities to increase their adaptation efforts—the brand ethos and identity are integrated into sustainable design concepts [24]. Meanwhile, the designer can better technical expertise in fibres and textiles, comprehend the supply chain, and build sustainable frameworks. Creating sustainable education would comparatively promote sustainable fashion development rapidly[31]. For example, as students with sustainable education knowledge become leaders, designers, and customers of apparel companies, sustainable conception from various aspects such as management, design, and awareness of consumption will increase. Sustainable fashion has established a path to teaching students how to achieve sustainability and making them more knowledgeable of problems within the sector

involving social, economic, cultural, and ecology fields.

Finally, circular economy. The fashion industry recognised the reduction of carbon emissions and textile waste as a responsible action for the community and the environment. Ellen MacArthur Foundation report-redesigning fashion's future in 2017 proposed an excellent vision for a new fashion economy that depends on a circular economy: restorative and regenerative by design and benefits business, society, and the environment. The circular economy of fashion companies faces quite onerous requirements across three sustainability pillars: economic, environmental, and social. The most effective way to achieve sustainability is collaboration across the supply chain [32], [33]. Circular economy is a systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution [34]. Meanwhile, it is also a significant step towards a circular economy for collaboration across the supply chain. Therefore, achieving a circular economy is the future of the sustainable fashion industry.

7. Conclusions

The present study aimed to evaluate the state of sustainability in the fashion industry, which was achieved by mapping research production through bibliometric analysis techniques. This methodology combines quantitative and qualitative content analyses and effectively provides a comprehensive view of the scientific literature in the field. Our research offers several valuable insights to fashion industry practitioners. The following concluding statements are constructed:

- The data distribution analysis, keywords, venues and citations indicated that the trend of sustainability-based fashion papers is constantly increasing from 2000 to 2021. Sustainability in the FASHION INDUSTRY has gained increasing interest among researchers and scholars.
- Stakeholders, designers and executors of strategies have attempted sustainable practices to resolve challenges in the fashion industry, such as sustainable fashion, sustainable consumption, supply chain management, sustainable design and recycling.

Given these findings, this study evaluated gaps and future research direction and predicted the trends and opportunities:

- A significant issue facing corporate competitiveness and growth will be researching the competitive integration and transformation of fast fashion;
- Studying the collaboration between consumer or user acceptance, perception, and emotional experience will be one of the major directions in the sustainable future;
- Sustainable fashion education is how to make people more knowledgeable of problems within the sector involving social, economic, cultural, and ecology fields.
- Collaboration in the supply chain is a crucial step towards a circular economy; achieving a circular economy is the future of the sustainable fashion industry.

Limitation: The limitations of this work are the databases used. The study's data collection has been affected by increased sustainable practices in the fashion industry. On the other hand, data extraction is April 5, 2021due to time constraints. Thus, the whole year of data in 2021 could not be extracted integrally.

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References

[1] J. F. Velasco-Muñoz, J. M. F. Mendoza, J. A. Aznar-Sánchez, and A. Gallego-Schmid, 'Circular economy implementation in the agricultural sector: Definition, strategies and indicators', *Resour. Conserv. Recycl*, vol. 170, Jul. 2021, doi: 10.1016/j.resconrec.2021.105618.

[2] R. Nayak, T. Panwar, and L. V. T. Nguyen, *Sustainability in fashion and textiles*. 2020.

[3] T. S. Thorisdottir and L. Johannsdottir, 'Sustainability within fashion business models: A systematic literature review', *Sustain,* vol. 11, no. 8, pp. 1–26, 2019, DOI: 10.3390/su11082233.

[4] S. Pookulangara and A. Shephard, 'Slow fashion movement: Understanding consumer perceptions-An exploratory study', *J. Retail. Consum. Serv.*, vol. 20, no. 2, pp. 200–206, 2013, doi: 10.1016/j.jretconser.2012.12.002.

[5] P. Gazzola, E. Pavione, R. Pezzetti, and D. Grechi, 'Trends in the fashion industry. The perception of sustainability and circular economy: A gender/ generation quantitative approach', *Sustain.* vol. 12, no. 7, pp. 1–19, 2020, DOI: 10.3390/su12072809.

[6] T. Brydges, 'closing the loop on the take, make, and waste: Investigating circular economy practices in the Swedish fashion industry, *J. Clean. Prod.*, vol. 293, p. 126245, 2021, DOI: 10.1016/j.jclepro.2021.126245.

[7] R. Pal and J. Gander, 'Modelling environmental value: An examination of sustainable business models within the fashion industry', *J. Clean. Prod.*, vol. 184, pp. 251–263, 2018, DOI: 10.1016/j.jclepro.2018.02.001.

[8] B. R. Keeble, 'the Brundtland Report: "Our Common Future"', *Med. War*, vol. 4, no. 1, pp. 17–25, 1988, DOI: 10.1080/07488008808408783.

[9] T. M. Choi and T. C. E. Cheng, 'Sustainable fashion supply chain management: From sourcing to retailing', *Sustain. Fash. Supply Chain Manag. From Sourc. To Retail.* pp. 1–205, 2015, DOI: 10.1007/978-3-319-12703-3.

[10] A. G. R Ananthashankar, 'Production, Characterization and Treatment of Textile Effluents: A Critical Review', *J. Chem. Eng. Process Technol.*, vol. 05, no. 01, 2013, DOI: 10.4172/2157-7048.1000182.

[11] R. B. Johnston, 'Arsenic and the 2030 Agenda for sustainable development', *Arsen. Res. Glob. Sustain. - Proc. 6th Int. Congr. Arsen. Environ. AS 2016*, pp. 12–14, 2016, doi: 10.1201/b20466-7.

[11] C. W. Ki, S. Park, and J. E. Ha-Brookshire, 'toward a circular economy: Understanding consumers' moral stance on corporations' and individuals' responsibilities in creating a circular fashion economy', *Bus. Strategy. Environ.* vol. 30, no. 2, pp. 1121–1135, 2021, doi: 10.1002/bse.2675.

[12] H. Goworek, L. Oxborrow, S. Claxton, A. McLaren, T. Cooper, and H. Hill, 'Managing sustainability in the fashion business: Challenges in product development for clothing longevity in the UK', *J. Bus. Res.*, vol. 117, no. August 2018, pp. 629–641, 2020, doi: 10.1016/j.jbusres.2018.07.021.

[13] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, 'How to conduct a bibliometric analysis: An overview and guidelines', *J. Bus. Res.*, vol. 133, no. May, pp. 285–296, 2021,

DOI: 10.1016/j.jbusres.2021.04.070.

[14] H. M. Hussien, S. M. Yasin, N. I. Udzir, M. I. H. Ninggal, and S. Salman, 'Blockchain technology in the healthcare industry: Trends and opportunities', *J. Ind. Inf. Integr.*, vol. 22, no. April 2020, p. 100217, 2021, DOI: 10.1016/j.jii.2021.100217.

[15] L. L. Santos, L. Cardoso, N. Araújo-Vila, and J. A. Fraiz-Brea, 'Sustainability perceptions in tourism and hospitality: A mixed-method bibliometric approach', *Sustain.*, vol. 12, no. 21, pp. 1–18, 2020, DOI: 10.3390/su12218852.

[17] A. Aghaei Chadegani *et al.*, 'A comparison between two main academic literature collections: Web of science and scopus databases', *Asian Soc. Sci.*, vol. 9, no. 5, pp. 18–26, 2013, doi: 10.5539/ass.v9n5p18.

[18] O. Ellegaard and J. A. Wallin, 'the bibliometric analysis of scholarly production: How great is the impact?' *Scientometrics*, vol. 105, no. 3, pp. 1809–1831, 2015, DOI: 10.1007/s11192-015-1645-z.

[19] F. Jia, S. Yin, L. Chen, and X. Chen, 'the circular economy in the textile and apparel industry: A systematic literature review', *J. Clean. Prod.*, vol. 259, p. 120728, 2020, DOI: 10.1016/j.jclepro.2020.120728.

[20] D. Moorhouse, 'Making Fashion Sustainable: Waste and Collective Responsibility', *One Earth*, vol. 3, no. 1, pp. 17–19, Jul. 2020, DOI: 10.1016/j.oneear.2020.07.002.

[21] G. Peters, M. Li, and M. Lenzen, 'The need to decelerate fast fashion in a hot climate - A global sustainability perspective on the garment industry', *J. Clean. Prod.*, vol. 295, p. 126390, 2021, DOI: 10.1016/j.jclepro.2021.126390.

[22] A. Moretto, L. Macchion, A. Lion, F. Caniato, P. Danese, and A. Vinelli, 'Designing a roadmap towards a sustainable supply chain: A focus on the fashion industry', *J. Clean. Prod.*, vol. 193, pp. 169–184, 2018, doi: 10.1016/j.jclepro.2018.04.273.

[23] R. Štefko and V. Steffek, 'Key issues in Slow Fashion: Current challenges and future perspectives', *Sustain,* vol. 10, no. 7, pp. 1–11, 2018, doi: 10.3390/su10072270.

[24] S. Claxton and A. Kent, 'the management of sustainable fashion design strategies: An analysis of the designer's role', *J. Clean. Prod.*, vol. 268, p. 122112, 2020, doi: 10.1016/j.jclepro.2020.122112.

[25] K. Niinimäki and L. Hassi, 'Emerging design strategies in sustainable production and consumption of textiles and clothing', *J. Clean. Prod.*, vol. 19, no. 16, pp. 1876–1883, 2011, doi: 10.1016/j.jclepro.2011.04.020.

[26] H. M. Kong, E. Ko, H. Chae, and P. Mattila, 'Understanding fashion consumers' attitude and behavioral intention toward sustainable fashion products: Focus on sustainable knowledge sources and knowledge types', *J. Glob. Fash. Mark.* vol. 7, no. 2, pp. 103–119, 2016, doi: 10.1080/20932685.2015.1131435.

[27] K. Reiley and M. DeLong, 'A Consumer Vision for Sustainable Fashion Practice', *Fash. Pract.* vol. 3, no. 1, pp. 63–83, 2011, Doi: 10.2752/175693811x12925927157054.

[28] J. Han, Y. Seo, and E. KO, 'Staging luxury experiences for understanding sustainable fashion consumption: A balance theory application', *J. Bus. Res.*, vol. 74, pp. 162–167, 2017, doi: 10.1016/j.jbusres.2016.10.029.

[29] T. Şener, F. Bişkin, and N. Kılınç, 'Sustainable dressing: Consumers' value perceptions towards slow fashion', *Bus. Strateg. Environ.* vol. 28, no. 8, pp. 1548–1557, 2019, doi: 10.1002/bse.2330.

[30] K. Fletcher and D. Williams, 'Fashion Education in Sustainability in Practice', *Res. J. Text. Appar.* vol. 17, no. 2, pp. 81–88, 2013, doi: 10.1108/RJTA-17-02-2013-B011.

[31] N. Radclyffe-Thomas, 'Designing a sustainable future through fashion education', *Cloth. Cult.* vol. 5, no. 1, pp. 183–188, 2018, doi: 10.1386/cc.5.1.183_1.

[32] J. Korhonen, C. Nuur, A. Feldmann, and S. E. Birkie, 'Circular economy as an essentially contested concept', *J. Clean. Prod.*, vol. 175, pp. 544–552, Feb. 2018, doi: 10.1016/j.jclepro.2017.12.111.

[33] Y. Geng, J. Fu, J. Sarkis, and B. Xue, 'towards a national circular economy indicator system in China: An evaluation and critical analyses, *J. Clean. Prod.*, vol. 23, no. 1, pp. 216–224, Mar. 2012, doi:

10.1016/j.jclepro.2011.07.005.

[34] Ellen MacArthur, 'A new textiles economy: Redesigning fashion's future', *Ellen MacArthur Found.*, pp. 1–150, 2017, [Online]. https://www.ellenmacarthurfoundation.org/publications/a-new-textiles-economy-redesigning-fashions-future.