Zhu *et al. J Smart Environ Green Comput* 2023;3:47-65
DOI: 10.20517/jsegc.2023.08

Journal of Smart Environments and Green Computing

Review

Open Access

Check for updates

A systematic review of sustainability driven apparel supplier selection

Zhongyi Zhu, Tingting Du, Qing Li, Tiantian Wang, Zhebin Xue

College of Textile and Clothing, Soochow University, Suzhou 215006, Jiangsu, China.

Correspondence to: Dr. Zhebin Xue, College of Textile and Clothing, Soochow University, 1 Shizi Street, Suzhou 215021, Jiangsu, China. E-mail: zhebin.xue@suda.edu.cn

How to cite this article: Zhu Z, Du T, Li Q, Wang T, Xue Z. A systematic review of sustainability driven apparel supplier selection. *J Smart Environ Green Comput* 2023;3:47-65. https://dx.doi.org/10.20517/jsegc.2023.08

Received: 1 Apr 2023 **First Decision:** 5 Jun 2023 **Revised:** 20 Aug 2023 **Accepted:** 29 Aug 2023 **Published:** 13 Sep 2023

Academic Editor: Witold Pedrycz **Copy Editor:** Dong-Li Li **Production Editor:** Dong-Li Li

Abstract

In recent years, there has been growing interest in sustainable supply chain management in the textile and apparel industry, leading to an increase in research on supplier selection. The purpose of this article is to present a comprehensive review of 105 publications on sustainable apparel supplier selection (SASS) that were published between 2001 and 2021. Firstly, the paper provides a systematic analysis of the research hotspots and trends in SASS. Secondly, the paper analyzes the research themes in this field from two perspectives: the construction of standards and the use of methods using content analysis. Finally, the paper explores the future prospects of the development of SASS studies under the influence of big data and blockchain. Through a systematic analysis of the literature, the following key findings have been revealed: (1) current research on SASS predominantly employs comprehensive methods and models, with an increasing use of fuzzy mathematics; (2) investigating the impact of consumer, social, and technological factors on sustainable supplier selection is a popular direction of research; (3) future research will focus on the application of information technologies, such as big data and blockchain, in supplier selection and sustainability management. This study will be helpful for practitioners in the textile and apparel industry, and for researchers who hope to understand the current status of SASS.

Keywords: Textile and apparel, sustainability, supply chain, supplier selection

INTRODUCTION

In recent years, sustainability in the textile and apparel industry has received widespread attention from various sectors of society. The textile and apparel industry is an important livelihood industry in many countries and an important component of the national economy. The production and operation of textile and apparel enterprises not only need to provide products and services that meet customer needs but also fulfill their social responsibilities by developing green trade demonstrations that promote ecological sustainability, which is an important part of the core competitiveness of enterprises. Therefore, incorporating sustainable concepts into the development process is an essential path for the long-term development of textile and apparel enterprises[1,2].

There are various methods for achieving sustainable development in textile and apparel enterprises, among which embedding sustainable concepts into supply chain management (SCM) is one of the important means of realizing sustainable development in apparel enterprises[3]. However, since the outbreak of COVID-19, the global supply chain has experienced significant disruptions, leading to a persistent situation of demand uncertainty and supply shortages[4]. As a result, there is an urgent requirement to optimize the supply chain structure and implement sustainable industrial upgrading. Supplier selection, being a crucial component of the entire supply chain, holds a position upstream. Cost savings and sustainable benefits derived from supplier selection can then be transmitted throughout the entire supply chain, ultimately benefiting all downstream links. Therefore, selecting the best supplier objectively and comprehensively can assist enterprises in establishing a positive social image, increasing corporate income, and reducing environmental pollution, among other sustainable benefits[5]. Consequently, research pertaining to supplier selection has consistently been highly regarded by academics and practitioners, given its pivotal role in enhancing the efficiency, competitiveness, and sustainability of core enterprises.

In research on supplier selection in the context of sustainability issues in the textile and apparel industry, Baskaran *et al.* (2012) established the criterion for a sustainable (social) supply chain and evaluated Indian textile and apparel suppliers and their second-tier suppliers[6]. Zeng and Rabenasolo (2013) proposed a fuzzy weighted system to select the most relevant materials and suppliers in the sustainable textile supply chain[7]. Jia *et al.* (2015) studied the basic concepts of the sustainable supply chain in the fashion industry by starting from social and environmental criteria[8]. Winter and Lasch (2016) proposed the most important and comprehensive social and environmental evaluation criteria for suppliers in the sustainable supply chain by interviewing procurement experts in the apparel and textile industry[9]. Amindoust and Saghafinia (2017) proposed a fuzzy reasoning system to rank the potential sources of textile suppliers based on limited economic, social, and environmental factors[10]. Yadlapalli *et al.* (2018) found that supplier selection had a significant impact on the social and environmental performance of the social responsibility supply chain in the apparel industry by applying structural equation modeling[11]. Kannan (2018) identified key success factors in the sustainable supplier selection (SSS) process for multinational textile companies from the perspective of multiple stakeholders and used various decision-making techniques, such as the fuzzy-Delphi analysis network process and complex proportional assessment for supplier ranking[12]. Guarnieri and Trojan (2019) proposed a multicriteria decision-making (MCDM) model that includes AHP (analytic hierarchy process) and ELECTRE (elimination et choice translating reality)-TRI to support managers in selecting suitable suppliers in the outsourcing process based on the triple bottom line (TBL) of sustainable development in the textile industry[13]. Darvishi *et al.* (2020) proposed a comprehensive mathematical model applied to the selection of global fabric suppliers and production planning for apparel manufacturers[14].

This study will conduct a systematic review of 105 studies on SSS in the textile and apparel field from 2001 to 2021 using bibliometric analysis. Specifically, the following questions will be addressed.

1. The research progress in the past decade on the selection of sustainable apparel suppliers (SASS) will be sorted and analyzed.
2. The research topics and methods in this field will be identified.
3. The future development direction of SASS will be explored.

Compared with previous studies, this study has the following innovations. First, this study collects a targeted literature dataset on SSS in the apparel industry through a query-based search method, which is more focused. Second, the use of bibliometric software for a systematic review and the combination of traditional literature review methods can help us obtain more objective research topics and track the development trends and evolution of knowledge structures. Finally, bibliometric software can assist scholars in quickly identifying key information and recognizing knowledge structures and evolution in a certain field of knowledge.This study is the first systematic review of supplier selection strategies in the apparel industry.

The contributions of this article are as follows. First, the research hotspots in the field of SASS were analyzed by co-occurrence keyword network analysis using CiteSpace and Vosviewer, and the development trends of this field were analyzed by time zone views in CiteSpace. Second, the research topics in the field of SASS were analyzed using content analysis. Finally, the future applications of big data and blockchain technology in SASS were predicted.

The remainder of this article is organized as follows. The second section introduces the research framework and methodology. The third section analyzes the research hotspots and trends. The fourth section provides a detailed analysis of the research topics, while the fifth section summarizes the main findings of the article and explores the development changes of SASS in the future under the influence of big data and blockchain technology. Finally, the article is concluded. This study will provide assistance to practitioners in the textile and apparel industry and researchers who are interested in understanding SASS.

RESEARCH FRAMEWORK AND METHODOLOGY

Research framework

The research framework of this paper is shown in Figure 1. First, the literature retrieval process is conducted by searching relevant literature in the field of SSS from the WoS (Web of Science) database based on the search formula and conducting a certain degree of screening. With a reasonable quantity and quality of literature obtained, a bibliometric analysis is conducted to understand the research trends and hotspots in the field of SASS. Then, the research topic is introduced in detail from two aspects: the construction of criteria and the use of methods. Finally, based on existing research, the development trends in the field of SASS are predicted.

Research methodology

Literature review

The sources of information for bibliometric analysis typically come from three channels: WoS, Scopus, and Google Scholar. In this study, WoS was selected as the database for literature retrieval, as it covers high-quality journals, is more comprehensive, and contains literature that is more representative of research.

The search for keywords in this study was conducted using a combination of three types of words. Each search used a mixture of the first type of words related to supply, such as supplier selection methods and supplier selection criteria; the second type of words related to green issues, such as green and sustainable; and the third type of words related to apparel, such as textiles, clothing, and fashion. By combining these three types of words, the research scope was limited to the field of SASS, making the research more targeted.

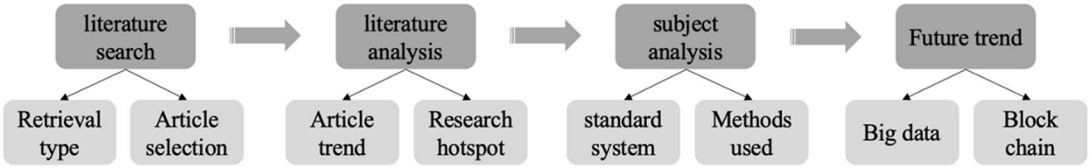

Figure 1. Research framework.

In terms of language, only English-language journals were considered. All data were obtained from the latest core collection of scientific.net. The search formula used in this article is as follows:

TS = ("supplier select* OR supply chain selection method* OR supply chain selection criteria*") AND ("apparel OR garment* OR cloth* OR textile* OR fashion OR fabric OR yarn") AND ("sustain* OR green OR environment OR econom* OR society OR ecological")

Among them,
TS/TITLE – ABS – KET = Title, Abstract, and Keywords
AND/OR = Boolean operators to connect different keywords
* = used for loose/approximate phrase
" " = used for exact phrase

Literature screening

To ensure that all relevant articles on the topic could be searched, a total of 112 relevant studies were retrieved through the search formula mentioned above in WoS, without any time limitation. However, in consideration of the validity and academic rigor of the retrieved literature, conference papers, editorial materials, letters, notes, sections, and book reviews were excluded. Therefore, four conference records and three review papers were deleted, resulting in a final set of 105 relevant studies. When we set the time span as "2001-2021", no literature was excluded, indicating that all relevant literature in this field has been published in the past 20 years under the search conditions we set. Consequently, this article ultimately set the time span as 2001-2021 and the number of studies at 105. Figure 2 illustrates the process of literature collection and screening.

RESEARCH HOTSPOT ANALYSIS

Literature publication status

By analyzing the literature publication status of the research topic of SSS in the textile and apparel industry from 2001 to 2021, the overall development process of research in this field can be grasped. Additionally, by conducting keyword clustering analysis and temporal keyword view analysis, the research hotspots and their changes in this field can be identified.

The annual publication output in a particular field of knowledge is an important indicator for assessing the development of scientific research. To some extent, it reflects the increase in the amount of knowledge and the research progress of researchers in that field[15]. The reviewed database includes 105 peer-reviewed papers published in journals in the past 21 years (2001-2021). The publication trends over the years are shown in Figure 3. The first paper was published in the JOURNAL OF THE AIR & WASTE MANAGEMENT ASSOCIATION in 2001, and until 2014, the number of papers published each year was less than three. From 2012, the publication output began to steadily increase, with approximately 62% of publications concentrated between 2019 and 2021.

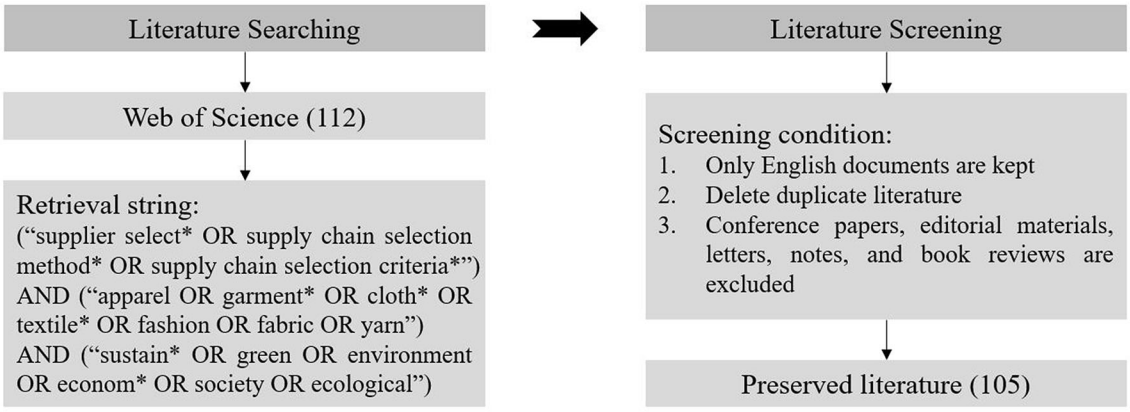

Figure 2. Literature retrieval process.

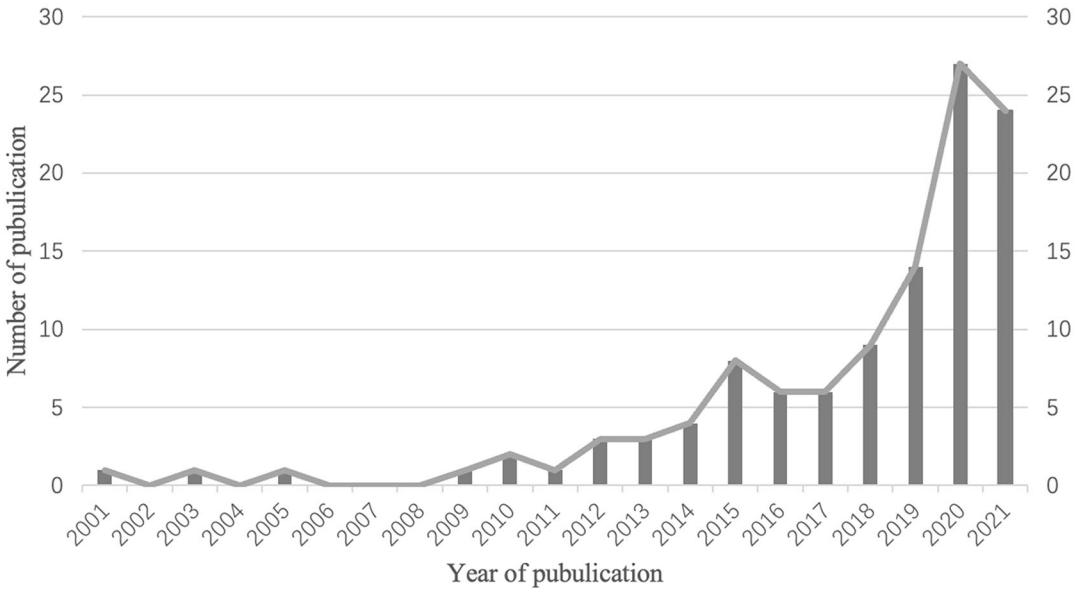

Figure 3. Publications volume of literature related to SASS from 2001 and 2021. SASS: Sustainable apparel supplier selection.

Research hotspots of SASS

This study employs the method of co-word analysis to reveal the research hotspots in the area of SASS. To identify the key themes, this study selected keywords that appeared at least three times among the 105 articles and retained the relevant keywords while removing the irrelevant ones. The resulting keywords were divided into three major clusters, as shown in Figure 4. The lines connecting two keywords in the figure represent their co-occurrence, with thicker lines indicating a higher frequency of co-occurrence and shorter lines indicating a closer relationship between the keywords. The following is an analysis of these three clusters.

Cluster 1 (in red) is the largest cluster, consisting of 87 keywords, and its theme is SSS factors and influences. By analyzing the keywords, current research hotspots on SSS include (1) environmental protection, the impact of enterprise environmental management and environmental practices on supplier selection; (2) social responsibility, the relationship between enterprise social responsibility practices and

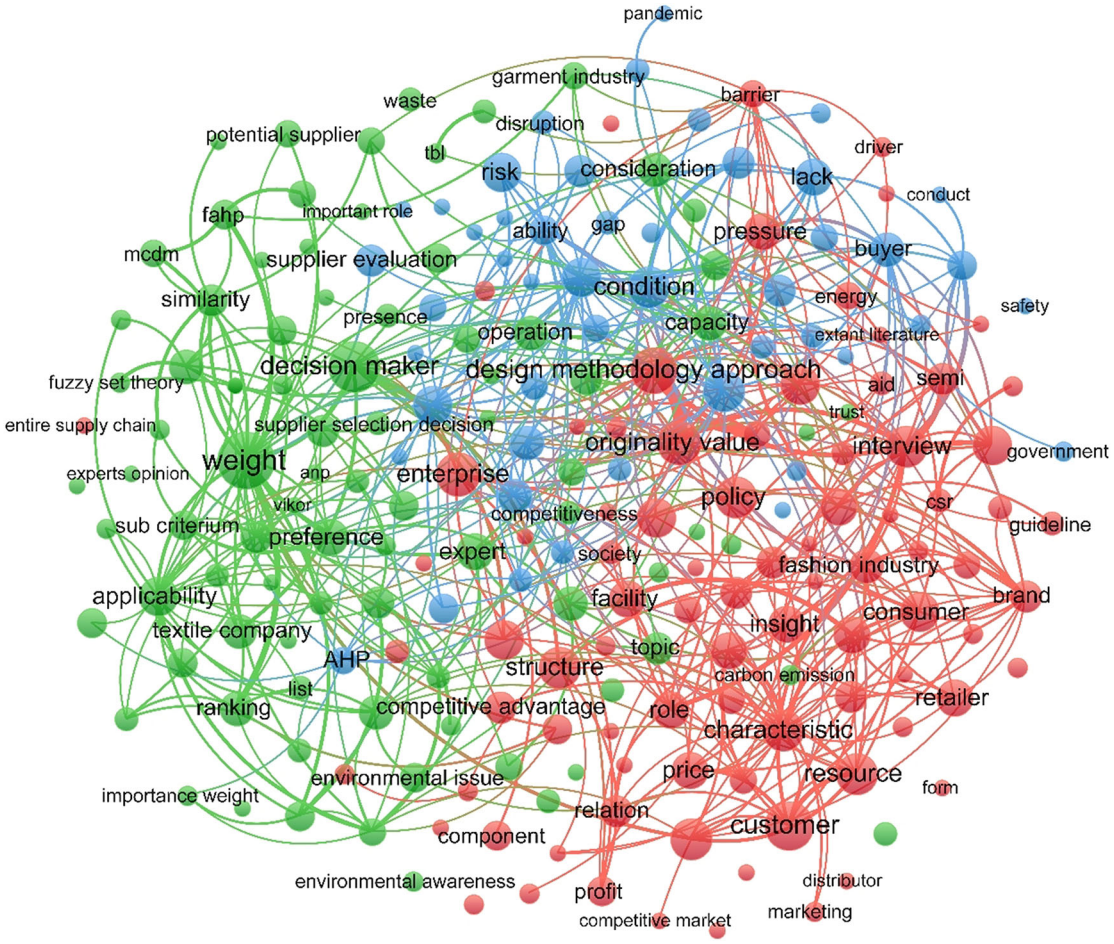

Figure 4. Clustered view of keywords for 105 articles.

consumer demands and their impact on supplier selection; and (3) sustainability trends, the impact of market trends and globalization on supplier selection. In the apparel industry, companies need to enhance their image and meet consumer demands through environmental and social responsibility practices while also adjusting their strategies in a timely manner according to market trends to seek competitive supplier cooperation and achieve sustainable development[16-18]. Cluster 2 (in green) consists of 86 keywords and mainly includes methods and tools for SSS. The main hotspots in this cluster include green supplier selection, MCDM methods and tools, consideration of social and environmental factors, and supply chain sustainability. In terms of green supplier selection, researchers focus on how to evaluate and select sustainable suppliers to reduce the negative impact of the supply chain on the environment. Commonly used MCDM methods and tools, such as the fuzzy AHP and VIKOR (VIseKriterijumska Optimizacija I Kompromisno Resenje), can help decision-makers consider multiple factors comprehensively and select the best supplier. In addition, social and environmental factors are also included in the scope of consideration, such as worker rights and environmental protection. Moreover, resource utilization, waste management, and carbon emissions are also studied. These research hotspots provide useful insights and practical significance for the sustainable development of the apparel industry[4,19-22]. Cluster 3 (in blue) consists of 50 keywords and mainly discusses the key considerations for SSS. The research hotspots in this cluster include but are not limited to (1) assessing the environmental impact of potential suppliers, considering their impact on the environment during the manufacturing and transportation process, and selecting suppliers

with minimal environmental impact; (2) sustainability criteria and certifications: developing and applying sustainability criteria and certifications to ensure that potential suppliers meet sustainability requirements; and (3) sustainable supply chain collaboration: establishing long-term collaborative relationships, working closely with potential suppliers, achieving sustainable supply chain goals, jointly addressing supply chain challenges, and improving overall performance. In practice, we can combine government policies, market trends, and technological innovations to develop relevant strategies to improve the sustainability of supplier selection and promote sustainable development[4,9,17,23].

Dynamic evolution of research hotspots

This section will conduct a dynamic evolution analysis of hot research topics. The dynamic evolution of keywords is shown in Figure 5. The horizontal axis in Figure 5 represents the timeline, with each time period divided into one year, and the keywords that appeared in each year are displayed within each time period. The larger the keyword, the higher its frequency of appearance. Based on Figure 5, the research on the SASS can be roughly divided into four stages. The first phase, from 2001 to 2009, was the starting stage of SASS research. The emerging keywords at this time were only basic supply chain terms such as cost, industry, construction, *etc*., and the emphasis was on cost performance. There was relatively little research on the supply chain environment or society during this period. The second phase, from 2010 to 2013, was the peak period for supplier selection research. During this period, keywords related to SSS research such as environment management, environment criteria, analytical hierarchy process, corporate social responsibility (CSR), *etc*., emerged one after another. This indicates that with the development of society, people are increasingly aware of the importance of sustainable development for human beings. During this period, scholars focused on SASS by analyzing the behavior criteria of suppliers through the analytical hierarchy process and then evaluating supplier selection. The third phase, from 2014 to 2017, was a period of steady development for SASS research. The main keywords during this period included group decision-making, SCM practices, environmental performance, and institutional pressure. Overall, the research during this period expanded the scope of the previous research, from the study of the green supply chain to the sustainable supply chain. The research focus continued to be on carbon emissions, mainly in the automotive industry. New keywords emerged, such as environmental performance and SCM practices. The research methods also became more standardized, considering sustainability issues from the perspective of the supply chain system and framework. The fourth phase, from 2018 to 2021, was another peak period for SASS research. The related keywords during this period included MCDM, AHP model, BWM (Best-Worst Method), CO_2 emission, *etc*. Due to the risks and uncertainties brought by external pressures to companies, research has begun to focus on the coordination of the supply chain. Companies began to voluntarily engage in sustainable development while also paying attention to service quality. The research mainly focused on establishing model frameworks and solving MCDM problems through mathematical models such as AHP models and BWM.

From the evolution of research hotspots over time, it can be seen that there is relatively little research in the academic community on the issue of SASS. Most studies solve common supplier selection problems across various industries by establishing general mathematical models, which lack specificity. In terms of research progress, the focus has shifted from green supply chain research to sustainable supply chain research, with greater emphasis on the coordination and risk-bearing capacity of the supply chain. The research methods have evolved from establishing a single mathematical model to establishing a stable mathematical framework. Overall, research on SASS is still in its early stages, and apparel companies need to establish sustainability awareness and embed sustainable SCM (SSCM) and SSS issues into their development plans.

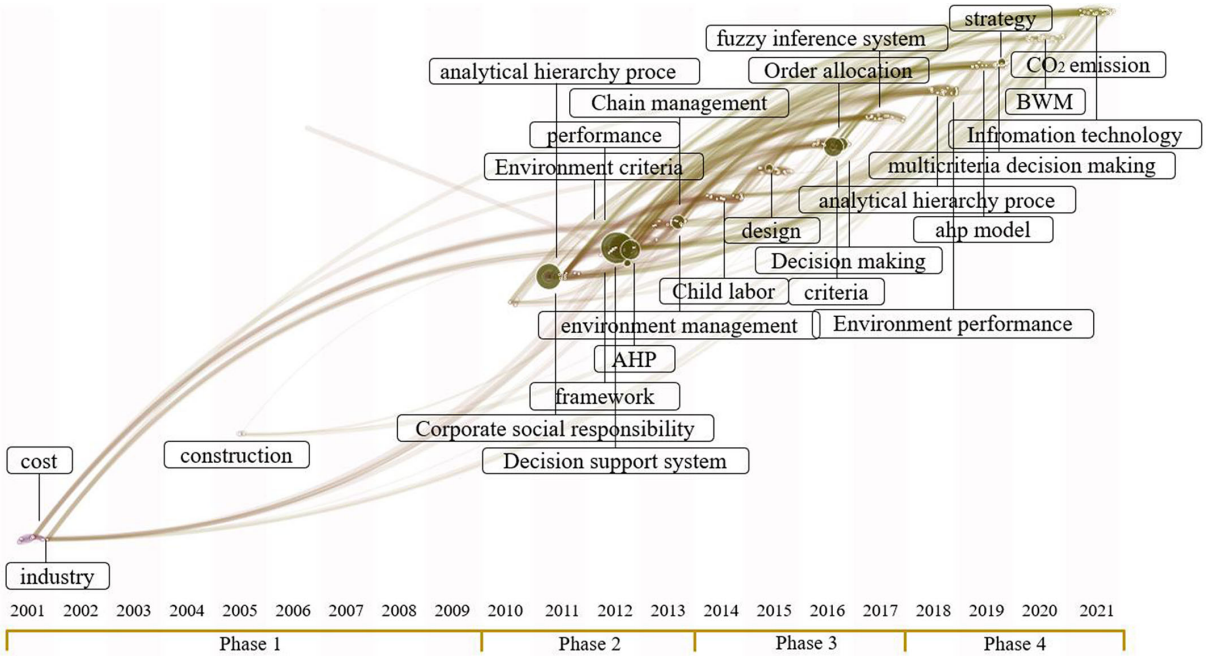

Figure 5. Temporal view of the development trend of keywords. AHP: Analytic hierarchy process; BWM: Best-Worst Method.

TOPIC ANALYSIS ON SASS FIELD

As can be inferred from the analysis in Section 3, the present study will proceed to conduct a theme analysis with respect to two aspects, namely, the establishment of criterion systems and the determination of selection methods, both based on the characteristics of the apparel industry.

Establishment of a criterion system

This section focuses on the construction of a criterion system from two perspectives: sustainable development criteria for apparel suppliers in the selection process and relevant criteria for apparel supplier selection.

Sustainable development criteria

Based on the three dimensions of the TBL framework, criteria that have influenced supplier selection for the past 20 years are typically classified into three categories: economic, environmental, and social. Traditional supplier evaluation research usually involves only economic performance. Common criteria in the economic dimension include cost/price[12,24], quality[24,25], technological capability[26,27], production capacity[28,29], financial condition[30,31], logistics[32,33], service[34,35], relationship[36], flexibility[37,38], *etc*. These criteria often only reflect the economic benefits that suppliers bring to companies. However, with increasing attention to global environmental issues and the enhancement of ecological awareness, environmental performance has become an important evaluation criterion for supplier selection systems. Widely recognized and used criteria in the environmental dimension include green image[39,40], environmental management system[41,42], environmental capability[43,44], pollution control[45,46], green products[47], resource consumption[48,49], green design[50,51], green SCM[52], green technology innovation[52], *etc*. Although research on CSR is not a new topic and has already made some achievements, research combining CSR with supplier selection has only emerged in recent years. Social dimension supplier selection criteria include employee rights[53], stakeholder rights[42,54], labor safety and health[55], impact on local communities[56], compliance with laws and policies[57], employee training[58], information disclosure[24], child labor or forced labor[59], *etc*.

Figure 6 summarizes some commonly used criteria in the field of SSS in recent years. Overall, the criteria for each dimension are currently quite comprehensive. However, there is a lack of research on the application of criteria that unify the three dimensions in the context of SSS in the apparel industry.

SASS criteria

When considering sustainability factors, there are currently only a few studies that have addressed SSS in the apparel industry and developed corresponding criterion systems. Shaw *et al.* considered criteria such as cost, quality compliance rate, delivery delay rate, greenhouse gas emissions, and demand and integrated the weights of these criteria into a fuzzy multiobjective linear programming problem for supplier selection[60]. Luthra *et al.* determined 22 SSS criteria based on TBL through literature screening and expert opinions[61]. The results showed that environmental cost, product quality, product price, occupational health and safety system, and environmental capability were the top five SSS criteria. In the research of Awasthi *et al.*, in the selection of multilevel sustainable global suppliers, the results showed that the economic criterion had the highest weight among the five sustainable criteria (economic, quality, environmental, social, and global risk), while global risk had the lowest weight[62]. In the construction of sustainable criterion systems for the textile and apparel industry, Baskaran *et al.* conducted a sample survey of 63 apparel suppliers based on six criteria, including discrimination, human rights violations, child labor, long working h, unfair competition, and pollution[6]. The results showed that long working hours were a key criterion for both apparel manufacturers and auxiliary suppliers. Pollution and unfair competition were the most important criteria for apparel manufacturers. Winter *et al.* studied how apparel companies apply environmental and social criteria in supplier evaluation[9].

Overall, as time goes on, the criteria for selecting sustainable apparel suppliers are becoming more comprehensive and diverse, and they consider more fuzzy factors in the supplier selection process. This is strongly related to the development of MCDM methods.

Analysis of research methods

This section will first introduce the research methods used in the area of supplier selection and provide a macrolevel understanding of the current hot research methods used in this field. Then, a detailed analysis of the methods applied in the sustainable apparel supplier field will be conducted.

Primary methods utilized for supplier selection

There are differences in supplier selection processes across various industries. Currently, AHP, TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution), VIKOR and their variants are commonly used methods in the supplier selection process. Scholars have explored different SSS methods, with most studies using a combination of multiple methods to improve decision quality. The following is a partial summary of these studies.

Gupta and Barua proposed a BWM-fuzzy TOPSIS model to address the green supplier selection problem for small and medium-sized enterprises[63]. Banaeian *et al.* combined fuzzy set theory with VIKOR, TOPSIS, and GRA (Grey Relation Analysis) to help the agriculture and food industries select green suppliers[64]. Babbar and Amin proposed a two-stage Quality Function Deployment (QFD) and stochastic multiobjective mathematical model to address the green supplier selection and order allocation problem in the beverage industry[65]. Gupta *et al.* proposed a FAHP-MABAC-WASPAS-TOPSIS model to evaluate green suppliers in the automotive industry[66]. Moheb-Alizadeh and Handfield proposed a multiobjective mixed integer linear programming model to address the SSS and order allocation quantity problem in the automotive industry, considering sustainability, stockout, and discount situations[67]. Memari *et al.* proposed an intuitive fuzzy

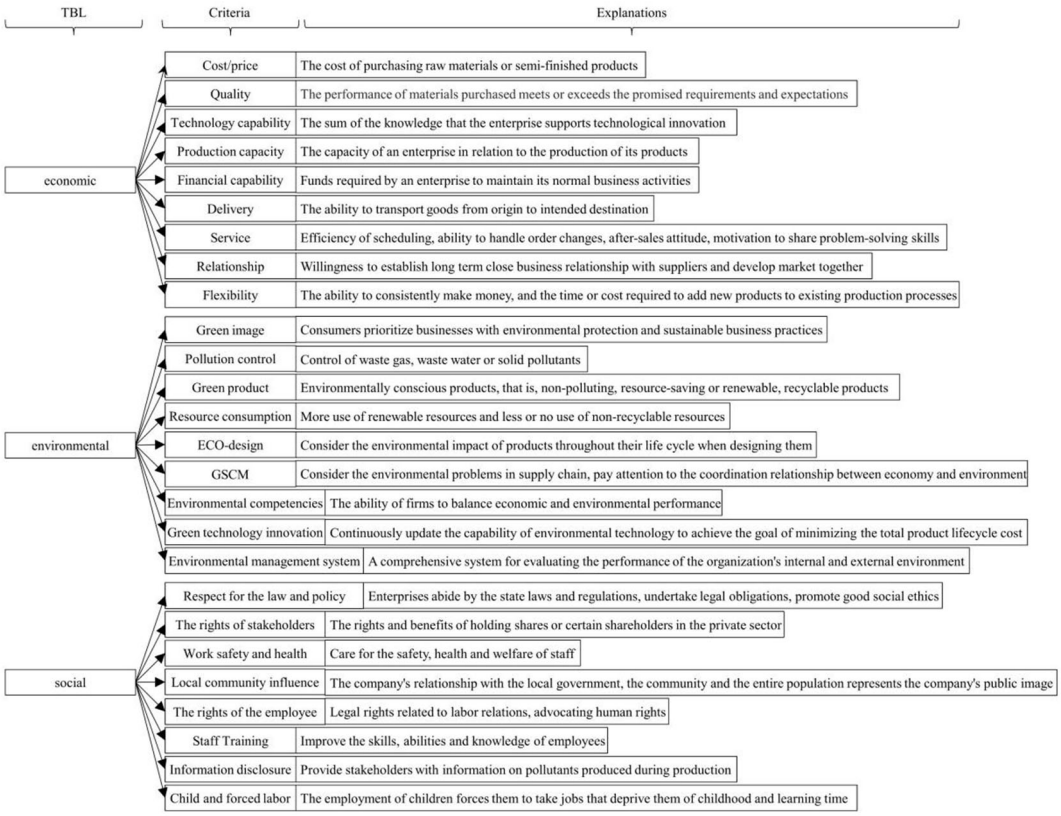

Figure 6. Sustainable supplier selection criteria. GSCM: Green supply chain management.

TOPSIS method to select reliable suppliers for automotive component companies[68]. Stević *et al.* developed a new compromise solution (MARCOS) for SSS in the healthcare industry[69]. Mahmoudi *et al.* combined the gray system theory (GST) and the ordered priority approach (OPA) method to address SSS in large investment projects[70]. Amiri *et al.* proposed combining FBWM and α-cut to address SSS in the automotive industry[71]. Li *et al.* developed a two-stage integrated mathematical model to select sustainable suppliers in the new energy automotive industry and allocate orders to each supplier[72].

The researchers in this field have employed various methods, including fuzzy set theory, VIKOR, TOPSIS, GRA, QFD, multiobjective mathematical models, intuitionistic fuzzy TOPSIS, compromise solution, gray theory, sequential priority, and α-cut. Each of these methods possesses its own characteristics and advantages. However, as time progresses, new methods are developed to overcome the limitations of the old ones, gradually enhancing the research on MCDM. For example, in the past, most of the methods used to determine the weight of criteria were AHP. However, due to the challenges associated with consistency testing and complex hierarchy structures, AHP has certain limitations. The introduction of the BWM method proposed by Rezaei in 2014 has gradually replaced AHP in the field of MCDM[73]. The BWM method offers advantages such as fewer comparison times and high result consistency. Another noteworthy method is MULTIMOORA[74] (Multiobjective Optimization on the Basis of a Ratio Analysis plus the full MULTIplicative). It is a comprehensive approach that combines several MCDM methods and fulfills all six robust conditions through three or more methods. Since its introduction, MULTIMOORA has found widespread application in various industries, including supplier selection, risk assessment, logistics partner selection, project management, and more.

The selection of these methods depends on the specific environment and problem of the SSS. Most researchers also combine multiple methods to improve decision quality. Table 1 summarizes the methods and their extensions currently used in the supplier selection process.

Methods used in SASS

As emphasized by de Boer *et al*., not all methods are equally applicable to every industry[90]. For the fashion industry, the particularity of the industry must be taken into account when selecting suppliers. The fashion industry is seasonal, so delivery time must be considered; product quality is related to brand image; trends are strong, requiring a certain degree of flexibility and market sensitivity; other factors such as price, design, stability, and social responsibility are also important considerations for companies in supplier selection. Moreover, with the increasing sustainability awareness of consumers, product sustainability has become a necessary consideration. The selection of fashion suppliers is a very obvious multicriteria decision problem. The following are the mainstream research methods for SSS in the textile and apparel industry.

Of all 105 literature reviewed, the first to research SSS in the fashion industry was Wang *et al*., who in 2012 combined fuzzy logic (a popular method for incorporating uncertain parameters into the decision-making process) with an analytical hierarchy process to form a model for selecting (decision-making) different green initiatives in the fashion industry[91]. Additionally, in 2012, Baskaran *et al*. classified suppliers into "good performance", "noncompliant", and "underperforming" categories by analyzing a sample of 63 suppliers and six sustainable development criteria (i.e., discrimination, human rights abuses, child labor, long working hours, unfair competition, and pollution) using gray methods and found that pollution and unfair competition were the most important criteria[6]. In recent years, Nasr *et al*. have used the fuzzy BWM to select the most suitable suppliers based on economic, environmental, social, and circular criteria and designed a multiproduct, multiperiod, closed-loop supply chain (CLSC) network, inventory location routing, vehicle scheduling, and quantity discount considerations using a multiobjective mixed integer linear programming (MOMILP) model[92]. Celik *et al*. used the Interval Type-2 Fuzzy Best Worst Method (IT2F-BWM) to determine evaluation criteria for selecting green suppliers and applied the Interval Type-2 Fuzzy TODIM (IT2F-TODIM) method for the selection of green suppliers[93]. A case study on the Turkish textile industry demonstrated the applicability of the method. Kusi-Sarpong *et al*. first used the BWM method to determine the relative importance weight and then applied VIKOR to rank the suppliers, helping a Pakistani textile manufacturing company find the best supplier[22]. Majumdar *et al*. captured opinions on each criterion and alternative using linguistic terms from experts, modeled them using fuzzy mathematics, and then introduced and demonstrated a solution algorithm for flexible supplier selection based on a trapezoidal intuitionistic fuzzy technique for order preference by similarity to ideal solution (TrIFTOPSIS)[94].

Table 2 summarizes the commonly used methods of supplier selection by some apparel suppliers in recent years, as well as the corresponding supplier selection criteria. Based on the table and the above content, it can be concluded that the research logic in this field is basically to formulate a framework for selecting suppliers for textile and apparel enterprises, calculate criterion weights, establish mathematical models, rank suppliers, obtain the best supplier, and finally verify the effectiveness of the established model through enterprise cases. The methods for calculating criterion weights include BWM and AHPANP. Mathematical methods for ranking suppliers include TOPSIS, VIKOR, TODIM, DEA, PROMETHEE, and so on.

DISCUSSION AND IMPLICATIONS

Findings

In the field of SCM, an increasing number of enterprises and scholars have become aware of the importance

Table 1. Supplier selection methods and related studies

Methods	Extension	Ref.
AHP	Fuzzy AHP	Shaw *et al.*[60], Kilincci and Onal[75]
	AHP and DEA	Ramanathan[76]
	AHP and VIKOR	Luthra *et al.*[61]
	AHP and Fuzzy TOPSIS	Lima Junior *et al.*[77], Beikkhakhian *et al.*[78]
TOPSIS	Fuzzy TOPSIS	Kannan *et al.*[79], Awasthi *et al.*[80]
	VIKOR-TOPSIS-GRA	Banaeian *et al.*[64]
	DEMATEL-ANP-TOPSIS	Büyüközkan and Çifçi[81]
BWM	Fuzzy BWM	Gan *et al.*[82]
	BWM-Fuzzy TOPSIS	Gupta and Barua[63]
	BWM and VIKOR	Kumar *et al.*[83]
GRA	Fuzzy GRA	Chen *et al.*[51]
	GRA and AHP	Li and Zhao[84]
	GRA and DEMATEL	Fu *et al.*[85]
VIKOR	Fuzzy VIKOR	Sanayei *et al.*[86]
	VIKOR and NGT	Awasthi and Kannan[55]
	VIKOR and Fuzzy ELECTRE	Zandi and Roghanian[87]
DEA	Fuzzy DEA	Mahdiloo *et al.*[43], Azadi *et al.*[88]
	DEA and ANN	Azadi *et al.*[88]
	DEA and RST	Bai and Sarkis[89]

AHP: Analytic hierarchy process; ANN: artificial neural network; BWM: Best-Worst Method; DEA: data envelopment analysis; DEMATEL: Decision-Making Trial and Evaluation Laboratory; ELECTRE: elimination et choice translating reality; GRA: Grey Relation Analysis; NGT: Nominal Group Technique; RST: Rough Set Theory; TOPSIS: Technique for Order Preference by Similarity to an Ideal Solution; VIKOR: VIseKriterijumska Optimizacija I Kompromisno Resenje.

of sustainable development and actively practice it to achieve their social, environmental, and economic goals. In enterprise SCM, procurement plays a critical role and has a significant impact on downstream activities. Consequently, an increasing number of empirical and conceptual papers are exploring the issue of SSS. Particularly in the fashion industry, choosing sustainable suppliers is crucial, but currently, there are relatively few quantitative and literature reviews on SASS. This limitation restricts our in-depth understanding and summary of the development in this field.

This article presents a visual and systematic analysis of 105 literature pieces published in the past 20 years in the field of SSS in the fashion industry. Based on this literature analysis, this paper identifies several research hotspots and starting points regarding the process of SSS in the fashion industry.

This article reveals that the majority of current research on SSS in the fashion industry employs integrated approaches and models, such as hybrid decision-making models and data collection and mining, to evaluate the suitability, environmental factors, complexity, and performance of suppliers to achieve the goal of selecting sustainable suppliers. The research also finds that an increasing number of studies apply fuzzy mathematics and MCDM methods to SSS, fully considering the subjective fuzziness of decision-makers, to address the applications of complex problems, environmental pollution, and resource conservation.

The study of the influence of consumer, social, and technological factors on SSS is a relatively popular research direction. Understanding consumer awareness and attitudes toward sustainability issues is the foundation for achieving sustainability. In addition, sustainability and environmental protection training and the awareness of supply chain partners are also crucial. The application of information technology in

Table 2. SASS criteria and methods

Relevant scholars	Year	TBL	Research methods	Relevant criteria
Fallahpour *et al.*[95]	2017	YES	FPP; FTOPSIS	Cost; quality; delivery and service; flexibility; workers' rights; health and safety at work; supportive activities; environmental management system; green products; green warehousing; ecological design; green transportation; green logistics.
Ulutaş *et al.*[96]	2019	NO	FROV; FPSI	Cost; defective rate; late delivery rate; technical capability; technical assistance; pollution control; environmental management; green transportation; green warehousing.
Guarnieria and Trojan[13]	2019	YES	AHP; ELECTRE-TRI	Geographical location; cost; quality; delivery date; human rights; charitable activities; certification; environmental impact; reverse logistics; environmentally friendly packaging; emission control.
Wang *et al.*[97]	2019	YES	FAHP; TOPSIS	Cost; delivery reliability; quality; technical ability; employment practice; health and safety; impact on local communities; impact on contractual stakeholders; pollution production; resource consumption; ecological design; environmental management system.
Yang and Wang[98]	2020	YES	FAHP; FTOPSIS	Funding for green innovation; research and development investment in green practices; reducing the cost of green products; improving the industry's social image; responding to customer and market demand for green products; adopting social and environmental policies in the industry; committed to developing environmental management systems; designing and developing green products; developing green manufacturing and operational practices.
Wang *et al.*[20]	2020	NO	ANP; FAHP; PROMETHEE II	Reliability; responsiveness; flexibility; cost; assets.
Nasr *et al.*[92]	2021	YES	FBWM; MOMILP	Quality; reputation; lead time; flexibility; technical capabilities; service and after-sales; use of environmentally friendly and recyclable raw materials; design of reusable products; environmental management system; management of air pollution caused by production; hazardous waste management; job creation; information disclosure; transparency.
Wang *et al.*[99]	2021	NO	FAHP; FTOPSIS; DEA	Financial capability; quality assurance; service commitment; technological advantage.
Karami *et al.*[19]	2021	YES	DEA; PCA; VIKOR	Reliability; responsiveness; flexibility; assets; employee benefits and rights; occupational safety and health; compliance with policies; information disclosure; environmental management system; environmental competitiveness.

AHP: Analytic hierarchy process; ANP: analytic network process; DEA: data envelopment analysis; ELECTRE: elimination et choice translating reality; FAHP: fuzzy analytic hierarchy process; FBWM: fuzzy best-worst method; FPP: fuzzy preference programming; FROV: fuzzy extension of range of value; FTOPSIS: fuzzy technique for order preference by similarity to ideal solution; FPSI: fuzzy extension of preference selection index; MOMILP: multiobjective mixed integer linear programming; PCA: principal component analysis; PROMETHEE: preference ranking organization method for enrichment of evaluations; SASS: sustainable apparel supplier selection; TBL: triple bottom line; TOPSIS: Technique for Order Preference by Similarity to an Ideal Solution; ELECTRE-TRI: elimination and choice expressing reality tree; VIKOR: VIseKriterijumska Optimizacija I Kompromisno Resenje.

supplier selection and sustainability management is also a future research hotspot. In conducting research on SSCM, the focus should be on environmental and sustainability issues, optimization of order allocation strategies, limiting factors and constraints in SCM, and data-driven decision support systems for SCM.

The research findings require scholars to pay more attention to stakeholder and regulatory issues in sustainable supply chains, such as CSR, globalization, policy makers, manufacturers, and consumers. It is necessary to apply the research results to practice and encourage suppliers to adopt environmental and sustainable measures to achieve the goal of sustainable development.

Future prospects

The application of information technology in supplier selection and sustainability management is a hot research topic[87]. Future research can explore how to use technologies such as artificial intelligence[24], the Internet of Things[100], and blockchain[101] to improve the visibility and transparency of the supply chain, enhance the efficiency and accuracy of supplier selection, and reduce environmental and social risks. The following discussion will delve into the future development prospects of the clothing industry, focusing on big data utilization and the selection process of clothing suppliers as examples.

Analysis of apparel supply chain partner selection in the big data environment

With the advent of the big data era and acceleration of economic globalization, supplier selection in the apparel industry has become more important than ever before. Apparel companies need to keep up with the development of the big data economy and adjust their supply chain partners in a timely manner to adapt to changing environments, which is crucial for their sustainable development.

With the help of big data, apparel companies can easily establish a scientific, systematic, informational and diversified evaluation index system[102]. The new system not only needs to consider various elements involved in the traditional supplier selection process but also needs to address two aspects of system element construction and system structure construction. System element construction involves establishing a clear index system based on evaluation criteria, including criterion concepts, calculation scope, and benchmark content. System structure construction refers to the interrelationships between criteria and the construction of hierarchical structures, which can improve evaluation efficiency and effectiveness. For the apparel industry, sustainable development is of great importance. Therefore, when selecting suppliers, their performance in environmental, social, and economic aspects needs to be taken into consideration. At the same time, factors such as product quality, service, and credibility of the supplier also need to be considered. By establishing a comprehensive, scientific, and applicable evaluation index system, each optional object can be carefully and scientifically evaluated to select partners that meet the requirements of sustainable development. In this process, big data can provide data support[103], analyze a large amount of supplier data, provide decision-making reference, and help enterprises choose more suitable partners to improve the efficiency and sustainability of the supply chain.

Characteristics of managing partner relationships in the apparel supply chain under the big data environment

With the advent of the big data era, significant changes have occurred in the management of the fashion supply chain, and the following are some characteristics of managing fashion supply chain partnerships in the big data environment based on literature analysis.

First, the SCM concept in the big data environment has achieved precision[104]. By collecting and feeding back consumer demand information to the production end and redesigning and producing products again, it meets the more precise needs of end consumers at a deeper level. Second, the synergy effect in the big data environment is amplified[105]. Through data processing of intelligent hardware and software technology, information processing, collection, analysis, and application in various links of the supply chain can be optimized in a timely and effective manner. This not only achieves academic rigor and operational agility at the execution level of each link but also realizes the synergistic effect of the whole chain. Third, the customization of consumer demand is propelled with in the big data environment[106]. Through the analysis of consumer demand, production customization is achieved, transforming the existing problem of batch production on the supply side into customized production that satisfies individualized needs. This model can satisfy the individual needs of consumers, improve the efficiency and reduce the production cost of enterprises. Fourth, supply-side structure management optimization is achieved in the big data environment[107]. By improving the quality of supply-side products, achieving industrial transformation and upgrading, optimizing the structure, improving the efficiency of production and manufacturing, and focusing on sustainable development strategies such as environmental protection, it can achieve competitive products that are suitable for sales and truly meet consumer needs. Finally, small- and medium-sized fashion enterprises use big data applications to enhance competitiveness[108]. With the sensitivity and flexibility of big data in the market, small and medium-sized fashion enterprises can maintain a certain living space in the fiercely competitive market. Big data provides strategic flexibility for small and medium-sized enterprises to better adapt to market demand and improve competitiveness.

In summary, in the big data environment, the management of partner relationships in the apparel supply chain has the characteristics of precision, collaborative effects, driving consumer demand customization, optimizing supply-side structural management, and enhancing the competitiveness of small and medium-sized enterprises through the use of big data applications.

CONCLUSION

This article conducts a comprehensive and systematic analysis of 105 relevant scholarly studies about the SASS published between 2001 and 2021. Using a methodology based on keyword co-occurrence, this investigation identifies the main research focal points and predicts future directions of progress in this field. Additionally, by scrutinizing the shared citations within the body of literature, this study identifies the predominant subject matters and principal methodological approaches that are prevalent in this sphere. Drawing upon the existing scholarship, this article offers predictions about possible directions for future research in this field. The principal empirical discoveries can be encapsulated as follows: (1) The study of SSS predominantly focuses on incorporating complex methodologies and models, utilizing fuzzy mathematics and MCDM approaches to effectively tackle the growing complexities that come with supplier selection concerns; (2) The main concerns within the field of SSCM include systematically addressing environmental and sustainability challenges, optimizing order allocation strategies, improving challenges and constraints within SCM, and creating data-centric decision support systems tailored to the SCM domain; (3) The exploration of merging information technology with supplier selection and sustainability management processes emerges as a significant research frontier. Cutting-edge technologies, such as artificial intelligence, the Internet of Things, big data, and blockchain can enhance the visibility of supply chains and data transparency. This, in turn, improves the effectiveness and precision of supplier selection while also reducing environmental and social risks.

This systematic and comprehensive review provides valuable insights and guidance for readers, encompassing researchers and practitioners in the sustainable clothing supplier selection field. For instance, this paper presents the most popular supplier selection methods in the garment industry, enabling researchers to establish the foundation for their own supplier selection systems. Simultaneously, it facilitates relevant scholars in identifying regions and institutions worldwide that have conducted in-depth research on supplier selection within the supply chain in the garment industry. This aids in discovering more suitable research methods and innovative ideas.

To sum up, this article provides readers with a better understanding of sustainable development in the garment industry. It focuses on the supplier selection, relevant scholars, and institutions concerned with this field, as well as the main research concepts, their evolution, and emerging trends.

DECLARATIONS

Authors' contributions

General framework proposition and funding arrangement: Xue Z
Literature analysis and paper writing: Zhu Z, Li Q
Data acquisition and analysis: Wang T, Du T

Availability of data and materials

Not applicable.

Financial support and sponsorship

This work was funded by the MOE (Ministry of Education in China) Project of Humanities and Social Sciences (grant number: 22YJC760111) and the Open Project of Jiangsu Key Laboratory of Silk Engineering (grant number: KJS 2057).

Conflicts of interest

All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

REFERENCES

1. Huang Z, Xue Z, Wang Y. Current situation and prospects of sustainable fashion design. *J Silk* 2019;56:50-5. Available from: https://kns.cnki.net/kcms/detail/33.1122.TS.20190917.1009.004.html. [Last accessed on 8 Sep 2023] (in Chinese)
2. Chen L, Yan X, Ding X, Gao C. Evaluation of sustainable competitiveness of textile and costume industry based on analytic network process theory. *Text Res J* 2018;39:162-7. (in Chinese). DOI
3. Ho W, Xu X, Dey PK. Multi-criteria decision making approaches for supplier evaluation and selection: a literature review. *Eur J Oper Res* 2010;202:16-24. DOI
4. Wang CN, Pan CF, Tinh Nguyen V, Tam Husain S. Sustainable supplier selection model in supply chains during the COVID-19 pandemic. *Comput Mater Contin* 2022;70:3005-19. DOI
5. Gao Q, Li G. Research on supplier selection model based on improved TOPSIS method. *Hebei J Ind Sci Technol* 2020;37:388-93. (in Chinese). DOI
6. Baskaran V, Nachiappan S, Rahman S. Indian textile suppliers' sustainability evaluation using the grey approach. *Int J Prod Econ* 2012;135:647-58. DOI
7. Zeng X, Rabenasolo B. Developing a sustainable textile/clothing supply chain by selecting relevant materials and suppliers. *Res J Text Appar* 2013;17:101-14. DOI
8. Jia P, Govindan K, Choi TM, Rajendran S. Supplier selection problems in fashion business operations with sustainability considerations. *Sustainability* 2015;7:1603-19. DOI
9. Winter S, Lasch R. Environmental and social criteria in supplier evaluation - lessons from the fashion and apparel industry. *J Clean Prod* 2016;139:175-90. DOI
10. Amindoust A, Saghafinia A. Textile supplier selection in sustainable supply chain using a modular fuzzy inference system model. *J Text Inst* 2017;108:1250-8. DOI
11. Yadlapalli A, Rahman S, Gunasekaran A. Socially responsible governance mechanisms for manufacturing firms in apparel supply chains. *Int J Prod Econs* 2018;196:135-49. DOI
12. Kannan D. Role of multiple stakeholders and the critical success factor theory for the sustainable supplier selection process. *Int J Prod Econ* 2018;195:391-418. DOI
13. Guarnieri P, Trojan F. Decision making on supplier selection based on social, ethical, and environmental criteria: a study in the textile industry. *Resour Conserv Recycl* 2019;141:347-61. DOI
14. Darvishi F, Ghasemy Yaghin R, Sadeghi A. Integrated fabric procurement and multi-site apparel production planning with cross-docking: a hybrid fuzzy-robust stochastic programming approach. *Appl Soft Comput* 2020;92:106267. DOI
15. Schramm VB, Cabral LPB, Schramm F. Approaches for supporting sustainable supplier selection - a literature review. *J Clean Prod* 2020;273:123089. DOI
16. Nath SD, Eweje G, Bathurst R. The invisible side of managing sustainability in global supply chains: evidence from multitier apparel suppliers. *J Bus Logist* 2021;42:207-32. DOI
17. Köksal D, Strähle J. Social sustainability in fashion supply chains - understanding social standard implementation failures in Vietnam and Indonesia using agency theory. *Sustainability* 2021;13:2159. DOI
18. Majumdar A, Shaw M, Sinha SK. COVID-19 debunks the myth of socially sustainable supply chain: a case of the clothing industry in South Asian countries. *Sustain Prod Consum* 2020;24:150-5. DOI PubMed PMC
19. Karami S, Ghasemy Yaghin R, Mousazadegan F. Supplier selection and evaluation in the garment supply chain: an integrated

DEA-PCA-VIKOR approach. *J The Text Inst* 2021;112:578-95. DOI

20. Wang CN, Hoang Viet VT, Ho TP, Nguyen VT, Nguyen VT. Multi-criteria decision model for the selection of suppliers in the textile industry. *Symmetry* 2020;12:979. DOI
21. Kaushik V, Kumar A, Gupta H, Dixit G. A hybrid decision model for supplier selection in Online Fashion Retail (OFR). *Int J Logist Res Appl* 2022;25:27-51. DOI
22. Kusi-Sarpong S, Gupta H, Khan SA, Chiappetta Jabbour CJ, Rehman ST, Kusi-sarpong H. Sustainable supplier selection based on industry 4.0 initiatives within the context of circular economy implementation in supply chain operations. *Prod Plan Control* 2023;34:999-1019. DOI
23. Maalouf MM, Hasle P, Vang J, Hamja A. Complementarities between operations and occupational health and safety in garments. *Sustainability* 2021;13:4313. DOI
24. Kuo RJ, Wang YC, Tien FC. Integration of artificial neural network and MADA methods for green supplier selection. *J Clean Prod* 2010;18:1161-70. DOI
25. Chiou CY, Hsu CW, Hwang WY. Comparative investigation on green supplier selection of the American, Japanese and Taiwanese electronics industry in China. In: 2008 IEEE International Conference on Industrial Engineering and Engineering Management; 2008 Dec 08-11; Singapore. IEEE; 2009. p. 1909-14. DOI
26. Rajesh R, Ravi V. Supplier selection in resilient supply chains: a grey relational analysis approach. *J Clean Prod* 2015;86:343-59. DOI
27. Chen YJ. Structured methodology for supplier selection and evaluation in a supply chain. *Inf Sci* 2011;181:1651-70. DOI
28. Sawik T. On the risk-averse optimization of service level in a supply chain under disruption risks. *Int J Prod Res* 2016;54:98-113. DOI
29. Punniyamoorthy M, Mathiyalagan P, Parthiban P. A strategic model using structural equation modeling and fuzzy logic in supplier selection. *Expert Syst Appl* 2011;38:458-74. DOI
30. Yu Q, Hou F. An approach for green supplier selection in the automobile manufacturing industry. *Kybernetes* 2016;45:571-88. DOI
31. Büyüközkan G, Çifçi G. Evaluation of the green supply chain management practices: a fuzzy ANP approach. *Prod Plan Control* 2012;23:405-18. DOI
32. Hsu CH, Wang FK, Tzeng GH. The best vendor selection for conducting the recycled material based on a hybrid MCDM model combining DANP with VIKOR. *Resour Conserv Recycl* 2012;66:95-111. DOI
33. Rezaei J, Ortt R. Multi-criteria supplier segmentation using a fuzzy preference relations based AHP. *Eur J Oper Res* 2013;225:75-84. DOI
34. Chan FTS, Kumar N. Global supplier development considering risk factors using fuzzy extended AHP-based approach. *Omega* 2007;35:417-31. DOI
35. Wang J, Cheng C, Huang KC. Fuzzy hierarchical TOPSIS for supplier selection. *Appl Soft Comput* 2009;9:377-86. DOI
36. Adobor H, Mcmullen R. Supplier diversity and supply chain management: a strategic approach. *Bus Horiz* 2007;50:219-29. DOI
37. Zhang HC, Li J, Merchant ME. Using fuzzy multi-agent decision-making in environmentally conscious supplier management. *CIRP Ann Manuf Technol* 2003;52:385-8. DOI
38. Hosseini S, Barker K. A Bayesian network model for resilience-based supplier selection. *Int J Prod Econ* 2016;180:68-87. DOI
39. Kannan D, Govindan K, Rajendran S. Fuzzy Axiomatic Design approach based green supplier selection: a case study from Singapore. *J Clean Prod* 2015;96:194-208. DOI
40. Finkbeiner M, Neugebauer S, Berger M. Carbon footprint of recycled biogenic products: the challenge of modelling CO_2 removal credits. *Int J Sustain Eng* 2013;6:66-73. DOI
41. Tseng ML, Chiu ASF. Evaluating firm's green supply chain management in linguistic preferences. *J Clean Prod* 2013;40:22-31. DOI
42. Humphreys P, Mcivor R, Chan F. Using case-based reasoning to evaluate supplier environmental management performance. *Expert Syst Appl* 2003;25:141-53. DOI
43. Mahdiloo M, Saen RF, Lee KH. Technical, environmental and eco-efficiency measurement for supplier selection: an extension and application of data envelopment analysis. *Int J Prod Econ* 2015;168:279-89. DOI
44. Cheng H, Chen C, Wu S, Mirza ZA, Liu Z. Emergy evaluation of cropping, poultry rearing, and fish raising systems in the drawdown zone of Three Gorges Reservoir of China. *J Clean Prod* 2017;144:559-71. DOI
45. Sardar S, Lee YH, Memon MS. A sustainable outsourcing strategy regarding cost, capacity flexibility, and risk in a textile supply chain. *Sustainability* 2016;8:234. DOI
46. Schiessl A, Müller R, Volk R, Schultmann F. Site-specific environmental impact assessment as a basis for supplier selections - exemplary application to aluminum. *J Clean Prod* 2021;290:125703. DOI
47. Wu S, Cao Y, He L. Temporal changes of carbon emission transmissions in China's supply chain, 1997-2017. *J Clean Prod* 2020;269:122367. DOI
48. Zhang X, Gao B, Zhao S, Wu P, Han L, Liu X. Optimization of a "coal-like" pelletization technique based on the sustainable biomass fuel of hydrothermal carbonization of wheat straw. *J Clean Prod* 2020;242:118426. DOI
49. Mangla SK, Sharma YK, Patil PP, Yadav G, Xu J. Logistics and distribution challenges to managing operations for corporate sustainability: study on leading Indian diary organizations. *J Clean Prod* 2019;238:117620. DOI
50. De Bernardi C, Pedrini M. Transforming water into wine: environmental bricolage for entrepreneurs. *J Clean Prod* 2020;266:121815. DOI

51. Chen CC, Tseng ML, Lin YH, Lin ZS. Implementation of green supply chain management in uncertainty. In: 2010 IEEE International Conference on Industrial Engineering and Engineering Management; 2010 Dec 07-10; Macao, China. IEEE; 2010. p. 260-4. DOI
52. Neubig CM, Vranken L, Roosen J, et al. Action-related information trumps system information: influencing consumers' intention to reduce food waste. *J Clean Prod* 2020;261:121126. DOI
53. Büyüközkan G, Çifçi G. A novel fuzzy multi-criteria decision framework for sustainable supplier selection with incomplete information. *Comput Ind* 2011;62:164-74. DOI
54. Ehrgott M, Reimann F, Kaufmann L, Carter CR. Social sustainability in selecting emerging economy suppliers. *J Bus Ethics* 2011;98:99-119. DOI
55. Awasthi A, Kannan G. Green supplier development program selection using NGT and VIKOR under fuzzy environment. *Comput Ind Eng* 2016;91:100-8. DOI
56. Sarkis J, Dhavale DG. Supplier selection for sustainable operations: a triple-bottom-line approach using a Bayesian framework. *Int J Prod Econ* 2015;166:177-91. DOI
57. Blome C, Hollos D, Paulraj A. Green procurement and green supplier development: antecedents and effects on supplier performance. *Int J Prod Res* 2014;52:32-49. DOI
58. Govindan K, Khodaverdi R, Jafarian A. A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach. *J Clean Prod* 2013;47:345-54. DOI
59. Zimmer K, Fröhling M, Schultmann F. Sustainable supplier management - a review of models supporting sustainable supplier selection, monitoring and development. *Int J Prod Res* 2016;54:1412-42. DOI
60. Shaw K, Shankar R, Yadav SS, Thakur LS. Supplier selection using fuzzy AHP and fuzzy multi-objective linear programming for developing low carbon supply chain. *Expert Syst Appl* 2012;39:8182-92. DOI
61. Luthra S, Govindan K, Kannan D, Mangla SK, Garg CP. An integrated framework for sustainable supplier selection and evaluation in supply chains. *J Clean Prod* 2017;140:1686-98. DOI
62. Awasthi A, Govindan K, Gold S. Multi-tier sustainable global supplier selection using a fuzzy AHP-VIKOR based approach. *Int J Prod Econ* 2018;195:106-17. DOI
63. Gupta H, Barua MK. Supplier selection among SMEs on the basis of their green innovation ability using BWM and fuzzy TOPSIS. *J Clean Prod* 2017;152:242-58. DOI
64. Banaeian N, Mobli H, Fahimnia B, Nielsen IE, Omid M. Green supplier selection using fuzzy group decision making methods: a case study from the agri-food industry. *Comput Oper Res* 2018;89:337-47. DOI
65. Babbar C, Amin SH. A multi-objective mathematical model integrating environmental concerns for supplier selection and order allocation based on fuzzy QFD in beverages industry. *Expert Syst Appl* 2018;92:27-38. DOI
66. Gupta S, Soni U, Kumar G. Green supplier selection using multi-criterion decision making under fuzzy environment: a case study in automotive industry. *Comput Ind Eng* 2019;136:663-80. DOI
67. Moheb-alizadeh H, Handfield R. Sustainable supplier selection and order allocation: a novel multi-objective programming model with a hybrid solution approach. *Comput Ind Eng* 2019;129:192-209. DOI
68. Memari A, Dargi A, Akbari Jokar MR, Ahmad R, Abdul Rahim AR. Sustainable supplier selection: a multi-criteria intuitionistic fuzzy TOPSIS method. *J Manuf Syst* 2019;50:9-24. DOI
69. Stević Ž, Pamučar D, Puška A, Chatterjee P. Sustainable supplier selection in healthcare industries using a new MCDM method: measurement of alternatives and ranking according to COmpromise solution (MARCOS). *Comput Ind Eng* 2020;140:106231. DOI
70. Mahmoudi A, Deng X, Javed SA, Zhang N. Sustainable supplier selection in megaprojects: grey ordinal priority approach. *Bus Strat Env* 2021;30:318-39. DOI
71. Amiri M, Hashemi-tabatabaei M, Ghahremanloo M, Keshavarz-ghorabaee M, Zavadskas EK, Banaitis A. A new fuzzy BWM approach for evaluating and selecting a sustainable supplier in supply chain management. *Int J Sustain Dev World Ecol* 2021;28:125-42. DOI
72. Li F, Wu CH, Zhou L, Xu G, Liu Y, Tsai SB. A model integrating environmental concerns and supply risks for dynamic sustainable supplier selection and order allocation. *Soft Comput* 2021;25:535-49. DOI
73. Rezaei J. Best-worst multi-criteria decision-making method. *Omega* 2015;53:49-57. DOI
74. Brauers WKM, Zavadskas EK. Multimoora optimization used to decide on a bank loan to buy property. *Technol Econ Dev Econ* 2011;17:174-88. DOI
75. Kilincci O, Onal SA. Fuzzy AHP approach for supplier selection in a washing machine company. *Expert Syst Appl* 2011;38:9656-64. DOI
76. Ramanathan R. Supplier selection problem: integrating DEA with the approaches of total cost of ownership and AHP. *Int J Supply Chain Manag* 2007;12:258-61. DOI
77. Lima Junior FR, Osiro L, Carpinetti LCR. A comparison between Fuzzy AHP and Fuzzy TOPSIS methods to supplier selection. *Appl Soft Comput* 2014;21:194-209. DOI
78. Beikkhakhian Y, Javanmardi M, Karbasian M, Khayambashi B. The application of ISM model in evaluating agile suppliers selection criteria and ranking suppliers using fuzzy TOPSIS-AHP methods. *Expert Syst Appl* 2015;42:6224-36. DOI
79. Kannan D, Lopes de Sousa Jabbour AB, Chiappetta Jabbour CJ. Selecting green suppliers based on GSCM practices: using fuzzy TOPSIS applied to a Brazilian electronics company. *Eur J Oper Res* 2014;233:432-47. DOI
80. Awasthi A, Chauhan SS, Goyal S. A fuzzy multicriteria approach for evaluating environmental performance of suppliers. *Int J Prod*

Econ 2010;126:370-8. DOI
81. Büyüközkan G, Çifçi G. A novel hybrid MCDM approach based on fuzzy DEMATEL, fuzzy ANP and fuzzy TOPSIS to evaluate green suppliers. *Expert Syst Appl* 2012;39:3000-11. DOI
82. Gan J, Zhong S, Liu S, Yang D. Resilient supplier selection based on fuzzy BWM and GMo-RTOPSIS under supply chain environment. *Discrete Dyn Nat Soc* 2019;2019:1-14. DOI
83. Kumar A, Alora A, Gupta H. Evaluating green performance of the airports using hybrid BWM and VIKOR methodology. *Tour Manag* 2020;76:103941. DOI
84. Li X, Zhao C. Selection of suppliers of vehicle components based on green supply chain. In: 2009 16th International Conference on Industrial Engineering and Engineering Management; 2009 Oct 21-23; Beijing, China. IEEE; 2009. p. 1588-91. DOI
85. Fu X, Zhu Q, Sarkis J. Evaluating green supplier development programs at a telecommunications systems provider. *Int J Prod Econ* 2012;140:357-67. DOI
86. Sanayei A, Farid Mousavi S, Yazdankhah A. Group decision making process for supplier selection with VIKOR under fuzzy environment. *Expert Syst Appl* 2010;37:24-30. DOI
87. Zandi A, Roghanian E. Extension of Fuzzy ELECTRE based on VIKOR method. *Comput Ind Engin* 2013;66:258-63. DOI
88. Azadi M, Jafarian M, Farzipoor Saen R, Mirhedayatian SM. A new fuzzy DEA model for evaluation of efficiency and effectiveness of suppliers in sustainable supply chain management context. *Comput Oper Res* 2015;54:274-85. DOI
89. Bai C, Sarkis J. Determining and applying sustainable supplier key performance indicators. *Int J Supply Chain Manag* 2014;19:275-91. DOI
90. de Boer L, Labro E, Morlacchi P. A review of methods supporting supplier selection. *Eur J Purch Supply Manag* 2001;7:75-89. DOI
91. Wang X, Chan HK, Yee RWY, Diaz-Rainey I. A two-stage fuzzy-AHP model for risk assessment of implementing green initiatives in the fashion supply chain. *Int J Prod Econ* 2012;135:595-606. DOI
92. Nasr AK, Tavana M, Alavi B, Mina H. A novel fuzzy multi-objective circular supplier selection and order allocation model for sustainable closed-loop supply chains. *J Clean Prod* 2021;287:124994. DOI
93. Celik E, Yucesan M, Gul M. Green supplier selection for textile industry: a case study using BWM-TODIM integration under interval type-2 fuzzy sets. *Environ Sci Pollut Res Int* 2021;28:64793-817. DOI PubMed
94. Majumdar A, Jeevaraj S, Kaliyan M, Agrawal R. Selection of resilient suppliers in manufacturing industries post-COVID-19: implications for economic and social sustainability in emerging economies. *IJOEM* 2021;ahead of print. DOI
95. Fallahpour A, Olugu EU, Musa SN, Yew Wong K, Noori S. A decision support model for sustainable supplier selection in sustainable supply chain management. *Comput Ind Engin* 2017;105:391-410. DOI
96. Ulutaş A, Topal A, Bakhat R. An application of fuzzy integrated model in green supplier selection. *Math Probl Eng* 2019;2019:1-11. DOI
97. Wang CN, Yang CY, Cheng HC. A fuzzy multicriteria decision-making (MCDM) model for sustainable supplier evaluation and selection based on triple bottom line approaches in the garment industry. *Processes* 2019;7:400. DOI
98. Yang Y, Wang Y. Supplier selection for the adoption of green innovation in sustainable supply chain management practices: a case of the chinese textile manufacturing industry. *Processes* 2020;8:717. DOI
99. Wang CN, Thi Pham TD, Nhieu NL. Multi-layer fuzzy sustainable decision approach for outsourcing manufacturer selection in apparel and textile supply chain. *Axioms* 2021;10:262. DOI
100. Ben-daya M, Hassini E, Bahroun Z. Internet of things and supply chain management: a literature review. *Int J Prod Res* 2019;57:4719-42. DOI
101. Kouhizadeh M, Sarkis J. Blockchain practices, potentials, and perspectives in greening supply chains. *Sustainability* 2018;10:3652. DOI
102. Banica L, Hagiu A. 4 - Using big data analytics to improve decision-making in apparel supply chains. *Inf Syst Fash Appar Ind* 2016:63-95. DOI
103. Yan J, Meng Y, Lu L, Li L. Industrial big data in an industry 4.0 environment: challenges, schemes, and applications for predictive maintenance. *IEEE Access* 2017;5:23484-91. DOI
104. Bo Y, Meifang Y. Construction of the knowledge service model of a port supply chain enterprise in a big data environment. *Neural Comput Appl* 2021;33:1699-710. DOI
105. Jiang W. An intelligent supply chain information collaboration model based on internet of things and big data. *IEEE Access* 2019;7:58324-35. DOI
106. Tien JM. Big data: unleashing information. *J Syst Sci Syst Eng* 2013;22:127-51. DOI
107. Qiao W, Huang K, Azimi M, Han S. A novel hybrid prediction model for hourly gas consumption in supply side based on improved whale optimization algorithm and relevance vector machine. *IEEE Access* 2019;7:88218-30. DOI
108. O'connor C, Kelly S. Facilitating knowledge management through filtered big data: SME competitiveness in an agri-food sector. *J Knowl Manag* 2017;21:156-79. DOI