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# Data-driven View of Customer Psychological Anxiety Attributes for Cooperate Social Responsibility in Supply Chain Management: a LDA Model



**Abstract:** - Background-Cooperate Social Responsibility (CSR) in supply chain management requires understanding customer psychological anxiety attributes. A data-driven approach, such as using a Latent Dirichlet Allocation (LDA) model, can provide insights. By recognizing and addressing customer psychological anxiety, CSR can provide better support, which leads to higher customer satisfaction. When customers feel understood and supported, they are more likely to have a positive perception of the company and its supply chain services.

**Subjects and methods-** The study aims to use the LDA method to explore consumer psychology anxiety and its attributes for CSR in supply chain management. The corpus is collected from the Web of Science core collection with keywords “CSR” and “supply chain management”, and 965 articles related to the field from 1990-2022. LDA is a natural language processing technique that uncovers thematic structures in textual data. By applying LDA to customer feedback, businesses can identify anxiety attributes. Steps include data collection, preprocessing, LDA model training, topic interpretation, and deriving business insights.

**Results-** The study used the Python program to run LDA, after putting in the text data, the study identifies a number of 11 topics according to the value of topic coherence, then identified topics based on the most representative words or phrases within each topic combined CSR and supply chain related knowledge and fit the service quality model to find the customer psychological anxiety attributes, the results reveal that customers tend to be anxious about the aspects of reliability and assurance for CSR in supply chain management, more concerned about the environmental and social aspects of responsibility.

**Conclusions-** The study revealed customer psychological anxiety about CSR initiatives and strategies within their supply chain management. The results show that consumers feel most anxiety about the aspects of reliability and assurance of supply chain management. They are concerned about the environment and social responsibility that the supply chain enterprise is taking, especially in the food supply chain field. By addressing these concerns, organizations can enhance customer satisfaction, build stronger relationships, and improve their overall CSR performance. The findings of this study also contribute to the field by providing valuable guidance, further research can add other text mining methods like structural topic modelling, or add deeper quantitative research in the field and develop a new customer-CSR service quality model in the service industry.

**Keywords:** Data-driven view, Customer psychological anxiety, Corporate social responsibility, Supply chain management, Latent Dirichlet Allocation (LDA).

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## 1. Background

Many organizations operate within complex and global supply chains that involve multiple suppliers and stakeholders. While pursuing profitability and business growth, these organizations must also address the social and environmental impacts associated with their supply chain activities, just like the committee of SDG 12 “Ensure sustainable consumption and production patterns” made by the UN [1]. CSR in the supply chain refers to the responsibility of companies to consider and mitigate the adverse effects their supply chain operations may have on society, the environment, and the well-being of workers [2]. CSR in supply chain management involves integrating social and environmental considerations into sourcing, manufacturing, transportation, and distribution processes, it focuses on sustainable practices, ethical sourcing, and stakeholder engagement [3]. Implementing CSR in supply chains can lead to improved brand reputation, reduced risks, increased customer loyalty, and long-term sustainability. The increasing importance of CSR activities from a corporation's perspective can be found in the research in a 2013 global survey of 1000 CEOs, 93% thought CSR activities played an important role in organizational future success [4].

There are some challenges in supply chain management in the field of CSR practice. Supply chain operations often contribute to environmental degradation through greenhouse gas emissions, resource depletion, waste generation, and pollution, balancing economic objectives with environmental sustainability goals requires organizations to implement eco-friendly practices throughout their supply chains, research shows that 90% of companies' impacts on the environment come from supply chains [5]. Moreover, managing a diverse network of suppliers spread across different geographies and cultures is a complex task. It needs to identify and select responsible suppliers, monitor their performance, and promote CSR practices within the supply chain. These business activities are resource-intensive and require effective collaboration. However, due to many supply chains lack transparency[6], making it difficult for organizations to trace the origin of raw materials, identify potential social or environmental risks, and assess the overall impact of their supply chain activities.

Supply chains also can impact local communities in various ways, such as land displacement, cultural disruptions, or exploitation of vulnerable populations. The consumer may be anxious about how supply chain activities would harm communities and their well-being, such as an aspect of ethical practices about safe working conditions control and human rights protections [7]. Companies may face difficulties in monitoring and verifying compliance across their supply chains, especially in regions with weak regulatory frameworks. Customers, investors, employees, and other stakeholders increasingly expect companies to demonstrate responsible supply chain practices [8]. Meeting these expectations and effectively communicating CSR initiatives require proactive engagement and transparency and reduce anxiety.

CSR is believed to be a source of several and several benefits that make it one of the most studied topics but so far a majority of scholars discussed the effect of CSR on corporate profitability. However, CSR and customer behaviour have still not been investigated widely by researchers. Customer psychological anxiety refers to the emotional state of unease or distress experienced by customers during their interactions with a business or when making purchasing decisions [9]. This anxiety can stem from various factors, such as uncertainty, information overload, and social influence and may impact customer behaviour, decision-making, and overall satisfaction [10]. Understanding and addressing customer psychological anxiety is important for businesses to provide a positive customer experience and build trust with their clientele. CSR initiatives can play a significant role in alleviating customer psychological anxiety and promoting a positive customer experience [11]. By integrating CSR practice into business operations and effectively communicating these efforts, businesses can gain customer psychological safety, build trust, and enhance the overall customer experience. Customers are more likely to feel confident, satisfied, and loyal when they perceive a business as socially responsible and aligned with their values.

Traditional methods may not fully capture the diverse aspects and emerging trends in CSR practices, Data-driven approaches offer an opportunity to uncover hidden patterns, relationships, and key topics that can enhance our understanding of CSR in supply chains [12]. Data-driven approaches utilize large datasets and advanced analytics techniques to extract meaningful insights from CSR-related data. These approaches enable researchers to uncover patterns, relationships, and trends that might not be apparent through traditional methods [13]. By leveraging data-driven approaches, researchers can enhance their understanding of CSR practices, measure performance, identify areas for improvement, and support evidence-based decision-making in supply chain management.

Latent Dirichlet Allocation (LDA) modelling is a popular probabilistic topic modelling technique used to analyze textual data, it allows for the identification of latent topics within a corpus and their distribution across documents [14]. LDA assumes that each document is a mixture of various topics, and each topic is characterized by a distribution of words. The modelling has been successfully applied in various domains, including CSR research. By applying LDA to textual data, such as sustainability reports, corporate disclosures, and industry publications, researchers can identify key CSR topics, understand their prevalence, and analyze their relationships within supply chains [15,16].

To conduct this study, a comprehensive dataset comprising textual data related to CSR in supply chains will be collected. The dataset may include reports, articles, websites, and other relevant sources. In the study, we chose to collect articles from the Web of Science core collection, the period from the year 1990 to 2022, finally, we collected 965 articles in the field of CSR in supply chain management. The collected textual data will undergo preprocessing, including noise removal, tokenization, and lemmatization, to enhance data quality. The pre-processed data will be used to train an LDA model, which will identify latent topics and their distribution across the dataset. The trained LDA model will generate a set of topics, each characterized by a distribution of words, these topics will represent the key themes and practices related to CSR in supply chains. Topic coherence measures will be employed to assess the quality and interpretability of the identified topics.

Thus, the study aims to provide a data-driven view of CSR in supply chain management with LDA modelling. By leveraging the power of data analytics and statistical modelling, this approach offers insights into key topics and practices related to customer psychological anxiety CSR in supply chains. To achieve the aims of the study, the research questions of the study are:

1. What are the main topics related to CSR and customer psychological anxiety in supply chain management?
2. What are customer psychology anxiety attributes for supply chain management of implementing CSR?

Firstly, the study will collect related articles to build a corpus, then use LDA to process the corpus and extract topics. Finally, interpreting the topics with related theory as support. Understanding these topics can guide businesses in implementing effective CSR strategies, improving sustainability, and enhancing stakeholder relationships and provide scholars with direction for future research in customer psychology for CSR and supply chain management.

## 2. Literature review

### 2.1 Big data and corporate social responsibility (CSR) disclosure

Socially responsible companies not only strive to meet the economic interests of their shareholders but also take into account their employees, local communities, the natural environment, and society [17]. As the demand for CSR has become prominent, more companies are engaging in CSR activities to contribute to social welfare. Accordingly, prior CSR studies have examined how a company's commitments to social and ecological CSR benefit its shareholders through capital cost reduction, corporate value increase, and financial performance

increase [18, 19]. Previous research has also investigated how external factors influence CSR performance, such as regulations, Hamed et al. found that regulators and the government as the most influential sources of external influences for CSR practices in the banking industry [20]. In an aspect of internal factors, as for ownership structure, Ghoul et al. stated that family-controlled firms exhibit lower CSR performance [21]. In addition, gender, tenure multiple directorships and the overall diversity measure also have the potential to influence CSR reporting according to Rao and Tilt's study in 2016 [22]. What's more, based on a sample of 130 Italian organizations, Testa et al.'s study shows that CSR performance depends on employees' commitment and the internalization of formalized CSR practices [23].

Big data refers to large and complex datasets that are generated from various sources, such as social media, sensors, and transaction records, these datasets are typically characterized by their volume, velocity, variety, and veracity [24]. With the advancement of technology and the increasing availability of data, organizations can now collect and analyse massive amounts of information to gain valuable insights and make informed decisions [25]. This data can be utilized to identify and monitor key CSR indicators, trends, and risks within the organization and its supply chain.

CSR disclosure refers to the practice of organizations sharing information about their environmental, social, and governance (ESG) performance and initiatives [26], it involves communicating details about the company's efforts to mitigate its environmental impact, promoting social well-being, and uphold ethical business practices [27]. Big data can play a significant role in CSR disclosure by enabling organizations to collect, analyse, and report on relevant ESG data. Big data analytics allows organizations to gather vast amounts of ESG-related information from multiple sources, including internal systems, external databases, and social media platforms, this data can include environmental impact measurements, employee satisfaction metrics, supply chain transparency, and more [28]. Furthermore, by analysing big data, companies can track and measure their ESG performance over time, this allows them to identify trends, set targets, and assess the effectiveness of their CSR initiatives. For example, data analytics can help monitor energy consumption, waste generation, and greenhouse gas emissions to evaluate the progress of environmental sustainability efforts [29].

Moreover, big data can help organizations engage with stakeholders and respond to their concerns, by analysing social media data and online discussions, companies can gain insights into public sentiment and identify areas where they need to improve their CSR practices and then use them to enhance transparency and communication with stakeholders [30]. As for risk management, big data can enable organizations to predict future CSR risks and opportunities. With historical data, companies can anticipate potential environmental, social, or governance challenges. the proactive approach allows them to develop strategies to address these issues proactively, minimize negative impacts, and seize opportunities for positive change [31]. It's worth noting that although big data can enhance CSR disclosure, organizations must also ensure responsible data management practices. They should prioritize data privacy and security, comply with relevant regulations, and use the insights gained from big data analytics to make meaningful and ethical decisions that align with their CSR goals [32].

## **2.2 CSR in Supply Chain Management**

There are still few literature reviews in the related research fields on CSR for supply chain management. For instance, Raja et al. (2015) proposed a conceptual model to evaluate the social dimension of sustainable development and its impact on supply chains. As a result, they pointed out that social aspects of supply chain management receive less attention than environmental and economic dimensions in this research field [33]. Other studies focus on specific topics related to CSR for supply chain management. For example, Wang et al.(2024) consider carbon emission reduction and CSR goodwill as endogenous variables in emission reduction in supply management, finding that the manufacturer-led Stackelberg master-slave game can achieve the Pareto

improvement in the profits of the supplier, manufacturer, retailer, and the entire supply chain system[34]. Hafezalkotob et al.(2023) examine the sustainability performance of competing smart supply chains that offer substitutable products under different CSR regulatory policies: deregulation, direct tariff on market, sustainability penalty and credits, direct limitation on sustainability, and government cooperative sustainability efforts, results reveal that direct tariff on market policy in the monopoly market is shown to be the preferred regulatory approach as it effectively enhances both supply chain profitability and environmental sustainability[35]. Yue et al.(2022) propose three dynamic models for the CSR investment in closed-loop supply chains, the result shows that CSR can increase the sales of new automotive lithium-ion batteries and the recycling of used automotive lithium-ion batteries. [36].

CSR in supply chain management encompasses a range of activities aimed at ensuring that the supply chain operates responsibly and sustainably while minimizing negative impacts and maximizing positive contributions to society and the environment. CSR in supply chain management focuses on implementing sustainable practices, such as reducing carbon footprint, minimizing waste, promoting renewable energy, and adopting eco-friendly packaging [37]. Environmental protection in supply chain management begins with sustainable sourcing practices, organizations should prioritize suppliers that adhere to eco-friendly principles, such as responsible resource extraction, sustainable farming practices, and renewable energy usage [38]. Assessing suppliers' environmental credentials and selecting those with a commitment to sustainability can minimize the ecological impact of the supply chain [39]. In the logistics aspect, organizations can adopt sustainable transportation practices by optimizing routes, consolidating shipments, and utilizing low-emission vehicles by implementing efficient logistics strategies. For example, just-in-time inventory management[40], can reduce the environmental footprint of transportation in the supply chain. Moreover, using friendly packaging materials[41] and reverse logistics[42] are also solutions for supply chain management to implement environmental protection.

In an aspect of social responsibility, CSR and supply chain management are interconnected concepts that focus on ethical, social, and human rights. Social responsibility in supply chain management entails considering and addressing the impact of supply chain activities on various stakeholders, including workers, communities, consumers, and society at the macro level [43]. This includes fair wages, safe working conditions, reasonable working hours, and freedom from discrimination or forced labour [44]. As for human rights, this involves conducting due diligence to identify and address potential human rights abuses, such as child labour, human trafficking, or violations of indigenous rights. Collaboration with stakeholders and adherence to international frameworks, such as the United Nations Guiding Principles on Business and Human Rights, are important in ensuring respect for human rights [45].

The field of CSR for supply chain management has been growing for more than twenty years. With the development of globalization, CSR for supply chain management has become more important in the last ten years [46, 47]. Research surges not only in the total number but also with emergent sub-fields such as drivers' analysis [48], supplier selection [49] and analytical models on buyer-supplier relationships [50]. However, using a data-driven view to extract the key topic of customer psychological anxiety for CSR in the supply chain still exists as a research gap. Hence, in the study, we will use a big data processing method- Latent Dirichlet allocation, to extract the main topics about customer anxiety in supply chain management.

### **2.3 Customer psychological anxiety and supply chain management**

Consumers become active and their involvement increases when a particular problem or issue is important to them, consumer pressures can take such different forms as shareholder activism, consumer boycotts, and adverse publicity in the media [51]. Anxiety has long been an interest in research in cognitive behaviour [52],

customer psychological anxiety is an important issue in the business world that has a significant impact on customer behaviour and overall business success. Customer psychological anxiety refers to the emotional and mental stress experienced by customers when they encounter uncertainties, concerns, or negative experiences related to the products or services they intend to purchase [53,54]. Understanding and addressing customer psychological anxiety is crucial for businesses to ensure customer satisfaction, loyalty, and long-term success. Studies have revealed that anxiety levels impact the relationship between perceived mental benefits and electronic loyalty, online trust, and electronic loyalty [55]. Customers who are high on social anxiety (relative to those low on it) are less willing to purchase a brand's products/services [56].

Consumer psychological anxiety and CSR are two interconnected concepts that have gained significant attention in the business world, CSR initiatives have the potential to alleviate consumer psychological anxiety by addressing the concerns that contribute to anxiety [57]. Consumers are increasingly concerned about ethical considerations, and environmental protection. Companies that engage in social impact initiatives, such as philanthropy, community development, and employee volunteer programs, can positively influence consumer perception [58]. Thus, consumers appreciate companies that contribute to social causes and may feel less anxious about supporting such companies.

Customer psychological anxiety and supply chain management are two interconnected aspects that significantly impact businesses and their ability to meet customer demands. The modern business landscape is characterized by complex and global supply chains, where products and services traverse multiple stages before reaching the end consumer. However, disruptions, uncertainties, and delays in the supply chain can create psychological anxiety among customers, leading to various challenges for businesses [59]. Effective supply chain management aims to minimize disruptions, optimize processes, and enhance customer satisfaction by delivering products on time and meeting their expectations. When supply chain disruptions occur, such as natural disasters [60], political instability, supplier failures, or unforeseen events like the COVID-19 pandemic [61], customers may experience heightened psychological anxiety. These disruptions can lead to product shortages, delays in deliveries, or compromised product quality, triggering concerns and uncertainties among customers. As a result, their trust in the brand may diminish, leading to a potential loss of sales and negative word-of-mouth [62]. However, studies about consumer psychological anxiety in supply chain management are still nascent, so the study aims to fill the research gap.

### **2.3 Related Theory**

CSR and supply chain management theory are interconnected in several ways. Supply chain management theory provides a framework for understanding and managing the flow of goods, information, and resources across the supply chain. CSR theory, on the other hand, focuses on the ethical, social, and environmental responsibilities of organizations. When it combined with supply chain management, CSR theories may emphasize the importance of integrating social and environmental considerations into supply chain practices.

After checking the literature, there are some key theories and concepts that underpin the relationship between CSR and supply chain management. The first one is the Triple Bottom Line (TBL) theory, which suggests that organizations should consider three dimensions of performance: economic, social, and environmental [63]. CSR in supply chain management aligns with TBL by emphasizing the need to balance economic objectives with social and environmental responsibilities [64]. Besides, the most used theory related to CSR and supply chain may be the Stakeholder Theory. It posits that organizations should consider the interests and expectations of all stakeholders, including employees, customers, suppliers, communities, and the environment. CSR in supply chain management involves engaging and collaborating with stakeholders to address their concerns, promote responsible practices, and create shared value [65,66].

In the aspect of customer psychology field, several theories and models provide insights into customer satisfaction, expectations, and anxiety and shape our understanding of customer behaviour, one of them is Service quality theory. Service quality, on the other hand, relates to the perceived excellence or superiority of the services provided by a company. Service Quality Theory is popularized by the SERVQUAL model, a model developed by Parasuraman et al. (1985) [67]. The model as the most often used approach for measuring service quality has been to compare customers' expectations before a service encounter and their perceptions of the actual service delivered. Its originally 10 dimensions of service quality were reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding/knowing the customer, and tangibles. Later, Zeithaml, Berry and Parasuraman, 1988 tested the variables and reduced them to five factors including tangibles, reliability, responsiveness, assurance (combining communication, credibility, security, competence and courtesy) and empathy (combining understanding and knowing the customer with accessibility) [68]. The theory suggests that customers form expectations based on the dimensions of service quality, including tangibles, reliability, responsiveness, assurance, and empathy [69]. Addressing consumer psychological anxiety and meeting customer expectations in each dimension of the service quality model can contribute to overall customer satisfaction. In the study, we will combine these theories to identify and give interpretations of each topic.

### **3. Research method**

#### **3.1 Text mining and LDA model**

Text mining is the process of deriving high-quality information from text. Text mining usually involves the process of structuring the input text, finding patterns within the structured data, and finally evaluation and interpretation of the output. Typical text mining tasks include text categorization, text clustering, document summarization, keyword extraction, etc and many more [70]. In machine learning and natural language processing, topic models are generative models, which provide a probabilistic framework. Topic modelling methods are generally used for automatically organizing, understanding, searching, and summarizing large electronic archives. The "topics" signifies the hidden, to be estimated, variable relations that link words in a vocabulary and their occurrence in documents [71]. A document is seen as a mixture of topics, topic models discover the hidden themes throughout the collection and annotate the documents according to those themes. Each word is seen as drawn from one of those topics. Finally, A document coverage distribution of topics is generated and it provides a new way to explore the data from the perspective of topics [72].

Latent Dirichlet allocation (LDA) is a generative model that allows sets of observations to be explained by unobserved groups that explain why some parts of the data are similar. LDA has made a big impact in the fields of natural language processing and statistical machine learning and has quickly become one of the most popular probabilistic text modelling techniques in machine learning [73]. Intuitively in LDA, documents exhibit multiple topics. In text pre-processing, we exclude punctuation and stop words (such as, "if", "the", or "on", which contain little topical content). Therefore, each document is regarded as a mixture of corpus-wide topics, a topic is a distribution over a fixed vocabulary, and these topics are generated from the collection of documents [74]. Then, a collection of documents has a probability distribution over topics, where each word is regarded as drawn from one of those topics. With this document probability distribution over each topic, we will know how much each topic is involved in a document, meaning which topics a document is mainly talking about [75]. In the study, we will use the LDA model to extract data from the data set and interpret it to identify the topics.

#### **3.2 Data collection**

Because of the big data needed, there are some sources to collect the 'CSR' and 'supply chain' text data. The first method is collecting from academic databases like Google Scholar, Scopus, or Web of Science. These

databases have a large number of literature about CSR and supply chain studies. Besides, it also can explore journals that specialize in supply chain management, sustainability, and CSR. In the studies, we choose literature from the Web of Science core collection. By using the keywords ‘CSR’ and ‘supply chain’, we collected 965 articles about the field from the year 1990 to 2022 as a result. The reason we chose the two keywords for search is that we want to find the literature that is related to CSR and the supply chain area at the same time. In addition, we also want to find interaction between them through the LDA research method. Thakur & Kumar (2022) said most of the studies in their selected group of articles were found to be having sample sizes below 1000 when conducting research with the text mining method [76], hence, 965 documents in the study are proper for the research.

### 3.3 Research process

The research process of the study will be illustrated in the figure 1,

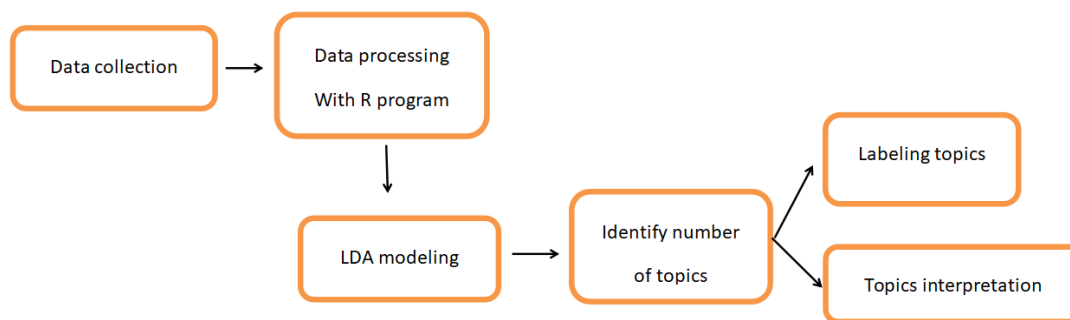


Figure 1 Process of the study

The first step of the study will be building a corpus with the collection of articles, then the text data will be put into a Python program for processing. The processing stage includes cleaning and preprocessing the data to remove irrelevant information, such as stop words and punctuation, the applying techniques like tokenization, stemming, and lemmatization. Data processing aims to standardize the text and make it ready for analysis. Then use the LDA package to the preprocessed corpus. Finally, analyze the results of the LDA model to identify key topics related to customer psychological anxiety for CSR in supply chain management, exploring the most prevalent and distinct topics emerging from the analysis, assign meaningful labels to the topics based on the most representative words or phrases within each topic with combining related literature and theory.

## 4. Results and finding

### 4.1 Identify the number of topics

Determining the optimal number of topics in LDA (Latent Dirichlet Allocation) is an important step in the research process. While there is no definitive method for selecting the exact number of topics, several techniques can be employed to make an informed decision [77].



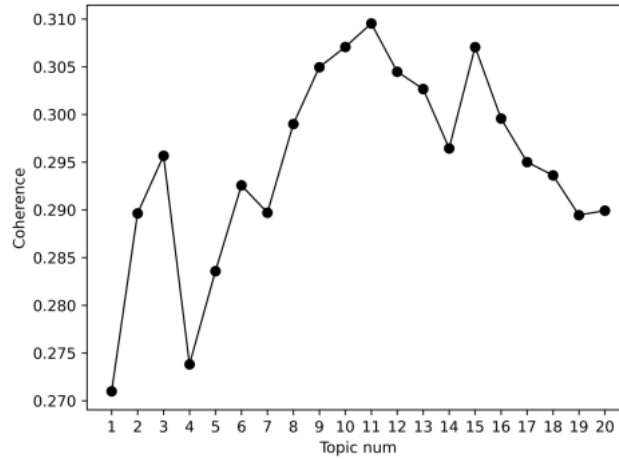


Figure 2 Topic coherence

The most used method is evaluating the coherence of topics generated by LDA for different numbers of topics. Coherence measures the semantic similarity between words within a topic and helps determine the interpretability and quality of the identified topics, researchers can calculate coherence scores for different numbers of topics and select the number that maximizes coherence [78]. Furthermore, using the perplexity metric, which measures how well the model predicts unseen data, to assess the quality of LDA models for different numbers of topics. Lower perplexity values indicate better model performance, so researchers can compare perplexity scores across different numbers of topics and select the number that yields the lowest perplexity[79]. In the study we compared the value of semantic coherence and perplexity, we chose to use topic coherence to identify the number of topics. The results of topic coherence are illustrated in Figure 2. As we can see in the results, according to Hu et al. (2019), the higher coherence score means that the most frequently used words within a topic may frequently appear together[80], so we chose topic number 11 to run the model for further exploration of the corpus.

#### 4.2 Labeling topics

Labelling topics in LDA involves assigning meaningful and descriptive labels to the identified topics based on the most representative words or phrases within each topic. Table 1 is about the results of the most frequent and distinctive (top words) words of each topic.

Table 1 Topic labelling

No.	Topic labelling	Top words
<b>Topic 1</b>	Finance performance and sustainability	Profit, manufacturer, model, channel, paper, study, retailer, decision, concern, management, practice, responsible, sustainable, sustainability, price, socially, results, fairness, propose, performance
<b>Topic 2</b>	Sustainable Marketing strategy	Strategy, business, company, study, manufacturer, supplier, enterprise, issue, result, paper, demand, responsible, society, country, organization, profit, term
<b>Topic 3</b>	Global supply chain management	Firm, practice, company, study, supplier, business, activity, decision, level, relationship, global, paper, performance, product, cost, issue, increase, consumer, management, manufacturer
<b>Topic 4</b>	Environment issue	Model, business, study, performance, retailer, paper, environment, industry, issue, practice, develop, base, manufacturer, approach,

		sustainable, result, sustainability, provide, decision, company
<b>Topic 5</b>	Food safety	Study, food, global, company, supplier, industry, paper, consumer, product, practice, impact, sustainability, firm, management, strategy, literature, approach, issue, business, safety
<b>Topic 6</b>	Stakeholder involvement	Company, management, environment, paper, practice, business, supplier, stakeholder, global, develop, development, industry, study, sustainable, performance, firm, international, focus, issue
<b>Topic 7</b>	Supplier and customer management	Supplier, sustainability, customer, firm, model, buyer, management, paper, study, develop, environment, company, system, lead, sustainable, industry, business, focus, organization, decision
<b>Topic 8</b>	CSR and sustainable distribution	Management, performance, study, sustainability, product, supplier, industry, firm, sustainable, green, enterprise, model, retailer, paper, business, contract
<b>Topic 9</b>	Social responsibility	Company, study, business, sustainability, management, supplier, practice, model, sustainable, approach, paper, environment, analysis impact, base, stakeholder
<b>Topic 10</b>	Sustainable supply chain	Supplier, company, retailer, manufacturer, practice, product, management, paper, sustainability, firm, environment, decision, model, level, study, result, impact, enterprise, performance, analysis
<b>Topic 11</b>	Sustainable Supplier management	Supplier, business, company, study, analysis, sustainability, practice, paper, environment, development, sustainable, management, performance, firm, result, stakeholder, approach, level, improve, increase

#### 4.2 Customer Psychology Anxiety Attributes Analysis

The attributes of Customer psychology anxiety are related to the specific qualities, features, or characteristics that customers anticipate or desire from a product, service, or overall customer experience. Including aspects of product quality, product price, timeliness, personalization and customization, convenience and ease of use, clear communication, responsiveness, trust and security, innovation and social and environmental responsibility, etc.

The study will use a service quality model combined with CSR and supply chain knowledge to analyse the customer psychology anxiety attributes at the macro level. The interpretation of customer expectation attributes combined with related theory is stated in Table 2.

Table 2 Customer psychology anxiety attributes

<b>Dimensions</b>	<b>Attributes</b>	<b>Related topics</b>
Tangibles	Products quality control, providing customer personalized service and products.	Topic 5(Food safety), topic 7(Supplier and customer management)
Reliability	Environmental responsibility, timeliness, profitable, quality control inside the supply chain especially supplier and retailer.	Topic 1(Finance performance and sustainability), topic 2(Sustainable Marketing strategy), topic 3(Global supply chain management), topic 4(Environment issue), topic 7(Supplier and customer management ), topic 8(CSR and sustainable distribution), topic 9(Social responsibility),

		topic 10(Sustainable supply chain), topic 11(Sustainable Supplier management)
Responsiveness	Caring about the related stakeholders' desire, such as customer, non-government organizations, etc.. Disclose CSR report or practice for the stakeholders.	Topic 6(Stakeholder involvement), Topic 7(Supplier and customer management)
Assurance	Thorough supply chain management and sustainable business development strategy, providing customer products in stable quality, and take social and environment responsibility to gain competency and reputation.	Topic 2(Sustainable Marketing strategy), topic 3(Global supply chain management), Topic 4(Environment issue), topic 9(Social responsibility), topic 10(Sustainable supply chain), topic 11(Sustainable Supplier management)
Empathy	Put effort to meet the customer's demand, take social responsibility, take caring of staff, providing safe work environment, reduce emission.	Topic 6( Stakeholder involvement), topic 7(Supplier and customer management), topic 9(Social responsibility)

#### 4.2.1 Tangibles

The dimension of tangibles refers to the effect of physical facilities, equipment, personnel and communication materials on customers [81]. Topic 4(Food Safety), and topic 7(Supplier and customer management) are related to the aspect of tangibles. Agri-food supply chain management has been referred to as CSR a lot in recent years. The framework details unique CSR applications in the food supply chain including animal welfare, biotechnology, environment, fair trade, health and safety, and labour and human rights [82]. Unlike the traditional service quality requirement, the customer expectation for CSR of food quality in agri-food supply chains more emphasis the sustainable or green farming, supply chain transparency and innovation, etc., through new technology or innovation such as blockchain, IOT or AI, providing safe and health food or products for customer. In an aspect of supplier and customer management, it emphasises responsible sourcing of raw materials, supplier and customer engagement and social impact. More and more companies release their CSR information to the public, and this increases customer engagement and reduces customer anxiety to a certain level.

#### 4.2.2 Reliability

Reliability shows the ability to provide services accurately, on time, and credibly. Topic 1(Finance performance and sustainability), topic 2(Sustainable Marketing strategy), topic 3(Global supply chain management), topic 4(Environment issue), topic 7(Supplier and customer management ), topic 8(CSR and sustainable distribution), topic 9(Social responsibility), topic 10(Sustainable supply chain), topic 11(Sustainable Supplier management) are related to the dimension. In the dimension of reliability the customer psychological anxiety for CSR in supply chain management, and the financial performance related to service accurately and credibly, so in the economic aspect of CSR practice also is important to do well to meet customer expectations. However, it needs to be noted that CSR practices for enterprises normally get long-term financial gain, not aim to get a short-term economic return.

In aspects of environmental issues, such as energy or water consumption management, and waste and emission management, customers want to see the supply chain enterprise take responsibility, which is why the “green supply chain” is a hot topic these years. Huang et al. (2017) study defines the internal and external factors stimulating firms to adopt green supply chains in Taiwan and found that institutional pressures include regulatory, customer awareness and competitive pressure [83].

An aspect of social responsibility has rarely been noticed by scholars in the recent decade from a macro level. Amengual et al.(2020) revealed that supplier pays their workers living wages and provide other benefits, such as job security, pensions, and unemployment insurance to reduce customer anxiety[84]. Moreover, increased service transparency, as reflected in greater product visibility by the end-consumer, in turn, can help to protect a firm's brands[85].

#### **4.2.3 Responsiveness**

This criterion measures the ability to solve the problem fast, deal with customers’ complaints effectively and the willing to help customers as well as meet the customers’ requirements. Topic 7(Supplier and customer management) is related to the dimensions. In the field of CSR in supply chain management, customer psychological anxiety for CSR (Corporate Social Responsibility) in supply chain management includes involving customers in initiatives and practices related to social and environmental responsibility throughout the supply chain. It entails creating opportunities for customers to participate, contribute, and align their values with the CSR efforts of the organization and its supply chain partners. Studies suggested that by using the strategy of social media to communicate with customers, a company can increase its e-reputation better than with a common CSR communication strategy[86]. Supply chain enterprises could actively seek customer feedback and input on CSR practices and supply chain performance by conducting surveys, focus groups, or online platforms to gather customer perspectives and expectations.

#### **4.2.4 Assurance**

This element creates credibility and trust for customers, which is considered through professional services, excellent technical knowledge, attitude courtesy, and good communication skills so that customers can believe in the quality of the firm’s services. Topic 2(Sustainable Marketing strategy), topic 3(Global supply chain management), Topic 4(Environment issue), topic 9(Social responsibility), topic 10(Sustainable supply chain), and topic 11(Sustainable Supplier management) are related to the dimensions. Customer anxiety for sustainable marketing and CSR practice in supply chain management emphasises the products and raw materials are obtained responsibly, without exploiting workers or causing harm to the environment, they also hope to see transparent supply chain practices, such as disclosing supplier information and certifications. Customers also are anxious about organizations upholding fair labour practices and respecting human rights within their supply chains. They want assurance that workers involved in the production process are treated ethically, paid fairly, and provided with safe working conditions. In addition, assurance of service in this context involves implementing robust data protection measures, ensuring secure online transactions, and being transparent about how customer data is collected, used, and protected.

#### **4.2.5 Empathy**

Sympathy is the caring, consideration, and best preparation for customers so that they can feel like ‘guests’ of the firm and are always welcome at any time, anywhere. Human factors are the core of this success and the more caring the bank gives to customers, the more customer understanding increases. Topic 6(Stakeholder involvement), topic 7(Supplier and customer management), and topic 9(Social responsibility) related to the

dimensions. Customers would be nervous and expect organizations to demonstrate empathy and ensure fair treatment of workers throughout the supply chain, this includes fair wages, safe working conditions, and respectful treatment, moreover, customers also expect organizations to be empathetic towards the communities in which they operate, support for local initiatives, and efforts to address community needs, at the same time reducing waste, conserving resources, and supporting initiatives for environmental protection.

**4.3.2 Customer psychological anxiety trend and expectation preference analysis**

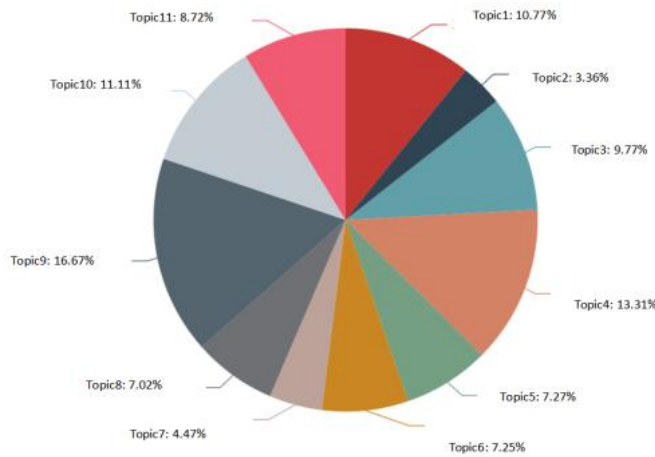


Figure 3 Proportion of each topic

According to the results of proportion for each topic in Figure 3, Topic 9(Social responsibility) takes the majority proportion of the corpus, it's 16.7%, the second-ranking is Topic 4(Environmental issue), and the following is Topic 10(Sustainable supply chain), with the proportion of 13.31% and 11.11% respectively. In contrast, the last three topics that take the least proportion are topic 1(3.61%), topic 6(4.47%) and topic 7(7.02%).

And for the proportion of each dimension of the customer expectation for CSR in supply chain management, the results are illustrated in Table 3.

Table 3 total proportion of each dimension

Dimensions	Total Proportion of topics
<b>Tangible</b>	11.74%
<b>Reliability</b>	85.2%
<b>Responsiveness</b>	11.49%
<b>Assurance</b>	62.94%
<b>Empathy</b>	28.39%

According to the results, we can see that customers tend to be anxious about the aspects of reliability and assurance for CSR in supply chain management, especially in social and economic areas, they hope supply chain enterprise can provide safe, healthy, and environmentally friendly products, at the same time, they hope supply chain enterprise can gain long-term competency through take social responsibility to gain brand reputation and trust. However, the dimension of tangible and empathy is less discussed in the CSR and supply chain field, that may be because, in the CSR field, its core emphasis is the environmental and social problem, the economic area is not the most important to notice when supply chain enterprise implements CSR practice.

## 5. Conclusions

This study utilized a data-driven approach, employing Latent Dirichlet Allocation (LDA) modelling to gain insights into customer psychological anxiety and its attributes related to CSR in supply chain management. By analysing the corpus of 965 articles from the year 1990 to 2022 on CSR and the supply chain field, the study aimed to identify key themes and attributes that customers' expectations for CSR in supply chain management, the findings provide valuable insights for organizations seeking to align their CSR efforts with customer expectations. The result shows that customers are more concerned about the environmental and social responsibility for CSR practice when doing supply chain management, and less care about the the financial performance and economic statement of the enterprise, but significantly, the economic aspect is the foundation of implementing CSR practice.

This study highlights the contribution of LDA modelling in understanding customer psychological anxiety attributes related to CSR in supply chain management. By identifying key themes and uncovering latent attributes, the model provides actionable insights for organizations to align their CSR strategies to deal with customer anxiety effectively. The quantitative and qualitative analysis and scalability of LDA modelling offer a rigorous and efficient approach to understanding customer demands. By incorporating these insights, organizations can enhance their supply chain practices, improve stakeholder engagement, and establish themselves as responsible corporate entities. The findings of this study also contribute to the field by providing valuable guidance, further research can add other text mining methods like structural topic modelling, or add deeper quantitative research in the field and develop a new customer-CSR service model in the service industry.

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