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SUSTAINABLE SUPPLY CHAIN RISK MANAGEMENT: PROPOSAL FOR A FRAMEWORK FOR RISK MAPPING AND MITIGATION

Amanda Chousa Ferreira

Dissertação de Mestrado apresentada ao Programa/Curso de Pós-Graduação *Stricto Sensu* em Engenharia de Produção e Sistemas do Centro Federal de Educação Tecnológica Celso Suckow da Fonseca, CEFET/RJ, como parte dos requisitos necessários à obtenção do título de Mestre.

Orientador: D.Sc. Pedro Senna Vieira
Coorientadora: D.Sc. Ana Carla de Souza Gomes dos Santos

Rio de Janeiro
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RESUMO

GESTÃO DE RISCOS DA CADEIA DE SUPRIMENTOS SUSTENTÁVEL: PROPOSTA DE FRAMEWORK PARA MAPEAMENTO E MITIGAÇÃO DE RISCOS

Atualmente, a Sustentabilidade vem trazer vantagem competitiva para as empresas em um mundo globalizado, e as organizações já perceberam que as crises podem continuar a surgir quando os impactos da sustentabilidade na cadeia de suprimentos são negligenciados. Nas últimas décadas, as interrupções na cadeia de suprimentos em torno da sustentabilidade tiveram um forte impacto nas comunidades sociais e nos setores industriais, ameaçando assim a implementação de estratégias baseadas em economias circulares e cadeias de suprimentos de circuito fechado. Nesse contexto, a gestão de riscos da cadeia de suprimentos sustentável é vista como elemento-chave para abordar impactos sustentáveis para a implementação da economia circular, ajudando a evitar colapsos na produção e fornecimento de produtos, mitigando os riscos que causam a incapacidade da cadeia de suprimentos para satisfazer a demanda do cliente. Diante do aumento da inserção da sustentabilidade nas cadeias de suprimentos e da gestão da economia circular, os riscos nas cadeias de suprimentos são muito atuais e seu mapeamento é cada vez mais relevante. A pesquisa traz os conceitos de sustentabilidade e gestão de riscos da cadeia de suprimentos (SCRM) aliados, trabalhando com o conceito inédito de Gestão de Riscos da Cadeia de Suprimentos Sustentável (SSCRM), não apresentado em trabalhos anteriores, assim identificando os principais riscos presentes em uma cadeia de suprimentos sustentável e as formas de mitigação desses riscos. A pesquisa busca responder a três perguntas de pesquisa: “quais são os principais autores, fontes, palavras-chave e principais assuntos publicados nos temas?”, “quais são os riscos identificados em SSCRM?” e “como mitigar os riscos identificados em SSCRM?”. A partir disso, o estudo bibliométrico é apresentado e permite identificar os principais assuntos publicados e palavras-chave mais utilizadas em SSCRM. Além disso, a revisão sistemática possibilita entender os riscos presentes no SSCRM e as maneiras de mitigá-los, sendo a base de estudo e construção do framework. Assim, a pesquisa mostra como a sustentabilidade está sendo aplicada em conjunto com o SCRM, indicando novos rumos para futuras investigações em SSCRM. Dessa forma, a pesquisa tem como objetivo geral a construção de um framework de estratégias de mapeamento e mitigação de risco em

SSCRM.

Palavras-chave: Bibliometria; Revisão Sistemática; Gestão de Riscos da Cadeia de Suprimentos; Sustentabilidade; Economia Circular.

ABSTRACT

SUSTAINABLE SUPPLY CHAIN RISK MANAGEMENT: PROPOSAL FOR A FRAMEWORK FOR RISK MAPPING AND MITIGATION

Currently, Sustainability brings a competitive advantage to companies in a globalized world, and organizations have realized that crises can continue to arise when the impacts of sustainability on the supply chain are neglected. In recent decades, supply chain disruptions around sustainability have had a strong impact on social communities and industrial sectors, thus threatening the implementation of strategies based on circular economies and closed-loop supply chains. In this context, sustainable supply chain risk management is seen as a key element to addressing sustainable impacts for the implementation of the circular economy, helping to avoid collapses in the production and supply of products, and mitigating the risks that cause the incapacity of the supply chain supplies to satisfy customer demand. Faced with the increased inclusion of sustainability in supply chains and management of the circular economy, risks in supply chains are very current and their mapping is increasingly relevant. The research brings together the concepts of sustainability and supply chain risk management (SCRM), working with the unprecedented concept of Sustainable Supply Chain Risk Management (SSCRM), not presented in previous works, thus identifying the main risks present in a sustainable supply chain and ways to mitigate these risks. The research seeks to answer three research questions: "what are the most used main authors, sources, keywords, and the main subjects published in the themes?", "what are the risks identified in SSCM?' e "how mitigate the risks identified in SSCRM?". From this, the bibliometric study is presented and allows identifying the main published subjects and keywords most used in SSCRM. In addition, the systematic review makes it possible to understand the risks present in the SSCRM and the ways to mitigate them, being the basis for the study and construction of the framework. Thus, the research shows how sustainability is being applied in conjunction with SCRM, indicating new directions for future investigations in SSCRM. Thus, the general objective of the research is the construction of a framework of risk mapping and mitigation strategies in SSCRM.

Keywords: Bibliometry; Systematic Review; Supply Chain Risk Management; Sustainability; Circular Economy.

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ACRONYMS LIST

CE – Circular Economy

CLSC – Closed-Loop Supply Chain

SC - Supply Chain

SCM - Supply Chain Management

SCRM - Supply Chain Risk Management

SSC – Sustainable Supply Chain

SSCM - Sustainable Supply Chain Management

SSCRM - Sustainable Supply Chain Risk Management

Introduction

General context

A reactive model day by day guides organizations. Every action taken is a response to current events, as economic, political, social, local, technological, or human factors. Hence, each organization is influenced by the environment that surrounds it, which is constantly changing and, in addition, requires analysis to maintain the company's survival by the expectations and needs of society in general. Each organizational system will suffer from interference and external pressure, such as new environmental laws to which it must adapt, new social issues that require a new look at consumption and marketing, and even face possible financial fluctuations. Therefore, companies as active agents, have the role of seeking innovation and the implementation of innovative technologies, to achieve customer satisfaction.

Nowadays, there is a dynamic flow between information, finance, services, and products, driven by the continuous interaction between supply and demand. Thus, supply chains are dynamic end-to-end networks that interconnect from the producer to the end customer through activities such as manufacturing, storage, and transportation. Due to the strong interaction present in supply chains and all the variables that interconnect them, they are subject to several uncertainties and risks that are mitigated through efficient risk management, such as process and control, operational, financial, management, environmental, logistical, IT, social, supply and demand risks. With good supply chain risk management, it is possible to obtain best practices in planning and control management, generating a competitive advantage for companies.

In recent decades, supply chain disruptions around sustainability have had a strong impact on social communities and industrial sectors, threatening the implementation of strategies based on circular economies. In this context, sustainability brings a competitive advantage to companies in a globalized world, and organizations have already realized that crises can continue to arise when the impacts of sustainability in the supply chain are neglected. In this sense, sustainable supply chain risk management is seen as a key element to addressing sustainable impacts for the implementation of the circular economy, helping to avoid collapses in the production and supply of products, and mitigating the risks that cause the inability of the supply chain, to satisfy customer

demand.

Besides, the vision of the organization that society expects is an active stance toward the dynamics and exchanges that occur in the internal and external environment of companies (Burrel and Cooper, 1988). Therefore, Supply Chains (SC) are dynamic networks that encompass entities, such as suppliers and customers, and activities, such as manufacturing, warehousing, and transportation. Supply Chains are subject to uncertainties and risks that can occur anywhere and anytime as they are driven by the exchange of materials and information due to supply and demand interactions (Vieira et al., 2020).

Supply Chain Risk Management (SCRM) identifies and analyzes vulnerabilities that may hinder the achievement of corporate objectives (Rashid et al., 2014), providing best practices in planning and control management, generating competitive advantage in companies (APICS, 2011), based on reaction to future trends (Normann and Jansson, 2004). Thus, SCRM's main objective is to help companies with strategies to mitigate the risks present in the supply chain (Neiger et al., 2009). Despite this, a supply chain is an operations management model, that is often analyzed under aspects in which it attributes sustainability as deterministic and predictable (Gino and Pisano, 2008), inserted in highly complex environments to achieve effectiveness, efficiency, and quality.

The idea of environmental sustainability and economic performance is just an idea of compensation that has been decreasing (Colicchia et al. 2016), as companies value the idea of remaining competitive while generating environmental and social value (Mishra et al. 2018). Currently, competitiveness, globalization, diversity of technological implementation, and the need to satisfy customer expectations have led to the abrupt growth of uncertainties and risks in the supply chain (Valinejad and Rahmani, 2018).

Therefore, sustainability inserted in an organizational context is fundamental to stimulate innovation with an inspiring vision to achieve organizational goals (Woo and Kang, 2020), integrating sustainability, responsibility, and ethics (Setó-Paimes and Papaoikonomou, 2016). Sustainability is identified as a risk in the supply chain as its parameterization influences several other factors such as management, environment, logistics, operation, finances, control, supply factors, social impacts, IT, and demand (Figueira et al., 2012). Some organizations have already realized that crises can continue to arise when the impacts of sustainability within the supply chain are neglected

(Krivkovich and Levy, 2015). In this way, economic and political development are directly applied to sustainable issues (Genovese et al., 2017). To maintain a sustainable supply chain, organizations are concerned with environmental and social issues to have good financial results (Abdel-Basset and Mohamed, 2020).

Thus, the global organizational contexts aim to mitigate the risks and analyze the life cycle of an SCM (Savaskan et al., 2004), emphasizing the concept of sustainable supply chain management (Touboulic and Walker, 2015) and closed-loop supply chains as key facilitators for implementing strategies in the circular economy (Geissdoerfer et al., 2017). The circular economy (CE) model is the ideal way to have sustainable production combined with growth as opposed to the current linear model (Geissdoerfer et al., 2017). In this regard, a closed-loop supply chain (CLSC) is the design, control, and operation of a system to maximize value creation in the life cycle (Hu et al. 2014). Planning and control in the supply chain process provide best practices in supply chain management, generating competitive advantage in companies (APICS, 2011; Kajüter, 2003) based on the reaction to future trends (Norrman and Jansson, 2004).

However, SCRM combined with sustainability is complex and requires learning processes in the business world (Montiel et al., 2020), requiring a comprehensive analysis of the economic, environmental, and social context within the organizational model (Ferraro et al., 2015). Corporate sustainability aims at cost savings and greater competitiveness while seeking a good reputation among stakeholders (Lovins, 2010). In contrast, entering a paradigm of globalization, each company has a different vision of sustainability, in which it seeks to apply it according to its organizational culture, reflecting on actions with the environment, with society, and in its internal processes (Landrum, 2018)

For this reason, some companies guide their actions by applying corporate sustainability for continuous improvement, while others see sustainability as a rupture in the internal culture, which can cause resistance to change, in addition to negatively impacting internal collaboration and creativity (Woo and Kang, 2020). In this way, the analysis of risks in corporate sustainability is fundamental to positively influencing a shared vision, and bringing corporate social responsibility (Casey and Sieber, 2016).

As a result, sustainable supply chain risk management (SSCRM) allows for controlling and mitigating risk factors within organizations, linking processes, and

meeting customer needs, in addition to creating resilience strategies, such as cost reduction, increase in productivity and waste reduction, to achieve organizational excellence and create value for the company, in addition to adapting to the emergence of Integrated Management Systems to help managers systematically address the requirements of an organization's stakeholders: the environment, corporate social responsibility, quality and occupational health and safety (Klute-Wenig and Refflinghaus, 2015). Sustainability applied to the supply chain is increasingly being researched (Lewandowski, 2016), considering that classic economic models are no longer able to mitigate challenges in the 21st century and in reducing risks (Yazdani et al., 2019).

The sustainable supply chain is then described as the management of activities within a supply chain to dye economic profitability with a look at social and environmental aspects and risks (Abdel-Basset et al., 2019). Therefore, an organization that disregards the uncertainties that impact the sustainability of the supply chain will tend to instability in its risk management (Dong and Cooper, 2016). In this way, sustainable supply management allows for an improvement in the long-term supply chain combined with the CE and CLSC concepts (Abdel-Basset and Mohamed, 2020).

One of the cases to illustrate the impact of interruption of the supply chain due to sustainable risks happened in March 2011 when a strong earthquake in Tohoku, Japan, interrupted the flow of the global automobile industry. Domestic assembly lines for Japanese automakers were closed for about a month and shortages of automotive electronic sensors due to the earthquake caused vehicle production to stop or reduce in Germany, Spain, France, and the US. Even so, only about 10% of companies have contingency plans for supply chain disruptions (Chang et al., 2014).

Risks in SSCRM are linked to activities, processes, and relationships in the supply chain, being both endogenous risks (operations within the supply chain) and exogenous risks (interaction of companies with external environments), when they are not controlled, they have severe impacts in companies, such as reputational damage, financial consequences and legal actions by governmental and institutional actors in the event of the company's non-compliance with laws and regulations (El Baz et al., 2023).

Given this context, this study presents a general objective: to build a framework that brings risks and risk mitigation strategies that were carefully adapted from a systematic review to address Sustainability through Supply Chain Risk Management,

which can be answered with three research questions: “what are the most used main authors, sources, keywords, and the main subjects published in the themes?”, “what are the risks identified in SSCM?’ e “how mitigate the risks identified in SSCRM?”. From that, the bibliometric study allows to answer the main subjects published in SSCRM and it is a tool that complements a review of the literature to guide the development of projects, indicating new directions for future investigations and identifying which research methods were used in Sustainable Supply Chain Risk Management (SSCRM) (Fagundes et al, 2020a).

In face of an increase in the insertion of sustainability in supply chains and the management of the circular economy, the risks in SC are very current and their mapping is increasingly relevant. A systematic review makes it possible to understand the risks present in SSCRM and shows how sustainability is being applied in conjunction with SCRM. Besides, the study answers the general objective of this dissertation: to build a Risk Mitigation Strategies Framework. In addition, it is possible to analyze the risks in SCRM applied closed-loop supply chains and how the researchers and the company are managing them to perform a joint analysis to minimize the gaps present in CLSC and CE in SCRM, offering ways to mitigate them, which can be applied in future research.

Objectives

This section presents the dissertation objectives.

General objective

The general objective of this dissertation is to build a framework that brings risks and risk mitigation strategies that were carefully adapted from a systematic review to address Sustainability through Supply Chain Risk Management.

Specific objectives

Three specific objectives were elaborated for the formulation of this research using the concepts of sustainable supply chain risk management from the perspective of the circular economy and closed-loop supply chain.

i. Identify the most used main authors, sources, keywords (word cloud), and the main subjects published in the themes.

ii. Identify and analyze the risks identified in SSCM.

iii. Identify and analyze the mitigation strategies in SSCRM.

Dissertation contributions

The main dissertation contribution is to build a framework that allied the concepts of SCRM and sustainability and brings the concept of Sustainable Supply Chain Risk Management (SSCRM), describing the risks present in a Sustainable Supply Chain and the strategies to mitigate it, in addition to relating concepts of circular economy and supply chains.

Research delimitation

This study is subject to limitations. First, the strings selected were Sustainability" and "SCRM". As the second limitation, the database chosen Scopus and Web of Science, and the publications were analyzed only in the English language. Besides, only papers as articles or reviews, and publications in the final stage were considered. These limitations are discussed in the Methodology chapter.

Study organization

This study is organized as follows; this introductory chapter provides an overview of the whole Dissertation.

Chapter 1 presents the theoretical background that provides the conceptual backbone and enables the understanding of the results and proposals.

Chapter 2 provides the methodological workflow alongside the explanation of the method, which guides the execution of this Dissertation.

Chapter 3 presents de bibliometric analysis, bringing the main authors, sources, keywords (word cloud), and the subjects that are most published.

Chapter 4 presents the Risks in SSCRM, as management, financial, logistical, environmental, process and control, operational, IT, social, supply, and demand risks.

Chapter 5 provides a discussion about the risks in SSCRM, and presents the mitigation risks strategies framework, which allows analyzing the ways to mitigate the

risks mentioned in Chapter 4, using the strategies to reach an efficient SSCRM, once the Framework identifies the mitigation strategies and related to CE e CLSC.

Chapter 6 presents the document's Conclusion, bringing back the search question in Methodology and the concepts in the theoretical background, and shows the Dissertation results. In the end, the conclusion presents the search contributions and the future steps.

1. Theorical Background

1.1. Supply Chain Risk Management (SCRM)

Supply Chains (SC) are dynamic networks that encompass entities such as suppliers and customers, and activities such as manufacturing, storage, and transportation. Supply chains are discussing uncertainties and risks that can occur anywhere and anytime because they are driven by the exchange of materials and information due to supply and demand interactions (Senna et al., 2020).

Globalization has effects on competition and demand, which are constantly increasing (Fan et al., 2011), influencing companies to increasingly look at the integration of processes (Kannengiesser et al., 2016). In this sense, supply chain management (SCM) seeks to manage material and information in an organizational network that produces and delivers products or services for the customer (Tang, 2006). In addition, SCs need coordination of cross-functional processes and activities, such as marketing, sales, production, product design, purchasing, logistics, finance, and information, while conversing with the entities, suppliers, and customers (Senna et. al, 2021).

Risk in the supply chain is a critical issue, if companies are not able to manage it, they will be susceptible to problems in their performance (Mitchell, 1995). Mismanaged risks can lead to uncertain forecasts, lower quality of delivered products, decreased business volume, damaged reputation, difficult relationships, and conflict of interest with stakeholders (Cousins et al, 2004). To eliminate, or at least mitigate these effects, companies must adopt SCRM strategies (Manuj and Mentzer, 2008).

SCRM relates the supply chain and its risks (Norrman and Lindroth, 2002), having as its main objective to assist companies with strategies to mitigate the risks present in the supply chain (Neiger et al., 2009). Thus, SCRM identifies and analyzes the vulnerabilities that can hinder the fulfillment of corporate objectives (Mohd et al., 2014), applying the concept of collaborative partnerships to minimize uncertainties in activities along the supply chain (Norrman and Lindroth, 2002).

Sodhi et al. (2012) systematically identified four key sub-processes for managing Supply Chain Risk (SCR):

i. recognize and identify the risks,

ii. evaluate and assess the risks,
iii. mitigate the risks and
iv. respond to risk incidents for both operational risks and catastrophic risks.

Besides, Senna et al. (2021) summarize SCRM in three main aspects: Identification, Assessment, and Mitigation. For good risk management, the initial identification of risks is necessary, then it is important to understand how risks occur, thus seeking to mitigate problems that may arise due to lack of initial identification or even ineffective risk management.

Christopher and Peck (2004) classify supply chain risk into five categories:

i. Process risk;
ii. Control risk;
iii. Demand risk;
iv. Supply risk; and
v. Environmental risk.

Categories (i) and (ii) are related to the organization's internal factors; categories (iii) and (iv) are related to internal supply chain factors; category (v) refers to external factors of the supply chain (Christopher et al., 2011).

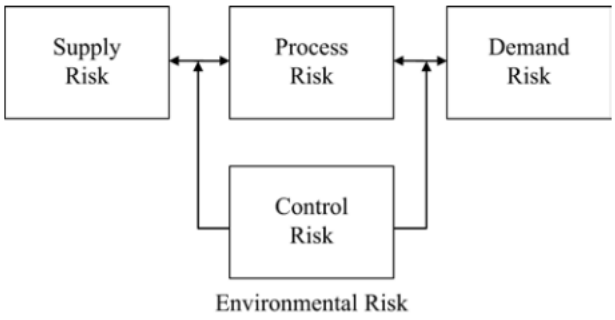


Figure 1 - The relationship between supply chain risks. (Christopher and Peck, 2004)

Manuj and Mentzer (2008) proposed eight categories for supply chain risks: (i) supply risks, (ii) operational risks, (iii) demand risks, (iv) security risks, (v) macro risks, (vi) policy risks, (vii) competitive risks and (viii) resource risks. However, the authors highlighted supply risks, operational risks, demand risks, and security risks as directly

affecting the supply chain.

1.2. Sustainability

Sustainability refers to the ability to satisfy basic human needs without depleting the available resources of the environment (Woo and Kang, 2020), outlining strategies for a good relationship between companies, authorities, society, and the environment (Mccann and Holt, 2010). In this way, sustainability is no longer linked only to environmental degradation and started to integrate issues such as quality of life, competitive advantage, economic viability, clean technologies, and conscious use of non-renewable resources (Silva, 2012).

Hence, Barbieri et al. (2010) characterize the three pillars of sustainability:

i. social aspects – the social impact of innovation inside and outside the organization (unemployment; organizational skills; social exclusion);
ii. environmental aspects – environmental impacts with the use of environmental resources and their; and
iii. economic aspects – economic efficiency from profit, continuous improvement, and competitive advantage.

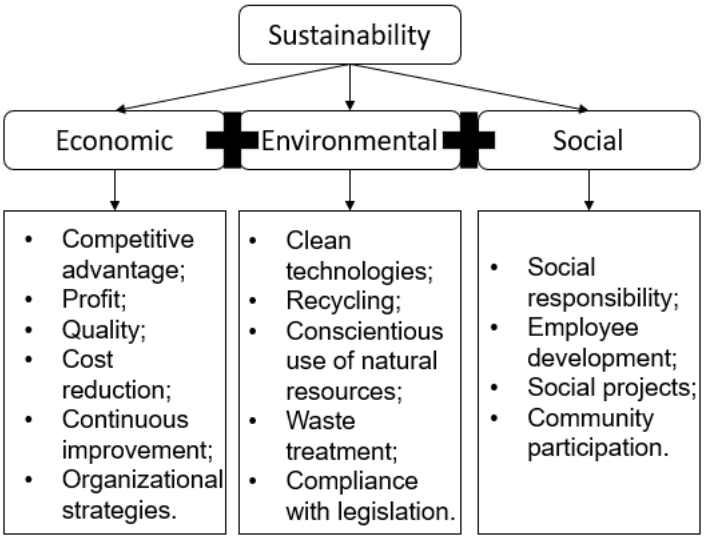


Figure 2 – Three pillars of sustainability. Adapted from Coral (2002).

In this sense, the three pillars of sustainability complement each other, allowing

the company to have a management that adds value to its stakeholders (Castro et al., 2016). Therefore, corporate sustainability is defined as an integrated and systemic approach of the organization that, instead of destroying social, economic, human, and natural capital (Visser, 2011), seeks to generate value for the company and society, the balance of interests financial and non-financial, and the responsibility of the organization's actions (Schwartz and Carroll, 2008). It is noted that the main directions of the organization (value, balance, and responsibility) are related to the sustainable development of the business, both internally and externally. In this sense, corporate sustainability aims to meet current needs without compromising the ability of future generations to meet their own needs (Landrum, 2018).

1.3. Circular Economy and Closed-Loop Supply Chain

Environmental sustainability and economic performance are still seen as a trade-off (Colicchia et al. 2016), so it is an ongoing challenge to create environmental and social value in a supply chain redesign framework to maintain competitiveness (Mishra et al. 2018). However, in supply chains, more and more advances are being made to avoid waste in production through resource efficiency. (Daaboul et al. 2016)

The Circular Economy (CE) according to Mishra et al. (2018) is defined as: "restaurant and regenerative by design, aims to keep the products, components, and materials at their highest utility and value", thus aiming to preserve natural, social, and cycle or cascade capital, in addition to optimizing the use of resources and minimizing the risks of finite stocks and renewable flows (Webster, 2015).

The circular economy criticizes the linear economy model and the disposal of products at the end of their use, as they are designed without considering the handling and disposal of products. Using the concept of promoting the preservation of the environment, it preaches minimizing the extraction of resources and waste generation, thus seeking to extend the useful life of products and materials incorporated into the product. In addition to bringing an environmental advantage, it also brings an economic advantage (Beames et al., 2021).

Therefore, the basis of the CE model is to close several cycles to achieve sustainable modes of production and consumption, characterized by resource efficiency, waste minimization, and regeneration (Kalmykova et al., 2018). In the literature on

SCRM, the implementation of the CE model involves designing and consolidating resilient systems that are supported by reinforcement networks (Geissdoerfer et al., 2018).

Value creation in CE has four basic principles (EMF 2012, 2013):

i. Inner value creation cycle: maintaining the integrity of a product at its highest level through service and maintenance (to preserve materials, labor, energy, and capital for its original purpose);
ii. Extend value creation cycles: using products and materials longer through product durability or design for remanufacturing and reuse (to allow for repeated cycles);
iii. Cascading Value Creation Cycles: Cascading use in adjacent value chains (where the costs of reused products and materials are lower or have a higher value compared to virgin or non-renewable materials);
iv. Pure Value Creation Cycles: Creating pure value, high-quality raw material from the start (avoiding contamination and toxicity to allow reuse and reduced cleaning or purification costs).

Closed-loop supply chain (CLSC) is defined by Guide and Vansenhove (2009) as “the design, control, and operation of a system to maximize the creation of value throughout the life cycle of a product with the dynamic recovery of value”. different types and volumes of returns over time", including returns management, leasing, and remanufacturing (Hu et al. 2014).

One of the features of a CLSC is an integrated forward and reverse SC to manufacture, return and recover products (Mahmoum Gonbadi et al., 2021). Traditional SC, or linear take-make-waste economics, is a one-way material flow starting with the extraction of raw materials, continuing through the process of making a product, and ending with customers discarding the same product after use (Souza, 2013).

The reverse SC includes the acquisition of used products from customers, recovering waste, and its value, in addition to the remarketing of products (Gaur and Mani, 2018). The main idea of CLSC is an integrated forward and reverse SC to recover products and produce the idea of perfect substitutes and selling remanufactured products that match the new products in both form and market (Berlin et al., 2022).

1.4. Sustainable Supply Chain Risk Management (SSCRM)

The traditional model of value creation in supply chain management theory literature is typically based on a one-way flow of primary activities: material inputs, inbound logistics, outbound logistics, marketing, sales, and service (Porter, 1985), being a linear model. The focus of design and revenue generation is often on the manufacturing and retail processes rather than the end-of-life product phases.

CLSC and CE offer the perspective of an integrated approach to generate economic, social, and environmental value (Porter and Kramer, 2011) and sustainable business models (Barber et al., 2012). Sustainability is defined as the level at which companies consider social and ecological requirements in addition to the minimum legal criteria (Hofmann et al., 2014). Sustainability is increasingly related to supply chain risk management (Tummala and Schoenherr, 2011), as SCRM can be defined as the ability of a company to analyze and manage its economic, environmental, and social risks within the supply chain (Gouda and Saranga, 2018).

Economic sustainability is said to be the ability to maintain the company's operations profitable (Yazdani et al, 2019). The fundamental requirement to analyze the entire product life cycle of an SCM is the initial step toward establishing green and sustainable production systems (Savaskan et al., 2004), as well as Sustainable SCM (SSCM) presents economic, and social developments to achieve the overall performance of business organizations in SC operations (Touboulic and Walker, 2015). Thus, sustainable SCM (SSCM) is the integration and coordination of social, environmental, and economic objectives (Carter and Rogers, 2008), presented in figure 3.

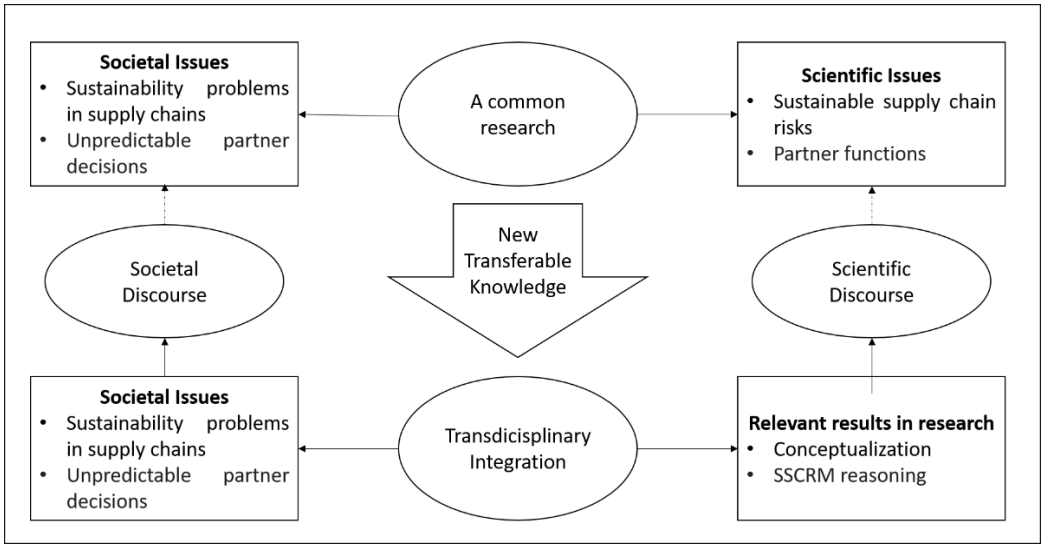


Figure 3 - Sustainable Supply Chain Risk Management. Adapted from Hofmann et al. (2014)

SSCM is the supply chain process that aims to reduce negative consequences on production and ensure the management of operating costs. In addition, there are risks within the sustainable supply chain that are not so explicit, such as risk management, transparency, strategy, and culture (Carter and Rogers, 2008). The SSCRM seeks to integrate environmental concerns in organizations by conducting social, environmental, and economic objectives of an organization in coordinating business processes to improve overall performance and their SCs. Therefore, the supply chain maintains business continuity and management of operational costs, allowing the implementation of a global environmental quality program (Neutzling et al., 2018).

The combination of value cycles and collaboration in SSCRM equates to Porter and Kramer's (2011) concept of shared value achieved through redefining productivity in the value chain and building industry support clusters across company locations. Four types of value creation were identified by Schenkel et al. (2015): economic, environmental, informative, and consumer-oriented.

Several risks to closing loops in SSCRM have been identified, including the globalized nature of production processes and material flows, target market identification and product design, customer acceptance, and customer relationship management (Zhu and Tian, 2016). Key enablers to overcome these challenges include proximity to end customers, incentives and coordination, and new business models

(Choi et al., 2013). Barber et al. (2012) emphasized the need for possible fundamental changes in the property business model for product access and service systems and/or servitization.

The capabilities for successful business model innovation in SSCRM include (Mishra et al., 2018):

i. The ability to identify the creation;
ii. Capture and delivery of value for any business context;
iii. Demonstrating superior business benefit compared to a basic linear case, business models such as based on service and performance, incentive return, and value-added services can be used;

Resources to identify, anticipate and leverage key enablers include (Mishra et al., 2018):

i. New forms of partnerships and collaboration across the value chain;
ii. Digital transformation;
iii. Rethinking internal incentives;
iv. Working with regulators and policymakers' policies;
v. Access funding;
vi. Develop existing systems; and
vii. Organizational characteristics.

Wang and Rani (2021) bring a Framework (figure 4) that presents the risks factors in sustainable supply chain management. The risks include: sustainable operational risks (product design risks, production capacity risk, risk of demand, risk of quality, poor planning, forecasting errors, labor strike, long lead times for green products, change in technologies); economic risks (economic recession, credit uncertainty, change in prices); environmental risks (pollution, non-compliance with laws, emissions of green house gases, energy consumption, product waste); social risks (child labor, working time, discrimination, safe working); and sustainable distribution and recycling risks (proximity to airports, quality of roads, demand fluctuations, market-related risks).

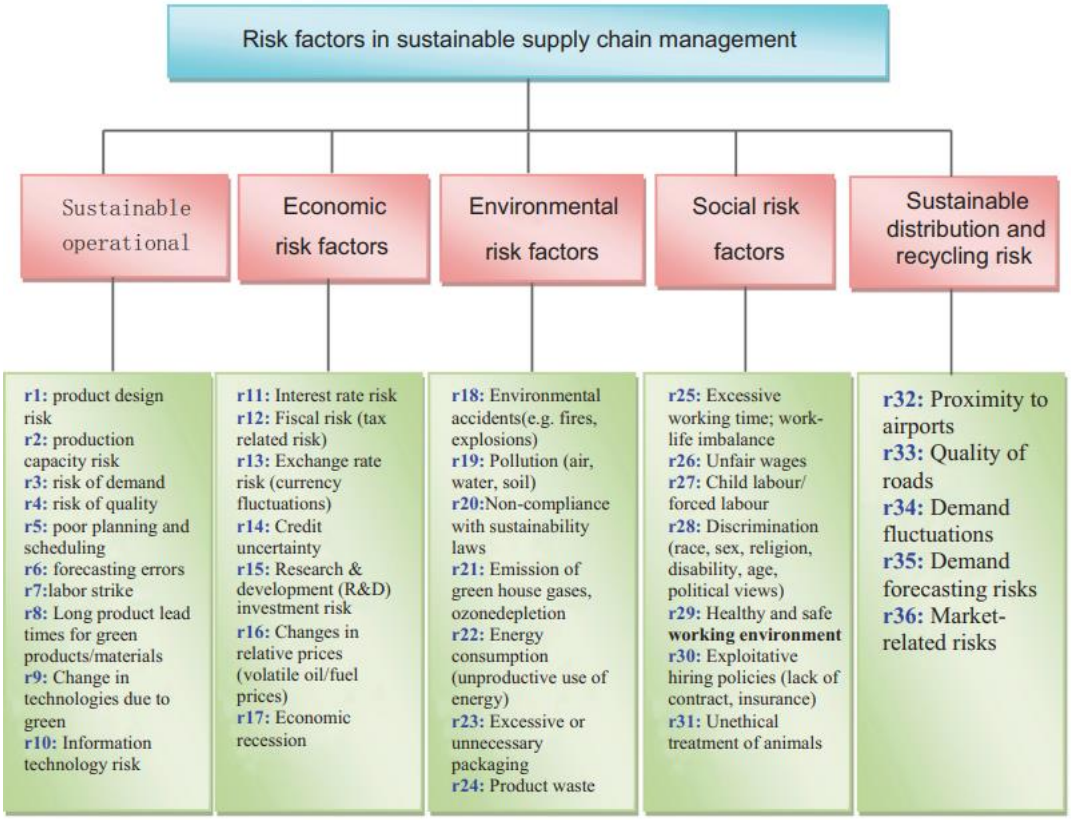


Figure 4 – Risks factors in Sustainable Supply Chain Management (Wang and Rani, 2021).

Elsami el al. (2021) define strategies for good SSCRM management include: strategic inventory; flexible supply base; make (in-house production) and buy (outsourcing); economic offer incentives; flexible transport: (Multimodal transport, Transport of several carriers, multiple routes); Dynamic variety of demand; and silent rollover of products (products replaceable in fluctuations in demand). Therefore, companies must consider the sharing of risks and rewards among supply chain members; supply chain partnerships; and trust between actors through effective communication, generating resources to create a competitive advantage and have long-term stability within the supply chain.

Oztek and Kabak (2022) bring a sustainable supplier risk criteria that identifies five categories: Operational and Technical (delivery, logistic, quality, capacity, infrastructure, technology, design), Environmental (use of resources, waste management, natural disaster), Management (contract, political, compliance with

legislation and standards, economic and financial, market), Security (physical security and information security) and Social (occupational health, working hours, social opportunities, human resources) present in figure 5:

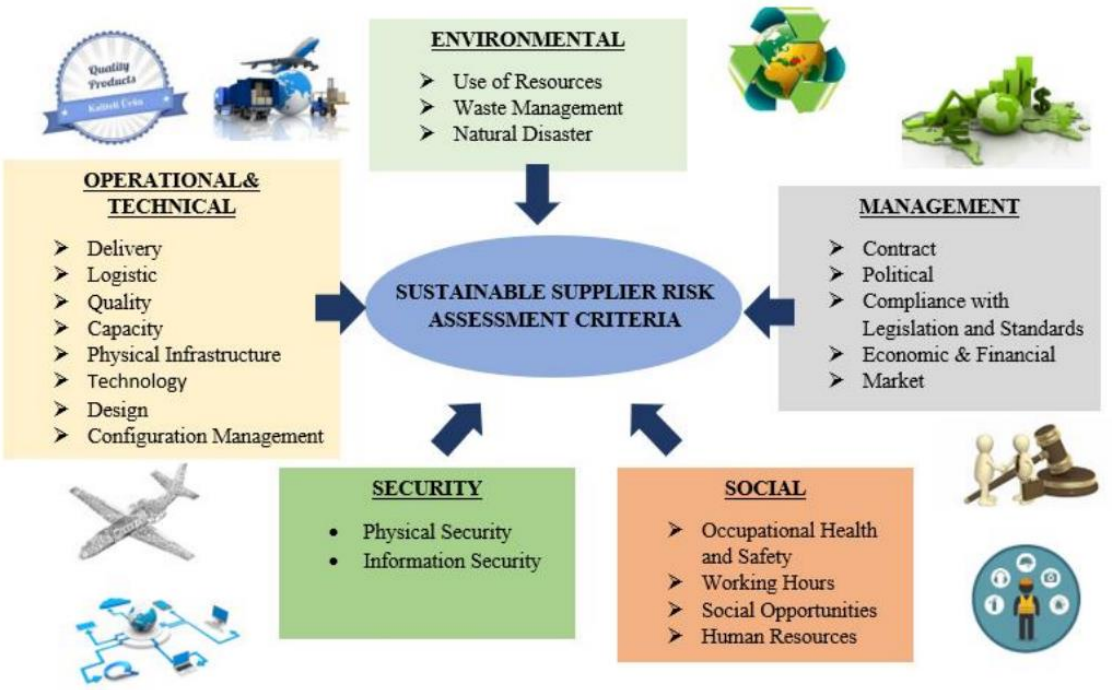


Figure 5 - Sustainable Supplier Risk Criteria (Oztek and Kabak, 2022).

2. Methodology

The methodology structured the search steps, and it was possible to do a bibliometric study and a systematic review, analyzing Sustainable Supply Chain Risk Management (SSCRM) in correlation with Circular Economy (CE) and Closed-Loop Supply Chain (CLSC). To fulfill the objectives of this article, three questions must be answered according to the analysis:

i. What are the most used main authors, sources, keywords, and the main subjects published in the themes?
ii. What are the risks identified in SSCM?
iii. And how mitigate the risks identified in SSCRM?

In figure 6, we present the first step of formulating the research questions mentioned above.

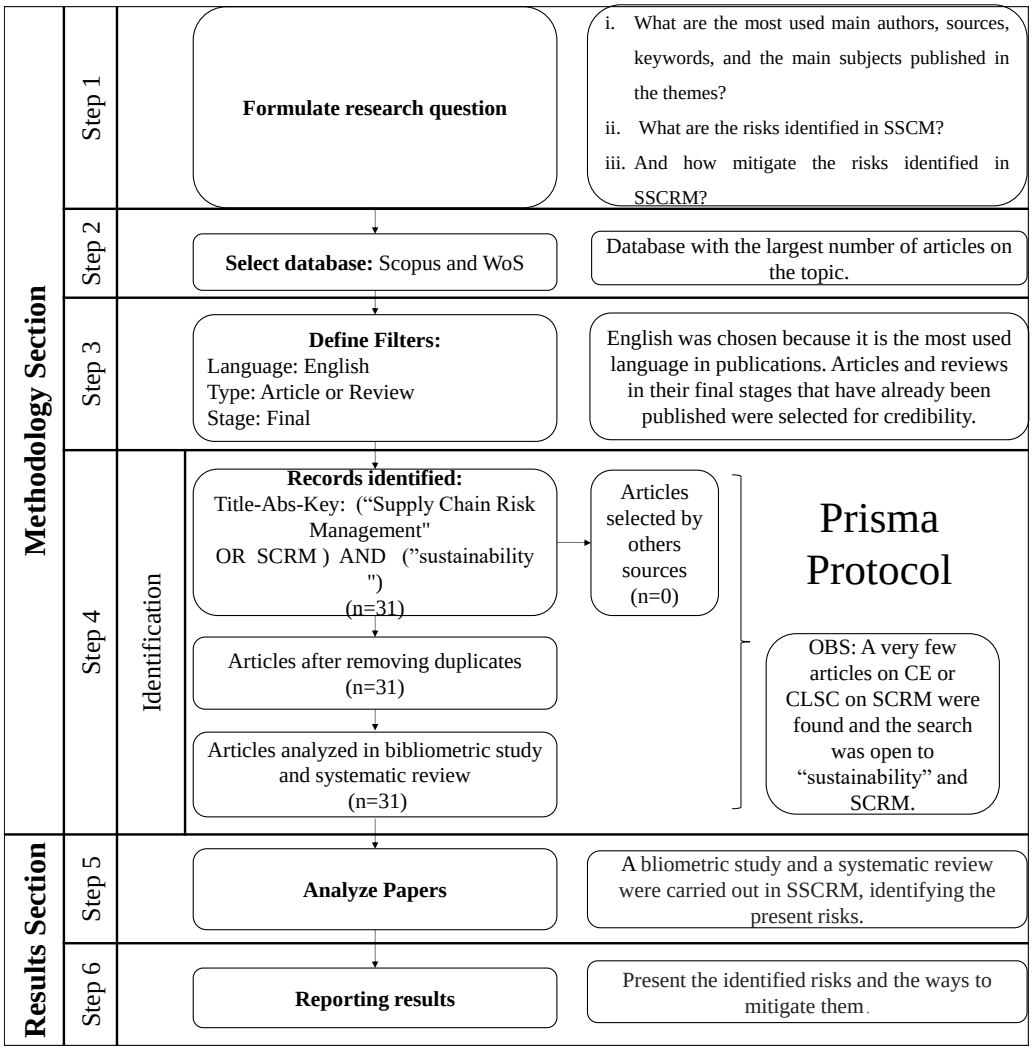


Figure 6 – Research Methodology

The first step of the research was to formulate the research questions. In the second step, the databases chosen were Scopus and ISI Web of Science (WoS), Elsevier's Scopus is the largest database of peer-reviewed literature and recovers journals from all major databases such as Emerald, Taylor & Francis, Science Direct, and PubMed; and is the largest searchable citation and abstract source (Chadegani et al., 2013).

Step 3 is the filter selection. The analyzed publications are only in the English language, a limitation of the study. This decision was taken based on: i) English is the main language used to communicate scientific research, ii) To guarantee that any researcher can understand any paper selected for this review systematic study. Furthermore, only papers as articles or reviews, and publications in the final stage were considered.

In step 4, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRISMA) method (Moher et al., 2009), the strings selected were "Sustainability", "Supply Chain Risk Management", "Circular Economy", "SCRM" and "CLSC". In the Web of Science, only 8 articles were found on the topics, which are also included in Scopus. Therefore, only Scopus was used in the analysis. Scopus was used based on the number of articles found (a total of 31 articles). There were no duplicated documents, and all articles found were analyzed, which is the research base of this document.

Table 1 shows the 31 articles that were found on SCRM and sustainability in the Scopus database between 2009-2020. Any papers were not found before 2009 about SCRM and sustainability. The research cut was in 2020 because the studies started in 2021 and were worked on every year closed to start the research.

Table 1 – Search strings

TITLE-ABS-KEY	Documents
("Supply Chain Risk Management" OR SCRM) AND ("Circular Economy")	1
("Supply Chain Risk Management" OR SCRM) AND ("CLSC")	1
("Supply Chain Risk Management" OR SCRM) AND (Sustainability)	31

The study as the topic of Supply Chain Risk Management allied to Closed-Loop Supply Chain (CLSC) and Circular Economy (CE) had to be opened to Sustainable Supply Chain Risk Management (SSCRM) because there is almost no research on CLSC or CE aligned to SCRM.

Previously, the search was on “SCRM and CE” or “SCRM and CLSC”, but only one article was published according to the themes. Because of this, the survey was open to Sustainability and SCRM, bringing a little-studied concept that is sustainable supply chain risk management (SSCRM).

In steps 5 and 6, the documents were analyzed, and a bibliometric study and a systematic review were carried out in SSCRM, identifying the present risks. Thus, the three research questions were answered, allowing to achieve the goal of creating a framework in SSCRM.

2.1 Bibliometric Search

Bibliometrics is the search, identification, and analysis of quantitative bibliographic data from scientific publications (Verbeek et al., 2002). From Scopus, a file with the extension “.bib” is generated, making a script in the language R containing 31 articles identified in the period from 2009 to 2020. For performing the bibliometric analysis, we used the Bibliometrix package written in R language (Aria and Cucurullo, 2017). The bibliometric analysis answers the first specific objective and allows the identification of the main sources, the main authors, the most used keywords (word cloud), and the main subjects published in the themes.

2.2 Systematic Literature Review

A systematic review is important to synthesize the literature on the topic to answer the research question from the evaluation of a dataset, thus it is possible to answer two specific objectives: identify and analyze the risks identified in SSCM, and identify and analyze the mitigation strategies in SSCRM. In this sense, the systematic review analyzes the risks involved in SSCRM through a spreadsheet elaboration containing the following columns for the analysis of each article: Title, Keywords Reference, Year, Country, Risks,

Gaps, Technique/approach, Conceptual/applied, Framework, Positive impacts, and Observations. The methodology was constructed based on an extensive paper reading and study along the master course.

From the individual analysis of each article, it is possible to identify the most frequent risks, such as management risks, sustainability risks, logistical risks, operational risks, financial risks, control risks, supply factors, social risks, information risks, and demand risks and then create a SSCRM risk mitigation framework with strategies to mitigate the risks identified. In this sense, the systematic review allows for building a Risk Mitigation Strategies Framework, which is the main objective of this research.

3. Results of Bibliometric Study

Table 2 shows the information obtained from bibliometrics. Articles from 2009 to 2020 were studied, with 31 documents in total, from these 27 articles and 4 reviews. In addition, it is possible to observe 25 sources and 87 authors, with 118 keywords on the subject. Besides that, there are almost three authors per document and only three single-authored documents, indicating the strong collaboration in theme.

Table 2 – Main Information about Data

DESCRIPTION	RESULTS
Main information about data	
Timespan	2009:2020
Sources (Journals, Books)	25
Documents	31
References	2287
Document types	
Article	27
Review	4
Document contents	
Keywords Plus (ID)	118
Author's Keywords (DE)	112
Authors	
Authors	87
Author Appearances	90
Authors of single-authored documents	3
Authors of multi-authored documents	84
Authors collaboration	
Single-authored documents	3
Documents per Author	0.356
Authors per Document	2.81
Co-Authors per Documents	2.9
Collaboration Index	3

Table 3 shows the subject areas from the articles and reviews. Business, Management, Accounting, and Engineering are the most apparent subjects but also is important to notice that subjects such as environmental, computer, and social sciences are incredibly significant areas in SCRM and sustainability.

Table 3 – Subject Area

Subject Area	
Business, Management and Accounting	19
Engineering	13
Decision Sciences	9
Environmental Science	8
Computer Science	6
Energy	5
Social Sciences	5
Economics, Econometrics and Finance	3
Mathematics	2
Multidisciplinary	2
Agricultural and Biological Sciences	1
Arts and Humanities	1

In figure 7, the production of articles is monitored over the years. It is noticeable that there has been an increase in SCRM and sustainability research since 2014, evidencing the importance of sustainability attributed to risk mitigation by companies and society. It is important to note that before 2009 there was no publication on the topics of sustainability and SCRM, proving to be a very current topic to be studied.

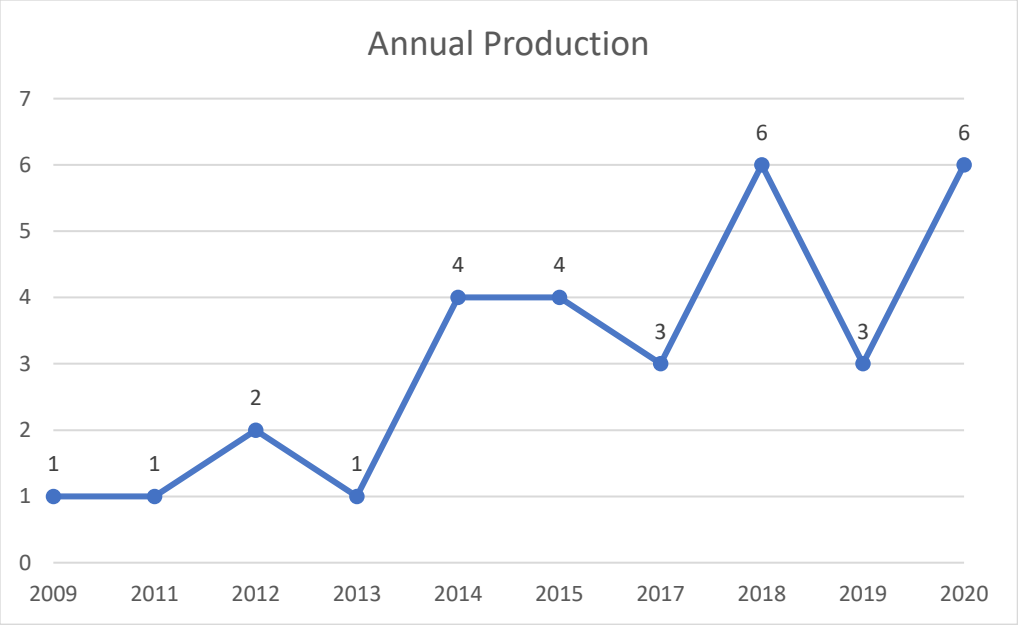


Figure 7 – Annual Production

Figure 8 shows the number of publications by principal sources, which the most relevant periodicals that have two or more than 2 publications were shown: International Journal of Production Research; Journal of Cleaner Production; International Journal Of

Agile Systems And Management; and Sustainability.

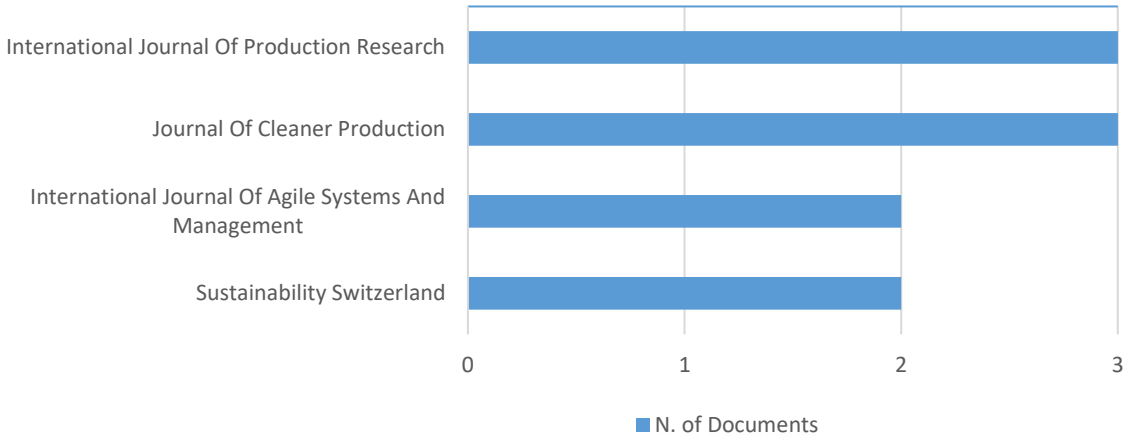


Figure 8 – Most Relevant Sources

Table 4 shows the top authors' production over time, that is, it shows the authors who made more articles on the topic and/or had the highest number of citations in their research. The authors who published the most on the theme of sustainability and SCRM were Govindan, Teles, and Vieira de Melo. Of the three, the one with the highest number of citations per year (TCPY) was Govindan, which shows he is doing relevant research in addition to being produced on the topic.

Table 4 - Top authors production over the time

AUTHOR	YEAR	SOURCE	TCPY
GOVINDAN	2018	JOURNAL OF CLEANER PRODUCTION	29.25
GOVINDAN	2014	JOURNAL OF CLEANER PRODUCTION	20.25
TELES	2020	IMA JOURNAL OF MANAGEMENT MATHEMATICS	0
TELES	2020	EUROPEAN RESEARCH ON MANAGEMENT AND BUSINESS ECONOMICS	2
VIEIRA DE MELO	2020	IMA JOURNAL OF MANAGEMENT [illegible]	0
VIEIRA DE MELO	2020	EUROPEAN RESEARCH ON MANAGEMENT AND BUSINESS ECONOMICS	2
AALTONEN	2020	RESOURCES	1.5
ABDEL-BASSET	2020	JOURNAL OF CLEANER PRODUCTION	28
ASROL	2018	INTERNATIONAL JOURNAL OF SUPPLY CHAIN MANAGEMENT	3
AZEVEDO	2014	JOURNAL OF CLEANER PRODUCTION	20.25
BANOMYONG	2012	INTERNATIONAL JOURNAL OF AGILE	0.4

BATALHA	2019	INTERNATIONAL FOOD AND AGRIBUSINESS MANAGEMENT REVIEW	2
BODE	2014	BUSINESS STRATEGY AND THE ENVIRONMENT	20.25

Table 5 shows the top authors' countries. USA, Europe, and Asia concentrate most productions and only Brazil in Latin America.

Table 5 – Authors Country

AUTHORS COUNTRY	
Germany	5
Indonesia	4
United Kingdom	4
United States	4
Brazil	3
India	3
Denmark	2
Finland	2
Portugal	2
Switzerland	2
Thailand	2
Turkey	2

Figure 9 reveals the country's productions, that is, how many authors from each country publish on the themes. Germany has five productions in the country but has eight authors publishing in various documents. Also, the relevant production authors countries appearing in both tables are Brazil, Indonesia, the UK, the USA, India, Finland, and Portugal. The productions in Latin America and Oceania do not show as much relevance as other continents, thus indicating a gap in the search for the theme in these areas.

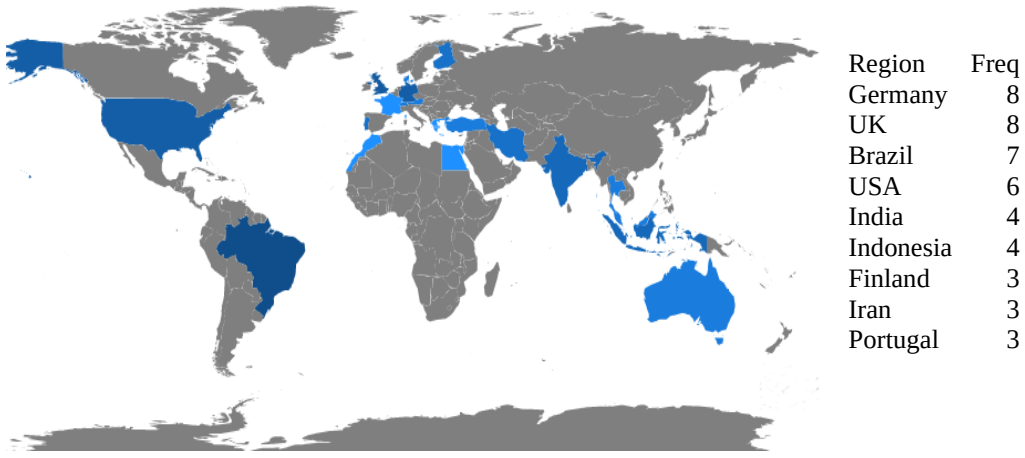


Figure 9 – Countries Productions

Figure 10 shows the keywords Word cloud. Although the most used keywords are sustainability and supply chain management, it is important to discover the correlated keywords, such as the covid-19 pandemic, a subject that is being studied in 2020 due to the global situation, analyzing how supply chains had to adopt even more sustainable measures due to a new risk that would be the pandemic.

“Analytic network process”, “electronics industry”, and “big data” show that sustainability is also applied in the concept of industry 4.0, thus showing how technological integration is related to the continuity of a sustainable system within the supply chain.

The social part also includes “child labor”, “emerging economics”, and “Brazilian amazon”. It is also noticeable ideas of circular economy, enterprise development, as well as continued business. Environmental risks may disturb food production in supply chains, thus climate changes, influenced by deforestation, impact the whole economic cycle. In other words, the creation of value and business maintenance based on sustainability is inserted in an SCRM model. In addition, it analyzes emerging economies present in the word cloud, and how they use sustainability within their business to try to compete with the strongest economies in the world.



Figure 10 – Word Cloud

Table 6 shows the ten most cited documents in sustainability and SCRM. The paper of Fahimia et al. (2015) was the most cited document (238 citations) in which it speaks of a systematic review of quantitative and analytical models for the management of supply chain risks, identifying risks such as Upstream supply chain risks, downstream supply chain risks, uncertainty modeling in the network design supply chain and location of facilities, uncertainty modeling in tactical/operational supply chain planning, supply and demand forecast analysis, uncertainty modeling in inventory management and process control, sustainability risks, purchasing and supply uncertainty retail.

Christopher et al. (2011) show how managers assess global sourcing risks across the supply chain and what actions they take to mitigate those risks. Gonvidan et al. (2014) demonstrate a model for the impact of lean, resilient, and green SCM practices on SC sustainability, and Hofmann et al. (2014) shows sustainability-related supply chain risks. Ivanov (2018) indicates a simulation that helps to identify which sustainability factors mitigate the ripple effect in the supply chain and which sustainability factors increase this effect.

Pujawan and Geraldin (2009) provide a framework for proactively managing CS risks. developed a framework called risk house that combines: the quality house of the quality function deployment and the failure mode and effect analysis. Roztamzadeh (2018) aims to develop a framework for the sustainable supply chain risk management (SSCRM) evaluation. Freise and Seuring (2015) show a model of environmental and social risk-related drivers and measures of risk. Abdel-Basset and Mohamed (2020) make classification and identification of risks: Financial risk; Supply risk factors; Environmental risk; Operational risk; Control and plan risk; Information/IT related risks. Finally, Gouda and Saranga (2018) talk about the impact of sustainability practices on supply chain risk.

Table 6 – Most Cited Documents

AUTHOR	JOURNAL	CITATIONS
Fahimnia et al. (2015)	European Journal of Operational Research	238
Christopher et al. (2011)	Supply Chain Management	227
Govindan et al. (2014)	Journal of Cleaner Production	162
Hofmann et al. (2014)	Business Strategy and the Environment	162
Ivanov (2018)	International Journal of Production Research	125
Pujawan and Geraldin (2009)	Business Process Management Journal	123

Rostamzadeh et al. (2018)	Journal of Cleaner Production	117
Freise and Seuring (2015)	Logistics Research	64
Abdel-Basset and Mohamed (2020)	Journal of Cleaner Production	56
Gouda and Saranga (2018)	International Journal of Production Research	50

Figure 11 shows the most cited countries' authors, with emphasis on Germany, which has the highest concentration of citations (351 citations), followed by the United Kingdom (238 citations), showing a large concentration in Europe. Indonesia, Iran, and India also show that there are many citations in Asia. Assuming that the chains are global and that much of the research is concentrated in certain continents, CE and SCRM may not be adopted in so many countries, not being on the path of concern and value creation yet.

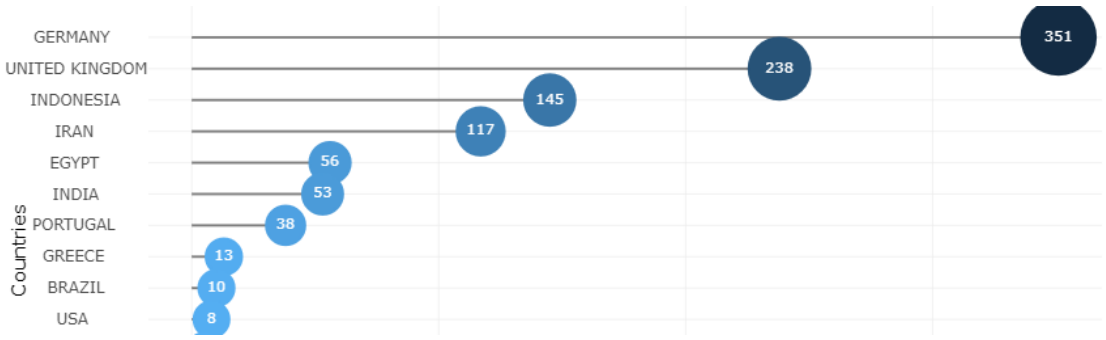


Figure 11 – Most Cited Countries Authors

4. Results of Systematic Review in SSCRM

In the systematic review, the analyzed articles considered management risks, sustainability risks, logistical risks, operational risks, financial risks, control risks, supply factors, social risks, information risks, and demand risks. With this, table 7 was created analyzing the risks and assigned a scale that represents the most reported risks in the percentage of the total. The main risks present in the analysis are risk behavior and attitude, market-related risks, long distances, long replenishment times, investment risk, coordination effort, and uncertainty of suppliers.

Table 7 – SSCRM Risks

Categorization	Identification	N.	Total	%	Source
Management Risks	Risk behavior and attitude	10	36	18%	Fagundes et al., 2020a; Fagundes et al., 2020b; Yazdani et al., 2019; Goçer et al., 2019; Rostamzadeh et al., 2018; Asrol et al., 2018; Ganji et al., 2017; De Silva and Paris, 2015; Fahimia et al., 2015; Freise and Seuring, 2015; Vlachos et al., 2012; Martin et al., 2011; Pujawan et al., 2009.
	Market-related risks	9			
	Communication between the parties	7			
	Poor management decisions	6			
	Adverse changes in regulation	4			
Environmental and sustainability risks	Environment pollution	7	27	13%	Abdel-Basset and Mohamed, 2020; Fagundes et al., 2020a; Fagundes et al., 2020b; Yazdani et al., 2019; Goçer et al., 2019; Galuchi et al. 2019; Gouda and Saranga, 2018; Rostamzadeh et al., 2018; Ganji et al., 2017; Mulyati and Geldermann, 2017; Mani et al., 2017; Fahimia et al., 2015; Freise and Seuring, 2015; Govindan et al., 2014; Mohd et al., 2014; Hofmann et al., 2014; Mandal, 2013; Vlachos et al., 2012; Christopher et al., 2011.
	Natural disasters	5			
	Energy/natural resource consumption	5			
	Inability to use green fuel	4			
	Waste generation	3			
	Ineffective reverse logistics practices	3			
Logistical risks	Long distances	9	25	12%	Yazdani et al., 2019; Mulyati and Geldermann, 2017; Fahimia et al., 2015; Govindan et al., 2014; Banomyong, 2012; Pujawan et al., 2009.
	Unreliability of some transport modes	8			
	Logistics provider failures	8			
Operational Risks	Long replenishment times (lack of agility in responding	9	24	12%	Fagundes et al., 2020a; Abdel-Basset and

	to demand)				Mohamed, 2020; Goçer et al., 2019; Rostamzadeh Gouda and Saranga, 2018; et al., 2018; Asrol et al., 2018; Ganji et al., 2017; De Silva and Paris, 2015; Soebandrija and Hendryvan, 2015; Fahimia et al., 2015;
	Utility failures	7			
	Production line interruption	4			
	Low quality	4			
Financial Risk	Investment risk	9	23	11%	Abdel-Basset and Mohamed, 2020; Yazdani et al., 2019; Goçer et al., 2019; Asrol et al., 2018; Thoni et al., 2018; Mulyati and Geldermann, 2017; Fischl et al., 2014.
	Price and cost volatility	7			
	Financial market instability	7			
Process and control risk	Coordination effort	13	19	9%	Abdel-Basset and Mohamed, 2020; Goçer et al., 2019; Mulyati and Geldermann, 2017; Fahimia et al., 2015; Christopher et al., 2011.
	Responsiveness Performance	6			
Supply Factors	Uncertainty of suppliers	10	16	8%	Abdel-Basset and Mohamed, 2020; Rostamzadeh et al., 2018; Mulyati and Geldermann, 2017; Fahimia et al., 2015; Christopher et al., 2011.
	Inventory / capacity risk	3			
	Lack of resources	3			
Social Risks	Failure to fulfill the social commitment	7	13	6%	Federova et al., 2020; Trautrims et al., 2020; Galuchi et al. 2019; Thoni et al., 2018; Mulyati and Geldermann, 2017; Mani et al., 2017; De Silva and Paris, 2015; Freise and Seuring, 2015.
	Human rights violation	4			
	Instability within a country or in neighboring countries, such as war, political conflict, terrorism, demonstration, and rebellion	2			
Information/IT Risks	Lack of information security	5	12	6%	Abdel-Basset and Mohamed, 2020; Fagundes et al., 2020b; Goçer et al., 2019; Rostamzadeh et al., 2018; Thoni et al., 2018; Ganji et al., 2017; Mohd et al., 2014.
	IT system failures	4			
	Technology decision failure	3			
Demand risk	Demand fluctuations	8	8	4%	Yazdani et al., 2019; Mulyati and Geldermann, 2017; Fahimia et al., 2015; Christopher et al., 2011.
Total		**203**	**203**	**100%**	

Management risks are the most expressive in supply chain risk analysis. Even considering the issue of sustainability, it is important to realize that attitudes and behaviors, behavioral problems not only affect management in the chain but also prospect the culture and the superior performance of employees. To have good supply

chain management, it is essential to have attitudes that are aligned with the company's values, starting from the leadership, which serves as an example for its subordinates. Goçer et al. (2019) indicated a driving Corporate Objective: use sustainability to immunize against reputational risk and improve the company's image.

Besides, risks in supply chain management impact market relations, and communication, as well as poor management significantly influences the sustainable supply chain. Roztamzadeh et al. (2018) provide management risks strategies as managing and controlling the effect of negative or positive events that influence an organization's objective, the ability to make decisions regarding managing the potentially negative effects of risk and taking advantage of opportunities, focusing on business activities and improve business using planning processes and performance management, notifying risk management benefits to stakeholders, creating an organizational culture in which all employees are aware of their role in achieving the organization's goals, determine organizational policy and risk management approach, determine the scope and application of risk management in the organization and, define the roles and responsibilities in the organizational risks management.

Ganji et al. (2017) bring a Sustainable Supply Chain Framework with strategies in Boeing's case study. The strategies adopted by Boeing in SSCRM were prioritized SWOT, effective collaboration with expert suppliers, stakeholders' coordination, and establishment of project management teams. In other words, it is no use just having the concept of sustainability if the way it is managed is not effective.

Environmental and sustainable risks directly affect the circular economy and CLSC. Environment pollution, resources consumption, inability to use green fuel, waste generation, and ineffective reverse logistics practices are risks that the efficient management of the supply chain using circular economy and CLSC is capable to mitigate, once it is characterized by resource efficiency, waste minimization, and regeneration (Kalmykova et al., 2018). In sustainability risk, Ganji et al. (2017) analyze themes involving economic sustainability (recycling, remanufacturing, reverse logistics, credit and exchange rate), and environmental sustainability (climate risks and greenhouse effect, natural hazards, renewable energies, food).

Freise and Seuring (2015) indicate strategies for managing environmental risks: play an active role in environmental interest groups; create requirements for product

development, specifying environmental criteria of a product; create a list of restricted substances as part of the product design specifications for sourced materials, which must be obeyed; product life cycle assessments (LCA) are an integral part of product evaluation in our company; only environmentally certified materials are to be used; during product design, material samples are tested towards being environmentally sound, thus avoiding environmental problems; environmental criteria play a key role in supplier selection and evaluation; the company conducts environmental audits at suppliers or employs third parties for such audits; and the company has policies in place for taking action if environmental misconduct (at suppliers) is documented. Gouda and Saranga (2018) identify Environmental Sustainability Efforts (ESE): environmental certifications (e.g. EMAS or ISO 14001); energy and water consumption reduction programs; and pollution emission reduction and waste recycling programs.

In addition, logistical issues interfere a lot in the sustainable supply chain, insofar as when there are large distances or outdated modes of transport, it becomes more difficult to apply sustainable management, in addition to having more polluting ways of making transport that impact the factor sustainability. Banomyong (2012) breaks risk distribution in two: risk distribution in supply chains is the phenomenon where the supply chain risks from a focal firm are broken into smaller units and then distributed to two or more supply chain members, and risk distribution in supply chains is an approach to mitigate risks without altering a firm practice. Govindan et al. (2014) bring strategies such as flexible transportation.

Operational risks also interfere with the quality of the final product, in addition to the supply chain risk of interruption of the production line. It is important to realize that the risks of coordinating efforts were the most expressive, so if there is no supply chain management with well-established processes and control indicators, the increase in supply chain uncertainties is very accelerated, due to not being able to measure goals and critical states. Gouda and Saranga (2018) analyze the operational risks and strategies: preventing operations risks (e.g. selecting a more reliable supplier, using clear safety procedures, preventive maintenance); detecting operations risks (e.g. internal or supplier monitoring, inspection, tracking); responding to operations risks (e.g. backup suppliers, extra capacity, alternative transportation modes); recovering from operations risks (e.g. task forces, contingency plans, clear responsibility); a key supplier fails to supply

affecting operations; the number of days of lost production last year due to supply failures or operations disruption; percentage of customer deliveries affected by operational failures.

Fagundes et al. (2020a) bring integration of SCRM process strategies: the risk recovery that should allow the supply chain to quickly return to its original state during an interruption, and current technologies such as RFID, ERP, 5G, smart devices, Internet of things, intelligent manufacturing, real-time computing, cloud computing, and blockchain bring the context of Industry 4.0, allows the organizations' visibility and traceability. Govindan et al. (2014) bring the concepts of Total Quality Management and Just in Time as operational risk strategies.

Gouda and Saranga (2018) analyze the process and control risks and identify Supplier Sustainability Development (SSD) strategies: suppliers' sustainability performance assessment through formal evaluation, monitoring, and auditing using established guidelines and procedures; training/education in sustainability issues for suppliers' personnel; and joint efforts with suppliers to improve their sustainability performance.

The financial risk is also strong, as there is an investment risk, sustainability being a relatively new concept applied to the supply chain and there is still uncertainty about how and why to invest in sustainability, combining the risk factor of demand and how to meet the organization's necessities. In addition, there are uncertainties with supply factors and fluctuations in demand as risks.

Gouda and Saranga (2018) also identify Supply Chain complexity (SCC): demand fluctuates drastically from week to week; total manufacturing volume fluctuates drastically from week to week; the mix of products you produce changes considerably from week to week; supply requirements (volume and mix) vary drastically from week to week; products are characterized by a lot of technical modifications; and suppliers frequently need to carry out modifications to the parts/components they deliver to your plant.

Fagundes et al. (2020a) bring the idea of risk contracts strategies: focus efforts on contracts for price and demand fluctuations, but there is a lack of research on long-term contracts for interruption management. Contracts for risk sharing are important in supply chain coordination. Also, adverse risk models strategies: as SCRM is driven by costs and

benefits, it is often difficult to justify investment in the recovery of disruptions or breakdowns of low probability. Therefore, risk-averse models such as value at risk (VaR), conditional at risk (CVaR), and stochastic dominance constraints need attention.

Social risks, as a pillar of sustainability, directly affect sustainable supply chain risk management. Human rights, the guarantee of a good relationship with society, and risks of social violence (terrorism, war) affect the progress of the supply chain, since, to maintain a healthy supply chain, it is necessary to have harmony between the financial process, sustainable and social, since the stakeholders, customers, employees, suppliers are part of society. Freise and Seuring (2015) identify social risks strategies: the company plays an active role in social interest groups/ NGOs; a code of conduct or similar standard such as SA 8000 is implemented and has to be obeyed for all business activities; the company conducts social audits at suppliers or employs a third party for such audits; the company offers incentives for suppliers if they engage in social responsible conduct; the company cooperates with business partners beyond the first tier towards improving social (working) conditions along the supply chain; and the company has policies in place for taking action if social misconduct (at suppliers) is documented.

It is important to emphasize that the risks of information technology were the lowest compared to the others. Although the world is living in an era of technology and globalization, few authors and companies relate sustainable supply chain risk management to IT. Risks are more present in coordination efforts than system failure or information security failure. It is worth mentioning that many management actions today are based on IT solutions. In other words, IT is not an imminent risk of sustainable supply chain management, but it is a factor that, breaking apart other actions, will always appear to support future improvements.

Fagundes et al. (2020a) identify information risk: supply chains operate and interact in a massive network of connections that expose them to various cyber threats. Proper information sharing can support risk management and interrupt mitigation. In this context, the tools of Big Data Analytics can contribute to the digitization challenges of SCRM. Architectures, algorithms, and models for processing large business and social media data sets improve the decision-making process and supply chain performance measurement. Ganji et al. (2017) bring IT risks strategies: apply an updated effective supply chain software system; train the suppliers through preparation workshops for IT

software; and use proven and validated technologies.

Once the risks were shown in the previous table, Table 8 presents Mitigation Risk Strategies. In this sense, each risk is analyzed, and presents the ways to mitigate them, using the SSCRM concepts to reach an efficient sustainable supply chain management.

Table 8 – SSCRM Risks Mitigation Strategy

Categorization	Identification	Mitigation	Source
Management Risks	Risk behavior and attitude	Management approach and employee training	Goçer et al., 2019; Rostamzadeh et al., 2018; Ganji et al., 2017;
	Market-related risks	Monitoring the political situation and reconsider the market	
	Communication between the parties	Frequent communication, mutual trust and sharing of decisions	
	Poor management decisions	Establish a leadership team consisting of highly professional members in supply chain risk management field	
	Adverse changes in regulation	Risk sharing agreements	
Environmental and sustainability risks	Environment pollution	Only environmentally certified materials are to be used	Gouda and Saranga, 2018; Ganji et al., 2017; Freise and Seuring, 2015;
	Natural disasters	Infrastructure investment projects	
	Energy/natural resource consumption	Resource restoration projects	
	Inability to use green fuel	Flexible sourcing	
	Waste generation	Cleaner production	
	Ineffective reverse logistics practices	Environmental audits at suppliers or employs third parties for such audits, ISO 14001 certification	
Logistical risks	Long distances	Offer diversification	Govindan et al., 2014; Banomyong, 2012;
	Unreliability of some transport modes	Flexible transportation	
	Logistics provider failures	Risk sharing agreements	
Operational Risks	Long replenishment times (lack of agility in responding to demand)	Just in Time	Fagundes et al., 2020a; Gouda and Saranga, 2018;
	Utility failures	Performance meters	
	Production line interruption	Smart devices, Internet of things, smart manufacturing, real-time computing, cloud computing and blockchain bring companies closer to the context of Industry 4.0 by allowing visibility and traceability	
	Low quality	Total Quality Management	
Financial Risk	Investment risk	Risk sharing agreements	Fagundes et al., 2020a; Gouda and Saranga, 2018;
	Price and cost volatility	Offer diversification and flexible sourcing	
	Financial market	Monitor and reconsider the market	

	instability		
Process and control risk	Coordination effort Responsiveness Performance	Management approach and employee training Performance meters	Fagundes et al., 2020a; Gouda and Saranga, 2018;
Supply Factors	Uncertainty of suppliers Inventory / capacity risk Lack of resources	Risk sharing agreements Infrastructure investment projects Flexible sourcing	Fagundes et al., 2020a; Gouda and Saranga, 2018;
Social Risks	Failure to fulfill the social commitment Human rights violation Instability within a country or in neighboring countries, such as war, political conflict, terrorism, demonstration, and rebellion	Local community programs Training for employees recognized human rights violations and develop human rights commitment programs involving stakeholders Cooperate with business partners beyond the first tier towards improving social (working) conditions along the supply chain	Freise and Seuring, 2015;
Information/IT Risks	Lack of information security IT system failures Technology decision failure	ERP Industry 4.0 Big Data Analytics	Fagundes et al., 2020a; Ganji et al., 2017;
Demand risk	Demand fluctuations	Demand diversification	Fagundes et al., 2020a; Gouda and Saranga, 2018;

5. Risks in SSCRM Discussion: a Mitigation Risk Strategy Framework

The risks identified in the previous chapter and the mitigation strategies allow the creation of a framework that synthesizes the main idea of this dissertation. In this sense, the framework allows the supply chain to reach the CE, CLSC, and SSCRM values:

i. The ability to identify the creation, of new forms of partnerships and collaboration across the value chain and rethink internal incentives.
ii. Capture and deliver value for any business context, improving organizational characteristics, developing existing systems, and digital transformation.
iii. Demonstrating superior business benefit compared to a basic linear case, business models such as based on service and performance, incentive return, and value-added services can be used, working with regulators and policymakers' policies and access funding.

It is important to identify the SSCRM aspects. The case studies as Boeing (Ganji et al., 2017), which brings financial risks, sustainability risks, demand risks, technology risks, supply risks, process risks, management risks, and labor risks, and then presents mitigation strategies as SWOT, collaboration with suppliers, stakeholders' coordination, project management teams, and IT projects shows the importance of a well-developed SSCRM in an organization.

Also, other companies that use mitigation strategies (Vlachos et al., 2012) as Intel (redundance of infrastructure prevented the disruption of its operations during the SARS outbreak in Asia in 2003); Wal-Mart (forecasting met customer demand despite the high impact disruption during the port closure in 2002); Coca-Cola (crisis and recovery management plan, same intent-to purchase levels as before the crisis after 2 months). Besides, the poor examples as Wal-Mart (inventory management by applying technical solutions without proper consideration of relevant regulations causing temporary failure of this risk mitigating strategy) and Mattel (did not impose specific regulations and global standards to its suppliers and problems might have been avoided through better information sharing, social responsibility, and quality management strategies). In this sense, the framework presented in this document brings the strategies to know the SSCM risks and applicate the mitigation strategies in the companies.

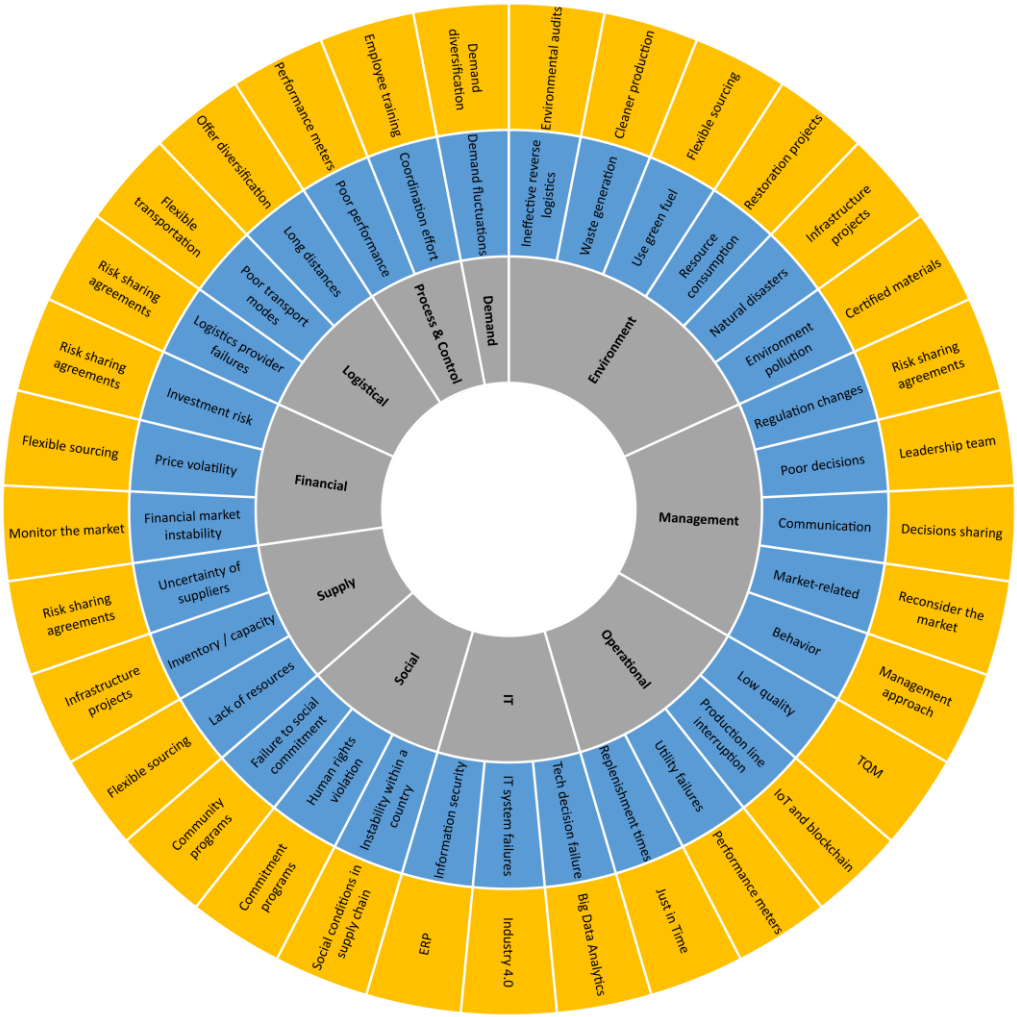


Figure 12 – Risks Mitigation Strategies Framework

The framework shows the strategies to mitigate the sustainable supply chain risks and uses the CE model, which is used to achieve sustainable modes of production and consumption, characterized by resource efficiency, waste minimization, and regeneration. The implementation of the CE model involves designing and consolidating resilient supply chains that are supported by reinforcement networks, and an inner value creation cycle, maintaining the integrity of a product at its highest level through service and maintenance (to preserve materials, labor, energy, and capital for its original purpose). Besides that, the Closed-loop supply chain (CLSC) concept, by the design, control, and operation of a system to maximize the creation of value throughout the life cycle of a product with the dynamic recovery of value.

In this sense, the mitigation strategies relate to the capabilities for successful business model innovation in SSCRM:

i. New forms of partnerships and collaboration across the value chain:
   - As management risks, the strategy to mitigate communication between de parties is frequent communication, mutual trust, and sharing of decisions. The market-related risk is managed to monitor the political situation and reconsider the market.
   - Logistics provider failures (logistical risks) and uncertainty of suppliers (supply risks) are mitigated by risk shares agreements.
   - The long distances and the unreliability of some transport modes are mitigated by offering flexible transportation and diversification.
   - As demand fluctuations are managed by demand diversification.
   - Coordination effort being a process and control risk, the strategy is management approach and employee training.
   - The strategy to cooperate with business partners beyond the first tier towards improving social (working) conditions along the supply chain is used to mitigate the instability within a country or in neighboring countries, such as war, political conflict, terrorism, demonstration, and rebellion.

ii. Digital transformation:
   - The information/IT risks such as lack of information security, IT systems failures, and technology decision failure are mitigated using digital transformation: ERP, Industry 4.0, and Big Data Analysis.

- Besides that, the production line interruption is mitigated by using smart devices, the Internet of things, smart manufacturing, real-time computing, cloud computing, and blockchain bringing companies closer to the context of Industry 4.0 by allowing visibility and traceability.

iii. Rethinking internal incentives:

- The risk behavior and attitude are mitigated by the management approach and employee training, reaching the strategy of rethinking internal incentives.

iv. Working with regulators and policymakers' policies:

- The adverse change in regulation is managed by risk-sharing agreements.
- Environmental and sustainable risks such as environment pollution, natural disasters, energy/natural resource consumption, inability to use green fuel, waste generation, and ineffective reverse logistics practices are mitigated by the strategies of only using environmentally certified materials, infrastructure investment projects, resource restoration projects, flexible sourcing, cleaner production, environmental audits at suppliers or employs third parties and be certified (ISO 14001).
- And social risks such as failure to fulfill the social commitment and human rights violations are managed by local community programs and training for employees to recognize human rights violations and develop human rights commitment programs involving stakeholders.

v. Access funding:

- The financial risks such as investment risk, price and cost volatility, and financial market instability are mitigated by offering diversification and flexible sourcing, monitoring, and reconsidering the market, and risk-sharing agreements.
- Supply factors such as inventory/capacity risks and lack of resources are mitigated by infrastructure investment projects and flexible sourcing.

vi. Develop existing systems:

- The operational risks such as long replenishment times (lack of agility in responding to demand), utility failures, and low-quality use quality concepts to manage them: Just in Time, performance meters, and Total Quality Management.

vii. Organizational characteristics:

- Poor management decisions are mitigated by establishing a leadership team consisting of highly professional members in the supply chain risk management field.
- The responsiveness performance is controlled by performance meters.

Therefore, a case study example brings four companies and the SSCRM to illustrate the strategies implementation (Christopher et al., 2011). The fashion retail and wholesale company use critical paths and process mapping to identify and manage risks and this enables them to view product risks, and transport risks, which they can mitigate, present strategies such as Re-evaluating sourcing criteria and decisions in the global context, Re-evaluating supply base network design and Mapping and critical path analysis.

The Oil/Gas company uses a standard methodology to assess the risks of demand and supply and has a cross-functional team to evaluate the risks. The level of risk is continuously assessed on quality, safety, and technology to work out the optimum strategic sourcing option, bringing the concepts of global sourcing and network re-engineering, re-evaluating sourcing criteria and decisions in the global context, re-evaluating supply base network design, mapping, and critical path analysis, creating a global sourcing risk management culture and establishing global sourcing continuity teams.

In the mechanical equipment company in this sector, all risk management techniques are based on qualitative statistical tools, which enable the companies to assess the risks in their supply chains. They have developed a low-cost manufacturing (LCM) project team to manage the risks of their low-cost sourcing decisions and present a board-led responsibility and leadership.

Also, the food and drink company business continuity planning is part of the risk management process and is supported by the health and safety team, which techniques consist of a business continuity plan for every plant of the company, for which the plant engineer is responsible and accountable, as well as for assessing risks in the supply base. The risk process for making a global sourcing decision is decentralized and managed by various teams such as health and safety, R&D, or plant engineering which all assess and manage risks associated with their function

Sustainability is identified as a risk that influences several other factors such as

management, environment, logistics, operation, finances, control, supply factors, social impacts, IT, and demand. In this sense, the framework allows the companies to analyze the risks as risk behavior and attitude, market-related risks, long distances, long replenishment times, investment risk, coordination effort, and uncertainty of suppliers in the context of SSCRM and implements the mitigation strategies as a management approach, reconsider the market, transport diversification, TQM, risk share agreements and employee training.

6. Conclusion

This document aimed to bring an analysis of the Sustainable Supply Cain Risk Management and identify the risks and mitigation strategies from the perspective of the circular economy and closed-loop supply chain. In this sense, the CLSC and CE concepts applied in the SCRM allow to build the general objective of this dissertation: a framework that brings risks and risk mitigation strategies that were carefully adapted from a systematic review to address Sustainability through Supply Chain Risk Management.

During the initial research phase, the topic had to be opened to “sustainability” and “SCRM”. Previously, the searched keywords were in "CE" and "sustainability" and/or "CLSC" and "sustainability", but only one article was found in the subjects, not allowing a bibliographic search or a robust systematic review. With the open topic on "sustainability" and "SCRM", 31 articles were found in the years 2009 to 2020. Before 2009, no article on the topic had been published. The research cut was in 2020 because the studies started in 2021 and were worked on every year closed to start the research.

Besides, a bibliometric search allows answering the first research question “what are the most used main authors, sources, keywords, and the main subjects published in the themes?” and identifying where subjects are being most studied, the main sources, the main keywords, and how authors are applying their research.

The systematic review allows answering “what are the risks identified in SSCM?’ and “how mitigate the risks identified in SSCRM?”, analyzing the risks and how they are correlated in research, in addition to knowing the main risks that permeate SSCRM. In this sense, identifying management risks, sustainability risks, logistical risks, operational risks, financial risks, control risks, supply factors, social risks, information risks, and demand risks, analyzing the uncertainty that affects the management of sustainable risks.

In conclusion, there is no point in having a proposal for a sustainable logistics chain if there is ineffective management. In addition, difficulties in the logistics system interfere with the application of sustainability in the supply chain. Another relevant point is to note that financial and investment risks are still a great fear for companies in terms of sustainability, in addition to having to face social fluctuations, demand, and in legislation. A change in the law may have to require the purchase of new equipment or the adaptability of an entire company to be within the sustainable bias. It is important to note that IT did not appear as a major risk in the systematic analysis but was often cited

when analyzing the word cloud. In other words, IT is seen as an ally to sustainability, and its lack can impact the implementation of sustainable supply chains.

The SSCRM Mitigation Risk Strategy Framework analyzed and presented the ways to mitigate the risks in a sustainable supply chain using the SSCRM concepts, EC, and CLSC models to reach an efficient sustainable supply chain management. In this sense, the main contribution of this research involves consolidating a resilient sustainable supply chain, identifying the strategies for the companies to create a value cycle and stay competitive in the market, adapting to the new social issues that require a new look at consumption and marketing, and even face possible financial fluctuations.

In addition, the academic contribution of this research was to identify the publication gap in SCRM and sustainability. Subjects in themes began to be published in 2009, and in a decade, there was a slow increase, with only 31 articles in 11 years. Analyzing CE and SCRM or CLSC and SCRM, the gap is even greater, with only one article published on the topics. The fields of study in sustainability and SCRM are still little studied, with great possibilities for future research.

Therefore, the capabilities for successful business model innovation in SSCRM encompass new forms of partnerships and collaboration across the value chain, digital transformation, rethinking internal incentives, working with regulators and policymakers' policies, access funding, develop existing systems and organizational characteristics, bringing strategies such as management mitigations (frequent communication, mutual trust, and sharing of decisions, monitor the political situation and reconsider the market, risk shares agreements, and management approach and employee training), logistical mitigations (flexible transportation and diversification), demand diversification, social mitigations (improving social conditions along the supply chain and local community programs), IT mitigations (ERP, Industry 4.0 and Big Data Analysis, smart devices, Internet of things, smart manufacturing, real-time computing, cloud computing and blockchain), environmental and sustainable mitigations (only using environmentally certified materials, infrastructure investment projects, resource restoration projects, flexible sourcing, cleaner production, environmental audits and ISO 14001 certification), financial mitigations (diversification and flexible sourcing, monitoring and reconsidering the market), supply mitigations (infrastructure investment projects and flexible sourcing) and operational mitigations (Just in Time, performance

meters and Total Quality Management).

In this sense, the framework allowed the supply chain to capture and deliver value for any business context and demonstrated superior business benefit compared to a basic linear case using the CE, CLSC, and SSCRM concepts.

As a proposal for future research, a specific systematic analysis only in CLSC and circular economy and SCRM can bring an in-depth identification of the related risks to resilience criteria and, in addition, in the future make an association of CLSC and circular economy and understand how these risks were mitigated as proposed by the articles in the systematic analysis, thus being able to demonstrate an overview of the main risks and the ways to mitigate them.

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Appendices

Systematic Review Worksheet

N	Title	Olhar doc	Keywords	References	Yea	Countr	Risks	Gaps	Technique/approach	Conceptual Applied	Framework	Positive Impacts	OBS1	OBS2
1	A novel plithogenic TOPSIS-CRITIC model for sustainable supply chain risk management	não	CRITIC; Plithogeny; Risk management; Supply chain sustainability; TOPSIS	Abdel-Basset, Mohamed; Mohamed, Rehab	2020	Egypt	Financial risk; Supply risk factors;Environmental risk; Operational risk; Control and plan risk; Information/IT related risks	consider the uncertain risk factors that threaten the sustainability of the supply chain	an integrated plithogenic TOPSIS-CRITIC approach that measured the uncertainty of the risk significantl	Applied	-	Supply Chain Sustainability atualizado	The results shows that the financial risk criteria is the most important main criteria.	
2	Decision-making models and support systems for supply chain risk: literature mapping and future research agenda	não	Bibliometrics; Multicriteria decision; Risk model; Stochastic and computational model	Fagundes, Marcus Vinicius Carvalho; Teles, Eduardo Oliveira; Vieira de Melo, Silvio A.B.; Freires, Francisco	2020	Brazil	agrifood risks, energy risks and sustainability risks	-	mapping the literature on SCRM decision-making models and support systems contribute	Conceptual	-	-		
3	Social sustainability dilemma: Escape or communicate? Managing social risks upstream of the bioenergy supply chain		Bioenergy supply chains; Socially sustainable supply chain; Stakeholder involvement; Upstream; Use of resources and social risks	Fedorova, Elena; Aaltonen, Kirsi; Pongrácz, Eva	2020	Finland	social risks	How can bioenergy production companies manage the social sustainability risks in their supply chain/country of raw material origin.	GRI boundary setting approach helps companies to define impacts that may potentially occur along bioenergy production supply chains	Conceptual	Social risks decision-making flow chart. Based	socially sustainable supply chain (SSSC)	Basic versus advanced social-risks-based GRI guidelines' recommendations	the importance of good social sustainability practices implementation and establishment of an effective communication between bioenergy production companies and nationalfregional
4	Supply chain risk management modelling: A systematic literature network analysis review	sim	Citation network analysis; Computer model; Quantitative model; Supply chain risk management; Systematic literature review	Carvalho Fagundes, Marcus Vinicius; Teles, Eduardo Oliveira; Vieira de Melo, Silvio A.B.; Mendonça Freires,	2020	Brazil	Design and risk propagation, Information risk, Risk contracts, Behaviour and risk attitude, Sustainability risk	reviews SCRM modelling and its evolution as a scientific field - 120 papers published in the Scopus database	bibliometric methods and tools of citation network analysis for a systemic understanding of the research flow in the field over time.	Conceptual	SCRM modelling timeline	sustainability, food and energy risk modelling	Trabalho de apoio	
5	Survival at the expense of the weakest? Managing modern slavery risks in supply chains during		COVID-19 pandemic; Supply chain risk management; labour exploitation; modern	Trautrims, Alexander; Schleper, Martin C.; Cakir, M. Selim; Gold, Stefan	2020	UK	supply chains slavery risks	implications of the Coronavirus (COVID-19) pandemic on modern slavery risks in supply	Discussion	Conceptual	-	covid 19 and SCRM - assunto atual		
6	A multi-criteria decision-making framework for agriculture supply chain risk management under a circular economy context	não	Circular economy; Flood and supply chain risk; Flood risk; Multi-criteria decision making; Step-wise Weight Assessment Ratio Analysis; Supply risks; Sustainable agriculture; Sustainable	Yazdani, Morteza; Gonzalez, Ernesto D.R.S.; Chatterjee, Prasenjit	2019		weather, demand, logistic and infrastructure, political, policy-related, financial, biological, market and environmental risks	study and identify flood risk drivers and their effects on the sustainability of an agriculture supply chain in connection with a circular economy strategy	Step-wise Weight Assessment Ratio Analysis method combined with a multi-criteria decision analysis	Applied	The decision structure for flood risk estimation	Sustainable SCM (SSCM)	The four-phase decision-making process for agriculture project development	

7	How does the contingent sustainability-risk-cost relationship affect the viability of CSR? An emerging economy perspective	sim	Emerging economies; Environmental sustainability; Multiple criteria decision-making; Supply chain risk management	Göçer, Aysu; Jin, Yao Henry; Fawcett, Stanley E.	2019	USA	sustainability–risk, repulional risk, behavioral risk, operational risk, cost risk, Organizational Routines, Safety and Traceability Routines, Systems Design, Behavioral, Opportunism	developing a nuanced framework for the sustainability–risk relationship in various industries in emerging economies	multi-method approach was used to collect both quantitative and qualitative data through interviews and site visits for supply chain members of four industries. A fuzzy AHP method was used to illustrate cross-industry differences in	Applied/Conceptual	A limits-to-growth model of the sustainability–risk interaction. Indeed,	Tradeoffs driving the risk profile patterns across industries.	Description of risk dimensions	
8	Management of socioenvironmental factors of reputational risk in the beef supply chain in the Brazilian Amazon region	sim	Brazilian Amazon; Cattle; Reputational risk; Supply chain risk management; Sustainability	Galuchi, Tharic Pires Dias; Rosales, Fabricio Pini; Batalha, Mario Otavio	2019	Brazil	social risks, environmental risks	area, but evidence about how companies have managed these efforts is scarce. The present study identified the main sources of reputational risks in Brazilian Amazon beef supply chains and the actions taken by	A multiple case study was developed in Brazilian beef supply chains that have suffered consequences to their operations from consecutive actions of stakeholders that link meat production with deforestation and the worst practices of production in the	Conceptual	Socioenvironmental factor management systems in beef supply chains in the Brazilian Amazon biome;	-		
9	Sustainability related supply chain risks: A case of multiple organizational strategic networks		SEM-PLS; Supply chain risk; Supply chain strategic network	Dechprom, Sasitron; Jermsittiparsert, Kittisak	2019	Thailand	-	explain the relationship between supply chain management, supply chain risk, supply chain risk management and supply chain strategic	SEM-PLS as a statistical tool	Applied/Conceptual	-	literature review SCRM		
10	Evaluation of sustainable supply chain risk management using an integrated fuzzy TOPSIS-CRITIC approach	sim	Critic; Fuzzy sets; Supply chain risk management; Sustainability; TOPSIS	Rostamzadeh, Reza; Ghorabaee, Mehdi Keshavarz; Govindan, Kannan; Esmaeili, Ahmad; Nobar, Hossein Bodaghi Khajeh	2018	Iran	Environmental risks, Organizational risks, Sustainable supply risks, Sustainable production/manufacturer risks, Sustainable recycling risks, Information technology-	This study aims to develop a framework for the sustainable supply chain risk management (SSCRM) evaluation.	To this end, an integrated fuzzy multi-criteria decision-making (MCDM) approach is pro- posed based on the technique in order of preference by similarity to ideal solution (TOPSIS) and criteria importance through inter-	Applied/Conceptual	Framework of SCRM	Summary of risks variables	Framework SSCRM	
11	Method and approach mapping of fair and balanced risk and value-added distribution in supply chains: A review and future agenda	sim	Fair risk and value-added distribution; Revenue sharing; Risk management; Risk sharing; Supply chain collaboration	Asrol, Muhammad; Marimin; Machfud; Yani, Mohamad	2018	Indonesia	price and demand risk, investment risk, Stakeholder sensitivity to risks, quality risk and cost risk	to analyze the existing methods and approaches for risk management, value adding, risk and revenue sharing to develop a new framework for balancing risk and value-adding in	reviewed and synthesized 165 scientific articles which were published between 2001 and 2017	Applied/Conceptual	Fair risk and value-adding distribution and balancing framework	Risk management guidelines	Modelo de metodologia	Method and approach for supply chain risk management

12	Revealing interfaces of supply chain resilience and sustainability: a simulation study		simulation; supply chain design; supply chain dynamics; supply chain resilience; supply chain risk management	Ivanov, Dmitry	2018	Germany	-	This simulation-based study helps to identify what sustainability factors mitigate the ripple effect in the supply chain and what sustainability factors	statistic	Applied	-	
13	Sustainable supply chains for supply chain sustainability: impact of sustainability efforts on supply chain risk	sim	preventive risk mitigation; reactive risk mitigation; supply chain collaboration; supply chain risk management; sustainability;	Gouda, Sirish Kumar; Saranga, Haritha	2018	India	preventing operations risks, detecting operations risks, responding to operations risks and recovering from operations risks	impact of sustainability practices on supply chain risk	using primary data from six manufacturing sectors and 21 different countries including developed as well as emerging markets across the globe	Applied	-	literature review SCRM
14	View of IJPR contributions to knowledge management in supply chains		business analytics; business information system; knowledge management; networks; supply chain collaboration	David L. Olson	2018	USA	-	view of four perspectives of IJPR papers related to knowledge management, focusing on the specific perspectives related to information systems, computer software and analytics support of supply	IJPR publications since 2006 that used these key terms are included in a primitive network analysis of these papers. A dichotomy of knowledge management into information systems versus quantitative analysis is detected, with some minimal overlap.	Conceptual	-	
15	An information system for assessing the likelihood of child labor in supplier locations leveraging Bayesian networks and text mining		Bayesian network risk model; Child labor; Social sustainability; Supply chain risk management; Text mining	Thöni, Andreas; Taudes, Alfred; Tjoa, A. Min	2018	Austria	risk child labor, financial risks, information risks	an expert system to monitor social sustainability compliance in supply chains. The system allows to continuously rank suppliers based on their risk of breaching sustainability standards on child labor.	Publicly available statistics on the frequency of child labor in differ- ent regions and industries are used as contextual prior. The	Applied		
16	Case study analysis of sustainable supply chain redesign linking with new product development	sim	Boeing; Manufacturing; New product development (NPD); Supply chain management (SCM); Supply chain risk management; Sustainable supply chain	Ganji, Elmira Naghi; Shah, Satya; Coutroubis, Alec	2017	UK	technological, organizational and marketing risks	This research seeks to investigate the new product development (NPD) approaches and the supply chain redesign strategies as part of the sustainable development.	A systematic approach of literature review will be undertaken in order for effective gathering a set of structured data to act as a basis for the further discussions. The case of Boeing Dreamliner provides with a qualitative research method in order for critical analysis of the main concepts of the research.	Conceptual	Identified framework linking NPD and supply chain	Sustainable supply chain management (SSCM)

17	Managing risks in the Indonesian seaweed supply chain	sim	MCDA; Marine biomass resources; Mitigation strategies; Seaweed supply chain risks; Supply chain risk management	Mulyati, Heti; Geldermann, Jutta	2017	Indonesia	process, control, supply, demand, policy, finance, infrastructure, social, environment risks	To identify seaweed supply chains, we conducted field research, in-depth interviews, and literature studies.	To identify and categorize the risks, we started with the risks mentioned in the existing literature works, and then applied the Delphi method to analyze the potential risk sources, their causes, and their impacts. To	Applied/Conceptual	Four critical steps in SCRM	Five level of collaborations and their characteristics
18	Mitigating supply chain risk via sustainability using big data analytics: Evidence from the manufacturing supply chain	não	Big data; Case study; Social issues; Social risk; Supply chain social sustainability; Sustainability	Mani, Venkatesh; Delgado, Catarina; Hazen, Benjamin T.; Patel, Purvishkumar	2017		social and environmental risks	importance to the sustainable enterprise. The aim of this research is to explore the application of big data analytics in mitigating supply chain social risk and to demonstrate how such mitigation can help in achieving environmental, economic, and social	The method involves an expert panel and survey identifying and validating social issues in the supply chain. A case study was used to illustrate the application of big data analytics in identifying and mitigating social issues in the supply chain.	Applied	-	
19	Delivering Crossrail, UK: A holistic approach to sustainability	sim	corporate responsibility; management; sustainability	De Silva, Michael; Paris, Robert	2015	UK	supplier diversity plan, equality and diversity strategic plan, strategic labour needs and training plan	The strategy adopts a holistic approach, taking a balanced view on environmental, social and economic performance.	The paper starts by providing a brief description of the scope of the project then describes how sustainability has been built into the delivery of the project, the governance structure and how performance is measured.	Conceptual	Supplier performance framework scores	Crossrail's sustainability themes and key sustainability initiatives as defined in its strategy
20	Enterprise risk management and case study: Supply chain management of PT. Kakada Pratama	não	Analytic network process; Enterprise risk management; PT. Kakada Pratama; Supply chain management	Soebandrija, Khristian Edi Nugroho; Hendryvan	2015	Indonesia	Downstream, Upstream and Operational Risks	28 risks resulted from brainstorming results and interviews with PT. KP, and at the risk of supply chain level PT. KP has a total of 14 low-risk categories, 15 moderate-risk categories, and zero high-risk categories	SuperDecision Software, through Analytic Network Process (ANP) that	Applied	-	
21	Quantitative models for managing supply chain risks: A review	não	Bibliometrics and network analysis; Quantitative Model; Review; Supply Chain Risk; Uncertainty	Fahimnia, Behnam; Tang, Christopher S.; Davarzani, Hoda; Sarkis, Joseph	2015	USA	Upstream supply chain risks, Downstream supply chain risks, Uncertainty modeling in supply chain network design and facility location, Uncertainty modeling in tactical/operational supply chain planning, Supply and demand forecasting analysis, Uncertainty modeling in inventory management and process control, Sustainability risks, Uncertainty in purchasing and retail sourcing	This paper presents a systematic review of the quantitative and analytical models (i.e. mathematical, optimization and simulation modeling efforts) for managing supply chain risks	bibliometric and network analysis tools to generate insights that have not been captured in the previous reviews on the topic. Inparticular, wecomplete a systemic mapping of the literature that identifies the key research clusters/topics, interrelationships, and generative research areas that have provided the field with the foundational knowledge, concepts, theories, tools	Conceptual	-	

22	Social and environmental risk management in supply chains: a survey in the clothing industry	sim	Clothing industry; Environmental and social issues; Risk management; Structural equation modelling; Supply chain management;	Freise, Matthias; Seuring, Stefan	2015	Germany	Management of environmental risk, Management of social risk	This study aims at analysing both why companies in the clothing industry are performing management of social and environmental risks in their supply chain and what kind of action they are taking	Based on the literature on sustainable supply chain management and supply chain risk management as well as 10 expert interviews, a conceptual model for risk man- agement in sustainable supply chains was developed	Applied/Conceptual	Model of environmental and social risk-related drivers and measures Risk	
23	Digging deeper into supply risk: A systematic literature review on price risks		Consumption factors; Price risks; Procurement; Purchasing; Supply chain risk management; Supply risk management	Fischl, Maria; Scherrer-Rathje, Maike; Friedli, Thomas	2014	Switzerland	price risks	provide an overview of existing knowledge pertaining to the management of price risks in manufacturing companies from an operations management (OM) perspective and to establish an agenda for future research	A systematic literature review was conducted following the literature search approach of vom Brocke et al. (2009). In total, 138 relevant articles were identified, analysed and synthesised	Conceptual	Concept map regarding price risks on the supply side of manufacturing companies Supply Chain/Value Chain	
24	Impact of supply chain management practices on sustainability	sim	Case study; Green; Lean; Resilient; Supply chain; Sustainability	Govindan, Kannan; Azevedo, Susana G.; Carvalho, Helena; Cruz-Machado, V.	2014	Portugal	environmental risk	investigate the impact of lean, resilient and green supply chain management practices on supply chain sustainability	A conceptual model to assess the impact of lean, resilient and green practices on supply chain sustainability was derived from the data analysis	Applied/Conceptual	Model for the impact of lean, resilient and green SCM practices on SC sustainability.	
25	Strengthening supply chain risk management for business continuity: A case study approach	não	Business continuity; Case studies; Electronics industry; Enterprise development; Malaysia; SCRM; Supply chain risk management	Mohd Rashid, Ainul Haniza; Loke, Siew Phaik; Ooi, Keng Boon	2014	Malaysia	eletronic risk, environmental risk	determine the current business scrm practices in Malaysia's electronics industry after the Japan earthquake and tsunami through assessment of robustness, resilience, flexibility and agility of the supply chain	findings of the case studies of buyer-seller (dyadic) relationships conducted on SCRM practices are reported. Three interviews were conducted with senior managers from one of the top Japanese electronics manufacturers as well as its component parts supplier.	Conceptual	-	
26	Sustainability-Related Supply Chain Risks: Conceptualization and Management		Corporate social responsibility; Legitimacy; Stakeholder; Supply chain risk; Sustainability	Hofmann, Hannes; Busse, Christian; Bode, Christoph; Henke, Michael	2014	Germany	sustainability risk	transdisciplinary approach and provide a concise description ofhow sustainability issues in supply chains materialize as risks for	Building on this mechanism and drawing on stakeholder theory, we develop a conceptual- ization of sustainability risks which lays the basis for future investigations in this	Conceptual	Sustainability-Related Supply Chain Risks	
27	Towards a new framework for sustainable supply chain management	não	Global Supply Chains; Green Supply Chain Practices; Risk Mitigating Strategies; Supply Chain Risk Management; Sustainable Supply Chain Management	Mandal, Santanu	2013	India	sustainability risk	allied literature by conceptually arguing that it to arrive at sustainability in supply chain operations, firms must co-integrate their supply chain risk management and green practices in supply	Based on sufficient theoretical tenets from related literature, the study attempts to develop a theoretical model linking supply chain risk management, green supply chain practices and sustainable supply chain	Conceptual	Theoretical model integrating SCRM, GSC practices and SSCM	A chronological list of various classifications of supply chain risks Authors(Year)