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Social Key Performance Indicator into Sustainable Supply Chains: a review

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Abstract – The incorporation of social Key Performance Indicators (KPIs) into sustainable supply chain management (SSCM) is a growing yet underexplored area of research. Social KPIs, which address critical aspects such as worker welfare, equity, and social responsibility, play a pivotal role in achieving the triple bottom line of sustainability. Despite the increasing volume of primary and secondary studies on SSCM, the social dimension remains underrepresented compared to environmental and economic factors. This study conducts a Systematic Literature Review (SLR) to analyze the integration of social KPIs into sustainable supply chains, focusing on their measurement, implementation, and alignment with broader sustainability objectives. The review follows a systematic approach using Scopus, applying specific keywords and inclusion criteria to identify peer-reviewed papers published between 2018 and the present. Articles were analyzed for the identification of research clusters and trends. The analysis highlights a growing emphasis on social KPIs but underscores the need for standardized frameworks and innovative solutions to address challenges such as data complexity and trade-offs between sustainability dimensions.

Keywords – Social Key Performance Indicators (KPIs), Sustainable Supply Chain Management, Triple Bottom Line, Social Sustainability

1 INTRODUCTION

Global market competition has expanded dramatically during the previous few decades. Market demands have increased considerably in terms of the quality and reaction time required by consumers. The modern business context is defined by rising globalization, which causes firms to face increased competitiveness, cost pressures, and complexity (Hutchins & Sutherland, 2008). Supply Chain Management (SCM) strategies have emerged as a critical component for bridging this gap. On the one hand, firms are constantly compelled to gain a competitive edge, with the ultimate objective of creating greater value for not only shareholders but all stakeholders. However, the growing importance of sustainability in business operations and the ongoing disagreement over the most effective approach have led to a strong commitment by the scientific community to study these topics (Seuring & Müller, 2008).

Key performance indicators (KPIs) are critical for assessing and improving SCM. Simões (2014) suggests that while economic parts are well established, social and environmental concerns

require additional development. The lack of established frameworks and widely acknowledged measures for social and environmental sustainability hinders efforts to conduct a comprehensive evaluation. Despite growing recognition of the relevance of these aspects, there are still gaps in how organizations include social equality, community impact, and environmental stewardship into their supply chain evaluations. The lack of a comprehensive framework for analyzing social sustainability in supply chains necessitates including stakeholder factors into decision-making processes (Simões, 2014).

This study is motivated by the growing emphasis on sustainability in supply chains, particularly the incorporation of social KPIs. The objective is to provide an inclusive analysis of the available literature through a scoping literature review (SLR) that synthesizes existing research on social KPIs in the context of sustainable supply chains. By identifying and analyzing primary and secondary studies, this review aims to uncover gaps, highlight trends, and provide a comprehensive understanding of the role social KPIs play in achieving

sustainability goals. This study contributes to the literature by offering a cohesive synthesis of existing works and outlining an analytical framework to guide future research. Other studies focused more on sustainability in supply chains, identifying key mechanisms and configurations to improve outcomes (Koberg & Longoni, 2019). Additionally, some studies demonstrated how Industry 4.0 technologies can enhance sustainable logistics, providing insights for businesses while acknowledging limitations in scope and the need for further research (Sun et al., 2022). The remainder of the article is organized as follows. Section 2 presents key concepts about supply chain and sustainability. The methodology and the results obtained are reported in Section 3. Section 4 summarizes and analyses the results. Finally, the main conclusions and for future research are presented in Section 5.

2 KEY CONCEPTS

2.1 *Supply chain management*

The SCM has undergone significant transformation since its inception, evolving from an operational, process-oriented focus to a more strategic and integrative approach. Contemporary definitions highlight this shift, such as the one provided by (Mentzer et al., 2001), which describes SCM as the systematic and strategic alignment of traditional business functions and their associated tactics, both within individual organizations and across the broader supply chain network, with the ultimate goal of enhancing the long-term performance of both individual entities and the entire supply chain.

SCM encompasses the comprehensive oversight of the flow of goods and services, spanning all processes from sourcing raw materials to delivering the final product to customers (Bagaria, 2021). It integrates upstream and downstream activities to maximize operational efficiency and customer value (Kleab, 2017), covering diverse functions such as production planning, inventory management, and logistics. This evolution reflects the growing complexity and strategic importance of SCM in creating value across interconnected networks.

2.2 *Performance measurement in sustainable supply chains*

Sustainable supply chain management (SSCM) has become crucial for businesses, offering competitive advantages and ensuring corporate survival (Jianxin Xu & Hecheng Wang, 2008). The concept of the “triple bottom line” refers to a holistic framework for sustainability that emphasizes the integration of economic, environmental, and social dimensions in

organizational performance (Elkington, 1997). This paradigm underpins much of the contemporary discourse on sustainability metrics and provides a normative foundation for evaluating supply chain impacts across multiple stakeholder dimensions. SSCM involves considering environmental and social impacts throughout the supply chain (Arora & Walia, 2015). Performance measurement in sustainable supply chains gained significant attention in recent years as organizations strive to align their operations with sustainability objectives. The integration of performance measurement (PM) systems is crucial for enabling collaboration, transparency, and supplier evaluation, core elements of sustainable SCM (Beske-Janssen et al., 2015). Beyond compliance and risk management, PM systems drive innovation in Supply Chains, helping organizations reduce costs, improve efficiency, and strengthen competitive advantages (Schaltegger & Burritt, 2014). Additionally, PM enables organizations to identify opportunities and manage trade-offs across economic, environmental, and social dimensions, while supporting sustainability reporting and the implementation of strategic goals (Kruger et al., 2022). Also, the companies implement new technologies to support the PM and the decision-making process to improve the performance. The study by Berrah et al. (2024) evaluate the ethical impact of artificial intelligence in industrial systems and the interaction with humans’ expertise in the decision-making process.

Despite progress, performance measurement in sustainable supply chains is a key factor to improve the sustainability of supply chains. Challenges such as the complexity of multi-stakeholder considerations and the lack of unified standards persist (Tajbakhsh & Hassini, 2015). Additionally, recent research has increasingly focused on integrating sustainability dimensions into supply chain operations and decision-making processes. The next section presents the methodology and papers collection and selection.

3 SCOPING LITERATURE REVIEW

In this section we present the study conducted, and report the results obtained.

3.1 *Methodology*

This study is categorized as a Systematic Literature Review (SLR) (Correia et al., 2017), which seeks to find all pertinent literature on the topic rather than being guided by a specific research question as is the case with a systematic review (Peters et al., 2015). Giving a general overview of the subject, emphasizing important discoveries, and pointing out

research gaps in the body of current knowledge are the goals (Arksey & O'Malley, 2005).

This SLR aims to discover and assess peer-reviewed publications that provide evidence for the integration of social KPI into sustainable supply chains. The research topics that guide this evaluation are intended to investigate definitions, frameworks, and issues related with adding social KPIs into supply chains while remaining aligned with sustainability objectives.

- How have social KPIs been defined and measured in supply chains?
- How do social KPIs align or conflict with environmental and economic KPIs in achieving sustainability goals?

3.2 Material collection

Scopus was the scientific database used in the searches. For that database, a collection of keywords was created and organized into three subject areas, as indicated in Table 1. To provide context for the search, Group A includes keywords related to supply chains and logistics. Group B focuses on terms associated with performance measurement methods. Group C incorporates keywords related to social KPIs, while Group D covers sustainability and its three pillars.

While the Boolean operator AND was used to link the groups together and determine the relationships between the themes, the Boolean operator OR was used to combine the keywords within each group to create the final keyword list for the search.

Group	Keywords
Group A: Supply Chain	"supply chain", "smart supply chains", "supply chain management", "logistic"
Group B: Performance Measurement	"key performance indicator*", "metric*", "performance evaluation", "sustainability performance indicators"
Group C: Social Dimension	"social", "social performance measure", "worker welfare", "social equity"
Group D: Sustainability	"sustainability", "sustainable development", "environmental, social, and governance (ESG)", "triple bottom line"

Table 1: Search terms

The search included only articles written in English and focused exclusively on peer-reviewed journal publications to ensure high-quality and reliable sources. The scope was restricted to articles published between 2018 and the present, ensuring that the findings are relevant to contemporary practices and trends. The search was conducted in the

title, abstract, and keyword fields to maximize the retrieval of relevant studies while maintaining a targeted approach. Additional search criteria excluded unrelated scientific fields and focused mainly on especially in tangible goods and manufacturing supply chains, sustainability, and social KPIs. These criteria were applied to refine the search and to provide a comprehensive yet relevant collection of articles for the scoping literature review.

3.3 Material selection

The selection process was divided into two stages. In the first stage, titles, abstracts, and keywords were screened, and articles were categorized as included, excluded, or classified as "undefined" based on specific inclusion and exclusion criteria. Table 2 describe the inclusion and exclusion criteria used to identify sources.

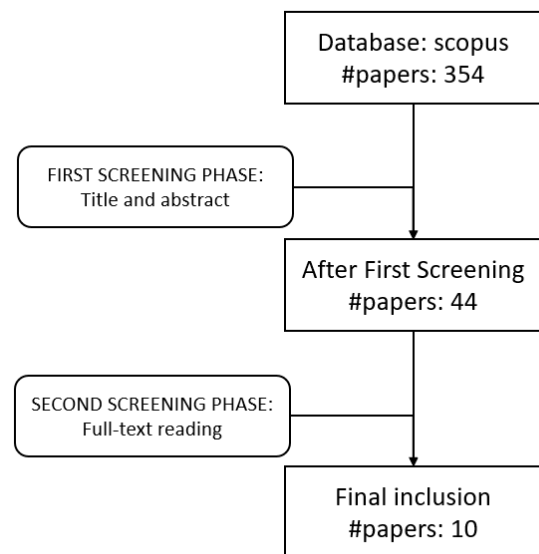


Figure 1: Literature review process

In the second stage, the full text of articles included in the first screening phase was reviewed. Papers were assessed against the criteria for a definitive decision on inclusion. Articles for which the full text was not accessible were excluded from the final selection.

4 RESULTS AND ANALYSIS

Figure 1 depicts the systematic literature review methodology used in this investigation. The initial search in the Scopus database turned up 354 publications. 44 papers were recognized as appropriate for further consideration during the initial screening step, which included an analysis of titles and abstracts. During the second screening step, which included full-text reading, ten publications were selected for inclusion based on the predetermined criteria described in the methodology.

The co-occurrence network analysis of keywords reveals a prominent focus on the concept of "sustainability," which serves as the central node in the research landscape. The network identifies

Kumar et al., 2022; Sangwan et al., 2019). Many frameworks have their main focus on reducing expenses and carbon footprints, but decision-making models partially incorporate social factors like labor

Section	Subsection	Content	Description
A. Search criteria	A.1	Language	English
	A.2	Scientific area(s)	Excluded: Medicine, Health professions, Neuroscience and areas related.
	A.3	Source type(s)	Limited to Journals and Conferences
	A.4	Journal(s)	Only peer-reviewed
	A.5	Article type(s)	Limited to articles
	A.6	Search field(s)	Title, abstract and keywords
	A.7	Date of publication	From 2018 until present
B. Inclusion criteria	B.1	Explicitly define or measure social KPIs	
	B.2	Follows sustainability approach	
	B.3	Subject is one or more supply chain functions	
C. Exclusion criteria	C.1	Editorials or conference proceedings	
	C.2	Tertiary studies or literature review	
	C.3	Examines only one or two sustainability pillars (e.g., environmental and economic) without considering social KPIs.	
	C.4	Not supply chain perspective	
	C.5	Opinion pieces or non-empirical studies without clear methodology	
	C.6	Sustainability is a secondary aspect	

Table 2: Selection criterias

significant interconnections between "sustainability" and related themes such as "supply chain management," "sustainable development," and "social sustainability." These connections underscore the holistic nature of sustainability in supply chain research, encompassing both environmental and social dimensions. Emerging clusters around "resilience," "decision making," and "economic and social effects" highlight the multidimensional challenges addressed in this domain. The findings of the SLR highlight many debate areas. Specifically, by extracting material from the existing literature, this has been compiled into subject parts that enable us to establish research clusters in the area of interest list as follows:

- Clustering social KPIs based on Sustainability Dimensions for Supply Chains
- Integration of social KPIs
- Role of Simulation in Balancing Sustainability KPIs

The next subsections go into further explanation about the debate areas.

4.1 Clustering social KPIs based on Sustainability Dimensions for Supply Chains

Several studies have called attention to the gap where economic and environmental KPIs are amply used, while social KPIs receive less attention or have a less precise implementation (Duque-Urbe et al., 2024;

Allaoui et al., 2018; Babagolzadeh et al., 2020). The literature research reveals that social KPIs are important but underutilized measures. Two primary categories can be used to cluster the social component of supply chains: labor indicators and community development.

The labor indicators consider factors including gender equity, labor rights, employee satisfaction, and worker health and safety. These KPIs have a close connection to the company's or industry's perception. For instance, health and safety standards are frequently evaluated using measures including workplace accident rates, safety procedure implementation, and employee training investments (Duque-Urbe et al., 2024; Sangwan et al., 2019). Another important social KPI is the gender equity that can be evaluated through metrics such as the percentage of women in leadership roles or the implementation of inclusion initiatives that support marginalized groups (Allaoui et al., 2018).

According to (Kumar et al., 2022), improving labor conditions, such as fair compensation and professional development opportunities, boosts employee retention and productivity, hence contributing to economic growth. Similarly, (Babagolzadeh et al., 2020) observed that effective health and safety rules reduce absenteeism and accidents while ensuring operational continuity and efficiency. On the other hand, community development KPI measurement has a more general

and global perspective and focuses on measuring the influence around the supply chain. Organizations and stakeholders may benefit from proactive social sustainability measures that significantly lessen these effects (Babagolzadeh et al., 2020; Zhao et al., 2020). KPIs for community development include investments in infrastructure and the generation of local jobs. Furthermore, the combination of labor and community development indicators has demonstrated tangible effects (Ali et al., 2024). Studies of agro-food supply chains by Allaoui et al., (2018) emphasize the relevance of job creation and fair-trade practices as key social performance indicators.

One of the primary challenges in the implementation of social KPIs is their subjective identity. Unlike economic KPIs, which are commonly represented in monetary terms, or environmental KPIs, which are linked to visible outputs like carbon emissions, social KPIs sometimes rely on proxies or subjective judgments. Metrics such as "worker satisfaction" or "community engagement" are typically generated from stakeholder surveys or expert evaluations, as demonstrated in the research of (Duque-Urbe et al., 2024), (Allaoui et al., 2018) and (Kazancoglu et al., 2024). (Sangwan et al., 2019) emphasize this difficulty, stating that while social indicators are important, they lack the defined standards required for widespread acceptance in industrial applications.

4.2 *Integration of social KPIs*

From a methodological perspective, the reviewed literature suggests diverse approaches to operationalizing KPIs. Kumar et al. (2022) highlight the potential of quantitative frameworks for balancing social, economic, and environmental objectives. In particular, fuzzy Analytic Hierarchy Process (fuzzy-AHP) and Mixed-Integer Linear Programming (MILP) models allow for the incorporation of qualitative social dimensions, such as employee well-being and community impact, into optimization frameworks. However, these approaches rely on assumptions or limited datasets. The case study by Yadav et al., (2021), focusing on food distribution networks in India, further illustrates the challenges of integrating social KPIs such as equitable access and customer satisfaction, which are inherently contextual and difficult to generalize.

Despite these limitations, there are a lot of chances to advance the use of social KPIs in supply chain management related to new technological advances and approaches.

One of the key areas of concern is still how to balance the sustainability dimensions. Some studies had explored the implementation of multi-objective

optimization models to manage the trade-offs between social, environmental, and economic objectives (Babagolzadeh et al., 2020). For example, prioritizing fair compensation and safe working conditions may increase operational costs in the near term but result in long-term benefits such as increased staff retention and brand reputation. Allaoui et al. (2018) demonstrate that investments in community development can promote goodwill and provide shared value, even if they initially conflict with cost-minimization goals.

Also, some frameworks emphasize the significance of adapting social KPIs to the specific characteristics of various businesses and areas. Duque-Urbe et al. (2024) present a structured instrument to evaluate the social implications of hospital supply chain operations in accordance with organizational performance indicators. Similarly, Sangwan et al. (2019) argue for the inclusion of region-specific social indicators, which recognize the contextual diversity of supply chain operations.

4.3 *Role of Simulation in Balancing Sustainability KPIs*

Simulation approaches have emerged as an active approach to sustainability research, providing an accurate technique of investigating trade-offs between different objectives. Models created by Yadav et al. (2021) use multi-objective optimization to balance economic, environmental, and social KPIs. This model demonstrates how to effectively control trade-offs using advanced decision-making methods, including fuzzy logic, MILP, and system dynamics. For example, Kumar et al. (2022)'s fuzzy-AHP paradigm provides dynamic weights to sustainability characteristics, allowing decision-makers to prioritize objectives based on current demands. The flexibility of simulation models makes them particularly suitable for addressing the complexities of supply chains.

Case studies serve a key function in validating theoretical and simulation models. Case studies, as demonstrated by Sangwan et al. (2019), (Javanmardan et al., 2024) and Allaoui et al. (2018), can help discover industry-specific obstacles and possibilities. For example, Sangwan et al. (2019) created a sustainability assessment framework for the cement industry that emphasizes emission management and resource efficiency, reflecting the sector's unique environmental problems. (Javanmardan et al., 2024) demonstrate that balancing costs, emissions, and social responsiveness is possible through dynamic allocation for a sustainable fruit Closed-Loop Supply Chain.

Similarly, Allaoui et al. (2018) employ a case study approach to assess the usefulness of their two-stage

hybrid decision-making model in agro-food supply chains. While simulation models and case studies offer valuable insights into sustainability trade-offs, their effectiveness is limited by context-specific assumptions and the challenge of generalizing findings across diverse supply chain environments. One notable limitation in integrating social KPIs lies in their often qualitative or perceptual nature, which poses challenges for mathematical modeling and optimization. Most multi-criteria decision-making or MILP-based approaches rely on quantifiable inputs. To incorporate qualitative dimensions such as worker well-being or community engagement, methodological adaptations are necessary. Without such adjustments, these models risk oversimplifying complex social dynamics.

5 CONCLUSIONS AND RESEARCH OPPORTUNITIES

This study conducts an analysis in the literature review of social Key Performance Indicators (KPIs) within the context of sustainable supply chain management. This study emphasizes the need for a balanced approach to integrating social KPIs, particularly in addressing trade-offs with economic efficiency and environmental objectives. By categorizing social KPIs into labor indicators and community development metrics, it emphasizes how the supply chain impact must be measured both inside and outside the network. Advanced methodologies such as multi-objective optimization models and simulation present opportunities to quantify, monitor, and manage these trade-offs effectively.

Despite immense advances in sustainability studies, numerous limits remain. First, focusing on simulations and theoretical models limits the generalizability of conclusions. Second, the emphasis on particular industries, such as agri-food and cement, limits the findings' application to other sectors. Expanding the research scope to include a wider range of sectors and supply chain topologies would provide a more complete picture.

The development of standardized measures and approaches for social sustainability should be prioritized in future study. While studies like Sangwan et al. (2019) and Babagolzadeh et al. (2020) incorporate social KPIs, they are frequently eclipsed by economic and environmental KPIs. One emerging concept that holds promise for improving the integration of social sustainability within supply chains is the Physical Internet (PI). PI-based logistics, which envisions an interconnected, open, and standardized freight system, can facilitate the equitable distribution of benefits across supply chain

stakeholders, enhance working conditions, and promote ethical labor practices (Montreuil et al., 2012).

Also, a responsible incorporation of future technologies, such as artificial intelligence, opens up new possibilities for enhancing sustainability. These technologies can improve data collection transparency, and real-time decision-making, addressing some of the shortcomings of present methods. But it also important take in consideration frameworks as ETHICS40 that highlights the risks of over-reliance on AI-driven decision-making, particularly in performance measurement systems (Berrah et al., 2024).

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