Social Sciences & Humanities Open 14 (2026) 103277

Contents lists available at ScienceDirect

Social Sciences & Humanities Open

journal homepage: www.sciencedirect.com/journal/social-sciences-and-humanities-open

Review Article

Sustainability impact assessment in corporate settings following triple bottom line lens: A qualitative systematic review and bibliometric analysis

Gitanjali K. Mehta [a,*], Sudhi Sharma [a,1], Vaibhav Aggarwal [b]

[a] Department of Finance, Fortune Institute of International Business, New Delhi, India
[b] Jindal Global Business School, O.P. Jindal Global University, Sonipat, Haryana, India

ARTICLE INFO

Keywords:
Sustainability impact assessment
Triple bottom line
Multi-criteria decision-making
Corporate sustainability
Sustainability indicators

ABSTRACT

Corporate Sustainability Impact Assessment (SIA) has gained prominence as firms face increasing pressure to demonstrate measurable environmental, social, and economic impacts beyond disclosure. However, corporate SIA research remains fragmented, methodologically heterogeneous, and difficult to operationalise. This study systematically reviews methodological developments in corporate SIA through a Triple Bottom Line (TBL) lens, integrating bibliometric analysis with a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-based qualitative systematic literature review. Using the Theory–Context–Characteristics–Methodology (TCCM) framework, the study analyses 303 articles for bibliometric mapping and 67 peer-reviewed studies (2015–2025) for in-depth synthesis. Findings reveal a strong methodological dominance of multi-criteria decision-making approaches (≈55% of studies), a pronounced focus on supply-chain contexts, and growing thematic convergence between SIA and sustainability disclosure frameworks, though methodological integration remains limited. Indicator synthesis shows that stakeholder-prioritised weights are distributed almost evenly across the three TBL pillars, with a slight economic emphasis; the most heavily weighted indicator groups—greenhouse gas emissions/climate change, pollution and waste management; green management and circularity; and operational and process efficiency—each span all three pillars. By consolidating heterogeneous indicator sets and introducing a study-specific normalised weighting approach, this review provides a preliminary integrative reference for simplifying early-stage SIA and enhancing cross-study comparability. The findings support research and practice aimed at strengthening accounting and modelling phases of SIA and linking sustainability implementation to measurable outcomes.

1. Introduction

In today's post-industrial era, accelerating resource depletion and social inequities have intensified scrutiny of corporate sustainability practices, shifting attention from disclosure to demonstrable impact. Sustainability Impact Assessment (SIA) has therefore emerged as a critical mechanism for evaluating how organisational activities generate environmental, social, and economic effects over time. The normative foundation of sustainability was formalised by the World Commission on Environment and Development (1987) and was subsequently operationalised in corporate contexts through Elkington's TBL framework (Elkington, 1998), which emphasises the joint creation of economic prosperity, environmental protection, and social well-being.

The UN 2030 Agenda and the Sustainable Development Goals (SDGs) embed sustainability targets into national and corporate policy frameworks; firms are therefore expected not only to implement sustainability initiatives but to demonstrate measurable, comparable impacts across TBL dimensions. Corporate sustainability (CS) relates to a firm's ability to meet the needs of its immediate and indirect stakeholders, both now and in the future, across economic, environmental, and social dimensions. Prior research demonstrates that embracing CS can generate competitive advantage through operational optimisation, stakeholder engagement, and long-term value creation (Alshukri et al., 2024). In response to climate change and broader environmental pressures, firms are increasingly integrating sustainability into operations, adopting circular business models, and committing to carbon neutrality.

* Corresponding author.
E-mail addresses: gitanjali.mehta-efpm@fiib.edu.in, gitanjalikaurmehta@gmail.com (G.K. Mehta), sudhisharma1983@gmail.com (S. Sharma), vaibhavapj@gmail.com (V. Aggarwal).
[1] Present Address: Amity University, Noida, Uttar Pradesh

https://doi.org/10.1016/j.ssaho.2026.103277
Received 13 August 2025; Received in revised form 13 July 2026; Accepted 15 July 2026
Available online 10 August 2026

However, embedding sustainability within core operations remains challenging due to the persistent sustainability–profitability trade-offs, whereby ecological and social imperatives must be reconciled with financial performance objectives (Pranugrahaning et al., 2021). These challenges are compounded by an increasingly complex and heterogeneous regulatory environment.[2] While evolving norms enhance transparency and accountability, translating sustainability initiatives into measurable and comparable outcomes remains challenging.

As organizations increasingly integrate sustainability into their strategic core, there is an urgent need for a forward-looking framework (Strömmer & Ormiston, 2022) that accounts for their sustainability impacts i.e. net triple bottom-line gains and losses. SIA addresses this need by systematically identifying and modelling the positive and negative environmental, social, and economic effects of organisational activities, spanning direct and indirect or systemic impacts (Gibson, 2006). Despite its conceptual relevance, corporate SIA research remains fragmented across three primary dimensions. First, context-specific sectoral applications limit cross-sector comparability and generalisability. Second, heterogeneous decision-support tools—particularly MCDM techniques—rely on divergent indicator sets and weighting schemes. Third, empirical coverage is geographically uneven, emphasising emerging economies.

These limitations constrain methodological standardisation and persist despite more than six decades of evolution, over which SIA has progressed from isolated, project-level assessment toward integrated, multidimensional frameworks and, most recently, toward nascent alignment with mandatory double-materiality-based disclosure regimes. While integrative frameworks have proliferated — from the Triple Bottom Line through to Life Cycle Sustainability Assessment— formal standardization has remained asymmetric, concentrated on the environmental strand (see Appendix F). Consequently, these methodological gaps and the limited integration of SIA findings and reporting of those sustainability impacts remain significant barriers to cumulative knowledge development and cross-study synthesis (Dendena & Corsi, 2015). A detailed review of this methodological evolution is presented in Appendix F.

1.1. Literature reviews

Existing literature reviews on Sustainability Impact Assessment (SIA) consistently highlight the growing adoption of TBL thinking and the proliferation of indicator-based assessment approaches across sectors. Worth noting that these reviews establish uneven indicator operationalisation across the TBL: environmental metrics (such as emissions, energy use, and resource efficiency) and traditional economic indicators (such as profit, company turnover, and sales volume) are most standardised and quantified, whereas social dimensions are measured more narrowly or contextually (Ahmad et al., 2023; Bahuriddin et al., 2025; Pranugrahaning et al., 2021).

While these metrics have enhanced measurability and comparability, recent literature highlights their limitations in supporting a holistic, forward-looking decision-making and informing strategic sustainability actions rather than merely documenting outcomes (Cerchione et al., 2025; Strömmer & Ormiston, 2022; Vitale et al., 2025). Moreover, sustainability assessment research remains heavily measurement-centric, with lack of theoretical grounding, systems thinking or long-term outcome-based modelling (Kantabutra, 2024; Kantabutra & Ketprapakorn, 2020). Key priorities include strengthening the accounting and modelling phases, leveraging digital technologies such as artificial intelligence and blockchain to manage complex datasets, standardising heterogeneous protocols, and aligning assessment systems with mandatory disclosure regimes and stakeholder expectations (Cerchione et al., 2025; Vitale et al., 2025). Finally, extensive methodological and contextual diversity—spanning sectors, geographies, and analytical techniques—continues to hinder cross-study comparability and cumulative knowledge building. Together, these gaps justify a systematic and transparent approach to synthesising the SIA literature.

Despite a growing body of review literature, critical methodological gaps persist. Foremost among these is the absence of a cross-study comparability framework: the prevalence of MCDM-based studies employing heterogeneous weighting schemes precludes the generalisation of stakeholder priorities across contexts, leaving indicator selection without a unified empirical foundation. Furthermore, prior reviews have typically presented bibliometric analyses and qualitative systematic literature reviews (SLRs) in isolation, foregoing the complementary hybrid approach that would offer practitioners a coherent, evidence-grounded reference for SIA design. Finally, insights on theory, context, characteristics, and methodology are often catalogued descriptively rather than interpretively connected, obscuring where evidence is well established and where opportunities for further inquiry and theoretical development remain.

In direct response to these gaps, the present study contributes to the corporate sustainability impact assessment discourse in three ways. First, it provides a preliminary yet comprehensive consolidation of corporate SIA research using the TBL and TCCM frameworks, supported by Bibliometrix science mapping (Aria & Cuccurullo, 2017) and PRISMA 2020-based SLR (Page et al., 2021) to enhance reproducibility and methodological rigor. Second, it addresses pressing regulatory and practical challenges—such as the growing emphasis on impact materiality, the SDG financing gap, and sustainability implementation bottlenecks—by offering evidence-based insights that support more systematic planning and control of corporate sustainability performance. Finally, the review advances the methodological understanding by simplifying the early stages of the SIA process through the Study-Specific Normalised Weight (SSNW) approach, enabling robust cross-study comparability of heterogeneous indicator weighting schemes prevalent in MCDM-based SIA research, thereby shifting the focus towards accounting and modelling of sustainability impact.

This review is guided by the TBL and the TCCM frameworks. TBL provides the dominant taxonomy for categorising corporate sustainability indicators, enabling systematic indicator extraction and comparison. As TBL primarily captures short-term sustainability outputs, the search also included outcome-oriented terms (sustainability performance outcomes and sustainable well-being). Lastly, TCCM is employed as the synthesis framework as it structures findings across theoretical foundations, contextual settings, indicator characteristics, and methodologies.

2. Methodology

This study adopts a hybrid review design integrating bibliometric analysis with a qualitative SLR, following PRISMA 2020 framework. Bibliometric analysis was employed to map the intellectual structure, thematic evolution, and methodological clustering of the field at a macro level, while the SLR facilitated in-depth qualitative synthesis and indicator-level extraction from a rigorously screened subset of influential studies. Together, this approach enables breadth and depth (Zupic & Čater, 2015).

This study addresses the following research questions.

RQ1: What are the dominant and emerging research themes prevalent within the TBL-focused Corporate SIA literature?

[2] The regulatory norms vary across economies: SEBI mandates top 1000 listed companies (by market capitalisation) to report on their sustainability performance, California law requires companies with over US$ 1 billion in annual revenue to publicly disclose their annual greenhouse gas (GHG) Scope 1, 2 and 3 emissions and the EU CSRD requires 50,000 EU firms to disclose their climate and environmental impacts.

RQ2: What theoretical foundations, contextual settings, indicator characteristics, and methodological approaches shape the TBL-focused Corporate SIA literature?
RQ3: Which TBL-based performance indicators are prioritised by stakeholders in corporate SIA studies?

2.1. Data sources

This hybrid review draws exclusively on previously published, peer reviewed literature. We considered original primary research on SIA due to their academic rigor and originality. The retrieved records were initially reviewed using source-type classifications in the bibliographic metadata, and early-access articles were manually excluded before PRISMA screening to ensure a stable, reproducible corpus, as such records had not yet been assigned to a final journal issue and might lack complete bibliographic metadata.

Scopus, Web of Science, Dimensions and Google Scholar were searched (per Fig. 1). Scopus and Web of Science offer curated coverage, Dimensions social sciences breadth, and Google Scholar additional unique citations (Singh et al., 2021), retrieved via Publish or Perish (Harzing, 2007) and harmonised through OpenAlex within the R Studio environment. Further details are outlined in Appendix D.

2.2. Search strategy

A multi-tiered search-string approach was used to identify relevant literature (Appendix D). The search was conducted on November 5th, 2025, using database-specific search strings (Table 8) adapted to each platform's indexing and search functionality. Minor cross-database retrieval variations were unavoidable.

The search yielded n = 695 records across the four databases; after consolidation, duplicates were removed prior to screening (Fig. 1).

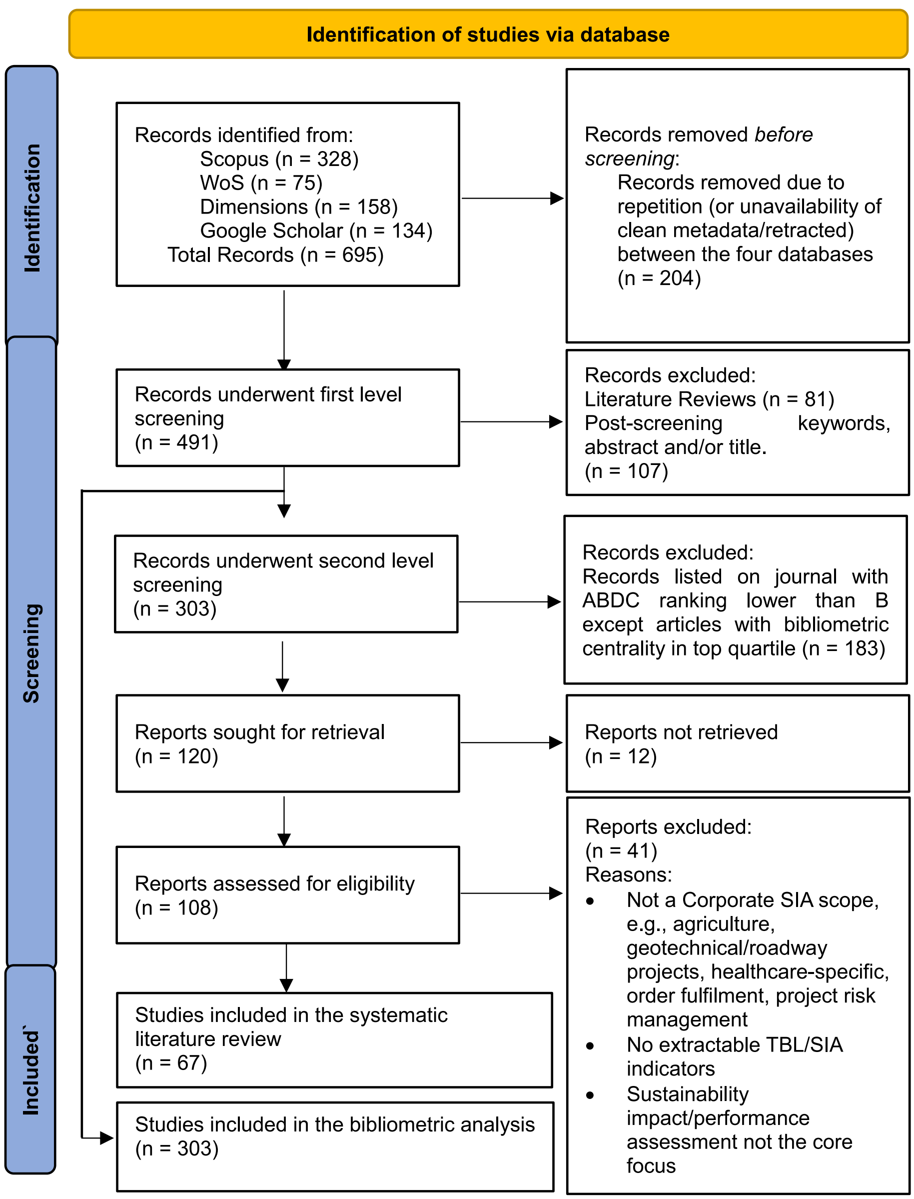

Fig. 1. Reporting items for systematic literature review (adapted from PRISMA[2] flow diagram for systematic review – 2020).
[2] Kindly reference Appendix D for further details on the exact Bibliometric Metadata retrieval and de-duplication.
Source: Author's own elaboration

2.3. Selection criteria and screening process

The selection process followed a multi-stage screening procedure consistent with PRISMA guidelines. Following deduplication, 491 unique records remained for eligibility assessment. Studies published between 2015 and 2025 were considered to capture the post-SDG era (Agenda 2030), a decade of heightened scholarly and practitioner attention to sustainability research (Pranugrahaning et al., 2021).

Review articles (n = 81) were excluded, as the scope covers primary empirical and conceptual studies. Titles and abstracts were then screened for long-term business/corporate relevance, excluding studies focused on short-term projects, cities, or events (n = 107). This process resulted in a corpus of 303 studies for bibliometric analysis.

A second-stage quality screening identified a focused subset combining journal quality and bibliometric influence. Accordingly, studies were retained if they were published in top ABDC-ranked journals (B or above), consistent with prior systematic reviews employing journal-ranking for quality assurance (Kumar & Ahuja, 2025; Munjal et al., 2025; Prabhu & Srivastava, 2023). To avoid excluding intellectually influential contributions solely on the basis of publication outlet, studies in the top quartile of PageRank centrality in the document co-citation network were also retained. This complemented outlet-based quality assessment with an indicator of scholarly influence. This ranking served exclusively as a study selection criterion, whereas the broader bibliometric analysis of the final corpus, including thematic mapping, is presented later in Section 3.1.

This excluded 183 studies; of the 120 sought for retrieval, 12 studies were inaccessible. Full text screening of the remaining 108 studies excluded 41 studies due to misalignment with the Corporate SIA research focus, the absence of extractable TBL-based SIA indicators and SIA not being core focus of the research. The final SLR corpus comprised 67 peer-reviewed studies. This systematic selection ensured relevance and academic rigor (Fig. 1).

2.4. Data extraction

A structured manual extraction of the final corpus was conducted in Microsoft Excel using two complementary extraction forms: a study-level summary form capturing bibliographic and contextual information, and a detailed indicator-level form capturing granular sustainability-related measures. A summary of extracted indicators and its extraction details are provided in Appendix A.

2.5. Indicator harmonisation: study-specific normalised weight (SSNW)

To enable comparison of indicator priorities across studies employing heterogeneous weighting schemes (e.g., fuzzy scales, ordinal ranks, or no explicit weights), this review applies a Study-Specific Normalised Weight (SSNW). SSNW standardises indicator importance within each study before cross-study aggregation, preventing any study from dominating the synthesis through its weighting scale or indicator count. The SSNW is derived in three stages—raw global weight, within-study normalisation, and decomposition into pillar and local shares—with the formal derivation and worked example (Onat et al., 2016) in Appendix A.

2.6. Sensitivity analysis

The harmonised synthesis embeds discretionary modelling choices: the salience threshold, the treatment of TBL pillar weights, and the defuzzification of fuzzy weights. The salience threshold is the minimum global SSNW required for an indicator to be retained in the cross-study synthesis. Indicators below this cut-off are treated as low-salience, long-tail entries and excluded prior to final renormalisation. While this improves parsimony but may exclude indicators that are individually minor yet collectively material, therefore, the base case retains all extracted indicators (a 0% salience threshold), while the robustness of the findings under more restrictive assumptions was evaluated through sensitivity analysis.

Consistent with recommendations for composite indicators (Saltelli et al., 2000), rankings were re-estimated under six alternative specifications (Appendix B, Table 4).

2.7. Risk of bias assessment

Given design heterogeneity and the review's exploratory objectives, a formal risk-of-bias assessment using standardised tools (e.g., ROBINS-I) was not undertaken. Quality was instead addressed through an additional screening based on predefined quality criteria (Section 2.3). This limitation is acknowledged, as the review aims to map trends and practices rather than support causal inference or meta-analytic estimation.

2.8. Summarization methods

The bibliometric analysis was conducted on the full corpus from the first stage (n = 303) using the Bibliometrix package in R environment, based on bibliographic records consolidated from four bibliographic databases (Web of Science, Scopus, Dimensions, and Google Scholar, retrieved and harmonised via OpenAlex). The analysis examined publication trends, keyword analysis, geographic distribution, and conceptual mapping, complemented by qualitative synthesis of influential studies. Thematic mapping used author keywords (top 250 terms; minimum occurrence three), unstemmed but normalised through manual synonym consolidation and exclusion of generic, geographic, or overly broad terms (full settings, exclusion list, and synonym rules in Appendix G).

A keyword co-occurrence matrix was clustered using the Louvain algorithm; low-frequency communities are displayed but treated as peripheral in the interpretation. The analysis is descriptive and exploratory, hence, does not involve inferential statistics. The PRISMA flow diagram detailing the study selection process is presented in Fig. 1.

3. Findings

The findings presented in this section are derived from a qualitative synthesis and descriptive bibliometric analysis of the reviewed studies. They identify dominant patterns and relative emphases, but do not support causal inference or statistical generalisation.

3.1. Bibliometric analysis

3.1.1. Publication trends

The analysis of publication trends indicates that corporate SIA research gained momentum after 2015, coinciding with the adoption of the SDGs, and stabilised after an initial surge during the COVID-19 period (Fig. 2). This suggests consolidation rather than decline in a maturing research domain responding to regulatory and organisational sustainability pressures.

3.1.2. Keyword analysis and thematic structures

Figs. 3 and 4 show that Multi-Criteria Decision-Making (MCDM), Sustainable Development, and Key Performance Indicators (KPIs) are the most researched topics: corporate SIA research is predominantly method-driven, emphasising MCDM techniques and KPI construction, while outcome-oriented and theory-driven concepts remain comparatively underrepresented. Since 2015, research has shifted from traditional LCA toward sustainability indicators, fuzzy methods, and advanced decision models, with growing focus on sustainable supply chains, the circular economy, the SDGs and, most recently, sustainability indices.

Fig. 5 classifies themes by relevance (centrality) and development

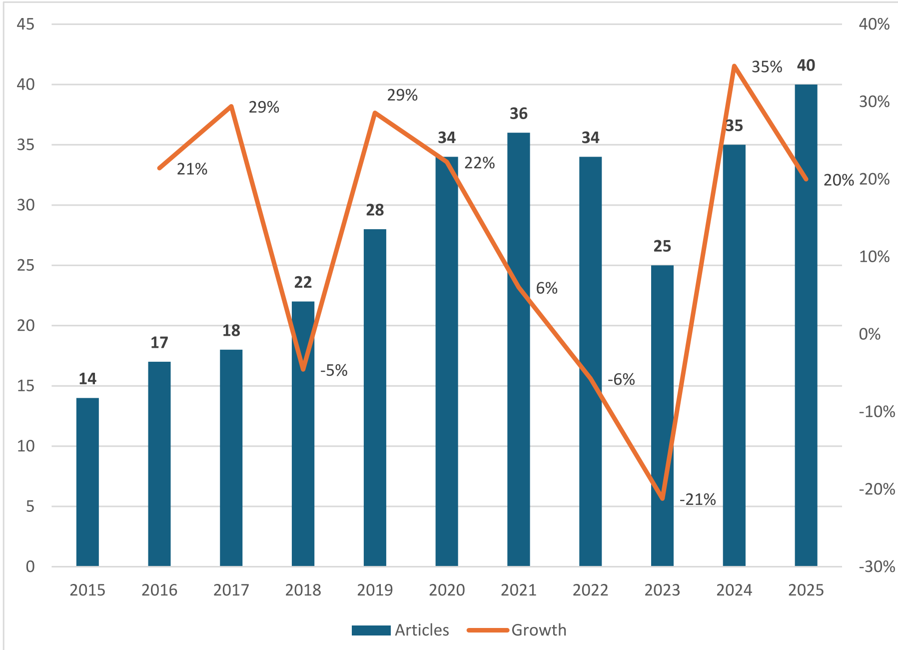

Fig. 2. Distribution of articles by Year of publishing.
Source: Author's own elaboration

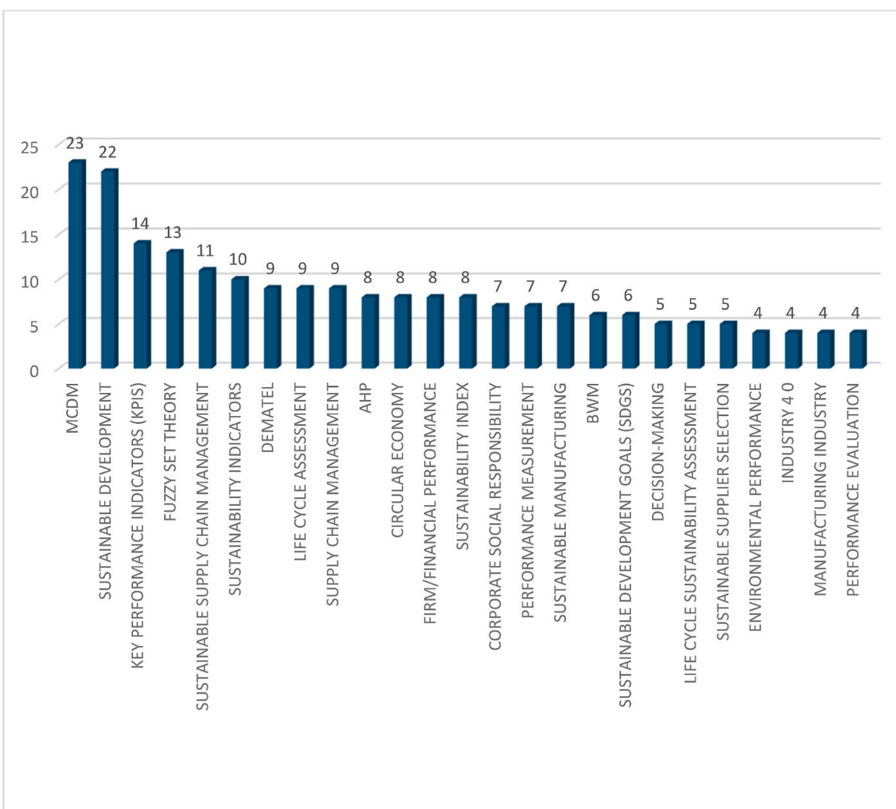

Fig. 3. Frequency of the top repeated author keywords in the BP.
Source: Author's own elaboration

(density) into Basic (high relevance, low development), Motor (high relevance, high development), Niche (high development, low relevance), and Emerging/Declining (low relevance, low development) (Cobo et al., 2011; Johri et al., 2024). Appendix E (Table 9) lists the broad research themes and subthemes relevant to this review. Fig. 5 shows that Firm/Financial Performance (with corporate social responsibility and the SDGs) occupies the motor-theme quadrant, while the KPIs cluster sits at the motor–basic boundary, reflecting the

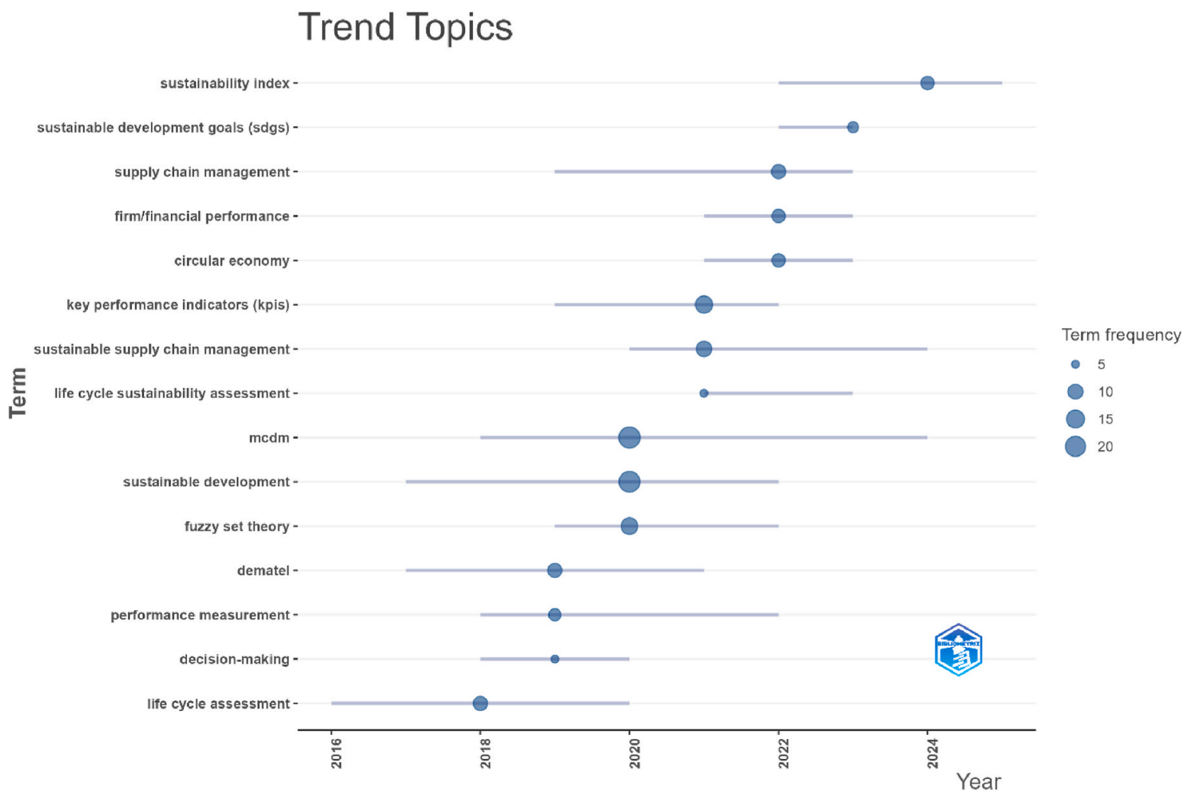

Fig. 4. Trend of the top repeated author keywords in the bibliographic sample.
Source: Author's own elaboration

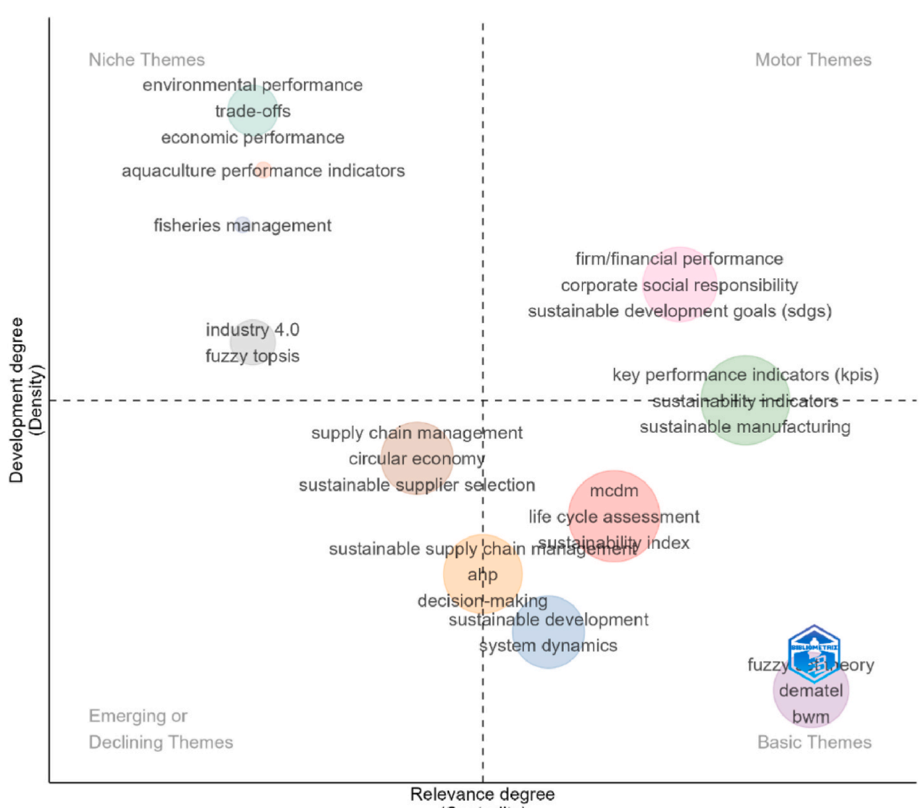

Fig. 5. Thematic map of BP.
Source: Author's own elaboration

prominence of firm level assessment (e.g., Wan et al., 2021). This pattern indicates that sustainability assessment is most strongly institutionalised where it aligns with corporate governance, disclosure, and financial accountability (e.g., Perello-Marin et al., 2022).

The Basic Themes (Fuzzy Set Theory, MCDM, and Sustainable Development,) remain methodologically intensive yet comparatively underdeveloped, operationalising subjective preferences through fuzzy and hybrid decision models (e.g.,Kusi-Sarpong et al., 2016; Tseng et al., 2024). The sustainable supply chain management cluster occupies transitional position between basic and emerging quadrants; while the supply-chain/circular-economy cluster lies within the emerging quadrant indicating growing importance (e.g.,Ecer & Pamucar, 2020; Sarkis & Dhavale, 2015). Lastly, niche themes (environmental and economic performance trade-offs, aquaculture and fisheries, Industry 4.0) stay specialised and weakly connected. Appendix E provides the full theme structure (Table 9) and detailed cluster-level interpretation.

3.2. TCCM framework

This study presents the key results and findings based on Paul and Rosado-Serrano's (2019) TCCM framework which directly addresses this study's RQ 1 and 2 (Fig. 6).

3.2.1. Existing theories

The literature is largely grounded in sustainability and corporate governance, with most studies adopting TBL to integrate the three dimensions (Nicoletti Junior et al., 2022; Yee et al., 2021). TBL is frequently complemented by Stakeholder Theory to address multi-stakeholder considerations in decision-making (Sharma & Kumar, 2024). Green/Sustainable Supply Chain Management is a key application domain, while Multi-Criteria Decision Theory supports sustainability assessments under competing criteria and uncertainty. Notably, most studies employ these frameworks primarily as classificatory or decision-support lenses rather than as explanatory or causal theories, indicating limited theoretical depth and a reliance on methodological rather than conceptual innovation.

3.2.2. Existing contexts

The geographic distribution of the sample studies is strongly skewed towards developing and emerging markets (58% of the studies), plausibly reflecting the implementation urgency associated with the SDG financing gap. At the sectoral level, the analysis reveals substantial heterogeneity, with considerable variation in TBL pillar prioritisation across sectors and contexts. Within the SLR corpus, Infrastructure, Consumer, and Logistics are the most frequently examined sectors (9 studies each). Within the logistics and consumer sectors, findings are mixed, with TBL priorities shaped either by trade-offs between economic and environmental or social dimensions, or by relatively neutral stakeholder treatment of all three pillars (Nicoletti Junior et al., 2022;Gandhi et al., 2022; Roy et al., 2020; Stefaniec et al., 2020). In contrast, studies in the infrastructure sector consistently emphasize the economic dimension over environmental and social considerations (Garcia et al., 2016; Kamali & Hewage, 2017; Ahmadian et al., 2017).

3.2.3. Existing characteristics

Key environmental subthemes—GHG emissions, climate change impacts, pollution, and waste management—are most prominent, as they affect all three TBL pillars by shaping systemic climate, social, and economic risks and opportunities (Garcia et al., 2016; Lombardi Netto et al., 2021; Onat et al., 2016; Stefaniec et al., 2020). Energy consumption and efficiency are commonly measured through total energy use, renewable energy share, eco-efficiency indicators (Garcia et al., 2016; Perello-Marin et al., 2022; Quilloy-Custodio et al., 2025). Green management and circularity are typically assessed through adoption or prioritisation rankings within decision models (Akhtar et al., 2023; Ecer & Pamucar, 2020; Sarkis & Dhavale, 2015). On the economic dimension, profitability and operating costs are evaluated using standard financial metrics (e.g., ROA, ROE, EBITDA) or expert-based assessments (Kannan, 2021; Sithi et al., 2025; Torabizadeh et al., 2020).

3.2.4. Existing methods

Most SIA methods can be grouped into three categories: participatory approaches, multi-criteria decision-making (MCDM), and accounting and modelling techniques (OECD, 2010). Participatory methods—such as expert surveys, Delphi studies, and focus groups—are widely used to elicit stakeholder preferences and build consensus in complex sustainability contexts (Ahmad & Wong, 2019; Strömmer & Ormiston, 2022). MCDM approaches form the methodological core of the literature, enabling the simultaneous evaluation of economic, environmental, and social criteria; recent studies increasingly employ hybrid and advanced models to address uncertainty and trade-offs, though reliance on subjective weighting remains prevalent (Ishizaka et al., 2022; Roy

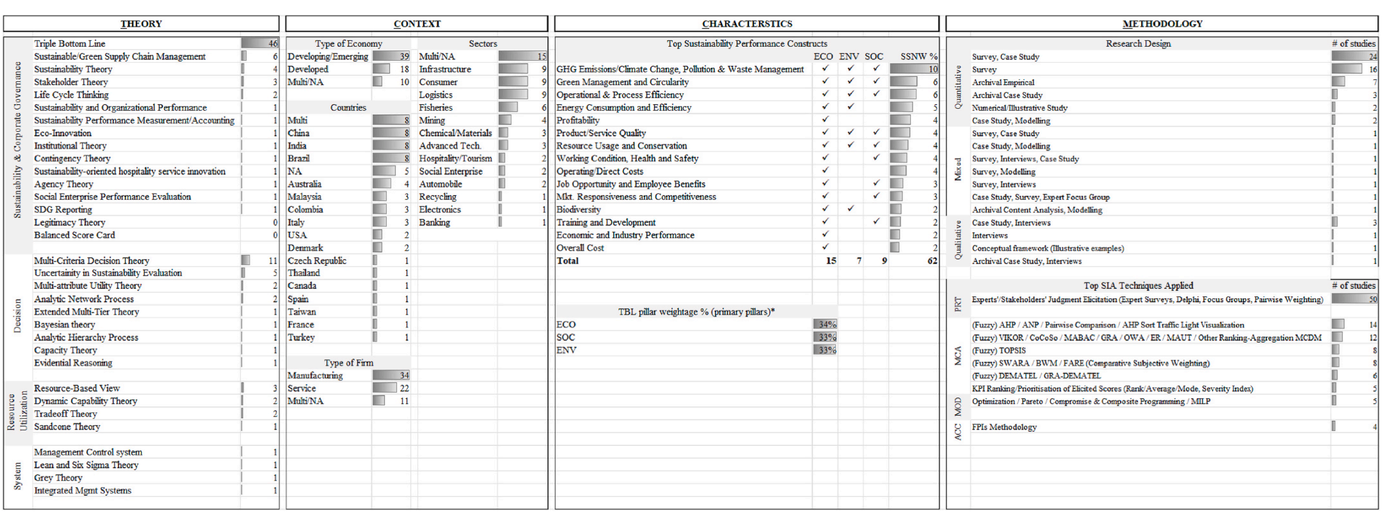

Fig. 6. SIA TCCM Framework outlining components' frequency of occurrence in the SLR corpus
Note: Research Design reflects intersection of data type and research methodology; Top SIA Techniques Applied reflect the top ten technique clusters within SIA applied most in the SLR corpus; *The TBL pillar weight for each pillar incorporates one-third of the weight assigned to the Overall category, reflecting its equal representation of the economic, environmental, and social pillars.
Source: Author's Own Elaboration

et al., 2020; Sharma & Kumar, 2024).

Across the review period, methodological development in MCDM-based SIA was characterised by the consolidation of established techniques alongside the incremental emergence of novel techniques. MCDM, often incorporating fuzzy or Delphi-based weighting, remained the dominant approach (55% of the SLR corpus) throughout 2015-2025. Hybrid frameworks were evident from the outset (Kusi-Sarpong et al., 2016; Ou, 2016), although their composition evolved. Earlier studies combined established methods such as AHP, TOPSIS, VIKOR, and DEMATEL, whereas studies from 2020 increasingly adopted BWM, SWARA, CoCoSo, MABAC, and entropy- or CRITIC-based weighting to better account for criterion interdependencies and reduce expert bias (Ecer & Pamucar, 2020; Kannan, 2021; Roy et al., 2020).[3]

Expert- and stakeholder-judgement elicitation (including Delphi) applied consistently across the review period (75% of SLR corpus) rather than within a distinct methodological phase (Ahmad & Wong, 2019; Ali et al., 2023; Negash et al., 2021; Tseng et al., 2024). Despite advances in weighing, modelling remained predominantly static: most studies relied on cross-sectional expert evaluations (SEM/PLS-SEM) while forward-looking approaches (multi-objective optimisation, probabilistic simulation, Bayesian methods) did not develop into a sustained methodological stream (12% of SLR corpus). Consequently, subjective, point-in-time weighting and limited long-term modelling remain defining characteristics of the literature. These two gaps motivate the contribution of this review: the Study-Specific Normalised Weight (SSNW) approach addresses cross-study comparability of subjectively derived weights across studies, while highlighting the need for more ex-ante, longer-term sustainability-impact modelling.

Accounting and modelling methods complement these approaches by providing systematic quantification and causal insights albeit with limited empirical diffusion (10% of SLR corpus).

The findings within this analysis are based on Qualitative synthesis, hence descriptive in nature. We should not draw causality from this data.

4. Discussion

4.1. Key findings

Extensive research has focused on integrative TBL-based SIA frameworks supporting organisational strategy and operations, including supply-chain and supplier practices (Cui et al., 2023; Kannan, 2021; Kusi-Sarpong et al., 2016; Sarkis & Dhavale, 2015; Wan et al., 2021), warehouse management (Ali et al., 2023; Ishizaka et al., 2022), and raw material sourcing (Yee et al., 2021; Ahmadian Ff et al., 2017). While corporate SIA has expanded considerably since 2015, methodological sophistication—particularly MCDM—has outpaced conceptual integration and outcome-oriented modelling, prioritising decision-support mechanics over explaining how initiatives translate into longer-term organisational and system-level impacts.

Consequently, social KPIs, longitudinal designs, and robust impact outcome modelling remain comparatively underdeveloped. This concentration reflects MCDM's flexibility in handling trade-offs and its limitations: stakeholder-driven weighting schemes are resource-intensive, context-dependent, and difficult to aggregate across studies. Research attention has thus concentrated on the diagnostic phase, with limited progress in the accounting, modelling, and consolidation phases required for impact-oriented decision-making. Recent regulatory developments—mandatory disclosure regimes such as the CSRD and double materiality—intensify the need for SIA approaches that are rigorous, scalable, auditable, and aligned with reporting standards.

To address RQ3, a two-level hierarchical classification schema was applied to the extracted KPIs, which were then categorised into eight groups: Ecological Responsibility (ER), Value/Return (VR), Workplace (WP), Cost/Time (CT), Local Community (LC), Governance and Disclosure (GD), Sustainability Engagement (SE), and Other Miscellaneous (OM) (as per Table 1). Subsequently, similar indicators were classified within one subtheme (for example, various operating costs like equipment, infrastructure, and energy costs are grouped under Direct Costs), and overall ranked based on their cumulative SSNW. At pillar level, aggregate SSNW is near-parity (economic 33.0%, social 32.1%, environmental 31.6%; Appendix B, Table 6).

4.2. Implication for practice and theory

From a practical perspective, the findings provide a consolidated reference set of commonly prioritised TBL indicators that simplifies early-stage SIA and reduces ad hoc indicator selection. For policymakers and regulators, it highlights the need for clearer alignment between SIA methodologies and mandatory reporting frameworks. From a theoretical perspective, the dominance of TBL as a classificatory framework reveals a gap in explanatory and dynamic theorisation. Existing studies rarely connect sustainability indicators to organisational learning, resilience, or long-term value creation, underscoring the need to integrate systems thinking, longitudinal designs, and outcome-based perspectives into future SIA research.

4.3. Limitations and future research

This study acknowledges several limitations that present opportunities for future research. First, the hybrid ABDC/PageRank screening may under-represent emerging, integrative, and practice-oriented SIA research published outside highly ranked outlets. Second, the predominance English-language journals introduce potential linguistic bias. Third, stakeholder weightings from the original MCDM studies may embed selection or procedural biases (e.g., Delphi execution). Finally, sectoral, geographical, and methodological heterogeneity precluded standardized risk-of-bias tools (e.g., ROBINS-I) and limits the inferential use of SSNW percentages, which are therefore descriptive.

Given the modest sample size (n = 67), the findings offer a directional synthesis rather than definitive conclusions.

The six major research gaps identified by this review– (1) limited

Table 1
Consolidated TBL performance themes ranked by cumulative SSNW.

Theme	Cumulative SSNW (%)	Leading construct (global SSNW %)
Ecological Responsibility (ER)	27.2	GHG Emissions/Climate Change, Pollution & Waste Management (8.2)
Value/Return (VR)	16.4	Profitability (3.9)
Cost/Time (CT)	14.9	Operational & Process Efficiency (4.9)
Workplace (WP)	13.8	Working Condition, Health and Safety (3.4)
Governance and Disclosure (GD)	9.8	Environmental Sustainability disclosure (2.8)
Sustainability Engagement (SE)	8.6	Stakeholder Responsiveness (2.9)
Local Community (LC)	8.4	Community Engagement & Responsibility (3.0)
Other Miscellaneous (OM)	0.8	Price/Return Volatility (0.4)
Total	100	

Note. The full two-level substantiation of all themes, with TBL pillar mappings and cumulative SSNW weights, is provided in Appendix A (Table 3).

[3] AHP = Analytic Hierarchy Process; TOPSIS = Technique for Order of Preference by Similarity to Ideal Solution; VIKOR = VIšekriterijumska Kompromisno Optimizacija i Rešenje; DEMATEL = Decision Making Trial and Evaluation Laboratory; BWM = Best-Worst Method; SWARA = Step-wise Weight Assessment Ratio Analysis; CoCoSo = Combined Compromise Solution; MABAC = Multi-Attributive Border Approximation Area Comparison; CRITIC = Criteria Importance Through Intercriteria Correlation.

digitalisation and automation of SIA processes; (2) weak SIA-sustainability reporting integration; (3) no clear taxonomy connecting sustainability performance enablers with performance outcomes (e.g., a climate-mitigation initiative is an enabler that results in GHG emissions reduction outcome); (4) MCDM dominance with lack of outcome-oriented modelling; (5) narrow sectoral coverage beyond manufacturing, and (6) lack of longitudinal designs supporting causal inference — motivate the following research priorities. Gap 1 calls for digitalising corporate SIA, particularly through Industry 4.0 technologies (big data, IoT, blockchain, AI/ML). Emerging technologies (such as Blockchain and IoT) remain underexplored for automating the SIA process (Cerchione et al., 2025; Kannan, 2021); where automation could significantly improve efficiency (Torabizadeh et al., 2020). Gap 2 calls for stronger alignment between SIA and reporting frameworks such as GRI, SDGs and Double Materiality to enhance cross-study comparability and policy relevance (Ferro et al., 2019; Garcia et al., 2016; Perello-Marin et al., 2022; Torabizadeh et al., 2020). Gap 3 calls for a structured taxonomy separating enabler-based measures (practices, capabilities, inputs) from outcome-based measures (realised TBL impacts), examine their interdependencies and trade-offs, and establish sector-specific weighting schemes supported by robust statistical techniques rather than resource-intensive Delphi studies to mitigate stakeholder bias (Abedini et al., 2020 Torabizadeh et al., 2020). Gap 4 calls for moving beyond MCDM research by advancing the accounting and modelling phases of SIA, including expanded application of Life Cycle Sustainability Assessment and the integration of efficiency-oriented approaches such as DEA and application of Artificial Intelligence to advance long term outcome-based modelling. Gaps 5 and 6 call for broader coverage beyond manufacturing—especially service sectors (hence, investigating the social aspect further)—and longitudinal or panel-based designs to strengthen causal inference. As the field matures and becomes more homogeneous, meta-analytic synthesis may become feasible, enabling stronger generalisation of findings.

Synthesising these directions, the corporate SIA research agenda can be organised around three broad trajectories: **Methodological Consolidation** (Gaps 1, 4) requiring standardized indicator libraries, automated weighting tools, and digitally enabled SIA workflows; **Regulatory Alignment** (Gap 2) requiring closer integration of SIA with mandatory reporting frameworks such as UN's SDG, CSRD, GRI, and TNFD/TCFD to support double-materiality disclosure; and **Theoretical Deepening** (Gaps 3,5, and 6) which calls for longitudinal, multi-level designs linking indicator performance to organisational resilience and long-term value creation.

5. Conclusion

This study reviews and consolidates corporate SIA research through a hybrid systematic literature review and bibliometric analysis using the TBL and TCCM framework. SIA addresses a key sustainability-transition bottleneck in practice: implementation within core procedures.

This review consolidates the domain by mapping the most addressed KPIs across TBL pillars. This also creates research avenues for assessing whether sustainability reporting and disclosure practices correlates with indicator choice across varying contexts. The findings are expected to help academia and policymakers simplify the MCDM process, bridge micro-level assessments and macro-level disclosure, and advance the accounting and modelling phases of SIA through digitalisation, data science, and artificial intelligence. The findings of this research are expected to support academia and policymakers in simplifying the MCDM process, bridge micro-level assessments and macro-level disclosures, and advance the accounting and modelling phases of SIA through digitalisation SIA and through application of Data Science and Artificial Intelligence. This review supports corporates in implementing sustainability assessment, investors in selecting sustainability-aligned funding and regulators in overseeing sustainability governance.

Data availability statement

The bibliometric and systematic review data supporting the findings of this study were extracted from the Scopus, Web of Science, Dimensions and Google Scholar databases. The data that support the findings of this study are available on request from the corresponding author.

Ethical statement

Ethical approval is not applicable to this manuscript.

Declaration of the use of AI assisted technologies

The authors declare that no AI assisted technologies were used during any stage in the preparation of this article.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Gitanjali K. Mehta: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Sudhi Sharma:** Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing – review & editing. **Vaibhav Aggarwal:** Funding acquisition, Supervision, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix H. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssaho.2026.103277.

Appendix A

Methodological Basis of the Study-Specific Normalised Weight (SSNW) and the Harmonised TBL Indicator Taxonomy.

A.1 Overview and Purpose

Each study included in the systematic meta-synthesis was coded for publication details, research design, SIA approach, sector, geography, and empirical scope. TBL indicators were then extracted and classified into economic, environmental, and social dimensions, with additional pillar(s) recorded wherever an indicator legitimately spans more than one dimension. Indicators framed holistically by a source are coded "Overall" and mapped to all three pillars, whereas those falling outside the TBL altogether—for example, indicators framed under technology, governance, operational, or financial constructs—were coded "Other"; where analytically warranted, such indicators were additionally assigned to the most appropriate TBL pillar on the basis of informed author judgement. Reported KPI or construct weights were standardised during synthesis irrespective of their original format, whether ranks, factor loadings, fuzzy numbers, or Likert-scale responses; where a source provided no explicit weighting, equal weights were imputed under the protocol described in Section A.2. Data extraction was conducted by one reviewer and cross-validated by co-authors to resolve discrepancies. A qualitative meta-synthesis was then used to identify theoretical, methodological, and contextual patterns.

The indicator weighting adopted in this study is based on the Study-Specific Normalised Weight (SSNW), a quantitative aggregation technique developed to harmonise the diverse weighting schemes encountered across the literature. The SSNW addresses a critical limitation of existing SIA research: the absence of comparability across studies that employ different weighting logics, including fuzzy scales, ordinal rankings, and unweighted indicator sets. By normalising indicator importance within each study before any cross-study aggregation is attempted, it enables a transparent and replicable synthesis of stakeholder priorities across heterogeneous methodological designs.

The full indicator-level extraction procedure—every KPI record with its classification, reported weighting, computed SSNW quantities, and salience decision—is provided in Supplementary Data S1. The reader is referred there for the complete evidentiary base; the present section and Sections A.2–A.3 set out the derivation logic that Supplementary Data S1 instantiates.

A.2 SSNW Derivation

For each TBL indicator in the SLR corpus, the derivation of weights follows the level of information reported in the source study. Where a source reports an indicator's pillar weight (the importance assigned to the indicator's TBL pillar) and its local weight (its importance within that pillar), the indicator's global weight is obtained as the product of the two. Where, instead, a global weight is reported directly, the derivation is reversed: the pillar weight is recovered by summing the global weights of all indicators belonging to each pillar, and the local weight is then derived from the pillar and global weights. Where the local weight is available only as a proxy—such as a ranking or other ordinal format—it is first normalised into the local and pillar SSNW measures, whose product yields the global SSNW. In all cases, normalising these quantities produces the three SSNW measures, which are subsequently aggregated across studies. The complete indicator-level derivation for every study, together with the reported inputs and the resulting SSNW values, is provided in Supplementary Data S1.

A.2.1 Notation and formulae

Let i index a study and j an indicator (KPI) within that study, which contains n_i indicators in total. Each indicator is assigned a primary TBL pillar $p(i,j) \in \{\text{Economic}, \text{Environment}, \text{Social}\}$. An indicator framed holistically is coded "Overall" and mapped to all three pillars, whereas one framed under a non-TBL primary construct (e.g., technology or governance) is recorded separately and does not enter the pillar shares. Denoted by $w_{i,p(i,j)}^{pillar}$ the reported or imputed weight of pillar p in study i for indicator j, and by $w_{i,j}^{local}$ the reported or imputed local weight of indicator j. The indicator's global weight within the study is their product:

$$w_{i,j}^{global} = w_{i,p(i,j)}^{pillar} \times w_{i,j}^{local}$$

This can be illustrated considering the working example of Onat et al. (2016) (Study ID = 60), which contributes $n_i = 16$ indicators distributed across the economic (3), environmental (9), and social (4) pillars under the source's balanced weighting scenario which assigns equal weightage of 0.5 to its environmental and socio-economic indicator groups ($w^{\text{pillar}} = 0.5$). The source reports no explicit indicator-level weights—only this equal-weighting logic between the two groups—so the cascading indicator weights are likewise assigned equally within each group. Accordingly, a pillar weight of 0.5 is recorded for the economic, environmental, and social pillars alike, and the SSNW computation normalises these automatically at the study level; each indicator's local weight is its equal share within the reported group (1/7 for the seven socio-economic indicators, which span the economic and social pillars, and 1/9 for the nine environmental indicators). Taking the economic indicator "Import (foreign purchase)" ($w^{\text{pillar}} = 0.5$, local weight $1/7 \approx 0.143$), its global weight is the product of the two i.e. $0.5 \times 0.143 = 0.071$.

The global SSNW rescales an indicator's global weight relative to the study total, so that the global SSNW values within a study sum to 100%. Similarly,

$$\text{SSNW}_{ij}^{\text{global}} = \frac{w_{i,p(i,j)}^{\text{pillar}} \times w_{i,j}^{\text{local}}}{\sum_k \left(w_{i,p(i,k)}^{\text{pillar}} \times w_{i,k}^{\text{local}} \right)} \times 100$$

where the summation in the denominator runs over all n_i indicators k in study i.

The local SSNW rescales an indicator's local weight relative to the other indicators within a given pillar P(j), summing to 100% within each pillar:

$$\text{SSNW}_{i,j}^{\text{local}} = \frac{w_{i,j}^{\text{local}}}{\sum_{m \in P(j)} w_{i,m}^{\text{local}}} \times 100$$

where the summation in the denominator runs over runs over all indicators m belonging to the same pillar P(j).

Lastly, the pillar SSNW is the study share attributable to a pillar, obtained by summing the global SSNW of the indicators it contains:

$$\text{SSNW}_{i,p}^{\text{pillar}} = \sum_{j \in p} SSNW_{i,j}^{\text{global}}$$

where the summation runs over all indicators j assigned to pillar p in study i. For the economic pillar of.

Summing the global weights across all 16 indicators yields a study denominator of exactly 1.000; the global SSNW of the Import indicator is 0.071/1.000 × 100 = 7.14%. Additionally, its local SSNW within the economic pillar is 0.143/(0.143 + 0.143 + 0.143) × 100 = 33.33%. Aggregating the global SSNW values by pillar yields an economic share of 7.14 + 7.14 + 7.14 = 21.43%, with the social and environmental pillars accounting for 28.57% and 50.00%, respectively. Under the salience convention adopted in this study—a 0% threshold on the global SSNW—every indicator with a non-zero global SSNW is retained, so all sixteen indicators, including the nine environmental indicators at 5.56% each, are included. Table 2 reports the corresponding derivation for all sixteen indicators, with the Import row in bold.

Table 2
SSNW derivation for all indicators of Onat et al. (2016).

KPI	Pillar	w(group)	w(local)	w(global)	SSNW Pillar %	SSNW Local %	SSNW Global %	Salience
Import (foreign purchase)	**Economic**	**0.5**	**0.143**	**0.071**	**21.43**	**33.33**	**7.14**	**Incl**
Gross operating surplus (Business profit)	Economic	0.5	0.143	0.071	21.43	33.33	7.14	Incl
Gross domestic product (GDP)	Economic	0.5	0.143	0.071	21.43	33.33	7.14	Incl
Carbon footprint	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
Water withdrawal	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
Energy consumption	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
Hazardous waste generation	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
Fishery	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
Grazing	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
Forestry	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
Cropland	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
CO2 uptake land	Environment	0.5	0.111	0.056	50.00	11.11	5.56	Incl
Employment	Social	0.5	0.143	0.071	28.57	25.00	7.14	Incl
Income	Social	0.5	0.143	0.071	28.57	25.00	7.14	Incl
Injuries	Social	0.5	0.143	0.071	28.57	25.00	7.14	Incl
Government tax	Social	0.5	0.143	0.071	28.57	25.00	7.14	Incl

Note. w(group) is the source's reported indicator-group weight (environmental vs. socio-economic; 0.5 each in the balanced scenario); w(local) is the within-group weight (1/7 for each socio-economic indicator; 1/9 for each environmental indicator, entered as equal shares); w(global) is their product. SSNW Pillar % (normalised TBL weight), SSNW Local % (normalised within the TBL pillar) and SSNW Global % are the measures defined in Section A.2.1; Salience: retain all KPIs with global SSNW of at least 0%.

Table 3
List of Key Performance Constructs employed in the SLR corpus

Themes > Subtheme(s)	TBL Pillars Impacted			Weightage (%)
	ECO	ENV	SOC	
Ecological Responsibility				**27.19**
ER1: Impact on Natural Environment				**14.95**
ER1.1: GHG Emissions/Climate Change, Pollution & Waste Management	✓	✓	✓	**8.24**
ER1.2: Resource Usage and Conservation	✓	✓	✓	**3.51**
ER1.3: Biodiversity	✓	✓		**1.73**
ER1.4: Land Use and Quality	✓	✓	✓	**1.18**
ER1.5: Human Health Impact		✓	✓	**0.29**
ER2: Green Management and Eco-efficiency				**12.25**
ER2.1: Green Management and Circularity	✓	✓	✓	**6.24**
ER2.2: Energy Consumption and Efficiency	✓	✓	✓	**4.74**
ER2.3: Environmental Performance		✓	✓	**1.15**
ER2.4: Government Incentives	✓			**0.11**
Value/Return				**16.42**
VR1: Profitability and Returns				**7.79**
VR1.1: Profitability	✓			**3.95**
VR1.2: Revenue/Sales	✓			**1.35**
VR1.3: Economic and Industry Performance	✓			**1.23**
VR1.4: Liquidity & Financial Stability	✓			**0.75**
VR1.5: Productivity & Net Worth	✓		✓	**0.52**
VR2: Market				**6.39**
VR2.1: Product/Service Quality	✓	✓	✓	**3.71**
VR2.2: Mkt. Responsiveness and Competitiveness	✓		✓	**2.28**
VR2.3: Product/Service Affordability	✓	✓	✓	**0.33**
VR2.4: Economic Tradeoffs	✓			**0.07**
VR3: Value Creation				**1.37**
VR3.1: Overall Value	✓			**0.47**
VR3.2: Technology & Innovation Capacity	✓		✓	**0.46**
VR3.3: Technology & Innovation Capability	✓			**0.45**
VR4: Corporate Reputation				**0.88**
VR4.1: Reputation and Market Position	✓	✓	✓	**0.88**
Cost/Time				**14.90**
CT1: Operational Efficiency				**5.13**
CT1.1: Operational & Process Efficiency	✓	✓	✓	**4.90**
CT1.2: Inventory Management	✓			**0.23**
CT2: Direct Costs				**3.41**
CT2.1: Operating/Direct Costs	✓			**3.26**
CT2.2: Initial Setup/Construction Cost	✓			**0.15**

(*continued on next page*)

Table 3 (*continued*)

Themes > Subtheme(s)	TBL Pillars Impacted			Weightage (%)
	ECO	ENV	SOC	
CT3: Investment				**2.25**
CT3.1: R&D/Innovation	✓	✓	✓	**1.37**
CT3.2: Investment Costs	✓			**0.51**
CT3.3: Supply Chain Investment	✓		✓	**0.19**
CT3.4: Investment Recovery	✓			**0.17**
CT4: Indirect Costs and ESG Investments				**2.09**
CT4.1: Env. Impact Costs or Fines	✓	✓	✓	**1.21**
CT4.2: Soc. Impact Costs or Fines	✓		✓	**0.44**
CT4.3: Indirect Overhead Costs	✓	✓		**0.43**
CT4.4: Depreciation	✓			**0.02**
CT5: Cost Management				**2.02**
CT5.1: Overall Cost	✓	✓		**1.44**
CT5.2: Cost Conformity & Reduction	✓			**0.52**
CT5.3: Loss & Damage Costs	✓			**0.05**
Workplace				**13.84**
WP1: Employee Welfare				**5.72**
WP1.1: Job Opportunity and Employee Benefits	✓		✓	**2.87**
WP1.2: Employee Motivation and Productivity	✓		✓	**1.27**
WP1.3: Employee Turnover			✓	**0.84**
WP1.4: Employee Relations	✓	✓	✓	**0.47**
WP1.5: Welfare Facilities			✓	**0.11**
WP1.6: Process Automation			✓	**0.11**
WP1.7: Unfair Practices Reduction			✓	**0.04**
WP2: Workplace Environment				**5.39**
WP2.1: Working Condition, Health and Safety	✓	✓	✓	**3.41**
WP2.2: Training and Development	✓		✓	**1.50**
WP2.3: Org. Culture and Work-Life Balance			✓	**0.39**
WP2.4: Eco-linked incentives	✓		✓	**0.09**
WP3: Diversity and Equality				**1.53**
WP3.1: Diversity and Equity			✓	**0.53**
WP3.2: Gender Equality			✓	**0.51**
WP3.3: Inclusion	✓		✓	**0.49**
WP4: Workplace Ethics				**1.20**
WP4.1: Human Rights Practices	✓	✓	✓	**1.07**
WP4.2: Workplace Regulation Awareness			✓	**0.09**
WP4.3: Workplace Ethics Regulation			✓	**0.03**
Governance and Disclosure				**9.83**
GD1: Disclosure & Compliance				**8.33**
GD1.1: Environmental Sustainability	✓	✓		**2.75**
GD1.2: Legal/Regulatory/Ethical Compliance	✓	✓	✓	**2.69**
GD1.3: Overall Sustainability	✓	✓	✓	**1.75**
GD1.4: Social Sustainability			✓	**0.92**
GD1.5: Quality Management	✓	✓	✓	**0.14**
GD1.6: Ethical Compliance			✓	**0.06**
GD1.7: Political Engagement Disclosure			✓	**0.02**
GD2: Transparency and Accountability				**1.50**
GD2.1: Strategic Alignment	✓	✓	✓	**1.04**
GD2.3: Active Top Management			✓	**0.22**
GD2.4: Financial Statement Transparency	✓			**0.10**
GD2.5: Firm Operations	✓	✓	✓	**0.06**
GD2.6: Corporate Tax Disclosure	✓			**0.06**
GD2.7: Board Composition			✓	**0.02**
Sustainability Engagement				**8.56**
SE1: Stakeholder Orientation				**5.76**
SE1.1: Stakeholder Responsiveness	✓	✓	✓	**2.93**
SE1.2: Collaboration Capability	✓	✓	✓	**2.28**
SE1.3: Social Impacts		✓	✓	**0.44**
SE1.4: Competitor Pressure	✓		✓	**0.07**
SE1.5: Stakeholder Rights			✓	**0.04**
SE2: Awareness and Acceptability				**2.80**
SE2.1: Sustainability Training, Knowledge & Capability	✓	✓	✓	**1.42**
SE2.2: Sustainability Motivation		✓	✓	**1.38**
Local Community				**8.42**
LC1: Social Factors				**5.58**
LC1.1: Community Engagement & Responsibility			✓	**3.01**
LC1.2: Health and Safety	✓		✓	**1.52**
LC1.3: Philanthropy/Donation	✓		✓	**0.85**
LC1.4: Cultural Heritage and Identity Preservation			✓	**0.20**
LC2: Economic Factors				**2.84**
LC2.1: Local Economy Contribution	✓	✓	✓	**1.88**
LC2.2: Government Regulation and Support	✓		✓	**0.57**
LC2.3: Local Demand	✓	✓	✓	**0.38**
Other Miscellaneous				**0.83**
OM1: Risk Factors				**0.83**

(*continued on next page*)

Table 3 (*continued*)

Themes > Subtheme(s)	TBL Pillars Impacted			Weightage (%)
	ECO	ENV	SOC	
OM1.1: Price/Return Volatility	✓			**0.37**
OM1.2: Capital Structure	✓			**0.26**
OM1.3: Sustainabiility Risk Management	✓	✓	✓	**0.18**
OM1.4: Supply Chain Risk Factors	✓			**0.02**
Grand Total				**100.00**

Appendix B

Sensitivity Analysis Specifications and Robustness Metrics

The salience threshold applied to the harmonised SSNW computation as reported in the main text rests on modelling choices. Therefore, their robustness is tested along three dimensions, each compared against the base case. First, the salience threshold: the base case retains all indicators with a non-zero global SSNW (0%), and the synthesis is re-run at 2% and 5% thresholds that progressively remove the least salient indicators, to establish whether the leading indicators' prominence is an artefact of the cut-off. Second, pillar weighting: in the base case each study's pillar weights enter as reported (or equally imputed where silent), and an alternative specification weights the three pillars equally across all studies, isolating the contribution of indicator frequency and local weighting from pillar-level emphasis. Third, ranking basis: because the weight-based SSNW is diluted for indicators appearing in KPI-dense studies, an additional specification ranks subthemes by KPI count with no weighting, providing a frequency-based counterpoint. Broad agreement across specifications indicates a robust synthesis; material re-ordering flags indicators whose standing depends on a particular assumption. The specifications are summarised in Table 4.

The specifications under S1a-b, S2 and S4-5 are robustness tests of the SSNW output, whereas S3 substitutes the ranking quantity (KPI count in place of cumulative SSNW) and is interpreted as a convergent-validity check: because the weight-based SSNW is diluted for indicators appearing in KPI-dense studies, the count-based ranking provides a frequency-based counterpoint. A specification was classified as Robust where $\rho \geq 0.90$ and Top-10 overlap $\geq$8/10, Moderately sensitive where $0.80 \leq \rho < 0.90$ or overlap of 6–7/10, and Sensitive otherwise. For the defuzzification dimension, a study is additionally classified Robust where the maximum absolute deviation from the centroid weight is < 0.05 and the within-study rank correlation is ≥ 0.95. These bands are conventional thresholds adopted a priori rather than universal standards as reported in Table 4. In addition, the robustness metrics are reported in Table 5.

Table 4
Specifications for each scenario

Scenario ID	Dimension	Definition	Comparison vs S0
S0	Base case	0% salience; centroid defuzzification; equal-pillar imputation where unreported	Reference
S1a	Salience threshold	Global-SSNW retention cut-off	2% vs 0%
S1b	Salience threshold	Global-SSNW retention cut-off	5% vs 0%
S2	Pillar weighting	Pillar and KPI weights within a study	Equal vs reported/imputed
S3	Ranking basis	Quantity used to order subthemes (triangulation)	KPI count vs cumulative SSNW
S4	Defuzzification	Operator for fuzzy weights (fuzzy study)	Mean-of-Maxima vs centroid
S5	Defuzzification	Operator for fuzzy weights (fuzzy study)	GMIV vs centroid

Note. SSNW = study-specific normalised weight; GMIV = graded mean integration value. S1a–S2 and S4–S5 are robustness tests; S3 is a convergent-validity check.

One study in the final corpus reports fuzzy weights without specifying a defuzzification operator: Roy et al. (2020), a triangular fuzzy AHP application with 18 fuzzy criteria. The base case defuzzifies by centroid; the sensitivity specifications substitute Mean-of-Maxima and GMIV. The maximum absolute deviation in defuzzified weight from the centroid was 0.022 under MoM and 0.011 under GMIV, and the within-study rank correlation against the centroid ordering was 1.00 for both operators, reflecting the near-symmetry of the underlying fuzzy sets. The choice of defuzzification operator is therefore immaterial to the synthesis.

Table 5
Robustness Metrics

Specification	ρ	Top-10	Max rank shift	Verdict
S1a: Salience 2%	0.994	9/10	—	Robust
S1b: Salience 5%	0.955	8/10	0	Robust
S2: Equal pillar & KPI weights	0.981	8/10	2	Robust
S3: Count-based ranking	0.948	8/10	2	Robust
S4: Mean-of-Maxima	0.999	9/10	0	Robust
S5: GMIV	0.999	9/10	0	Robust

Note. ρ = Spearman rank-order correlation of the full subtheme ranking against the base case (S0). Top-10 overlap = number of base-case top-ten subthemes retained in the specification's top ten. Max rank shift = largest change in rank position of any single subtheme; a dash indicates the value was not recorded. S3's ρ reflects agreement between the frequency-based and weight-based orderings.

Table 6
Aggregate TBL pillar shares by salience threshold

Pillar/total	0% (base)	2% saliance	5% saliance	Δ 2%	Δ 5%
Economic	32.77	32.79	33.05	0.0	0.3
Environmental	31.88	32.97	31.51	1.1	−0.4
Social	32.10	30.81	31.52	−1.3	−0.6
Overall	2.48	2.72	3.62	0.2	1.1
Other/N/A	0.76	0.70	0.29	−0.1	−0.5
Indicators retained (n)	1635	1047	463		

Note. Shares are cross-study percentages of summed global SSNW, by primary pillar; columns may not sum to 100 because of rounding. Δ columns report the percentage-point change from the 0% base case. No pillar share moved by more than 1.3 percentage points across thresholds. Because exclusion thresholds discard low-weight, long-tail indicators asymmetrically, the base case retains all extracted indicators and treats salience cut-offs strictly as sensitivity specifications.

The synthesis is robust to all modelling choices examined. Rank-order agreement with the base case remains high under both salience thresholds and under equal pillar-and-KPI weighting (ρ = 0.947–0.994), with the leading subthemes essentially unchanged; the salience threshold redistributes aggregate pillar shares by at most 1.3 percentage points even as the retained indicator count falls from 1635 to 454. The equal-weighting result indicates that the harmonised hierarchy reflects the breadth of indicator coverage across the corpus rather than any individual study's weighting scheme, the defuzzification operators are effectively interchangeable, and the count-based ranking converges with the weight-based ranking. Taken together, the harmonised weights and the resulting prioritisation of subthemes are not artefacts of the discretionary choices made in their construction.

Appendix C

Table 7
Study Level Synthesis Table

Study	Country, Region	No. of Observations	Sector/ Subsector	Type of Firm	Type of Research	Type of Data	Research Methodology	Data Time Horizon
Quilloy-Custodio et al. (2025)	Multi	Survey: 300 & 226 (2 studies)	Social Enterprise	Non-Financial Service	Mixed	Quantitative	Survey	Cross Sectional
Sithi et al. (2025)	Bangladesh, Asia	10	Consumer	Manufacturing	Deductive	Quantitative	Case Study, Survey	Cross Sectional
Cantele et al. (2024)	Italy, Europe	Survey: 303	Multi	Manufacturing	Mixed	Mixed	Case Study, Survey, Expert Focus Group	Cross Sectional
Tseng et al. (2024)	Vietnam, Asia	14 experts	Fisheries	Manufacturing	Mixed	Mixed	Survey, Modelling	Cross Sectional
Mengistu and Panizzolo (2024)	Italy, Europe	6	Consumer	Manufacturing	Deductive	Quantitative	Survey, Case Study	Cross Sectional
Sahoo and Upadhyay (2025)	India, Asia	Survey: 224	Multi	Manufacturing	Deductive	Quantitative	Survey	Cross Sectional
Mishra et al. (2023)	India, Asia	Survey: 403	Mining	Manufacturing	Deductive	Quantitative	Survey, Case Study	Cross sectional
Sharma and Kumar (2024)	India, Asia	10 (largest commercial banks)	Banking	Service	Abductive	Mixed	Content Analysis, Archival Research, Modelling	Cross sectional
Akhtar et al. (2023)	India, Asia	Case Study: 1 | Survey: 15 (DMs); 5 MOP alternatives	Consumer	Manufacturing	Deductive	Quantitative	Case Study, Survey	Cross sectional
Ali et al. (2023)	Saudi Arabia, Middle East	10	Logistics	Service	Abductive	Quantitative	Survey, Case Study	Cross sectional
Cui et al. (2023)	China, Asia	10 (experts); 1 case study	Advanced Tech.	Manufacturing	Abductive	Quantitative	Survey, Case Study	Cross sectional
Ishizaka et al. (2022)	India, Asia	7 (warehouses classified)	Infrastructure	Manufacturing	Deductive	Quantitative	Survey, Case Study	Cross sectional
Nicoletti Junior et al. (2022)	Brazil, Latin America	6	Consumer	Manufacturing	Deductive	Quantitative	Case Study, Survey	Cross sectional
Gandhi et al. (2022)	India, Asia	14 years (FY 2007-08 to 2020-21)	Logistics	Service	Deductive	Quantitative	Archival Research, Case Study	Longitudinal
Henao and Sarache (2022)	Colombia, Latin America	Survey: 116	Multi	Manufacturing	Deductive	Quantitative	Survey	Cross sectional
Perello-Marin et al. (2022)	Multi, Europe	7 (GRI reports/car manufacturers); 12 expert validators	Automobile	Manufacturing	Deductive	Quantitative	Archival Research, Experimental	Cross Sectional
Hao et al. (2022)	China, Asia	30	Mining	Manufacturing	Mixed	Qualitative	Case Study, Interviews	Longitudinal
Procházková et al. (2021)	Czech Republic, Europe	319	Social Enterprise	Service	Abductive	Quantitative	Survey	Cross sectional

(continued on next page)

Table 7 (*continued*)

Study	Country, Region	No. of Observations	Sector/ Subsector	Type of Firm	Type of Research	Type of Data	Research Methodology	Data Time Horizon
Danielsen et al. (2021)	Denmark, Europe	3 (Faroese fisheries)	Fisheries	Service	Deductive	Quantitative	Survey, Case Study	Panel
Kannan (2021)	Denmark, Europe	8	Multi	Manufacturing	Abductive	Qualitative	Case Study, Interviews	Cross sectional
Marco et al. (2021b)	Colombia, Latin America	1 (Colombian queen conch fishery)	Fisheries	Service	Deductive	Quantitative	Case Study, Survey	Longitudinal
Marco et al. (2021a)	Colombia, Latin America	1 fishery; 2 time-points (2012 & 2018)	Fisheries	Service	Deductive	Quantitative	Case Study, Survey	Panel
Lombardi Netto et al. (2021)	Brazil, Latin America	Case Study: 6	Consumer	Manufacturing	Deductive	Mixed	Case Study, Modelling	Cross sectional
Martins et al. (2021)	Brazil, Latin America	Survey: 50	Logistics	Multi	Deductive	Quantitative	Survey	Cross Sectional
Ozturkoglu et al. (2021)	NA	DEMATEL: 6	Hospitality/ Tourism	Service	Abductive	Quantitative	Survey	Cross Sectional
Liu et al. (2021)	China, Asia	9	Fisheries	Service	Deductive	Quantitative	Archival Research, Experimental	Cross Sectional
Yee et al. (2021)	Malaysia, Asia	Interview: 6	Multi	Manufacturing	Abductive	Qualitative	Interviews, Content Analysis	Cross sectional
Negash et al. (2021)	Thailand, Asia	Delphi: 30	Chemical/ Materials	Manufacturing	Deductive	Quantitative	Survey	Cross Sectional
Wan et al. (2021)	China, Asia	8 experts (Delphi: 4 rounds)	Fisheries	Service	Abductive	Quantitative	Survey	Cross sectional
Figueiredo et al. (2021)	Brazil, Latin America	7	Infrastructure	Manufacturing	Deductive	Quantitative	Case Study, Survey	Cross Sectional
Roy et al. (2020)	India, Asia	6	Logistics	Service	Abductive	Quantitative	Survey, Case Study	Cross Sectional
Stefaniec et al. (2020)	China, Asia	300	Logistics	Service	Deductive	Quantitative	Archival Research, Experimental	Panel
Paul et al. (2020)	NA	Survey: 15 | BWM: 10	Logistics	Service	Abductive	Quantitative	Survey	Cross sectional
Abedini et al. (2020)	NA	NA	NA	Manufacturing	Deductive	Quantitative	Numerical Study/ Illustrative Example	Cross sectional
Holgado et al. (2020)	Italy, Europe	9	Multi	Manufacturing	Abductive	Qualitative	Archival Research, Case Study, Interviews	Cross Sectional
Agrawal and Singh (2021)	India, Asia	Survey: 208	Electronics	Manufacturing	Deductive	Quantitative	Survey	Cross Sectional
Mastrocinque et al. (2020)	Multi, Europe	3 experts; 7 country alternatives assessed	Infrastructure	Multi	Deductive	Quantitative	Survey	Panel
Hendiani et al. (2020)	Multi	4	Multi	Manufacturing	Deductive	Quantitative	Case Study, Archival Research	Cross Sectional
Ecer and Pamucar (2020)	Serbia, Europe	Suppliers: 6 | Experts (for weightages): 3	Consumer	Manufacturing	Abductive	Quantitative	Survey, Case Study	Cross Sectional
Torabizadeh et al. (2020)	Malaysia, Asia	35 (questionnaire respondents)	Logistics	Manufacturing	Abductive	Quantitative	Case Study, Survey	Cross sectional
Nadae et al. (2019)	Brazil, Latin America	253	Multi	Multi	Deductive	Quantitative	Archival Research, Experimental	Cross sectional
Oliveira et al. (2019)	Multi	24	Mining	Manufacturing	Deductive	Quantitative	Case Study, Archival Research	Cross sectional
Miemczyk and Luzzini (2019)	Multi, Europe	Survey: 305	Multi	Multi	Deductive	Quantitative	Survey	Cross Sectional
Ferro et al. (2019)	Spain, Europe	Survey: 89	Multi	Multi	Deductive	Quantitative	Survey	Cross Sectional
Wu et al. (2019)	China, Asia	Survey: 17 | Eco-Innovation Practice Sample (Vague Set, DEMATEL & ISM): 26	Hospitality/ Tourism	Service	Abductive	Quantitative	Survey, Case Study	Cross Sectional
Ahmad and Wong (2019)	Malaysia, Asia	Delphi: 14	Consumer	Manufacturing	Abductive	Quantitative	Survey, Case Study	Cross Sectional
Cubas-Díaz and Martínez Sedano (2018)	Multi	635	Chemical/ Materials	Manufacturing	Deductive	Quantitative	Archival Research, Experimental	Panel
Allaoui et al. (2018)	France, Europe	12 candidate suppliers	Consumer	Multi	Deductive	Quantitative	Case Study, Modelling	Cross Sectional
Caiado et al. (2018)	Brazil, Latin America	30	Multi	Multi	Mixed	Mixed	Survey, Content Analysis, Interviews	Cross Sectional
Thabrew et al. (2018)	USA, N. America/ Canada	1 (case study)	Logistics	Service	Deductive	Quantitative	Case Study, Survey	Cross Sectional
Erdil et al. (2018)	Multi	NA	Multi	Multi	Deductive	Qualitative	Conceptual framework + illustrative examples	Cross Sectional

(*continued on next page*)

Table 7 (*continued*)

Study	Country, Region	No. of Observations	Sector/ Subsector	Type of Firm	Type of Research	Type of Data	Research Methodology	Data Time Horizon
Nicoletti Junior et al. (2018)	Brazil, Latin America	1 (case study)	Consumer	Manufacturing	Deductive	Quantitative	Survey, Case Study	Cross Sectional
Xu et al. (2018)	Australia, Australia/NZ	1 (case study)	Recycling	Service	Abductive	Quantitative	Case Study, Survey	Panel
Ahmadian Ff et al. (2017)	Multi	20 (supply-decision alternatives); 1 building case	Infrastructure	Service	Deductive	Quantitative	Survey, Case Study	Cross Sectional
Anvari and Turkay (2017)	Turkey, Eurasia	7	Advanced Tech.	Manufacturing	Deductive	Mixed	Survey, Case Study	Cross Sectional
Diaz-Sarachaga et al. (2017)	Multi	Survey:100	Infrastructure	Multi	Abductive	Quantitative	Survey	Cross Sectional
Amarah and Langston (2017)	Australia, Australasia	12	Infrastructure	Service	Inductive	Qualitative	Case Study, Interviews	Cross Sectional
Kamali and Hewage (2017)	Multi	40 (questionnaire respondents)	Infrastructure	Service	Deductive	Quantitative	Survey	Cross sectional
He et al. (2017)	China, Asia	Survey: 128; Interviewees: 45	Logistics	Non-Financial Service	Deductive	Mixed	Survey, Interviews, Case Study	Cross Sectional
Onat et al. (2016)	USA, N. America/ Canada	7 vehicle types x 16 impacts x 2 scenarios	Automobile	Manufacturing	Deductive	Quantitative	Archival Research, Experimental	Cross sectional
Ou (2016)	Taiwan, Asia	34	Advanced Tech.	Manufacturing	Deductive	Quantitative	Archival Research, Experimental	Cross sectional
Kusi-Sarpong et al. (2016)	Ghana, Africa	DEMATEL: 6 | Survey: 10	Mining	Manufacturing	Deductive	Quantitative	Case Study, Survey	Cross sectional
Xu et al. (2016)	China, Asia	12	Chemical/ Materials	Manufacturing	Deductive	Quantitative	Case Study, Modelling	Cross Sectional
Garcia et al. (2016)	Brazil, Latin America	1 (case study)	Infrastructure	Manufacturing	Deductive	Quantitative	Case Study, Survey	Longitudinal
Hossaini et al. (2015)	Canada, N. America/ Canada	2	Infrastructure	Service	Deductive	Quantitative	Survey, Case Study	Cross Sectional
Sarkis and Dhavale (2015)	NA	15 suppliers x 9 criteria x 5 years (illustrative)	NA	NA	Deductive	Quantitative	Numerical/ Illustrative Example (Bayesian + MCMC)	Cross Sectional
Venkatraman and Nayak (2015)	Australia, Australasia	Survey: 85	Multi	Multi	Mixed	Quantitative	Survey	Cross Sectional

Appendix D

Metadata Retrieval and Consolidation Workflow

The first tier established a foundational conceptual base covering broad keywords related to sustainability assessment, measurement, and well-being, supporting a combination of keywords related to TBL; and methods, approaches, techniques, or tools. The second tier established performance orientation (using keywords such as performance indicators, KPI, performance output or outcome), which goes hand in hand with sustainability assessment underpinning TBL-related keywords. The third tier concentrated on decision-making and frameworks integrated with TBL.

Table 8
Detailed search string across the four databases

Database	Search Date	Search String	Records Retrieved	Deduplication method	Unique records contributed
Scopus	**November 5, 2025**	TITLE-ABS-KEY ((("triple bottom line" OR "triple bottom-line" OR "economic* environment* social*") AND ("sustainab* assessment" OR "impact assessment" OR "impact analys*" OR "impact measur*" OR "impact assess*" OR "performance assessment" OR "performance measurement" OR "sustainab* performance assess*" OR "sustainab* performance measur*" OR "sustainab* well-being") AND ("methods" OR "approaches" OR "techniques" OR "tools")) OR (("triple bottom line" OR "triple bottom-line" OR "economic* environment* social*") AND ("performance indicators" OR "performance indicator" OR "key performance indicator*" OR "KPI" OR "performance output*" OR "performance outcome*")) OR ("triple bottom line" AND "decision making" AND "framework")) AND PUBYEAR >2014 AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA,	328	Bibliometrix "Merge Data" function, supported by manual DOI matching	281

(*continued on next page*)

Table 8 (*continued*)

Database	Search Date	Search String	Records Retrieved	Deduplication method	Unique records contributed
		"ECON") OR LIMIT-TO (SUBJAREA, "DECI") OR LIMIT-TO (SUBJAREA, "ARTS") OR LIMIT-TO (SUBJAREA, "MULT")) AND (LIMIT-TO (LANGUAGE, "English"))			
Web of Science	**November 5, 2025**	TS = ((("triple bottom line" OR "triple bottom-line" OR "economic* environment* social*") AND ("sustainab* assessment" OR "impact assessment" OR "impact analys*" OR "impact measur*" OR "impact assess*" OR "performance assessment" OR "performance measurement" OR "sustainab* performance assess*" OR "sustainab* performance measur*" OR "sustainab* well-being") AND ("methods" OR "approaches" OR "techniques" OR "tools")) OR (("triple bottom line" OR "triple bottom-line" OR "economic* environment* social*") AND ("performance indicators" OR "performance indicator" OR "key performance indicator*" OR "KPI" OR "performance output*" OR "performance outcome*")) OR ("triple bottom line" AND "decision making" AND "framework")) AND PY=(2015–2025) AND WC=(Management OR Operations Research Management Science OR Business OR Business Finance OR Economics OR Multidisciplinary Sciences OR Social Issues OR Social Sciences Interdisciplinary)	75	Bibliometrix "Merge Data" function, supported by manual DOI matching	75
Dimensions	**November 5, 2025**	(("triple bottom line" OR "triple bottom-line" OR "economic environmental social") AND ("sustainability assessment" OR "impact assessment" OR "impact analysis" OR "impact measurement" OR "impact assessment" OR "performance assessment" OR "performance measurement" OR "sustainability performance assessment" OR "sustainability performance measurement" OR "sustainable well-being") AND ("methods" OR "approaches" OR "techniques" OR "tools")) OR (("triple bottom line" OR "triple bottom-line" OR "economic environmental social") AND ("performance indicators" OR "performance indicator" OR "key performance indicator" OR "KPI" OR "performance output" OR "performance outcome")) OR ("triple bottom line" AND "decision making" AND "framework")	158	Bibliometrix "Merge Data" function, supported by manual DOI matching	76
Google Scholar (via Publish or Perish)	**November 5, 2025**	Conducted iteratively using five focused strings to enhance precision in title-keyword detection for 2015 onward: 1) ("triple bottom line" OR "triple bottom-line") AND ("sustainability assessment" OR "impact assessment" OR "impact analysis" OR "impact measurement") 2) ("triple bottom line" OR "triple bottom-line") AND ("performance assessment" OR "performance measurement") 3) ("triple bottom line" OR "triple bottom-line") AND ("performance indicators" OR "key performance indicators" OR "KPI") 4) ("triple bottom line" OR "triple bottom-line") AND ("decision making" AND "framework") 5) ("triple bottom line" OR "triple bottom-line") AND ("sustainable well-being")	134	DOI matching against the Scopus/WoS/Dimensions pool, supplemented by manual title verification	59

The five search strings for Google Scholar outlined above were executed in via Publish or Perish on November 5, 2025 using both keyword-based and title-based search functionalities, with the retrieval limit capped at 50 records per query yielding a total of 134 records. A consolidated bibliographic metadata structure across the four databases was established using Bibliometrix within R Studio. However, as this tool does not support direct metadata consolidation from Publish or Perish exports, OpenAlex was utilized for metadata retrieval and harmonisation of the Publish or Perish outputs. Approximately 44 out of the 134 records overlapped with studies already extracted from Scopus, Web of Science, and Dimensions. Duplicate records across databases were identified using DOI matching, supplemented by manual title verification where DOI metadata were unavailable. Following this deduplication process, 90 non-overlapping records remained. Among these, 17 records were either not indexed in OpenAlex or retracted and were therefore excluded from the analysis, as the bibliographic metadata required for bibliometric analysis could not be reliably retrieved. The records retrieved through Publish or Perish were exported in RIS/CSV format and post deduplication and elimination explained above the 73 records were subsequently extracted from OpenAlex using an R Studio Script as provided in Appendix D.1. Lastly, these records were then merged with dump retrieved for the other three databases for a final de-duplication yielding 59 unique records. This created an R dataframe which was loaded to Bibliometrix along with the other three database extracts (i.e. Scopus, WoS and Dimensions) to merge the data sets and get a consolidated extract in RData format. The data extract then was flattened to make it excel readable using the R Script outlined in Appendix D.2.

Appendix D.1

R Script for OpenAlex Metadata Retrieval and Bibliometrix Conversion.

```
#=====================================================================
# OpenAlex Metadata Extraction → Excel.
# Fetches metadata for a list of OpenAlex IDs and writes a.
```

```
# clean, Excel-ready spreadsheet of the main scalar fields.
#= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
# --- 1. Install & load packages (run install lines once) ----
# install.packages("openalexR")
# install.packages("bibliometrix")
library(openalexR)
library(bibliometrix)
# --- 2. Define your OpenAlex IDs ---------------------------
ids < - c(
"W3157501675″, "W3208540540″, "W4281685656″, "W4405867885″, "W4405868969″, "W2071326715″, "W2290213882″, "W3108475847″, "W4385743378″, "W2944157488″, "W2910528270″, "W3174327807″, "W4396741677″, "W3084015542″, "W4315628901″, "W3110623023″, "W3036224841″, "W3137394487″, "W2901607897″, "W4312644915″, "W4415909571″, "W4205435482″, "W1838819674″, "W3089466284″, "W2901607897″, "W2966243901″, "W4412833646″, "W4393988787″, "W3000025268″, "W2464811856″, "W2765901584″, "W3080602032″, "W3167515569″, "W4385731580″, "W4285231924″, "W4406189146″, "W4391989816″, "W2968860394″, "W4412760514″, "W981254799″, "W3214928539″, "W2787347899″, "W3089466284″, "W4206081367″, "W2945830169″, "W4294883758″, "W4413799826″, "W2622279482″, "W2766006388″, "W3119398056″, "W2968438349″, "W2608863529″, "W4382068141″, "W4388735457″, "W3032264402″, "W4307046623″, "W3041913904″, "W2969768732″, "W4225278922″, "W4390128178″, "W2402294011″, "W2895254152″, "W2785846836″, "W4410144834″, "W3113263848″, "W2955340710″, "W2582743722″, "W3213839133″, "W4402803356″, "W2439336039″, "W4288535577″, "W2131100331″, "W2969336308″)
# --- 3. Fetch metadata ------------------------------------–
df_metadata < - oa_fetch(
identifier = ids,
output = "tibble"
)
# --- 4. Convert to bibliometrix format ------------------–
M < - oa2bibliometrix(df_metadata)
# --- 5. Save it so Biblioshiny can load it ------------------–
save(M, file = "openalex_biblio.RData")
biblioshiny(.)
```

Appendix D.2

R Script for Flattening the Consolidated Bibliometrix R Data format file for CSV Export.

```
# --- load the consolidated Bibliometrix R Data File --------------
load("Bibliometrix-Export-File-2026-05-24-Consolidated.RData")
# --- Convert list columns into semicolon-separated strings -------–
M_flat < - as.data.frame(lapply(M, function(x) {
if (is.list(x)) {
sapply(x, paste, collapse = "; ")
} else {
x.
}
}))
# --- 5. Save the flattened data frame --------------------------–
write.csv(M_flat, file = "Bibliometrix_Consolidated_Master.csv", row.names = FALSE)
```

Appendix E

Table 9
Co-word analysis based on the Authors' keywords of BP, with the number of studies in parentheses

Cluster	Broad Theme (cluster frequency)	Subthemes (keyword occurrence)
1	MCDM (51)	MCDM (23); life cycle assessment (9); sustainability index (8); life cycle sustainability assessment (5); sustainability criteria (3); topsis (3)
2	sustainable development (25)	sustainable development (22); system dynamics (3)
3	key performance indicators (kpis) (47)	key performance indicators (kpis) (13); sustainability indicators (10); performance measurement (7); sustainable manufacturing (7); sustainable performance (4); delphi (3); maintenance (3)
4	fuzzy set theory (28)	fuzzy set theory (13); dematel (9); bwm (6)
5	sustainable supply chain management (32)	sustainable supply chain management (11); ahp (8); decision-making (5); performance evaluation (4); supplier selection (4)
6	supply chain management (25)	supply chain management (9); circular economy (8); sustainable supplier selection (5); environmental sustainability (3)
7	firm/financial performance (27)	firm/financial performance (8); corporate social responsibility (7); sustainable development goals (sdgs) (5); manufacturing industry (4); anp (3)
8	industry 4.0 (9)	industry 4.0 (6); fuzzy topsis (3)
9	environmental performance (11)	environmental performance (4); trade-offs (4); economic performance (3)

(*continued on next page*)

Table 9 (*continued*)

Cluster	Broad Theme (cluster frequency)	Subthemes (keyword occurrence)
10	aquaculture performance indicators (3)	aquaculture performance indicators (3)
11	fisheries management (3)	fisheries management (3)

Source: Author's own elaboration

Appendix F

Evolution of SIA Approaches

This appendix details the chronological evolution of Sustainability Impact Assessment (SIA) introduced in Section 1. From its origins in the 1960s, SIA has developed in response to changing societal priorities, regulatory developments, and methodological advances, culminating in the gradual convergence of three methodological lineages: environmental (Environmental Impact Assessment [EIA] and Life Cycle Assessment [LCA]), social (social indicators and Social Impact Assessment), and economic-accountability (Triple Bottom Line reporting and Social Return on Investment [SROI]). Table 10 sets out the key milestones of this trajectory across five overlapping phases, from the early origins of impact assessment in the 1960s to the regulatory convergence and digital transformation of the 2020s.

The Early Origins Phase (1960-80s) marked the foundation of SIA through the emergence of Environmental Impact Assessment (EIA), which evolved between 1960s and 70s from a rationalist decision-making approach to a formally mandated process under the U.S. National Environmental Policy Act (NEPA) of 1969/70 (Dendena & Corsi, 2015). In parallel, the foundations of Social Impact Measurement were laid with the introduction of social indicators and eventual progression and refinement of the formal Social Impact Assessment (SoIA) process between 1970 and 76. Around the same time, Life Cycle Assessment (LCA) emerged as an early cradle-to-grave study conducted by the Midwest Research Institute for the Coca-Cola company in 1969 (Guinée et al., 2011).

The next phase of Methodological Development (late 1980s–2000s) marked a systematic consolidation and formalization within SIA. The European Union adopted the EIA Directive (85/337/EEC), extending project-level environmental assessment internationally (Council of the European Communities, 1985; Dendena & Corsi, 2015). Additionally, LCA was standardized with the publication of ISO 14040 in 1997, followed by the revision and consolidation of standards under ISO 14044 (Finkbeiner et al., 2006). On the environmental side, the first specialised LCA software (e.g., SimaPro, GaBi) emerged in the early 1990s (Herrmann & Moltesen, 2015). SoIA matured in parallel, with the introduction of Social Return on Investment (SROI) in 1996 (Alomoto et al., 2022), though it attained ISO-level standardization only recently with introduction of ISO 14075 (ISO, 2024).

The Triple Bottom Line Integration Phase (late 1990s-2010s) marked a shift toward integrated frameworks that simultaneously considered economic, environmental, and social dimensions, including the Triple Bottom Line (TBL) Accounting, Integrated Environmental and Social Impact Assessment, Sustainability-Oriented Balanced Scorecards, and a holistic Life Cycle Sustainability Assessment integrating LCA, life cycle costing, and social LCA (Alomoto et al., 2022; Dendena & Corsi, 2015; Figge et al., 2002).

The dissemination and early transformation phase (2010s–2020s) were characterised by the development of methodological tools, supporting infrastructure, and increasing policy adoption. The OECD's guidance sought to streamline and consolidate SIA research methods (OECD, 2010). This period also saw the emergence of algorithmic approaches to impact assessment, with early applications of big data, machine learning and impact prediction into assessment practice (Lang & Siler, 2013; Kuldna et al., 2015; Wu et al., 2018). In parallel, social impact measurement research grew rapidly, supported by policy initiatives such as Horizon 2020 programme (Alomoto et al., 2022).

Finally, the regulatory convergence and digital transformation phase (2020s-25) has witnessed SIA beginning to converge with regulatory disclosure regimes. In parallel, the maturing of Industry 4.0 technologies within supply chains — blockchain and digital twins from the mid-2010s, and recent emerging use of artificial intelligence and machine learning for predictive modelling within environmental impact assessment (Anifowose & Anifowose, 2024; Wang et al., 2025) represents the start of a broader shift from static, retrospective reporting toward dynamic, real-time sustainability management. Concurrently, the Corporate Sustainability Reporting Directive (CSRD, in force January 2023) signaled a transition from voluntary reporting toward mandatory impact disclosure grounded in double materiality, reinforced by the emerging interoperability between GRI and the IFRS Foundation's ISSB standards (GRI, 2023). Taken together, these phases show a field maturing from fragmented, project-level origins toward integrated and increasingly mandated assessment; yet persistent methodological heterogeneity, weak assessment–reporting integration and emerging convergence with technology, underscore the continued need for synthesis and alignment in corporate SIA research .

Table 10

Early Origins: 1960-80s	Methodological Development: Late 1980-2000s	Triple Bottom Line Integration: Late 90s-2010s	Dissemination and early transformational phase: 2010s-2020	Regulatory Convergence & Digital Transformation: 2020s-25
1969/70: National Environment Policy Act - Environmental Impact Assessment Mandate **1969**: Coca Cola's Life Cycle Assessment (LCA) study **1966/69**: Introduction of Social Indicators and Impact measurement – foundations laid by Bauer (1966) and Olson (1969)	**1985–90s**: Post US National Environmental Policy Act (NEPA) in 1969 - EU EIA Directive international adoption **1997**: publication of ISO 14040 (revision and consolidation under ISO 14044 in 2006; introduction of ISO 14075 in 2024) **1996**: Introduction of Social	Late 1990s: Triple Bottom Line (TBL) Accounting popularised by Elkington (1998) **Early 2000**: Emergence of Integrated Environmental and Social Impact Assessment **2000/02**: Emergence of Social enterprise balanced scorecard and expansion to Sustainability balanced scorecard	**2010s**: OECD published guidance to streamline SIA research Emergence of data-driven approaches (Big Data, Machine Learning) in assessment practice **2014–20**: Conceptualization of Social Impact Measurement; Launch and progression of Horizon 2020 Program towards policy implementation	**2016–2020s**: Emergence of Blockchain and Digital Twins within Supply Chain, with nascency in SIA **2023:** Introduction of the Corporate Sustainability Reporting Directive (CSRD)-shift from voluntary reporting toward mandatory impact disclosure based on double materiality **2024–25**: Emerging use of Artificial Intelligence (AI) and Machine

(*continued on next page*)

Table 10 (*continued*)

Early Origins: 1960-80s	Methodological Development: Late 1980-2000s	Triple Bottom Line Integration: Late 90s-2010s	Dissemination and early transformational phase: 2010s-2020	Regulatory Convergence & Digital Transformation: 2020s-25
1970–76: Social Impact Assessment origin and improvements	return on investment by Lingane and Olsen (2004) and Nicholls et al. (2012)	**2007**: Expansion to a holistic Life cycle sustainability assessment process – foundation laid by Zhou et al. (2007) and Klöpffer (2008)		Learning for predictive modeling and simulation within EIA

Source: Author's own elaboration

Appendix G

Bibliometric thematic-map parameters, term-exclusion list, and synonym consolidation

This appendix reports the full specification of the conceptual thematic mapping summarised in Section 2.8. and presented in Fig. 5. The analysis was performed on a corpus assembled from four bibliographic databases (Web of Science, Scopus, OpenAlex, and Dimensions) and merged through the Bibliometrix R package routines. Owing to non-standard formats across databases, some metadata fields (notably Cited References and Science Categories) were not consistently available after merging and were therefore excluded from the co-word analysis.

Mapping parameters. The thematic map was generated from author keywords (field DE) using the following settings.

Table G.1
Bibliometrix Parameter Summary and Description

Parameter	Setting	Description
Field	DE (author keywords)	Terms drawn from the authors' keywords field as the unit of co-word analysis
N	250	Maximum number of most frequent terms considered for the map
Minfreq	3	Minimum occurrence threshold; terms appearing fewer than three times were excluded
Ngrams	1	Term length set to single-word (unigram) keywords
Stemming	FALSE	No stemming applied; keywords retained in their original form
Size	0.3	Scaling factor governing node and label size in the map
n.labels	3	Number of representative labels displayed per cluster
community.repulsion	0	Repulsion force applied between communities (0 = none)
Repel	FALSE	Automatic label repulsion disabled
clustering algorithm	*Louvain*	*Community-detection algorithm used to delineate the thematic clusters*

Source: Author's own elaboration

A total of 51 generic, methodological, geographic, and otherwise non-substantive terms were removed prior to mapping so that the analysis would focus on conceptually meaningful themes. The full exclusion list is reported in Table G.2.

Table G.2
Term-exclusion list applied prior to thematic mapping

models, theoretical	malaysia	business
algorithms	organizations	evaluation
animals	pakistan	triple
assessment	policy	smes
australia	research design	development
bangladesh	review	analysis
bibliometric analysis	survey	analytic
bibliometrics	surveys and questionnaires	project success
brazil	systematic literature review	entropy
china	systematic review	solution
cities	efficiency, organizational	sensitivity analysis
commerce	na	data envelopment analysis
corporate sustainability	case study	structural equation modelling (sem)
costs and cost analysis	sustainability	structural equation modeling (sem)
cross-sectional studies	content analysis	triple-bottom-line
iran	measurement	sustainability assessment
literature review	framework	

Source: Author's own elaboration

Additionally, semantically equivalent keywords and spelling or formatting variants were merged into a single canonical term before mapping to avoid artificial fragmentation of themes. The consolidation scheme is reported in Table G.3.

Table G.3
Synonym consolidation scheme applied to author keywords

Consolidated (canonical) term	Merged keyword variants
MCDM	mcdm, multi-criteria decision analysis, multi-criteria decision making, multi-criteria decision-making, multi-criteria decision-making (mcdm), multicriteria decision making, multicriteria decision analysis
DEMATEL	decision-making trial and evaluation laboratory, decision-making trial and evaluation laboratory (dematel)
BWM	best-worst method
AHP	analytic hierarchy process (ahp), analytic hierarchy process
ANP	analytic network process
DELPHI	delphi method, delphi
decision-making	decision making
sustainable performance	sustainability performance
corporate social responsibility	corporate social responsibility (csr), csr, social responsibility
sustainable supply chain management	sustainable supply chain
sustainable supplier selection	sustainability supplier selection
supply chain management	supply chain
industry 4.0	industry 4
trade-offs	trade-off
firm/financial performance	firm performance, financial performance, performance
fuzzy set theory	fuzzy theory, fuzzy logic, vague set
life cycle assessment	lifecycle assessment
manufacturing industry	manufacturing
sustainable development goals (sdgs)	sustainable development goals, sdgs
sustainability	sustainable
triple-bottom-line	triple bottom line (tbl), triple bottom line performance, triple bottom line, triple bottom-line, triple-bottom line, tbl
key performance indicators (kpis)	key performance indicators, performance indicators, indicators, indicator

Source: Author's own elaboration

References

Abedini, A., Li, W., Badurdeen, F., & Jawahir, I. S. (2020). A metric-based framework for sustainable production scheduling. *Journal of Manufacturing Systems, 54*, 174–185.

Agrawal, S., & Singh, R. K. (2021). Outsourcing and reverse supply chain performance: A triple bottom line approach. *Benchmarking: An International Journal, 28*(4), 1146–1163.

Ahmad, S., Wong, K. Y., & Butt, S. I. (2023). Status of sustainable manufacturing practices: Literature review and trends of triple bottom-line-based sustainability assessment methodologies. *Environmental Science and Pollution Research, 30*(15), 43068–43095.

Ahmad, S., & Wong, K. Y. (2019). Development of weighted triple-bottom line sustainability indicators for the Malaysian food manufacturing industry using the Delphi method. *Journal of Cleaner Production, 229*, 1167–1182.

Ahmadian Ff, A., Rashidi, T. H., Akbarnezhad, A., & Waller, S. T. (2017). BIM-enabled sustainability assessment of material supply decisions. *Engineering, Construction and Architectural Management, 24*(4), 668–695.

Akhtar, M., Gunasekaran, A., & Kayikci, Y. (2023). A novel stochastic fuzzy decision model for agile and sustainable global manufacturing outsourcing partner selection in footwear industry. *Journal of Enterprise Information Management, 36*(4), 979–1007.

Ali, S. S., Kaur, R., & Khan, S. (2023). Evaluating sustainability initiatives in warehouse for measuring sustainability performance: An emerging economy perspective. *Annals of Operations Research, 324*(1), 461–500.

Allaoui, H., Guo, Y., Choudhary, A., & Bloemhof, J. (2018). Sustainable agro-food supply chain design using two-stage hybrid multi-objective decision-making approach. *Computers & Operations Research, 89*, 369–384.

Alomoto, W., Niñerola, A., & Pié, L. (2022). Social impact assessment: A systematic review of literature. *Social Indicators Research, 161*(1), 225–250.

Alshukri, T., Seun Ojekemi, O., Öz, T., & Alzubi, A. (2024). The interplay of corporate social responsibility, innovation capability, organizational learning, and sustainable value creation: Does stakeholder engagement matter? *Sustainability, 16*(13), 5511.

Amarah, B., & Langston, C. (2017). Development of a triple bottom line stakeholder satisfaction model. *Journal of Corporate Real Estate, 19*(1), 17–35.

Anifowose, B., & Anifowose, F. (2024). Artificial intelligence and machine learning in environmental impact prediction for soil pollution management–case for EIA process. *Environmental Advances, 17*, Article 100554.

Anvari, S., & Turkay, M. (2017). The facility location problem from the perspective of triple bottom line accounting of sustainability. *International Journal of Production Research, 55*(21), 6266–6287.

Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics, 11*(4), 959–975.

Bahuriddin, N. S., Saman, M. Z. M., Mohamad-Ali, N., Ngadiman, N. H. A., & Maulana, M. I. I. M. (2025). State of sustainability assessments of metal additive manufacturing: Literature review and triple-bottom-line perspectives. *Environmental Science and Pollution Research*, 1–19.

Bauer, R. A. (1966). Social indicators and sample surveys. *Public Opinion Quarterly, 30*(3), 339–352.

Caiado, R. G. G., Quelhas, O. L. G., Nascimento, D. L. M., Anholon, R., & Leal Filho, W. (2018). Measurement of sustainability performance in Brazilian organizations. *The International Journal of Sustainable Development and World Ecology, 25*(4), 312–326.

Cantele, S., Landi, S., & Vernizzi, S. (2024). Measuring corporate sustainability in its multidimensionality: A formative approach to integrate ESG and triple bottom line approaches. *Business Strategy and the Environment, 33*(7), 7383–7408.

Cerchione, R., Morelli, M., Passaro, R., & Quinto, I. (2025). A critical analysis of the integration of life cycle methods and quantitative methods for sustainability assessment. *Corporate Social Responsibility and Environmental Management, 32*(2), 1508–1544.

Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the Fuzzy Sets Theory field. *Journal of informetrics, 5*(1), 146–166.

Council of the European Communities. (1985). Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment. *Official Journal of the European Communities, L, 175*, 40–46. Retreived from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31985L0337.

Cubas-Díaz, M., & Martínez Sedano, M.Á. (2018). Measures for sustainable investment decisions and business strategy–a triple bottom line approach. *Business Strategy and the Environment, 27*(1), 16–38.

Cui, L., Wu, H., & Dai, J. (2023). Modelling flexible decisions about sustainable supplier selection in multitier sustainable supply chain management. *International Journal of Production Research, 61*(14), 4603–4624.

Danielsen, R., Anderson, C. M., & Agnarsson, S. (2021). Trawling for triple bottom line results: Applying the Fishery Performance Indicators in the Faroe Islands. *Marine Policy, 125*, Article 104250.

Dendena, B., & Corsi, S. (2015). The Environmental and Social Impact Assessment: A further step towards an integrated assessment process. *Journal of Cleaner Production, 108*, 965–977.

Diaz-Sarachaga, J. M., Jato-Espino, D., & Castro-Fresno, D. (2017). Methodology for the development of a new Sustainable Infrastructure Rating System for Developing Countries (SIRSDEC). *Environmental Science & Policy, 69*, 65–72.

Ecer, F., & Pamucar, D. (2020). Sustainable supplier selection: A novel integrated fuzzy best worst method (F-BWM) and fuzzy CoCoSo with Bonferroni (CoCoSo'B) multi-criteria model. *Journal of Cleaner Production, 266*, Article 121981.

Elkington, J. (1998). *Cannibals with forks: The triple bottom-line of 21st century business*. Gabriola Island. BC: New Society Publishers.

Erdil, N. O., Aktas, C. B., & Arani, O. M. (2018). Embedding sustainability in lean six sigma efforts. *Journal of Cleaner Production, 198*, 520–529.

Ferro, C., Padin, C., Høgevold, N., Svensson, G., & Sosa Varela, J. C. (2019). Validating and expanding a framework of a triple bottom line dominant logic for business sustainability through time and across contexts. *Journal of Business & Industrial Marketing, 34*(1), 95–116.

Figge, F., Hahn, T., Schaltegger, S., & Wagner, M. (2002). The sustainability balanced scorecard–linking sustainability management to business strategy. *Business Strategy and the Environment, 11*(5), 269–284.

Figueiredo, K., Pierott, R., Hammad, A. W., & Haddad, A. (2021). Sustainable material choice for construction projects: A Life Cycle Sustainability Assessment framework based on BIM and Fuzzy-AHP. *Building and Environment, 196*, Article 107805.

Finkbeiner, M., Inaba, A., Tan, R., Christiansen, K., & Klüppel, H. J. (2006). The new international standards for life cycle assessment: ISO 14040 and ISO 14044. *International Journal of Life Cycle Assessment, 11*(2), 80–85.

Gandhi, N., Kant, R., & Thakkar, J. (2022). Sustainable performance assessment of rail freight transportation using triple bottom line approach: An application to Indian Railways. *Transport Policy, 128*, 254–273.

Garcia, S., Cintra, Y., Rita de Cássia, S. R., & Lima, F. G. (2016). Corporate sustainability management: A proposed multi-criteria model to support balanced decision-making. *Journal of Cleaner Production, 136*, 181–196.

Gibson, R. B. (2006). Sustainability assessment: Basic components of a practical approach. *Impact Assessment and Project Appraisal, 24*(3), 170–182.

Global Reporting Initiative [GRI]. (2023). Double materiality. The guiding principle for sustainability reporting. https://www.globalreporting.org/media/rz1jf4bz/gri-double-materiality-final.pdf.

Guinée, J. B., Heijungs, R., Huppes, G., Zamagni, A., Masoni, P., Buonamici, R., … Rydberg, T. (2011). *Life cycle assessment: Past, present, and future*.

Hao, S., Ren, C., & Zhang, L. (2022). Research on performance evaluation of coal enterprises based on grounded theory, entropy method and cloud model from the perspective of ESG. *Sustainability, 14*(18), Article 11526.

Harzing, A. W. (2007). Publish or perish. [Software]. https://harzing.com/resources/publish-or-perish.

He, Z., Chen, P., Liu, H., & Guo, Z. (2017). Performance measurement system and strategies for developing low-carbon logistics: A case study in China. *Journal of Cleaner Production, 156*, 395–405.

Henao, R., & Sarache, W. (2022). Sustainable performance in manufacturing operations: The cumulative approach vs. trade-offs approach. *International Journal of Production Economics, 244*, Article 108385.

Hendiani, Sepehr, Liao, Huchang, Ren, Ruxue, & Lev, Benjamin (2020). A likelihood-based multi-criteria sustainable supplier selection approach with complex preference information. *Information Sciences, 536*, 135–155. https://doi.org/10.1016/j.ins.2020.05.065. https://linkinghub.elsevier.com/retrieve/pii/S0020025520304606

Herrmann, I. T., & Moltesen, A. (2015). Does it matter which Life Cycle Assessment (LCA) tool you choose?–a comparative assessment of SimaPro and GaBi. *Journal of cleaner production, 86*, 163–169.

Holgado, M., Macchi, M., & Evans, S. (2020). Exploring the impacts and contributions of maintenance function for sustainable manufacturing. *International Journal of Production Research, 58*(23), 7292–7310.

Hossaini, N., Reza, B., Akhtar, S., Sadiq, R., & Hewage, K. (2015). AHP based life cycle sustainability assessment (LCSA) framework: A case study of six storey wood frame and concrete frame buildings in Vancouver. *Journal of Environmental Planning and Management, 58*(7), 1217–1241.

Ishizaka, A., Khan, S. A., Kusi-Sarpong, S., & Naim, I. (2022). Sustainable warehouse evaluation with AHPSort traffic light visualisation and post-optimal analysis method. *Journal of the Operational Research Society, 73*(3), 558–575.

International Organization for Standardization. (2024). *Environmental management — Principles and framework for social life cycle assessment (ISO Standard No. 14075: 2024)*. https://www.iso.org/standard/61118.html.

Johri, A., Joshi, P., Kumar, S., & Joshi, G. (2024). Metaverse for Sustainable Development in a bibliometric analysis and systematic literature review. *Journal of Cleaner Production*, Article 140610.

Kamali, M., & Hewage, K. (2017). Development of performance criteria for sustainability evaluation of modular versus conventional construction methods. *Journal of Cleaner Production, 142*, 3592–3606.

Kannan, D. (2021). Sustainable procurement drivers for extended multi-tier context: A multi-theoretical perspective in the Danish supply chain. *Transportation Research Part E: Logistics and Transportation Review, 146*, Article 102092.

Kantabutra, S. (2024). Toward a sustainability performance management framework. *Heliyon, 10*(13), Article e33729.

Kantabutra, S., & Ketprapakorn, N. (2020). Toward a theory of corporate sustainability: A theoretical integration and exploration. *Journal of Cleaner Production, 270*, Article 122292.

Klöpffer, W. (2008). Life cycle sustainability assessment of products: (with Comments by Helias A. Udo de Haes, p. 95). *International Journal of Life Cycle Assessment, 13*(2), 89–95.

Kuldna, Piret, Peterson, Kaja, & Kuhi-Thalfeldt, Reeli (2015). Knowledge brokering on emissions modelling in Strategic Environmental Assessment of Estonian energy policy with special reference to the LEAP model. *Environmental Impact Assessment Review, 54*, 55–60. https://doi.org/10.1016/j.eiar.2015.06.001. https://linkinghub.elsevier.com/retrieve/pii/S0195925515000529

Kumar, J., & Ahuja, A. (2025). Journey of financial inclusion: A systematic literature review and conceptual framework for future research. *Asia-Pacific Journal of Business Administration, 17*(3), 632–656.

Kusi-Sarpong, S., Sarkis, J., & Wang, X. (2016). Assessing green supply chain practices in the Ghanaian mining industry: A framework and evaluation. *International Journal of Production Economics, 181*, 325–341.

Lang, Corey, & Siler, Matthew (2013). Engineering estimates versus impact evaluation of energy efficiency projects: Regression discontinuity evidence from a case study. *Energy Policy, 61*, 360–370. https://doi.org/10.1016/j.enpol.2013.06.122. https://linkinghub.elsevier.com/retrieve/pii/S0301421513006290

Lingane, A., & Olsen, S. (2004). Guidelines for social return on investment. *California Management Review, 46*(3), 116–135.

Liu, L., Chu, J., Anderson, J. L., & Xu, J. (2021). Sustainability comparisons in the triple bottom line for Chinese fisheries. *Marine Policy, 125*, Article 104259.

Lombardi Netto, A., Salomon, V. A., Ortiz-Barrios, M. A., Florek-Paszkowska, A. K., Petrillo, A., & De Oliveira, O. J. (2021). Multiple criteria assessment of sustainability programs in the textile industry. *International Transactions in Operational Research, 28*(3), 1550–1572.

Marco, J., Valderrama, D., & Rueda, M. (2021a). Triple bottom line assessment for the historically underperforming Colombian queen conch fishery. *Marine Policy, 125*, Article 104257.

Marco, J., Valderrama, D., & Rueda, M. (2021b). Evaluating management reforms in a Colombian shrimp fishery using fisheries performance indicators. *Marine Policy, 125*, Article 104258.

Martins, V. W. B., Anholon, R., Sanchez-Rodrigues, V., Leal Filho, W., & Quelhas, O. L. G. (2021). Brazilian logistics practitioners' perceptions on sustainability: An exploratory study. *International Journal of Logistics Management, 32*(1), 190–213.

Mastrocinque, E., Ramírez, F. J., Honrubia-Escribano, A., & Pham, D. T. (2020). An AHP-based multi-criteria model for sustainable supply chain development in the renewable energy sector. *Expert Systems with Applications, 150*, Article 113321.

Mengistu, A. T., & Panizzolo, R. (2024). Metrics for measuring industrial sustainability performance in small and medium-sized enterprises. *International Journal of Productivity and Performance Management, 73*(11), 46–68.

Miemczyk, J., & Luzzini, D. (2019). Achieving triple bottom line sustainability in supply chains: The role of environmental, social and risk assessment practices. *International Journal of Operations & Production Management, 39*(2), 238–259.

Mishra, A., Das, S. K., & Reddy, K. R. (2023). Life cycle triple bottom line sustainability assessment of coal mine overburden sand versus river sand. *Resources Policy, 86*, Article 104140.

Munjal, N., Sachdeva, G., & Garg, N. (2025). The empirical and managerial landscape of workplace spirituality: A systematic literature review of studies published in ABDC list journals. *International Journal of Organizational Analysis*.

Nadae, J. D., Carvalho, M. M., & Vieira, D. R. (2019). Exploring the influence of environmental and social standards in integrated management systems on economic performance of firms. *Journal of Manufacturing Technology Management, 30*(5), 840–861.

Negash, Y. T., Sriplod, T., & Hassan, A. M. (2021). A causal sustainable natural rubber development framework using a hierarchical structure with linguistic preferences in Thailand. *Journal of Cleaner Production, 305*, Article 127095.

Nicholls, J., Lawlor, E., Neitzert, E., & Goodspeed, T. (2012). *A guide to social return on investment*.

Nicoletti Junior, A., de Oliveira, M. C., & Helleno, A. L. (2018). Sustainability evaluation model for manufacturing systems based on the correlation between triple bottom line dimensions and balanced scorecard perspectives. *Journal of Cleaner Production, 190*, 84–93.

Nicoletti Junior, A., de Oliveira, M. C., Helleno, A. L., Campos, L. M. D. S., & Alliprandini, D. H. (2022). The organization performance framework considering competitiveness and sustainability: The application of the sustainability evaluation model. *Production Planning and Control, 33*(13), 1215–1230.

Oliveira, R., Zanella, A., & Camanho, A. S. (2019). The assessment of corporate social responsibility: The construction of an industry ranking and identification of potential for improvement. *European Journal of Operational Research, 278*(2), 498–513.

Olson, J. M. (1969). Social indicators and social accounts. *Socio-Economic Planning Sciences, 2*(2–4), 335–346.

Onat, N. C., Kucukvar, M., Tatari, O., & Zheng, Q. P. (2016). Combined application of multi-criteria optimization and life-cycle sustainability assessment for optimal distribution of alternative passenger cars in US. *Journal of Cleaner Production, 112*, 291–307.

Organisation for Economic Co-operation and Development [OECD]. (2010). Guidance on sustainability impact assessment. https://www.oecd.org/greengrowth/46530443.pdf.

Ou, Y. C. (2016). Using a hybrid decision-making model to evaluate the sustainable development performance of high-tech listed companies. *Journal of Business Economics and Management, 17*(3), 331–346.

Ozturkoglu, Y., Sari, F. O., & Saygili, E. (2021). A new holistic conceptual framework for sustainability oriented hospitality innovation with triple bottom line perspective. *Journal of Hospitality and Tourism Technology, 12*(1), 39–57.

Page, Matthew J, McKenzie, Joanne E, Bossuyt, Patrick M, Boutron, Isabelle, Hoffmann, Tammy C, Mulrow, Cynthia D, Shamseer, Larissa, Tetzlaff, Jennifer M, Akl, Elie A, Brennan, Sue E, Chou, Roger, Glanville, Julie, Grimshaw, Jeremy M, Hróbjartsson, Asbjørn, Lalu, Manoj M, Li, Tianjing, Loder, Elizabeth W, Mayo-Wilson, Evan, McDonald, Steve, … Moher, David (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, n71. https://doi.org/10.1136/bmj.n71. https://www.bmj.com/lookup/doi/10.1136/bmj.n71. (Accessed 29 March 2021)

Paul, A., Moktadir, M. A., & Paul, S. K. (2020). An innovative decision-making framework for evaluating transportation service providers based on sustainable criteria. *International Journal of Production Research, 58*(24), 7334–7352.

Paul, J., & Rosado-Serrano, A. (2019). Gradual internationalization vs born-global/international new venture models: A review and research agenda. *International Marketing Review, 36*(6), 830–858.

Perello-Marin, M. R., Rodríguez-Rodríguez, R., & Alfaro-Saiz, J. J. (2022). Analysing GRI reports for the disclosure of SDG contribution in European car manufacturers. *Technological Forecasting and Social Change, 181*, Article 121744.

Prabhu, M., & Srivastava, A. K. (2023). Leadership and supply chain management: A systematic literature review. *Journal of Modelling in Management, 18*(2), 524–548.

Pranugrahaning, A., Donovan, J. D., Topple, C., & Masli, E. K. (2021). Corporate sustainability assessments: A systematic literature review and conceptual framework. *Journal of Cleaner Production, 295*, Article 126385.
Procházková, P. T., Nosková, M., Machová, K., & Velíšková, V. (2021). Development of performance evaluation indicators for social enterprises: The use of Delphi Technique. *Business Economics and Management (JBEM), 22*(6), 1396–1415.
Quilloy-Custodio, K., Newman, A., & Pyman, A. (2025). Measuring the social impact of social enterprises–scale development and validation. *Business & Society, 64*(7), 1269–1312.
Roy, J., Pamučar, D., & Kar, S. (2020). Evaluation and selection of third party logistics provider under sustainability perspectives: An interval valued fuzzy-rough approach. *Annals of Operations Research, 293*, 669–714.
Sahoo, S., & Upadhyay, A. (2025). Improving triple bottom line (TBL) performance: Analyzing impacts of industry 4.0, lean six sigma and circular supply chain management. *Annals of Operations Research, 355*(1), 951–982.
Saltelli, A., Tarantola, S., & Campolongo, F. (2000). Sensitivity analysis as an ingredient of modeling. *Statistical Science*, 377–395.
Sarkis, J., & Dhavale, D. G. (2015). Supplier selection for sustainable operations: A triple-bottom-line approach using a Bayesian framework. *International Journal of Production Economics, 166*, 177–191.
Sharma, D., & Kumar, P. (2024). Prioritizing the attributes of sustainable banking performance. *International Journal of Productivity and Performance Management, 73*(6), 1797–1825.
Singh, V. K., Singh, P., Karmakar, M., Leta, J., & Mayr, P. (2021). The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics, 126*(6), 5113–5142.
Sithi, S. S., Ara, M. A., Dhrubo, A. T., Rony, A. H., & Shabur, M. A. (2025). Sustainable supplier selection in the textile industry using triple bottom line and SWARA-TOPSIS approaches. *Discover Sustainability, 6*(1), 344.
Stefaniec, A., Hosseini, K., Xie, J., & Li, Y. (2020). Sustainability assessment of inland transportation in China: A triple bottom-line-based network DEA approach. *Transportation Research Part D: Transport and Environment, 80*, Article 102258.
Strömmer, K., & Ormiston, J. (2022). Forward-looking impact assessment–An interdisciplinary systematic review and research agenda. *Journal of Cleaner Production, 377*, Article 134322.
Thabrew, L., Perrone, D., Ewing, A., Abkowitz, M., & Hornberger, G. (2018). Using triple bottom line metrics and multi-criteria methodology in corporate settings. *Journal of Environmental Planning and Management, 61*(1), 49–63.
Torabizadeh, M., Yusof, N. M., Ma'aram, A., & Shaharoun, A. M. (2020). Identifying sustainable warehouse management system indicators and proposing new weighting method. *Journal of Cleaner Production, 248*, Article 119190.
Tseng, M. L., Tran, T. P. T., Fujii, M., Lim, M. K., & Negash, Y. T. (2024). Modelling hierarchical circular supply chain management enablers in the seafood processing industry in Vietnam under uncertainties. *International Journal of Logistics Research and Applications, 27*(1), 30–58.
Venkatraman, S., & Nayak, R. R. (2015). Corporate sustainability: An IS approach for integrating triple bottom line elements. *Social Responsibility Journal, 11*(3), 482–501.
Vitale, G., Rosignuolo, A., & Riccaboni, A. (2025). Sustainability performance measurement systems: A systematic literature review and research agenda for (a better) future. *Measuring Business Excellence, 29*(3), 609–634.
Wan, X., Liu, X., Du, Z., & Du, Y. (2021). A novel model used for assessing supply chain sustainability integrating the ANP and ER approaches and its application in marine ranching. *Journal of Cleaner Production, 279*, Article 123500.
Wang, T., Zuo, Y., Manda, T., Hwarari, D., & Yang, L. (2025). Harnessing artificial intelligence, machine learning and deep learning for sustainable forestry management and conservation: Transformative potential and future perspectives. *Plants, 14*(7), 998.
World Commission on Environment and Development. (1987). *Report of the World Commission on environment and development:" our common future*. UN.
Wu, K. J., Zhu, Y., Chen, Q., & Tseng, M. L. (2019). Building sustainable tourism hierarchical framework: Coordinated triple bottom line approach in linguistic preferences. *Journal of Cleaner Production, 229*, 157–168.
Wu, Yimin, Chen, Zhixin, & Xia, Panpan (2018). An extended DEA-based measurement for eco-efficiency from the viewpoint of limited preparation. *Journal of Cleaner Production, 195*, 721–733. https://doi.org/10.1016/j.jclepro.2018.05.200. https://linkinghub.elsevier.com/retrieve/pii/S0959652618315464
Xu, J., Jiang, X., & Wu, Z. (2016). A sustainable performance assessment framework for plastic film supply chain management from a Chinese perspective. *Sustainability, 8*(10), 1042.
Xu, Y., Zhang, L., Yeh, C. H., & Liu, Y. (2018). Evaluating WEEE recycling innovation strategies with interacting sustainability-related criteria. *Journal of Cleaner Production, 190*, 618–629.
Yee, F. M., Shaharudin, M. R., Ma, G., Zailani, S. H. M., & Kanapathy, K. (2021). Green purchasing capabilities and practices towards Firm's triple bottom-line in Malaysia. *Journal of Cleaner Production, 307*, Article 127268.
Zhou, Z., Jiang, H., & Qin, L. (2007). Life cycle sustainability assessment of fuels. *Fuel, 86*(1–2), 256–263.
Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods, 18*(3), 429–472.