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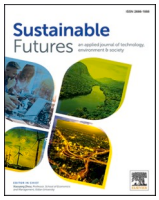

Mapping CSR/ESG challenges through double materiality: A comparative sectoral analysis for advancing the SDGs

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ABSTRACT

While the Sustainable Development Goals (SDGs) provide a global sustainability framework, limited research explains why firms in emerging economies struggle to integrate Corporate Social Responsibility (CSR) and Environmental, Social, and Governance (ESG) practices systematically. Prior studies often examine barriers in isolation, without distinguishing between financial and impact materiality or accounting for cross-sectoral variation. Addressing this gap, the present study integrates the double materiality perspective with Delphi assisted total interpretive structural model (D-TISM) and MICMAC analysis to uncover the structural interdependencies among CSR/ESG barriers across sectors and firm sizes in India.

Using a mixed-method design combining a systematic literature review, expert-based Delphi rounds, D-TISM modelling, MICMAC classification, and semi-structured interviews, the study identifies twelve interrelated barriers and classifies them into driving, linkage, dependent, and autonomous categories. The findings reveal that high-driving barriers particularly limited access to information and lack of government incentives that generate cascading effects across both financial and impact materiality dimensions. Moreover, barrier configurations differ significantly across sectors and firm sizes, highlighting that double materiality is operationalized unevenly in practice. By structurally mapping barrier interdependencies through a double materiality lens, this study advances sustainability scholarship beyond descriptive barrier identification and offers sector-sensitive strategies for firms, regulators, and policymakers seeking to accelerate CSR/ESG adoption and SDGs alignment in emerging economies.

1. Introduction

The Sustainable Development Goals (SDGs) were established by the United Nations in 2015, comprising 17 goals aimed at eradicating poverty, promoting equality, and safeguarding both society and the environment.[1] The SDG framework guides countries, institutions, and organizations toward sustainable and inclusive development. In the corporate context, SDGs are interpreted as initiatives such as 'being green,' achieving carbon neutrality, or reducing carbon footprints. Consequently, many organizations have integrated SDGs into their goals through Corporate Social Responsibility (CSR) and Environmental, Social, and Governance (ESG) practices, aiming to build a balanced and resilient future for their firms and nations [1,2]. India, among other nations, has embraced the concept of SDGs, with firms actively aligning their objectives accordingly [3]. Numerous policies and agendas have been developed to advance SDGs, making them a national priority, as reflected in the motto 'Sabka Saath, Sabka Vikas, Sabka Vishwas, Sabka Prayas,' echoing the SDGs' principle of 'Leaving No One Behind.[2]' Many Indian firms have also recognized this spirited endeavour and aligned their objectives with the SDGs.

Prior studies have clearly distinguished between "CSR" and "ESG." Corporate Social Responsibility, or CSR as defined by UNIDO, is a management concept that involves businesses incorporating social and environmental factors into their operations and interactions with

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[1] https://sdgs.un.org/goals
[2] https://unsdg.un.org/2030-agenda/universal-values/leave-no-one-behind

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stakeholders. CSR, sometimes known as the "Triple-Bottom-Line Approach," is widely seen as the process by which a business balances the demands of the economy, the environment, and society while also attending to the expectations of stakeholders and shareholders. However, the acronym "ESG" stands for Environmental (E), Social (S), and Governance (G) elements, which are assessed to determine organizational effect and sustainability [4]. Interestingly, CSR implicitly contains governance issues based on their impact on social and environmental variables, while ESG expressly includes governance [5]. Since both frameworks focus on the social and environmental performance of businesses, many studies have combined the ideas of CSR and ESG to improve insights into sustainability [6]. Although ESG and CSR differ slightly in scope and emphasis, both frameworks aim to enhance corporate sustainability performance. In this study, consistent with Chang et al. [7] and Gillan et al. [5], we use the terms interchangeably to explain their implications for sustainability. Therefore, it may be difficult for MSMEs (Micro, Small, and Medium Enterprises) and large companies to distinguish between ESG and CSR. While individual barriers may differ in emphasis e.g., regulatory and reporting barriers lean ESG-specific, while community engagement barriers lean CSR-specific the structural barriers examined here apply to both frameworks.

Highlighting the new idea of double materiality, which broadens the conventional definition of corporate sustainability, is crucial to advancing this conversation. Double materiality encompasses impact materiality, which considers how a company's operations affect society and the environment, in contrast to financial materiality, which concentrates on how environmental and social issues impact a company's financial performance. This dual viewpoint emphasizes the reciprocal relationship between sustainability and business: companies both impact and are influenced by ESG issues. Because it portrays businesses as both change agents and systemic risk subjects, integrating this perspective is especially important for coordinating CSR/ESG initiatives with the larger objectives of the SDGs. It also illustrates the moral duty placed on businesses to take into consideration the effects they have on society as a whole. Importantly, the relevance and operationalization of double materiality may vary across sectors, such as BFSI and manufacturing, where stakeholder expectations, regulatory pressures, and environmental impacts differ substantially. From a stakeholder theory and institutional lens, firms face varying levels of pressures to engage with CSR/ESG, particularly in contexts like India where the institutional environment is evolving [8]. The ethical demands placed on businesses by governments, investors, and customers to go above and beyond compliance and actively support sustainable development amplify these pressures [9,10].

Despite India's focused efforts, the country still lags in achieving its Sustainable Development Goals (SDGs), ranking 109 out of 167 countries.[3] While firms may contribute to SDGs either intentionally through CSR/ESG initiatives or incidentally via ethical practices, the adoption of such standards remains challenging. Achieving CSR/ESG benchmarks is often hindered by structural, organizational, and policy-level barriers, making widespread implementation difficult. These challenges span from firm-level constraints to systemic national-level issues, underscoring the complexity of aligning business practices with SDG targets. Integrating ESG and CSR into business models is therefore critical and requires coordinated, cross-sectoral efforts to ensure inclusive and sustainable development.

Previous studies have explored these challenges. For instance, Bux et al. [11], using ISM-MICMAC, identified a lack of resources, regulations, and policy incentives as key barriers to CSR in Pakistan. In India, Dixit and Priya [8] used ISM to highlight how limited access to CSR knowledge deters engagement. Similarly, Parameswaran et al. [12], through m-TISM and MICMAC, emphasized that ambiguity in regulatory and reporting standards impedes ESG adoption. However, prior studies exhibit three key limitations. First, most research identifies CSR/ESG barriers descriptively without distinguishing between financial materiality (how ESG affects firm performance) and impact materiality (how firms affect society and the environment). Second, existing ISM or MICMAC-based studies largely focus on single-sector or firm-level analyses, overlooking sector-wise and firm-size variations in materiality exposure. Third, limited research integrates a double materiality perspective with interpretive structural modelling to uncover the hierarchical and causal interdependencies among barriers. Addressing these gaps, the present study integrates the double materiality lens with Delphi-assisted D-TISM and MICMAC to conduct a cross-sectoral and firm-size comparative analysis in the Indian context.

While prior research predominantly examines firm-level CSR/ESG barriers, this study advances the literature by offering a sector-wise and firm-size comparative analysis grounded in the double materiality framework. By integrating Delphi-assisted D-TISM and MICMAC, we move beyond descriptive identification of barriers to structurally mapping their hierarchical and causal interrelationships. This approach provides both theoretical advancement and sector-sensitive managerial insights.

RQ1: What barriers do Indian firms face in integrating CSR/ESG initiatives to achieve the SDGs when examined through the lens of financial and impact materiality (double materiality)?

RQ2: How do the identified barriers interconnect within each sector, and how do these interconnections reflect sector-specific variations in financial and impact materiality?

RQ3: How can these barriers be assessed to develop a sector-sensitive framework that supports practitioners and managers in advancing CSR/ESG integration through the lens of double materiality?

To address research questions, we integrate insights from relevant theoretical frameworks and expert perspectives to identify the key barriers hindering CSR and ESG adoption in Indian firms, with specific attention to the dual lens of double materiality how firms are both affected by and contribute to ESG-related outcomes. Drawing on extensive literature and semi-structured interviews with senior-level managers, we first extract and validate a comprehensive set of barriers. To explore the interconnections among these barriers and their sector- and size-specific dynamics, we employ D-TISM and MICMAC analysis. This methodological approach enables us to uncover both structural and causal relationships, reflecting the two-way interaction between firms and their socio-environmental contexts.

The structure of the paper is as follows: Section 2 presents a comprehensive review of literature, focusing on the ethical, organizational, and regulatory challenges related to CSR/ESG adoption and their implications for achieving the SDGs. In light of current GDP distribution in India where the service and manufacturing sectors contribute approximately 82%,[4] the analysis focuses on these sectors. Within services, IT/ITES and BFSI are separately considered due to their economic significance and unique ESG profiles. We further conduct a comparative analysis based on firm size (large firms vs. MSMEs) to highlight differences in resource capabilities, stakeholder pressures, and materiality exposure. Section 3 details the identification of barriers and the construction of a structural model using D-TISM and MICMAC. Section 4 discusses the findings, offering theoretical insights and managerial strategies tailored to double materiality and sectoral contexts. The paper concludes with limitations and future research directions.

2. Literature review

The research methodology employed in this study adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, as depicted in Fig. 1. The PRISMA process consists of four stages: Identification, Screening, Eligibility, and Inclusion.

[3] https://dashboards.sdgindex.org/rankings

[4] https://pib.gov.in/PressReleseDetailm.aspx?PRID=2022323

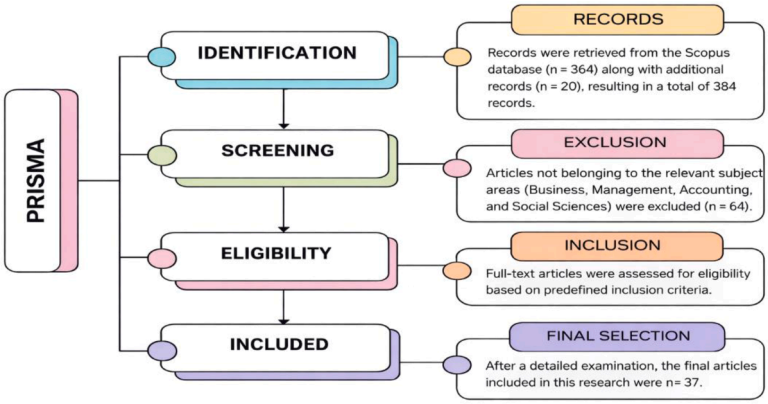

Fig. 1. PRISMA model of the present study.

The search strategy was developed using relevant keywords related to CSR/ESG, barriers, firms, and the Indian context. The detailed search string is provided in Appendix A. The literature review was conducted using the Scopus database, which includes a variety of scientific and scholarly journals related to the topic of sustainability. Only peer-reviewed journals published between 2010 and 2024 were considered in this search. The string used within the Scopus database to search for relevant literature was as follows: TITLE-ABS-KEY (("CSR" OR "Corporate Social Responsibility" OR "ESG" OR "Environmental Social Governance") AND (“barrier*” OR “challenge*” OR “obstacle*”) AND (“India” OR “emerging economy”)). Through this search, 384 records were identified (Scopus n = 364; additional records n = 20). From these initial records, 64 articles related to the relevant subject areas for the literature review (Business, Management, Accounting, and Social Sciences) were identified. Of these 64 articles, 37 passed the title and abstract screening and were determined to relate to the topic of CSR/ESG barriers within emerging markets, particularly India. These articles were then assessed on a full-text basis to determine their inclusion in the literature review. The screening of titles and abstracts was performed by two independent researchers, with any disagreements resolved through discussion between the two researchers and a third reviewer. Articles were included if they were peer-reviewed and contained empirical and/or conceptual knowledge regarding corporate social responsibility and its barriers in emerging markets, specifically India. Non-English articles, grey literature, and editorials were excluded. Data regarding the identified barriers were obtained through open coding of the articles and grouping similar codes into 17 initial barriers.

The reviewed studies employ diverse methodological approaches, including qualitative case studies, survey-based empirical analyses, and conceptual frameworks. While qualitative studies provide rich contextual insights into firm-level barriers, quantitative studies tend to generalize findings across sectors. This methodological diversity partly explains inconsistencies in identifying and prioritizing CSR/ESG barriers, highlighting the need for a structured and integrative approach.

2.1. Corporate sustainability and the shift toward double materiality in india

The formulation and implementation of the SDGs and CSR initiatives in India evolved concurrently. While CSR initiatives have provided structured mechanisms for operationalizing SDGs in India, prior studies diverge on their effectiveness. Some scholars argue that regulatory mandates such as the Companies Act (2013)[5] have institutionalized sustainability practices, whereas others highlight that such compliance-driven approaches often result in symbolic adoption rather than substantive integration.

Recent CSR expenditure patterns indicate strong corporate focus on education, healthcare, rural development, and environmental sustainability (MCA CSR Data; KPMG[6]). Simultaneously, regulatory reforms such as SEBI’s Business Responsibility and Sustainability Report[7] (BRSR) have shifted firms from a single-materiality perspective toward a double materiality approach, requiring disclosure of both financial risks and societal impacts [13].

Double materiality distinguishing between financial materiality (impact of ESG on the firm) and impact materiality (impact of the firm on society and environment)—represents a conceptual shift in sustainability governance [14]. In the Indian context, this dual lens is particularly significant, as firms must simultaneously respond to regulatory compliance pressures and developmental expectations aligned with the SDGs. Despite progress in reporting, firms continue to face challenges in embedding ESG considerations into organizational culture, strategic planning, and resource allocation. This tension between disclosure compliance and substantive integration underscores the need to examine structural barriers through a double materiality lens.

2.2. Barriers indian firms' experience

A positive trend toward sustainable development is the adoption of CSR/ESG initiatives by Indian companies. Growing awareness, a move toward integrated sustainability frameworks, and proactive corporate actions that demonstrate a commitment to the Sustainable Development Goals (SDGs) all promote this trend. Comprehensive ESG integration is nevertheless hampered by issues such a lack of money, regulatory uncertainty, a lack of experience, and a lack of resources.

The concept of double materiality provides a clearer understanding of these challenges. Double materiality highlights a two-way relationship how ESG concerns influence the firm and how the firm's activities impact the environment and society in contrast to traditional financial materiality, which simply considers how ESG issues affect corporate performance. Given the dual imperatives of sustainable development and economic growth, the concept of double materiality is particularly relevant for Indian businesses. It highlights that firms face not only financial risks but also internal challenges arising from increasing expectations of communities, consumers, and regulators regarding their social and environmental impacts. The double materiality perspective encourages Indian businesses to go beyond compliance, acknowledging

[5] https://www.icsi.edu/media/webmodules/companiesact2013/CSR%20Final%2002022015.pdf

[6] https://indiacsr.in/wp-content/uploads/2023/10/India-CSR-Outlook-Report-2023.pdf

[7] https://www.sebi.gov.in/sebi_data/meetingfiles/apr-2023/1681703013916_1.pdf

that ESG and CSR are strategic levers that influence stakeholder trust and social value in addition to being instruments for risk mitigation. It reinterprets hurdles as obstacles to organizations' ability to align with both financial and impact materiality dimensions. For example, leadership lethargy, poor stakeholder involvement, and a lack of standardization are no longer merely internal inefficiencies.

Double materiality can be used to reinterpret the Four Ps Model for Sustainable Development via People, Planet, Prosperity, and Partnerships in this perspective, establishing businesses as both actors and influences in the sustainability ecosystem. Indian businesses must create comprehensive, forward-looking strategies based on materiality evaluations that take into account both financial exposure and societal effect in order to improve SDG adoption. Although the desire to achieve the SDGs is admirable, companies must recognize and respond to the dynamic connections between their external influence and internal capabilities.

2.3. Theoretical background: toward a double materiality lens

To strengthen the conceptual foundation of this study, we position double materiality as the integrative lens through which CSR/ESG barriers are interpreted. Double materiality distinguishes between:

(1) financial materiality — how environmental and social issues affect firm performance; and
(2) impact materiality — how firms affect society and the environment [14].

We explicitly map these two dimensions onto complementary theoretical foundations.

Financial materiality is primarily explained through internal firm-level theories, which emphasize how managerial cognition and resource constraints shape firms' ability to respond to ESG demands. Managerial Cognition Theory suggests that leadership myopia, short-term profit orientation, and bounded rationality constrain long-term ESG integration [15]. Resource Dependence Theory further explains how limited financial, technological, and human resources restrict CSR/ESG adoption [16]. Together, these theories clarify how internal financial exposure and capability constraints shape ESG responses.

In contrast, impact materiality is grounded in external-facing theories. Stakeholder Theory explains how firms are pressured by customers, regulators, communities, and investors to address societal expectations [17]. Legitimacy Theory further posits that firms must align with social norms and institutional expectations to maintain credibility and social license to operate [18]. Institutional Theory reinforces how regulatory structures and governance mechanisms influence ESG adoption [9].

By explicitly integrating these perspectives, double materiality serves as a bridging framework connecting internal financial constraints with external societal pressures. This dual mapping advances existing CSR/ESG literature by demonstrating that barriers persist not merely due to isolated firm-level weaknesses, but due to structural misalignment between financial and impact materiality dimensions—a tension particularly salient in emerging economies such as India.

However, existing studies have not explicitly examined how these barriers simultaneously affect financial and impact materiality dimensions, thereby limiting a holistic understanding of ESG adoption challenges.

The identified barriers can be explicitly interpreted through these theoretical lenses. Barriers such as resource constraints, lack of infrastructure, and high perceived cost reflect Resource Dependence Theory, as they indicate limitations in accessing critical financial and technological resources. Similarly, short-term profit orientation and lack of leadership commitment align with Managerial Cognition Theory, highlighting bounded rationality and managerial biases that hinder long-term ESG integration. In contrast, barriers such as limited stakeholder engagement, lack of trust, and lack of accountability are better explained through Stakeholder and Legitimacy theories, as they reflect pressures arising from external expectations and the need for social acceptance. Furthermore, regulatory uncertainty and lack of standardization correspond to Institutional Theory, indicating the role of weak or evolving governance structures in shaping firm behaviour.

Importantly, the structural relationships identified through TISM further reinforce these theoretical linkages. Internal barriers associated with financial materiality tend to occupy foundational levels in the hierarchy, indicating their role as root causes that constrain firm capabilities. In contrast, externally driven barriers linked to impact materiality emerge at higher levels, reflecting their manifestation as pressures and outcomes shaped by underlying internal limitations. This hierarchical structuring provides empirical support for the dual theoretical framing, demonstrating that ESG barriers are not isolated but systematically organized across internal and external dimensions.

2.3.1. Operationalizing double materiality in the context of csr/esg barriers

To operationalize the concept of double materiality in the present study, each identified CSR/ESG barrier was classified according to its relationship with financial materiality, impact materiality, or both. This classification was developed through an interpretation of the literature on each identified barrier, as well as through expert feedback during the Delphi rounds.

More specifically, financial materiality relates to the way each barrier impacts a firm's financial performance, resources, and financial sustainability. In contrast, impact materiality relates to the way each barrier affects a firm in relation to society, the environment, or regulatory requirements. Finally, barriers classified as "Both" affect a firm in relation to both of these concepts.

For instance, barriers such as "Resource Constraints" and "High Perceived Fee/Cost" were classified as having a relationship with financial materiality, as these factors can prevent firms from having the resources necessary to implement CSR and ESG practices. Similarly, barriers such as "Poor Regulatory Framework" and "Lack of Standardization" were classified as related to impact materiality, as these factors can limit a firm's ability to create a positive impact on society or the environment. Finally, barriers such as "Lack of Awareness" and "Limited Integration with Business Strategy" were classified as related to both financial and impact materiality, as these factors affect a firm's internal performance as well as its potential to create a positive societal and environmental impact.

During the Delphi process, experts were also asked to review the materiality classification of each identified barrier. Consensus was achieved when at least 75% of the experts assigned the same classification to a given barrier. Based on expert feedback during the study, only minor changes were made to the classifications before finalizing them, as presented in Table 5.

The initial 17 barriers identified through the systematic literature review exhibited significant conceptual overlap. For instance, "limited collaboration" and "limited stakeholder engagement" both reflect deficiencies in external relational capabilities, while "lack of infrastructure" and "resource constraints" capture similar capacity limitations. To address this redundancy, a Delphi-based refinement process was employed, wherein experts iteratively evaluated and consolidated overlapping constructs. This resulted in 12 distinct barriers that more accurately represent systemic challenges while ensuring conceptual clarity and parsimony for subsequent modelling Table 6.

These 17 barriers were subsequently refined through Delphi consensus into 12 core barriers that better reflect systemic challenges within the Indian context. This refinement ensured conceptual parsimony and avoided redundancy before structural modelling using D-TISM.

Despite extensive research on CSR/ESG adoption, three key gaps remain. First, existing studies predominantly examine barriers in isolation, without capturing their structural interdependencies. Second, prior

research largely adopts either a firm-centric (financial materiality) or stakeholder-centric (impact materiality) perspective, with limited integration of both. Third, there is a lack of context-specific modelling of barriers within emerging economies such as India. Addressing these gaps, this study adopts a double materiality lens and employs D-TISM to systematically identify and structure CSR/ESG barriers. The literature reveals that CSR/ESG barriers are not isolated but clustered around key themes. These include (1) resource and capability constraints, (2) institutional and regulatory challenges, and (3) strategic and managerial limitations. Importantly, these barriers are interrelated for instance, lack of leadership commitment often reinforces weak stakeholder engagement, while regulatory ambiguity exacerbates strategic misalignment. This indicates that barriers operate as a system rather than independent factors Table 1 and 1a.

2.4. Various sectors

This study focuses on IT/ITES, Manufacturing, BFSI, Services & Utilities, and firm-size comparison (Large vs MSMEs) due to their economic significance and differentiated ESG exposure. The selection of these sectors enables examination of how financial and impact materiality pressures vary structurally across industries and firm sizes. For instance, manufacturing firms face higher environmental impact materiality, whereas BFSI firms face stronger financial and governance materiality pressures. MSMEs, conversely, experience acute resource dependence and information asymmetry. By adopting a sector-wise lens, the study moves beyond generic firm-level analysis and captures contextual heterogeneity in barrier structures, thereby strengthening its contribution to both theory and practice as presented in Table 2.

3. Methodology

3.1. Delphi study

When examining subjects with little to no research, the Delphi procedure is a reliable empirical technique for reaching consensus among experts. In this study, a consensus threshold of 75% agreement (at least 5 of the 7 experts) was adopted for retaining, merging, or refining barriers across the two Delphi rounds. The Delphi technique's thorough expert investigation makes it superior to alternatives like surveys [35]. Additionally, it makes it possible for several decision-makers from various professions to contribute with a fair amount of effort. Its worth is further increased by providing experts with iterative rounds to reevaluate their initial thoughts on the subject. During several meetings or iterations, the Delphi technique collects, synthesizes, and presents inputs to the expert panel for additional assessment [36]. Its application spans various domains including policy formulation, strategic decision-making, and resolving complex multidimensional issues through consensus. Consensus stability was confirmed in Round 2 when no barrier received fewer than 5/7 expert agreements ($\geq$75%), and no new barriers were introduced — indicating saturation.

In addition to validating the barriers, the Delphi panel was asked to assess the materiality orientation of each barrier (financial, impact, or both). Experts evaluated whether each barrier primarily affected internal firm performance, external societal/environmental outcomes, or both simultaneously. The final categorization was retained only after achieving consensus among at least 75% of the expert panel.

3.2. TISM–MICMAC method

To examine relationships among factors, DEMATEL and Interpretive Structural Modelling (ISM) are commonly used in decision-making. DEMATEL explores cause-and-effect links, while ISM decomposes complex problems into a bottom-up hierarchical model for structured decision support. However, a major limitation of ISM lies in its limited interpretive justification for the established relationships. To overcome

Table 1
Barriers to CSR/ESG adoption: SLR using PRISMA guidelines.

S. no	Barrier	Description	Source
1	Lack of Awareness	Many Indian firms lack awareness regarding CSR/ESG principles, including their benefits and effective implementation strategies.	Kulkarni & Aggarwal, [19]; Ganguly et al., [20]; Goyal & Kumar [21]; Muthiah [22]
2	Resource Constraints	Limited financial, human and technological resources pose significant challenges for Indian firms in undertaking CSR/ESG initiatives.	Ganguly et al., [20]; Madaan et al., [23]; Kumar et al., [3]
3	Short-term Profit Orientation	Some Indian firms prioritize short-term profit gains over long-term sustainability and societal responsibilities.	Kumar et al., [3]; Arevalo & Aravind, [24]
4	Regulatory Framework	Despite the mandatory CSR spending stipulated by the Indian Companies Act of 2013, a comprehensive regulatory framework for CSR/ESG remains lacking.	Kulkarni & Aggarwal, [19]; Ganguly et al., [20]; Mishra et al., [25]
5	Lack of Standardization	The absence of standardized CSR/ESG implementation approaches in India hinders firms from benchmarking against industry best practices.	Mishra et al., [25]; Singh et al., [26]
6	Limited Stakeholder Engagement	Engaging stakeholders such as communities, NGOs, and employees are often lacking in the development and execution of CSR/ESG initiatives.	Jumde & Du Plessis, [27]; Arora & Sharma [1]
7	Limited Integration with Business Strategy	CSR/ESG initiatives are frequently viewed as separate from core business strategies, diminishing their impact.	Kalagnanam & Rajeev [28]; Jha & Aggarwal [29]; Arevalo & Aravind, [24]
8	Lack of Trust	Stakeholders' lack of trust in firms' ability to effectively implement CSR/ESG initiatives may deter investment in such endeavours.	Subramaniam et al., [30]
9	Time Consuming & complex	CSR/ESG principles can be time consuming and complex in nature.	Goyal & Kumar [21]; Arevalo & Aravind, [24]
10	Lack of Leadership Commitment	Strong leadership commitment is crucial for successful CSR/ESG implementation, yet it may be lacking in some firms.	Ganguly et al., [20]; Kumar et al., [3]; Singh et al., [26]; Goyal & Kumar [21]; Arevalo & Aravind, [24]
11	Limited Access to Information	Some Indian firms face challenges in accessing comprehensive information on CSR/ESG best practices and success stories.	Kulkarni & Aggarwal, [19]; Ganguly et al., [20]; Govindan [31]
12	Limited Collaboration	Collaboration with other firms, NGOs, and governmental bodies is essential for effective CSR/ESG initiatives but may be limited due to competition concerns.	Bergman et al. [32]; Bernier & Almasi, [33]

(continued on next page)

Table 1 (*continued*)

S. no	Barrier	Description	Source
13	Lack of Accountability	Some firms lack the necessary mechanisms to ensure accountability in CSR/ESG endeavours, hindering proper monitoring and evaluation.	Jumde & Du Plessis, [27]
14	Lack of Clarity on Impact	Uncertainty regarding the societal and environmental impact of operations complicates the development of targeted CSR/ESG initiatives.	Mishra et al., [25]; Arevalo & Aravind, [24]
15	High Perceived Fee/ Cost	Perceived high costs associated with CSR/ESG initiatives may discourage firms from investing in them.	Gupta & Aggarwal, [34]; Kalagnanam & Rajeev [28]; Arora & Sharma [1]; Kumar et al., [3]; Arevalo & Aravind, [24]
16	Lack of infrastructure	Inadequate infrastructure poses challenges for firms in effectively implementing CSR/ESG initiatives.	Ganguly et al., [20]; Goyal & Kumar [21]
17	Lack of rewards and encouragement from Government	A lack of government incentives and encouragement may dampen firms' motivation to engage in CSR/ESG activities.	Bergman et al. [32]; Subramaniam et al., [30]; Bernier & Almasi, [33]

this, Total Interpretive Structural Modelling (TISM) adds transparency by incorporating expert reasoning. Experts are asked interpretive questions, providing explicit rationales for each linkage. To further classify the factors, MICMAC analysis is used, relying on the interpretive links from TISM to categorize elements based on driving and dependence power. This study adopts an integrated Delphi–TISM–MICMAC approach, combining expert consensus with structural modelling and classification. The following section outlines the steps involved Fig. 2.

3.3. Proposed integrated Delphi–TISM–MICMAC method

The proposed integrated method consists of three phases. In Phase I, the Delphi method was adopted to finalize the proposed barriers. In Phase II, the TISM method was used to understand the interrelationships among the barriers, and in Phase III, MICMAC analysis was applied to categorize them. The detailed method is discussed below (Fig. 3).

Phase 1 – Delphi Study.

Step 1: Identifying Barriers.

A comprehensive literature review was conducted to identify potential barriers to ESG adoption. A panel of experts finalized these through multiple Delphi rounds, continuing until consensus was reached. The finalized barriers became inputs for the TISM process.

Phase II – TISM-Based Interrelationship Analysis.

Step 2: Interpretation Knowledge Database.

Pairwise contextual relationships among barriers were evaluated by Indian corporate managers. For each pair, respondents indicated whether Barrier A influences Barrier B (Yes/No). If 'Yes', they provided justification, forming the interpretive knowledge base. To convert the qualitative assessments into the initial reachability matrix, a 50% majority threshold was applied. A relationship was recorded as "1″ only if a simple majority of respondents agreed on the influence. This threshold balances consensus with diversity of expert judgment, avoiding overly restrictive cut-offs while ensuring that retained linkages reflect collective agreement. A higher threshold could eliminate meaningful but context-specific relationships, whereas a lower threshold may introduce noise; therefore, a simple majority is appropriate for capturing dominant causal patterns in TISM-based modelling.

Step 3: Reachability Matrix and Transitivity Check.

Responses were translated into a binary matrix (Yes = 1, No = 0), producing the initial reachability matrix. A transitivity check was then performed (e.g., if A→B and B→C, then A→C), resulting in the final reachability matrix.

Step 4: Level Partitioning.

From the final matrix, antecedent and reachability sets were derived. Their intersection determined the hierarchical level of each barrier. Barriers with identical reachability and intersection sets were placed at the top level (Level I), and this was repeated iteratively.

Step 5: TISM Model Construction.

A threshold of mean score ≥ 3 (on a 5-point Likert scale) was adopted for retaining links in the final TISM model. This cut-off represents influence above neutrality and ensures that only substantively meaningful relationships are preserved. In line with prior TISM and ISM-based studies, this threshold distinguishes between weak (below neutral) and meaningful (above neutral) relationships, thereby improving model interpretability without overfitting the structure. By excluding weak or marginal associations, this criterion enhances the structural robustness of the final TISM model.

Phase III – MICMAC Analysis.

To classify the barriers, MICMAC analysis [37] was applied using the driving and dependence scores from the final reachability matrix. Barriers were grouped into Autonomous, Linkage, Dependent, and Driving categories. This graphical representation helps managers assess the strategic importance and influence of each barrier for effective ESG implementation.

Overall, the methodological choices in this study are guided by the need to balance analytical rigor with the exploratory nature of CSR/ESG barrier identification. The combination of Delphi consensus, TISM structural modelling, and MICMAC classification enables both validation and interpretation of complex interrelationships, ensuring

Table 1a
Research gap matrix comparing prior studies with the present study.

Study (Author, Year)	Country	Method	Sectors	Materiality Lens	Limitation Addressed by Present Study
Bux et al. [11]	Pakistan	ISM–MICMAC	Manufacturing	Financial (resource & cost)	Limited to one country and one sector; no double materiality lens
Goyal & Kumar [21]	India	ISM–MICMAC	Manufacturing	Financial (firm-level)	Single-sector; no firm-size comparison or materiality framing
Kumar et al. [3]	India	Fuzzy AHP	Services	Financial (firm-level)	Single-sector; ranks barriers without structural interdependencies
Dixit & Priya [8]	India	ISM	SMEs (cross-sector)	Financial (awareness/ knowledge)	Single firm-size focus; no impact materiality perspective
Parameswar et al. [12]	India	m-TISM, MICMAC	Cross-sector (ESG)	Impact (regulatory/ reporting)	No sectoral comparison or firm-size analysis; lacks double materiality lens
Present Study	**India**	**Delphi + D-TISM + MICMAC**	**BFSI / IT-ITES / Manufacturing / Services + Large vs MSME**	**Both (Double Materiality)**	**Integrates cross-sector + firm-size comparison through the double materiality lens**

Table 2
Sectors: Economy, CSR/ESG challenges, research focus, and rationale.

Sector	Contribution to Indian Economy	Challenges towards CSR/ESG	Rationale
IT/ITES	- Expected to account for 10% of India's GDP by 2025	- Low labour productivity - Limited access to basic services for the poor -Weak infrastructure - Disparities in education quality	- High potential for CSR due to educated and youthful workforce - Active empowerment of women for SDGs - Significant GDP contribution anticipated - Commitment to SDGs makes understanding CSR/ESG barriers crucial
MSME	- Contributed 29.1% to All India GDP in FY 2021–22. - Projected growth is 7% in FY 24	- Difficulty in implementing CSR activities - Environmental conservation - Recycling - Adherence to ethical standards	- Vital for socioeconomic development - Challenges in CSR/ESG reflect broader sectoral issues - Government initiatives underscore importance - Examining barriers aids in enhancing socioeconomic impact through CSR/ESG initiatives
Manufacturing	- 4.7% annual production growth rate in FY 2023	- Inadequate infrastructure - Poor connectivity - Relevance of financial services - Sociocultural barriers	- Significant GDP contributor and employment generator - CSR/ESG challenges pivotal for sustainable growth - Government focus on 'Make in India' highlights sector's importance - Addressing barriers can inform policies for achieving SDGs through manufacturing
BFSI	- Fintech market valued at $50 billion in 2021. - Projected to hit $150 billion by 2025	- Inadequate infrastructure - Poor connectivity - Relevance of financial services - Sociocultural barriers	- Rapid technological advancements present CSR/ESG challenges - BFSI sector pivotal for financial inclusivity and sustainability - Challenges in CSR/ESG adoption crucial for sector transformation towards sustainability
Service & Utilities	- Contributes 53% to India's Gross Value Added in FY22 - Services market is also set to reach US$ 19.93 billion by 2025	- Employment issues - Limited access to basic services for the poor - Weak infrastructure - Disparities in education quality	- Key driver of economic growth - Challenges in CSR/ESG directly impact service delivery and sustainable development - Understanding sectoral barriers crucial for aligning with SDGs and promoting sustainable development

robustness of findings despite the inherent complexity of the research context.

3.4. Data collection procedure

For the initial phase, a subject expert team of seven members was formed, comprising four senior managers from the Indian corporate sector and three accomplished academicians. While the panel size may appear small, it aligns with methodological guidance suggesting that a panel of 5–15 experts is adequate for Delphi applications, provided the participants possess significant domain knowledge and represent diverse perspectives (Okoli & Pawlowski, 2004). The inclusion of both high-level industry practitioners and researchers ensured a "heterogeneous" panel, which is vital for enhancing the validity and robustness of consensus in exploratory ESG research. By balancing practical corporate insights with theoretical rigor, the panel was better equipped to identify and validate complex CSR/ESG challenges across different sectors. Although the panel size ($n = 7$) may appear modest, Delphi research prioritizes expertise heterogeneity over numerical magnitude. Given the exploratory and structural nature of this study, theoretical saturation was achieved after two rounds, as no new barriers emerged in Round 2. This convergence indicates stability of expert judgment rather than dependence on panel size alone. Furthermore, prior Delphi-based studies in exploratory and structural modelling contexts have successfully employed small expert panels where domain expertise is high and the problem is complex. In such cases, reliability is ensured through iterative consensus and convergence rather than sample size alone. The stability observed after two rounds in this study further confirms the adequacy of the panel.

Further, for Phase II, 330 respondents were invited to participate in the study, which included independent presidents, Senior Manager/General Manager, CSR Implementation Managers and so on from the sectors considered for this study. It is ensured that experts were professionals with practical experience in the area of ESG/CSR adoption. In total, 253 respondents agreed to participate in the study, which involved Government and non-government organizations. All experts were from Indian states. The questionnaire was shared with researchers personally, and their responses were collected and recorded. The details of the respondents are presented in Table 3.

3.5. Methodological limitations and transparency

It is important to note the sector-wise composition of the respondents. A large proportion of responses came from the manufacturing sector ($n = 140$), while the representation from the IT/ITES sector was comparatively smaller ($n = 19$). This pattern broadly reflects the existing industrial structure of the regions covered in the survey. To address any possible bias toward asset-intensive ESG issues arising from this imbalance, the study followed a two-step analytical approach. First, an overall TISM model was developed using the complete dataset to capture common ESG relationships across sectors. Second, to improve sector-specific relevance, separate refinements were carried out by consulting experts from individual sectors. By incorporating these sectoral expert insights into the overall framework, the study ensures that the perspectives of IT/ITES and other smaller sectors are adequately represented and not dominated by manufacturing-centric concerns. While the present results offer a strong cross-sectoral foundation, the overrepresentation of manufacturing firms may influence the relative driving power of certain barriers. Future studies employing stratified sampling could further validate the sectoral robustness of the structural relationships identified.

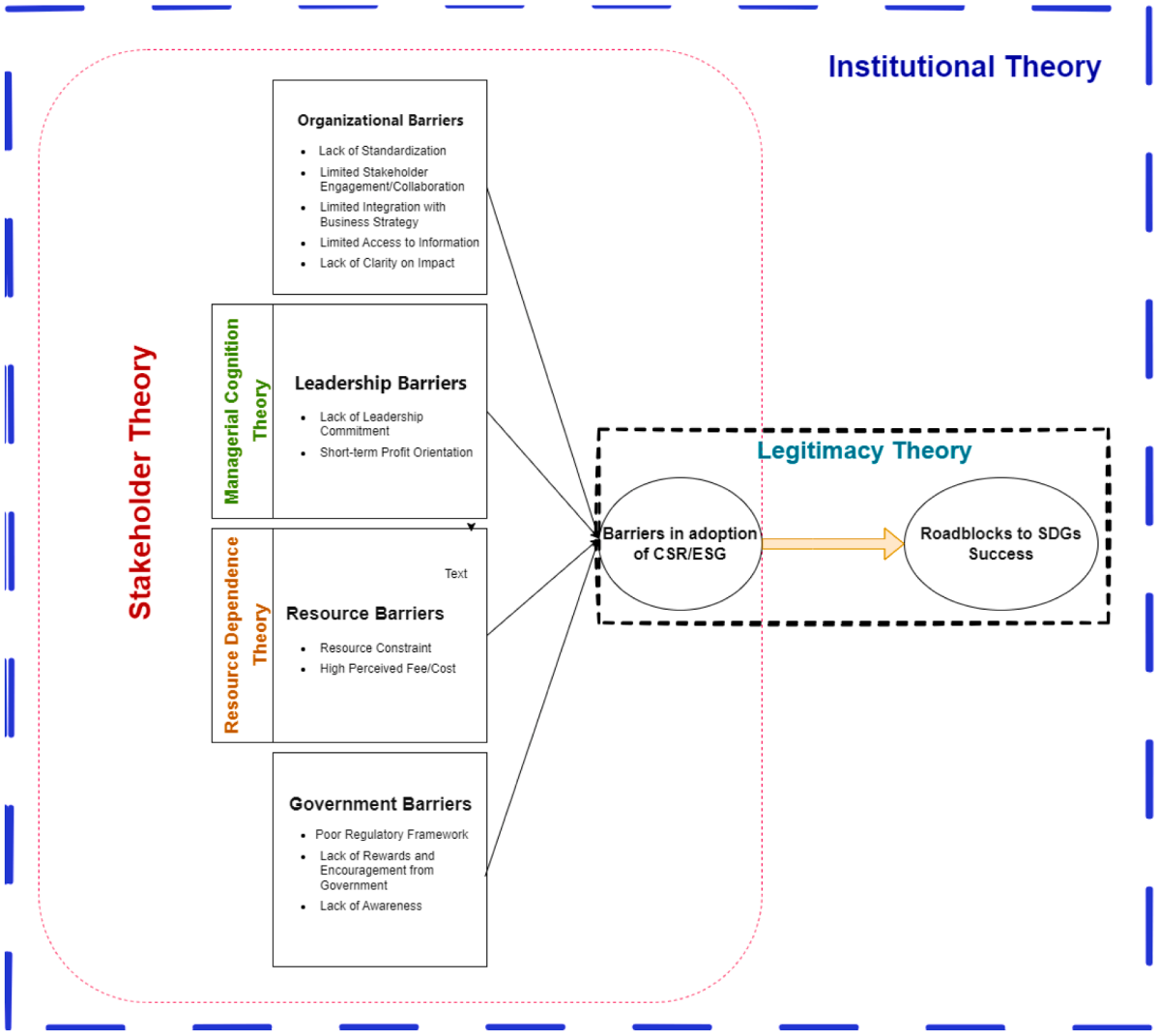

Fig. 2. Theoretical model.

4. Results

4.1. Results of Delphi rounds (Phase 1)

Two Delphi rounds were conducted with subject expert team, starting with the pilot meeting, which scaled the objective of the study, including discussions over the barriers that affects ESG implementation. The experts' panel objective was to assess and attain a consensus on the barriers proposed initially, satisfying the following criteria for evaluation namely importance, internal coherence, parsimony, and experiential sufficiency. The details of results from round 1 and round 2 are presented below. In the first round of the Delphi process, the experts' comments on each barrier were gathered initially. The comments from all experts were consolidated, and the refined barriers resulting from Round 1 are presented in Table 4. The 17 barriers identified from the literature are reduced to 12 at the end of round 1. In the second round, experts were asked whether the changes made were consistent. In round 2, experts have not suggested making any significant changes in the list of 12 barriers, however, there are few suggestions to reframe the barriers to make it more consistent with the objective. Table 4 summarizes the modifications made during Round 1 and Round 2 of the Delphi process, while Table 5 presents the final set of 12 validated barriers used for subsequent analysis. The Delphi process resulted in the consolidation of 17 initial barriers into 12 validated barriers, reflecting conceptual refinement and elimination of overlaps. This final set provides a focused and structured foundation for subsequent TISM analysis.

The validated barriers reveal that CSR/ESG adoption challenges are distributed across both financial and impact materiality dimensions. Financially oriented barriers such as resource constraints and perceived costs primarily influence internal organizational capacity, whereas impact-oriented barriers such as regulatory weakness and lack of standardization shape firms' external accountability and stakeholder legitimacy. Importantly, several barriers operate simultaneously across both dimensions, supporting the argument that CSR/ESG adoption in emerging economies is inherently embedded within a double materiality structure.

4.2. Results of TISM (Phase II)

The objective of the study is to conduct inter-sector analysis for Indian scenario. The sectors considered for this study are ITES, manufacturing, and service & utilities. Further, on the basis of firm size, the companies are divided into the MSME and large-scale sectors. The results obtained by adopting the TISM method are presented below.

4.2.1. TISM model for barriers to CSR/ESG adoption across sectors in the Indian scenario

The 12 validated barriers were subjected to TISM analysis using

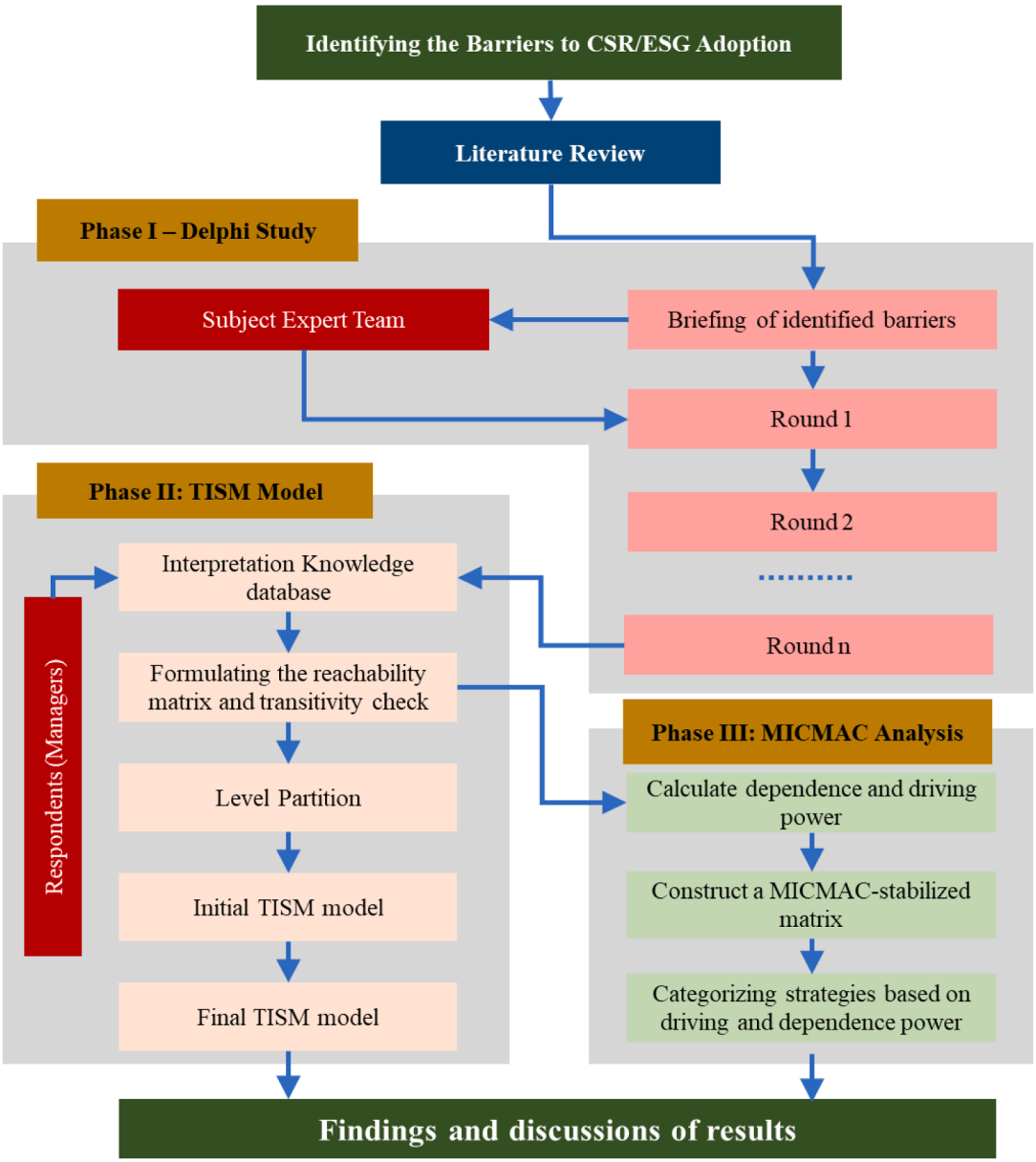

Fig. 3. Proposed integrated methodology.

Table 3
Business demographics and statistics.

Category	Subcategory	Number of Firms- 253
Business Structure	Public	167
	Private	86
Business Size	MSME	106
	Large	147
Business Age	01–25 years	67
	26–50 years	110
	51–100 years	66
	101–150 years	9
	>150 years	1
Business Sector	BFSI	39
	IT/ITES	19
	Manufacturing	140
	Service and Utilities	55

responses from 253 experts. Following transitivity checks and expert validation, 47 significant linkages were retained to construct the final structural model (Fig. 4). The resulting hierarchy and driving–dependence patterns are presented in Tables 7, 8, and 9.

The reachability analysis highlights that barriers such as B12 (lack of government support), B4 (regulatory framework), and B10 (lack of clarity on impact) exhibit high driving power, indicating their role as foundational constraints. In contrast, barriers such as B7 (strategic integration) and B8 (leadership commitment) show higher dependence, suggesting that they are outcomes of upstream structural factors.

The level partitioning further confirms a hierarchical structure in which external and informational barriers occupy higher driving levels, while strategic and leadership-related barriers appear at lower levels. This indicates that internal organizational challenges are largely shaped by upstream institutional and resource constraints.

4.2.2. TISM model for other considered sectors

The structural analysis reveals three dominant patterns. First, external regulatory and government-related barriers (e.g., B12 and B4) demonstrate strong driving power across sectors. Second, internal managerial and resource constraints (e.g., B2, B3, and B6) act as linkage barriers, amplifying systemic instability. Third, strategic integration

Table 4
Results of the Delphi technique.

Round 1 – Delphi			Round 2 – Delphi	
Barriers identified through literature	**Actions taken**	**Outcome**	**Actions taken**	**Outcome**
Lack of Awareness	Retained	Lack of Awareness	Finalized	Lack of Awareness
Resource Constraints	Merged	Resource Constraints	Finalized	Resource Constraints
Lack of infrastructure				
Profit Orientation	Refined	Short-term Profit Orientation	Finalized	Short-term Profit Orientation
Regulatory Framework	Refined	Poor Regulatory Framework	Finalized	Poor Regulatory Framework
Lack of Standardization	Retained	Lack of Standardization	Finalized	Lack of Standardization
Limited Stakeholder Engagement	Merged	Limited Stakeholder Engagement/ Collaboration	Finalized	Limited Stakeholder Engagement/ Collaboration
Lack of Trust				
Limited Collaboration				
Limited Integration with Business Strategy	Retained	Limited Integration with Business Strategy	Finalized	Limited Integration with Business Strategy
Time Consuming & complex	Merged	Lack of Leadership Commitment	Finalized	Lack of Leadership Commitment
Leadership unwillingness				
Lack of information	Refined	Limited access to Information	Finalized	Limited access to Information
Lack of Accountability	Dropped			
Lack of Clarity on Impact	Retained	Lack of Clarity on Impact	Finalized	Lack of Clarity on Impact
High Perceived Fee/Cost	Retained	High Perceived Fee/Cost	Retained	High Perceived Fee/Cost
Lack of rewards	Retained	Lack of rewards and encouragement from Government	Retained	Lack of rewards and encouragement from Government

barriers (e.g., B7 and B8) tend to appear at lower hierarchical levels, reflecting their dependent nature. These patterns suggest that CSR/ESG adoption challenges are structurally rooted in institutional and policy environments but operationalized through internal firm capabilities.

4.3. Results of MICMAC (Phase III)

Using the final reachability matrix, the driving and dependence power score are computed as shown for Indian scenario (across sector) in Table 8. With the driving and dependence score, the barriers are categorized into four groups namely, autonomous, dependent, linkage, and driving. The MICMAC representation of Indian scenario (across sector) is presented in Fig. 5. Similarly, the barriers are categorised accordingly for cross sector analysis and presented in Fig. 5b to f in Annexure. The MICMAC results reinforce the structural findings by classifying barriers into driving, linkage, and dependent clusters. Driving barriers represent root causes requiring policy-level intervention, while linkage barriers indicate areas where managerial actions can significantly influence the overall system.

5. Discussions

The double materiality lens provides deeper insight into the hierarchical structure of CSR/ESG barriers identified through TISM and MICMAC. Barriers associated with impact materiality, such as poor regulatory frameworks and lack of standardization, predominantly emerge as high-driving factors, indicating that external institutional conditions shape the sustainability ecosystem within which firms operate. In contrast, financially material barriers such as resource constraints and cost perceptions appear as linkage barriers that translate external pressures into internal operational challenges. Dependent barriers such as leadership commitment and strategic integration emerge as organizational outcomes shaped by the interaction between financial and impact materiality dimensions.

Based on the Delphi results and linkage table and considering an average score above 3, we have accepted all linkages between the barriers. Below, we elaborate on the interrelationships among the 12 identified barriers. Several barriers exhibit recurring causal patterns. In particular, lack of awareness, regulatory weaknesses, and cost perceptions consistently reinforce short-term orientation, resource constraints, and weak strategic integration. To avoid repetition, these relationships are interpreted collectively rather than repeatedly across levels.

At Level 6, Limited Access to Information (B9) and Lack of Government Rewards (B12) emerge as key driving barriers. These factors constrain transparency and financial motivation, reinforcing short-term orientation and weakening ESG commitment.

At level 5, we identify two prominent barriers: (B4) Poor Regulatory Framework and (B5) Lack of Standardization. As elucidated earlier, B4 is influenced by B12, as limited rewards disincentivize firms from investing in the establishment of comprehensive CSR/ESG regulations. Intriguingly, it is observed that B4 leads directly to B5, B6, and B7, while indirectly influencing B2. A weak regulatory framework leads to poor standardization, which limits stakeholder engagement, strategic integration, and leadership commitment. Weak regulation indirectly intensifies resource constraints by creating uncertainty in how firms allocate financial and human resources. Moreover, B10 is influenced by B9 as previously discussed, and it, in turn, influences B1, B3, B6, and B5 directly, and B7 indirectly. The direct impact of B3 includes a lack of clarity regarding the consequences, leading to a corresponding lack of awareness. This lack of clarity intensifies resource constraints and amplifies the focus on short-term profits, thereby hindering collaboration and fostering a limited commitment to leadership. As a result, other initiatives that offer greater returns frequently push CSR to the side. This implies that B7 has a direct impact on resources, causing businesses to give priority to short-term objectives and obstructing the incorporation of CSR/ESG practices into company strategy. Additionally, it has been seen that Lack of Awareness (B1) and Lack of Standardization (B5) are influenced by both a poor regulatory framework (B4) and a lack of clarity on impact (B10). One respondent (R7) shared, for example, that "*sometimes we get clueless about what to do and how to do it and how it impacts*." This ambiguity results in a lack of knowledge and uniformity in the procedures and approaches used to carry out CSR/ESG activities. Furthermore, the lack of a Poor Regulatory Framework (B4) makes matters worse by not offering guidance or a code of conduct.

At level 4, Lack of Awareness (B1), Lack of Standardization (B5), and High Perceived Fee/Cost (B11). According to the Fig. 6, it has been observed that Lack of rewards and encouragement (B12) contributes to High Perceived Fee/Cost (B11). This suggests that Indian firms perceive CSR/ESG activities as costly endeavours when they lack monetary rewards, government subsidies, or financial benefits. From a double materiality perspective, the absence of government incentives shifts CSR/ESG considerations toward financial materiality (cost and short-term profitability concerns), thereby weakening firms' engagement with impact materiality objectives such as long-term societal and environmental outcomes. In such cases, these activities are viewed as expenditure rather than investments for the future as (R15) mentioned "*In this, a lot of money is spent, and nothing is received back*". Furthermore, B11 has a direct correlation with B3, B6, and B8, indicating that the perception of

Table 5
List of final selected barriers.

Barrier Code	Barrier	Materiality Type	Classification Rationale
B1	Lack of Awareness	Both	Affects internal strategic understanding of CSR/ESG while also limiting firms' ability to respond to societal and environmental expectations.
B2	Resource Constraint	Financial	Directly affects firms' ability to allocate financial, technological, and human resources toward CSR/ESG implementation.
B3	Short-term Profit Orientation	Financial	Reflects managerial focus on immediate financial returns over long-term sustainability investments and ESG integration.
B4	Poor Regulatory Framework	Impact	Influences external governance structures, accountability mechanisms, and firms' responsiveness to societal and environmental obligations.
B5	Lack of Standardization	Impact	Limits comparability, transparency, and legitimacy of CSR/ESG practices across firms and sectors.
B6	Limited Stakeholder Engagement/ Collaboration	Impact	Restricts firms' interaction with communities, NGOs, regulators, and other stakeholders essential for societal and environmental responsiveness.
B7	Limited Integration with Business Strategy	Both	Weakens internal strategic alignment while also reducing firms' long-term social and environmental impact creation.
B8	Lack of Leadership Commitment	Both	Affects internal decision-making and organizational direction while also constraining firms' commitment toward broader sustainability responsibilities.
B9	Limited Access to Information	Financial	Restricts firms' ability to acquire knowledge, ESG reporting guidance, and implementation capabilities necessary for operational decision-making.
B10	Lack of Clarity on Impact	Impact	Prevents firms from understanding and evaluating their social and environmental consequences on external stakeholders and ecosystems.
B11	High Perceived Fee/ Cost	Financial	Increases managerial perception that CSR/ESG initiatives are economically burdensome and financially risky.
B12	Lack of Rewards and Encouragement from Government	Both	Reduces external institutional support while also discouraging firms from allocating internal resources toward CSR/ESG initiatives.

large fees or costs may have an impact on a concentration on short-term profitability. This view is also the cause of low stakeholder participation and a lack of leadership commitment. Furthermore, B12 might makes B2 resource limitations worse since businesses believe that CSR and ESG initiatives are more expensive than they are profitable, which could result in inefficient resource use hence it has transitivity link. At this juncture, it is noteworthy that the absence of standardization within B5 directly impacts B6 and indirectly influences B2, B7, and B8. Inadequate standardization indirectly affects other barriers by limiting clear guidance and formal procedures, which in turn weakens resource allocation, strategic alignment, and leadership commitment. The prevalence of B5 primarily stems from B4, denoting poor regulation, indicating that when CSR/ESR activities lack regularity, it engenders inadequate structuring of standards within firms as R5 mentioned "The irregularities greatly affected the community and this was a departure from CSR norms". Concerning B1, it directly leads to the barriers of B3, B6, and B8, while also indirectly contributing to B2 and B7. This assertion is substantiated by existing literature and respondent insights, suggesting that firms, due to a lack of awareness, tend to prioritize short-term profits over long-term objectives. This lack of awareness further translates into diminished stakeholder engagement and collaboration, alongside a scarcity of leadership commitment. As articulated by one respondent, *"We sometimes struggle to find the scheme or understand the meaning of CSR or ESG, so we are uninformed and don't know how to work on it."* A lack of managerial awareness triggers multiple downstream barriers across the system. Also, Lack of awareness (B1) leads to Short-term Profit Orientation (B3) as firms are not aware and don't think of long-term benefits with respect to sustainability and strategic vision.

At Level 3, significant barriers to adoption include Resource Constraints (B2), Short-term Profit Orientation (B3), and Limited Stakeholder Engagement/Collaboration (B6). These barriers exert a substantial influence on adoption and are also influenced by other barriers at Level 4. They are inherently unstable, and addressing them can profoundly impact the entire system. Resource Constraints (B2) arise from financial limitations or manpower constraints. According to the results, these constraints are caused by B1, B4, B5, and B12 through transitivity links. Lack of awareness (B1) can lead to poor allocation of resources due to ineffective monitoring of progress and evaluation of impact, resulting in inefficient resource allocation. Similarly, B2 directly leads to B6, causing disintegration in stakeholder engagement and imposing restrictions on collaboration and organization of CSR-related activities, as highlighted in the literature. Respondents consistently highlighted this issue as a key challenge affecting CSR/ESG adoption. This illustrates how B2 indirectly leads to B3. Short-term Profit Orientation (B3) is directly influenced by B2 and B6, and indirectly by B4 and B12. It is crucial for firms to balance short-term profit orientation to prevent myopia and ensure long-term sustainability. B6 (Limited Stakeholder Engagement) is influenced by nearly all other barriers, highlighting its central role in the system. R4 clearly articulated, "*In engaging CSR activities, balancing the expectations of different stakeholders, such as customers, employees, investors, regulators, media, and communities, is crucial. CSR activities may not always yield good results or benefit everyone, and sometimes they create conflicts or trade-offs between stakeholder groups. Due to limited resources, it is not possible to fully satisfy everyone.*" B6 directly impacts B7 and B8, indicating that limited integration with business strategy is linked to restricted stakeholder engagement. Ultimately, the lack of leadership commitment can result from limited stakeholder engagement.

B8, Lack of leadership commitment, is positioned at Level 2 and is influenced by all barriers except B7. This suggests that most barriers significantly impede leaders' commitment to achieving CSR/ESG goals, as indicated by respondents such as R7, who stated, "Whatever the top management says, we will do it," and R11, who noted, *"Low willpower is the main reason for poor CSR compliance. Lack of willingness to invest in CSR hampers compliance.*" Additionally, R9 mentioned, "*There are no commitments from the top*." Moreover, all barriers, including B8, directly and indirectly contribute to B7, Limited Integration with Business Strategy, situated at Level 1. This implies that all barriers affect business strategy and the commitment of Indian firms to achieving CSR/ESG objectives. As mentioned by R5, *"When the vision is poor, the mission cannot be accomplished."*

Table 6
Interview respondent details: Demographics and firm characteristics.

Respondents	States	Company Class	Listed/ Unlisted	Gender	Designation:	Area of business of the Firm	Business Size	Years in business
R1	NEW DELHI	Public	Listed	Male	Talent acquisition Managers	Financial And Insurance Service	Large	29
R2	MAHARASHTRA	Private	Unlisted	Female	CSR Implementation Managers	Financial And Insurance Service	MSME	26
R3	MAHARASHTRA	Private	Listed	Female	Field Managers	Financial And Insurance Service	Large	22
R4	DELHI	Private	Unlisted	Male	ESG Sustainability and CSR Manager	Electricity, Gas, Steam And Air Condition Supply	MSME	50
R5	KARNATAKA	Public	Listed	Male	Strategic Partnership Manager	Manufacturing	Large	65
R6	MAHARASHTRA	Public	Listed	Male	Training and Skills Managers	Manufacturing	Large	113
R7	GUJARAT	Public	Listed	Male	Senior Manager/ General Manager	Manufacturing	Large	65
R8	WEST BENGAL	Private	Unlisted	Male	Field Managers	Information And Communication	MSME	30
R9	TELANGANA	Private	Unlisted	Male	Senior Manager/ General Manager	Utilities- Electricity	MSME	39
R10	PUNJAB	Private	Listed	Female	Senior Manager/ General Manager	Financial And Insurance Service	Large	5
R11	MADHYA PRADESH	Private	Listed	Female	ESG Sustainability and CSR Manager	Construction	Large	79
R12	Odisha	Public	Listed	Male	Manager	Manufacturing	Large	97
R13	TAMIL NADU	Private	Unlisted	Male	ESG Sustainability and CSR Manager	Electricity, Gas, Steam And Air Condition Supply	MSME	14
R14	HARYANA	Public	Listed	Male	Manager	Public Transport Service	Large	75
R15	ANDHRA PRADESH	Private	Unlisted	Female	Strategic Partnership Manager	Information And Communication	MSME	13

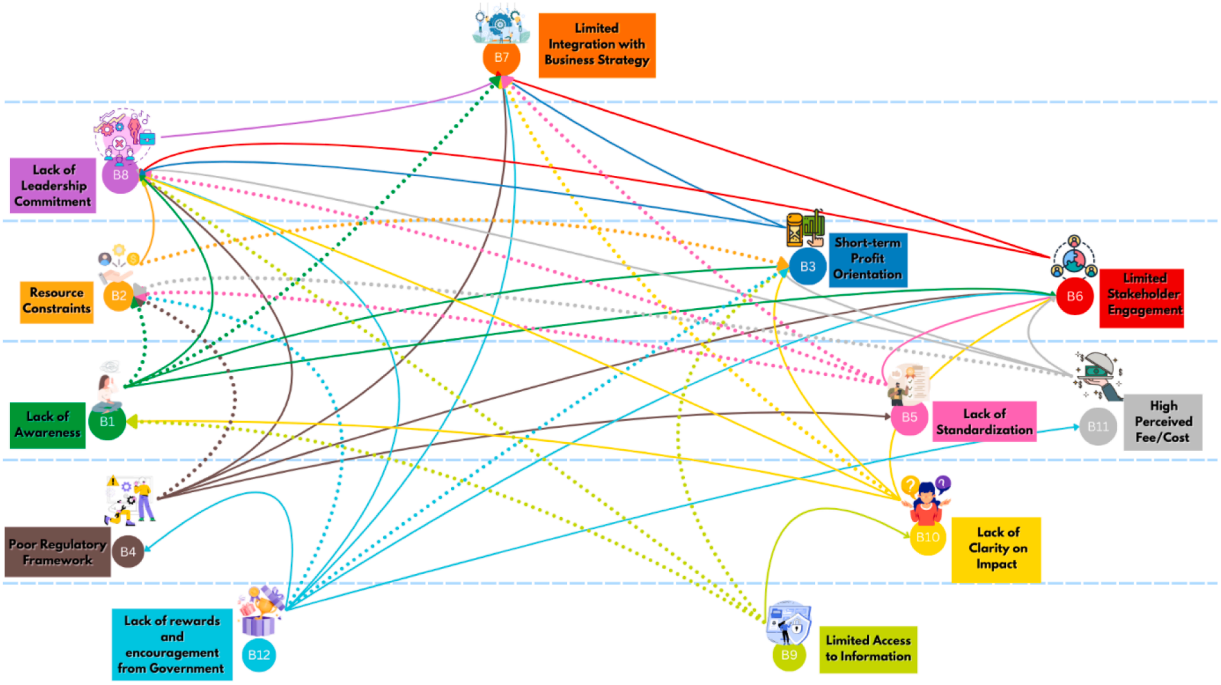

Fig. 4. Final TISM Model (Overall Sector).

These findings indicate that CSR/ESG barriers operate as a reinforcing system rather than independent constraints. Foundational barriers such as information access, regulatory support, and cost perceptions shape managerial cognition and resource allocation, which in turn influence strategic integration and leadership commitment. This suggests that addressing surface-level barriers without resolving structural drivers is unlikely to result in meaningful ESG adoption.

Finally, this study utilizes the MICMAC method to assess the driving power and dependence power of elements, categorizing them into four distinct quadrants.

Quadrant I: Autonomous Cluster (Low Driving – Low Dependence)- Barriers in this quadrant exhibit low driving and dependence powers, indicating minimal relationships with other barriers and consequently, limited significance. None of the barriers in our study fall into this category.

Quadrant II: Dependent Cluster (Low Driving – High Dependence)- Barriers here possess low driving powers but high dependence powers, signifying their susceptibility to influence from other barriers. These barriers rely on the presence or absence of other barriers. In our study, B8 and B7 are classified in this category, suggesting that Limited

Table 7
Initial reachability matrix (**across sector**).

Barriers	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
B1	1	0	1	0	0	1	0	1	0	0	0	0
B2	0	1	0	0	0	1	0	1	0	0	1	0
B3	0	0	1	0	0	1	1	1	0	0	0	0
B4	0	0	0	1	1	1	1	1	0	0	0	0
B5	0	0	0	0	1	1	0	0	0	0	0	0
B6	0	1	1	0	0	1	1	1	0	0	0	0
B7	0	0	0	0	0	0	1	0	0	0	0	0
B8	0	0	0	0	0	0	1	1	0	0	0	0
B9	0	0	0	0	0	0	0	0	1	1	0	0
B10	1	0	1	0	0	1	0	1	0	1	0	0
B11	0	0	1	0	0	1	0	1	0	0	1	0
B12	0	0	0	1	0	1	1	1	0	0	1	1

Table 8
Final reachability matrix (**Across sector**).

Barriers	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	Driving power
B1	1	1	1	0	0	1	1	1	0	0	0	0	6
B2	0	1	1	0	0	1	1	1	0	0	1	0	6
B3	0	1	1	0	0	1	1	1	0	0	0	0	5
B4	0	1	1	1	1	1	1	1	0	0	0	0	7
B5	0	1	1	0	1	1	1	1	0	0	0	0	6
B6	0	1	1	0	0	1	1	1	0	0	1	0	6
B7	0	0	0	0	0	0	1	0	0	0	0	0	1
B8	0	0	0	0	0	0	1	1	0	0	0	0	2
B9	1	0	1	0	0	1	0	1	1	1	0	0	6
B10	1	1	1	0	0	1	1	1	0	1	0	0	7
B11	0	1	1	0	0	1	1	1	0	0	1	0	6
B12	0	1	1	1	1	1	1	1	0	0	1	1	9
Dependence power	3	9	10	2	3	10	11	11	1	2	4	1	

Table 9
Levels partition of barriers (**Overall sector**).

Barriers	Reachability set	Antecedent set	Intersection set	Level
B1	(B1, B2, B3, B6, B7, B8)	(B1, B9, B10)	(B1)	4
B2	(B2, B3, B6, B7, B8, B11)	(B1, B2, B3, B4, B5, B6, B10, B11, B12)		3
B3	(B2, B3, B6, B7, B8)	(B1, B2, B3, B4, B5, B6, B9, B10, B11, B12)		3
B4	(B2, B3, B4, B5, B6, B7, B8)	(B4, B12)		5
B5	(B2, B3, B5, B6, B7, B8)	(B4, B5, B12)		4
B6	(B2, B3, B6, B7, B8, B11)	(B1, B2, B3, B4, B5, B6, B9, B10, B11, B12)		3
B7	(B7)	(B1, B2, B3, B4, B5, B6, B7, B8, B10, B11, B12)		1
B8	(B7, B8)	(B1, B2, B3, B4, B5, B6, B8, B9, B10, B11, B12)		2
B9	(B1, B3, B6, B8, B9, B10)	(B9)		6
B10	(B1, B2, B3, B6, B7, B8, B10)	(B9, B10)		5
B11	(B2, B3, B6, B7, B8, B11)	(B2, B6, B11, B12)		4
B12	(B2, B3, B4, B5, B6, B7, B8, B11, B12)	(B12)		6

Integration with Business Strategy and Lack of Leadership Commitment barriers are influenced by other barriers.

Quadrant III: Linkage Cluster (High Driving – High Dependence)- Linkage barriers exhibit both high driving and dependence power, making them highly interactive and structurally unstable within the system. Actions targeting these barriers can significantly affect the entire system. B2, B3, and B6 are categorized as linkage factors in our study, indicating that Resource Constraints, Short-term Profit Orientation, and Limited Stakeholder Engagement/Collaboration act as mediator variables, facilitating the relationship between autonomous and dependent factors.

Quadrant IV: Driving Cluster (High Driving – Low Dependence) - Barriers in this quadrant possess high driving powers but low dependence powers, making them the most influential barriers in the system. Barriers such as B1, B4, B5, B9, B10, B11, and B12 fall into this category. This suggests that these barriers exert influence on other barriers and require attention.

Across sectors, notable contrasts emerge. Manufacturing displays a structurally dense barrier network driven primarily by awareness and cost perceptions, reflecting stronger financial materiality pressures. In contrast, the IT/ITES and Services sectors are more influenced by informational and regulatory constraints, indicating the centrality of impact materiality and institutional pressures. MSMEs demonstrate heightened dependence on external support mechanisms, particularly government incentives and information access, underscoring structural vulnerability. These differences confirm that while certain barriers (e.g., B9 and B12) operate as systemic drivers, their relative materiality orientation varies across sectors.

5.1. Barriers in IT/ITES sector

In the IT/ITES sector, Resource Constraint (B2) remains central despite a relatively informed workforce. B2 directly affects B10 and indirectly B6, reflecting operational and expertise limitations, particularly in areas such as e-waste management. Poor Regulatory Framework (B4) and B10 reinforce collaboration challenges, while B6, B8, and B9 influence B1 and B7 at lower levels. Barriers such as B3, B5, B11, and B12 exhibit weaker structural interrelations. MICMAC results indicate

	Financial Materiality (Affects Firm)	Impact Materiality (Affected by Firm)
Internal Barriers	B2: Resource Constraint B3: Short-term Profit Orientation B9: Limited Access to Information B11: High Perceived Cost	B1: Lack of Awareness B7: Limited Integration with Business Strategy B8: Lack of Leadership Commitment
External Barriers	B12: Lack of Government Incentives	B4: Poor Regulatory Framework B5: Lack of Standardization B6: Limited Stakeholder Engagement B10: Lack of Clarity on Impact

Fig. 5. Classification of CSR/ESG barriers using the double materiality framework.

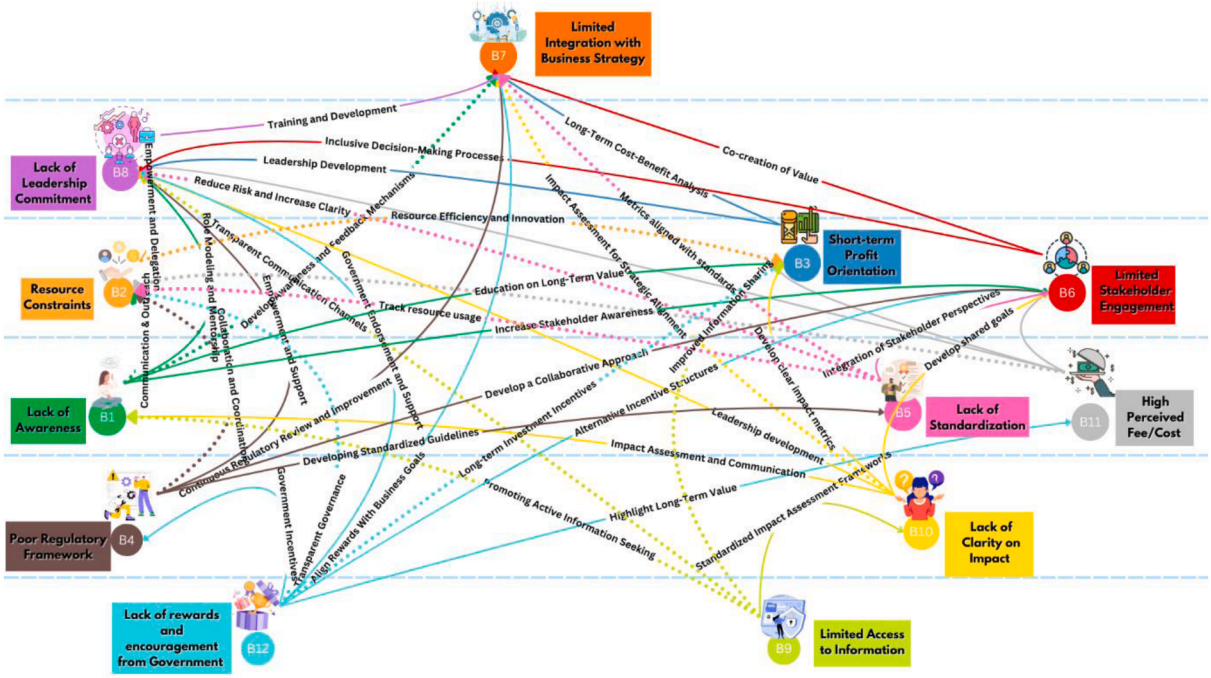

Fig. 6. TISM barriers for each linkage (Overall sectors).

B2, B4, B8, B9, and B10 as driving factors, while B1, B6, and B7 are linkage barriers. No dependent barriers emerged.

5.2. Barriers in manufacturing sector

Manufacturing demonstrates a more layered structure. Lack of Awareness (B1) and High Perceived Cost (B11) serve as foundational drivers, triggering B2, B3, B5, B6, and B7. Leadership Commitment (B8) and Access to Information (B9) further shape strategic alignment, while B12 intensifies regulatory weakness and cost sensitivity. Resource Constraint (B2) and Short-term Profit Orientation (B3) emerge as dependent barriers, heavily influenced by systemic drivers. MICMAC analysis identifies B1, B4, B11, and B12 as primary drivers, while B5, B6, and B8 act as linkage factors.

5.3. Barriers in services and utilities sector

In this sector, Limited Access to Information (B9) is the dominant driving barrier, influencing B2, B3, B7, and B8. Limited Stakeholder Engagement (B6) and Short-term Profit Orientation (B3) operate as linkage barriers, while B1, B2, B4, B5, B7, B8, and B11 are dependent. B10 and B12 appear autonomous, indicating limited systemic influence within this sector.

5.4. Barriers in MSME sector

For MSMEs, B9 and B12 function as primary drivers, reflecting high dependence on external informational and institutional support. B1 and B8 reinforce regulatory and structural inefficiencies, while B2, B4, B5, B6, and B7 emerge as dependent barriers. B10 and B11 remain relatively autonomous, indicating lower interaction within the MSME system.

6. Implications

India faces structural sustainability challenges that require deeper integration of CSR/ESG into firm-level strategy. This study identifies how interlinked structural and managerial barriers constrain such integration, thereby limiting firms' contributions to the SDGs. Despite broad sustainability goals, challenges persist in integrating them into local city planning, impeding the comprehensive realization of SDGs [38]. To address this challenge, India must prioritize enhancing livelihoods, rejuvenating natural resources, and restructuring financial mechanisms to effectively achieve SDGs. Integrating environmental considerations into development planning is vital for sustainable progress alongside economic aspirations. This necessitates collaborative efforts from all stakeholders to overcome barriers to CSR/ESG adoption. Therefore, this study outlines general and sector-specific barriers, providing a comprehensive analysis to facilitate SDG achievement in India and globally. As emphasized by the current government's vision of 'Sabka Saath Sabka Vikas Sabka Vishwas' and 'One Earth, One Family, One Future,' the insights from this research aims to contribute to a unified and sustainable future.

6.1. Theoretical implications

This study's theoretical implications come from the way it integrates several frameworks to provide a comprehensive explanation of the enduring obstacles to the adoption of CSR and ESG practices and how they affect the accomplishment of the SDGs. The study uses Stakeholder Theory to show how poor leadership commitment, lack of standardization, and low stakeholder participation hinder sustainable practices [17]. Managerial Cognition Theory provides information on how managerial decision-making cognitive limitations are reflected in short-term profit orientation and poor integration with long-term strategy [15]. According to Resource Dependence Theory, human and financial capital limitations are major roadblocks, especially in industries with limited resources [16]. The failure of policy incentives and regulatory frameworks to institutionalize CSR/ESG practices across industries is further explained by institutional theory [9]. Lastly, the study concludes that these obstacles impede enterprises' ability to contribute to SDGs by undermining their social legitimacy through the lens of Legitimacy Theory [18]. This multi-theoretical approach provides a strong basis for future research and policy alignment while deepening the conceptual understanding of why CSR/ESG integration is still unequal. Beyond individual theoretical lenses, this study advances sustainability scholarship by integrating double materiality with structural modelling. By distinguishing between financial and impact materiality barriers and mapping their interdependencies, the findings demonstrate that CSR/ESG adoption failures are systemic rather than isolated managerial shortcomings. This integrated perspective clarifies how regulatory, informational, and institutional pressures shape sustainability implementation in emerging economies.

6.2. Barrier wise implications

The lack of awareness has been identified as a significant driving factor across industries, particularly acting as a major barrier within each sector and often influencing other obstacles. Consequently, firms must address this barrier both internally and externally (refer Table 5). Internally, this can be achieved by conducting campaigns, workshops, and training sessions to educate employees about CSR/ESG initiatives. Implementing a rewards and recognition system can further motivate employees to demonstrate leadership and commitment in this regard. Externally, active engagement in press releases and media outreach is essential to communicate the organization's CSR/ESG activities and achievements. Additionally, transparent disclosure of sustainability reports to stakeholders plays a crucial role in providing comprehensive information on the organization's ESG performance.

In addressing the barrier of resource constraints in CSR/ESG adoption, it has been identified as primarily caused by other barriers and is positioned at level 1 in TISM. Therefore, it is crucial for firms to pinpoint the underlying reasons contributing to this barrier, as inadequate allocations and mobilization of resources can impede the achievement of SDGs. Internally, firms can align their focus and resource allocation with the core values of the organization to effectively mobilize internal resources for CSR/ESG initiatives. Establishing an internal foundation dedicated to supporting CSR/ESG efforts can foster a structured approach to social responsibility within the organization. Additionally, efforts should be made to enhance cost-effectiveness and operational efficiency to minimize errors and optimize effectiveness, thereby preventing resource wastage. Externally, firms should cultivate partnerships with governmental bodies, other firms, NGOs, and non-profit organizations actively engaged in CSR/ESG efforts to leverage collective impact and resources. Furthermore, since funds are essential for conducting CSR/ESG activities, firms should seek funding opportunities from third-party sources to supplement internal resources and support the expansion and sustainability of CSR/ESG initiatives.

Profit maximization is the primary objective of any firm, with all efforts and resources dedicated to achieving this goal. Consequently, short-term profit orientation often takes precedence over long-term sustainability goals, as confirmed by this study, acting as a mediating factor and contributing to other barriers that hinder the adoption of CSR/ESG across sectors. Internally, firms can address this issue by integrating CSR/ESG into their long-term agenda, making decisions based on sustainability considerations, and establishing metrics to track not only financial performance but also CSR/ESG initiatives. Planning long-term co-creation with stakeholders requires external cooperation with the government, investors, and other parties. One major factor impeding the adoption of CSR and ESG is inadequate regulation. As a result, businesses ought to recognize regulatory loopholes and take proactive steps to develop and implement frameworks and standards. In order to overcome this obstacle internally and take advantage of sustainable economic prospects, it is necessary to invest in developing internal CSR/ESG competence. This entails adopting sustainable frameworks to direct CSR/ESG initiatives, such as the UN Global Compact, ISO 26,000, or GRI Standards, in addition to having strong leadership assurance and openness in work procedures. By taking part in public debates, gatherings, and stakeholder talks to influence legislation that support sustainable development goals, businesses can improve these hurdles from the outside. Furthermore, it is crucial to lobby the government and legislators for stricter rules. Businesses should promote fairness, transparency, and comparability in internal communication to overcome the difficulty of the absence of standards, which is also seen as a linking and dependant element. In order to standardize the process, businesses should also create internal standards and comparison measures. Another good way to get beyond this obstacle is to work together and share expertise.

Businesses must place a high priority on good communication in order to overcome the problems of low stakeholder participation and inadequate integration with company strategy, which are interconnected and dependent barriers that lead to the formation of other challenges. The obstacle of a lack of leadership commitment can be successfully overcome by providing leaders with ongoing training and development, as well as acknowledgment, incentives, and advancements. Additionally, external collaboration and benchmarking are crucial. The Limited Access to Information as a driving barrier

significantly contributes to the emergence of other obstacles, thus it is essential for firms to establish a capacity-building, knowledge-sharing, and MIS-based system for smooth action. The Lack of Clarity on Impact and High Perceived Cost as mainly Autonomous barrier has no direct impact on other barriers, but firms cannot ignore it. Addressing this barrier requires assessment metrics, cost-benefit analysis, and collaboration with the government. The lack of rewards and encouragement from the government in some sectors is a significant driving force and influence on other barriers. Firms require recognition for their extra efforts in CSR/ESG, which can be addressed by implementing an internal reward system and maintaining good liaison with the government. From a double materiality perspective, the absence of government incentives shifts managerial focus toward financial materiality concerns (cost and short-term profitability), thereby weakening engagement with impact materiality objectives such as long-term environmental and societal outcomes.

6.3. Sector- wise implications

Barriers B9 and B12 are key driving factors due to their high influence and low dependence. Their presence significantly hinders CSR/ESG adoption by affecting multiple other barriers. The scarcity of accessible information on CSR/ESG (B9) limits firms' ability to set targets and monitor progress. Likewise, absence of rewards and incentives (B12) demotivates employees and can fuel competitive pressures. As Fig. 6 illustrates, resolving B9 can alleviate B1, B3, B8, and B10 by enabling information flow, standardized assessments, and knowledge sharing. Addressing B12—linked to B3, B4, B6, B7, B8, and B11—requires strong government backing through funding, training, and dissemination. Continuous internal/external review is critical for B4, while B10 demands clear assessment metrics. Though B7 is a dependent barrier, it should not be ignored. A holistic approach, including government involvement, financial provisions, transparent communication, and structured knowledge exchange, is essential to overcome these interlinked barriers.

In the BFSI sector, B1 and B9 emerge as primary drivers influencing barriers such as B3–B10. Firms must leverage public databases and secondary sources and train employees in CSR/ESG data analytics. B4 and B5 also contribute to other challenges; hence, standardizing compliance, metrics, and reporting is vital. Even B6, while less critical, should not be neglected. Overall, BFSI can strengthen CSR/ESG adoption by improving data access, conducting training programs, and promoting transparency.

In the IT/ITES sector, fewer barriers exist due to a skilled, gender-sensitive workforce contributing to SDGs [39]. However, poor financial and human resource allocation remains a concern. Also, e-waste management is critical due to ICT's environmental impact [40]. To address these, the sector should adopt green IT practices, seek stakeholder integration via government funds, and set SMART goals with KPIs. Standardized metrics can help streamline CSR/ESG efforts while improving innovation and efficiency.

In the manufacturing sector, despite schemes like *Make in India* and *Atmanirbhar Bharat*, barriers such as B1 and B11 persist. As a labour-intensive sector, strategies should include awareness campaigns, resource optimization training, and PLIs. Leadership training and low-cost, high-impact methods are necessary. In the services sector, B9 remains a critical barrier. Promoting knowledge-sharing platforms and communication channels is key. Addressing B6 and B3 requires collaborative stakeholder efforts and a unified sustainability roadmap.

Barriers vary across firm sizes. In large firms, B3 and B4 dominate, pointing to a need for a more structured CSR framework and long-term value creation via innovative reporting. In MSMEs, B1 and B9 are primary, driven by limited funding, weak leadership, and lack of information. Solutions include leadership development, awareness-building, and partnerships with larger firms for advisory and financial support. Large firms should focus on stakeholder collaboration, knowledge-sharing, and impact assessments. MSMEs must strengthen outreach, leadership capacity, and communication mechanisms to institutionalize CSR/ESG frameworks effectively. The sectoral differences observed in barrier configurations indicate that double materiality is not uniformly experienced across industries. While manufacturing firms face cost and awareness constraints, IT/ITES firms struggle primarily with resource allocation and informational barriers, and MSMEs are shaped by institutional and leadership gaps. These findings suggest that policy interventions and regulatory frameworks must be sector-sensitive rather than universally designed.

7. Conclusion

This paper identifies twelve barriers to the adoption of corporate social responsibility (CSR) and environmental, social, and governance (ESG) practices in Indian firms. Using double materiality and structural modelling techniques, the study explains how these barriers are interrelated and how they impact firms' sustainability contributions.

The results of the study show that high-driving barriers, such as limited access to information and a lack of government incentives, negatively affect both the financial and impact materiality dimensions of firms. The driving, linkage, dependent, and autonomous barriers relate to the theories of institutional theory, resource dependence theory, and managerial cognition. These factors influence a firm's decision to allocate resources to CSR, the quality of leadership within the firm, and the extent to which CSR is integrated into business strategies. Consequently, these barriers limit firms' contributions to the Sustainable Development Goals (SDGs). However, some barriers were significantly more prominent in certain sectors of the Indian economy than in others. For instance, manufacturing firms exhibited significantly higher barriers related to limited financial resources than firms in knowledge-intensive sectors such as information technology (IT) and information technology-enabled services (ITES). The significance of these findings for countries such as India is that they provide a strategic framework that firms can use to focus their efforts on the most critical barriers to the adoption of CSR and ESG practices.

The study makes several important contributions to the existing literature on corporate social responsibility and environmental, social, and governance practices. First, by linking the theory of double materiality to the study of barriers to CSR and ESG practices, the research provides a more holistic explanation of the challenges that firms in India and other emerging economies face in adopting CSR and ESG practices. This offers a broader perspective than previous studies, which often focused on only one dimension of the challenges associated with CSR and ESG adoption. Second, the study contributes to the literature by employing a methodology that combines the Delphi method with double materiality and structural analysis to identify barriers to CSR and ESG practices. This approach enables researchers to move beyond earlier studies on CSR and ESG that were primarily descriptive in nature. Finally, these findings can assist policymakers and managers in making informed decisions by identifying the most critical barriers that need to be addressed to improve the implementation of ESG practices.

By linking the theory of double materiality to an investigation of barriers to implementing CSR and ESG practices in firms, this study extends the existing literature and provides a more comprehensive understanding of the sustainability challenges faced by firms in emerging economies Fig. 7.

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CRediT authorship contribution statement

Nitika Sharma: Writing – review & editing, Writing – original draft,

Resources, Methodology, Formal analysis, Conceptualization. **Vimal K E K:** Writing – original draft, Validation, Methodology, Conceptualization. **Justin Paul:** Writing – review & editing, Supervision. **Pinaki Dasgupta:** Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

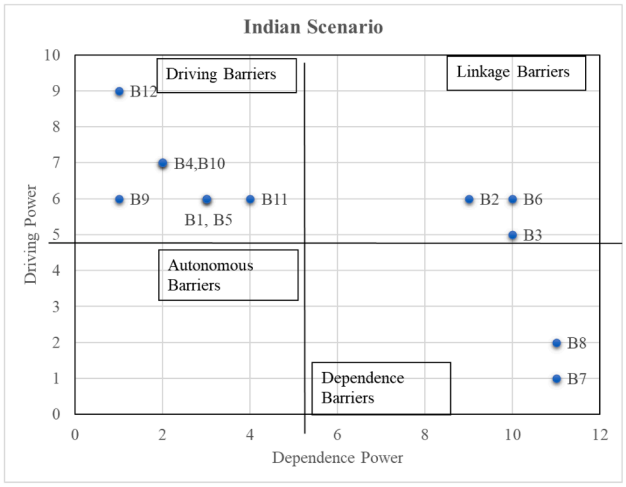
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

We confirm that there are no conflicts of interest related to this manuscript. All authors have contributed equally and have disclosed any financial or personal relationships that could be perceived as potential conflicts of interest. Data can be available on request.

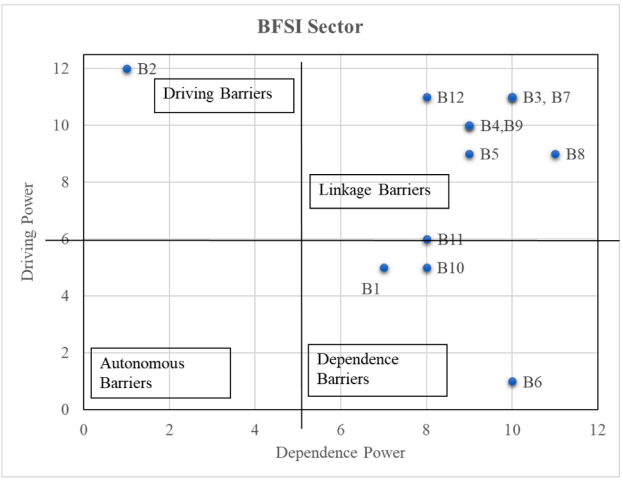
Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.sftr.2026.101975.

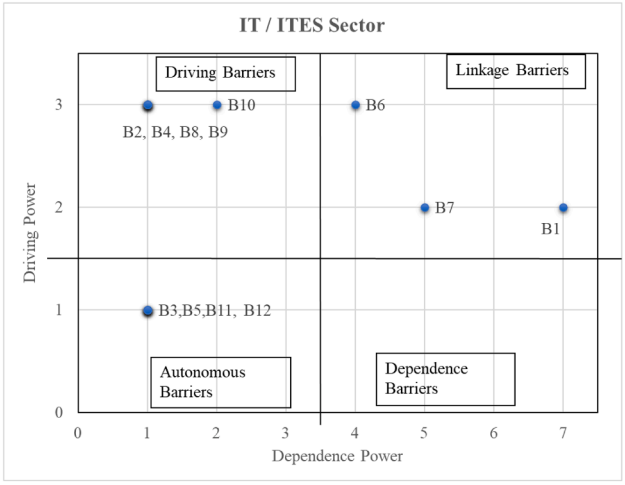
Annexure



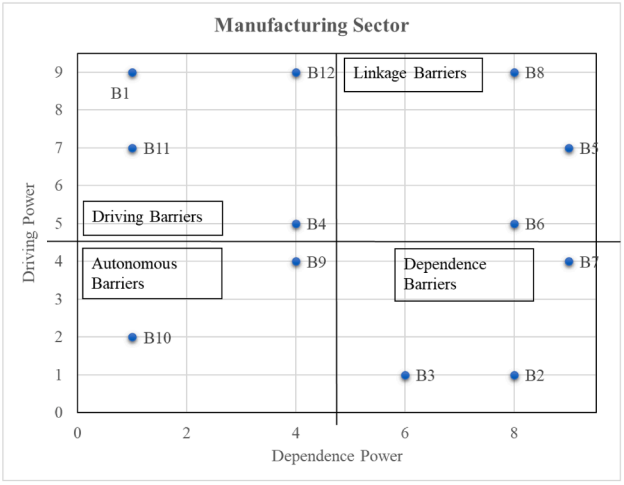
a. Indian Scenario (across sector)



b. BFSI Sector

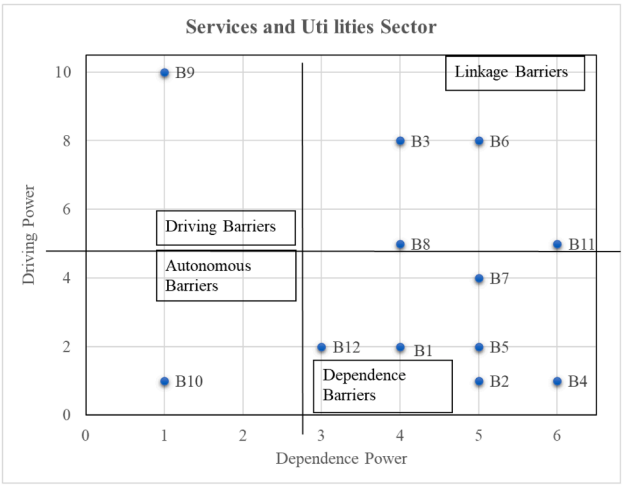


c. IT / ITES Sector

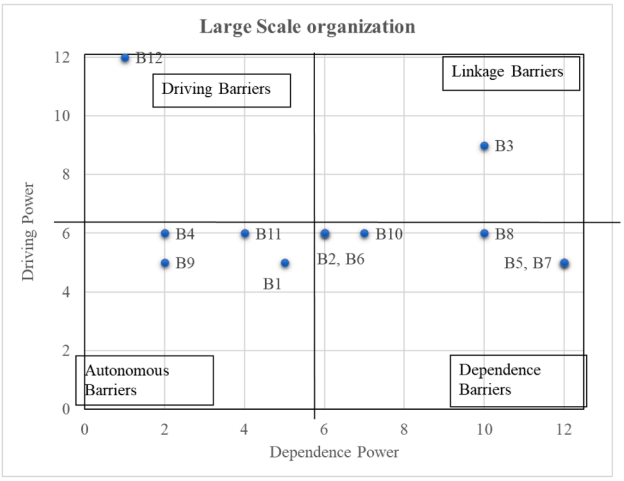


d. Manufacturing Sector

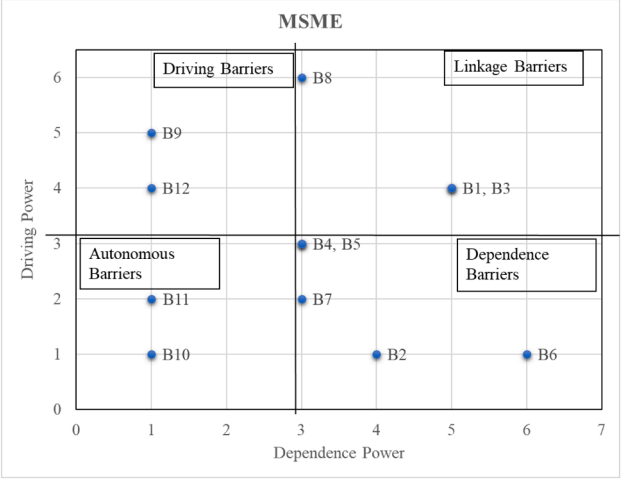
Fig. 7. MICMAC results.



e. Services and utilities sector



f. Large Scale organization



g. Small scale organization

Fig. 7. (*continued*).

Data availability

Data will be made available on request.

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