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FINANCING SUSTAINABLE SUPPLY CHAIN: A VIEW FROM GEOPOLITICAL RISK AND GENAI FOR INDIAN ECONOMY

Indranil Deb[1]*, Shraddha Shetty[2], Piyali Roy Chowdhury[3]

Original Article

[1]Adamas University, North 24 Parganas, 700126 West Bengal, India

[2,3]Christ University, Bangalore, 560029 Karnataka India

Corresponding Author's Email: nilwork2025@gmail.com

Abstract

The present conceptual review study attempts to focus on the crucial execution gap in the establishment of sustainable supply chains in the Indian economy under unpredictable conditions. Management Commitment and Technological Readiness are the main organisational antecedents considered in the conventional literature; however, this study indicates that such internal competencies are not enough when facing macro-environmental shocks. Based on the emerging literature, the authors build a novel conceptual framework based on the Resource Based View, treating a GenAI Decision Support System as an active cognitive mediator. This intermediary layer is crucial for the integration of unstructured data, the refinement of pathways for green financing, and the translation of corporate intent into Environmental and Social Supply Chain Sustainability (ESSCS). Importantly, the paradigm conceptualises Geopolitical Risk as a broad macro-environmental moderator that constrains capital allocation and destabilises logistical networks. This article gives a strong theoretical blueprint to help corporate leaders and policy architects to negotiate the challenges of green financing in a global systemic uncertain world inside the Indian regulatory framework and National Logistics Policy.

Keywords: Gen AI; Geopolitical Risk; India; Sustainability; Supply Chain

Introduction

Environmental, social and governance (ESG) criteria have made sustainable supply chain management transition from a minor corporate social responsibility project to an essential strategic goal. In emerging markets such as India, this is driven by a risky cocktail of strong regulatory frameworks, greater scrutiny from stakeholders and sensitivity to climate degradation. Indian firms are facing their own systemic issues typified by significant data fragmentation, lack of infrastructure and ongoing shortage of green finance, however the usage of Green Supply Chain Management (GSCM) is increasing [1]. Adding to the operational picture are unprecedented global geo-political challenges of trade protectionism and marine disruptions. To cope up with these developments, Indian economy needs financial agility and technical resilience with objective for deep integration of the global value chains through the "Make in India" campaign [2]. Traditional predictive artificial intelligence (AI) has been used to detect trends and predict demand, but it is insufficient in highly changeable, data-scarce or unstructured contexts [3].

The advent of Generative Artificial Intelligence (GenAI) represents a paradigm change. GenAI can synthesise unstructured global data, model complex geopolitical events, and provide optimal green financing pathways under deep uncertainty [4]. Unlike its analytical predecessors, Therefore, as seen in the authors conceptual framework, GenAI is not simply an administrative tool, but an active cognitive mediator. It bridges the important gap between internal antecedents in the firm, i.e. top-management commitment and technical preparedness, and concrete ESSCS. The paper addresses a key gap in the literature on the lack of an integrated conceptual framework to examine the process of

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transforming entrepreneurial skills into sustainable outcomes under the pressures of geopolitical risks and financial constraints in the Indian macroeconomic context through GenAI.

Literature Review

Determinants of Green Supply Chain Sustainability

Early pioneering publications identified organisational commitment and technical infrastructure as crucial factors for the efficient implementation of green supply chain management (GSCM) [5, 6]. Today's sustainable supply chain management is a comprehensive implementation of green techniques from sustainable procurement of raw materials to closed-loop circular logistics [7]. However, as the authors point out in the conceptual framework, these internal drivers of Management Commitment and Technological Readiness are often vulnerable to systemic friction in real-world implementation. However, the deep-rooted data silos and massive capital investment for sustainable overhauls in the emerging nations pose severe challenges for the adoption. Real sustainability benefits require cross-functional alignment and intelligent decision support systems [8, 9].

The Expansive Role of Industry 4.0 And AI

Technologies of Industry 4.0 including the Internet of Things (IoT), big data analytics and blockchain increased the visibility in supply chain and monitoring of the carbon emissions [10]. The disruptions created by the COVID-19 pandemic underscored the importance of digital agility in maintaining supply chain continuity during institutional crises [11]. Blockchain technologies have demonstrated the benefits of traceability and mitigation of the dangers of counterfeits in agriculture and industry networks. However, the growing acceptability of these is largely limited by technological complexity, high energy footprints and unclear regulatory frameworks in emerging areas. Some of the difficult optimisation approaches being employed to increase the accuracy of forecasts and reduce inventory wastage are metaheuristic algorithms and predictive AI [12]. However, these conventional projection models are brittle and ill-equipped to handle non-linear anomalies such as rapid adoption of trade restrictions or sudden swings in regional regulatory compliance [13]. This constraint highlights the need of a cognitive intermediate to handle unstructured data circumstances.

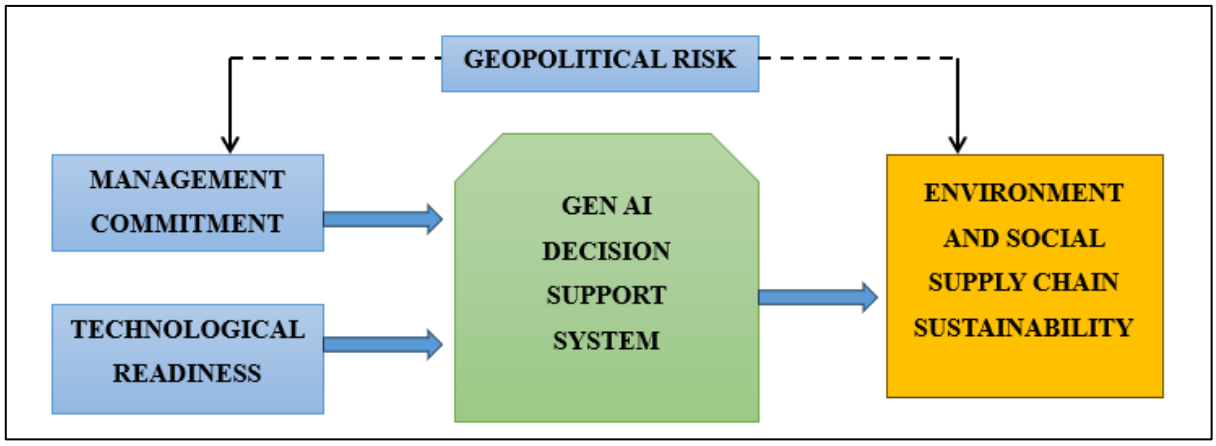
Geopolitical Risk, Gen AI and Green Finance Nexus

The effect of geopolitical risk on green supply chain finance has not been adequately investigated. Challenges from geopolitical issues are rising the expenses of supply chains and limiting traditional financial sources [14]. As a result, Indian firms have turned to alternate sustainable finance options like as green bonds and ESG-linked loans [15]. To address this challenge, the authors conceptualise an active cognitive intermediate, a GenAI Decision Support System. Meanwhile, it checks a few risk indicators to ensure that a company's operational data in real-time fulfils the demanding and dynamic criteria of global green fund allocators. Companies can use GenAI to generate predictive simulations to mitigate the adverse moderating effects of geopolitical risk to ensure compliance and achieve sustainable financing and successfully attain the sustainability of the environmental and social supply chains in the dynamic Indian economy [16].

Methodology

The present study employs a systematic conceptual synthesis approach using secondary literature and policy data to validate the structural pathways presented in the conceptual framework. Instead of main empirical data collecting, this review theoretically maps the links between five core aspects of the framework. The first, Management Commitment and Technological Readiness are discussed as the underlying independent organisational antecedents. Second, a GenAI Decision Support System (DSS) is operationalised as the core cognitive mediator evaluating its capacity to be optimised, unstructured data synthesis and scenario development. Third, the model guides these mediated paths on the dependent variable Environmental and Social Supply Chain Sustainability (ESSCS). Finally, Geopolitical Risk is incorporated as a macro-environmental moderator that covers the complete conceptual model confined geographically and regulatory inside the Indian Economy's specific macroeconomic setting (e.g., green financing channels and the National Logistics Policy) (Refer to figure 1).

Figure 1: Conceptual Framework



Source: Author's Compilation

The diagram of the conceptual framework is used to map the key theoretical contributions of this study. Key independent organisational drivers include Management Commitment and Technological Readiness. The model does not directly link them to Environmental & Social Supply Chain Sustainability (ESSCS). Instead, it develops a GenAI Decision Support System as the main mediating variable. This mediator translates, processes, synthesises and optimises internal company capabilities to real sustainable outcomes. In the framework, Geopolitical Risk is a superordinate contextual element that disrupts initial leadership decisions as well as final operational outcomes. The model is entirely based on macro-environmental aspects of Indian Economy considering local structures like green financing channels and National Logistics Policy.

Discussion

The structural synthesis of this conceptual framework reveals that internal organisational enablers i.e. Management Commitment and Technological Readiness, merely exist as static baseline requirements and are inherently inadequate to achieve long-term ESSCS alone. Literature indicates that the leadership purpose and key infrastructure are the drivers for early adoption of GSCM [5, 6]. The truth of emerging economies, however, is that they have big structural impediments to adoption, such as data silos and budgetary constraints [8]. This approach challenges the linear notion of technology adoption, by conceptualising a GenAI DSS as an active cognitive mediator. From RBV standpoint, GenAI is not a passive IT asset but a dynamic capacity that fits the VRIN criteria. Industry 4.0 technologies include blockchain and analytics enable visibility to stable metrics [10, 11]. However, they are vulnerable to non-linear aberrations [12, 13]. The model's core is the complete structural paths that explain how GenAI translates abstract business preparedness into tangible mitigation measures. The mediation of cognition is very important because Geopolitical Risk has negative moderating effects that hinder the conventional green financing channels and highlight border friction [15]. The idea is based on the macroeconomic fundamentals of Indian Economy and emphasises the relevance of GenAI as a stabilising interface. It integrates real-time operational data with the escalating compliance obligations of global green fund allocators under severe unpredictability [16]. Therefore, in the context of global financial volatility, the model provides a strong theoretical approach to explain how micro-level enterprise readiness can directly contribute towards macro-level national targets. Namely, on the alignment of Indian logistics with UN SDGs 9 and 12 [17].

Conclusion

The role of the ICT approach in multidisciplinary learning can ameliorate classroom learning and be an effective tool to provide quality education to all. The NEP 2020 conducted an analysis on the significance of quality education in India and presented a range of policies slated for implementation soon. Thus, the authors present a concise analysis that challenges the provision of high-quality education in India. The study's main contribution is to promote the role of a multidisciplinary approach and ICT integration in improving the quality of the education system. NEP 2020 guarantees the provision of quality education in India, encompassing both school-level and HEIs. At the school level, NEP aims to

attain its goal of universal foundational numeracy and literacy among students by the year 2025 and to enhance the gross enrolment ratio (GER). The entire HEI should soon incorporate ICT and a multidisciplinary approach. Finally, they conduct and analyse an online survey to gather responses from various experts on the integration of ICT in the education system, providing evidence to support the use of ICT in education. ICT can be an elixir for education.

Conflict of Interests

The authors declare that they have no conflict of interests.

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