УДК 658.3
DOI 10.47367/0021-3497_2025_5_408

RESOLVING ETHICAL DILEMMAS IN THE BUSINESS PRACTICES OF INTERNATIONAL TEXTILE COMPANIES

РЕШЕНИЕ ЭТИЧЕСКИХ ДИЛЕММ В БИЗНЕС-ПРАКТИКЕ МЕЖДУНАРОДНЫХ ТЕКСТИЛЬНЫХ КОМПАНИЙ

O. ABBAS [1], M.M. ABDUL-JABBAR [2], A.E. ISAEVA [3], D. ALDABAGH [4], S.T.Y. ALFALAHI[5]

О. АББАС [1], М.М. АБДУЛ-ДЖАББАР [2], А.Э. ИСАЕВА [3], Д. АЛДАБАХ [4], С.Т.Ю. АЛЬФАЛАХИ[5]

**([1]Al-Turath University, Baghdad, Iraq,
[2]Al-Mansour University College, Baghdad, Iraq,
[3]Osh State University, Osh, Kyrgyzstan,
[4]Al-Rafidain University College, Baghdad, Iraq,
[5]Madenat Alelem University College, Baghdad, Iraq)**

**([1]Университет Аль-Турат, Багдад, Ирак,
[2]Университетский колледж Аль-Мансура, Багдад, Ирак,
[3]Ошский государственный университет, Ош, Кыргызстан,
[4]Университетский колледж Аль-Рафидаин, Багдад, Ирак,
[5]Университетский колледж Маденат Алелем, Багдад, Ирак)**

Email: omar.abbas@uoturath.edu.iq

Ethical aspects in the global textile industry are becoming increasingly important due to increasing regulatory requirements, environmental concerns, and consumer perceptions. This study examines the relationship between ethical compliance metrics, such as labor standards, environmental sustainability, and supply chain transparency, and operational performance in the global textile industry. A structured approach combining multivariate analysis, canonical correlation, and multicriteria optimization modeling was used to systematically evaluate data from five different textile mills. The results show that improved labor compliance and environmental management are significantly positively associated with production efficiency, resource utilization, and reduced operating costs. Furthermore, the

implementation and integration of blockchain technology into supply chain processes significantly improves transparency, providing a strategic lever for risk mitigation and increased brand trust. Multicriteria modeling demonstrated the potential for joint optimization of ethical and economic metrics, offering companies practical strategic recommendations for operating in a volatile global marketplace. These results support the need to incorporate codes of ethics into the corporate strategies of textile companies.

Этические аспекты в глобальном текстильном бизнесе приобретают всё большую значимость в связи с растущими нормативными требованиями, экологическими проблемами и потребительским восприятием. В данном исследовании изучается взаимосвязь между показателями этического соответствия, такими как стандарты труда, экологическая устойчивость и прозрачность цепочки поставок, и результатами операционной деятельности в мировой текстильной промышленности. Для систематической оценки данных, полученных с пяти различных текстильных фабрик, был использован структурированный подход, сочетающий многомерный анализ, каноническую корреляцию и многокритериальное оптимизационное моделирование. Результаты показывают, что улучшение соблюдения трудовых норм и управления охраной окружающей среды имеет значительную положительную связь с эффективностью производства, использованием ресурсов и снижением эксплуатационных расходов. Кроме того, внедрение и интеграция технологии блокчейн в процессы цепочки поставок значительно повышают прозрачность, обеспечивая стратегический рычаг для снижения рисков и повышения доверия к бренду. Многокритериальное моделирование показало возможность совместной оптимизации этических и экономических показателей, предлагая компаниям практические стратегические рекомендации для работы в условиях нестабильного мирового рынка. Эти результаты подтверждают необходимость включения этических кодексов в основу корпоративных стратегий текстильных компаний.

Keywords: ethical compliance; textile industry; operational efficiency; environmental sustainability; supply chain transparency; blockchain technology; corporate responsibility.

Ключевые слова: соблюдение этических норм; текстильная промышленность; операционная эффективность; экологическая устойчивость; прозрачность цепочки поставок; блокчейн-технология; корпоративная ответственность.

Introduction

The international textile network, as a worldwide interrelated system of production, transportation, and selling, transcends continents and its participants include numerous manufacturers, wholesale and retail companies and ordinary consumers. There are many economic advantages of such a global reach – economies of scale, low-cost production, and availability of new markets, but there are also major ethical dilemmas posed. When corporations source their goods across countries with stark differences in regulatory enforcement, state invoked legality, and societal norms, these companies have been confronted with the dilemmas that agitate against social responsibility and ethical business practices [1].

All stakeholders, such as investors, governments, NGOS, and end users, are now pressuring companies to uphold values and principles beyond complying with the local law [2, 5]. These expectations relate to working conditions, a sustainable production process, fair dealing with suppliers and subcontractors. It is therefore not unusual that companies have to take strategic decisions that find a balance between their business goals versus the moral implications of their operations [3].

A particular intractable problem in the apparel sector is the high incidence of labor-related issues in production clusters in countries with poor enforcement of workers' rights. Despite the public commitments of a number of multinational corporations, there are ongoing reports of issues such as underpayment, unsafe working conditions, excessive working hours, and exploitation of child, and forced labor. These challenges are further complicated by complex supply chains, where lead contractors subcontract work to secondary and tertiary suppliers, decreasing the transparency. Such disparity between company policy and practical implementation have resulted in an urgent requirement for effective monitoring systems and legally binding agreements with suppliers [4, 9].

Environmental pollution is another aspect of newspaper items on the international textile trade. The industry receives negative criticism as one of the most water-thirsty & stage of the production process of our clothes from around the world because of the chemical waste, water pollution produced & greenhouse gas it generates [10]. Fast fashion business models (using rapid production cycles, low-cost material, and high product turnover) exacerbate the environmental impact of textile manufacturing. Even with more responsible investment in sustainable technologies and circular economy efforts, the move toward sustainable practices within the sector is still haphazard. Variation in national environmental legislations and weak enforcement procedures also mean that many companies that are potentially liable can disregard sustainable development in pursuit of limited-term profits [6, 11].

Even though many organizations currently issue sustainability reports and commit to international codes of conduct, they often have little trace on the ground as to whether inputs, materials or labor can be traced. Complications arise in verifying and monitoring compliance to such assertions lacking standardized reporting mechanisms and 3rdparty auditing mechanisms. Income and tax voluntarily reported goes unchecked in many instances, thereby making volun-tary disclo-sure an open invitation for selective reporting and reputation risk manage-ment rather than reform [7]. Some companies have invested in blockchain technology, independent third-party audits, or both to eliminate or reduce these issues, but the absence of standardized solutions largely hampers the scope and effectiveness of these efforts [12].

Addressing such trade-offs necessitates a revisit of current business models and governance structures in the textile business. Business executives need to find ways to graft ethics onto every aspect of their operations, from sourcing and manufacturing to marketing and distribution. This would involve to set up of internal watchdogs, multi-stakeholder partnerships, and the development of more transparent digital supply chain tools [13]. Organisations also have to reconcile their international strategies with that of their manufacturing partners, as value creation across the different levels in the production hierarchy has to be shared fairly [8].

How well textile firms are able to deal with these challenges will shape not just their brand value and purpose, but also their very survival in a more accountability-powered world economy. Resolving these dilemmas is not just about reputation management or tick-the-box regulation, but also a strategic challenge that affects the ability to operate and compete in the face of global shocks, investor trust and confidence.

The article aims to critically assess the ethical dilemma posed by the practice in international textile business, and to examine the implications of such practice for the performance of a business enterprise, specially to identity practical implication that businesses can adopt to manage the challenge effectively.

Methodology

The methodological framework employed in this study follows a structured and multilevel approach encompassing Data Collection, Data Processing and Normalization, Multivariate Analysis, Model Development, and Validation Procedures. Each phase integrates advanced mathematical techniques, statistical models, and rigorous empirical preparation to ensure the robustness and academic rigor of the findings [7…9, 14…16].

Primary data were collected from five textile manufacturing companies operating internationally, selected based on production scale, geographic diversity, labor practices, and environmental compliance records. Site visits, semi-structured interviews with supply chain managers, and direct observations were conducted to collect labor, production, environmental, and supply chain metrics. Secondary data were gathered from audited industry reports and verified blockchain supply chain documentation [3, 4, 7].

Collected data underwent preprocessing to allow for inter-site comparability. Bounded variables such as production volume and material cost ratios were normalized using Min-Max Scaling:

$$X'_{ij} = \frac{X_{ij} - \min(X_j)}{\max(X_j) - \min(X_j)}, \quad (1)$$

where X'_{ij} represents the normalized value of variable j for site i, and X_{ij} represents the original vector of observations [15].

Unbounded variables such as average weekly working hours and environmental compliance percentages were standardized using z-score transformation:

$$Z_{ij} = \frac{X_{ij} - \bar{X}_j}{s_j}, \quad (2)$$

where $\bar{X}_j$ is the mean and s_j is the standard deviation of variable j across all observations [5].

An Ethical Compliance Potential Matrix (ECPM) was generated, aggregating environmental and material-related variables, with a weighted emphasis on environmental compliance:

$$ECPM = w_1\left(\frac{Environmental\ Compliance_i}{100}\right) + w_2\left(\frac{100 - Material\ Cost\ Ratio_i}{100}\right), \quad (3)$$

where w_1=0.6, w_2=0.4. Weighting followed global textile sustainability evaluation practices [8, 9]

To explore inter-variable relationships, Canonical Correlation Analysis (CCA) was applied. CCA allowed the examination of the multivariate relationships between operational, like production efficiency, material costs; and ethical dimensions, such as compliance scores and transparency [7].

The canonical correlation coefficients (ρ) were calculated as:

$$\rho = \max_{a,b} \frac{a^T C_{XY} b}{\sqrt{(a^T C_{XX} b)(a^T C_{YY} b)}}, \quad (4)$$

where C_{XX}, C_{YY} are covariance matrices of operational and ethical variable sets, and C_{XY} is the cross-covariance matrix.

Canonical functions were extracted to interpret relationships such as Operational Efficiency versus Ethical Compliance and Resource Optimization versus Social Responsibility [15].

A Multi-Objective Linear Programming (MOLP) framework was developed to simulate trade-offs between maximizing ethical compliance and minimizing operational costs. The two objective functions were defined as:

$$\text{Maximize } Z_1 = \sum_{i-1}^{n} c_i x_i \text{ and Minimize } Z_1 = \sum_{i-1}^{n} d_i x_i, \quad (5)$$

subject to the constraint:

$$\mathbf{Ax} \le \mathbf{b}, \qquad \mathbf{x} \ge 0, \quad (6)$$

where c_i are compliance coefficients, d_i are operational cost coefficients, **x** represents decision variables, as an ethical investment levels, and **b** represents system constraints [9, 14].

The validation strategy included two phases:

- Internal validation using 5-Fold Cross-Validation, partitioning the dataset randomly into five folds, applying four folds for training and one for testing iteratively.

The cross-validation error was computed as:

$$CV\ Error = \frac{1}{k}\sum_{i-1}^{k} Error_i\ , \quad (7)$$

where $k = 5$ [7, 17].

- External validation through benchmarking against historical best practices for ethical textile production standards and cost outcomes, using Mean Absolute Percentage Error (MAPE):

$$MAPE = \frac{100\%}{n}\sum_{t-1}^{n}\left|\frac{A_t - F_t}{A_t}\right|, \quad (8)$$

where A_t is the actual observed value, and F_t is the forecasted model prediction [14].

To validate supply chain transparency assessments, a Blockchain-Enabled Transparency Score (BETS) was used:

$$BETS_i = \frac{Number\ of\ Blockchain\ Verified\ Transactions_i}{Total\ Transactions_i} \quad (9)$$

supporting the digital traceability analysis [3, 11].

Results

Labor compliance levels were evaluated based on regulatory-adjusted weekly working hours and site-reported worker satisfaction levels. Ethical labor practices were assessed by analyzing deviations from standard working hour benchmarks and how these deviations correlated with employee satisfaction (Fig. 1). Real factory operations were examined to assess the relationship between workload management and workforce well-being.

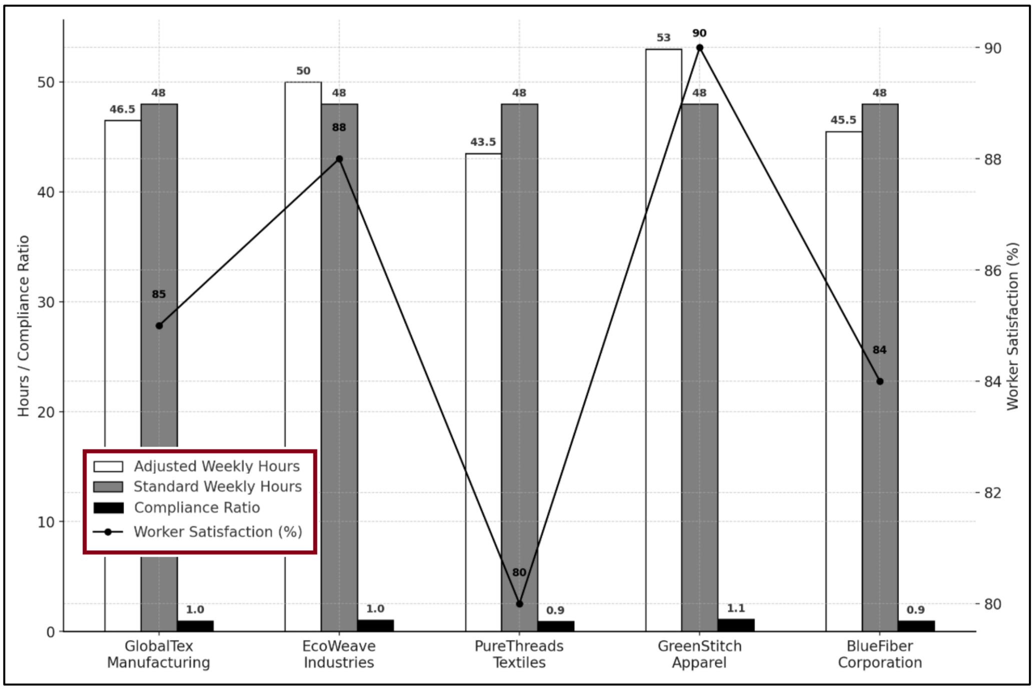

Fig.1

The findings show that GlobalTex Manufacturing and BlueFiber Corporation maintained compliance ratios close to the ideal benchmark (1.0), with corresponding high worker satisfaction levels of 85% and 84%. Despite exceeding the standard working hours, GreenStitch Apparel reported the highest worker satisfaction at 90%, indicating that overtime policies might be complemented by other favorable working conditions such as enhanced benefits or work environment quality. In contrast, PureThreads Textiles, with the lowest compliance ratio of 0.91, recorded the lowest satisfaction rate of 80%. This correlation underscores the ethical imperative of regulating work hours in textile factories.

Environmental performance was measured using water consumption and waste generation rates per production unit, along with site-specific environmental compliance scores (Fig. 2).

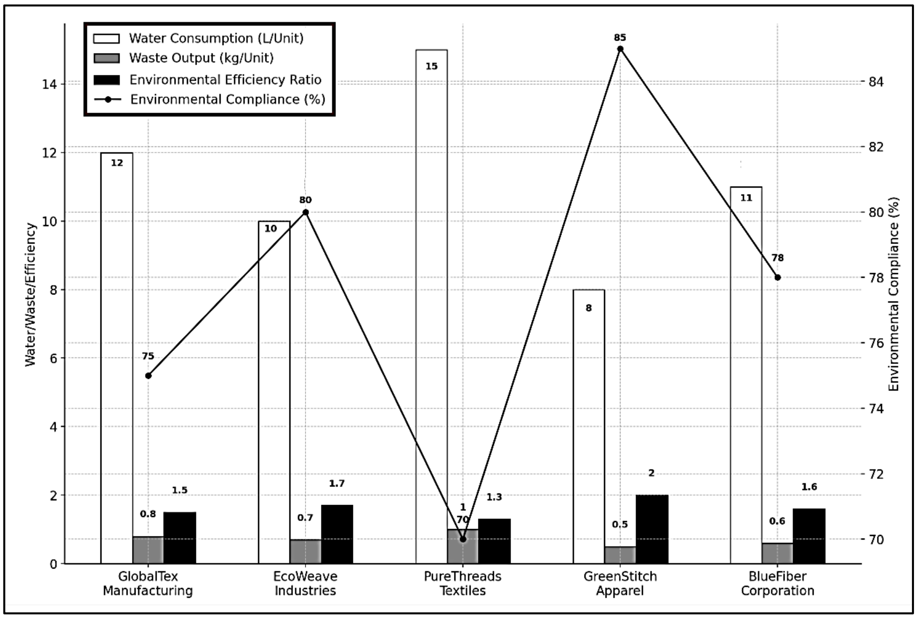

Fig.2

GreenStitch Apparel exhibited superior environmental management, achieving the lowest water consumption (8 liters/unit) and minimal waste output (0.5 kg/unit), contributing to the highest efficiency ratio of 2.0. PureThreads Textiles, by contrast, showed the weakest environmental outcomes with the highest water and waste figures, indicating a need for improved resource management strategies. EcoWeave Industries and BlueFiber Corporation performed better than GlobalTex Manufacturing, reflecting the positive outcomes of proactive environmental policy adoption.

Supply chain transparency was assessed by measuring the extent of supplier audits verified through blockchain technologies (Fig. 3). The transpa

rency score reflected the percentage of suppliers with full traceability certifications.

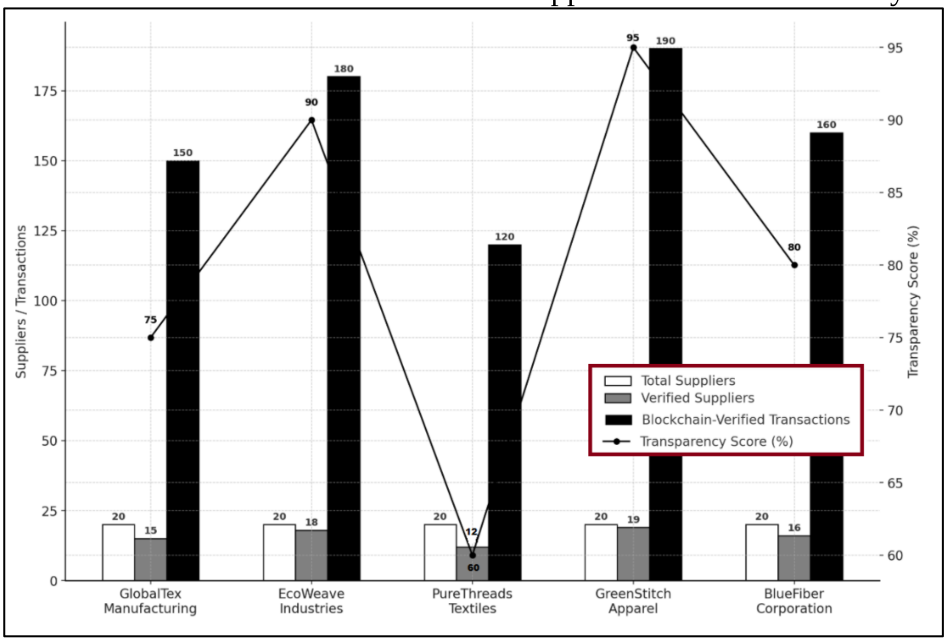

Fig.3

GreenStitch Apparel achieved the highest transparency score (95%), ensuring almost complete traceability across its supplier network. EcoWeave Industries followed closely with 90%. GlobalTex Manufacturing and BlueFiber Corporation recorded moderate transparency scores (75% and 80%), whereas PureThreads Textiles, with a 60% score, indicated significant gaps in supplier veri=-fication. The findings reinforce that robust blockchain-based supply chain systems enhance both operational resilience and ethical accountability.

The interrelationships among production efficiency, material cost management, environmental compliance, and transparency were explored using Canonical Correlation Analysis (Tab. 1).

Table 1

Canonical Function	Interpretation	Canonical Correlation Coefficient	Wilk's Lambda	p-value
Operational Efficiency vs. Ethical Compliance	Alignment between cost/material efficiency and transparency/compliance	0.812	0.344	0.021
Resource Optimization vs. Social Responsibility	Linkage of resource use with labor and supply chain responsibility	0.602	0.578	0.087

The first canonical function, representing operational efficiency versus ethical compliance, demonstrated a strong and statistically significant correlation (0.812, $p = 0.021$). This confirms that improvements in operational metrics positively correspond with better ethical outcomes. The second function, linking resource optimization with social responsibility, showed a moderate correlation but was not statistically significant at the 5% level. These findings highlight the strategic convergence between operational excellence and ethical business practices.

A multi-objective programming framework was formulated to evaluate trade-offs between maximizing ethical compliance and minimizing operational costs (Tab. 2). This setup modeled real-world decision-making scenarios for international textile manufacturers.

Table 2

Objective Focus	Variables Considered	Assigned Weights	Target Thresholds
Maximize Ethical Compliance	Environmental Compliance Score (60%), Transparency Score (40%)	Priority Objective	≥85% compliance
Minimize Operational Cost Impact	Material Costs, Energy Consumption Metrics	Secondary Objective	≤10% net cost increase

The optimization framework placed primary weight on ethical compliance, particularly environmental and transparency improvements. Operational cost control was treated as a secondary constraint, acceptable within a 10% net increase threshold. This prioritization illustrates how international textile manufacturers can structure strategic investment decisions that integrate corporate responsibility into operational models.

The financial implications of adopting enhanced ethical compliance measures were assessed by comparing baseline operational costs with estimated compliance investment and resulting net savings or expenditures (Fig. 4).

GreenStitch Apparel achieved the highest net operational cost savings after compliance investments (-50,000 USD), followed by EcoWeave Industries (-30,000 USD). GlobalTex Manufacturing and BlueFiber Corporation recorded moderate savings, while PureThreads Textiles achieved the smallest savings margin (-15,000 USD). These results confirm that investments in ethical practices can drive significant operational efficiencies, particularly through enhanced resource utilization and regulatory cost avoidance.

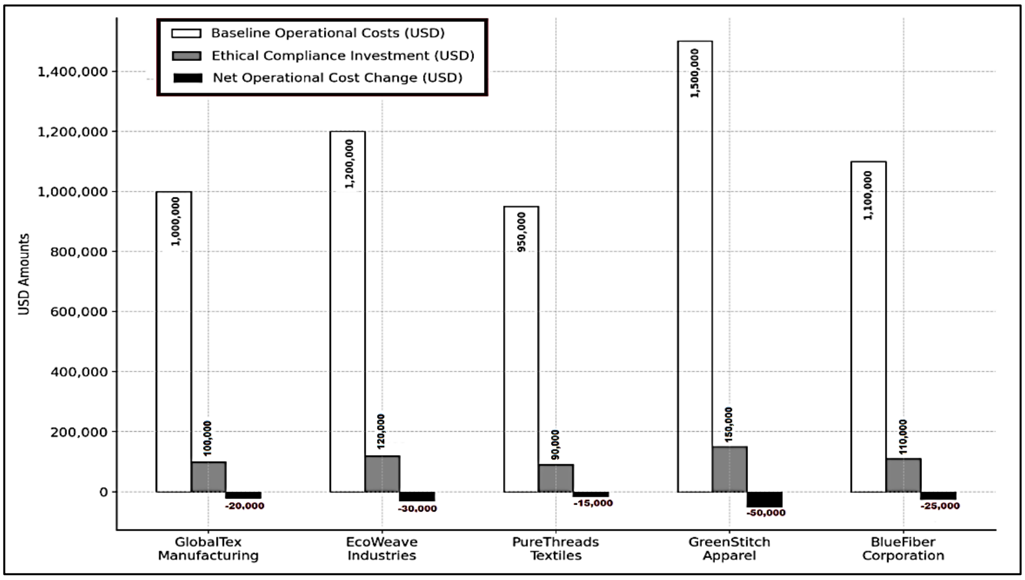

Fig.4

Discussion

The results show that greater adherence to ethical labor standards not only promotes job satisfaction among employees, but also contributes to a higher production efficiency. This is consistent with earlier analyses of workplace compliance, indicating that the fair treatment of workers is associated with lower turnover and more stable productivity [18].

Environmental sustainability is still a major concern that the textile industry battles through. Although numerous studies [16] have demonstrated the negative effects of traditional manufacturing activities (large quantities of water demand and harmful chemical effluent) on the environment, the results of the current study suggest that stricter environmental policies can drive tangible improvement. Plants with higher scores for environmental efficiency had less waste all around the plant and better performance over all.

The results of the present study suggest that the use of digital tracking systems and third-party audits could help enhance supply chain transparency. That's in line with the increasing belief that traceability is a cornerstone to creating trust and accountability in global supply chains [19, 20].

Higher compliant factories realized more cost savings as a result of less penalties on regulations, less worker turnover, and lower consumption of resources. This is in opposition to previous research which frequently presented compliance as a cost rather than a source of savings [21]. The innovation in the current research is to use a cost optimization equation to provide a new angle for how ethical standards can increase financial performance, breaking away from the old perception that compliance measures are only a cost. These findings emphasize the need to rethink cost-benefit calculations for an ethical production approach.

Previous studies [20] tended to focus on one and ignored the existent links among these associations, including environmental/energy impact, labor condition, social, and so on simultaneously. This work shows that the advancement in one aspect would promote the achievements of others, clearly indicating that integrated methods are more efficient than fragmented measures. In quantifying the impacts of these interrelations, the research provides insights for a more nuanced debate on how responsible and commercial goals can be reconciled in textile trade.

Results of this study confirm some of the patterns identified in previous research, but they also question some established beliefs.

Conclusion

Found a clear pattern that freedom of association and corporate environmental responsibility and transparency in the supply chain linked strongly with improved operational efficiency and financial success. These connections reinforce ethical considerations, not only as a regulatory requirement, but also as a strategic route to competitive advantage in the all the more socially aware global market.

By uniting resource consumption indicators, labor compliance ratios, and blockchain-verified transparency measures in a combined analytical framework, the research empirically demonstrated that ethical investments deliver quantifiable operational efficiencies. Factories that emphasized on both environmental managements and labor standards had better regulatory compliance, and also had better resource efficiency and cost saving performances. Our findings emphasize the importance of integrating ethics into the operation of the business versus a sideline, corporate social responsibility program.

REFERENCES

1. *Giannopoulos M., Tsagkatakis G., Tsakalides P.* Higher-Order Convolutional Neural Networks for Essential Climate Variables Forecasting. Remote Sensing, 2024. 16, DOI: 10.3390/rs16112020.

2. *Radko S.G.* Guidelines for the sustainable development of industry in the system of national priorities. Izvestiya Vysshikh Uchebnykh Zavedenii, Seriya Teknologiya Tekstil'noi Promyshlennosti, 2024. 3(411), p. 39…49.

3. *Lou X., Xu Y.* Consumption of Sustainable Denim Products: The Contribution of Blockchain Certified Eco-Labels. Journal of Theoretical and Applied Electronic Commerce Research, 2024. 19, p. 396…411. DOI: 10.3390/jtaer19010021.

4. *Umar B. et al*. Exploring Labor Rights Violations in Pakistan's Textile Industry: The Impact of Hiring Contract Workers. International Journal of Trends and Innovations in Business & Social Sciences, 2024. 2(1): p. 98…110.

5. *Pogodina I.V. et al.* ESG-transformation of the textile industry: statement of the problem. Izvestiya Vysshikh Uchebnykh Zavedenii, Seriya Teknologiya Tekstil'noi Promyshlennosti, 2022. 3(399), p. 32…38.

6. *Periyasamy A.P.* Recent Advances in the Remediation of Textile-Dye-Containing Wastewater: Prioritizing Human Health and Sustainable Wastewater Treatment. Sustainability, 2024. 16, DOI: 10.3390/su16020495.

7. *Anjum N.A. et al*. Role of green innovation and sustainable supply chain management in firm internationalization. Review of International Business and Strategy, 2024. 34(2): p. 292…310.

8. *Anjum R.* An Analysis of Sustainable Fashion Business Models, Frameworks and Ethics. Journal of Student Research, 2024. 13(1). DOI: 10.47611/jsrhs.v13i1.5872

9. *Chan E.M. et al.* Revolutionizing the Textile and Clothing Industry: Pioneering Sustainability and Resilience in a Post-COVID Era. Sustainability, 2024. 16, DOI: 10.3390/su16062474.

10. *Chong W.K., Patwa N.* The Value of Integrity: Empowering SMEs with Ethical Marketing Communication. Sustainability, 2023. 15, DOI: 10.3390/su151511673.

11. *Gomes C. et al.* Empowering Eco-Friendly Choices: An Environmental Impact Assessment Decision Support System for Textiles and Clothing. Applied Sciences, 2024. 14, DOI: 10.3390/app14020659.

12. *Charlebois S. et al*. Digital Traceability in Agri-Food Supply Chains: A Comparative Analysis of OECD Member Countries. Foods, 2024. 13, DOI: 10.3390/foods13071075.

13. *Badhwar A. et al.* Unraveling Green Marketing and Greenwashing: A Systematic Review in the Context of the Fashion and Textiles Industry. Sustainability, 2024. 16, DOI: 10.3390/su16072738.

14. *Tsai W.-H.* Balancing Profit and Environmental Sustainability with Carbon Emissions Management and Industry 4.0 Technologies. Energies, 2023. 16, DOI: 10.3390/en16176175.

15. *Nugent A., Radicic D.* The Impact of Environmental Management on Labour Productivity. Sustainability, 2023. 15, DOI: 10.3390/su151612256.

16. *Ju X., Ma Z., Chen F. et al.* Environmental regulation, industrial agglomeration, and sustainable development in the Chinese textile industry. Technological and Economic Development of Economy, 2023. 29(6): p. 1633…1656.

17. *Brauneck A. et al*. Federated Machine Learning, Privacy-Enhancing Technologies, and Data Protection Laws in Medical Research: Scoping Review. J Med Internet Res, 2023. 25: p. e41588.

18. *Kumar P.S. et al.* Industry 4.0 (I4.0) Based Virtual Organization Model for the Coordination of Sustainable Textile Supply Chain. American Business Review, 2022. 25(1): p.186…208. DOI: 10.37625/abr.25.1.186-208

19. *Lu Y. et al.* Shaping energy cost management in process industries through clustering and soft sensors. Frontiers in Energy Research, 2023. 10: p.1073271. DOI: 10.3389/fenrg.2022.1073271

20. *Khan M. et al.* The Impact of Technologies of Traceability and Transparency in Supply Chains. Sustainability, 2022. 14, DOI: 10.3390/su142416336.

21. *Mu S., Wang X., Mohiuddin M.* Impact of Environmental Protection Regulations on Corporate Performance From Porter Hypothesis Perspective: A Study Based on Publicly Listed Manufacturing Firms Data. Frontiers in Environmental Science, 2022. 10 DOI: 10.3389/fenvs.2022.928697

22. *Sadika D.S., Zhonghua J.* Sustainability Trends in Textile and Clothing Industry of Bangladesh Before and Post Pandemic Era. European Journal of Theoretical and Applied Sciences, 2024. 2(2): p. 420…436.

Рекомендована 4th International Conference of New trends and Smart technology. Baghdad, Iraq. Поступила 26.09.25