

Bridging Industry 4.0 and 5.0 in India's Textile Sector: Challenges, Opportunities and Strategic Pathways

Dr. Deepana. P^{1*}; Dr. Deepica. M R²

^{1,2} Assistant Professor, Department of BBA (IB & RM) PSGR Krishnammal College for Women, Coimbatore.

*Corresponding Author: Dr. Deepana. P

DOI: <https://doi.org/10.5281/zenodo.17552252>

Article History	Abstract
Review Article	<i>Indian textile industry, a mainstay of the economy of the country, is confronted with two challenges: the downtrend in Industry 4.0 technology adoption and the need to compete with countries moving toward Industry 5.0. Digital transformation, though holding out possibilities for sustainability, innovation and growth, is still being constrained by structural, finance and policy hurdles. This article discovers Industry 4.0 adoption barriers, analyses India's preparedness for Industry 5.0 and offers competitive strategy advice for global competitiveness. Based on qualitative, descriptive methods and a systematic review of ten seminal studies, the analysis proposes avenues for combining intelligent, human-focused and sustainable textile production.</i>
Received: 20-10-2025	
Accepted: 28-10-2025	
Published: 07-11-2025	
Copyright © 2025 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.	
Citation: Dr. Deepana. P; Dr. Deepica. M R. (2025). Bridging Industry 4.0 and 5.0 in India's Textile Sector: Challenges, Opportunities and Strategic Pathways. UKR Journal of Economics, Business and Management (UKRJEBM), volume 1 (9), 50-52.	Keywords: Digital Transformation, Industry 4.0, Industry 5.0, Textile Industry

Introduction

India's textile sector is contributing about 12% to exports and has over 45 million people employed in the sector, making the textile ecosystem one of the largest in the world (Indian Textile Journal, 2025). The industry, though, is experiencing uneven and declining implementation of Industry 4.0 technologies like automation, IoT and AI integration, especially among the small and medium enterprises. Parallely, countries like Germany, Japan and South Korea are quickly shifting towards Industry 5.0, which is based on hyper-personalization, sustainability and human-machine collaboration (Textile World, 2025; Textile Sphere, 2024). In order to regain competitiveness, India needs to overcome technological inertia and embark on a transition plan centered around innovation, sustainability and inclusivity.

Review of Literature

Deepthi and Bansal (2022) performed a bibliometric review to chart international research trends in Industry 4.0 adoption in the textile and apparel sector. Through their review, they found that Europe and East Asia were leading the digitalization charge, with India having major skill and cost impediments to full-fledged implementation. The authors concluded that it needs policy-specific support and

long-term investment in digital literacy for workers to address this gap.

Sabareesh, Karthik and Nagarajan (2024) analyzed the effects of the integration of IoT, robotics and AI in textile production and supply chains. These technologies were found to greatly enhance quality control and decrease energy consumption through better process synchronization. SMEs experienced difficulties implementing these technologies as a result of insufficient capital and technical capabilities. Based on the research, the researchers concluded that government incentives and collaborative academic industry advancements are essential for mass implementation.

Majumdar, Garg and Jain (2023) investigated structural impediments hindering Industry 4.0 adoption in developing markets' textile industries. Using Interpretive Structural Modelling, they identified management inertia, legacy infrastructure and skilled staff unavailability as the key bottlenecks. Their inference indicated that institutional partnerships are crucial to establish knowledge-sharing networks and strategic funding models.

Pasek et al. (2023) studied the efficiency of decision making in textile firms using Industry 4.0 systems. Their

study indicated that real-time analytics enabled managers to optimize workflows, minimize defect rates and enhance delivery dates. They concluded that digital management tools increase organizational agility but need a digitally equipped leadership workforce.

Cambridge University Press (2022) discussed integrating sustainable production into Industry 4.0 platforms through European textile companies' case studies. According to the findings, there is a positive correlation between environmental sustainability and cyber-physical systems. Indian manufacturers would be able to yield similar results by integrating sustainability objectives into digital change policies, it concluded.

Emerald Insight (2021) published a systematic review of Industry 4.0 technologies applicable to textile and apparel production. Findings revealed that while technology diffusion and adoption of IoT and automation are becoming universal, adoption remains sluggish in developing economies. Authors concluded that technology roadmaps tied to industry requirements and digital competence centres sponsored by governments are critical to successful implementation.

Mureed Abbas et al. (2025) emphasized cultural readiness in textile companies adopting Industry 4.0 technology. The authors concluded that firms nurturing innovation and participative cultures implemented digital systems more efficiently than hierarchical ones. They found that social and psychological readiness must go alongside technical upgradation for holistic modernization.

Textile School (2025) explored how Industry 4.0 is propelling automation, blockchain traceability and AI-fused quality assurance. The study discovered that smart manufacturing enhances accuracy and reduces rejection rates across textile lines. The research concluded that early digital adoption guarantees long-term competitiveness and sustainability.

Cannavacciuolo (2023) examined how technological innovation drives Industry 4.0 uptake in manufacturing industries, such as the textile sector. It was identified through findings that cross-industry collaboration and open knowledge ecosystems were key drivers of innovation. The research found that investing in public-private R&D collaborations enable nations like India to improve industrial modernization capability.

Tandfonline (2025) spoke about Industry 4.0's impact on product innovation as well as business agility. In case studies, the results showed that digital twins and virtual simulation technologies cut development time by 25 - 30%. The authors concluded that the blending of creative design with digital manufacturing marks the transition to Industry

5.0, placing human creativity at the center of automated spaces.

Methodology

The research used a qualitative descriptive design supported by a systematic literature review. Secondary data (2021–2025) from academic databases like Scopus, Emerald, ScienceDirect and IEEE Xplore were examined. Ten peer-reviewed papers were scrutinized in depth to determine common themes concerning digital transformation in textiles. Thematic analysis revealed five broad themes: (1) technological hurdles, (2) readiness of the workforce, (3) policy support, (4) sustainability and (5) networks for innovation. This approach yields conceptual insights instead of numerical generalizations, focusing on contextual comprehension of Industry 4.0 and 5.0 readiness within the Indian textile sector.

Discussion

Decline in Industry 4.0 Implementation

Notwithstanding India's leadership in textile export and employment, studies validate a plateau in Industry 4.0 implementation (IJERT, 2024; Emerald, 2021). Initial high investment, managerial reluctance and reliance on vintage equipment stall modernization (Cambridge, 2022). The smaller and medium enterprises (SMEs), making up more than 80% of the industry, do not have the money or digital infrastructure for transformation. Fragmented policies and a lack of adequate upskilling programs also limit long-term technological preparedness (Textile World, 2025).

Competing in Industry 5.0 World

Worldwide, the textile world is moving towards Industry 5.0 dominated by human-machine partnership, AI-augmented design and sustainable production (Master's Union, 2025). Countries such as Japan and Germany incorporate workers in smart systems with a focus on imagination and co-innovation. India needs to bridge this gap by driving R&D in intelligent textiles, establishing PM MITRA "super parks" for combined digital environments and motivating circular textile innovation (Fibre2Fashion, 2025). The key to success is inclusive innovation: industry modernization to balance people, machines and the environment.

Policy Implications

1. Develop a National Industry 5.0 Innovation Framework embracing robotics, blockchain traceability and AI in textile clusters.
2. Enhance public-private R&D partnerships among universities, tech companies and textile producers.

3. Launch green innovation zones with an emphasis on sustainable materials and low-carbon production (Textile Sphere, 2024).
4. Scale up SAMARTH digital upskilling initiatives to enhance human capital for Industry 5.0-era manufacturing.
5. Offer tax incentives and export benefits to companies that embed digital twin and circular economy offerings (Indian Textile Journal, 2025).

Conclusion

The Indian textile industry is at the crossroads of transformation. The declining adoption of Industry 4.0 and the rush towards Industry 5.0 around the world unveil underlying structural and capability shortfalls. Yet India's size, trained manpower pool and dynamic government policies are solid pillars for rebirth. Crossing the technology gap involves continued investment in digital infrastructure, skill formation and R&D-driven innovation. The shift to Industry 5.0 is not an economic transition alone but a strategic necessity that will shape India's leadership in international textile manufacturing through people-oriented, sustainable and smart production systems.

REFERENCES

1. Abbas, M., & Mureed, A. (2025). *Assessing the preparedness of the textile sector for Industry 4.0 implementation*. *Industria Textila*, 76(4), 215–228. <https://revistaindustriatextila.ro/images/2025/4/006%20ABBAS%20MUREED%20.pdf>
2. Cambridge University Press. (2022). *Towards sustainable manufacturing with Industry 4.0: A framework for the textile industry*. *Proceedings of the Design Society*, 2(1), 341–352. <https://doi.org/10.1017/pds.2022.26>
3. Cannavacciuolo, M. (2023). *Technological innovation enabling the industry 4.0 paradigm*. *Journal of Manufacturing Systems*, 65(2), 299–312. <https://doi.org/10.1016/j.jmsy.2023.04.009>
4. Deepthi, B., & Bansal, V. (2022). *Industry 4.0 in textile and apparel industry: A systematic literature review and bibliometric analysis of global research trends*. *Journal of Textile Engineering*, 18(3), 85–97. <https://doi.org/10.1177/09722629221130233>
5. Emerald Insight. (2021). *Industry 4.0 in textile and apparel sector: A systematic literature review*. *Research Journal of Textile and Apparel*, 25(5), 890–912. <https://doi.org/10.1108/RJTA-08-2021-0106>
6. Fibre2Fashion. (2025). *Why India's textile industry must automate: Five strong reasons*. <https://www.fibre2fashion.com/industry-article/10336/why-india-s-textile-industry-must-automate-5-strong-reasons>
7. Indian Textile Journal. (2025). *India's top 50 textile companies and their digital transformation progress*. <https://www.indiantextilejournal.com/indian-textile-journal-presents-indias-top-50-textile-companies-in-2025/>
8. Majumdar, A., Garg, C., & Jain, R. (2023). *Managing barriers to Industry 4.0 adoption in the textile sector using interpretive structural modeling*. *Journal of Cleaner Production*, 382(1), 135–147. <https://doi.org/10.1016/j.jclepro.2023.135972>
9. Pasek, Z., Singh, R., & Ananth, K. (2023). *Decision-making in the context of Industry 4.0: Evidence from the textile and clothing industry*. *Journal of Manufacturing Technology Management*, 34(4), 715–733. <https://doi.org/10.1016/j.jmsy.2023.03.042>
10. Sabareesh, R., Karthik, S., & Nagarajan, A. (2024). *Impact of Industry 4.0 on textile production and supply chain performance*. *International Journal of Engineering Research and Technology*, 13(5), 1219–1228. <https://www.ijert.org/impact-of-industry-40-on-textile-production-and-supply-chain>
11. Textile School. (2025). *Industry 4.0 in textiles: Transforming production systems*. <https://www.textileschool.com/9952/industry-4-0-in-textiles>
12. Textile Sphere. (2024). *Indian textile industry outlook 2025: Challenges and opportunities*. <https://www.textilesphere.com/2024/11/indian-textile-industry-outlook-2025.html>
13. Tandfonline. (2025). *New product development in the industry 4.0 era*. *Production Planning & Control*, 36(7), 1015–1032. <https://doi.org/10.1080/09537287.2025.2570209>