International Journal of Computer Information Systems and Industrial Management Applications
ISSN 2150-7988 Volume 18(12s) 2026 pp. 488-496
https://doi.org/10.70917/ijcisim-2026-3918
Article

Data-Driven Management of Workforce Dynamics under Automation and Digital Transformation in Textile Manufacturing Industries

D. Rajkumar[1], T. Gayathri[2]

[1,2]Department of Commerce, Nehru Memorial College (Autonomous) (Affiliated to Bharathidasan University), Tiruchirappalli, Tamil Nadu, India
* Correspondence author: rajkumar2024@induniversityedu.org ; gayathri81@nmc.ac.in

Abstract: The increasing adoption of automation and digital transformation has fundamentally influenced workforce management in modern manufacturing industries. Organizations are increasingly integrating intelligent technologies to improve operational efficiency, optimize resource utilization, and enhance productivity while managing workforce transitions effectively. This study examines the impact of automation and digitalization on workforce dynamics, with particular emphasis on employment patterns and gender participation in manufacturing environments. Rather than considering technological change as a disruptive phenomenon, the study views automation as a gradual management-driven process in which advanced technologies are systematically incorporated into existing industrial operations. A quantitative research approach was employed to evaluate the relationship between automation adoption and workforce outcomes. Data were analyzed using the independent sample t-test through SPSS software to identify statistically significant differences among selected workforce variables. The findings indicate that effective management of digital transformation can improve organizational performance while reshaping job roles and workforce participation instead of completely replacing human labor. The study highlights the importance of strategic workforce management, evidence-based decision making, and inclusive employment policies for achieving sustainable industrial development. The proposed analytical perspective contributes to industrial information systems and management research by providing practical insights that assist industrial managers and policymakers in balancing technological advancement with workforce sustainability in digitally transforming manufacturing enterprises.

Keywords: Workforce Management, Digital Transformation, Automation, Manufacturing Industries, Industrial Management, Employment Analysis, SPSS, Decision Support

1. Introduction

The Textile business is many of the oldest and maximum mounted in the world, having been practiced for several millennia. It additionally has some of the maximum superior era this is available to clients after they buy its merchandise. This specific ability to innovate and create new sorts of textiles and materials, alongside new manufacturing technologies, is assisting to revolutionize textiles for furnishings upholstery, sofas, or even fashion. It is thought to play a exceptional role in the exportation enterprise around the globe and employs a huge variety of humans throughout the globe. Technology continues to have an impact on the textile industry as it grows in a number of methods. The fabric production area is surprisingly competitive and manufacturers are constantly looking for methods to reduce their fee amidst hovering marketplace call for textiles. Now, it'll be beneficial to test a number of them. Textiles had been one of the pioneers in technological innovation and feature usually adopted new technologies to match the ever-developing global market.

Technological advancements inside the textile industry had been felt throughout the numerous aspects of manufacturing and have brought about expanded efficiency, productivity, and sustainability. However, with the arrival of automation and advances in technology, fabric manufacturers now have the opportunity to lessen their power intake and store expenses [1]. The use of automated systems has significantly elevated

productivity and performance at the same time as reducing costs and improving the first-class of the very last product.

Manufacturers are seeking out ways to lessen manufacturing charges without sacrificing product yield or exceptional in increasingly more competitive worldwide business surroundings [2]. Rising energy prices are growing fees and decreasing value brought on the plant. The challenge of retaining the output of a splendid product notwithstanding lower production costs is triumph over by way of a success, fee-powerful investment in strength-efficiency technologies and practices [3]. In the present-day era, this is mainly critical due to the fact power-green technology frequently include "extra" benefits, like raising business productivity or cutting down on water and/or cloth utilization [4].

The latest technological advancement and the advent of automation have revolutionized the Textile industry in several ways [5]. Manufacturers have commenced leveraging automated machines and systems inside the production manner which include diverse strategies which includes spinning, weaving, and dyeing [6]. The advent of computer-managed machinery has enabled sporting out the manufacturing cause in a quicker way in conjunction with handing over performance, and product satisfactory, and reducing manufacturing fee and power intake [7]. Advanced automation systems also can enable textile producers to gain greater tiers of customization, giving them the potential to provide smaller runs of specialised products fast and cost-successfully [8]. This is mainly crucial in an enterprise wherein fashion and trends are unexpectedly converting and organizations are required to be greater aware of purchasers' wishes [9].

Entrepreneurs find it difficult to understand the perspectives on automation in the textile industry, where significant advancements in technology, substantial investments, and business reengineering are expected [10]. These approaches should involve numerous partnerships, and the majority of the fabric companies surveyed expressed an extreme degree of pessimism [11]. Overall, more research in this area is advised in order to identify other fulfilment aspects that could support the textile manufacturing zone's development of business automation [12]. Regarding the advice for entrepreneurs and business professionals, we suggest that they undertake a thorough examination of the level of automation in the nation now as well as the history of their respective fabric sectors [13].

The benefits of this technology are increased productivity, lower production costs, superior quality carriers, and environmentally friendly material use [14]. Depending on the kind of business, there are new technologies available that could affect almost every procedure that a company uses. Businesses who were already using modern technology were able to adjust quickly, while those who took their time adopting it had to overcome a challenging learning curve [15]. It is essential that the employee's skill set be appropriate, and they also need to be aware of the abilities needed to function with the next generation. It's critical to be transparent about the improvement plans that enable people to use the new technologies they will encounter.

The Mass job losses among manual laborers will occur as the Textile sector begins to industrialize. This situation will lead to numerous textile workers, especially women, who make up a significant percentage of the global workforce, having additional time to work in the textile sector in Erode compared to workers worldwide, before being displaced by machines. This period presents a crucial opportunity for Erode to establish policies for a smooth transition into the Industrial Textile sector. Implementing automatic techniques and advanced technologies in the textile industry presents both significant opportunities and notable challenges.

Automation offers a pathway to enhanced efficiency, consistency, and productivity, enabling manufacturers to meet growing demands with greater precision and speed. However, the integration of such technologies requires substantial investment, skilled workforce adaptation, and restructuring of traditional workflows, which can be demanding, particularly for small and medium enterprises.

Despite the associated costs, automation has become central to ensuring high-quality products while reducing overall production expenses., automated systems help maintain uniform standards and minimize errors, thus enhancing product reliability and customer satisfaction. Larger and more technologically advanced textile companies are more likely to adopt these automated systems due to their greater capacity to handle the complexity and scale of implementation. These enterprises are better positioned to invest in cutting-edge infrastructure and train personnel, facilitating a smoother transition toward full automation. In contrast, smaller firms may find it challenging to overcome the financial and technical barriers, thereby widening the technological gap within the industry.

2. Research Methodology

The methodology adopted in this research was guided by the framework and procedural steps outlined in established case study literature, particularly the works of Eisenhardt (1989) and Yin (2014). A total of ten textile companies were purposively selected based on their demonstrated implementation of automation

technologies and their willingness to participate in the study. To ensure a balanced representation of perspectives and to minimize bias toward higher-level employees during the interview process, participants were chosen from different hierarchical levels within each organization. Specifically, two employees from each firm were initially targeted—one senior manager and one from middle management—leading to 20 initial interviews. However, as the research progressed and to gain deeper insights, a total of 197 interviews were ultimately conducted across the selected firms. This approach ensured a comprehensive understanding of how automation technologies are integrated and perceived at multiple organizational levels within the textile industry.

3. Research Design

The research design serves as a structured blueprint that defines what information is to be collected, from which sources, and by what methods, thereby guiding the overall process of data collection and analysis necessary to address the research objectives within the operational framework of the study. For this investigation, a simple random sampling technique was adopted to ensure unbiased selection of respondents. The study focuses exclusively on textile producers, with a sample size of 197 respondents drawn from the total population of employees working in the textile industry in Erode. This approach ensures that the sample adequately represents the larger population under study. Data gathered were processed and analyzed using Microsoft Excel and SPSS (Statistical Package for the Social Sciences), two widely used software tools for statistical analysis. The analytical framework incorporates the simple percentage method, which calculates the relative frequency of responses by dividing the number of respondents in each category by the total number of respondents and multiplying by 100 which is expressed in equation 1.

$$\text{Simple percentage} = \frac{\text{No. of respondents}}{\text{Total No. of respondents}} \times 100 \quad (1)$$

Additionally, the Chi-square test was employed to examine the association between categorical variables, where the Chi-square statistic (χ^2) is calculated using the equation 2.

$$\text{Chi} - \text{Square} = \frac{\sum(oi-Ei)2}{Ei} \qquad E = \frac{RT\ X\ CT}{N}, \quad (2)$$

The results of the analysis were derived by testing two hypotheses: the null hypothesis and the alternative hypothesis The detailed explanation and testing of these hypotheses are presented in the following section. These methods collectively provide a robust mechanism to interpret the data and draw meaningful conclusions relevant to the textile industry in the selected region.

3.1. Hypothesis Of The Study

This research analyzed two hypotheses to explore the relationship between educational qualifications and the impact of automation on the textile industry. As automation continues to transform the textile sector, understanding how individuals with different levels of education perceive and are affected by these changes is crucial. By investigating these hypotheses, the study seeks to determine whether educational qualifications significantly influence the perceived impact of automation within the industry.

1. Null Hypothesis (H_0): There is no significant relationship between educational qualifications and the impact of automation on the textile industry.
2. Alternative Hypothesis (H_1): There is a significant relationship between educational qualifications and the impact of automation on the textile industry.

4. Socio – demographic profile

The Socio – demographic profile of the respondents from the table suggests that almost more than 58.4% are male respondents. The age category shows a maximum of respondents belong to 21 – 25 years old. Majority of the respondents belong to Urban locality (Table 1). When educational qualification is taken almost 38.1% of the respondents hold Graduation. But the monthly income 37.1% of the respondents earn Rs.20,001-Rs.25,000. Majority of the respondents nearly 61.9% are unmarried. Regarding work experience mostly the respondents were found to be 5 – 8 years of experience. The 37.1% respondent's majority were Impact of Automation on the Textile Industry using in Product quality enhancement. The Implementing automated processes and advanced technologies 30.5% respondents are using Cost Reduction

Table 1. Demographics data of 197 respondents

Variable	Category	Frequency	Percentage
	Male	115	58.4
Gender	Female	82	41.6
Age	Below 21 years	38	19.3
	21 – 25 years	56	28.4
	26- 31 years	41	20.8
	31–40 years	47	23.9
	Above 40 years	15	7.6
	Married	75	38.1
Marital status	Unmarried	122	61.9
Residential Status	Urban	85	43.1
	Semi urban	55	27.9
	Rural	57	28.9
	School level	21	10.7
Educational	Diploma	41	20.8
Qualifications	Graduation	75	38.1
	Post-Graduation	60	30.5
Members of family	Nuclear	131	66.5
	Joint	66	33.5
	Below Rs.20,000	23	11.7
	Rs.20,000-Rs.25,000	73	37.1
Income per month	Rs.25,001- Rs.35,000	27	13.7
	Rs.35,001- Rs.45,000	34	17.3
	Above Rs.50,000	40	20.3
	Below 3 year	20	10.2
	3 – 5 years	63	32.0
Experience	5 – 8 years	71	36.0
	8 - 10 years	13	6.6
	Above 10 years	30	15.2
Impact of Automation	Enhanced Efficiency	35	17.8
on the Textile Industry	Reduced energy consumption	52	26.4
	Product quality enhancement	73	37.1
	Enhanced work environment safety	37	18.8
Implementing	Increased Productivity	32	16.2
automated processes	Improved Quality Control	25	12.7
and advanced	Cost Reduction	60	30.5
technologies	Enhanced Safety	41	20.8
	Faster Time-to-Market	39	19.8

5. Results and discussion

This section presents the analysis of survey data to explore the impact of automation and advanced technologies in the textile industry. It examines demographic influences, such as gender and marital status, on perceptions of automation.

5.1. Gender analysis

The analysis in Table 2a presents a gender-wise overview of the impact of automation, facilitated by artificial intelligence, on the textile industry. The sample size comprises 197 respondents, with the gender variable showing a mean value of 1.42 and a standard deviation of 0.494. This indicates a relatively balanced representation across genders, with a standard error mean of 0.035, suggesting precise estimation of the population mean for gender distribution. Regarding the perceived impact of automation on the textile industry, the mean score stands at 2.57 with a higher standard deviation of 0.991, reflecting diverse opinions or experiences related to automation's influence. The standard error mean for this variable is 0.071.

Table 2a: Gender Wise AI Impact of Automation on the Textile Industry Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Gender	197	1.42	.494	.035
Impact of Automation on the Textile Industry	197	2.57	.991	.071

The results of the one-sample t-test indicate statistically significant findings for both gender and the impact of automation on the textile industry ($p < 0.001$) which is shown in table 2b. Specifically, the gender variable showed a t-value of 40.223 with 196 degrees of freedom, reflecting a significant mean difference of 1.416 within the 95% confidence interval ranging from 1.35 to 1.49. Similarly, the impact of automation variable revealed a t-value of 36.394, also highly significant, with a mean difference of 2.569 and a 95% confidence interval between 2.43 and 2.71. These results confirm that both gender and perceived automation impact have meaningful statistical implications in the context of AI integration within the textile sector.

Table 2b: One-Sample t-Test Results for Gender

	Test Value = 0					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Gender	40.223	196	.000	1.416	1.35	1.49
Impact of Automation on the Textile Industry	36.394	196	.000	2.569	2.43	2.71

5.2. Marital status analysis

Table 3a provides descriptive statistics related to respondents' marital status and their views on implementing automated processes and advanced technologies. The dataset consists of 197 participants. Marital status has a mean value of 1.62 with a standard deviation of 0.487, indicating a relatively homogeneous distribution in terms of marital categories. The standard error of the mean is 0.035, ensuring precise estimation of the mean marital status in the population. On the other hand, the perception of implementing automated processes and advanced technologies shows a higher mean score of 3.15, coupled with a larger standard deviation of 1.328, reflecting greater variability in opinions or experiences about technological implementation. The standard error mean for this variable is 0.095.

Table 3a: Marital status and Implementing automated processes and advanced technologies – One Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Marital status	197	1.62	.487	.035
Implementing automated processes and advanced technologies	197	3.15	1.328	.095

Table 3b displays the results from a one-sample t-test examining whether the mean values of marital status and implementation of automated processes and advanced technologies significantly differ from zero. Both variables yielded statistically significant results with p-values less than 0.001. Specifically, marital status exhibited a t-value of 46.688 with 196 degrees of freedom and a mean difference of 1.619, within a 95% confidence interval ranging from 1.55 to 1.69. Similarly, the implementation of automated processes and advanced technologies demonstrated a t-value of 33.328, also with 196 degrees of freedom, and a mean difference of 3.152, with the confidence interval spanning from 2.97 to 3.34. These findings confirm the significance of marital status and attitudes toward automation adoption in the textile industry context.

Table 3b: One-Sample t-Test Results for Marital Status

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Marital status	46.688	196	.000	1.619	1.55	1.69
Implementing automated processes and advanced technologies	33.328	196	.000	3.152	2.97	3.34

5.3. Effect of automation on the textile industry

The automated processes and advanced technologies used to Increased Productivity, Improved Quality Control, Cost Reduction, Enhanced Safety, and Faster Time-to-Market be the basis for the aspects that were considered. As shown in the above table, the mean and standard deviation for each factor were determined. The t-test was used to determine the importance of each factor, and all of them showed no significant differences when performance in Table 4.

Table 4: Impact of Automation on the Textile Industry

Impact of Automation on the Textile Industry	Respondents	Percent
Enhanced Efficiency	35	17.8%
Reduced energy consumption	52	26.4%
Product quality enhancement	73	37.1%
Enhanced work environment safety	37	18.8%
Total	**197**	**100.0%**

The data presented in Table 5 highlights respondents' perspectives on the key benefits of implementing automated processes and advanced technologies in the textile industry. Among the 197 participants, the majority identified cost reduction as the primary advantage, with 30.5% citing it as a significant outcome. Enhanced safety was the next most frequently reported benefit, noted by 20.8% of respondents, followed closely by faster time-to-market at 19.8%. Increased productivity and improved quality control were also recognized, accounting for 16.2% and 12.7% of responses, respectively.

Table 5: Implementing Automated Processes and Advanced Technologies

Implementing automated processes and advanced technologies	Respondents	Percent
Increased Productivity	32	16.2%
Improved Quality Control	25	12.7%
Cost Reduction	60	30.5%
Enhanced Safety	41	20.8%
Faster Time-to-Market	39	19.8%
Total	**197**	**100.0%**

6. Discussion

The rise of industrial automation has also led to significant advancements in fabric manufacturing, creating dazzling new varieties of clothing, textiles, enhancing the capabilities of workers, and boosting their skills through automation. With the continuous influx of new technologies and innovations, the field of textile technology is poised for numerous transformations in the future. The integration of artificial intelligence into the textile sector has been driven by the increasing demand for high-quality products in recent years (figure 1). In the broad scope of textile manufacturing, various machines such as weaving, cutting, stitching, and handling fabrics are utilized, which can lower production costs and minimize errors. Often, there are high risks of mistakes in textile production.

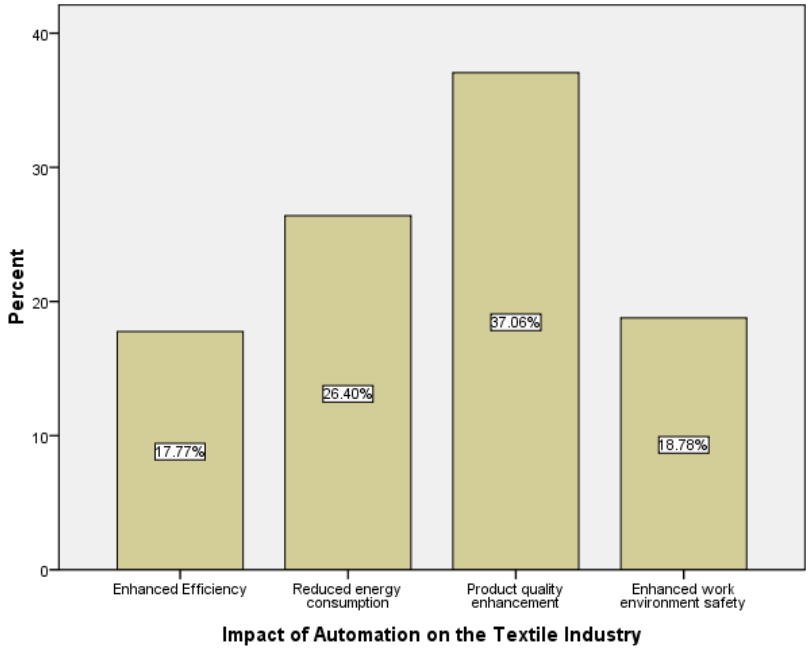

Figure 1. Impact of Automation on the Textile Industry

The Chi-Square tests (Pearson and Likelihood Ratio) both indicate a highly statistically significant association between the two categorical variables being analyzed, given the p-values of .000. The Linear-by-Linear Association also suggests a significant linear trend. However, the caveat regarding the expected cell counts (2 cells with less than 5) means that the results in Figure 1 and 2, particularly the Pearson Chi-Square, should be interpreted with this limitation in mind.

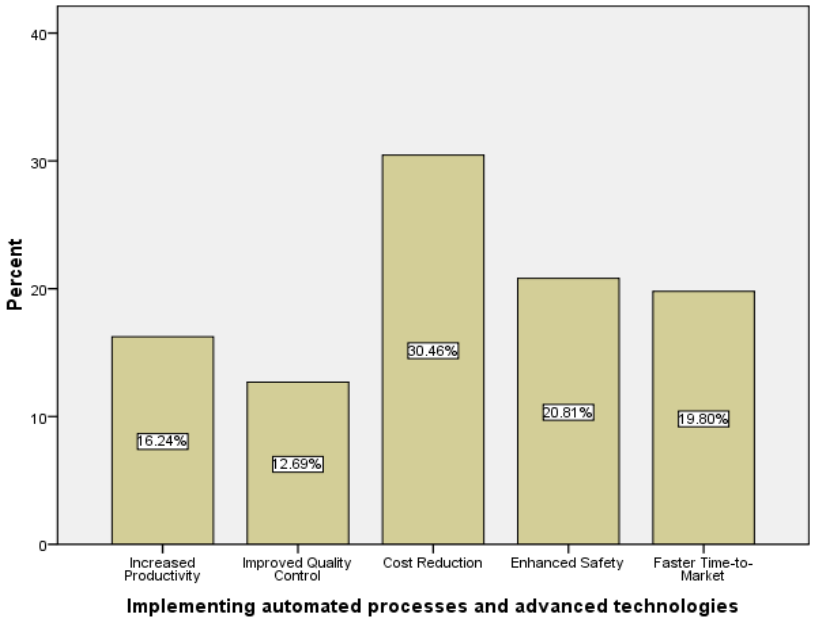

Figure 2. Implementing Automated Processes and Advanced Technologies

By adopting an automation approach, production can be carried out without errors. This report delves into the various challenges faced by different sectors and different levels within the supply chain. Future studies may also consider this diversity as an area to explore and understand more deeply, focusing on the relationship between the workforce and skills, and how it affects the connection between the manufacturing sector and the adoption of new technologies. An examination of workforce management and skills practices could also reveal more about the link between the manufacturing sector and the opportunities to embrace new technologies.

7. Suggestion and social implications

From the analysis of the numerous categories of technology, it's far clean that the fabric manufacturing industry has not best been stimulated by way of generation but has additionally embraced it in a huge way. In line with automation and digitization, new techniques in fabric materials and concepts of sustainable manufacturing have modified the manner textiles are created, synthetic, and advertised international. It is, consequently, vital that the developing innovations in the fabric enterprise are embraced and incorporated through manufacturers in order to align to the new traits inside the market and foster sustainable development. In this way, the fabric enterprise also can enjoy the modifications in technology and the potential of the brand new products, becoming a key detail of the contemporary economy.

The social implications of automation in the textile industry are far-reaching, influencing employment patterns and workforce composition. Automation can lead to shifts in job availability and require new skill sets, impacting workers unevenly across gender and experience levels. Understanding these implications is essential to develop policies that support workforce adaptation and promote equitable opportunities in a rapidly evolving industrial landscape

8. Conclusion

In end, with advances in automation and technology, textile producers now have the possibility to lessen their energy consumption and fees, while additionally reducing their environmental effect. The textile producers to reduce their strength intake, lower prices, and improve the great of their merchandise. Additionally, with the aid of enforcing power-saving measures to fabric producers can meet their sustainability desires and reduce their environmental impact. As the textile enterprise maintains to evolve and new technologies retain to emerge, the usage of strength-green solutions will become increasingly more vital for textile producers seeking to live aggressive and sustainable. It helps in enhancing productiveness and efficiency within the textile industry through its superior automation solution. Now an afternoon’s innovation and technological up gradation is this sort of critical issue for each fabric organization to live to tell the tale because of the multiplied competition that is found inside industries.

References

1. Singh, S., Vig, S., & Dwivedi, S. (2024). Impact of uses of artificial intelligence (AI) in textile industry in India. 2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT), 1–9. IEEE. https://doi.org/10.1109/ICCCNT60196.2024.10498492
2. Akter, S., Al Amin, M., Hossain, M. N. U., Yasmin, A., Sarker, M. N. I., Ali, I., & Azman, A. (2024). The impact of the fourth industrial revolution on female workers in the ready-made garments and textile industry, Bangladesh. The International Journal of Community and Social Development, 6(3), 317–338. https://doi.org/10.1177/25166026221089297
3. Gayathri, T., & Rajkumar, D. (2020). A study on technology automation and labor skill development in textile industry at Salem. International Journal of Management (IJM), 11(11), 1–7.
4. Kazancoglu, Y., Mangla, S. K., Berberoglu, Y., Lafci, C., & Madaan, J. (2024). Towards Industry 5.0 challenges for the textile and apparel supply chain for the smart, sustainable, and collaborative industry in emerging economies. Information Systems Frontiers, 26(5), 1857–1872. https://doi.org/10.1007/s10796-023-10456-7
5. Herath, H. H., Jayaweera, J. M. M. G., Jayasinghe, J. M. Y., Randeni, K. M. T. D., Amarasena, N. C., Rathnayake, S., & Chandanathilaka, S. N. (2024). Crafting tomorrow's trends with automated precision, efficiency, and faultless excellence in apparel industry for medium scale businesses. 2024 6th International Conference on Advancements in Computing (ICAC), 37–42. IEEE. https://doi.org/10.1109/ICAC57213.2024.10017654
6. Orisadare, E. A., Achukwu, O. E., Ogunyemi, A. A., Adedeji, D. O., Diyaolu, I. J., Ugwu, E. I., et al. (2025). Digitalisation and green strategies: A systematic review of the textile, apparel and fashion industries. Circular Economy and Sustainability, 1–53. https://doi.org/10.1007/s43615-025-00187-2
7. de Mattos, F. B., Dutrénit, G., Esquivel, V., & Moreno-Brid, J. C. (2024). The effects of automation on employment: Case studies in Mexico's apparel and footwear sectors. Latin American Policy, 15(3), 535–559. https://doi.org/10.1111/lamp.12345
8. Chaudhary, S., Kumar, P., & Johri, P. (2020). Maximizing performance of apparel manufacturing industry through CAD adoption. International Journal of Engineering Business Management, 12, 1–8. https://doi.org/10.1177/1847979020975528
9. Mim, I. Z., Rayhan, M. G. S., & Syduzzaman, M. (2024). Prospects and current scenario of Industry 4.0 in Bangladeshi textile and apparel industry. Heliyon, 10(11). https://doi.org/10.1016/j.heliyon.2024.e11234
10. Roy, S., Orthy, A. R., & Roy, P. P. (2023). The role of resource allocation efficiency in supply chain of textile & apparel manufacturing industries. American Journal of Scholarly Research and Innovation, 2(2), 30–51.
11. Yusriza, F. A. (2025). Navigating the future: Impact of automation and technology on women's work-life balance. In Women in Logistics, Transport and Commodity Sector: Gender Equality, Recent Trends and Key

Challenges (pp. 119–130). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-8705-2_8
12. Das, S. K. (2025). Investigating circularity in India's textile industry: Overcoming challenges and leveraging digitization for growth. arXiv Preprint, arXiv:2501.15636. https://doi.org/10.48550/arXiv.2501.15636
13. Hoque, M. A., Rasiah, R., Furuoka, F., & Kumar, S. (2022). Linkages among automation, job displacement and reshoring: Evidence from the Bangladeshi apparel industry. Research Journal of Textile and Apparel, 26(4), 515–531. https://doi.org/10.1108/RJTA-04-2021-0044
14. Ponnambalam, S. G., Sankaranarayanan, B., Karuppiah, K., Thinakaran, S., Chandravelu, P., & Lam, H. L. (2023). Analysing the barriers involved in recycling the textile waste in India using fuzzy DEMATEL. Sustainability, 15(11), 8864. https://doi.org/10.3390/su15118864