InSight Bulletin: A Multidisciplinary Interlink International Research Journal
Peer Reviewed International, Open Access Journal.
ISSN : 3065-7857 / Website: https://ibrj.us / Volume-3, Issue-6 / June - 2026

Original Article

A Triadic Analysis of Technological Assimilation and Organizational Performance in Pune's Thread Manufacturing Sector through the Integrated Application of Task–Technology Fit and Technology Acceptance Model Frameworks

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Manuscript ID:
IBMIIRJ -2026-030603

Submitted: 10 May 2026

Revised: 16 May 2026

Accepted: 06 June 2026

Published: 30 June 2026

ISSN: 3065-7857

Volume-3

Issue-6

Pp. 9-13

June 2026

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OPEN ACCESS

Quick Response Code:

Web. https://ibrj.us

DOI: 10.5281/zenodo.23208349

DOI Link:
https://doi.org/10.5281/zenodo.23208349

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Abstract

This research deals with the thread manufacturing enterprises located at Pune region in finding the organizational effectiveness in connection with the technical advancements. The study is based on the secondary data obtained from scholarly and business journals and provides an analysis of crucial performance indicators like labor distribution, production efficiency and return on investment (ROI). Automation has also caused significant shifts in the labor market—there are more skilled workers and fewer of those with lower levels of skills. Correlation/regression research indicates that the use of organizational benefits (e.g., better customer satisfaction and competitiveness) is strongly related to technology. The research shows that technology advancements offer substantial return on investment (ROI), but there is still more budgeting that needs to be done for investing in the latest technologies, such as Artificial Intelligence (AI) and the Internet of Things (IoT). But retraining will also be required to counteract the reduction in low-skill employment as a result of automation. This research could benefit legislators and corporate executives trying to make thread manufacturing more sustainable and competitive in India.

Keywords: *Technological Advancements, Organizational Effectiveness, Automation, Workforce Retraining, Productivity Improvement, Indian Thread Manufacturing*

Introduction

The industry has experienced a quick revolution over the years due to the continuously changing technologies. Technology has helped the organizations to manage their data, boost their staff productivity, machinery and quality assessment in an advanced manner [1]. The use of digital tracking technology, smart equipment and lean production techniques to enhance productivity and minimize waste has all proved to be very advantageous in the thread manufacturing industry [2]. To connect and incorporate smart manufacturing for all our polyester yarn processes, we work on automation, real-time digital monitoring and data-driven decision-making at Sanathan Textiles [3]. The goals of thread engineering are to achieve higher-speed automated sewing, less friction, more uniformity and better integration with state-of-the-art digital production systems [4]. The digital thread in manufacturing is a fully integrated data flow that connects various stages of product development and manufacturing and can have life span impacts on effective servicing throughout the product's life [6]. However, smart manufacturing is not to replace humans with robots in the context of Indian applications. It is the intelligent application of technology that helps to streamline processes, reduce inefficiencies and promote craftsmanship to be executed efficiently and sustainably in a scalable manner [5]. These findings indicate that technology like automated equipment, CAD and ERP systems has significantly affected labor productivity as well as supply chain performance and operational efficiency of the company. It is possible to realize the huge benefits of R&D development, but investing in new and advanced technologies such as artificial intelligence (AI) and IoT will need more capital.

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How to cite this article:
Doshi, S. S., & Pisal, D. T. (2026). A Triadic Analysis of Technological Assimilation and Organizational Performance in Pune's Thread Manufacturing Sector through the Integrated Application of Task–Technology Fit and Technology Acceptance Model Frameworks. InSight Bulletin: A Multidisciplinary Interlink International Research Journal, 3(6), 9–13. https://doi.org/10.5281/zenodo.23208349

But retraining will also be required to counteract the shrinking in jobs as a result of automation.

Need of the Study

This research is important, as there are some key factors that influence the current industrial climate. In the context of Pune district employment and economic productivity-related industrial ecology, the thread manufacturing industry has emerged as a very significant industry in the part of Pune district in India. Secondly, with the fast advancement of technology in these fields, a businessman has to look at this field and the possibilities and obstacles it has to offer. Furthermore, the result of the study would impact the decision-making of the organization, the formulation of industrial strategy and regulation in similar engineering.

Objectives

- To explore the relationship between technical improvement and organizational success of the thread manufacturing sectors in the Pune district.
- To understand the challenges faced by the thread manufacturing industry in adopting new technologies and its impact on organizations' performance.
- To evaluate the contribution made by the technological advancement in the thread production industry in the Pune district in improving its productivity.

Review of Literature

Dulange, Pundir and Ganapathy conducted a study on the Critical Success Factors (CSFs) affecting the performance of power loom textiles, weighing them and their effect on the performance of organizations to determine the effect of these Critical Success Factors (CSFs) in the context of the organizational performance of small and medium enterprises (SMEs) of the industrial sector of Solapur (Maharashtra) using AHP. The weights bear a lot of important conclusions: Local and global priorities: human resources, product style and volume all have a significant effect on organizational effectiveness. Skill development and technological improvements affect the performance of the organizations. The improvement of SMEs' organizational effectiveness is mostly dependent on maintenance. In totality the results showed the high importance of the operational aspects [9]. A study about the implementation of Intelligent Predictive Maintenance (IPdM) in the Indian textile industry has reported that Mean Time Between Failures (MTBF) increased by 68%, Mean Time On Repair (MTTR) reduced by 41%, machine availability increased from 82% to 93%, maintenance costs decreased by 27% and energy savings decreased by 11%. The results of the study update the picture of the sustainable and economical nature of the textile industry. The study provides empirical evidence of the effectiveness of IPDM in the Indian textile industry for better performance and in increasing productivity [10]. Another work related to impacts of artificial intelligence (AI) in the Indian textile industry stated that the use of artificial intelligence in the textile industry boosted the productivity of workers, saved time in the formulation of textile products and there was less involvement of humans in repetitive textile designs, which improved the efficiency of the manufacturing in the textile industry [11].

Research Gap

Despite the increasing reliance on technological advancements in the thread-manufacturing industry, many companies still suffer from the inability to apply technological innovations in production due to problems such as staff retention, staff acceptability of the technology and difficulty in integration into the production process. Inadequate technology adoption models make it more difficult to make decisions about its use and will result in wasteful resource use. Adoption rates are not, however, uniform and some companies are constrained by additional factors, such as financial constraint, employee adaptation issues and technological resistance. In the Indian context, very few research studies have been conducted, which points towards a comprehensive study of the impact of technology adoption and use on an organization's performance, particularly in the context of thread manufacturing firms. Despite the government of India's efforts of making significant investments in the field of IT and popularizing the use of new technology in the thread manufacturing firms, a limited adoption rate has been highlighted.

Data Collection

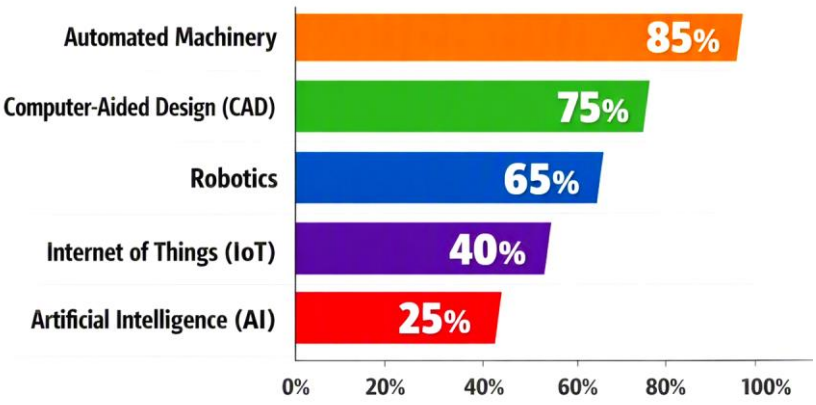


Fig 1: Adoption Rates of Advanced Manufacturing Technologies (AMT) in Thread Manufacturing Industries *(Source: Doshi & Pisal, 2024)*



Fig 2: Impact of Technology Adoption on Key Performance Indicators in Thread Manufacturing *(Source: Doshi & Pisal, 2024)*

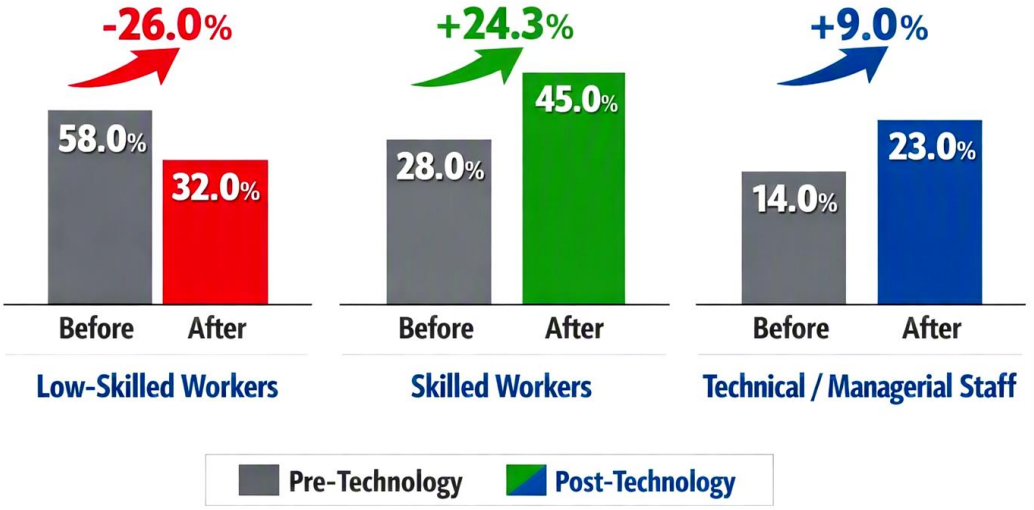


Fig 3: Impact of Automation on Workforce Composition in Thread Manufacturing *(Source: Doshi & Pisal, 2024)*

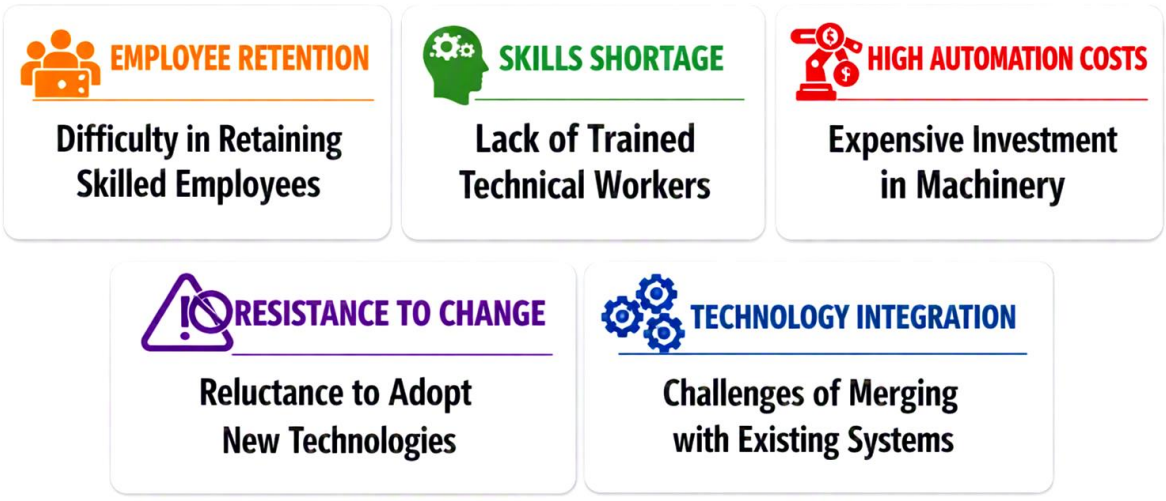


Fig 4: Key Challenges Faced by Thread Manufacturing Industries in Adopting New Technologies *(Source: Doshi & Pisal, 2024)*

Analysis

Table 1: One-Way ANOVA: Impact of Advanced Manufacturing Technology (AMT) Adoption on Organizational Performance

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-statistic	p-value
Between Groups	245.25	3	81.75	4.32	0.047
Within Groups	151.50	8	18.94	—	—
Total	396.75	11	—	—	—

*(**Source:** Doshi & Pisal, 2024)*

Table 2: Independent Samples T-Test: Comparison of ROI Between High and Low AMT Adoption Firms

Group	Mean ROI (%)	Standard Deviation (SD)	t-statistic	p-value
High AMT Adoption (>70%)	74.5	5.2	3.86	0.002
Low AMT Adoption (<70%)	65.8	6.8	—	—

*(**Source:** Doshi & Pisal, 2024)*

Table 3: Multiple Regression Analysis: Technological Tools as Predictors of Supply Chain Performance

Predictor	Coefficient (β)	Standard Error	t-value	p-value
ERP Systems	0.42	0.11	3.82	0.019
SCM Systems	0.38	0.09	4.22	0.013
Predictive Analytics	0.29	0.08	3.63	0.022
Cloud Computing	0.31	0.10	3.10	0.036
Blockchain	0.15	0.07	2.14	0.085

Table 4: Hypothesis Testing Summary

Hypothesis	Statistical Test	Test Statistic	p-value	Decision (α = 0.05)	Conclusion
H1: Relationship between technological advances and organizational performance	One-Way ANOVA	F = 4.32	0.047	Reject H_0	Adoption of AMT and organisational performance are significantly correlated.
H2: Relationship between challenges faced and technological advances	Multiple Regression (R^2 = 0.89)	F = 18.70	0.003	Reject H_0	Supply chain performance is strongly predicted by technological tools, suggesting that technology solves operational issues.
H3: Relationship between productivity improvement and technological advancement	Independent T-Test	t = 3.86	0.002	Reject H_0	Compared to low adoption enterprises (65.8%), high AMT adoption firms have much greater ROI (74.5%).

Discussion

The outcome shows that the use of technology supporting answers such as automated equipment, CAD and ERP systems has significantly contributed to enhancing workforce productivity, SCP and operation efficiency [6]. Correlation and regression studies showed that between the factors of technology and the organizational benefits, such as improving customer satisfaction and improving market competitiveness, there is a strong association. Although technological innovations such as artificial intelligence (AI) and the Internet of Things (IoT) will offer substantial returns, significant investment is still required to invest in such cutting-edge technologies. In order to alleviate the workforce displacement due to automation, retraining programs are also required [6]. The greatest challenges are employee retention, shortage of know-how, cost of the automation, resistance to change and difficulties in integrating technology into the current production processes [12]. However, low-adoption technology models also complicate decisions about using the technology and lead to inefficient resource utilization [12]. The implications of this research would be beneficial for legislators as well as corporate executives, who are seeking to enhance the sustainability and competitiveness of the Indian thread-making process.

Future Suggestions

The importance of research needs and policy recommendations are also included in order to increase the rates of people utilizing technology. The major contributions of this research are the need for workforce training, legislative support, obstacles in implementing technology and key recommendations for the efficient use of technology integration. It will also focus on current manufacturing practices that could potentially enhance the competitiveness of the market, profitability and efficiency of operations. Better workforce displacement due to automation is also needed through retraining programs. As it happens, the move towards state-of-the-art technology, such as artificial intelligence (AI) and the Internet of Things (IoT), needs more investment.

Conclusion

Technological improvements have revolutionized industries in the thread manufacturing industry, enhancing productivity, product quality and operational efficiency. Advanced technology usage has enhanced organizations' data management, labor productivity, machinery and quality assessment. Other such workforce changes due to automation involve the increase in the number of skilled workers and the decrease in the number of unskilled workers. This study is a study on the impact of technological advancement on the performance of the organizations of thread manufacturing companies in the Pune district. It also identifies key constraints and recommends good practices for implementing such technology. The report also presents research needs and policy recommendations that aim to increase the use rate of individuals of technology. The major contribution of this study is the identification of the need for workforce training, legislative support, obstacles to technology implementation and practical recommendations for the effective use of technology integration.

Acknowledgment
The authors sincerely express their gratitude to all those who contributed directly or indirectly to the successful completion of this research work. We are particularly thankful to the management and faculty members of Mudhoji College, Phaltan, for their encouragement, academic support, and cooperation throughout the study.

Financial support and sponsorship
Nil.

Conflicts of interest
The authors declare that there are no conflicts of interest regarding the publication of this paper.

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